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High Safe Adapting Workflow Engines to Dynamic Use Cases

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***Abstract*—existing workflow engines do not sufficiently address the concept of rapidly changing user environments and requirements. In such environments (for instance, steel plants and shipbuilding yards), the system users have to make ad-hoc decisions in order to achieve predetermined targets, and at the same time observe the corresponding safety policies. Moreover, a workflow engine deployed to such scenarios should be able to incorporate inputs from varying sources. Assuming a homogenous input system would expose the resulting system to inadequacies that are likely to cause grievous harm to the users. This thesis will propose an unconventional workflow engine that relies on adaptive implementations – in contrast to the common approach of workflow systems that provide for static implementation of requirements. In addition, the proposed system will assume that it cannot incorporate all possible environmental scenarios; hence, it will leave room for on-site adaptations that will allow it to mirror the use cases more accurately. This report provides a study of existing workflow engine concepts and implementations before suggesting a more agile solution from the related research.**

***INDEX TERMS*—workflow engine; safety; dynamic use case;**

Introduction

A workflow engine provides for a more suitable system if it is adaptable and able to account for requirements that the designer(s) did not explicitly provide for in the conception and design phase. Such an approach results in a dynamic system capable of rapidly fitting unpredictable work environments. In addition, such a system increases the safety of the targeted environment because the users can offer inputs, which the system processes according to a high-level design compared to a closely matching procedural system. This thesis explores this idea in seven major sections. It first provides a background of the workflow engine, and in turn examines the development of workflow software and management. The background informs the context, which will justify the research approach, questions and subsequently the literature survey. Moreover, it will suggest use case and requirements analysis before intimating a design and implementation approach.

Background and Context

Minor, Bergmann and Görg contend that workflow engines conceptualize actual business processes [HYPERLINK \l "Min141" *1*]– for instance, document sharing and information passing. In addition, they observe that the engine should conform to certain procedures that define how the business aims to achieve its objectives. However, they argue that conventional workflow designs are overly rigid. That is, they do not provide for future adaptations. Usually, workflow engines have five major constituents.

- *Definitions*, which model business processes and provide for the proposed system's template.
- *Tasks*, which describe the activities that users or other related systems will perform in conjunction with the proposed system.
- *Data objects*, which describe the communication objects, for instance, documents and information .
- *Procedures*, which define the sequences through which the system's users will interact with the data objects.
- *Data flow*, which describes how the system's actors will interact with the system's data objects when carrying out tasks.

Nevertheless, current business requirements change over time; therefore, a static workflow engine would not serve the extra demands that advanced information technology exerts on manufacturing processes *2*]. As a result, the workflow engine approach that this thesis proposes better matches what Guerrero-García terms as "evolutionary prototyping" (89) in software development.

Accordingly, the prototype should adapt to the design requirements. That is, the design phase should reiterate over the changing requirements of previous phases. It also suggests that the initial prototype should give more attention to the general design of the real-life process, but gradually consider the input from multiple process factors in order to generate a working model rapidly. Furthermore, the workflow engine should avoid "large upfront requirements and design processes in favor of an incremental, evolutionary process" [HYPERLINK \l "Jos14" *3*].

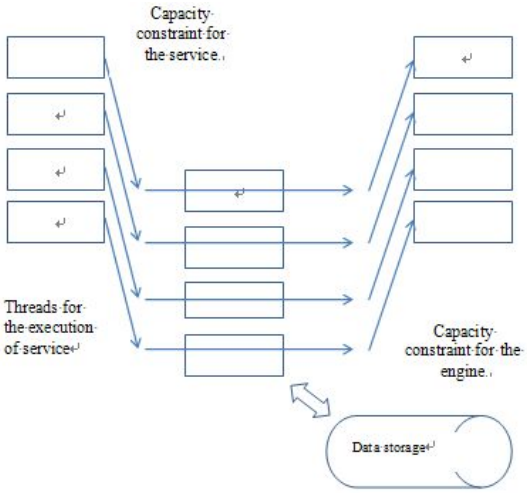

Fig. 1. Multithread processing

Research Approach

The research methodology that this thesis employs borrows from the engineering principle of prototype development, with continuous periodic testing to determine whether the workflow engine adapts to the ad-hoc environment of a manufacturing plant *2*]. Furthermore, it employs an evidenced-based research approach to establishing what existing literature concludes about "adaptive workflow systems" [HYPERLINK \l "Min141" *1*]. The study relied on literature from peer-reviewed journal articles written between 2010 and 2014. The peer-review and time of publishing ensured that the thesis borrowed from established studies, and more importantly that their arguments mirrored current developments in the workflow-engine development field. In addition, the thesis' research relied on engineering and computer science-related databases; for instance, *ScienceDirect*, *Computers & Applied Sciences Complete* and *IEEE Explore*.

A.Research Questions

Subsequently, the research formulated the following research question:

> How can a workflow engine factor in dynamic environmental changes, and in turn, reduce the occurrence of events that can lead to unsafe conditions?

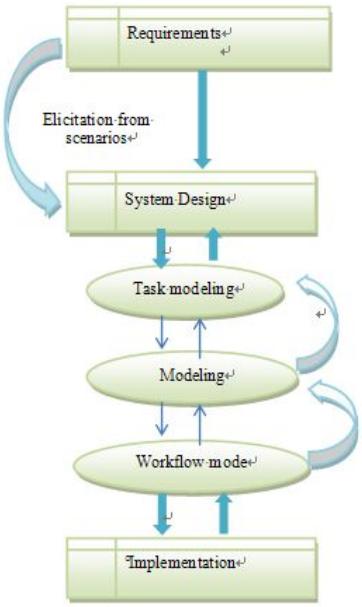

Fig. 2. Engine requirements modeling and design

Literature Review

Ye, Li, Yu et al argue that for a workflow engine to achieve adaptability, its components should feature "low coupling and high cohesion" *4*]. Therefore, although the various components should accept and produce inputs and outputs from other parts, respectively – their functions should hide as much information as possible from the other related components to allow the developer(s) to modify it without excessive consequences to the system as a whole (see Appendix A – A low-coupled workflow engine model).

On the other hand, Czarnul argues that a workflow engine should account for high numbers of processing threads and resource (for example, storage facilities) limitations for it to serve an intensive processing environment; and a result, reduce the risk of putting crucial tasks on hold for unacceptable delays. He states, if "more processors/cores are available, several service instances may be executed in parallel, but must still observe the storage limitations" [HYPERLINK \l "Cza13" *5*]. As a result, the proposed system should feature a scheduling mechanism to allow for concurrent processing capability, which is important for a manufacturing plant scenario, where rapid changes in operating conditions could lead to dangerous situations, if not attended to in a timely manner (see Figure1: Multithread Processing).

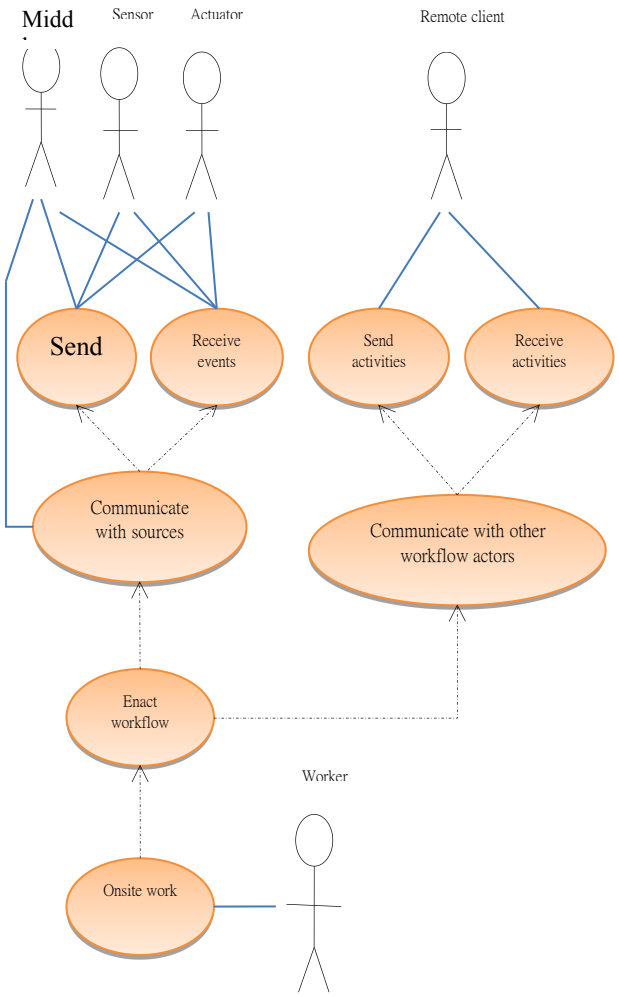

Fig. 3. Use case flow

Chen, et al, however, argue that in cases where the development of a new workflow engine causes a massive deployment of resources that a business may not afford, the re-engineering approach may save on expenses while introducing an adaptable system. They argue that in such cases "reverse engineering rather than the forward engineering" *6*] may be the only solution. As a result, they establish that existing workflow management systems justify adaptation because the rapid change of business processes in the current economic competitiveness could lead to loss of integrated operations because of the static nature of conventional systems.

Use Case Analysis

According to the proposed system, factory workers should have mobile devices (for example, smartphones) that have the capability to interact with the main system via the corresponding mobile applications (apps). As a result, there are five major actors. That is, (1) the worker; (2) sensor; (3) middleware; (4) actuator and (5) remote client.

The workflow engine actualizes when a worker installs the corresponding app in his or her smartphone. The workflow process, however, initializes when the worker runs the app. When the corresponding sensors and actuators interact with the agents in the environment (for example, by sensing high levels of heat) it triggers the enactment of the workflow. Subsequently, the interactions between the various actors lead to a trigger of the consequent actions. If, for instance, the sensors note that the workers are operating in an overly hot environment, it could send messages to all workers and initiate an adaptation of the climate system; hence, reducing the chances of fainting, which might lead to injuries and fatalities in case the affected worker was operating a machine (see Figure 3: Use Case Flow).

User Requirements

For the proposed system to serve an ad-hoc environment, it should receive inputs from the environment (via sensors or workers) before using the pre-defined procedures to initiate action in corresponding sections of the workflow. Furthermore, it should be able to create a log of its outputs and reactions in a persistent store, in order to generate reports that would be useful for future data mining operations. On the other hand, the system's outputs should have a level of complexity that is relevant to the manufacturing domain. That is, it should use metrics that are easily recognizable by the users. Subsequently, the friendly output would support fast decision-making. That would be in line with what Bergmann and Gil term as "the need to enable non-IT staff to create workflows and to control their execution" [HYPERLINK \l "Ber14" *7*].

Design, Implementation and Testing

According to the proposed system, the workflow engine should have multiple installations. Those include the mobile deployments in the workers' smartphones and desktop-based systems in the offices. The main system will have a graphical user interface (GUI) to interact with the end users, modules (to control and respond to various environmental conditions) and a persistent store to record a log of its activities. In addition, the system will interact with the peripherals (sensors and actuators) to influence the interactive contexts *8*] (see Table 1: Proposed workflow engine design).

On the other hand, the workflow system's testing and implementation will occur iteratively, where each module's development predicates a testing regime, which indicates how it performs according to given constraints [HYPERLINK \l "Bec12" *9*]. However, the system's prototyping (according to the agile development approach) will require actual users to get a hands-on use of the completed modules.

Discussion

The research question asked if the workflow engine could factor in dynamic environmental changes, and in turn, improves safety. In turn, the proposed system considered the environmental context of a manufacturing plant to determine the factors that it would incorporate into its design. The major

consideration was whether the actors and peripherals' interaction could provide a system that was adaptable to a high-risk environment.

As a result, the system relied on the environmental context to inform the systems' data fields. Furthermore, the system relied on the nodes of interaction between the various actors to define transaction exceptions. In a programming sense, the system defined subsequent actions depending on how the interactions between the actors played out. If a user, for instance, does not reply to any of the workflow engines dialog boxes, the system would throw a transaction exception; hence, preventing subsequent automatic response. The modular nature of the system reflects what Callaú and Tanter term as writing " a procedure to address a given problem by relying on smaller auxiliary procedures that might not yet be implemented"*10*].

Table 1. Proposed workflow engine design

Main System	Workers	Peripherals
Interface		
Workflow Modules		
Workflow operational contexts		Actuator(s) and Sensor(s)
Workflow fragment contexts		
Workflow interactive contexts	Worker x, …, n	
Persistent storage		

However, consequent response patterns would enable the system to generate an automatic response system that takes place when there is a lapse of a pre-determined amount of time. To create a workflow engine that adapts to the ad-hoc environment, the system will create a database of common reactions that workers generate in given conditions. For instance, if the floor manager of the plant reacts to an increase in the temperature by instructing the system to reduce the climate control's temperature to twenty-four degrees (240C), the system will learn to reduce the temperature to that level automatically, when the manager does not respond in a given amount of time.

Conclusion

Although the workflow engine's development will consist of controlling simple scenarios, further development will lead to a large-scale deployment of an adaptive workflow system. It however requires continuous testing and factoring in of the end users' experience with the system. Considering the information-technology (IT) sophistication levels of the users, the system would feature a simple interface that befits the contextual setting of the workers. Consequently, the system aims to produce a rapid response system for the challenges that face the environmental setup of a manufacturing plant.

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A Design of FPGA-based System for Image Processing

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***Abstract*—We evaluated the performance of a hardware architecture designed to perform a wide range of fast image processing tasks. The system architecture is based on hardware featuring a Field Programmable Gate Array(FPGA) co-processor and a host computer.A host application controlling a frame grabber and an industrial camera is used to capture and exchange video data with the hardware co-processor via a high speed USB3.0 channel , implemented with a standard macrocell, The FPGA accelerator is based on a XILINX kintex-7 chip and is designed as a system-on-a-programmable-chip with the help of an embedded software processor. The SOPC system integrates the CPU,external and on chip memory,the communication channel and typical image filters appropriate for the evaluation of the system performance. Measured transfer rates over the communication channel and processing times for the implemented hardware logic are presented for various frame sizes. A comparison with other solutions is given and a range of application is also discussed.**

***Index Terms*—Field Programmable Gate Array,image filters , Universal Serial Bus , system-on-a-programmable-chip**

I. Introduction

The traditional hardware implementation of image processing uses Digital Signal Processors (DSP) or Application Specific Integrated Circuits (ASIC). However, the growing need for faster and cost-effective systems triggers a shift to Field Programmable Gate Arrays (FPGA), where the inherent parallelism results in better performance. When an application requires real-time processing, like video or television signal processing or real-time trajectory generation of a robotic manipulator, the specifications are very strict and are better met when implemented in hardware. Computationally demanding functions like convolution filters, motion estimators, two-dimensional Discrete Cosine Transforms (2D DCT) and Fast Fourier Transforms (FFT) are better optimized when targeted on FPGA[1-4]. Features like embedded hardware multipliers, increased number of memory blocks and system-on-a-chip integration enable video applications in FPGA that can outperform conventional DSP designs.

On the other hand, solutions to a number of imaging problems are more flexible when implemented in software rather than in hardware, especially when they are not computationally demanding or when they need to be executed sporadically in the overall process. Moreover, some hardware components are hard to be re-designed and transferred on a FPGA board from scratch when they are already a functional part of a computer-based system. Such components are frame grabbers and multiple-camera systems already installed as part of an imaging application or other robotic control equipment.

Following the above considerations we conclude that it is often needed to integrate components from an already installed computer-based imaging application dedicated to some automation system, with FPGA-based accelerators that exploit the low-level parallelism inherent in hardware structures. Thus a critical need arises for an embedded software/hardware interface that can allow for high-bandwidth communication between the host application and the hardware accelerators.

In this paper we apply and evaluate the performance of an example mixed hardware design that includes on the one side a host computer running imaging application, equipped with a camera and a frame-grabber, and on the other side a XILINX FPGA board [5] running an image filter hardware accelerator and other system components. The communication channel transferring image data from the host computer to the hardware board is a high-speed USB3.0 port. The various hardware parts and external circuit on the FPGA board are controlled. As a result of this evaluation one can explore the range of applications suitable for a host/co-processor architecture including an embedded processor and utilizing a USB3.0 communication channel.

In the following, we first give a short account of the tools we used for system design. We also present an overview of the particular image filtering application we embedded in the FPGA chip for the evaluation of the host/co-processor system architecture. We describe the modular interconnection of different system parts and assess the performance of the system. We examine the speed and frame-size limits of such a design when it is dedicated to image processing. Finally.

II. Image Processing Algorithms

Low-level Vision 3x3 Gaussian pyramid Algorithm: two dimensional low-pass filters, such as the Gaussian low-pass filter, work with a filter kernel, calculate an average value for a destination pixel using a number of neighboring source pixels. The two dimensional Gaussian filter is shown in following figure1.

When dealing with digital images integer weighting factors are used. A typical 3x3 Gaussian filter matrix and the decimation of the pixels are shown in Figure 1. The anchor point of the Gaussian filter kernel is marked with an ” X” .

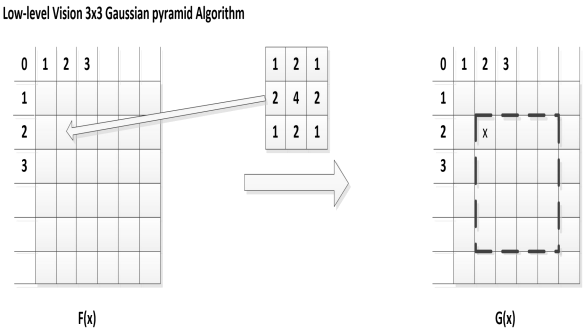


Figure1. Gaussian pyramid filter 3x3 kernel

Obviously for every calculated pixel one neighboring pixels in both dimensions are required. Therefore, this function uses a Region of Interest (ROI). With every Gaussian pyramid level the number of pixels in x- and y-coordinates is reduced by a factor of 1.

According to Gaussian calculation method for using the neighbor pixels window 3x3 or 5x5 to get the new pixel data, taking into consideration that their differences in their kernel's size. Taking into consideration that; expressing the kernel operation in each frame process can be decomposed into block processing mode, and this block has the same processing function and the number and size determine degree of algorithm parallelism.

The degree of parallelism for one (256x256) image frame is 256x3 or 256x5 delay element blocks respectively with. Computing time is determined by number of machine cycle to get the first frame pixel plus number of a the whole frame pixels calculated in the pipe line, total number of machine cycles = 9 + 256*256 = 65,545 machine cycle. Working with frequency 100MHz (10nSec) we found that time = 10nSec * 65,545 = 0.6554 mSec almost 0.66 mSec for single frame. so from that; we defined a new general structure design of fast image processing as we will explain later. This process and technique for Gaussian 3x3 and Gaussian 5x5 will have the same speed of calculations versus using a little more of FPGA utilization resources.

Edge detection is the name for a set of mathematical methods which aim at identifying points in a digital imageat which the image brightness changes sharply or, more formally, has discontinuities. The points at which image brightness changes sharply are typically organized into a set of curved line segments termed edges. The same problem of finding discontinuities in 1D signals is known as step detection and the problem of finding signal discontinuities over time is known as change detection. Edge detection is a fundamental tool in image processing,machine vision and computer vision, particularly in the areas of feature detection and feature extraction.

The purpose of detecting sharp changes in image brightness is to capture important events and changes in properties of the world. It can be shown that under rather general assumptions for an image formation model, discontinuities in image brightness are likely to correspond to: discontinuities in depth;discontinuities in surface orientation;changes in material properties and variations in scene illumination.

III. design tools overview

The design of a DSP system with FPGA often utilizes both high-level algorithm development tools and hardware description language (HDL) tools. It can also make use of third-party intellectual property (IP) cores implementing typical DSP functions or high speed communication protocols.

In our application we use model-based design tools like The Mathworks Simulink (based on Mathwork's MATLAB) with the libraries of XILINX's IP core. The core uses model design to produce and synthesize HDL code, which can then be integrated with other hardware design files within a synthesis tool, like the ISE 14.4 development environment. In the present work, we designed image filter components using IP libraries and the resulting blocks were integrated with the rest of the system in XILINX's Embedded Development Kit (EDK) Builder.

EDK-Builder design software resides as a tool in the XILINX environment[6]. Its purpose is to integrate an embedded software processor like Platform Studio(XPS) with hardware logic and custom or standard peripherals within an overall system, often called Embedded Development Kit (EDK). EDK-Builder provides an interface fabric in order to interconnect the Platform Studio processing path with embedded and external memory, the filter co-processors, other peripherals and the channels of communication with the host computer.

On the host side one may develop a control application by means of any suitable language like C. We use software by National Instruments Corporation[10], which provides a very flexible platform for image acquisition, image processing and industrial control.

IV. System design and implementation of the filter design

The proposed methodology and its corresponding architecture for the image processing are illustrated in Fig. 2. It describes the architecture in the camera in which data acquisition; signal processing and communication capabilities are embedded.

The main target of this work is to evaluate the performance of a host/co-processor architecture including an embedded processor and utilizing a communication channel between host and hardware board, like a USB3.0 channel. The task-logic performed by the embedded accelerator can be any image function within the limitations of existing FPGA devices.

For our purpose we built a typical image-processing application in order to target the FPGA co-processor. It consists of a noise filter followed by an edge-detector. Noise reduction and edge detection are two elementary processes required for most machine vision applications, like object recognition, medical imaging, lane detection in next-generation automotive technology, people tracking, control systems, etc.

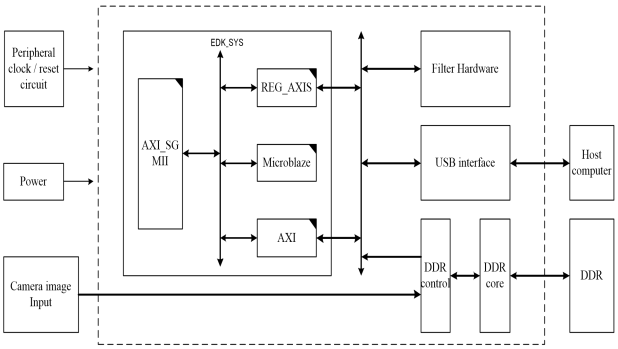


Fig.2 System Architecture

We model noise and edge filtering using the XILINX's DSP Libraries in Simulink. An example of this procedure can be found in. Noise reduction is applied with a Gaussian 3x3 kernel while edge detection is designed using typical Prewitt or Sobel filters. These functions can be applied combined in series to achieve edge detection after noise reduction. Apart from noise and edge filter blocks, there is also a block representing the intermediate logic between the MicroBlaze data and control paths and our filter task logic. Such intermediate hardware fabric follows a specific protocol referred to as Avalon interface. This interface cannot be modeled in the Simulink environment and is rather inserted in the system as a verilog file. Design examples implementing the Avalon protocol can be found in XILINX reference designs and technical reports. In brief, our Avalon implementation consists of a 16-bit data-input and output path, the appropriate Read and Write control signals and a control interface that allows for selection between the intermediate output from the Gauss filter or the output from the edge detector. Data input and output to and from the task logic blocks is implemented with the help of Read and Write instances of a 4800 bytes FIFO register.

Each image frame when received by the hardware board is loaded into an external SDRAM memory buffer and is converted into an appropriate 16-bit data stream by means of MicroBlaze instruction code. Data transfer between external memory buffers and the MicroBlaze data bus is achieved through Direct Memory Access (DMA) operations controlled by appropriate instruction code for the MicroBlaze soft processor.

Incoming pixels are processed by means of a simple 2D digital Finite Impulse Response (FIR) filter convolution kernel, working on the gray scale intensities of each pixel's neighbors in a 3x3 region. Image lines are buffered through delay-lines producing primitive 3x3 cells where the filter kernel applies.A delay block produces a neighboring pixel in the same scan line, while a 640 delay block produces the neighboring pixel in the previous image scan line. We assume image size of 640x480 pixels. The line-buffer circuit is implemented in the same manner for both noise and edge filters. Frame resolution is incorporated in the line-buffer diagram as a hardware built-in parameter. If a change in frame size is required we need to re-design and re-compile. The number of delay blocks depends on the size of the convolution kernel, while delay line depth depends on the number of pixels in each line. Each incoming pixel is at the center of the mask and the line buffers produce the neighboring pixels in adjacent rows and columns. Delay lines with considerable depth are implemented as dedicated RAM blocks in the FPGA chip and do not consume logical elements.

After line buffering, pipeline adders and embedded multipliers calculate the convolution result for each central pixel. The model-design for implementation of the 3x3 Gauss kernel calculations. Logic-consuming calculations, like multiplications are implemented using dedicated multipliers available in medium-scale XILINX FPGA.

V. EDK system design

The co-processor parts described above were implemented as components of an embedded system controlled by a MicroBlaze processor, and is shown in Fig.3. The MicroBlaze software which is used here for data streaming control, is often the basis for industrial as well as academic projects. It can be used in its evaluation version along with the tools for assembling and downloading instruction code. Once installed within the synthesis software, the MicroBlaze processor becomes integrated as a library component in XILINX's EDK-builder tool.

EDK-Builder converts the model-based design into HDL code appropriate for integration with other hardware components. The filter is readily recognized by the synthesis software as a System-on-a-Programmable-Chip (SOPC) module and can be integrated within a MicroBlaze system with suitable hardware fabric[7]. Other modules that are necessary for a complete system are the MicroBlaze soft processor, external memory controllers, DMA channels, and a custom IP peripheral for high speed USB communication with the host. A VGA controller can be added in order to monitor the result on an external screen. Many of such peripheral functions can be found as open source custom HDL Intellectual Property (IP) or as evaluation cores provided by XILINX or third party companies.

USB 3.0 high speed connectivity is added to the FPGA board by means of a daughter-card by System Level Solutions (SLS) Corporation. It can be added to any XILINX board featuring a Santa-Cruz peripheral connector. This daughter-card provides an extension based on CY7C68000 PHY USB3.0 transceiver. A USB3.0 IP core compliant with Transceiver Macrocell Interface (UTMI) protocol allows integration of the USB function with the MicroBlaze system. We tested evaluation versions of the IP core and present practical transmit and receive rates. The FPGA chip along with the embedded MicroBlaze processor is always a slave device in the communication via the USB channel, while the host computer is always the master device.

The embedded system is assembled by means of the SOPC-Builder tool of the synthesis software, by selecting library components and defining their interconnection. After being generated by SOPC Builder, the system can be inserted as a block in a schematic file for synthesis and fitting processing. The only additional components that are necessary are PLLs for Nios and memory clocking.

After we synthesize and simulate the design by means of the tools described in Section 2, we target a FPGA chip incorporated on a development board manufactured by Altera Corporation. The board also features external memory and several typical peripheral circuits.

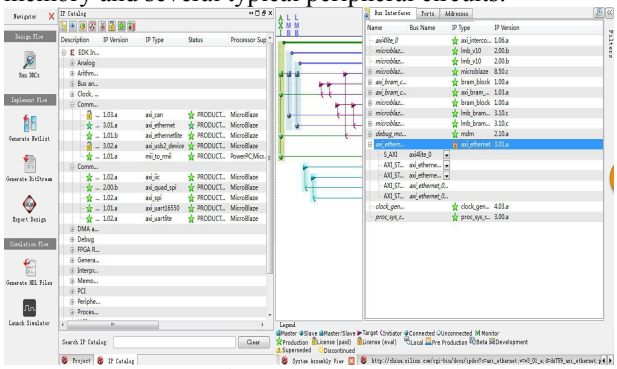
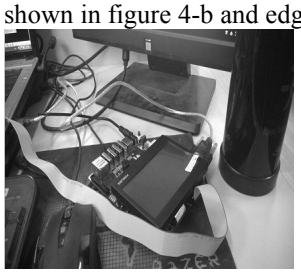


Fig.3 EDK architecture

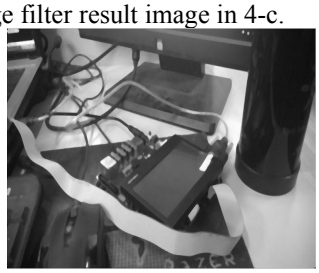
VI. System Performance Evaluation

Integrated Software Environment (ISE14.4) software for FPGA and Matlab Math-works (R2011a) software both were used for design, validate and simulate our general structure fast image design, the FPGA embedded system used was from Xilinx Company product Kintex-7.

