

RESEARCH AND APPLICATION OF WIRELESS NETWORK EQUIPMENT IN COAL MINE GAS MONITORING SYSTEM

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ABSTRACT

This paper presents a research which based on the protocol.802.11, which is a universal standard put forward for each manufacturer. The advance of this proposal not only guaranteed the data exchange of Wireless network of different manufacturer but also provided guarantee on the application in various area. Especially in recent years, home use wireless network provided chance of application in various areas of devices which are based on 802.11 protocols. This paper discussed the real time transfer technology of dangerous gas content which based on 802.11 protocols and the composition and method of well wireless network monitoring under the background of safety process for coal mine production. In the end, this paper proposed a solution of multi-functional monitoring system which composed of voice, image and data by using 802.11 protocols.

Keywords: 802.11 Protocol, Monitoring System, WIFI.

1. INTRODUCTION

Currently, as the improvement of coal output of coal mining enterprises, the accidents of coal mining are increasing constantly. So, it is meaningful to establish a dependable timely accurate monitoring system for the workers of coal mining enterprises.

As wireless sensor network are developing rapidly in recent years, more and more applications based on Wireless network technology come into our daily lives. For example, the applications in medical monitoring, environment monitoring, military affairs and etc. furthermore, in 1997, IEEE formulated the first standard for wireless local network, short for WLAN, ---IEEE 802.11. In 1999, IEEE group proposed standards of 802.11b [1] and 802.11a [2] separately. In July of 2003, standard 802.11g has been approved by IEEE

group, which is based on 802.11b, and its speed can reach 54Mbit/s. In September of 2009, standard 802.11n was passed by IEEE group. The speed of 802.11n was improved by 300Mbps to 600Mbps compared with 54Mbit/s of 802.11a [3]. Intelligence antenna technology was also used in 802.11n [4], and its coverage may extend to several million square kilometers. Wireless network technology has a widely use in mobility.

The coal mine gas monitoring system is a basic requirement of coal production. The coals mine gas monitoring mainly contains methane, carbon monoxide and oxygen monitoring. Methane is the primary dangerous gas of the three, so it should be key monitoring object Dispatching room should take care of the areas where is dangerous. Methane sensor or other gas sensors need to be established so that we can take action in time to control harmful gas saturation once the saturation is out of limit, in



order to avoid the life or property losses. In this paper, we mainly make a research on how to transfer the data of the gas saturation in time.

The reminder part of this paper are as follows: The second part introduced the application of the gas monitoring system [5,8], the real-time data system of gas monitoring, the research of wireless monitoring system, the research of workers locating based on MAC address [6]. This part proposes the coal mine gas monitoring system based on fiber Ethernet and wireless LAN [7]. The third part researched how to choose the wireless devices. Network schemes and the equipment [9, 10, 11] chosen are also proposed in this part. Finally, the conclusion is given to describe the development direction of coal mining systems and further research method.

2. THE MONITORING SYSTEM

2.1 Wireless Voice Protocol

SIP (Session Initiation Protocol) [2] is a kind of Session layer protocol which can reduce the time delay for applications development. Wireless communication system has been designed based on this VoIP (Voice over Internet Protocol).

There are four components of SIP: they are SIP User Agents, SIP registrar, SIP proxy servers and SIP redirect server. SIP user agent could be divided into two parts, the user end caller and the user response. When user "A" calls another user "B", the procedures are as follows:

(1) "A" send message to SIP proxy server, which proxy server used to contact to user "B" according to the message;

(2) SIP proxy server requires SIP registrar server provides the IP address of user "B", it will forward the invitation message which user "A" communicates with user "B" and ready for communication as soon as SIP proxy server get the user's IP address;

(3) SIP proxy server convey this message to user "B", thus, SIP session is established.

2.2 Gas Data Real-Time Monitoring

System can control the throttle amount of state, hairdryer state, local fans of the open stop, major fan of open stop through monitoring centration of methane, carbon monoxide, carbon dioxide, oxygen, and hydrogen sulfide and etc. It has methane gauge alarm by sound and light, if the amount of the methane is out of the range, the power will be off automatically, methane's wind power will also be locked, and the same as other control functions. Coal mining gas monitoring system was composed of three parts:

(1) Gas detection part: the main function of this part is detecting the air quality of the coal mining system; its method is transforming physical quantity into electrical signal to meet sub-station. The sensor itself must be able to sensor the voice and light alarm.

