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# Embedded System Design for Environmental Prediction System for Under Ground Mines

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***Abstract:***

***This project tackles the problem of underground mine accidents which results in the death of several people per year. It is found out that the rate of fatality in the underground mines is nearly six times the rate for all private industry. And most of these accidents are due to toxic gases, fires and lack of rescue system.***

***By implementing a prediction system, which can move around unmanned in the mine and detect the level of different toxic gases and temperature level and report them live to the control room, this level of fatality can be considerable reduced. The objective of this project is to accomplish this task.***

***From a technical aspect this project is software and hardware oriented project. It requires very specific types of sensors, and innovative methods in transmitting and receiving data. Because a conventional approach will not do much good from an industrial aspect.***

***The project can be considered valid if it can detect different sorts of gases, the temperature and give a warning to the miners inside the mine as well as give alarm at the control room outside the mine in case of a danger.***

## 1. Introduction

It's more and more urgent that the efficient information of mine rescue because of Mining accidents happened frequently in recent years. Mine rescue command platform is a rescue system that consistent with efficient command. The mainly existing communication equipment is mine rescue calls, whose information is limited and can't fully accurate reflect the reality of the scene which result in poor rescue command.

Therefore, it's very necessary to research and develop a mine rescue command platform that meeting the needs of mine rescue. The mine rescue command platform can transfer the video and audio information from the mine rescue scene to the rescue command center instantaneously and accurately, and support three parties that the mine rescue scene, the underground base and the rescue command center call instantaneously and instantaneously reflect the environment parameter information of the mine rescue scene. Mine rescue command platform play an important role on the rescue command center decisively command, enhancing decision ability of mine rescue, improving national mine rescue ability and disaster research and accident responsibility. [l]

## 2. Software Requirement Analysis

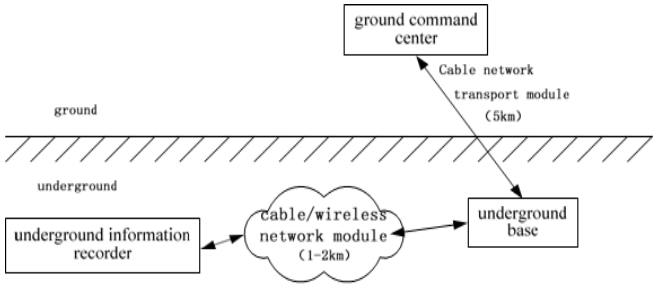


Figure l. Mine rescue command platform overall architecture

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Underground information recorder: Underground signal acquisition side, it's mainly complete acquisition of various signals in underground scene, including video signal and environment information parameters. The recorder is still completing the video signal compression, display, transmission and storage.
Underground base: The middle of the device connect underground information recorder and rescue command center.
Ground command center: The command center of mine rescue command platform, it's in charge of directing rescue operations, material and manpower scheduling. It plays a decision-making role on rescue command.
Three party of mine rescue command platform mainly implement functions as follows:
(l) Three party call in real time;

(2)Ground command center and underground base can decode and display the video and audio signal transferred in real time, and display environmental parameters;

(3)Alarm function;

(4)The video screen of ground command center should be able to display related information, such as video frames and specific time;

(5)The three party software screen of mine rescue command platform should display related information in real time, such as user online status, and the software system configurations, such as volume control;

(6)All the stored information on ground command center can playback synchronously. [3]

## 3. Software Architecture

### Software Functional Architecture.

Based on the above analysis of demands, the terminal software architecture of mine rescue command platform is divided into several main functional modules. Functional structure diagram is as shown in Figure 2:

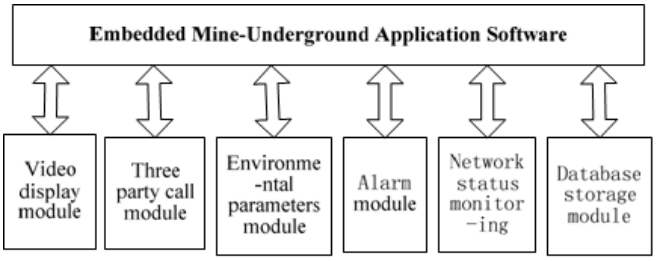


Figure 2. Software functionality structure chart

### The Module Function.

### Video display module.

In addition to displaying live video, it also shows the real time, including date and clock time, video window zoom and also implements video forwarding. Showing time has to use the timer, and through the SetTimer (l, lOOO, NULL) to set the timer to display time.

### Three party call display module.

Displaying three party contacts, including mine rescue team, Underground base and ground command center, as well as their online status. Displaying call objects and time, when calling. It can also adjust the volume size and other functions. We set two icons to indicate their online status. OnPaint () function uses Image interface object to display icon. It adjusts the volume size through the waveOutSetVolume (handleX, volume) function.

### Environmental parameters display module.

Environmental parameters are drawn by real time curve, which accomplish sensor data intuitive graphic display in real time. It's easier for users to view data and timely report dangerous information about underground.