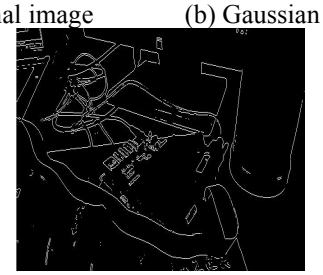
FPGA resources consummated due to our proposed design in Xilinx Kintex-7 number XC7K160T, that DSP48 slices is 2% in Gaussian kernel size 3x3 and 5% in Gaussian kernel size 5x5. Also umber of number of Digital Clock Manager (DCM) and other resources almost the same. Finally The main target is to see the both low level different kernel algorithm deals with real image with the size of 256x256 in figure 4-a and the output image result from applying Gaussian filter 3x3 shown in figure 4-b and edge filter result image in 4-c.



(a) Original image



(b) Gaussian Filter 3x3



(c) Edge filter

Fig.4. Result of successive processing

VII. Conclusion

The great advantage in our design implementation on FPGA is that whatever the kernel size and more usage of DSP48 slice the time difference is slightly change not the same as if we were using C language Programming technique, designing fast image algorithm main concerns is accuracy and reducing the time as minimum as possible which we applied the high accuracy by using DSP slice 18bit by 18 bit in multiplication and 48 bit in addition, in the other hand by using the implementation target is an FPGA instead of DSP we reduce the total image frame processing time.

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Automation Development and Research Based on Ethernet Control

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Abstract— **With the rapid development of computer technology and network technology, the industrial automation is becoming to be influenced by the low data transmitting speed. This paper introduces the application of Ethernet in the Automation Industry to improve the data transmitting and data management situation. The System hardware architecture and The structure of the monitoring software are shown in the paper.**

Index Terms— **Ethernet; control system; automation**

I. Introduction

The rapid development of computer technology and network technology makes industrial automation technology create great progress, especially since the last century, the 1990s, it has become a revolutionary advancement in the field of industrial automation. Fieldbus technology allows field devices and control units, field operating stations and other components together with data communication network, digital, two-way transmission, multi-branch and other interactive features that make the field of industrial control networks to further development. Ethernet technology is an open standard network technology, it has a strong compatibility and interoperability, it can easily access the remote system to connect the Internet and office automation and industrial control automation seamlessly overcome fieldbus defects in technology to improve the stability and reliability of the fieldbus.

Ethernet is used mainly in industrial areas of the following advantages: ① Ethernet is the most widely used in today's most popular communication network and it has the advantages of low prices, a variety of transmission media options, high-speed, easy-to-network applications and it runs with a lot of installation and maintenance personnel. ② easy connection to the Internet. Over the past ten years, the rise of the Internet and Windows, Unix and other operating systems gradually dominate, like TCP / IP, and other well-defined transport protocols are widely used. ③ Ethernet fieldbus can overcome the disadvantages that can not be synchronized with the development of computer network technology. Ethernet as a fieldbus, especially the main framework of the high-speed fieldbus, fieldbus technology to avoid the development of computer network technology drifted outside, so that the field bus technology and computer network technology are well integrated to form a mutually reinforcing situation.

The current epidemic field control, is generally the underlying device layer using low-speed fieldbus networks, high-speed Ethernet upper management structure. Fieldbus fields still plays a big role, which shows that the technology has its own advantages. However, because its diversity makes standard range of products, it will eventually be replaced by a certain standard, namely, the development direction --- Industrial Ethernet fieldbus.

II. Design Based on the Ethernet management control

Design of the monitoring system takes the use of software Think & Do OptiLogic Ethernet RTU hardware. This system is simple, and there is no limit on the I / O points and extension of the base frame, and the occupying of industrial Ethernet protocols in occupied bandwidth is extremely small, all products can achieve a modular, hot-swappable, scalable, plug and the whole system takes low overall system price.

The following is an example of a unit of automated production line management and control integration. The company take their own development needs into consideration, requiring three production lines to achieve comprehensive automation management. In this paper, we take the production monitoring system downtime for example. This part is called Autoline Downtime Record System(referred ADRS), in which system structure is shown in Figure 1. As can be seen from Figure 1, the entire system is divided into three levels: the first level is the management of information within the enterprise LAN connection layer, called the corporate management; the second layer is an internal plant three mutually networked monitoring host, which is monitoring layer; layer 3 is the network layer for each combination of devices called field control layer.

III. System hardware architecture

In order to consider the stability of the whole system and real-time management section in Figure 1 uses hot standby to ensure the security of the system. Two hosts are connected via a crossover cable, and the share data are collected at the same time a machine fails, starting another host control. All hosts install a dual card, which is connected to a network adapter to the site shut down the production line Ethernet controller RTU, constituting a centralized monitoring LAN (LAN); another card is connected plant control center switch, which carry out data exchange with the host data workstation, the workstation shares the same group of 3 stations with real-time control of PC machine, to collect the record production line monitoring data. There are some auxiliary system hardware not displayed in the diagram, for example, in the control layer, the data need to be monitored because of the production line, there are many

require special record, so if every day you want to print a specific report, you need to install the monitoring layer printer. System hardware architecture is show in figure1.

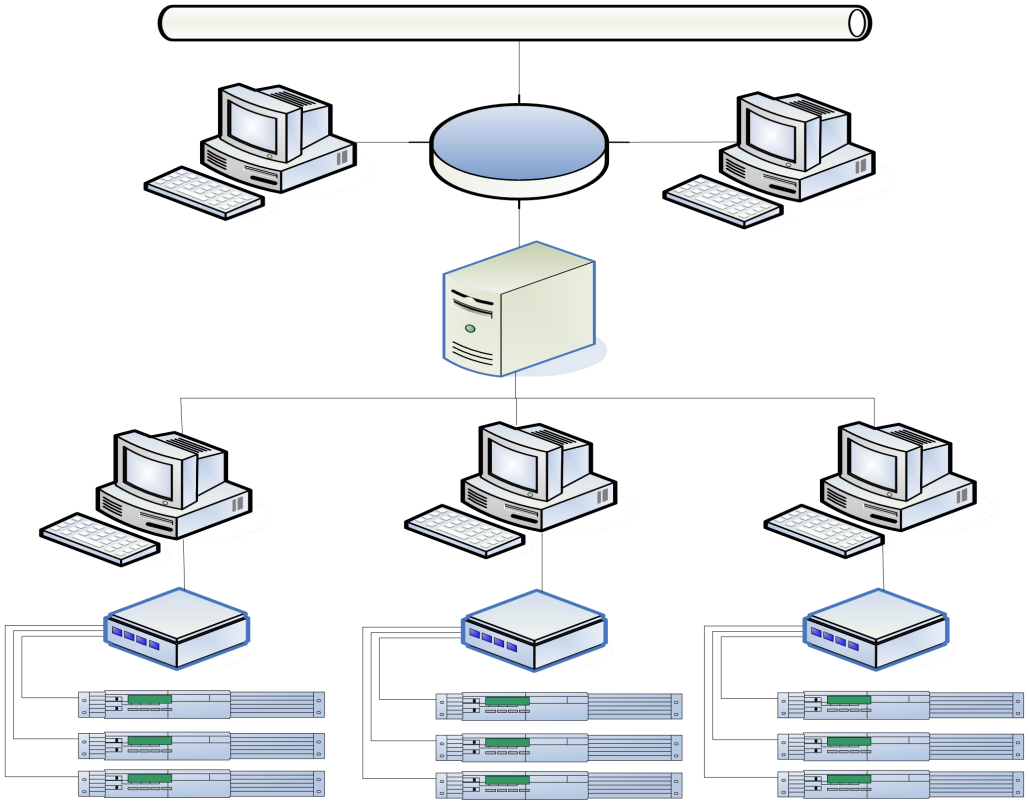

FIGURE 1. The structure of Hardware and Networks

IV. The structure of the monitoring software

The monitoring systemn Think & Do application software runs on the workstatio to scan rate data by 50ms refreshing all I / O, and all data is stored in a text file classification (.TXT). At the same time, the use of Think & Do can develop a good user interface, and perform real-time data display status and control equipment, and the use of its RUN module can run external executable file, and VB can be used to develop some produce special reports and interface programme. VB meets the needs of users and real-time data exchange with Think & Do through the COM component. The original data monitoring stations are on the timely delivery through 100M Ethernet to the data server, for higher level queries which can be passed between the DCOM standard interfaces or Think & Do TnD-NTag widget of real-time data communication.

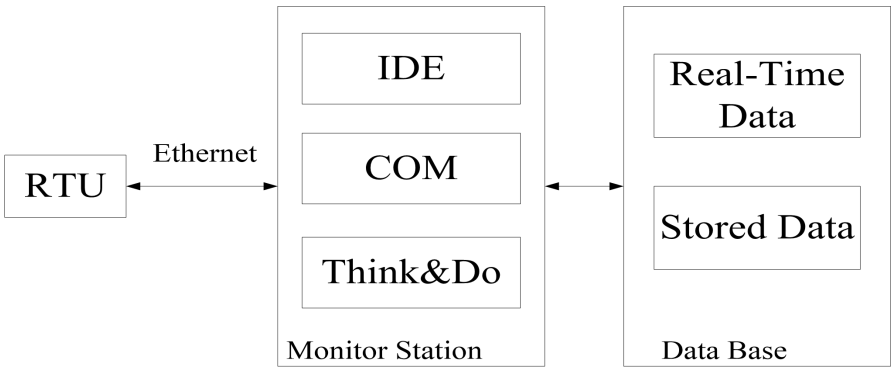

FIGURE 2. Digram of Data Transimiting

V. Application of Ethernet in the industrial structure in the field of automation

From the current development situation, Ethernet applications in industrial automation perform as two kinds of structures, which is the control center network architecture and equipment center network architecture, and in fact it corresponds to two different depths in the control center application's Ethernet network architecture. The Ethernet is used upon enterprise network, and connected controller, operator stations and manage computers together. The lowest level in the enterprise network is still in the form of fieldbus,

constituting simple LAN/Fieldbus network structure. In the device structure in the center of the network, I/O devices are connected to an Ethernet or connected to the Ethernet-compatible I/O data concentrator. In this structure, a substituted Ethernet fieldbus, really constitutes a corporate network from the upper and lower layers unified Ethernet fabric.

Since Ethernet's connection is simple, and it can be extended without any adverse impact on existing devices, which is fit for networked office and production site and other different areas. By company-wide communication and other advantages over the Internet or ISDN, Ethernet in the industrial automation field has been more widely applied, and the application depth and breadth are continuing to expand. Current applications are mainly concentrated in the control center of the structure, to go deep into the field device level there is much work to be done.

Nevertheless, at the field level networking device level, the fieldbus has turned to the development trend of Ethernet.. Some experts believe that in two or five years, EthernetTCP / IP may be applied to large-scale field bus, it takes about five years to develop a kind of Ethernet connector which are suitable for field control.

VI. Conclusions

Fieldbus technology has gotten decades of development, which is widely used in process automation, manufacturing automation and control numerous on-site automation, building automation, etc. But the fieldbus packet transmission delay, transient errors, packet loss and other phenomena, seriously influence the reliability and security of the system. The combination of Ethernet technology and fieldbus technology builds automation control system that can effectively avoid this pitfall, which can improve system security and reliability, as well as reduceingthe cost of system construction, and shows a high economic value and practical value, worthy of further study and promotion.

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In the Well-Testing Interpretation Software, How to Calculate the Formation Parameters in the Log-Log Coordinate System in the Well-Testing Interpretation Model of Fractured Vertical Well

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***Abstract*—Unconventional oil and gas resources have been paid more and more attention, and the fracturing technology play a key role in the development of unconventional oil and gas. Especially for tight reservoir, fracturing technology is currently only developmen technology. And so, in the well-testing interpretation software (referred WTIS), integrating the well-testing interpretation model (referred WTIM) of fractured vertical well (referred FVW) has important practical economic and social value; therefore, it is particularly necessary to study on how to calculate the formation parameters in the log-log coordinate system of this model. In this paper, the realization process of calculating the formation parameters in the log-log coordinate system (referred CFPLLCS) in the WTIS has been firstly discussed, and the dimensionless parameter definitions of the WTIM of FVW have been given, finally based on the flow chart of CFPLLCS in the WTIM of FVW, how to calculate the formation parameters in the WTIS has been pointed out. The research has laid a necessary foundation for finally integrating the WTIM of FVW in the WTIS.**

***Index Terms*—Fractured Vertical Well; Calculating Formation Parameters in Log-log Coordinate System; Well-Testing Interpretation Software; Algorithm Research;**

I. Introduction

With the rapid increase of the energy demand of the world, unconventional oil and gas resources have been paid more and more attention[1-2]. Fracturing technology has become the core technology of a cost-effective development of unconventional oil and gas resources, and play a key role in the rapid development of unconventional oil and gas[3-5]. As for part wells in Xinjiang oilfield of Lucaogou Formation reservoir, because they are typical tight reservoir, and they can only be mined by fracturing[4]. Therefore, in the well-testing interpretation software (referred WTIS), integrating the well-testing interpretation model (referred WTIM) of fractured vertical well (referred FVW) has important practical economic and social value.

The essence of the WTIS is still a simulation of artificial fitting process[6], therefore in the development process of WTIS, need fitting the measured pressure difference curve and theoretical charts in the log-log coordinate, and then calculate formation parameters by the fitting results[6-8]. Literature survey shows that there are more literatures, which discuss and analysis the WTIM of FVW[9-20], but there are a few research reports about calculating formation parameters in the log-log coordinate system (referred CFPLLCS) of the WTIM of FVW.

In this paper, from the realization process of developing WTIS, combined with the characteristic of the WTIM of FVW, based on the flow chart of CFPLLCS in the WTIM of FVW, how to calculate the formation parameters has been pointed out.

II. Research on the process of CFPLLCS in WTIS

At an early stage, due to the lack of WTIS, people adopted manually fitting charts to calculating formation parameters during the time of well test interpretation. The procedure is as follows: The first step drew respectively the charts and the curve, which is the relation between the measured pressure difference ($\Delta p = P_i - p_{wf}(t)$) and the time difference ($\Delta t = t_i - t_0$), in the two sheet of transparent paper with exactly the same size and log-log coordinate system. The second step moved parallel the measured pressure difference in the vertical and horizontal direction, while parallel moving should always keep the two log coordinate axes parallel to each other, and then found one curve of the best fitting with the measured curve in charts. Finally, selected the appropriate fitting points, and calculated formation parameters according to the pressure fitting values and time fitting values[6]. Seen from the above operation process, while CFPLLCS, the solving parameters process in the WTIS is essentially still a simulation of the solving parameters process in artificial fitting, this process can be illustrated in Fig. 1.

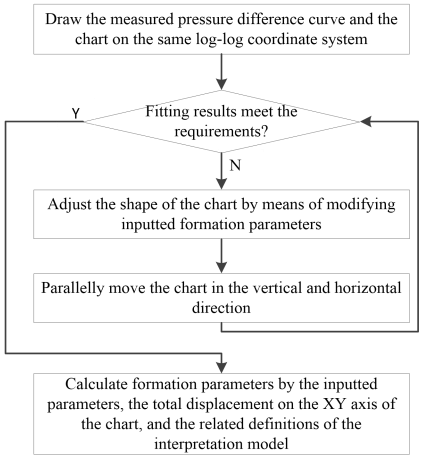

FIGURE 1. The flow chart of CFPLLCS in the WTIS.

From Fig. 1, in the WTIS, firstly drew the measured pressure difference curve and the chart on the same log-log coordinate system, and then adjusted the shape of the chart by the inputted parameters to make the chart as far as possible similar to the measured pressure difference curve, then parallel moved the chart in the vertical and horizontal direction to make the chart as much as possible coincide with the measured pressure difference curve. In the above process, the adjustment parameters and parallel movement generally needed adjust repeatedly to achieve the best fitting effect. Finally, calculated formation parameters by these known quantity: the inputted parameters, the total displacement on the XY axis of the chart and the related definitions of the interpretation model.

In the above-described process, the role of the total displacement on the XY axis of the chart is discussed as follows. The process of parallel movement can be illustrated in Fig. 2. The dotted line L in the Fig. is the measured pressure difference log-log curve, and the solid line L' is theoretical log-log chart, which is most similar to the measured pressure difference log-log curve in many theoretical log-log charts (that is to say, its fitting results is the best). Assuming that L' achieves the best fitting effect after respectively moving units in X-axis and units in Y-axis, that is to say, the coincidence effect of the two curves achieves the best results at this time.

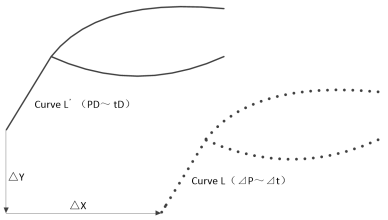

FIGURE 2. The diagram of parallel moving the chart in WTIS

On the curve L and L', respectively takes the first point for the observation point, assume their coordinates are respectively (Δt_1 , Δp_1) and (tD_1 , pD_1), and suppose that the coordinate of the first point on the moved curve L' is ($tD_1^{'}$, $pD_1^{'}$). According to the characteristics of log-log coordinates system[21], at this time, there are:

$$\Delta X = \lg(tD_1^{'}) - \lg(tD_1) \quad (1)$$

$$\Delta Y = \lg(pD_1^{'}) - \lg(pD_1) \quad (2)$$

When achieves the best fitting effect, namely thinks that the curve L and L' coincide on every point at this time, there are:

$$\Delta t_1 = tD_1^{'} \quad (3)$$

$$\Delta p_1 = pD_1^{'} \quad (4)$$

After putting the equation (3) into the equation (1) and inserting the equation (4) in the equation (2), the result can be obtained:

$$\frac{\Delta t_1}{tD_1} = 10^{\Delta X} \quad (5)$$

$$\frac{\Delta p_1}{pD_1} = 10^{\Delta Y} \quad (6)$$

Because the observation point is taken randomly, therefore, for every fitting points (two points can be coincided at the best fitting results) on the curve L and curve L', there should be:

$$\frac{\Delta t}{tD} = 10^{\Delta X} \quad (7)$$

$$\frac{\Delta p}{pD} = 10^{\Delta Y} \quad (8)$$

The tD and pD in the above equation is respectively the dimensionless time and dimensionless pressure of the WTIM, which are given by the specific WTIM. Therefore, in the WTIS, according to the WTIM selected by users, formation parameters can be calculated by the equation (7)-(8).

III. THE RESEARCH OF CFPLLCS OF FVW

A. Study on the WTIM of FVW

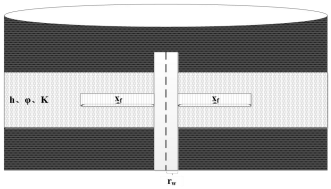

FIGURE 3. The WTIM of FVW

The WTIM of FVW is shown in Fig. 3. According to the model, make assumptions as following: 1) The reservoir is homogeneous, uniform thickness and isotropic. The thickness of the reservoir is h ; 2) The fluid is single-phase and slightly compressible, the C_t of comprehensive compression coefficient, the μ of viscosity and the B of volume coefficient are constant. The porosity and permeability is respectively ϕ and K , and the value of them cannot change with time; 3) Before the oil well open and produce, the original reservoir pressure equal everywhere, are all P_i ; 4) The radius of the well is r_w , the fracture half-length is x_f , and the yield of the well is the given q . After the well open and produce, the q remains unchanged; 5) The process of

flow and testing are both the isothermal process; 6) Ignoring the influence of gravity and capillary force.

Dimensionless parameters of the WTIM of FVW are defined as follows[6]:

The relationship between the dimensionless pressure pD and the measured pressure p is as follows:

$$pD = \frac{Kh}{1.842q\mu B}[P_i - p] = \frac{Kh}{1.842q\mu B}\Delta p \quad (9)$$

The relationship between the dimensionless pressure pD_w and the measured pressure p_w at the bottom hole is as follows:

$$pD_w = \frac{Kh}{1.842q\mu B}[P_i - p_w] = \frac{Kh}{1.842q\mu B}\Delta p_w \quad (10)$$

The relationship between the dimensionless time tD and the test time t is as follows:

$$tD = \frac{3.6\times10^{-3}K}{x_f^2\phi\mu C_t}\Delta t \quad (11)$$

The relationship between the dimensionless wellbore storage coefficient CD, the wellbore storage coefficient C and the fracture half-length x_f is as follows:

$$CD = \frac{C}{2\pi\phi hC_t{x_f}^2} \quad (12)$$

The relationship between the dimensionless fracture conductivity $KfwD$ and the fracture conductivity Kfw is as follows:

$$KfwD = \frac{Kfw}{x_f K} \quad (13)$$

B. Algorithm research of CFPLLCS of FVW

Known from the equation (10):

$$\frac{pD_w}{\Delta p_w} = \frac{Kh}{1.842q\mu B} \quad (14)$$

$\frac{pD_w}{\Delta p_w}$ is the ratio of measured dimensionless pressure pD_w and measured pressure Δp_w at bottom-hole, its physical meaning is consistent with $\frac{pD}{\Delta p}$ in the equation (8). Therefore, the result can be obtained by using of combining the equation (8) and (14):

$$K = \frac{1.842q\mu B}{10^{\Delta Y}\times h} \quad (15)$$

Therefore the permeability K can be calculated by using of the equation (15) . Similarly, the physical meaning of $\frac{tD}{\Delta t}$ in the equation (7) is consistent with $\frac{tD}{\Delta t}$ in the equation (11); therefore the result can be obtained by using of combining the equation (7) and (11):

$$x_f = \sqrt{\frac{3.6\times10^{-3}\times10^{\Delta X}\times K}{\phi\mu C_t}} \quad (16)$$

So the fracture half-length x_f can be calculated by using of the equation (16). And by the equation (12) shows that:

$$C = 2\pi\phi hC_t{x_f}^2CD \quad (17)$$

In the above equation, CD is a parameter of calculation chart, in other words, its value can impact the chart shape and when the chart is being moved, its value will not change. Therefore the wellbore storage coefficient C can be calculated by using of the equation (17). And by the equation (13) shows that:

$$Kfw = x_f \times K \times KfwD \quad (18)$$

Because the dimensionless fracture conductivity $KfwD$ is a parameter of calculation chart, so the fracture conductivity Kfw can be calculated by using of the equation (18).

Algorithm research of CFPLLCS of the WTIM of FVW in the WTIS is shown in Fig. 4.

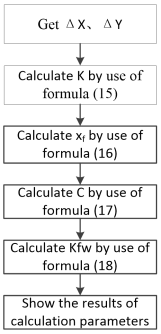

FIGURE 4. The flow chart of CFPLLCS in the WTIM of FVW in the WTIS

The following Fig. 4 shows:

1) The ΔX and ΔY , which is respectively the accumulative total displacement of the chart in X-axis and Y-axis, are obtained by the software recorded.

2) The reservoir permeability K is calculated by putting the ΔY and some known parameters (the q of well yield, the B of volume coefficient, the μ of viscosity, the h of reservoir thickness) into the equation (15).

3) The fracture half-length x_f of the fracturing fracture is calculated by putting the ΔX , the above calculated K and some known parameters (the ϕ of reservoir porosity, the μ of viscosity, the C_t of comprehensive compression coefficient) into the equation (16).

4) The wellbore storage coefficient C is calculated by putting the CD of calculation chart parameter, the above calculated x_f and and some known parameters (the ϕ of reservoir porosity, the h of reservoir thickness the C_t of comprehensive compression coefficient) into the equation (17).

5) The fracture conductivity Kfw is calculated by putting the $KfwD$ of calculation chart parameter, the

above calculated x_f and the above calculated K into the equation (18).

6) All calculated parameters are displayed into the interface in the WTIS.

IV. Conclusions

1) Based on the discussion of the process of CFPLLCS in the WTIS, pointed out the role of the dimensionless parameter definition of specific WTIM, ΔX and ΔY, which is respectively the accumulative total displacement of the chart in X-axis and Y-axis, recorded by the WTIS.

2) Give the relevant dimensionless parameter definitions from the specific WTIM of FVW.

3) Based on the flow chart of CFPLLCS in the WTIM of FVW, pointed out how to calculate the formation parameters in the WTIS.

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The Research And Implementation Of The Input Subsystem Based On Android

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***Abstract*—The input sub system of Android is composed of the driver layer, core layer of the input sub system and event processing layer. This paper analyzes the level and operation mechanism of input sub system of Android system, and analysis on program form the equipment model most lower level to the equipment, the drive, the bus, the input subsystem, input device and user space layer separately. Finally, the rationality and practicability of this technology is verified by the realization of the input subsystem in Qualcomm processor chip.**

***Index Terms*—Android; input subsystem; drive program; user space**

I. INTRODUCTION

There are many kinds of input devices under Linux, and we need to write a different driver program for different devices, which is a large of workload and the more complicated the work. If we build an input subsystem framework[1], and put the shared attributes into this framework structure, only set the corresponding interface for different hardware at the bottom, and this can greatly reduce the difficulty of program development.

Android[2][3] operating system is an open source code based on Linux, and it has been widely applied to mobile devices. According to the latest statistics show, Android operating system has occupied 2/3 of the market of intelligent equipment. The keyboard, Touch screen and the track ball is the input device of Android. In the Linux kernel[4][5], the input device is described by the input_dev structure. When using the input subsystem achieve input device driver, the core work of drive is to report the input event of touch screen, keyboard and the mouse etc (the event is described by the input_event structure), and no longer need to be concerned about the file operation interface because the input subsystem has completed the corresponding operation interface. The event of drive report using the InputCore and Eventhandler reached the user space finally.

In this paper, we analyze the characteristics of these input devices, and research and implement of the Android input subsystem. It has very important significance to development of Android driver and upper layer application.

II. THE LEVEL OF INPUT SUBSYSTEM

The input devices of Linux usually contain the mouse, keyboard, touch screen and other related equipment. And the type of input device is dispersed, and there is no unified mechanism, this paper introduces the mechanism of input subsystem in order to unify the processing function of similar device of physical shapes. It extracts the common part of input driven, simplifies the drive, and provides a consistent interface, and it is used to distribute the input report to the simple event interface of the user application program. In this process, the driver does not need to create and manage /dev node and the related access method, therefore it is very convenient that call the input API to send mobile mouse, keyboard keys or touch event to the user control.

The input subsystem of Android[6][7] uses a standard Linux-input subsystem[8][9], which includes driver layer, input subsystem core layer and event processing layer. That is it use key events to obtain keyboard information in this system, use sports event to get touch screen information and trackball information in Java frameworks[10][11] and application layers, and it can respond to the device in the upper application layer by obtaining these devices generate events. The user input hierarchical graph can be described as shown in Figure 1.

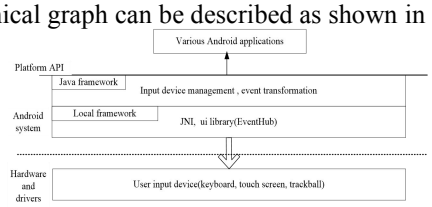

Figure 1.User input hierarchical graph

The Android application layer[12][13] receivers the athletic events by implementing onTouchEvent function and onTrackballEvent function, and it receivers the key events by reimplementing onKeyDown function and onKeyUp function and other function.

Java framework layer contains KeyInputDevice class which is used to process information uploaded by EventHub, and it is usually represented by a data structure RawInputEvent and KeyEvent. For key events, the Java framework layer directly use KeyEvent transmit information to the application layer. For touch screen events and trackball events, the Java framework layer uses RawInputEvent to convert information into MotionEvent and transmits this information to the application layer.

The EventHub of Local framework layer is part of libui, and it implements the control of the driver, and obtains information form this EventHub. The definitions of button layout and key character map need to support running configuration file. The driver is stored in the /dev/input directory, and it is usually Event types of drivers, the input system achieved the driver, the intermediate layer and the upper application by layering,

so that developers can focus on the development of a particular layer for their expertise.

Ⅲ. THE OPERATING MECHANISM OF INPUT SUBSYSTEM

A. The work process of application threads

Step1: WindowManagerService run InputDeviceReader thread to read the following message: key messages, touch screen messages and trackball messages.

Step2: WindowManagerService run PolicyThread thread and combine PhoneWindowManager.java and KeyguardViewMediator.java to manage the current window displays.

Step3: WindowManagerService run InputDispatcherThread thread and put the InputDeviceReader() thread on the event queue and distribute messages.

B. Running processes of InputDeviceReader()

Step1: the InputDeviceReader read the input event from the input device of /dev/input by calling the underlying function.

Step2: Pretreatment read input event, and it is used to decide whether to divide the other modules of systems (the input events that are not distributed is processing by its own or discarded, which is determined by PhoneWindowManager)

Step3: put the read input event into their corresponding event queue.

C. Principle of Android looking KI file

Step1: First, Android looks for /system/usr/keylayout/gpio-keys.kl => I/EventHub(698): New keyboard: publicID=65537 device->id=65537 devname='gpio-keys' propName='hw.keyboards.65537.devname' keylayout='/system/usr/keylayout/qwerty.kl'.

Step2: If Android does not find it, which defaults to using /system/usr/keylayout/qwerty.kl.

D. Reading information input events

Read the information form the drive to the input event, then the CPP layer read input events are written to code of java layer that is env->SetIntField(event, gInputOffsets.mDeviceId, (jint)deviceId);

Ⅳ. REALIZATION OF INPUT SUBSYSTEM

The input subsystem drive completion corresponding working by registering devices, loading subsystem, event handing, and the user space is realized through the class of local framework layer.

A. Device registration

The input device is registered into the input system by the method of the module loaded in Android, that is:

```
static struct platform_driver s3c_ts_driver= {
.probe=s3c_ts_probe,
.remove=s3c_ts_remove,
.suspend=s3c_ts_suspend,
.resume=s3c_ts_resume
```

}use these functions to be registered. When the s3c_ts_probe is loaded by this system, we use input_register_device to complete device initialization, and add input_dev to input_dev_list, and find the appropriate handler paired with input_handler, and then call input_register_handle to register.

B. Subsystem load

When the system module is loaded, Input registration operation function input_fops to the Linux kernel, and initialize device interface, as shown in the structure.

```
static const struct file_operation input_fops={
.owner=THIS_MODULE,
```

.open=input_open_file}//when performing open operation, calls input_open_file function, as follows:

```
static int input_open_file(struct inode *inode,struct file *file){
struct input_handler *handler;
const struct file_operation *old_fops ,*new_fops=NULL;
handler=input_table[iminor(inode)>>5];
if(!handler||!(new_fops=fops_get(handler->fops))){
err=-ENODEV;
}}
```

C. Event processing of subsystem

The event processing layer and the user program and the input subsystem core is interactive, and the evdev can handle all events, register evdev_handler corresponding interface to the system, the structure is as follows:

```
static struct input_handler evdev_handler= {
.event=evdev_event,
.connect=evdev_connect,
```

.fops =&evdev_fops}， structure evdev find input_dev structure by handle->dev, which corresponds to the input device.

When the user receive the input request, it will generate the corresponding interrupt and calls input_event() function. As shown follows:

```
void input_event(struct input_dev *dev,unsigned int type,unsigned int code,int value){
if(is_event_supported(type,dev->evbit,EV_MAX)){
spin_lock_irqsave(&dev->event_lock,flags);
add_input_randomness(type,code,value);
input_handle_event(dev,type,code,value);
spin_unlock_irqstore(&dev->event_lock,flags);
}}
```

Then call input_handle_event to perform the corresponding process with input_pass_event function according to the type of event. Final call evdev_pass_event function is bound to evdev clients, and passed the client event to the input_event array of evdev_client structure of client. And then this array is passed to the user space, so you can receive user input information.

D. Handing mechanism on user space

The information reported by touchscreen event and trackball event that is coordinates are pressed or not, the key processing needed to use key scan code Scancode

form a KeycodeLabel, and form integer keycode again. In KeyCharacterMap class of local framework layer, it realize get(int keycode,int meta)、 getDisplayLabel(int keycode) and getEvents(unit16_t *chars,size_t len,Vector<int32_t> *keys,Vector<uint32_t> *modifiers) function to get the character mappings. There are various Listener in android.text.method of upper application, and it can monitor various information of KeyCharacterMap, and serve upper layer applicatios.

E. Realization of input subsystem in Qualcomn processor

In Qualcomm processor, the touchscreen achieve synaptics_ts_probe() function in synaptics_i2c_rmi.c and msm_ts.c, the touchscreen operation mode is initialized in this function, and the corresponding device is registered in the Linux kernel, and the interrupted operations caused by touch screen events are initialized.

Static int synaptics_ts_probe(Struct i2c_client *client,const struct i2c_device_id *id){

Struct synatics_ts_data *ts;//The definition of structure pointer of a synatics_ts_data

If(!i2c_check_functionality(client->adapter,I2C_FUNC_I2C))//Determine the status of i2c

Printk(KERN_ERR "synaptics_ts_probe:need I2C_FUNC_I2C")

Ts=kmalloc(sizeof(*)ts,GFP_KERNEL); Apply for a space in kernel space

INIT_WORK(&ts->work,synaptics_ts_work_func);//Add the work to the corresponding queue

I2c_smbus_write_byte_data(ts->client,0xf4,0x01);//The data is written to the i2c bus

……

I2c_smbus_read_word_data(ts->client,0x04)//Read register data to i2c bus

}

The key events and trackball events are achieved through the GPIO system, &mahimahi_keypad_matrix_info.info keyboard matrix is defined in array of structures struct gpio_event_info *mahimahi_input_info[], and the x information of trackball is defined by &jogball_x_axis.info.info, the y information of trackball is defined by &jogball_y_axis.info.info. The input subsystem registration keys device and trackball device in structure struct gpio_event_platform_data mahimahi_input_data, and in response to the user through the upper application.

Ⅴ. CONCLUSION

The advantage of Android input subsystem hierarchy is top drive without knowing the working methods of the lower drive, and lower drive provides a unified interface for the same function variety of models of drives. For different input devices, Android input subsystem write a different driver program and serving for the upper application only need to accord to the requirements of input subsystem at the bottom layer which reduces the difficulty of program development greatly.

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Review on Image Processing Methods Based on Sparse Representation

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***Abstract*—As an effective image representation method, sparse representation technique has been extensively studied and it has been widely used in the field of image processing. Based on the analysis of the sparse representation models in the paper, the key problems of the models are discussed in detail including sparse decomposition and dictionary learning. Then, the applications of sparse representation in the fields of image denoising, image inpainting, face recognition, and compressed sensing are summarized in detail. Finally, the problems in research of sparse representation are discussed and the research direction is also given in the paper.**

***Index Terms*—Sparse representation, sparse decomposition, dictionary learning, image processing**

I. INTRODUCTION

With the advent of the era of information, images become the main source of access to information, in the face of a surge in image data, how to effectively according to image characteristics and structure of the image to become the hot topic which the researchers to explore, image sparse representation is proposed under the background of an image representation, expect fewer elements to represent the original image information as possible. That is to say, according to human visual system is able to use fewer neurons observed objective things, so as to lay the foundations for the image can be sparse representation.

In recent years, the technology of image sparse representation for the further research, and has been widely used in image processing field, such as image denoising, image restoration, face recognition, target tracking and compression perception, etc.This paper introduces the basic sparse representation model, on the basis of sparse representation is discussed in detail two core issues: the sparse decomposition and dictionary structure, and finally points out the sparse representation in application and the further research direction in the field of image processing.

II. SPARSE REPRESENTATION MODEL

Sparse representation of the basic idea is that natural images or signal can be represented by a linear superposition of basis function dictionary. For a given signal $Y \in Rn$, Basis function dictionary $D=\{d1,d2,\ldots,dm\} \in Rn\times m$, then Y available the following sparse model representation:

$$\text{Min}\|X\|0 \quad \text{st.} \quad Y=DX \qquad (1)$$

Type: X for signal Y on the dictionary D sparse representation or sparse coding, norm, ||X||0 is the norm of L0, said the number of china-africa zero component X.

When the dimensions of the dictionary D meet n > m, Y = DX is overdetermined linear equation and X has a unique solution. When n < m, with the dimension of the atomic number is greater than the signal to represent the signal, the column number of the dictionary D is greater than the number of rows, according to the dictionary for complete dictionary. When the dictionary D for complete dictionary, linear equation Y = DX is underdetermined equation, the solution is not only of X, at this point you need to add some constraints, such as type (2) and (3).In this case, the solution of (1) into the type (2) or (3) optimization problem.

$$\text{Min}\|Y\text{-}DX\|22 \quad \text{st.} \quad \|X\|0 \le k \qquad (2)$$

$$\text{Min}\|X\|0 \quad \text{st.} \quad \|Y=DX\|2 \le \varepsilon \qquad (3)$$

As you can see, (2) is to use the linear combination of no more than k atoms that under the condition of sparse model, and the approximation error as small as possible, and (3) are in Y meet under the condition of sparse approximation error model (A) is approximation precision.

In order to achieve the sparse representation of signals, the key to achieve the above-mentioned sparse representation model. For this need to solve two basic problems: one is sparse decomposition, the solution of the sparse coefficient; Another is sparse dictionary learning, namely how to construct a complete dictionary makes the representation of a signal is sparse.

A. Sparse Decomposition

The purpose of the sparse decomposition is to get the optimal sparse representation of signals. Mallat and Zhang[1] for the first time putting forward the idea of signal decomposition in a complete dictionary, and points out that the signal in a complete dictionary must be sparse decomposition results, which laid the groundwork for the signal sparse decomposition. At present commonly used sparse decomposition algorithm is mainly divided into two kinds, one kind is approximate approximation algorithm, the greedy algorithm; Another kind is the objective function for transformation, simplify the solving process.

B. Greedy Algorithm

Greedy algorithm is the basic principle of iterative way choice and signal is most similar to that of atoms in the dictionary to approximate approximation to the original signal, the commonly used method of Matching Pursuit, Orthogonal Matching Pursuit[2], etc. MP algorithm in each iteration process, choose from a complete atomic database and signal most similar atoms to represent the signal, and the residual volume, and choose with the residual amount to match most atoms. The algorithm is a kind of pure greedy algorithm, under the condition of finite dimensional meet exponential convergence, but to the infinite dimensional, MP algorithm is not convergence.MP algorithm, moreover, is not to orthogonalization has selected atoms, but only with the recently elected orthogonal atom, therefore, in the selected dictionary atoms on the subspace of the optimal signal may be the result of each iteration times.That is to say, the MP algorithm can guarantee signal of the optimal approximation.

Aiming at the existing problem of MP algorithm, Pati OMP algorithm is presented, It through recursive in each iteration of the selected orthogonalization all atoms to guarantee the optimality of the iteration.OMP algorithm, however, cannot achieve accurate reconstruction of all signal, therefore, Suggestions on the basis of the OMP Neeldell of Regularized Orthogonal Matching algorithm[3], the algorithm uses the Restricted Isometry Property to ensure that the solution stability, so as to realize the RIP conditions set of atoms and accurately reconstruct sparse signal. Compared with the OMP algorithm, ROMP first select multiple atoms as the candidate set, and then selected in accordance with the principle of regularization from a candidate set of atoms, finally it incorporated into the final set of atoms, so as to realize the rapid and effective choice of atoms. Followed by the compression sampling matching pursuit algorithm and subspace pursuit algorithm is introduced into the back thought to reduce the complexity of the reconstruction, the algorithms of reconstruction quality and linear programming method.

The above is the premise of known signal sparse decomposition algorithm, but the practical application of the sparse degree is often unknown. To Do such as Sparse Adaptive Matching Pursuit algorithm[4] is proposed, the algorithm by setting a variable step length approach to reconstruction, which can be obtained under the condition of the sparse degree of unknown better reconstruction effect, speed is faster than the OMP algorithm. According to ROMP and SAMP, instead Liu Yaxin Regularized Adaptive Matching Pursuit algorithm is proposed, such as the algorithm is simple and effective regularization process was adopted to realize library of atoms, screening, at the same time, by setting the iterative threshold of signal sparse degree are estimated adaptively. Experiments prove that the reconstruction of the RAMP quality both in visual effect or objective data is superior to the existing similar algorithms.

C. Objective Function Transformation

Because according to the sparse model directly to solve the sparse representation of signal has been proved to be NP - hard problem, therefore many researchers expected by the method of transformation of the objective function, to solving the 0 - norm to solve problem is converted into other forms of function. The common method to transform are: the LP norm approximation algorithm and Newton Smooth L0 Norm etc.

Based tracking algorithm BP is LP ($0<p\leq1$) a special case of norm algorithm, i.e. $p = 1$, this method will not convex optimization problem into a convex optimization problem, so the classical theory of convex optimization can be used to solve BP algorithm, however, large amount of calculation, and also can't fully reflect the sparse feature of Y. In fact, in $0<p\leq1$, p is smaller, the better approximation 0 - norm, namely, get the solution of the sparse, Zhao Qian etc. Through the research to find the most representative, $p = 1/2$ for L1/2 regularization Logistic regression model, and construct the effective algorithm for this model. Experiments show that the algorithm has good capability of variable selection in classification problem and the ability to predict, superior to the traditional Logistic regression and L1 regularization Logistic regression.

D. The Dictionary Structure

Construct an appropriate dictionary plays an important role in the sparse representation, used in the applications of sparse representation more complete dictionary, a complete dictionary is much more than the signal of atoms, able to form a more concise way to represent a variety of types of signals. Complete dictionary and used to approximate signal, can greatly reduce the approximate distortion and mean square error, effective performance signal sparse. At present a complete dictionary construction method mainly divided into two categories: one is based on the mathematical model of a dictionary structure method. Another kind is dictionary construction method with adaptive ability.

E. A Dictionary Structure Based on Mathematical Model

A dictionary is based on the generating function of mathematical model structure geometry transformation. Therefore, based on the mathematical model of a dictionary structure method is the key is to choose the appropriate generating function.

At present, the commonly used generating function mainly includes the Ridgelet transformation, Curvelets transformation, Contourlets transformation, Bandelets transformation, etc. Candes given in literature[5] the basic theoretical framework of ridgelet transform, ridgelet transform for linear singular signals have a very good approximation, but for the boundary curve of the image, Ridgelet transformation can’t sparse representation. For this, based on Ridgelet transformation, Candes and Donoho that Curvelet transform is proposed, which provides a way in the construction of the continuous form but produce high redundancy in the process of discretization and

complicated calculation. Aiming at this problem, Do and Vetterli that Contourlets transformation was proposed, it is directly defined in discrete domain, so its representation for discrete signal is simple, and low redundancy. After Le Pennec and Mallat Bandelets transformation was proposed, it take full advantage of image intrinsic geometric regularity, especially the edge and direction, adaptive to obtain the optimal representation of the image. Because the dictionary structure method based on mathematical model, by constructing the corresponding mathematical model to approximate the unknown signal, so the unknown complex signal, the method to construct the adaptive ability is poor.

F. The Dictionary Structure of Adaptive Ability

Method based on adaptive dictionary structure mainly by learning from samples of implementation, although this kind of method, such as lack of theoretical guidance, large amount of calculation, but compared with dictionary structure method based on mathematical model, this kind of method is the adaptive ability is strong, the experimental effect is obvious, therefore, the dictionary structure method based on adaptive become the most widely used method at present. Commonly used adaptive dictionary construction method has a Maximum Likelihood methods, the Method of Optimal Directions, Maximum A-Posteriori Probability Approach and market promotion of PCA, K - SVD algorithm, etc.

Maximum likelihood method by making the maximum likelihood function p(Y|D)take to get the dictionary, it gets the solution is approximate solution; MOD method due to the need for matrix inversion in the solving process, thus has high complexity; MAP algorithms require a dictionary p(Y|D) maximize meet function, and the algorithm has the advantage of can join all sorts of prior knowledge, but the computation speed slow; Promotion of PCA method by limiting the atoms in the same subspace selection to construct the dictionary, but the constructed dictionary structure for more complex signal too many restrictions.

Existing problems, based on the above algorithm Aharon et that K-SVD algorithm is proposed, in this method, the renewal of the dictionary is a simple and efficient way each atom, and at the same time update the current atoms and the correlation coefficient in order to achieve further accelerated. K - SVD dictionary construction method effect is obvious, at present it has been widely used in the field of image processing. However, K - SVD highly non convexity problems make it solution is usually a local minimum value, and the training result is often an unstructured dictionary. Therefore, K - often apply to smaller signal SVD method. To solve this problem, researchers in recent years the introduction of online learning dictionary method, and based on the analytical dictionary of parameter dictionary training method.

II. SPARSE REPRESENTATION IN THE FIELD OF IMAGE PROCESSING APPLICATIONS

A. Iimage Denoising

The traditional denoising method often assume useful information of the image signals with noise in low frequency region, and the noise information in high frequency region, which is based on the median filtering, Wiener filtering, wavelet transform methods such as image denoising, and, in fact, this assumption is not always true.

Based on image sparse representation, the researchers in recent years is presented based on a complete dictionary sparse representation of image denoising model, its basic principle is to transform the image sparse representation as a useful information, the approximation residuals as noise[6]. using the K - SVD algorithm based on sparse and redundant dictionary, at the same time for K - SVD algorithm is suitable for processing small data limitations, only by defining the global optimal to force local block sparse. proposed sparse regularization of the poisson image denoising algorithms, the algorithm adopts the log likelihood function of the poisson as fidelity term, with image sparse constraint under redundant dictionary as a regular item, so as to achieve better denoising effect.

B. Face Recognition

In recent years, the sparse representation is widely used in face recognition, and good recognition effect is obtained. Wright and others think that: (1) the similar samples in the same linear subspace, any test samples are from the class of training samples can be used linear representation;(2) with all of the training sample dictionary, the test sample is sparse in the dictionary says, at the same time, the sparse coefficient contains sample category information. Based on this, Wright was proposed based on sparse representation, such as face recognition framework, namely the first library constructed over complete dictionary based on human face, and then calculate sparse coefficient of the image on the dictionary under test, according to the discriminant image reconstruction error status again. The algorithm is not sensitive to feature selection, can have very strong anti-noise Force, and has good shade processing functions, and thus received extensive attention in the field of face recognition[7]. weighted sparse coding algorithm, the method in solving the face cover, illumination, expression of good results have been achieved.

C. The Image Restoration

With the deepening of the sparse representation research, sparse representation has been widely used in the field of image restoration. In order to ensure the repair when the visual rationality and consistency between the hole and the surrounding, Shen[8] put forward full area sampling directly on the image to be processed, redundant dictionary structure, and then through the calculation in turn hole boundary incomplete block of sparse representation. The algorithm in dealing with a large hole and preserving image details with good ability.

D. Compression Perception

In order to reconstruct the original signal effectively, the traditional mode based on Nyquist sampling theorem to the signal sampling. In recent years, with the rise of sparse representation to reconstruct the original signal compression, this paper proposes a new theory in perception[9].

Compressed sensing theory broke through the lower limit of Nyquist sampling frequency and its signal sparse sex as a prerequisite, the traditional mode of signal sampling and compression of two process into a process, direct access to the sparse signal, and then use a has nothing to do with the transformation matrix of the observation matrix of transform coefficient vector transform, finally by solving an optimization problem to reconstruct the original signal. At present, the domestic and foreign researchers in this field were studied, and put forward the effective compression perception theory and method[10].

III. EXISTENCE QUESTION AND THE NEXT RESEARCH DIRECTION

Sparse representation is currently a hot issue in research of image processing, the solution of the sparse or dictionary learning problems have received extensive attention of the researchers, while the related research has made great achievements, but there are still some problems to be solved.

In sparse solution: although the sparse algorithm are many, but most algorithm computational complexity is higher, how to guarantee the dictionary learning at the same time improve the calculation speed is a concern. In dictionary learning: the dictionary learning mostly characterized by image pixels, or a first image segmentation, then after segmentation of the image block of pixels to study, so learning the dictionary contains no image spatial structure in the form of information. Therefore, consider how image spatial information added to the dictionary learning, improve the dictionary resolution performance is also the important research direction of learning. In addition, the current dictionary constructor often for a specific problem or some kind of problem, so how to construct a universal dictionary is also a problem worthy to be discussed.

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Stability Research of Huangjialong Slope Considering Rheology Influence

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***Abstract*—Based on non-continuum deformation theory, taking consideration of the uncertainty and gradualism of mechanical parameters for rock and soil medium, the stability of Huangjialong slope of expressroad from Ruzhou to Chenzhou (K106+680-K107+000) is study in this paper. The mechanical effects in spatial and temporal of instability are researched. The intrinsic relationship between the propagation regularity of slope instability and integral failure is obtained through the improved laboratory test, three dimensions numerical simulation. The results obtained are important to improve the stability evaluation and design principal for slope, to similar project construction and post-operation as a reference.**

***Index Terms*—rheology property; slope stability; strength reduction method; numerical calculation**

I. Introduction

During the excavation, the slope is affected by various factors, including deformation and instability, etc, which becomes more complex over time. Consequently, lots of attentions have been paid by the research topics of many domestic and foreign scholars[1-3]. The analysis of slope stability is mainly based on the analysis of slope current situation. The slope stability affected by the time is seldom taken into account. However, the rheological phenomena in practical project likely impacts on the stability of the slope.

Based on the equivalent Mohr-Coulomb yield criterion, Duan Jian Et al. put forward a practical calculation method, combined with the rheological properties of rock, by means of the theory of rheological model with fractional order derivatives. Song Fei[9] explored the instantaneous deformation and failure characteristics of gypsum breccia, as well as the creep characteristics under different confining pressure and stress levels. It turned out that the rheology of gypsum breccia is provided with nonlinear characteristics. According to the study of K108 slope of Jingzhu Expressway, Chen Weibing[10] came up with the rheological parameters of weak interlayer by means of sticky elastic-plastic numerical method and inversion analysis of artificial neural networks. Thus, the parameters can be used for the analysis and early warning of slope stability. Ma Chunchi Et al. [11] introduced initial damage tensor reflecting the joint distribution, as well as a damage evolution equation derived from the partial visco-plastic strain. Thus, a new equivalent rheological damage model for jointed rock masses is established. Wang Jun Et al. [12] worked out the rheological consolidation equation and its difference scheme, reflecting the coupling relationship of rheological consolidation, in line with one-dimensional consolidation theory proposed by Terzaghi. Futhure, the calculation formulas of strength reduction under the rheological effect and rheological consolidation effect were respectively set up by means of the strength reduction technology. Based on the shear rheological test data of diabase on the site of Dagangshan hydropower, Chen Fang Et al. [13] calculated the long-term strength of shear rheology and made comparative analyses respectively by means of isochronous stress - strain curve, unsteady creep discrimination law, and steady creep rate method. Combined with the survey results of the project, this study analyzes the stability of Huangjialong slope in Hunan by means of FLAC3D and strength reduction method. Besides, it compares the performance between the rheological properties considered and non- considered. Thus, it lays important basis for the similar projects in practice.

II. Project Overview

A. Geological Conditions

The project is located in the boundary area of Tingziba tunnel and Huangjialong slope of expressroad from Ruzhou to Zhangzhou. The abutment 23# to pier 28 # of Huangjialong viaduct, as well as the entering part of the Tingziba tunnel, stand at the mountainside. The surface layer is mainly composed of debris soil caused by the piedmont alluvial, block stone, and crushed stone, etc. So it is complex in poor uniformity with large thickness and the underlying bedrock surface is uneven. Moreover, the slope is in poor stability and complicated geological conditions.

B. Site Investigations

According to the geological survey on site, there are seven shallow slumps in the slope with the slump depth from 5m to 8 m, natural slope form 35° to 45°, slump area from 80 m2 to1800 m2, and slump accumulative thickness from 0.5m to 3.0m. It mainly consists of gravel, crushed stone, silty clay, and block stone with the maximum diameter of 1.8m. The front edge of slope slump is accumulative area, shaped in step with large thickness and poor slope stability. On July 16, 2006, the rainwater scoured the slope heavily and led to the slope

slump. The slope is in less stable state in the light of the slump on the slope surface.

Through the observation of slope surface, the longitudinal cracks in the Tingziba tunnel do not vary significantly. However, the transverse cracks and longitudinal cracks in the left of cutting in the entering part tend to extend. Four points of displacement observation were set by the construction unit on the slope on March 27, 2010. As the surface observation results show, there are displacements towards the slope toe in the observation points in varying degrees, with the maximum displacement of 8.7cm. The surface cracks tends to develop further. new small secondary cracks , as well as the small deformation, take place near the earth's surface.

III. Project Overview

A. Computational Model and Boundary Conditions

A representative cross-section of Huangjialong slope is taken as the computational model. In y direction, a unit width (15m) is adopted and the displacement of all the nodes in y direction are constrained, in order to carry out the plane strain analysis. the schematic diagram of computational model is shown in Figure 1.

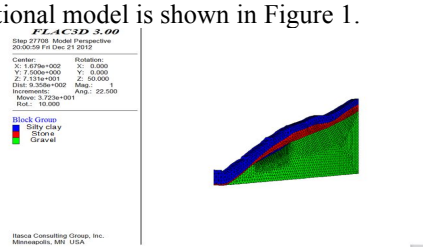

Figure 1. Schematic diagram of computational model

B. Determine the Initial Stress Field

On the basis of geological exploration of slope, there are no damages caused by the tectonic stress field, such as faults, etc. So in the analysis and calculation, the gravitational field is treated as the initial stress field.

C. Select the Calculation Parameters

The physical and mechanical parameters of rock layers of Huangjialong slope are shown in Table I.

TABLE I.
Physical and Mechanical Parameters of Various Rock Layers

Type	Natural Severe（kN/m3）	Saturation Severe（kN/m3）	Cohesiveness C（kPa）	Friction Angle φ (Degrees)	Bulk Modulus（MPa）	Shear Modulus（MPa）	Tensile Strength（MPa）
Silty Clay	18.5	19.5	20	24	11.1	2.9	1
Block Stone	23.5	23.5	5	30	5.56×104	3.36×104	20
Gravel	22.0	22.0	5	26	9.5×104	1.97×104	10

IV. Strength Reduction Method Excluding the Rheological Properties

A. Basic Principles

The Mohr - Coulomb yield criterion is adopted in the tradition limit equilibrium method for the slope stability. The safety factor [14] is defined as the ratio between the shear strength on the sliding surface and the actual shear on the sliding surface. The formula is shown as follows.

$$\omega = \frac{\int_0^l (\mathrm{c} + \sigma \tan\varphi)\,\mathrm{dl}}{\int_0^l \tau\,\mathrm{dl}} \qquad (1)$$

Divide the Formula (1) by ω on both sides. The Formula (1) turns into:

$$1 = \frac{\int_0^l \left(\frac{\mathrm{c}}{\omega} + \sigma\frac{\tan\varphi}{\omega}\right)\mathrm{dl}}{\int_0^l \tau\,\mathrm{dl}} = \frac{\int_0^l \left(c' + \sigma\tan\varphi'\right)\mathrm{dl}}{\int_0^l \tau\,\mathrm{dl}} \qquad (2)$$

Where the $c' = \frac{\mathrm{c}}{\omega}$, $\tan\varphi' = \frac{\tan\varphi}{\omega}$,φ denotes friction angle, c denotes cohesive force, ω denotes safety factor, and σ denotes the normal stress.

B. Selection of Constitutive Relation

As the most common rock constitutive model, the mohr-coulomb model is selected, thus simulating the stability of slope.

C. Analysis of Calculated Results

Displacement Analysis

The left of Formula (2) equals to 1. It indicates that the slope reaches the limit state when the strength is divided by ω. In addition, the FEM strength reduction method is similar to the traditional methods in essence.

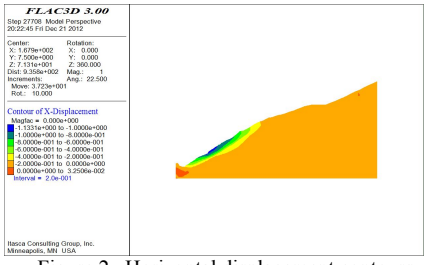

Figure 2. Horizontal displacement contours

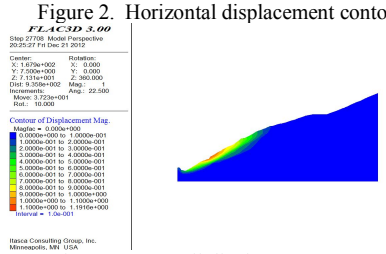

Figure 3. Overall displacement contours

Stress Analysis

The elastoplastic yield state of slope is shown as the Figure 4. Most of the lower part and small area of the upper part of the slope have already been in the elastic-plastic behavior, and shaped in the connecting circular. As the Figure 5 shows, the safety factor of slope equals to 1.27. Obviously, the potential sliding surface covers the entire region of the slope toe. And it is damaged in the type of shearing slip and tends to toppling failure.

On the basis of the above analysis, the slope profile is likely damaged partially in failure mode of arc damage, namely "pressure - shear" failure.

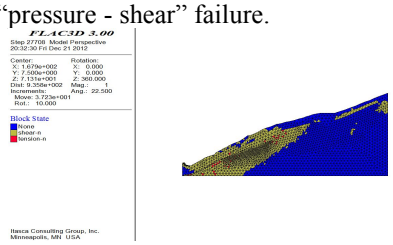

Figure 4. Diagram of elastoplastic yield state

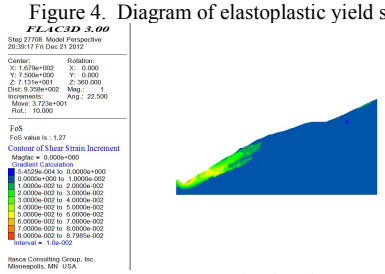

Figure 5. Contours of safety factor and shear strain increment

V. Strength Reduction Method with the Rheological Properties

A. *Selection of Constitutive Relation*

The NVPB model is adopted. The value of viscoelastic modulus (e), viscosity coefficient (η), and plasticity threshold (σs) can be referred to the Table I I.