WinCE provides powerful graphics device interface (GDI). The CDC class device context class is used in this design. It uses the SelectObject method in GDI elected to GDI drawing tool brush (CPen) to draw. The x- axis of curve window displays real time when the y-

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axis shows the real-time values of environmental parameters.

### Alarm module.

It includes environmental parameters concentration outlimit alarm, network failures alarm, equipment failure alarm. Alarm is divided into different levels. The form is alarm sound or flash. It's very humane of the settings of alarm module to take timely measures to avoid personal injury occurred.

### Network status monitoring.

It can monitor network connection status by real time, and check whether or not indicating the check box to show that the network is connected or disconnected.

### Database storage module.

When you try to communicate, In order to achieve sensor data storage by real time, system joined the operations on the database at design when communication. It stores all the collected data from site information recorder.

## 4. Software Design

### Development environment.

The software development environment is VS2005 and uses C\C++ language to develop. The embedded operating system is WinCE 6.0.

Visual Studio 2005 supports application development of Microsoft.Net Framework version 2 and integrates with all development environment languages of Microsoft. All languages uses the same set of tools and develop in the same development environment, and improve a variety of tools that environment contains. It integrates with the Platform Builder software, which is convenient for system customization.

We create WinCE project to custom system software of underground information recorder and underground base when we develop platform software and application software. We export customized SDK on account of mine rescue command platform and start to develop application program in VS2005 after installing it. [5]

### Software Design Process.

This design uses a multithreaded to implement the software modules. It includes the main program; receive thread (receiving video and audio data and environmental parameters), the display thread and judge alarm thread.

### The software works as follows:

l) The main program executes first. It configures the communication module after system initialization. It includes network communication part and serial communication part. Serial communication part open serial port of sending commands firstly to establish communication with data acquisition front-end. Then create three threads to respectively receive storage data, display data and judge alarming. Main program exits after the end of three threads.

2) Receive thread mainly receive audio and video data and serial data of environmental parameters from the network and store data. It closes the serial port and other equipment and exit the thread when finished.

3) Display thread will display the data received on the LCD. One of the data from underground information recorder collected by camera directly display on the LCD screen, the other is coding and then send over the network; Underground base discoed the video data transmitted through the network to display on the LCD screen. Video display section uses DirectShow technology, including camera capturing video and decoding to show. We use H.264 codec in this design. [5]

4) Judgment alarm thread compares the data received with alarm threshold. It use MoveTo, LineTo function to draw a line of alarming. The color of curve will turn red and start the buzzer if out the limit. Then waiting for the alarm purge and determine whether exit or not. [6]

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**The flowchart in Figure 3 below shows:**

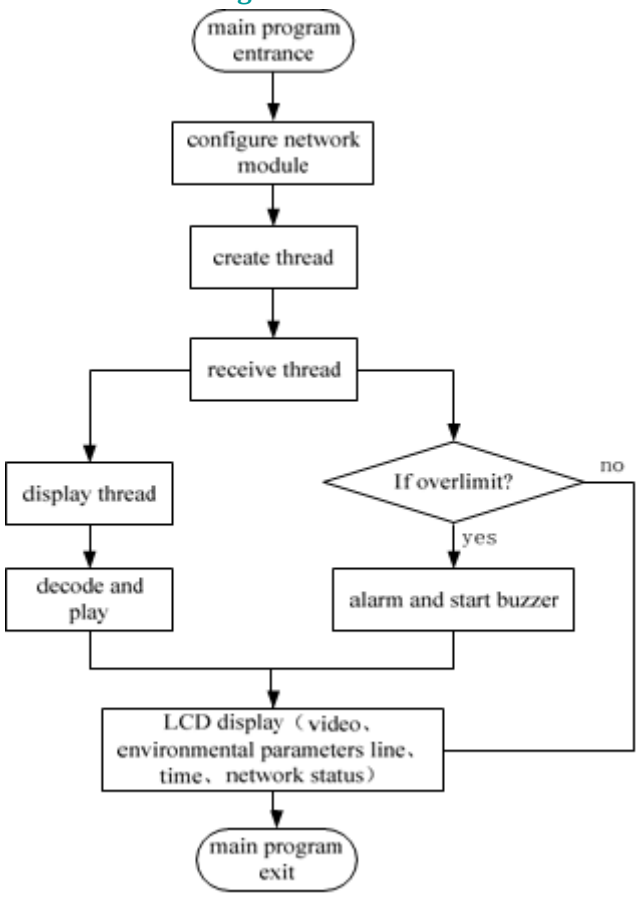


Figure 3. Software flowchart

## 5. Conclusions

The underground embedded application software of rescue communication system has been nearly completed and is in debug optimization phase. At present, the test result shows that it has implemented video display, environmental parameters display, alarm display, network status monitoring, volume adjustment, time display and other functions. Command center can know underground rescue situations in real-time. I believe that it can bring great convenience in the course of mine rescue and improve rescue efficiency. Although it is designed for mine rescue applications, it also applies to other rescue.

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