TABLE II.
SELECTION OF PARAMETERS IN THE NVPB MODEL

Type	E_1 (MPa)	E_2 (MPa)	E_3 (MPa)	η_1 (GPa·d)	η_2 (GPa·d)	η_3 (GPa·d)	σ_{s1} (MPa)	σ_{s2} (MPa)
Silty Clay	296	396	225	5	4	7	35	39
Block Stone	397	409	256	15	12	23	68	74
Gravel	366	400	240	12	9	19	52	48

B. *Analysis of Calculated Results*

Displacement Analysis

As Figure 6 indicates, most slope horizontal displacements occur in the slope Toe. The nearer to the slope, the larger displacement will be. Most large horizontal displacements take place in the area A, far more than the one excluding the rheology. So the region likely slides. As shown in Figure 7, the overall displacement of slope is significant. Compared to the results excluding the rheological properties, the displacement with the rheological properties mainly happen in the upper part with larger scope.

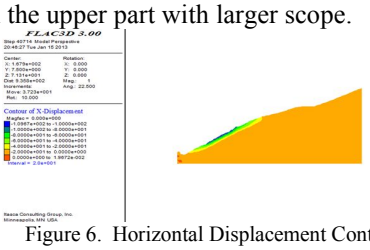

Figure 6. Horizontal Displacement Contours

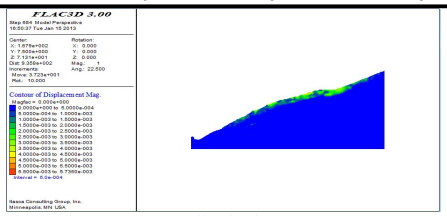

Figure 7. Overall Displacement Contours

Stress Analysis

From the stress nephogram, the stress distributes significantly in horizontal direction and is dominated by the compressive stress, shown in Figure 8. The potential failure mode of slope is "pressure - shear" failure. Obviously, the potential sliding surface covers the entire region of the slope toe. And it is damaged in the type of shearing slip and tends to toppling failure.

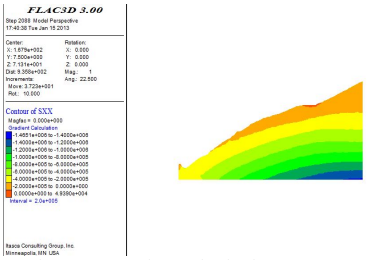

Figure 8. Horizontal Displacement Contours

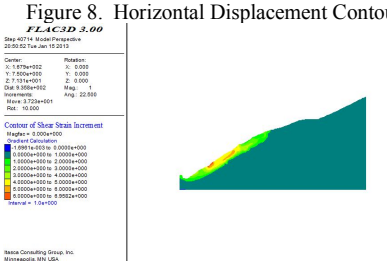

Figure 9. Overall Displacement Contour

Above all, the slope profile is likely damaged partially in failure mode of arc damage, namely "pressure - shear" failure. Besides, the displacement and stress, as well as the extent of damage, by the method with the rheological properties are more than the ones excluding the rheological properties. So it is necessary to take the rheological effect into consideration in practice.

VI. Conclusion

Based on the stability analysis of specific engineering, namely Huangjialong slope, the study selects the typical profiles and compare the circumstances of the rheological properties considered to the one non- considered, by means of numerical software FLAC3D. Thus, the following conclusions can be drawn.

- When the rheological properties are not considered, Most of the lower part and small area of the upper part of the slope have already been in the elastic-plastic behavior, and shaped in the connecting circular. The potential sliding surface happens in the slope and its safety factor equals to 1.27, namely in unstable state.
- When the rheological properties are considered, the horizontal displacement is larger and takes place in the upper slope, in a larger scope while it happens in the lower slope when not considered.
- The displacement, stress, and the scope of potential damage are larger, and safety performance are lower when the rheological properties are considered. So it is necessary to take the rheological effect into consideration in the analysis of slope stability.
- The results of slope stability by the strength reduction method with the rheological properties meets the survey results of project on site better. The corresponding reinforcement measures should be taken, in order to ensure the safety of the slope.

Acknowledgment

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The Remote Multi-point Temperature Monitoring System Based on CAN-bus

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Abstract: **In order to achieve the temperature of several remote points, a real-time online temperature monitoring system is designed , which is based on CAN-bus. The system consists of several slave nodes, a master node and a computer .The STC89C52 is used as the controller of slave nodes, slave nodes achieve the surroundings' temperature by controlling the digital temperature sensor DS18B20 and transmitted the collecting temperature data to master node via the CAN-bus. STM32107VC is used as the controller of master node, the master node processed the data of each child nodes and sent to the host computer display through the serial port .The system can be easily expended with the character of further transmission distance and reliability.**

Index Term: **CAN; industrial control; temperature monitoring**

I. INTRODUCTION

With the development of technology and factory intelligence ,temperature monitoring and control is an important parameter in industrial production sites,warehouses and other important applications.By monitoring temperature,staff can make the right judgment and operation to ensure the most effective and economical industrial and agricultural production.The wireless transmission technology is the most commonly used in temperature monitoring and control system, the stability of wireless transmission distance and data transmission are subject to varying degrees impacted due to various conditions of obstacles, electrical interference in some complex industrial applications. CAN bus is one of the mostly widely used field bus in the world. It is of high rate, high resistance to electromagnetic interference, and it has the function of point to point ,one point to the multi-point data receiving and transferring. What is more, the slave nodes are up to 110. The paper presents a new type of multi-channel temperature acquisition system equipped with STM32F107VC and combined the CAN bus communications technology. Experiments shows, this system has the advantage of collection temperature precise, high reliability, and communication distance.

II. HARDWARE SYSTEM DESIGN

A. CAN bus distributed control system architecture

Network structure of the system includes a host PC, a master node, several slave nodes. The slave node is responsible for collecting temperature data from each site and sent to the master node, the master node will transmit temperature data for each child node performs a calculation and conversion, and then transferred to the host computer via the serial port and for the host computer to display. Distributed remote monitoring temperature acquisition system is shown in Fig.1

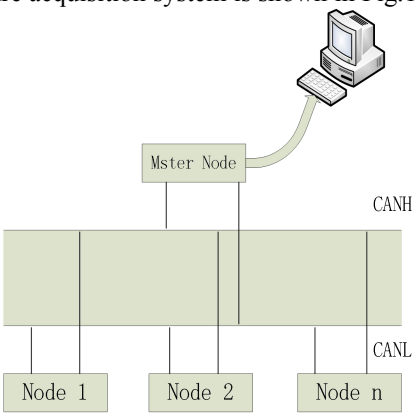

Figure 1. Network structure of the system

B. The master node hardware system design

Master control chip select STM32107VC , the chip is based on ARM Cortex-M3, 32-bit RISC core operating frequency up to 72MHZ, abundant on-chip resources, it has 32 hardware division and single-cycle multiplier, such as a series of advanced architecture, greatly enhancing its data processing and computing capability. So it can easily process the temperature data from each slave node. the master node structure is shown in Figure 2:

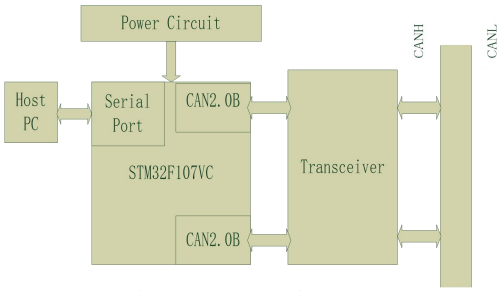

Figure 2. master node structure

C. Slave node hardware system design

Child node controller chip select common control chip STC89C52, low cost of the chip, the system can satisfy the control requirements. Temperature sensor developed by the United States DALLAS digital temperature sensor DS18B20, it is an excellent smart digital instruments, temperature range of -55 ~ + 125 ℃ , the maximum resolution of up to 0.0625 ℃ , the temperature of the child node sampling circuit schematic Figure 3:

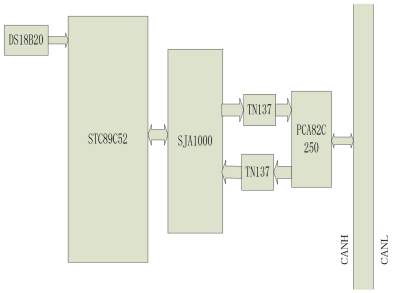

Figure 3. slave node structure

III.SOFTWARE SYSTEM DESIGN

A. child node software design

The main function of the child node is to achieve the real-time temperature of the environment, when the system power, DS18B20 start and maintain a low-power state, CPU first sends a command to skip the ROM area (0xcc), and then send temperature conversion command (0x44) and initialization, and finally send the data read command (0xbe) to read the data and save it. Child nodes flowchart software program shown in Figure 4:

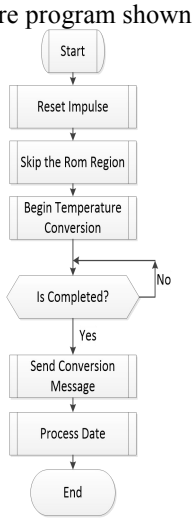

Figure 4 .child nodes software program

B. CAN bus communication with the master node and the child node

CAN2.0 protocol is divided into two parts: CAN2.0A and CAN2.0B, CAN protocol is mainly to regulate the transport layer ,there is not too much physical layer CAN protocol. CAN bus communication is a serial communication mode, it has the following characteristics:

(1) Multi-master controls. All nodes can begin to send information in the bus is idle.

(2) Packets have priority. Two or more units can send message at the same time, according to the decision marked the beginning of symbol priority.

(3) Ensure that the delay time, the use of the transmission time is short frame structure, differential mode anti-interference ability.

(4) The multi-point time synchronization can achieve a multi point transmission, no special scheduling.

(5) Error detection and calibration errors. Transient errors will permanently separate and automatically shut down the wrong node.

(6) The maximum transfer rate of up to 1Mbps, the transmission distance can be up to 1Km (40Kbps).

Packet transmission CAN bus represented and controlled by the following four kinds of frames:

(1) a data frame: a data frame carrying data from the transmitter to the receiver.

(2) Remote Frame: bus unit issues a remote frame requesting unit transmits the data frame has the same identifiers.

(3) Error Frame: An error was detected in any one unit sends the wrong frame.

(4) Overload Frame: used between the preceding and subsequent data frame (remote frame) provides certain delay.

CAN protocol can be divided into the object layer, transport layer and physical layer, the object layer and the transport layer covers all features and services in the OSI model data link, CAN hierarchy shown in Figure 5:

Application Layer
● Packet Filtering ● Processing Messages And Status
Transport Layer
● Fault Confinement ● Error Detection And Calibration ● Packet Inspection ● Answer ● Arbitration ● Message Framing ● Transfer Rate And Timing
Physical Layer
● Signal Level And Bit Representation ● Transmission Media

Figure 5 .the hierarchy of CAN protocol

1. The child node packets: according to the CAN protocol, packets sent independently by the CAN controller, temperature controller data to be transmitted in the form of packets sent to the transmit buffer CAN controller, and then sends the request flag bit so that the packet sent. This design uses the interrupt mode to send packets, the program flow chart shown in Figure 5:

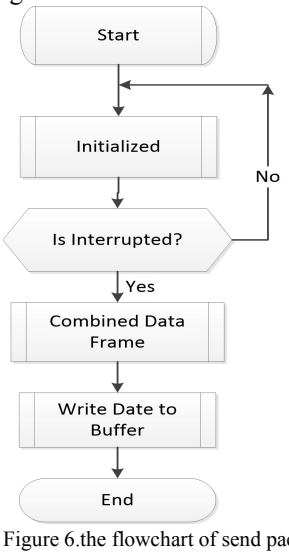

Figure 6.the flowchart of send packet

2. The master node accepts the message: According to the CAN protocol, accept packets is done by independent CAN controllers, the received packets in the receive buffer, just read the corresponding subroutine receives information from the receive buffer, the receiver when packets per frame identifier must accept verification filtering. This design uses interrupt receiving packets to reduce CPU load and improve real-time, the program flow chart shown in Figure 6 :

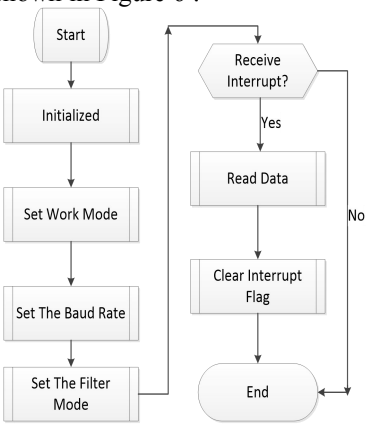

Figure 7.the flowchart of receive packet

C. Master node communication with the host computer.

VB programmers are generally in the Windows environment the most common serial programming language developed by VB serial communication program controls are mainly including two methods: First, using MSComm serial control, the second is to call the Windows API functions. this paper select the first method, because MSComm serial control method is more convenient than calling Windows API functions , and with less code can achieve the same function, so that the programming efficiency is greatly improved, but also due to reduced programming system incorrectly instability. The design flow chart VB PC programming is shown in Figure 8

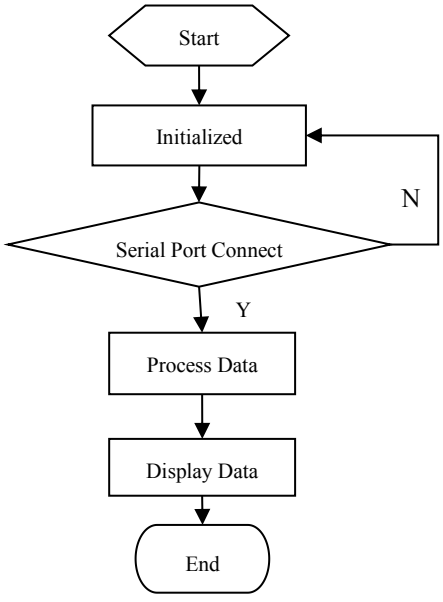

Figure 8.the host pc design flowchart

The design of the PC using VB serial communication control MSComm serial communication function to communicate, then control to start the conversion operation, and the data processed through the program, the node number and the corresponding temperature is displayed, satisfied the basic design requirements. The child nodes of each temperature acquisition value shown in Figure 9:

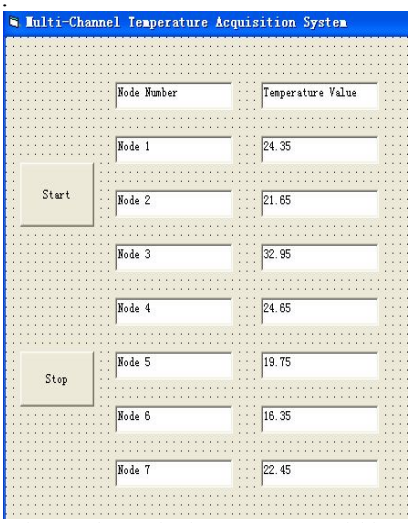

Figure 9.the result of temperature acquisition

Ⅳ. CONCLUSION

The design of multi-channel temperature acquisition system has advantages of low cost, fast response, long distance communication. System platform can be applied to remote monitoring of some power system equipment, intelligent agriculture remote monitoring, intelligent warehouse monitoring and so on. The temperature measurement accuracy is within 0.5 ℃ .The system is reliable and high reliability, it has a good future in certain social application.

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Study on Application of VLAN technology and ACL in the computer room of Campus

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***Abstract*—With the development in the past few years, VLAN technology got extensive support, the VLAN and ACLS technologies becomes primary technologies in application of network. This paper aims to design a new network service mode in garden area based on the exploration of VLAN and ACLs technologies Through the garden area network construction example, VLAN and ACLs technologies greatly strengthened capabilities of the garden area network management and safe guard.**

***Index Terms*—vlan,acls,three-layer switching, project of the network**

I. Introduction

Vlan is a switched network that is logically segmented by function, project team, or application, without regard to the physical locations of the users. vlans have the same attributes as physical LANs, but you can group end stations even if they are not physically located on the same LAN segment.

A local area network (LAN) is a private network usually confined to one plant. Virtual LANs (VLANs) allow a single physical LAN to be partitioned into several smaller logical LANs. VLANs limit the broadcast domain, improve security and performance and are ideal for separating industrial automation systems from information technology systems.

There is another reason to separate the information technology LAN and the industrial automation system LANs. A LAN is considered a single broadcast domain. This means that broadcast messages (messages destined to all stations) will be sent to every station on the LAN. This is usually true for multicast messages (messages destined to many, but not all stations). If the exact location of stations that are to receive a multicast message is not known, then all stations will receive the message. Industrial automation protocols frequently use the producer/consumer model in order to improve real-time response. In the producer/consumer model, one originating message that is produced by one station is consumed by several stations called consumers. With Ethernet, this generates many broadcast and multicast messages that can consume the total bandwidth of the lan. Is there another way of retaining the same physical network but allowing separate lan functionality? Yes there is, and it is called virtual local area networks (vlans).

A. Types of Vlan

Several types of vlan are defined, depending on switching criteria and the level at which the VLAN is conducted:

A level 1 vlan (also called a port based vlan) defines a virtual network according to the connection ports on the switch.

A level 2 vlan (also called a MAC Address-Based vlan) comprises of defining a virtual network according to the MAC addresses of the stations; this type of vlan is much more flexible than the port based vlan because the network is independent from the location of the station.

A level 3 vlan: there are several types of level 3 vlan the Network Address Based vlan links subnets according to the source IP address of the datagrams. This type of solution provides great flexibility insofar as the configuration of the switches changes automatically when a station is moved. On the other hand there may be slight degradation in performance since the information contained in the packets must be analysed more closely.

The Protocol Based vlan makes it possible to create a virtual network by protocol type (for example TCP/IP, IPX, AppleTalk, etc.), therefore grouping together all the machines using the same protocol on the same network.

B Advantages of the VLAN

The VLAN makes it possible to define a new network above the physical network and therefore offers the following advantages:net

More flexibility in administration and changes to the network because all the architecture can be changed by simple parametering of the switches.

Increase in security because information is encapsulated in an additional level and possibly analysed Reduction in the broadcasting of traffic on the network.

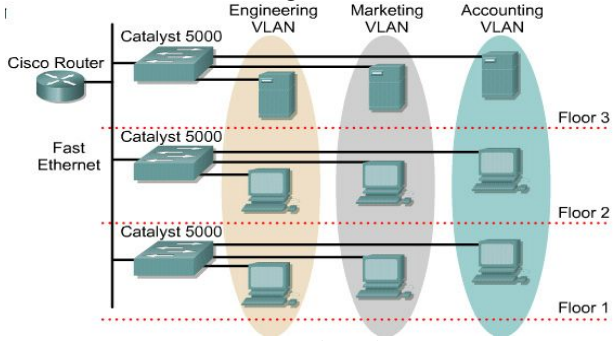

FIGURE1. network topology

II ACLS INTRODUCTION

Access control list, referred to as ACLs, is characterized by the use of packet filtering technology, read the third layer and four layer in Baotou information such as the source address, destination address, source port on a router, the destination port, according to predefined rules packet filtering, so as to achieve the purpose of access control.

The technology of initial support only in the router, in recent years has been extended to the three layer switch, and part of the two layer switch. Three layer network equipment in this paper the use of Ruijie 53550 is a support ACLs.

A The purpose of using access control list

1.limit network traffic and increase the network performance. For example, queue technology, not only the network traffic and reduce congestion.

2. provide traffic flow control. For example, can be used to control via a table by a network device of flow.

3. provides a basic level of security for network access. For example, in the company, allowing financial staff computer can access the server and other departments of finance financial access server in .

4. by the device interface, decided to allow some flow or forwarded. For example, the communication flow allows ftp, communication flow and telnet.

5.The analysis of the demand of the network

To provide services for the whole region of a campus network in Figure 1 W ebServer (PC2) concentration at LAN100 53550, and other buildings is the use of 52126 cascaded or interconnected to the user PC machine, the host can access the park park all server cluster Web Server, and between the buildings due to the nature of the work or function the same, need to visits within vlan, such as the computer department, electronic department office and laboratory located in different buildings office building S3 and S4 lab building, then need to partition of vlan, the exchange of visits between the lines within a group.

III APPLICATION OF VLAN TECHNOLOGY AND ACL IN THE COMPUTER ROOM OF CAMPUS

Demand analysis is as follows:

1.Any one of the PC main internal network can access the vlan100 on the Web Server server.

2.Visits each group vlan internal need to implement the pc host.

3.Between the group vlan requests the data packet filtering, limiting access to.

Table I. Vlan Id and Ip Address

.Description	Vlan Id	Network address	Ip address	Gateway
Server Groups	Vlan 100	172.16.100.0		
Department of Cmputer Science	Vlan 10	172.16.10.0		
Telecommunications Department	Vlan 20	172.16.20.0		
Server(PC2)	Vlan 100	172.16.100.0	172.16.100.2	172.16.100.1
Telecommunications Department PC5	Vlan 20	172.16.20.0	172.16.20.5	172.16.20.1
Department of Cmputer Science PC6	Vlan 10	172.16.10.0	172.16.10.6	172.16.10.1
Department of Cmputer Science PC7	Vlan 10	172.16.10.0	172.16.10.7	172.16.10.1
Telecommunications Department PC8	Vlan 20	172.16.20.0	172.16.20.8	172.16.20.1

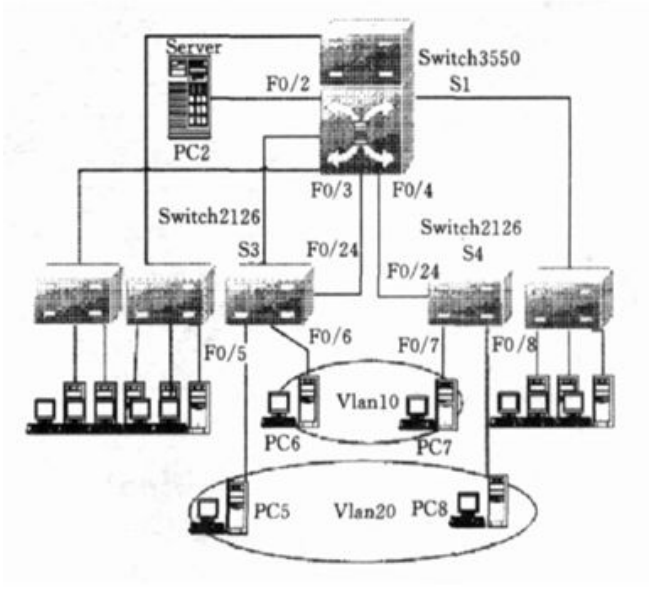

FIGURE2. Campus network topology

IV CONFIGURATION PROCESS AND STEPS

Definition 2 vlans at s3 (office building) respectively vlan10 (deparment of computer science), vlan20 (department of electronic), and the port of f0/ 6, f0/ 5 were added to the vlan10 and vlan20, the f0/ 24 port is defined as trunk model and connect s3550 f0/ 3 port.

```
vlan 10
name CSdepart
!
….
interface fastEthernet 0/ 6
switc;hport access vlan 10
!
…..
```

Definition 2 vlans at s4(experimental building), respectively vlan10 (department of computer science), vlan20 (department of computer science), and the port of f0/ 7, f0/ 8 were added to the vlan10 and vlan20, port of f0/24 defined as trunk model and connect s3550 f0/ 3 port.

Definition 3 vlans at s1, respectively vlan10 (department of computer science), vlan20 (department of electronic information) and vlan100 (server cluster), and the port f0/ 2 into vlan100, f0/3, f0/4 port is defined as the trunk model and connect the f0/24 of S3 and the f0/24 of S4.

The expansion of the definition of the access control list of Swlistl and Swlist2

```
access-list extended swlistl
permit ip 172. 16. 10. 0 0. 0. 0. 255 172. 16. 100. 0
0. 0. 0.255 eq w w w
permit ip 172. 16. 10. 0 0. 0. 0. 255 172. 16.10.0
0.0.0.255
deny ip 172. 16. 20. 0 0. 0. 0. 255 172. 16.10.0.0
0.0. 0.255
interface FastEthernet 0/ 2
switchport access vlan 100
interface Vlan 10
ip address 172. 16. 10. 1 255. 255. 255. 0
ip access-group sw list 1 in
interface Vlan 100
ip address 172. 16. 100. 1 255. 255. 255. 0
```

V CONCLUSION

Through the use of vlan technology and access control list technology acls, can significantly improve the flexibility and security of network. In the definition of acls can also be through controlled access or access control by the expert to specify the host, to do further planning of network security. In the configuration process should pay attention to the interconnection between the switch ports are trunk mode, the other hosts and switches interconnected ports are access mode, in the three layer switch should be specified for vlan ip.

The PC address, gateway machine should be specified in the corresponding vlan ip address, each PC machine in vlan100 (access the server cluster) need routing to achieve, can use static routing routing protocol, rip protocol,igmp protocol.

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The Application and Implementation of Tunneling on Cisco2801 Routers

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***Abstract*—As a new technology, virtual private networks (VPNs) are often used in enterprise networks. As to a large enterprise network, it always includes different types of routers, some of them are the low end routers. This paper illustrates how to set up a VPN using the low end routers of the enterprise network to make two branches communicate, which separates these two branches logically from the other part of the enterprise network to simplify the routing tables included in the separated part and make it successful to reduce the cost by still using the low end routers such as cisco2801 in these two branches. This paper also provides the configuration of tunneling which is one technology to build VPNs on the router cisco2801 and illustrates the procedure of the data transmission in the tunnel. The implementation discussed in this paper is based on the real structure of the enterprise network and completed after a lot of tests. It has been used in the real enterprise network.**

***Index Terms*—VPN; Tunneling; Cisco2801; Router; Enterprise network; Branch**

I. Introduction

The enterprise network often stretches across many cities. Suppose two branches of the enterprise network named B1 and B2 are in different cities. The IP address of the enterprise network is 10.*.*.*, the IP address of B1 and B2 is 192.*.*.*. There are low end routers, for example cisco2801, in B1 and B2,whose capacity is 40M. B1 and B2 can communicate with each other by different ways, such as leased line, the enterprise network directly and VPN created by tunneling. It will increase the cost if the lines are leased. It will make the routing tables complex if they communicate directly through the enterprise network. But it is the best choice to use tunnel to avoid the disadvantages mentioned above[1]. The additional advantage to use tunnel is that it can make the low end routers still work well.

II. VPN

A virtual private network (VPN) extends a private network across a public network, such as the Internet. It enables a computer or network-enabled device to send and receive data across shared or public networks as if it were directly connected to the private network, while benefiting from the functionality, security and management policies of the private network[2]. The VPN mentioned in this paper is created on the enterprise network. A VPN can be created by establishing a virtual point-to-point connection. A VPN provides security by the use of tunneling protocols and through security procedures such as encryption or Authentication.

A. Tunneling

Tunneling is the basic technology to create VPNs. It establishes a virtual point-to-point connection by the use of IP over IP to build a tunnel across a public network, in which data can be transferred. Several protocols are used to tunnel the traffic. Tunneling protocols can be divided into two groups. One belongs to OSI Layer 2, The other belongs to OSI Layer 3. The Layer 2 group includes L2TP(Layer 2 Tunneling Protocol), PPTP(Point to Point Tunneling Protocol) and L2F(Layer 2 Forwarding)[3][4]. All of these three protocols encapsulate the whole data package into the tunneling protocol after encapsulating all the network protocols into PPP(Point to Point Protocol). The data packages made by twice encapsulating are transferred on OSI Layer 2. The Layer 3 group includes VTP(VLAN Trunking Protocol) and IPSec(Internet Protocol Security). They encapsulate all the network protocols into the tunneling protocol directly to create data packages which are transferred on OSI Layer 3[5].

B. Encryption

To prevent disclosure of private information, VPNs typically make use of encryption techniques. Which kind of encryption techniques is used by VPN depends on the type of the tunneling protocol. For example, MPPE(Microsoft Point-to-Point Encryption) works with PPTP(Point-to-Point Tunneling Protocol) while IPSec(Internet Protocol Security) is also widely used with L2TP(Layer 2 Tunneling Protocol).

C. Authentication

Authentication prevents unauthorized users from accessing the VPN. It means VPNs allow only authenticated remote access. The authenticated users must provide the right usernames and passwords. Authentication is used among mobile users.

From the security standpoint, VPNs either trust the underlying delivery network[6], or must enforce security with mechanisms in the VPN itself. If a VPN is set up on the public internet encryption mechanisms must be used to protect the privacy of data. But trusted VPNs do not use cryptographic tunneling, and instead rely on the security of a single provider's network to protect the traffic. The enterprise network mentioned in this paper is such a secure network that encryption need not be used. It means that the two branches B1 and B2 can communicate by tunneling without encryption mechanisms in the VPN itself. Otherwise, it becomes a heavy burden for the routers to set up the tunnel with

encryption. Because B1 and B2 use cisco2801 routers with the poor capacity .The capacity of cisco2801 is 40M without encryption but it is only 2M with encryption. The routers with such a poor capacity can't work regularly. They should be replaced by higher performance routers. But that leads to a higher cost. It is the better way to still use cisco2801 to set up the tunnel without encryption because the underlying delivery network is trusted.

III. Implement

A. The topological graph of Tunnel0

In the topology, R1 and R2 are cisco2801 routers. The IP address of R1 is 192.168.1.0. The IP address of R2 is 192.168.129.0. B1 connects the port FastEthernet0/0 of R1 and this port (IP address: 192.168.1.114)is the gateway of B1. B2 connects the port FastEthernet0/0 of R2 and this port(IP address: 192.168.129.114) is the gateway of B2. The tunnel between B1 and B2 is named Tunnel0.

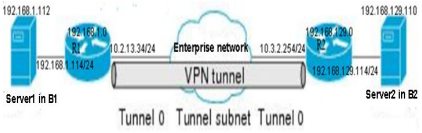

Figure 1. The topological graph of Tunnel0

B.Configuring the two routers of tunnel

In this experiment Tunnel0 is set up to connect B1 and B2. The two ends of Tunnel0 are all on cisco2801 routers.(shown as Figure.1)

The following is the configuration of the router cisco2801(R1) connecting B1.

```
interface Tunnel0  //define one end of Tunnel0
 tunnel source FastEthernet0/1   // This end of Tunnel0 is FastEthernet0/1
 tunnel destination 10.3.2.254   //The other end of Tunnel0 is 10.3.2.254
 !
 interface FastEthernet0/0
  ip address 192.168.1.114 255.255.255.0  //R1 is the gateway of B1
 !
 interface FastEthernet0/1
  ip address 10.2.13.34 255.255.255.0   //This port communicates with the enterprise network
 !
 ip route 10.0.0.0 255.0.0.0 10.2.13.1  //This router can communicate with the part whose IP address belongs to  10.0.0.0
 ip route 192.168.129.0 255.255.255.0 Tunnel0  // This router can communicate with R2 whose IP address is  192.168.129.0.
 !
 !
```

The following is the configuration of the router cisco2801(R2) connecting B2.

```
 interface Tunnel0  //define the other end of Tunnel0
  tunnel source FastEthernet0/1   // This end of Tunnel0 is FastEthernet0/1
  tunnel destination 10.2.13.34   // The other end of Tunnel0 is 10.2.13.34
 !
 interface FastEthernet0/0
  ip address 192.168.129.114 255.255.255.0  //R2 is the gateway of B2
 !
 interface FastEthernet0/1
  ip address 10.3.2.254 255.255.255.0   // This port communicates with the enterprise network
 !
 ip route 10.0.0.0 255.0.0.0 10.3.2.129   // This router can communicate with the part whose IP address belongs to  10.0.0.0
 ip route192.168.1.0 255.255.255.0 Tunnel0   // This router can communicate with R1 whose IP address is192.168.1.0
 !
 !
```

C. The declaration of the processs

Tunnel0 has been set up by the foregoing configuring. One end of Tunnel0 is the port FastEthernet0/1 of R1(IP address: 10.2.13.34/24).The other end of Tunnel0 is the port FastEthernet0/1 of R2(IP address: 10.3.2.254/24).So the data transmission between B1 an B2 can be done through Tunnel0.Now the device with the IP address 192.168.1.112 which belongs to B1 will send data to the other device with the IP address 192.168.129.110 which belongs to B2.At first, the device 192.168.1.112 send data to the gateway of B1.The IP address of this gateway is 192.168.1.114 and it is the port FastEthernet0/0 of R1.Because One end of Tunnel0 is the port FastEthernet0/1 of R1 , all of the data which will be sent to R2(192.168.129.0/24) is forwarded to the enterprise network(10.0.0.0 /8). Through the enterprise network the data reaches the other end of Tunnel0 that is the port FastEthernet0/1 of R2. The port FastEthernet0/0 of R2 is the gateway of B2. The IP address of this gateway is 192.168.129.114.R2 checks its routing table and then send this data to the destination which is 192.168.129.110 of B2 through the port FastEthernet0/0.

After receiving the data 192.168.129.110 should send a response to 192.168.1.112 . The response is also transmitted through Tunnel0.Firstly, 192.168.129.110 send the response to the gateway of B2 ,that is FastEthernet0/0 of R2.In order to be sent to R1(192.168.1.0/24) this response should be forwarded to the enterprise network(10.0.0.0 /8) through the port FastEthernet0/1 of R2.Then the response reaches FastEthernet0/1 of R1.After checking its routing table R1 send the response to the destination that is 192.168.1.112 of B1 through FastEthernet0/0. So the device 192.168.1.112 of B1 and the device 192.168.129.110 of B2 communicate successfully through Tunnel0.

Ⅳ.Conclusion

By using tunneling, the two different branches of the enterprise network successfully communicate with each other, which simplifies the routing tables included in the separated part. This process doesn't depend on the leased line so that a lot money can be saved. It just uses the technology IP over IP of VPN without encryption, which makes the low end routers still useful.

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Research and Design on Microgrid Control Strategy of Distributed Generation

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Abstract: **This paper designed a microgrid system includes two DG (distributed generation), this system uses master-slave control strategy. When the microgrid is in island operation mode, one DG or energy storage device adopts V/f control, provides reference voltage and frequency to the other DG of the microgrid, and the other DG adopt PQ control. When the system is in grid-connected operation, all DGs adopt PQ control. Finally, build a microgrid control strategy modeling simulation based on single phase inverter in Matlab environment, and the simulation results show that the output grid waveform is good, the validity of the design is verified by simulation and test.**

Keywords: **Distributed Generation; Microgrid; Master-slave control**

I. INTRODUCTION

In recent years, distributed generation has been widely attention and research. Moreover, small capacity of distributed power as the core network research marked more attention. Under the premise of without changing the existing distribution network structure, in order to weaken the negative impact of distributed generation for the distribution network's operation, the American association of electric reliability technical solution proposed a form of organization to give a better play of the distributed generation potential, this organization is called Microgrid. Microgrid has two kinds of operation mode: parallel operation and island operation, and it can be seamless transition between the two kinds of operation mode.[1]

II. OVERALL DESIGN OF SYSTEM

In this paper, the design of microgrid system adopts master-slave control strategy, namely when microgrid is in island operation mode, one of DG or energy storage device to V/f control, used to provide certain reference voltage and frequency to the other DGs of microgrid, and the other DGs adopt PQ control. When the system is in grid-connected operation mode, all DGs adopt PQ control, namely the microgrid is not involved in the frequency regulation, only output designated active and reactive power. Energy storage device, DG unit can be independent or joint as main control unit. DGs are feeded in the distribution network with interconnection switch and transformer. The control diagram between the various modules of microgrid system is shown in figure 1.

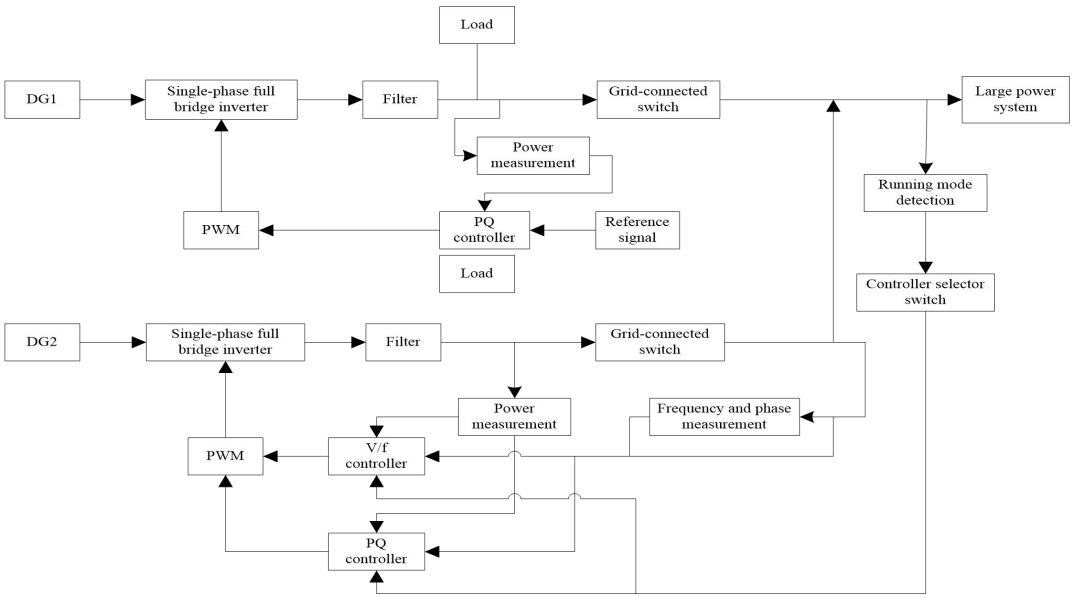


Figure 1. The control diagram of modules in microgrid system

III. CONTROL STRATEGY OF DG

The inverter power supply works in the wireless parallel mode, then, each DG only can according to their

own output power to adjust the output voltage frequency, amplitude and phase through certain control algorithm.

When the system output voltage size is known and constant, the parallel inverter according to the capacity of itself and testing its output power value to make amplitude and frequency to approximate decoupling control by reactive power and active power.

A. Droop Control Strategy

Droop control feature refers to the relationship between DG output active power and frequency is linear, and the relationship between reactive power and voltage amplitude is linear. In the communication systems of inverter power supply, inverter does its own power detection, and works out the output voltage amplitude and the reference input value of frequency with according to the droop control coefficient, and then through the corresponding control device inversing fine-tuning its output voltage amplitude and frequency to achieve a reasonable allocation of reactive power and active power. When a unit's output power is biggish, then this unit can reduce its output on the basis of V/f droop characteristic; similarly, when a unit's output power is relatively small, then this unit can increase its output. This ongoing self regulating process will continue until system enters into the minimum point of circulation.[3]

Generally, the inverter resistance is small, and then the output of external characteristic will be hard, even a small amplitude or phase difference can produce a very big system circulation among the parallel inverters. Introduction of V/f droop control method will make the output characteristic become "soft", the inverter output voltage frequency and amplitude will change with the type:

$$\begin{cases} w_n = w_{on} - m_n p_n \\ E_n = E_n - n_n Q_n \end{cases} \quad (n=1, 2.....) \quad (1)$$

There: w0n and E0n respectively are the nth inverter's no-load output angular frequency and voltage amplitude, mn and nn respectively are theirs droop coefficient; Pn and Qn respectively are the inverter's active power and reactive power.

B. PQ Control Strategy

When microgrid is in grid-connected mode, the control strategy of the system's reference voltage mainly is to ensure that the output power size of DG change within the scope of controllable. Microgrid voltage can be regulated by current control loop to ajust the inverter output current, to reactive decoupling control of reactive power and active power.[4] Figure 2 shows classical PQ controller's basic structure.

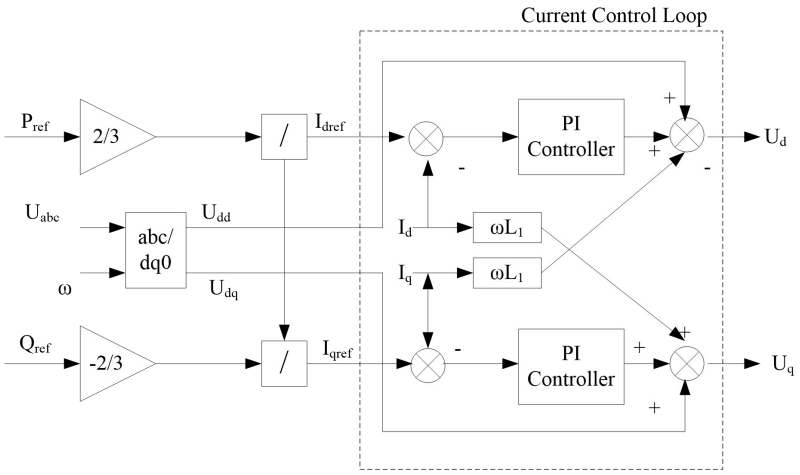


Figure 2. PQ controller structure

As shown in figure 2: Qref and Pref respectively are reference input of reactive power and active power; ω is power grid's frequency; Iqref and Idref respectively are reference current of q and d axis after power decouple. Ud and Uq respectively are modulation signal of d and q axis which has gotten by the current loop. PQ controller mainly consists of two parts, the first part is the external power control device, and the second part is the inner current control loop, the two parts are in series. PQ controller can realize the active and reactive power decoupling control, and provide reference frequency to the system through phase locked loop. Input current reference can be obtained by regulating power, and then comparing the input current reference to the feedback actual current signal and analyzing the deviation, then according to the analysis result for quick adjustment, producing reference voltage control signal, making the output voltage signal to track reference voltage value. Decoupling control is required in current loop design, to increase the feedforward control and reduce the influence of grid voltage to the control system.

C V/f Control Strategy

When microgrid run in island mode, the system uses master-slave control strategy, master control power uses V/f control strategy to control the output voltage frequency and amplitude of micro power supply, at the same time providing reference frequency and voltage to microgrid, and the other micro powers adopt PQ control. V/f controller structure is shown in figure 3.

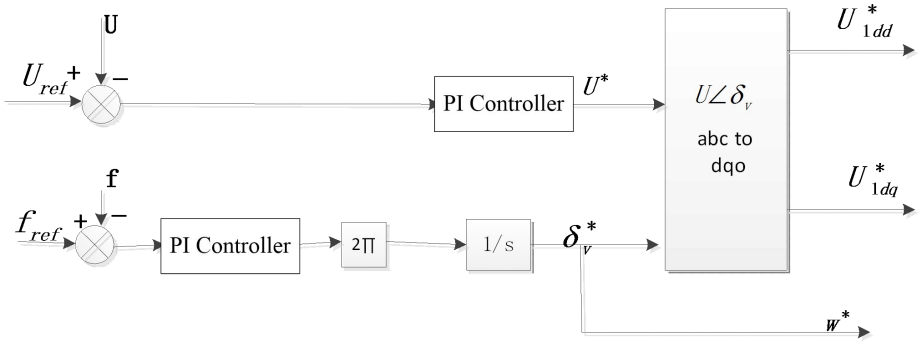


Figure 3. V/f controller structure

There: Uref is reference input voltage amplitude; U* is reference voltage amplitude of double-loop controller, is direct-axis component, is quadrature-axis component; fref is reference frequency; is reference voltage phase angle of double-loop controller; ω* is reference angular frequency. Abc to dq0 express d-axis and q-axis transform result of abc three-phase electric in the power grid. The output voltage of V/f controller is used for voltage and current double-loop control reference signal. PI controller in figure 3 has the effect of holding the output voltage accuracy unchanged.

IV. The Simulation Results

The simulation experiment waveform of PQ controller strategy is shown in figure 4. The first channel is output voltage of DG, its value is 650V; the second channel is SPWM wave of ab phase; the third channel is inverter three phase voltage waveform; the fourth channel is inverter three phase current waveform.

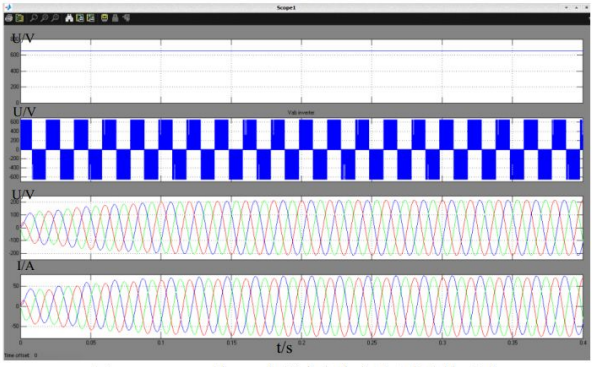
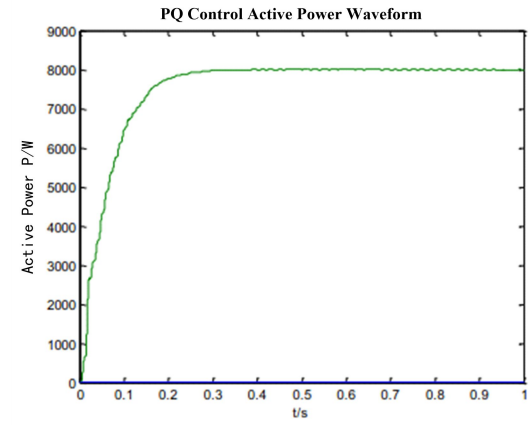
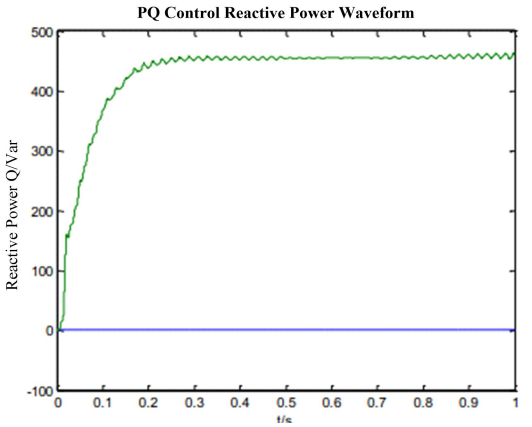


Figure 4. PQ controller simulation oscillogram(a) and (b) in figure 5 show the output waveform of constant active power and reactive power, set the expectation active power is 8 Kw, the expectation reactive power is 460Kvar. It is observed that the system almost has no overshoot, response time is less than 0.3s, the result meet expectation requirement.





(a) Active power output waveform (b) Reactive power output waveform

Figure 5. PQ control active power and reactive power output waveform

V/f control strategy simulation experiment oscillogram is shown in figure 6.

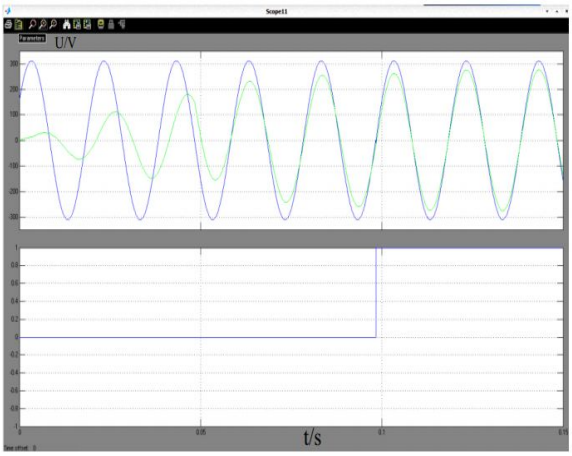


Figure 6. V/f control grid-connected oscillogram

According to the high and low amplitude, the waveforms in first channel respectively are load voltage and grid voltage. The second channel is grid-connected switch, it is closed set "1" when grid connected. In figure 6, we can see the system can be connected to grid in 0.098s through frequency phase tracking grid voltage and grid current, grid switch is closed at this moment, the grid voltage and load voltage are synchronization, the system send power to the grid, in order to validate the correctness of the frequency and phase tracking algorithm. Also can be seen from the figure 6, when the grid interconnection the switch has been set "1", grid current and power grid voltage achieve phase tracking, and in a steady state. When the grid has been connected, the load current add grid current is equal to the inverter output current. The purpose of supply power to the load and grid can be achieved.

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V. Conclusion

Using different control method to different DG in microgrid can optimize the operation of microgrid system. This paper analyzed master-slave PQ-V/f control method in detail, and builded control strategy simulation model, the simulation result proved that the method was scientific and feasible. Distributed grid generation has a vast development prospects, microgrid control is a critical question that still requires the unremitting exploration, and intelligent microgrid control strategy will be a new direction of future development.

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Research of RFID Security Based on Internet of Things

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Abstract: **As RFID system applies in an increasingly larger range, its security and privacy problems emerge day by day. Based on analyzing the security threats faced by RFID technology, detailed introduces the existing security strategies and their good and bad. In addition, it put forward dealing with RFID security attack through physical security mechanism, encryption mechanism and combination of the two mechanisms.**

Keywords: **Internet of things (IOT), RFID system security strategy**

I. INTRODUCTION

Radio Frequency Identification (RFID) technology is the general term of the technology of automatically contactless identifying individual object using radio waves. [1]IOT automatically identifies and gets information through RFID technology, therefore achieves real-time tracing and sharing of information. Consequently, RFID technology becomes the key technology of IOT in which e-Tag turns into the foundation of realizing IOT application. While RFID technology brings convenience and increases efficiency for our daily life, there follows problems like e-Tag information security and privacy protection. Because RFID system usually functions under isomerism and complex IOT environment, it is low-cost and has limited resources and e-Tags are vulnerable to opponents' hostile attack. Presently safety factors become the biggest problem restricting the large-scale application of RFID system.[2] As a result, IOT data and information security based on RFID has become hot spots in people's research on IOT.

II. PRIVACY AND SECURITY PROBLEM FACED BY RFID

RFID has features like low-cost and open data transmitting procedure; meanwhile it functions under IOT's open, isomerism and complex environment which brings many security problems while bringing broad prospects for RFID-based IOT. Relevant people think that the adoption of RFID tags is the beginning of society stepping out into strict control then depersonalization. Influence of RFID technology to personal security and privacy has become a problem we must pay attention to.

Technical defects and systematic design of RFID lead to privacy threats problem in RFID-based IOT, and the privacy problem can generally be divided into two categories which are privacy disclosure and malicious tracing.

Privacy disclosure: because e-Tags can store more data and information than bar codes in the past and they have higher data processing efficiency, people centrally store more information in RFID tags which usually include personal-related private information, trade secrets and even proper security information such as ID card, communication log and e-record, etc.. If users have unsafe tags products, illegal reader will read users' information in the tags so that their privacy will be illegally obtained. Therefore, how to guarantee the information not to be illegally read, obtained and tampered has become a big difficulty in RFID system privacy protection.

Malicious tracing: e-Tags usually need readers sending electromagnetic wave signals and providing energy to work. If attackers use counterfeit readers to send read-write requests to legal tags, even they can't obtain private information within tags; they can lock the e-Tags locations information through scanning and tracing them. And locations such as positioning of moving vehicles and tracks of products in producing and sales process are as well a kind of private information. If an attacker get these information, he can observe, analyze and asses some personal behavioral habits and business model information therefore damage personal and related organizations' benefits. Even we can also track by other technologies such as video monitoring, GSM and Bluetooth, RFID identification equipments are relatively cheap, especially when RFID enters peoples' daily life; people no matter who have readers can scan and track others. What's more, passive tag signal cannot be cut off, and has very small size, is easily hidden, has long service time and can automatically identify and collect data which make malicious tracing much easier. Hence, in the process of RFID system application, location disclosure of e-Tags and easy lock by attackers should also be avoided.

Radio identified tags and readers are transmitted by RFID signals and have no physical visible contacts so that they are easily attacked. in addition practical application's requests for cost, the memory space and computing power of radio identified tags are both very limited. All these bring big difficulties for safe access of RFID technology. Security threats faced by RFID system can be sorted as followed[3]:

Attacks enforced to different physical locations of RFID-based IOT from the perspective of e-

communication. For example, use high power RF electric field in workplaces using RFID readers and create overload electricity in the circuit of e-Tags so that burnout tags circuits.

Information tamper is active attacker pass on the altered information to the original receiver after altering the hacked information. The attacker can cheat readers by using counterfeit immediate ID tag and making illegal objects or personals legal. For erasable tags, there are situations in which using illegal readers to read and rewrite tags data arbitrarily.

It also can be called man-in-the-middle attack. It is the man-in-the-middle who can use communication signals between equipment intercepted labels and readers to save information and repeatedly rend it to tags or readers on time. As these data information are correct and effective, tags and readers will receive these data normally.

So called denial of service attack is using rogue tag to attack servers in order to lower their normal work efficiency or even breakdown. Attacker can send large amount of data signals to readers in a short period of time through some radio-frequency signal devices. Limited processing capability of readers and servers lead RFID system overwhelmed by large amount of signals therefore RFID system break down and in a dead state. [4]

So called denial after service is one side of the two trading parties denies its participation in the trade after completion of the transaction. This threat is normal in e-business. Suppose a customer chooses some goods in an online shop and pays to the online shop through digital payment system. There exist two kinds of denial after service in this e-business application: the customer denies he had chosen some or all of the goods and denies paying for them, or the shop denies delivering the goods after receiving the customer's payment.

So called virus and Trojan is that readers read tags containing malicious code and the malicious code enters the computer system of RFID. Its perniciousness lies in its powerful ability of controlling and damaging computer system, stealing passwords, controlling system operations, manipulating data and so on. Once the computer system of RFID implanted with powerful malicious code, attackers can deploy malicious damage like controlling this computer, changing products' prices and sales data and so on.

III.RFID SAFETY POLICY

There are three kinds of solving strategies to deal with RFID safety attacks now: physical security mechanism, encryption mechanism and the combination of the two mechanisms.

Physical methods are increasing physical shielding facilities to make tags inaccessible by attackers or destroying or removing tags to make tags impossible for reusing. This kind of method is simple and effective but its simplicity limits its range of application for it can only be applied in simple application occasions. The specific methods include:

Kill instruction mechanism

Kill instruction mechanism is the firstly proposed by the predecessor of EPC Global—Auto-ID center. This method is to integrate destroy function in tags so that tags will destroy themselves when receiving kill instruction from readers. This method physically destroys tags thoroughly which although protects privacies effectively but making tags impossible for reusing and it's difficult to verify whether tags are destroyed or not.[5Faraday net

Faraday net (also called electrostatic shielding) is to use a metal net or foil container to shield tags for which the container cannot be penetrated by radio signal but can protect tags from hacking by attackers. However, this needs an external device which not only causes inconvenience but also increases cost. This method is a primary privacy enhancement technique which can only be applied in partial occasions. [6]

Active disturbing method

Disturb scanning of RFID readers using special devices, to destroy and resist illegal reading process. Actively disturbing radio signals is another method to shield tags. Tag users can actively broadcast radio signals through a device to stop or destroy the near RFID reader. But abusing active disturbing may cause illegal disturbing which other near and legal RFID system may be disturbed and more importantly, it may influence regular wireless communication and the use of related communication device.[7]

Blocking mechanism[8] use a blocking tag set with privacy post, this tag has the ability of passive jammers. When inspecting tags' security is threatened such as when users leave the market after buying products, the privacy post of blocking tags will alter and send disturbing signals. Blocking tags protect tags' information security through this way which preventing attackers' malicious scanning. Blocking tags basically don't need altering and don't have to do password operation or other operations, it has low cost. But RFID system reader with blocking mechanism must use specific separation algorithm which makes the application bounded. More severely, this interception way may not succeed every time and attackers can filter it through signal strength or other features.

Since physical protective mechanism realizes the protection by sacrificing tags' certain functions, for example, faraday net limits tags' flexible applicability, kill method make tags impossible for reusing and so on. Different from physical methods, because of the features of convenient implementation, no need for extra hardware addition, swift data processing and good expandability of the security mechanism based on ciphergraph, this mechanism attracted more comprehensive research by scholars domestic and overseas. Common encryption mechanisms include:

This protocol is an access control protocol based on hash function. Create a Metal ID using hash function encryption to replace the real ID for network communication which can protect the real ID information. It solves privacy protection problem to some degree, while as the Metal ID doesn't change and it

communicate in clear texts, so it is easily cheated, copied and tracing attack.[9]

To solve the location tracing problem in hash-lock protocol, Weis improved hash-lock method and there comes the random hash-lock method in which stores all values of tags' IDs in background database and they are identified as ID1， ID2。。。。。。。。IDN.[10] Specific steps are as follows:

Reader sends request to tags.

Tags automatically generate random number R and calculate Hash (ID||R) and send Hash (ID||R) and R to readers.

Reader sends request to host machine in the back-end and gets all the ID numbers.

Reader calculate the Hash value of every (ID||R) respectively, if Hash(IDj ||R) is the same as the Hash(ID||R) send from tags, the tags will pass identification, otherwise communication between reader and this tag is ended.

Reader sends IDj to the tags.

Tags compare the ID with its real ID, if they are equal, reader pass identification and tag is unlocked, otherwise the tag is still locked.

In this method, tags' answers are random every time so that it can prevent location tracing attack based on specific output. However, this method also has defects: first, tags don't indentify readers so that attackers can read related information of the tags by counterfeiting legal readers. That is it doesn't meet prevention of cheating. Next, readers need to search every tag's ID and calculate the Hash function value of every tag, so that when there are a large number of tags, the system delay will be very long and the efficiency is low which can't meet high efficiency.

Hash-chain protocol is put forward by NTT laboratory in which stores tags' ID and secret value updated every time in back-end data base. Hash-chain protocol uses two different Hash function using G() and H() to represent calculation. The beginning secret value of the tags is Sj and there exist every e-tag's ID and its beginning secret value. Specific steps of Hash-chain protocol are as follows:

Reader sends query to tags.

Tags send G（Sj）to reader and update its own secret value Sj+1= H(Sj).

Reader transmits G (Sj) to system in the back-end.

System in the bask-end begin to calculate all IDs' G(H(S)), if the corresponding G(H(S)) of ID equals G (Sj), the identification is passed and update the corresponding S of ID to Sj.

Hash-chain protocol can guarantee the forward security effectively. In RFID system using Hash-chain protocol, e-tags relatively have the capability of independent update. And during the process of identification, there doesn't appear tag's ID from beginning to end in the communication between reader and tag which prevents illegal tag tracing and revealing tag information. But in Hash-chain protocol, a lot of Hash calculation and comparison are needed for an e-tag identification, the task load is heavy and the efficiency of identification is low which make it the same unsuitable for situation of large amount of tags working.

Distributed RFID inquire-response identification protocol

Rhee and others put forward a RFID identification protocol suitable for the environment of distributed database and it is a typical inquire-response type bidirectional identification protocol.

Implementations are as follows:

Reader creates random number RReader, and send Query request for comment to e-tag, send RReader to e-tag.

E-tag creates random number RTag and calculates H (ID||RReader||RTag). E-tag sends H (ID||RReader||RTag) to reader.

Reader sends H (ID||RReader||RTag, RTag,RReader) to database in the back-end. Database in the back-end checks if there is an IDj (1<j<n) making H(IDj||RReader||RTag)= H(ID || RReader | IRTag) valid, if there is one, the identification pass and sends H (IDIIRTag) to reader.

E-tag verifies whether H (IDjIIRTag) =H (IDIIRTag) is the same, if it is, the identification pass.

So far, we have not found obvious security flaw or defect in this protocol. But in this protocol, to conduct identification protocol once needs the e-tag making twice Hash calculations. There should be integrated random producer and Hash function module in the e-tags so that is yet not suitable for low-cost RFID system.

There are many other RFID security programs based on password such as pound ID variation protocol, Public Key Cryptology mechanism and Key value updated random Hash lock and so on. Through comparative analysis we found that at present there is no one protocol based on encryption can not only meet system security but also considerate system cost and expense which can be extensively used in real-world scenes. So it needs that science researchers put more energy to research for balancing security and cost, data organization and management, query and search and data consensus as well as security problem of RFID system in specific occasions.

IV. CONCLUSION

Construction of IOT has drawn more attention day by day in China and IOT technology based on RFID has been applied in various areas in social life which has large market scale and development space. However as RFID system has limited calculating capability and no effective protective procedures and its extensive use, the security and privacy problem of RFID has become the emphasis of people's attention. Therefore, researching RFID security problem and solving security and privacy problem has practical significance. This article detailed described some security problems of RFID technology, introduced solution currently existed and analyzed and compared their good and bad. At last, this article summarized RFID security technology and pointed out research direction from now on. As technology advances,

it's sure that the security problem of RFID can be further improved.

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Research on effect of Management Experience on Enterprise Innovation Based on Opportunity Cost

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***Abstract*—The purpose of this paper is to explore direct and indirect effects of pre-venture managerial experience (PVME) on new venture innovation. Data were obtained from the Panel Study of Entrepreneurial Dynamics II, which is a national database of individuals in various stages of starting a business. Overall sample consisted of 982 nascent entrepreneurs. Statistical methods explored a multiple serial mediation model using OLS regressions supplemented by analyses based on bootstrapping for assessment of indirect effects. PVME effect on innovation is associated with abilities and financial motives, supporting a partial serial multiple mediation model in which PVME affects innovation indirectly through abilities and where abilities affect innovation directly as well as indirectly through expectations. Results also suggest a suppression effect and a possible negative effect of PVME. Abilities facilitate innovation, which has implications for policy makers who aim to enhance innovations, for investors in assessing potential of innovations, and for entrepreneurs who aim at improving innovation. Shedding light on the mechanism by which prior experience affects innovation, including the role of financial expectations and how abilities possibly negate negative effects associated with experience improve the understanding of and ability to enhance innovation and improve new venture competitive stand.**

***Index Terms*— Enterprise Innovation, Entrepreneurship, New Venture, Opportunity cost, Management experience**

I. Introduction

It has long been accepted that startups and new ventures that foster and generate innovations are the hallmark of economic renewal and progress. Given the importance of innovation as a strategy in new firms, identifying antecedents of the decision to start innovation ventures is of great value. The focus in this paper is on one such antecedent: the entrepreneurial founder's pre-venture managerial experience (PVME). In the context of new venture startups, it is often the case that entrepreneurs start a new venture following other career experiences. Founders' pre-venture experience affects their skills, abilities, and general mindset. As such, it becomes a relevant factor not only in their decision to venture into entrepreneurship but also in their goals for the new venture, the risks they are willing to assume, and the overall expectations in terms of the scope and direction of the new venture (Caliendo *et al.*, 2014; Davidsson and Honig, 2003; Hellmann, 2007; Kickul and Gundry, 2002; Rodenbach and Brettel, 2012).

This work focusses on the relationship between PVME and the extent of innovation in a new venture. Innovation startups are new ventures in which there is intent to create products or services that will likely result in patents or proprietary knowledge, typically by means of focusing on research and development. By this definition, compared to traditional start-ups, innovations start-ups involve greater degrees of uncertainty and risk due to novelty of markets or products. Innovation startups are also associated with greater potential returns. Using nascent entrepreneurs who are in the process of starting a new venture, I explore direct and indirect effects of their PVME on the innovation of their new firms.

Opportunity costs (OC) theory provides the theoretical framework in this work. This framework has been explored in past research and emerged as a viable explanation for entrepreneurial behavior (Amit *et al.*, 1995, 2001; Arora and Nandkumar, 2011; Cassar, 2006; Hormiga *et al.*, 2013). OC perspective suggests that individuals engage in a form of cost benefit analyses in which current opportunities and their returns are compared to prospects associated with alternative opportunities. In the context of entrepreneurship, potential entrepreneurs consider current work situation, benefits, and its outlook against the prospects associated with starting a new venture. Individuals that have extensive PVME typically enjoy high wages and have other career alternatives, and will venture into those enterprises that they believe can provide opportunities that are superior to those available in the pre-entrepreneurship context (Arora and Nandkumar, 2011; Cassar, 2006; Shane and Venkataraman, 2000). Because innovation startups are typically characterized by high potential returns, they are likely to be appealing especially to those with high PVME.

This paper is expected to have both practical and theoretical contributions. From a practical perspective, understanding the nature of the relationship between PVME and innovation in new ventures may shed light on factors that increase or inhibit this type of start-ups. Findings can provide useful insight as to the role of financial expectations and managerial abilities in the emergence of innovation start-ups and suggest potential strategies for encouraging innovation in entrepreneurial and small business contexts. From a theoretical perspective, findings will shed light on the role of OC and human capital in explaining innovation in entrepreneurial firms, add to the body of knowledge on entrepreneurial innovation, and provide additional avenues for further study of the antecedents of innovation in the context of

established economic and management theories in Figure 1.

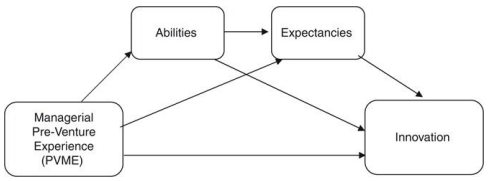

Figure 1 A Pictorial Depiction of the Model

Ⅱ. THEORETICAL BACKGROUND AND HYPOTHESES

A Conceptualizing innovation in new ventures

Innovations activity in new ventures can be conceptualized in many ways, including introducing new products, targeting new markets, defining new business models, establishing new distribution channels, introducing new organizational forms, or launching innovative technologies (Baregheh *et al.*, 2009; Cliff *et al.*, 2006; Shane and Venkataraman, 2000). In the context of entrepreneurship, and nascent entrepreneurship in particular, it is important to consider innovation in a manner that allows to capture the varied manifestations of innovation that occur in different types of businesses, industries, and life-stages of the emerging business (e.g. Berkhout *et al.*, 2011; Brem, 2011). One commonly used indicator of innovation is the extent to which the venture's outputs are innovative. In nascent firms, where products or services may only be in development or planning stages, the issue may be the overall intent to have products or services that are innovative compared to having actual outputs (e.g. patents) or actual activities undertaken by the entrepreneur (e.g. Kraiczy *et al.*, 2014). This aspect of innovation pertains directly to the firm's outputs – the goods or service provided by the firm, and likely affects resource allocation, personnel issues, or other organizational or operational aspects of the venture. A second aspect pertains to the general perceptions of the role of innovation in establishing a desirable competitive position for the new firm (Lichtenthaler, 2008; Stam and Wennberg, 2009). To the extent that innovation is viewed as important to the future success and growth of the venture and to creating a defensible competitive position, it will likely enhance the development of a culture of experimentation and exploration, and facilitate internal allocation of resources in a manner that supports this innovation. These two aspects of innovation–output innovation and competitive innovation (CI)–are expected to correlate, although it is possible that in some firms one will be more prominent than the other will.

B OC as theoretical framework

OC have been discussed in the context of entrepreneurship, and have been shown to provide an appropriate framework for explaining entrepreneurial behavior and expectations (e.g. Arora and Nandkumar, 2011; Cassar, 2006). Amit *et al.* (1995) used OC framework to study the transition to entrepreneurship from paid employment. They found that those individuals who started new ventures had lower income compared to those who chose to remain in paid employment, suggesting those who ventured into entrepreneurship were individuals with seemingly fewer career alternatives. Cassar (2006) explored the relationship between OC and entrepreneurs' intended venture growth. He operationalized OC as household income, arguing that this variable is associated with managerial experience and manifests the potential loss for the entrepreneur by starting a new venture. Cassar (2006) found that individuals with high OC sought venture with greater potential future sales compared to those with low OC. Hormiga *et al.*(2013) found a positive association between individual propensity to innovate and entrepreneurial intent, and that this relationship was related to OC considerations. Arora and Nandkumar (2011) explored the relationship between OC and entrepreneurial strategies and found that those individuals with greater OC tended to have shorter timespans for deploying and assessing their firms' strategies. Specifically, they showed that individuals with high OC were more likely to cash out faster compared to individuals with lower OC, suggesting that the economic evaluation of opportunities and alternatives affects one's assessment of the value associated with success, failure, and overall risk one is willing to assume.

An OC explanation is logical in the context of innovation in entrepreneurial firms where the scope of innovation reflects potential returns. The typical OC explanation thus suggests that individuals who transition from a successful career are more likely to do so in order to start a venture that offers high potential returns because in such ventures the future returns are more likely to compensate for the lost opportunities associated with a previously successful career.

H1. PVME is positively associated with new venture innovation.

H2. Entrepreneurs' financial expectancies are positively associated with new venture innovation.

H3. Entrepreneurs' financial expectancies mediate the relationship between PVME and new venture innovation.

H4. Entrepreneurs' abilities are positively associated with new venture innovation.

H5. Entrepreneurs' abilities mediate the relationship between PVME and new venture innovation.

H6. Entrepreneurial abilities are positively associated with expectancies.

H7. Entrepreneurs' abilities and expectancies mediate the relationship between PVME and new venture innovation.

Ⅲ. METHOD

A Sample

Data for this study were based on a sample of 982 nascent entrepreneurs, obtained from the Panel Study of Entrepreneurial Dynamics II (PSED II), a national database of individuals in various stages of starting a business (www.psed.isr.umich.edu/psed/). PSED data were derived from nascent entrepreneurs, which were

defined as individuals who are currently, alone or with others, trying to start a new business; over the past 12 months have taken specific action to start a new business such as looked for equipment or organized a start-up team; and will personally own all or part of this new business. The method for designating nascent entrepreneurs is consistent with that used in other studies using PSED data (e.g. Carter *et al.*, 2003; Schjoedt and Shaver, 2007).

B Measures

The measures used in this work have been taken from the PSED database, and the survey questionnaire is published on the PSED web site. In discussing the measures and their operationalization, the PSED questionnaire item number is noted in parentheses.

Dependent variable

Two measures of innovation in new startups were used. The first – outcome innovation (OI) – is based on earlier operationalizations (Liao and Welsch, 2003), and reflects actual or intended innovation outputs in the new startup. The measure consisted of four items pertaining to the generation of innovation in new ventures as follows:

1. whether the venture has/will in the future or has not/will not develop any proprietary technology, processes, or procedures that no other company can use (AD11);
2. whether an application for a patent, copyright, or trademark relevant to the new business has/will be submitted (AD13);
3. whether spending on research and technology will be a major priority for the venture (AS5); and
4. whether the venture is considered a high-tech business (AS6).

For items (1) and (2) above answers were coded as 1, yes/will in future and 0, no/not relevant; and for item (3) and (4) above the possible answers were coded as 1, yes and 0, no. The OI was created by adding the affirmative responses on all items, creating a measure ranging from 0 to 4. A second measure–CI–reflects the overall perceived importance of innovation for the firm's strategic advantage. The measure is based on respondents' assessment of the importance of emphasizing the following aspects in order for the new venture to be an effective competitor: technical and scientific expertise (AF8); development of new or advanced product or process technology for creating goods and services (AF9); development of intellectual property such as a patent, copyright, or trademark (AF10); and being first to market a new product (AF4). Answers were coded on a five-point Likert type scale, and were recoded so that higher scores reflect higher levels of innovation, ranging from 1 (strongly disagree) to 5 (strongly agree). The items (Cronbach's α=0.71) were averaged to create the CI measure.

Independent variable

PVME was measured based on two indicators. First, respondents answered the question "for how many years, if any, have you had managerial, supervisory, or administrative responsibilities?" (AH21). Because this measure may reflect administrative experience but not necessarily managerial experience, another item was included, asking about the number of people the respondent supervised in his/her recent position (AX16). The average years of managerial experience was 8.30 (SD 8.54) and the average of people supervised was 17.62 (SD 67.02). It was assumed that those two indicators reflect different aspects of PVME, and the significant correlation between them (r=0.193, p<0.001) supports this assumption. The two items were standardized and combined to reflect respondents' overall PVME.

Mediating variables

The first mediating variable – financial expectancies – was comprised of three items indicating the extent to which they were important for the entrepreneur in establishing this new venture:

1. to give yourself, spouse, or children financial security;
2. to earn a larger personal income; and
3. to have a chance to build great wealth or a very high income (AW6, AW9, AW12).

Answers were coded on a five-point Likert type scale, ranging from 1 (no extent) to 5 (very large extent). The three items (Cronbach's α=0.78) were averaged to create the financial expectancies measure. The second mediating variable – abilities – was comprised of three items indicating respondents' beliefs in the positive effect of their past experience on their ability to start and run a new venture:

1. overall my skills and abilities will help me start this new business (AY6);
2. my past experience will be very valuable in starting this new business (AY7); and
3. I am confident I can put in the effort needed to start this new business (AY8).

This measure is based on research showing that perceptions of abilities were an acceptable indicator of actual abilities and positively associated with managerial performance (Chandler and Jansen, 1992). These items were measured on a five-point Likert type scale ranging from 1 (strongly disagree, recoded) to 5 (strongly agree, recoded). The items (Cronbach's α=0.70) were averaged to create the abilities measure.

Control variables

Five demographic control variables were included:

1. Respondents' gender (AH1) coded as 1 (male) and 2 (female).
2. Respondents' age (AH2), measured in years.
3. Marital status, coded as 1 (married/partnered) and 0 (single/divorced/separated).
4. Number of children in the household and (AZ11).
5. Highest education level was included (AH6), coded as 1, high school degree or less; 2, technical, vocational, some college, community college; 3, bachelor's degree; 4, graduate degree including masters, law, and doctoral.

These variables were included, as they typically reflect learning ability, possible openness and comfort level with innovation, as well as overall willingness to abandon

managerial careers and preference for innovation or high-risk ventures. Lastly, to control for possible industry effects, the type of venture was coded as being in the retail/restaurant, manufacturing, or services sectors (AB1). A dummy variable was created and was included in the analyses as control.

C Analytical strategy

The theoretical model corresponds to a multiple serial mediation model (Hayes, 2013) in which a direct effect is expected between PVME and innovation and indirect effects vial abilities and outcome expectancies. Tests for mediation have traditionally relied on the popularized causal steps approach introduced by Baron and Kenny (1986). That method relies on a series of regressions, and a mediation effect is deemed to exist if a set of conditions are met regarding the significance of each of step. However, researchers have been increasingly questioning the appropriateness of this method given its assumptions and requirements associated with its causal steps (e.g. Edwards and Lambert, 2007; Hayes, 2009, 2013; MacKinnon, 2008; Preacher and Hayes, 2004; Rucker *et al.*, 2011; Zhao *et al.*, 2010). For example, Preacher and Hayes (2004) note that the method proposed by Baron and Kenny, which is based on a series of regressions, is prone to both Type I and Type II errors, and suffers from low statistical power, while Hayes (2009) notes that in mediation models, "[…] it is possible for an indirect effect to be detectably different from zero even though one of its constituent paths is not […] [and] the more nulls that must be rejected in order to claim an indirect effect, the more likely the analyst will go away empty handed" (2009, p. 411).

Recently, a modernized view on mediation analyses has been proposed (Hayes, 2009, 2013), which attempts to provide strategies that overcome some the issues identified with traditional methods. The new methods focus on OLS regressions supplemented by analyses based on bootstrapping for assessment of indirect effects, which has been shown to constitute a more valid and powerful method for assessing indirect effects (Hayes, 2009; MacKinnon *et al.*, 2004). The analyses in this paper focus on those methods, using OLS regression analyses and additional proposed a computational procedure – PROCESS – that is based on bootstrap confidence intervals to derive the estimates for the indirect effects. Bootstrapping is used to estimate indirect effects by repeatedly resampling the obtained data a large number of times (5,000 times in the present study) which generates 5,000 estimates of the indirect effect, at which point an estimate of the indirect effect is obtained with 95 percent confidence interval (for detailed discussion see Hayes, 2009, 2013). Analyses performed in this study are done using SPSS OLS regressions and PROCESS macros to explore the direct and indirect effects.

Ⅳ. RESULTS

Means, standard deviations, and inter-correlations of the study variables are presented in Table I. These inter-correlations show several noteworthy associations. First, as expected, both measures of the dependent variables are positively and significantly correlated (r=0.365, p<0.01), providing validity to the use of the two operationalization for innovation in new ventures. Second, as expected, each mediator is positively and significantly correlated with the two measures of the independent variable (r=0.108,p<0.05 and r=0.155, p<0.01 for abilities with OI and CI, respectively, and r=0.099, p<0.05 and r=0.147, p<0.01 for expectancies with OI and CI, respectively). Lastly, although not shown in Table I, the two indicator used to create the independent variable – years of managerial experience and number of people supervised are positively and significantly correlated (r=0.193, p<0.001). Those correlations provide basic support to the underlying assumptions of the research model.

TABLE I. Means, Standard Deviations, and Inter-correlations of the Study Variables

		Mean	SD	1	2	3	4	5	6	7	8	9
1	Gender	1.370	0.484	–								
2	Age	38.220	11.965	0.064	–							
3	Marital status	0.593	0.492	0.160**	0.109**	–						
4	Children	1.01	1.252	0.057	−0.157*	0.245**	–					
5	Education	2.179	0.929	0.085*	0.198**	0.146**	−0.111*	–				
6	Abilities	4.491	0.531	−0.006	0.030	0.068*	0.012	0.050	–			
7	Expectancies	3.581	1.064	−0.069*	−0.259**	−0.027	0.099*	−0.216**	0.124**	–		
8	Managerial experience	−0.142	0.657	−0.043	0.460**	0.141**	−0.075*	0.219**	0.117**	−0.134**		
9	Outcome innovation	1.090	1.162	−0.080*	−0.048	−0.116**	−0.027	−0.025	0.108*	0.099*	−0.023	–
10	Competitive innovation	3.802	0.844	0.019	0.046	0.026	0.023	−0.009	0.155**	0.147**	−0.018	0.365**

Notes: n = 885 (missing cases deleted listwise). *p<0.05; **p<0.01

The first hypothesis posits a direct effect of PVME on innovation. Results are presented in Table II. Model 3 presents the results for OI, and model 4 presents the results for CI. Results show the main effect of MVPE is not significant for OI (t=0.140, ns). Results also show a significant negative main effect of PVME on CI (t=−1.699, p<0.05). *H1* is not supported, and the significant effect that was found in the opposite direction to that hypothesized may suggest of other explanations for the relationship. This result will be discussed later.

TABLE Ⅱ. First Hypothesis Posits a Direct Effect of PVME on Innovation

	1 DV: abilities		2 DV: expectancies		3 DV: outcome innovation		4 DV: competitive innovation	
	b (SE)	t	b (SE)	t	b (SE)	t	b (SE)	t
Control variables								
Gender	−0.026(0.037)	−0.712	−0.085(0.068)	−1.253	−0.096(0.076)	−1.259	0.051(0.054)	0.947
Age	−0.001(0.002)	−0.686	−0.019(0.003)	−6.062***	−0.003(0.003)	−0.877	0.007(0.002)	2.919**
Marital status	0.083(0.038)	2.191*	0.043(0.070)	0.605	−0.246(0.078)	−3.132**	0.006(0.056)	0.099
Children	−0.005(0.015)	−0.337	0.043(0.028)	1.574	−0.002(0.031)	−0.064	0.016(0.022)	0.744
Education	0.023(0.020)	0.997	−0.215(0.037)	−5.874***	−0.013(0.042)	−0.313	0.005(0.030)	0.183
Sector retail	0.010(0.045)	0.224	0.054(0.085)	0.648	−0.287(0.093)	−3.071**	−0.064(0.067)	−0.964
Sector manufacturing	−0.030(0.052)	−0.565	−0.168(0.097)	−1.752****	−0.184(0.108)	−1.703****	−0.040(0.077)	−0.521
Managerial exp.	0.093(0.029)	3.183**	0.001(0.054)	0.023	0.008(0.061)	0.140	−0.073(0.043)	−1.690*
Abilities			0.273(0.059)	4.604***	0.211(0.067)	3.164**	0.208(0.048)	4.367***
Expectancies					0.078(0.036)	2.189*	0.117(0.026)	4.582***
	R^2= 0.02 F(8,973) = 2.752**		R^2= 0.12 F(9,972) = 15.200***		R^2= 0.05 F(10,971) = 4.547***		R^2= 0.05 F(10,971) = 5.428***	

Notes: ****p<0.10; *p<0.05; **p<0.01; ***p<0.0001 two-tailed for control variables, one-tailed for independent variables

It should be noted here that based on the traditional causal step approach (Baron and Kenny, 1986), the existence of a significant direct effect is a pre-requisite for the existence of mediation effects, and in its absence no further mediation analyses are possible. However, researchers have increasingly been challenging this assumption behind the traditional approach as they find that the assumptions may result in failure to detect significant and actual mediated effects (Hayes, 2013; MacKinnon, 2008). Further, those researchers suggested that it is possible that in one model multiple mediators exist that negate each other, which can result in a non-significant direct effect but actual and significant mediated effects (Hayes, 2013; MacKinnon, 2008). In fact, Hayes (2013) argues that "it is possible for X to exert an effect on Y indirectly through M even if one cannot establish through hypothesis tests that the total

effect is different from zero" (Hayes, 2013, p. 169), concluding that "[…] it is a mistake to condition the hunt for indirect effects on evidence of a total effect of X […]. Fewer mistakes of inference will be made in the long run if this strategy is abandoned" (2013, p. 170). Based on those approaches, this paper proceeds to investigate mediation effects in the model.

Analyses to test the indirect effects hypotheses for the serial multiple mediation models used in this study are presented in Tables II and III. *H2* posited those entrepreneurs' expectancies for returns from the new venture will be positively related to the degree of innovation. Results support this hypothesis, showing a significant positive effect of expectancies on OI (t=2.189, p<0.05, Table II Model 3) and on CI (t=4.582, p<0.001, Table II Model 4). *H3* dealt with the mediating role of expectancies on the effect of PVME on innovation. Results are presented in Table III, and are based on bias corrected bootstrapping analyses, as recommended in recently developed approaches (Hayes, 2009, 2013; Preacher and Hayes, 2004). *H3* posited that expectancies mediate the effect of PVME on innovation (PVME→expectancies→OI/CI). Results do not support this hypothesis. First, analyses show that the effect of PVME on expectancies (the mediator) are not significant (t=0.023, ns, Table II Model 2). Second, the bootstrapping tests for indirect effects (Table III) show that the indirect effect of PVME on OI through expectancies was −0.002, with a 95 percent bias-corrected bootstrap CI of (−0.0197, 0.0133) and that the indirect effect of PVME on CI through financial expectancies was −0.003, with a 95 percent bias-corrected bootstrap CI of (−0.0203, 0.0157). Since the confidence interval did contain zero, the effect is not significant. Thus, results do not support *H3*.

TABLEⅢ. Mediating Role of Expectancies on the Effect of PVME on Innovation.

Indirect effects[a]		*b* (boot SE)	LLCI/ULCI[b]
Outcome innovation	PVME→abilities→OI	0.013(0.012)	0.0028/0.0324
	PVME→expectancies→OI	−0.002(0.009)	−0.0197/0.0133
	PVME→abilities→expectancies →OI	0.002(0.001)	0.0005/0.0050
Competitive innovation	PVME→abilities→CI	0.013(0.006)	0.0035/0.0287
	PVME→expectancies→CI	−0.003(0.009)	−0.0203/0.0157
	PVME→abilities→expectancies→CI	0.002(0.001)	0.0005/0.0046

Notes: [a]Unweighted data used for bootstrap CI analyses of indirect effects. [b]Bias corrected bootstrap CI, 95 percent level of confidence. The number of bootstrap samples used: 5,000

H4 posited that abilities be positively related to the degree of innovation. Results support this hypothesis, showing a significant positive effect of abilities on OI (t=3.134, p<0.01, Table II Model 3) and on CI (t=4.367, p<0.001, Table II Model 4). *H5* posited that abilities mediate the effect of PVME on innovation (PVME→abilities→OI/CI). Results support this hypothesis. First, analyses show that the effect of PVME on abilities (the mediator) is significant (t=3.183, p<0.01, Table II Model 1). Second, the bootstrapping tests for indirect effects show that the indirect effect of PVME on OI through abilities was 0.013 with a 95 percent bias-corrected bootstrap CI of (0.0028, 0.0324), and that the indirect effect of PVME on CI through abilities was 0.013, with a 95 percent bias-corrected bootstrap CI of (0.0035, 0.0287). The confidence interval did not contain zero, which indicates that the mediating effect is significant for both operationalization. Thus, results support *H5*.

H6 dealt with the relationship between the two mediators, and posited that abilities will affect expectancies. Results are presented in Table II Model 2, and show that when managerial experience is controlled, abilities have a positive significant effect on expectancies (t=4.604, p<0.001). Thus, results support *H6*. *H7* posited that the effect of PVME on innovation is mediated in a serial manner by both abilities and expectancies, such that PVME affects abilities, which affect innovation, and PVME affects abilities, which affect expectancies, which affect innovation. Results support this hypothesis for both operationalization of innovation. The bootstrapping tests for indirect effects show that the indirect effect PVME→abilities→expectancies→OI is 0.002 with a 95 percent bias-corrected bootstrap CI of (0.0005, 0.0050), and that the indirect effect PVME→abilities→expectancies→innovation orientation is 0.002, with a 95 percent bias-corrected bootstrap CI of (0.0005, 0.0046). The CI did not contain zero, which indicates that the mediating effect is significant for both operationalization. Thus, results support *H7*.

A pictorial representation of the revised research model is presented in Figure 2.

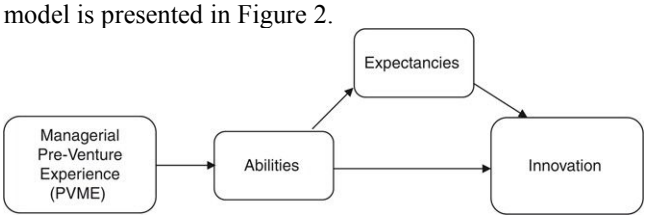

Figure 2 A pictorial representation of the revised research model

Lastly, it is noted that a suppression effect appears to exist in the relationship between PMVE and CI. The pairwise correlation between PVME and CI is close to zero (r=−0.018), and the main effect of MPVE on CI is not significant when entered as a sole predictor variable (Table IV Model 1). However, when entered in the regression along with the mediators, the effect becomes significant (Table II Model 4). Systematically omitting one variable from the equation reveals that PMVE becomes significant when abilities is in the equation and is acting as the suppressor (Table IV). Additionally, abilities and PVME are positively correlated (r=0.117, p<0.01) which also supports the notion of suppression. It appears that abilities remove variance associated with effects of skills that managers have from the PVME construct, resulting in a more accurate depiction of the nature of the effect of PVME on CI (Henle and Blanchard, 2008; Tzelgov and Henik, 1991). This finding suggests that without abilities in the equation, the effects of PVME are underestimated (Cohen *et al.*, 2003). Although suppression effects are not unusual in the context of mediation models (Cohen *et al.*, 2003) and can be sample specific (Wiggins, 1973), the particular result here is interesting as it shows a negative effect once suppression occurs. This effect is in the opposite direction to that

hypothesized and may suggest an alternative interpretation to the effect of PVME than OC.

TABLEⅣ. Pairwise Correlation Between PVME And CI

	1		2		3	
	b (SE)	*t*	*b* (SE)	*t*	*b* (SE)	*t*
Control variables						
Gender	0.035(0.056)	0.633	0.041(0.055)	0.756	0.047(0.055)	0.866
Age	0.005(0.003)	1.927****	0.005(0.002)	2.062*	0.007(0.003)	2.921*
Marital status	0.031(0.057)	0.534	0.011(0.057)	0.186	0.022(0.056)	0.387
Children	0.020(0.023)	0.901	0.021(0.022)	0.966	0.015(0.022)	0.659
Education	−0.015(0.030)	−0.503	−0.020(0.029)	−0.670	0.013(0.030)	0.433
Sector retail	−0.056(0.068)	−0.813	−0.058(0.067)	−0.860	−0.063(0.067)	−0.937
Sector manufacturing	−0.067(0.079)	−0.852	−0.060(0.078)	−0.772	−0.043(0.078)	−0.559
Managerial exp.	−0.051(0.044)	−1.149	−0.073(0.044)	−1.669*	−0.054(0.043)	−1.247
Abilities			0.240(0.048)	5.040***		
Expectancies					0.134(0.026)	5.229***
	$R^2 = 0.01$ $F(8,973) = 0.879$		$R^2 = 0.03$ $F(9,972) = 3.623$***		$R^2 = 0.03$ $F(9,972) = 3.840$***	

Notes: **** $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.0001$ two-tailed for control variables, one-tailed for independent variables

Ⅴ. DISCUSSION

The objective of this paper was to explore the relationship between PVME and the degree of new venture innovation, specifically, OI and CI. The research yielded several interesting findings. First, it was hypothesized that PVME will lead to the development of skills and abilities, and that those skills will affect the extent of innovation. Results support this hypothesized relationship on the mediating effect of abilities, showing that PVME positively predicts abilities, and that those abilities positively predict both the extent of technological innovation and the overall orientation toward innovation. These results suggest that abilities associated with PVME are an important factor in the development innovation ventures. Further, results also show that those abilities affect entrepreneurs' wealth expectancies from the new venture, which leads to greater innovation. This finding suggests that managerial experience not only increases one's abilities to deal with the challenges associated with innovation ventures, but that when those abilities are enhanced, they affect expectation for compensation and returns, which in turn, influence the entrepreneur's decisions regarding innovation in the new venture.

Thus, entrepreneurs appear to exhibit path-dependent thinking that is entrenched in existing cognitive schemas (Fern *et al.*, 2012; Fiske and Taylor, 1991; Ward, 2004), which results in exploitation of the familiar rather than exploration of the new. Findings suggest that to the extent that managerial experience is also associated with increased abilities, this negative effect will likely be neutralized by the positive effect of abilities.

Hypotheses couched in OC theory posited that those with greater PVME have greater opportunities in their prior employment and, in order to recoup the opportunities lost when transitioning to entrepreneurship, will expect higher returns from the new venture and, ultimately, select those ventures that offer greater potential returns. Results indeed support the assumption regarding the positive relations between expectations for returns and innovation, suggesting that more innovation occurs when wealth seeking plays a role in the entrepreneurial decisions. However, no indication was found that those wealth motives directly emerge from managerial experience. Although results do not show a direct effect of PVME on financial expectancies, an indirect effect does appear to exist, through abilities. In other words, it appears that PVME affects abilities, and those abilities affect financial expectancies, which are positively associated with innovation.

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Research on Vehicle Human Machine Interface Design

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***Abstract*—Vehicle Hunan machine interface is undergoing a tremendous change with the widely use of technologies in communication and information. In the paper, the influences between vehicle human machine interaction and the driver's cognition factors such as driving distraction, driving workload and the situated awareness were analyzed and the design issues of vehicle human machine interface design were put forward. Finally natural interaction and augmented reality which are two major design fields for the multimodal human-machine interface of vehicles were investigated and practiced. The study findings can guide the vehicle human-machine interface design. According to the existing problems and research data, I put forward an idea that transfer part of pilot's control functions to passengers. Passengers directly control some "non-security" function of the car through mobile phones with different gestures, not only reduce the burden of the driver, but also optimize the human-car interaction experiences.**

***Index Terms*— Human machine Interaction, Interaction Design, Human Factors UI Assessment**

I. Theoretical Introduction of Vehicle Interactive Interface

Human-computer interaction is a person, and their mutual influence of computer technology research. HCI refers to the communication between the user and the computer system, which is a two-way exchange of information between the various symbols and actions of people and computers. "Interactive" is defined here as a communication, information exchange, and is a two-way exchange of information, people can enter information into the computer, but also by the computer to the user feedback. This form of information exchange can occur in various ways, such as mobile keystrokes on the keyboard, mouse, display symbols or graphics on the screen so you can also use voice, gestures or body movements, etc. The characteristics of human-computer interaction: Information positive feedback: people can pass information in a timely manner to the object, the object can give timely feedback information, and people can make judgments based on the feedback information. People's participation and initiative: people are participants in the interactive process, has accepted, judgment, decision-making, the right to operate, but also take the initiative, rather than passive recipients of information.

The automotive industry has gradually formed a series of new research areas of automotive emotional design, interactive design, Automobiles, which also for the automotive industry and Automobiles innovation development provides a new opportunity. Interaction design has really changed the way the interaction between people and information, and change the way people interact with vehicles. Car of the future will be more closely associated with integration of the external environment, "communication" the ability of other vehicles, pedestrians and motorists will become more outstanding among the future will be a diverse people and vehicles interactive era. Interaction design is an innovative Automobiles research disciplines. The interaction of people and vehicles interactive environment, people and cars outside, interactive, interaction between motorists and pedestrians between cars belong to the field of Automobiles research interaction design [1].

With the continuous development of computer technology and network technology in the field of transport vehicles and automotive technology is widely used, the internal space, man-machine interface, operation and interaction of cars being revolutionary change. Currently, the car's internal information model has gradually evolved from a single lane and condition information models become complex information including vehicle information, the information between the car (Car to Car) information, automobile and other information carriers (Car to X), including interactive system. Although faced with a rapid increase in the complexity of driving and driving safety risk issues, but a large number of in-vehicle information systems or continue into the car driving space. Pursuit of complex human emotional experiences of product features and reflect the needs, the key question is not simply to reduce the complexity, but to good management through careful design complexity. Driving complexity and interaction space is the more driving experience and the pursuit of functional information caused by requirement. Therefore, in the context of complex information, a critical issue about cars interactive interface design is how to design interactive interface and process information systems, both to meet the needs of the driver's secondary mission, but also to ensure driving safety and efficacy.

II.Vehicle Interactive Interface Design

From the angle of human-centered view, from a driver's point of view the main interactions can be in the car room interactive interface is divided into: the main driver interface, auxiliary drive interface, interactive

information and entertainment both inside and outside the car interface, mobile devices and vehicles integrated interface. The main interface is the main driving driver steering wheel to see the road ahead, the basic operation of the accelerator stampede, brake, clutch pedal. Auxiliary drive interface include viewing dashboard information, operating wipers, lighting control, intelligent driving system (such as adaptive cruise control), parking assist, lane keeping assist, maintain a steady speed while maintaining a safe distance from the vehicle in front, warning all kinds potentially dangerous driving and other auxiliary operations. A parking aid interface design, the interface through the front car and the distance between the sensor sensing the position of the car itself, and feedback information to graphically show the way to the center console, the driver side auxiliary parking position [2].

The purpose of the driving assistance system is designed to assist the driver so that many more safe and comfortable driving, these systems can even change the understanding of driving, especially when the system takes over driving a specific tasks, such as controlling the speed. Currently, the most significant challenge is interactive driver assistance systems and purely functional level. Although trust is often relinquish control performance, but when the driver assistance systems to take over the task, the driver must believe the car is doing the right thing. For high system capacity evaluation will lead to abuse and potentially dangerous situation, this will reduce the driver's sense of trust. These are critical auxiliary drive interface design. Figure 1 fully guarantee the driver's sense of control auxiliary parking system

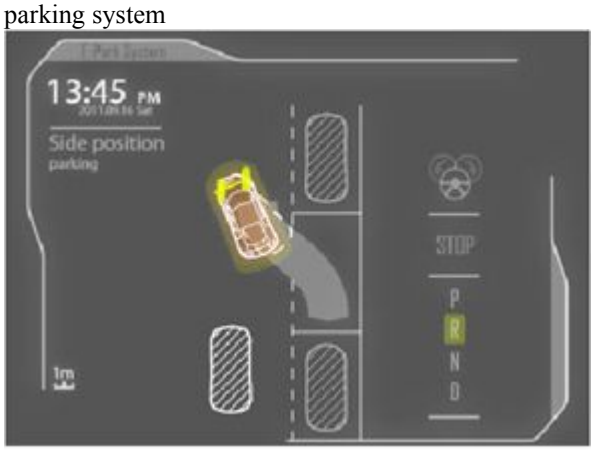

Fig. 1.The control auxiliary parking system

Information interactive entertainments include music, in-car entertainment, phone, GPS navigation, and online e-mail and SMS. The user can obtain the current state of Automobiles information, information obtained by the sensor and the Automobiles through the network integrated information (such as weather and traffic conditions). Continuous development of intelligent transportation systems and "car to car" communication technologies, the environment are available to increase the car. From a technical point of view, Automobiles is to get the information flow directly from the other Automobiles, but the problem lies in how the driver selection screen, and how will this be presented to the driver, which is the human-machine interface issues to be addressed. The interface cellular data transmitted via the Internet, the current interface status information after leading the team Automobiles to change the route, each automobile received on the interface. Figure 2 is about the exchange of information among the team's interface design.

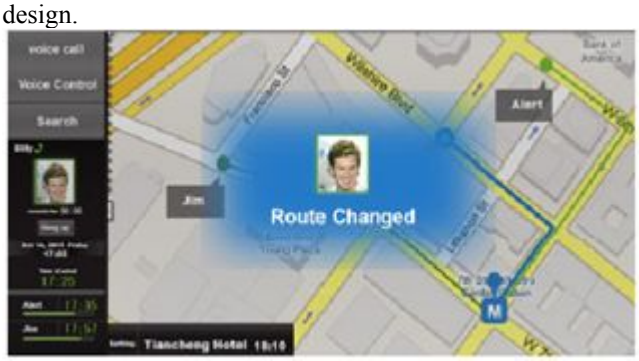

Fig. 2.The exchange of information among the team's interface design

Integration of mobile devices and vehicle interface changes, and mobile devices including mobile phones, tablet computers and other equipment used in the car due to car and Automobiles interface occurred in car applications. When driving, the driver with many mobile devices to interact, such interactions may affect driving performance and visual attention. Therefore, interface design, and how these interior design interface and interaction devices without causing cognitive load has become a key design. Information needs for the development of mobile phones while driving for the user interface. Which can provide mobile phone-based navigation, and media control functions, and interact with the system by displaying relevant technology and car sharing screen [3].

III. The Vehicle Interactive Interface Design of Multi-channel Mode

On the basis of the interface on the body, the interactive mode interactive interface design is the design of the car key. The traditional car interaction interactive interface is mainly based on the steering wheel, physical buttons and other related equipment (such as a steering lever) interactive form. Most users facing this interface will have a strong fear. In this case, the car man-machine interface interaction inevitably toward increasing in the function room of information exchange within the development environment, and even the direction of reducing the number of control buttons. Multi-channel mode is mainly focused on human-computer interaction and natural interaction augmented reality in two ways [4].

The typical natural interaction associated with the passenger compartment includes voice interaction, interactive touch-screen interactive somatosensory and location. Sound as a control device to interact first need to be resolved at the technical level to enhance speech recognition technology. Because of the language have greater difficulty and complexity of machine learning, therefore, the current sound control vehicle information systems focused on voice commands based navigation

system. The biggest advantage of the navigation voice is its limited geographic information, and the information is relatively simple format. For example, in the development of the domestic Kay voice control navigation system is the use of voice navigation equipment. In addition to navigation, for the hierarchical menu, the sound control also has a large advantage, especially for those more complex hierarchical menu trees, voice control has a large advantage.

Interactive touch-screen as a typical natural interaction forms a major breakthrough in handheld mobile devices. However, in car information systems, interactive touchscreen subject to certain limitations. First, in a complex case of the car, touch interaction to identify the level of the controller, there is no physical controller so easy. Secondly, in the car driving situations, the feedback on the touch-screen interaction is not as physical buttons and vibration feedback for mobile devices so obvious. But the advantage of touch-screen display can be solved only as a function of physical buttons leading to the problem of increasing the number of buttons. The most classic is the Chrysler 200C concept car is a full touch screen products, the entire inner chamber does not have a physical button, to achieve a full touch screen control. Fig.3 shows the Interactive touch-screen technology.

Fig. 3.The Interactive touch-screen technology

Augmented reality is a virtual on-screen and real-world information nesting, and as a basis for interaction. Human-computer interaction design can combine in the automotive field, and the rapid development of augmented reality head-up display. Head-up display information directly projected onto the front windshield, and then created a virtual graphics. HUD largely solved the current driver's Automobiles when viewing the display device needs gaze saccade ((Glance) potential safety problems. Fig.4 shows the reality combines navigation case of peace depends on the target display.

Fig. 4.The navigation case of peace depends on the target display

IV. The Vehicle Interactive Interface Design Human Factors

Driving-related tasks, the most important task is to control Automobiles, keep the driveway and monitoring road hazards, and to the interior of complex information exchange is one of the major factors mentioned above. Therefore, the study of Automobiles user interface for driving behavior and cognition, will conduct research on the driving task and interactive tasks in two ways. In recent years, for the relevant factors including Automobiles human-computer interaction and information related to the role of situational factors on distracted driving, and on this basis, the impact caused by the driving load Workload, situational awareness (Situation Awareness) cognitive indicators. Driving distracted attention are driving the process of resource allocation problems multitasking situations, the driver due to the influence of external factors, their attention and cognitive resources from the control Automobiles, lane keeping, monitoring road conditions and other basic driving tasks transfer [5].

The key issue is that distracted driving caused by distracted driving source of distraction, distraction can be divided into two categories avoidable and unavoidable. In general, you can avoid the distraction most drivers chose to ignore them. Distraction inevitably contains emergencies or driving the process must complete tasks, such as watching the speedometer, etc., are important factors driving performance generated effects. Generally by increasing the driver's ability to identify and respond to the good interface design to reduce driving distractions. Apart from disparate sources, research shows that the duration of the driving task is also a factor in the impact of distracted driving. Driving load is limited cognitive resources issues, namely the driver's cognitive process to bring the load limited processing capacity. Driving load is a multi-dimensional structure, closely related to multi-task driving environment, by task, driving under the influence of external support and individual factors. From automotive HMI design perspective driving load should be maintained at a reasonable level, load level is too high and too low are not conducive to driving performance.

Relationship situational awareness ((Situation Awareness) refers to the user to change the context of the environment perception and cognition, it explains how to manage the driver to drive long-term goal (destination) and short-term objectives (to avoid accidents) between situational awareness to perceive a certain time and space environmental factors, in order to understand its significance and speculated that the future state has a very important role in a large number of studies have shown that interactive interface complexity increases, there is a significant impact on the driver's situational awareness. For example, Experience the driver the ability to identify the danger of detection are better than inexperienced drivers; but if a driver using a cell phone, due to reduced situational awareness, perception of danger will be reduced to the same level with the new driver.

V. CONCLUSIONS

With the advent of the intelligent information age, the traditional way of physical interaction is facing challenges of new technologies. Under such circumstances, the development of the car interactive man-machine interface is toward to the trend of the numbers of control buttons under the premise of increasing function. Innovative, complementary, mufti-channel interactive car mode design is becoming increasingly important. Vehicle Hunan machine interface design is a new subject, the need for new thinking and practice in the design content, methods and processes. Vehicle Hunan machine interface design this paper from the field of human factors, interface design and interaction patterns three aspects of automotive design interactive interface design and research are discussed, depicts academia and industry development in the area status quo. The purpose of design is to provide a better life for people, not just technology show, the car of the future interactive interface will give people a better life and the driving experience.

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Intelligent Reactive Compensating Controller Based on The Cooperative Control of FPGA and DSP

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***Abstract* - This paper puts forward an intelligent Reactive Compensating Controller which uses instantaneous reactive power theory and based on the cooperative control of FPGA and DSP. The application of FPGA is to complete the controller complexity, time-consuming multiplication and division operations. The adoption of DSP is to complete instantaneous wattless power detection, the management of keyboard display and signal communication, and capacitor switching control. Therefore the cooperative control of FPGA and DSP can be realized. This paper uses the vector instantaneous wattless power algorithm, improves the speed of operation and processing and realizes dynamic wattless power compensation through capacitors. Meanwhile, this paper puts forward the concept of wattless power compensation capacity weight, which can control many sets of equipment operation of grid connected at the same time and compensate the weights and manually set each equipment, which effectively improves the wattless power compensation rationality, compatibility and flexibility.**

***Index Terms* - Reactive power compensation; Controller; Capacity weight; DSP; FPGA;**

I INTRODUCTION

Asynchronous motors are widely used in modern industry, Asynchronous motor gets active power from the grid and meanwhile absorbes a lot of wattless power from the grid. If there is no local compensation for reactive power, reactive power will transmit in the network, resulting in increased power loss, voltage of the end user down. The transmission of active power will also be affected and the grid polluted. The traditional way of wattless compensation uses synchronous condenser, but its dynamic response speed is slow and the operation and maintenance are complex. The mode of parallel capacitor has very small power waste and can realize flexible installation, scalable, packet switching, and saving investment, but it's not suitable to apply to the places where the load fluctuates frequently. The current widely used dynamic wattless compensation is static var compensator (SVC), which has the characteristics of fast response, continuously adjustable wattless power output. This paper introduces a kind of coordinated control of DSP and FPGA based on the new reactive power compensation controller, which can accurately calculate the wattless power and fast switch.

II. THE OPERATIONAL PRINCIPLE OF REACTIVE POWER COMPENSATION CONTROLLER

As shown in Figure 1, the controller is mainly composed of voltage acquisition, current acquisition, DSP,FPGA, data display, key communication, and capacitor switching module. The working process is as follows: the voltage and current acquisition module collects the voltage and the current from the grid; the collected data are sent to the controller for processing; the controller calculates the active power, reactive power, active current and reactive current, through the analysis of these data to determine whether to compensate for the power grid. If there is a need to compensate for power grid, the controller generates a control signal, driving thyristor to switch the capacitor.

Compared with the reactive power compensation controller in the past, the controller using the DSP and FPGA dual core processor has higher sensitivity and reliability. DSP is responsible for the peripheral module; FPGA is responsible for data processing, data transfer between processors through dual port RAM. This design uses the instantaneous wattless power theory. Instantaneous wattless power theory has broken the traditional power defined by mean value, can calculate the reactive power much faster and more accurate, and improve the speed of the controller.

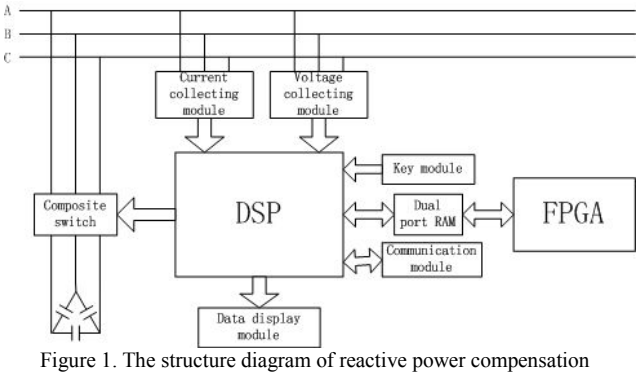

Figure 1. The structure diagram of reactive power compensation controller

With the development of FPGA technology and integration, There are more and more kinds of embedded

hard, so FPGA can achieve more and more digital algorithm. The computing speed is also greatly improved, FPGA chip of the controller uses Altera's Cyclone II series EP2C8Q208C8N; DSP chip uses TI company's C2000 series TMS320F2812, Which has an advantage of low price and high performance and can measure and sample the frequency of grid and the grid signal, through its built-in AD module and acquisition module.

III. THE SAMPLING AND CALCULATION PRINCIPLE OF ELECTRICAL SIGNALS

Voltage and current detection circuit transform the voltage and current of the grid into the 0 ~ 3.3V signal that DSP pin of the chip can identify. The zero crossing detection circuit transforms the sine signal into square wave signal. The capture unit of DSP captures the square wave signal edge and measures grid frequency is f; the sampling points of a cycle is N; the interval time of every sampling is t=1 / (fN). The t value is assigned to the period register DSP event manager, through periodic interrupt way to implement ADC sampling.

The voltage detection circuit and its measured waveform as shown in Figure 2 and Figure 3: the grid voltage after two100K/1W 1% precision resistors R1 and R2 is transformed into AC current signal, and then through the TV19E precision voltage transformer's isolation transform, to complete the transform of the current 1:1. Through broadband, high speed TL082 integrated operational amplifier, current signal realizes the I-V transform. And first through the inverse addition circuit, coupled with external 3.3V DC voltage source, and then through the voltage follower and first-order high frequency filter circuit, the 0 ~ 3.3V voltage signal is realized.

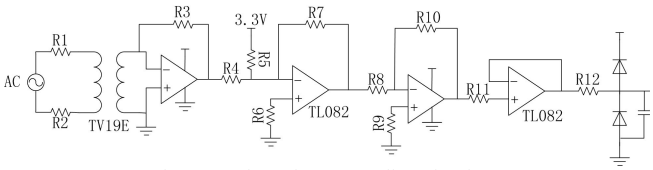

Figure 2. The voltage sampling circuit

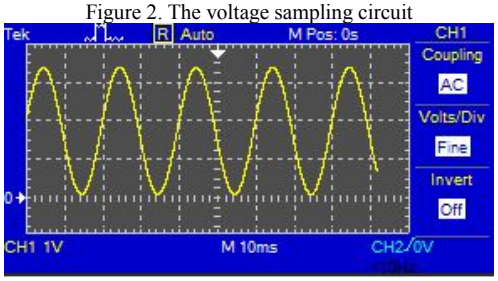

Figure 3. The measured waveform of voltage sampling circuit

The current detection circuit and its measured waveform as shown in Figure 4 and Figure 5: alternating current through the current transformer TA12-100 is 0 ~ 5mA current, then through I-V conversion circuit composed of OPA227, is converted into a voltage signal. After inverting summing circuit, inverse ratio circuit, filter circuit, and follow clamping limiter circuit, the voltage signal 0 ~ 3.3V is obtained.

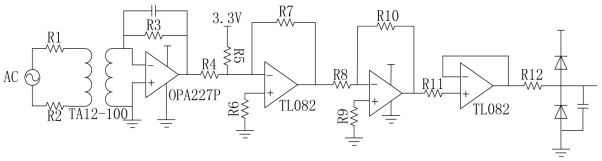

Figure 4. The current sampling circuit

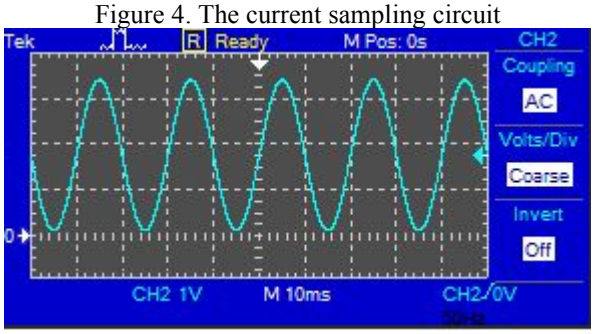

Figure 5. The measured waveform of current sampling circuit

The zero crossing detection circuit and its measured waveform as shown in Figure 6 and Figure 7. The circuit uses the LM311 open collector(OC) voltage comparator; the input uses two balance resistors and two clamping diodes. In order to eliminate some narrow square wave dithering due to interference of the voltage (current) output zero in the zero crossing detection circuit, we parallel a 470nF capacitor in the output. Two IN4148 diodes are used to clamp for circuit output voltage control in 0 ~ 3.3V.

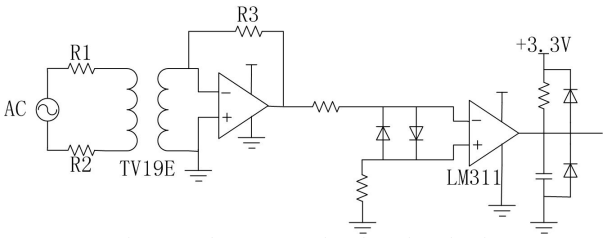

Figure 6. The zero-crossing detection circuit

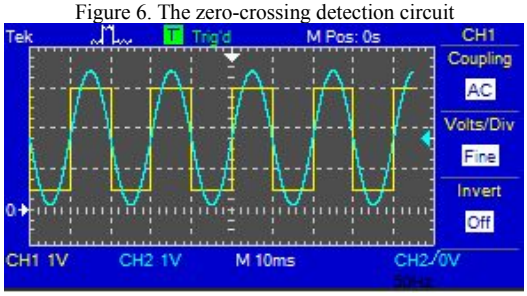

Figure 7. The measured waveform of zero-crossing detection circuit

The vector diagram of instantaneous wattless power algorithm principle as shown in figure 8:

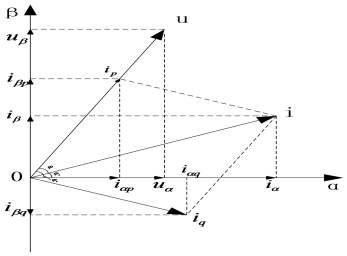

Figure 8 .The voltage and current vector in the αβ0 coordinate system

Suppose three-phase voltage and current instantaneous values are respectively ua , ub , uc , ia , ib , ic. uα , uβ ,

iα . iβ is the instantaneous voltage and current in the α-β coordinates. Transforming the collected three-phase voltage and current signals in perpendicular α-β coordinate system, what we get is as follows:

$$\begin{bmatrix} u_\alpha \\ u_\beta \end{bmatrix} = C_{32}\begin{bmatrix} u_a \\ u_b \\ u_c \end{bmatrix} \begin{bmatrix} i_\alpha \\ i_\beta \end{bmatrix} = C_{32}\begin{bmatrix} i_a \\ i_b \\ i_c \end{bmatrix} \quad (1)$$

$$C_{32} = \sqrt{\frac{2}{3}}\begin{bmatrix} 1 & -\frac{1}{2} & -\frac{1}{2} \\ 0 & \frac{\sqrt{3}}{2} & -\frac{\sqrt{3}}{2} \end{bmatrix}$$

Supposing three-phase circuit instantaneous active power is p

$$\begin{aligned} p &= ui_p \\ &= ui\cos\varphi \\ &= ui\cos(\varphi_u - \varphi_i) \\ &= ui\cos\varphi_u\cos\varphi_i + ei\sin\varphi_u\sin\varphi_i \\ &= u_\alpha i_\alpha + u_\beta i_\beta \end{aligned}$$

Similarly we can get three-phase circuit instantaneous wattles power q

$$q = ui_q = u_\beta i_\alpha - u_\alpha i_\beta$$

By formula (2) and formula (3)

$$\begin{bmatrix} p \\ q \end{bmatrix} = \begin{bmatrix} u_\alpha & u_\beta \\ u_\beta & -u_\alpha \end{bmatrix}\begin{bmatrix} i_\alpha \\ i_\beta \end{bmatrix} = C_{pq}\begin{bmatrix} i_\alpha \\ i_\beta \end{bmatrix} \quad (4)$$

three-phase voltage:

$$\begin{aligned} u_a &= E_m\sin\omega t \\ u_b &= E_m\sin(\omega t - 2\pi/3) \\ u_c &= E_m\sin(\omega t + 2\pi/3) \end{aligned} \quad (5)$$

The voltage value for u:

$$u = \sqrt{u_\alpha^2 + u_\beta^2} = \sqrt{\frac{3}{2}}E_m \quad (6)$$

Put above formula into formula(1):

$$\begin{bmatrix} u_\alpha \\ u_\beta \end{bmatrix} = \sqrt{\frac{3}{2}}E_m\begin{bmatrix} \sin\omega t \\ -\cos\omega t \end{bmatrix} \quad (7)$$

Put formula (7) into formula (4):

$$\begin{bmatrix} p \\ q \end{bmatrix} = \sqrt{\frac{3}{2}}E_m\begin{bmatrix} \sin\omega t & -\cos\omega t \\ -\cos\omega t & -\sin\omega t \end{bmatrix}\begin{bmatrix} i_\alpha \\ i_\beta \end{bmatrix} \quad (8)$$

By formula (8):

$$\begin{bmatrix} i_p \\ i_q \end{bmatrix} = \begin{bmatrix} p/u \\ q/u \end{bmatrix} = \begin{bmatrix} \sin\omega t & -\cos\omega t \\ -\cos\omega t & -\sin\omega t \end{bmatrix}\begin{bmatrix} i_\alpha \\ i_\beta \end{bmatrix}$$

$$= \sqrt{\frac{2}{3}}\begin{bmatrix} \sin\omega t & \sin(\omega t - 2\pi/3) & \sin(\omega t + 2\pi/3) \\ -\cos\omega t & -\cos(\omega t - 2\pi/3) & -\cos(\omega t + 2\pi/3) \end{bmatrix}\begin{bmatrix} i_a \\ i_b \\ i_c \end{bmatrix} \quad (9)$$

The above formula ip , iq——active current and reactive current.

Above all we can get:

$$\begin{bmatrix} p \\ q \end{bmatrix} = E_m\begin{bmatrix} \sin\omega t & \sin(\omega t - 2\pi/3) & \sin(\omega t + 2\pi/3) \\ -\cos\omega t & -\cos(\omega t - 2\pi/3) & -\cos(\omega t + 2\pi/3) \end{bmatrix}\begin{bmatrix} i_a \\ i_b \\ i_c \end{bmatrix} \quad (10)$$

The above formula p , q——active power and reactive power

Reactive power compensation is achieved by switching capacitor. Therefore, high speed, safe and reliable switching device is the key. Single use of AC contactor will cause inrush phenomena when capacitor input, so that the capacitor capacity declines and causes severe fever and swelling damage. Thyristory alone can solve the current problem, but its high conduction loss and heat quantity is large. In order to solve the above problem, this design uses the PDKF type, namely the thyristor and contactor combination switch. Its basic principle is connecting thyristor and magnetic latching, as shown in figure 9. The thyristor switches tube in a composite control capacitor's input and removal. Contactor is used for holding a circuit of capacitors into the conduction. When contactor is input, the thyristor immediately stopping running, which prevents the switching surge current and greatly eliminates the heating of the thyristor. The actual control is issued by DSP ,sending low voltage drive signal, so the PDKF type switch control is completed.

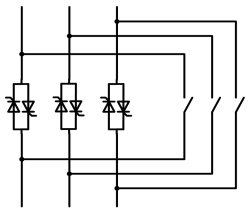

Figure 9. The Block diagram of PDKF type switch

IV. WATTLESS POWER COMPENSATION CAPACITY WEIGHT

This paper puts forward the concept of wattless compensation capacity weight, that is, the total reactive power that every wattless power equipment can compensate is controlled by a weight factor λ ($0 \le \lambda \le 1$) , Suppose by calculating the wattless power is Q, then Multiplied by the weight, namely a weight factor, the actual compensation capacity Qs = λ Q, ($0 \le \lambda \le 1$). When λ =0 the device has no compensation, When λ =1 the device is fully compensated. Reactive power compensation amount will not have to worry about excessive compensation to improve the compatibility and flexibility of the device as long as the weight factor is set up well. So the controller can be extended when the control terminal is limited.

Its working principle as shown in Figure 10. In the fixed capacitor compensation branch connected with a variable voltage source Uv, Uv has the same frequency and phase with the grid voltage U , its size can be varied from 0 to Uv, If a compensation capacitor is C, then the branch from the compensation current Ic and the capacitive wattlespower Qc is

$$I_c = \frac{U - U_c}{X_c} = UwC(1 - \frac{U_v}{U})$$

$$Q_c = I_c U = U^2 wC(1 - \frac{U_v}{U})$$

Obviously, when the Uv changes, Qc can realize continuous adjustment from 0 ~ Q, the schematic diagram as shown in fig10.

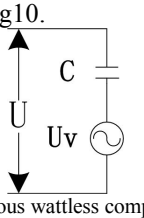

Figure 10 .Continuous wattless compensation diagram

V. SIMULATION OF FPGA MULTIPLICATION AND DIVISION

Within the instantaneous reactive power algorithm, the majority are data multiplication and division. Simulation timing diagram multiplication and division operation in FPGA as shown in Figure 8 and figure 9.

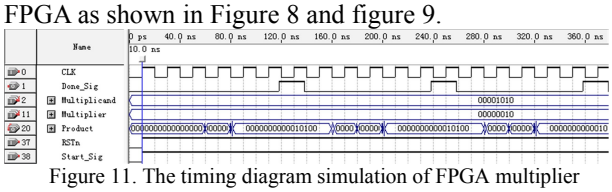

Figure 11. The timing diagram simulation of FPGA multiplier

From Figure 11 we can see: when Start_Sig jump from low level to high level, it represents the start of operation; when Done_Sig generates a high pulse, it represents the end of operation. When Multiplicand is binary 00001010 and Multiplier is 00000010 in binary, then we get the value of Product is a binary 00010100, just as the product of Multiplicand and Multiplier.

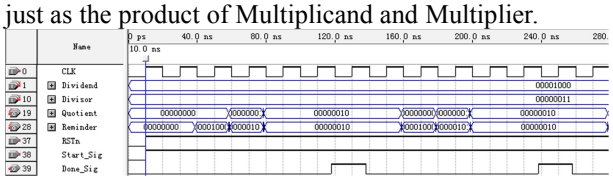

Figure 12. The timing diagram simulation of FPGA divider

From figure 12 we can see: when Start_Sig jump from low level to high level it represents the start of operation; when Done_Sig generates a high pulse it represents the end of operation. When Dividend is binary 00001000, Divisor is 00000011 in binary, then the value of Quotient is a binary 00000010 and the value of Reminder is binary 00000010, which is the quotient and remainder of division calculation of the Multiplicand and Multiplier.

VI. SIMULATION BASED ON MATLAB

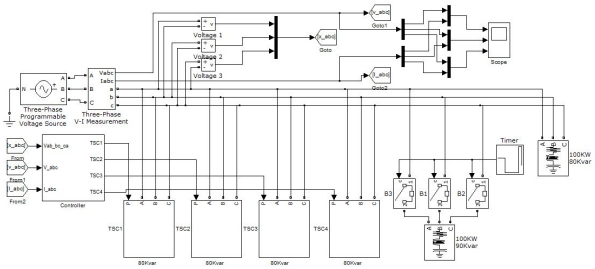

Figure 13. The simulation diagram of whole system

Use SIMULINK in MATLAB software to build a simulation platform. Simulation of TSC type SVCsystem runs a situation of wattless power compensation in the low voltage 380V/50Hz three-phase three wire system with inductive load. Figure 13 is the overall system simulation diagram, mainly including the three-phase power supply module, 4 groups of 80K var triangle connection capacitor group module, controller module and two inductive load access to grid in different time (one is 80Kvar, the other is 90Kvar).

The simulation process is as follows: in the beginning, the three-phase inductive 100KW/80Kvar load access to circuit; at the moment of 40ms, the controller based on the detection of wattless power size, put the first group of capacitor into use. The second three-phase perceptual load 100KW/90Kvar access to rid at 100ms. The controller switches into the second groups of capacitors based on the calculation. The simulation of A, B, C three-phase voltage and current phase diagram is shown in Figure 14: solid lines indicate voltage, the dotted line represents the current.

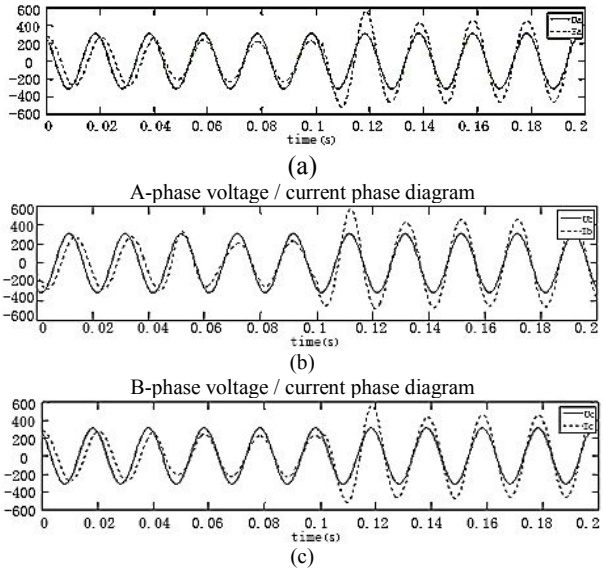

Figure 14. Three-phase voltage / current phase diagram

At the beginning of time, as the power grid access three-phase inductive 100KW/80Kvar load, the current phase that the dotted line represents obviously lag behind the voltage that the solid line represents. That is, the perceptual load. At 40ms enable controller, the controller is based on the detection of wattless power size and put into the first group of capacitor, so at the moment of 50ms, the basic voltage and current have the same phase

and the response time is within 10ms. And then the current of each phase decreases obviously and reduce the line power loss. 100KW/90Kvar three-phase perceptual load access to grid at 100ms, as can be seen from Figure 14. The phase of the current lag behind the phase of the voltage and current increases. The controller switches into the second groups of capacitors after calculation. Voltage and current phase is basically the same and current decreases. From the chart we can see that the power factor decreases first and then increases. The changes of power factor is hown in Figure 15.

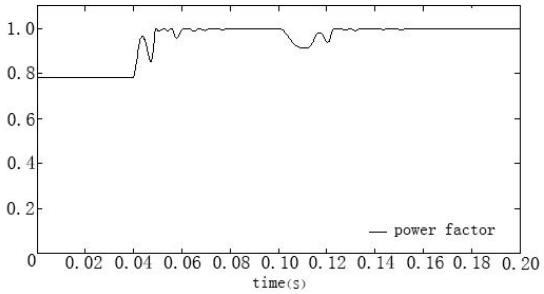

Figure 15. Power factor variation before and after compensation

From Figure 15: we can see that at the start time, system power factor is less than 0.8. when the first group of capacitors is put into the system at the 40ms, the power factor improves significantly, despite a little fluctuation, finally close to 1 and remaines stable. because of the input load at the 100ms, the power factor declined, but at 120 ms when the second set of capacitor is put into the system, power factor is close to 1, reaching a satisfactory compensation effect.

VII. CONCLUDING REMARKS

This paper presents a design scheme of dynamic reactive power compensation controller based on theDSP and FPGA cooperative control. The structure can give full play to the advantages of FPGA and DSP, maximize the increase of the wattless power compensation calculation and control speed. Through the measured waveform of instantaneous voltage and current detection circuit, power compensation control process and imulation test results of control algorithm, the paper proves that the design scheme is feasible. In addition, the concept of the compensation weights is proposed in design, which has the practical value. Therefore, the scheme can also provide a reference for the development of a new generation of reactive compensation controller.

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The Impact Analysis of the Subway Deep Foundation Pit Open-cut Method Changed to Cover-excavation Method

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***Abstract*—The article is base on HeFei subway line one Mingguang road subway station construction. In the process of pit excavation, in order to reduce the impact on traffic, make the plan of the open-cut Method changed to cover-excavation Method construction. Frame beam in advance to ensure the normal running of ground transportation. According to the actual situation of the construction process, using large-scale finite element software Midas GTS\NX for two kinds of process are analyzed in numerical simulation. Comparative analysis two kinds of schemes of surface subsidence and deformation of the retaining piles in detail，to illustrate the safety of frame beam construction plan in advance, providing the reference to similar deep foundation pit construction scheme change.**

***IndexTerms*—deepfoundation pit; underground diaphragm wall; ground surface settlement; inner support**

I. Introduction

In the process of subway construction, the depth of foundation pit excavation becomes deeper, and the impact on the surrounding environment becomes bigger. How to guarantee the safety of construction, reduce the impact on the environment, is an important problem in construction[1]. In actual construction, the construction methods usually will change with the changes in the environment; ensure to reduce the influence of nearby residents and the surrounding environment. At present, the excavation of main monitoring objects have inside palisade structure sideway, surface subsidence, supporting axial force changes, etc[2-4]. Retaining structure internal force and deformation due to foundation pit excavation problems can get practical application by bar system finite element method. Ground settlement caused by excavation; basically have the measured statistical methods and numerical analysis [5-6]. In Hefei subway line one, for example, during the construction of Mingguang road station, in order to reduce the influence on ground transportation, the project department to change the original design and construction scheme, the solution to the first concrete construction to support after the erection of Mingguang road bridge to wear under the body, can be applied at the same time for erection of beam body structure layer, the station construction of pit open-cut method changed to cover-excavation method. In order to ensure the change plan in Mingguang road in the construction of bridges under the safety and feasibility, this paper using Midas software for both the palisade structure in construction process simulation analysis, and calculate the horizontal displacement of underground diaphragm wall, ground surface subsidence displacement and retaining structure by the load value, based on the results of the two comparative analysis, to control the related factors, so as to ensure the engineering quality and safety, saving cost and time limit for a project goals.

II. Project Profile

Mingguang road station is located at Mingguang road and Shengli road junction, along the north and south Sheng li road to decorate, the east-west direction is the road which is to be built through Mingguang Bridge. The station starts mileage K6+ 179.787, ending in the K6+448.697, the total length is 268.91 m, the station foundation pit standard section 23.2m wide, roof covering about 0.8 ～ 4.4 m, the standard floor buried depth is about 22.8m. The principal foundation pit is far from the surrounding buildings, southeast corner is Changan driving school and 30 floor commerce-residence building and some shops and houses; northeast is the low multi-layer shops and houses, northwest is Post Office ,north of the station for the demolition of the old Huainan railway. Proposed site terrain is relatively flat, micro geomorphic units belong to the Nanfei river level terrace.

The original design using the open-cut method of construction that the excavation to make pit stops along the bottom rear end, the roof and the side walls and other structures, building envelope using underground diaphragm wall + inner support, the inner support are the first reinforced concrete support + four steel support. To reduce the influence on road traffic, the solution to the first concrete support after the erection of Mingguang road bridge to wear under the body, can be applied at the same time for erection of beam body structure layer, recover part of the road traffic, and then build the lower part of the construction structure in turn.

TABLE 1

PHYSICAL AND MECHANICAL PROPERTIES OF SOIL

Materials	Modulus of elasticity （Mpa）	Poisson ratio	Appearance density （kN/m³）	The initial stress parameters	Cohesion （kpa）	Frictional angle	Thickness （m）
Miscellaneous fill	10	0.3	17.5	0.3	10	8	1.4
Clay	16.10	0.31	20	0.5	74.7	15.9	2.2
Silt	13.27	0.33	20.5	0.4	13.8	21	17.1
Weathered sandstone	150	0.35	21.5	0.4	35	45	49.3

III. NUMERICAL CALCULATION

A. The selection of calculation parameters

According to construction survey report, do the corresponding simplified of the soil, dividing layers and each layer of the soil mechanics calculation parameters are shown in table 1. Underground diaphragm wall uses C35 concrete, twisted elastic beam element simulation, according to the experience will take 30 Gpa as elastic modulus, take 0.20 as the Poisson's ratio, 25KN/m3 as the appearance density. Support uses linear elastic truss element simulation, modulus of elasticity takes 200 Gpa, poisson's ratio is 0.30. Structure by constant load are gravity and earth pressure, live load are ground overload which take 20 kpa, in order to convenient for simulation, the bridge deck vehicle dynamic load and the construction load simplified as uniformly distributed load, its value is 45 kpa.

B. The establishment of calculation model

Foundation pit standard section is 23.2 m wide, 21.8 m deep, and underground diaphragm wall take 34.8 m deep, the first concrete supports are apart from the ground 2.3 m, the second steel supports are from the concrete supports 3.5 m, the third steel supports are away from the second steel supports 4.75 m, the forth steel supports are from the third steel supports 4.2 m, the fifth steel supports are from the forth steel supports 3.53 m. The influence of the deep foundation pit excavation scope determined by the plane shape of the foundation pit excavation, excavation depth and soil conditions and other factors. To meet the requirements of accuracy, calculate to take the K6 + 251.787 standard section, set up 163.2 m × 70 m (width ×depth) of two-dimensional calculation model, compute grid have total of 11425 units and 11458 nodes. Model around the boundary used normal constraints, bottoms adopt fixed end constraint, and calculation model is shown in figure 1.

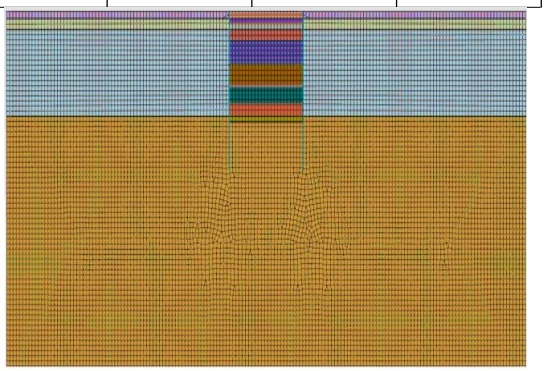

Figure 1. Numerical model and grid division

C. The results of analysis

1. Excavation step

The original plan model is divided into nine steps: step 1: initial stress analysis, step 2: build underground diaphragm wall, step 3: excavation + the first concrete support; Step 4: excavation + the second steel support; Step 5: excavation + the third steel support; Step 6: excavation + fourth steel support, Step 7: excavation + 5 steel support, Step 8: excavation to the pit; Step 9: set up T beam. The changed plan is setting up T beam after the project of the first concrete support, model calculation is divided into eight steps: step 1: initial stress analysis; Step 2:build underground diaphragm wall; Step 3: excavation + the first concrete support + set up T beam; Step 4: excavation + the second steel support; Step 5: excavation + the third steel support; Step 6: excavation + fourth steel support, Step 7: excavation + the fifth steel support, Step 8: excavation to the pit.

2. The results of analysis

(1)Underground diaphragm lateral analysis

The role of diaphragm walling mainly resistance lead to wall of foundation pit excavation unloading dorsal to the pit sliding soil, so as to ensure the safety of foundation pit excavation. After the excavation, the soil stress state changes, retaining wall becomes deformation. When foundation pit inside discharge the original earth pressure, the wall of the lateral bear active earth pressure, and the inside wall bear part of the passive earth pressure[7]. Figure 2 and figure 3 are two plans underground diaphragm wall of the lateral contours.

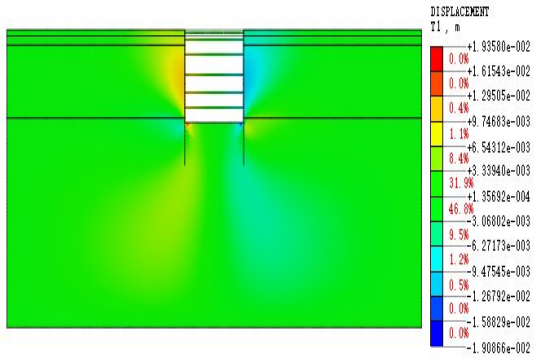

Figure 2. The original plan of underground diaphragm wall lateral contours

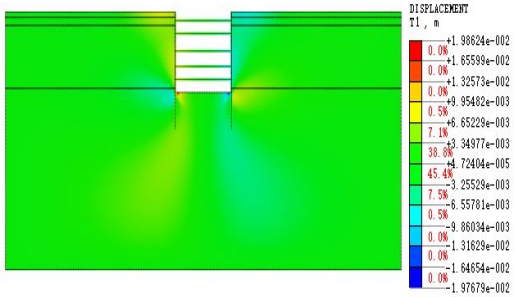

Figure 3. The changed plan of underground diaphragm wall lateral contours

Through the analysis of figure 2 and figure 3, the biggest underground diaphragm wall of the lateral occurring in the foundation pit of the middle and lower position, rather than the bottom of foundation pit, the site construction process, buried the embedded clinometers. Figure 4 shows the in-situ test to the lateral wall and numerical simulation of the amount of lateral analysis contrast, three curves have the same change trend, presents two small middle big "Pot-bellied form". The original plan of the maximum lateral is 11.21 mm, only 0.051% of the excavation depth, the changed plan maximum lateral is 10.04 mm, only 0.046% of the excavation depth, the measured maximum lateral is 10.77 mm, 0.049% of the excavation depth, which is far less than the rules and regulations. Advanced T-beam construction the lateral value decreases, indicating that the excavation process, T-beam construction have an inhibition on foundation pit lateral.

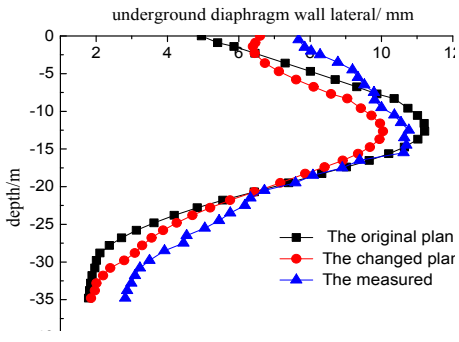

Figure 4. The lateral curve of underground diaphragm wall

Figure 5 shows the different time in the cross section of the K6 + 251.787 standard the lateral curve of underground diaphragm wall, monitoring and measuring time for the first time after 30 days of the construction. When construction to 105 days reached the maximum value of the lateral, the maximum value of 10.91 mm, lateral occurred in the location of the foundation pit depth of 12 meters; Before the excavation to the bottom, the lateral curve increases with the increase of excavation depth, maximum when excavation to the pit, and the lateral curve are present two small middle big "Pot-bellied form", then began to do the floor and in the process of medium plate, lateral became reducing .

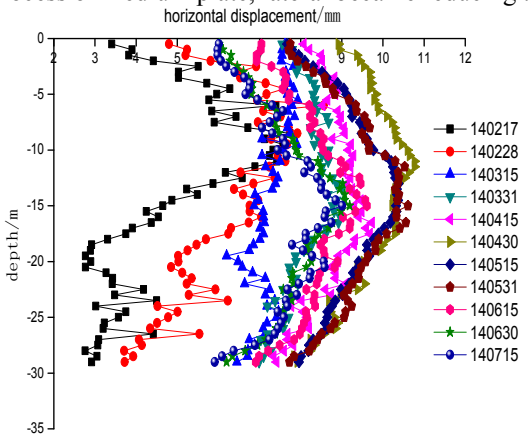

Figure 5. The measured later curve of underground diaphragm wall

(2)The surface subsidence analysis

Excavation process, the forces make the underground diaphragm wall deformation, the soil foundation pit periphery of the original stress state change which caused by the ground movement and ground subsidence. Monitoring on the surrounding surface subsidence, ensure the safety of the buildings and structures, is essential to the construction and content. The calculation of the selected section, every 5 meters set up a surface subsidence monitoring, at the same time in the construction of on-site monitoring. Figure 5 is the surface settlement figure, it can be seen that different construction step impact on surface subsidence is different, but the cause of the settlement of roughly the same change trend, the maximum ground surface settlement is not produced in the vicinity of the pit wall, but the position of a certain distance from the pit wall. The original plan of ground subsidence is largest, which is 16.59 mm. And the changed plan is only 12.03 mm, the measured maximum ground surface settlement is 14.97 mm. All are smaller than warning value 30 mm of the earth's surface subsidence, to prove that the changed scheme is feasible. In soft soil area, according to the method of formation damage, to estimate the maximum ground settlement of foundation pit retaining structure is about 0.7 times the maximum lateral, in this project, retaining structure of the maximum lateral is 10.77 mm, and maximum ground settlement value is 14.97 mm, this have larger gap of soft soil area, experience in soft soil area is not suitable for the soil of Hefei.

TABLE 2
THE EVENTUALLY SUPPORT AXIAL FORCES OF TWO DIFFERENT CONSTRUCTION METHOD

Construction method	The first concrete support	The second steel support	The third steel support	The forth steel support
Original method（kN）	90.61	323.623	269.131	214.034
Changed method（kN）	53．25	260.79	285.619	218.94

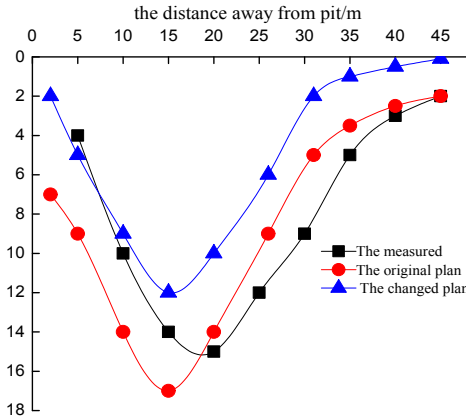

Figure 6 The surface subsidence figure

(3)The strut axial forces analysis

Supporting axial force is an important part of the foundation pit monitoring, it is verifying the rationality of foundation pit design, and the important basis of safe construction, numerical simulation analysis was carried out on the strut axial forces can avoid strut axial forces over design strength to support to lead to the instability of the whole support system [8]. Figure 7 and figure 8 are scheme supporting axial force cloud of two options:

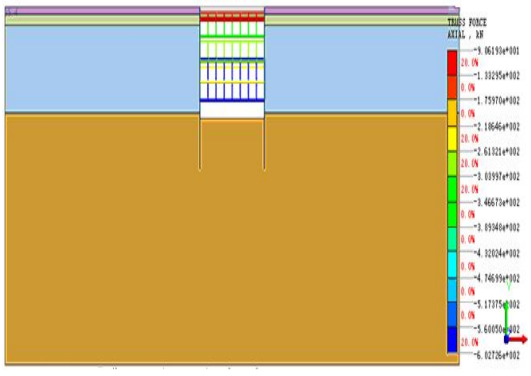

Figure 7. The original scheme supporting axial force cloud

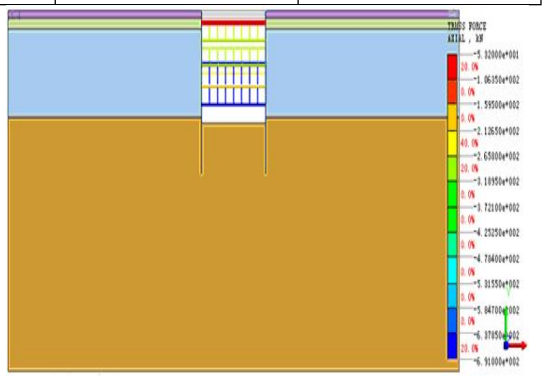

Figure 8 The changed scheme supporting axial force cloud

By the picture above you can see, two schemes of strut axial forces were similar, minimum axial force is produced in the first line of concrete support, and the maximum axial force is produced in the fifth steel support, the changed plan maximum axial force is 691.375 KN, which is larger than original plan of axial force, but less than the strut axial forces of design, and the middle three steel support axial force value difference is not big, change of plan in supporting axial force of the impact is not big.

IV. CONCLUSION

By comparison with the measured results and simulation results, and the value of maximum lateral wall occur in two-thirds of pit excavation depth, and presents two small middle big “pot-bellied form”trend. The maximum lateral value of changed plan is 10.44 mm, which is less than the original design scheme 11.21 mm.

The maximum ground surface settlement is not occurred around the pit wall, the results of numerical simulation of the maximum subsidence occurred near 15m away from the pit wall and the in-situ observation results of maximum subsidence occurred near 20m from the pit wall.

Two plans of minimum strut axial forces are generated in the first line of concrete support, and the largest strut axial forces are generated in the fifth steel support, and the simulation results of less than the design value of strut axial forces.

Through analyzing the simulation of two kinds of schemes and the results of actual construction, it can be concluded that change the plan is feasible, provide experience for the similar projects in the future.

ACKNOWLEDGMENTS

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