(2) Data transmission part: Its main function is to send the electrical signals of underground's monitor to the receiver of ground via RS485 or Ethernet port, for example, on the ground switch, or voice conversion boxes, and etc.

(3) Data processing and display section: Its main function is to display and alarm handling information underground. Then show the real-time information and process the information. For example: control main or sub blower fan ON-OFF or stop, etc.

2.3 Wireless Video Systems

Video surveillance system is applicable to life and production in many aspects, which is primarily used in the long-term monitoring the region and the incident for processing. This video surveillance system mainly includes cameras, video processor and the monitor.



In the coal mining surveillance system, wireless monitoring system has better flexibility and reduces the expense of cable compared with cable monitoring system because its monitor point is not restricted to the geographical position. What's more, the convenience of wireless makes wireless surveillance system easier to maintain and upgrade.

2.4 People Tracking System

The staff and positioning system is an important component of a coal production safety monitoring system, which can get hold of the flow information of the staff and traffic. Once an accident happened, it can obtain the accident ready-made personnel quantity and geographic location in the shortest possible time to cooperate with other coal mine monitoring system in order to improve the efficiency. Personnel and positioning system can be real understanding of the underground dynamic, it also has some special job to track and improve management standards by keeping in touch with the equipment at the same time of ensuring staff of the register.

WIFI location system is based on IEEE 802.11b/, it is the same as family wireless networks we use. It sends its own MAC address to the wireless station. Then, the data is sent to the ground by the switcher.

3. THE DESIGN AND IMPLEMENT OF WIRELESS MONITORING SYSTEM

The multi-functional monitoring system is an integration of wireless communication system, gas monitoring system and people tracking system, which based on fiber ring network platform.

3.1 Fiber Ring Network Platform

This system uses the ZoneDirector 1012 series program which is proposed by RUCKUS Wireless^[4]. Wireless network can cover the areas by connecting ZoneDirector 1012 and ZoneFle

x 2942. It has the following functional characteristics.

(1) Intelligence Wi-Fi antenna-array technology which is known as BeamFlex. It can provide a broader coverage which aims to implement a more reliable Wi-Fi access^[5]

(2) Intelligent mesh network. It can reduce the cost for laying Ethernet cable in the areas if necessary.

(3) Security. We can easily encrypt the devices by sharing the secret key from 802.1x.

(4) The best signal path selection, interference avoiding and the management of radio frequencies.

(5) High-performance 802.11n access point. Within the scope of coverage it can give service to 802.11n and 802.11a/b/g client continuous.

(6) The set spend only few minutes, and the installation process need only several hours.

(7) Intelligence Wi-Fi access point can work whether the WLAN controller is installed or not.

(8) The controller is deployed outside WLAN client, and it just manage flow.

(9) Intelligence Wi-Fi interface deals with all the control of flow include data flow and deals with various requests/ response.

3.2 VOIP Wireless Communication Systems

Wireless communication systems use MDS80 IP-PBX host of ZED-3 as primary telephone switching equipment, and access it to the Internet switchers. The host set the same network segment as RUCKUS Wireless Zone director1012 in order to manage wireless or telephone network terminal. The structure of the RUCKUS is shown as figure 1.

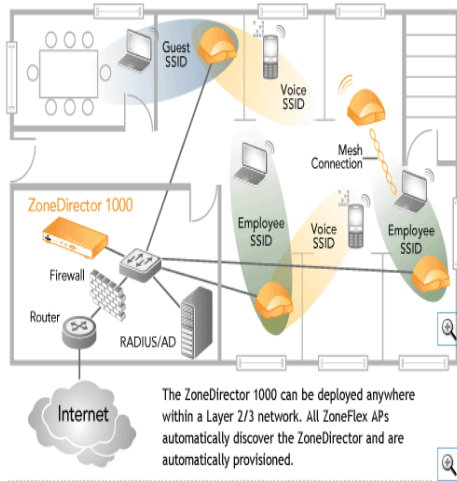


Figure 1 RUCKUS Wireless

3.3 Gas Monitoring System

This system mainly monitors the concentration of harmful gases by various sensors such as temperature sensors, methane sensor, carbon monoxide sensors, etc. Monitoring host can do related operations according to the gas concentration. For example, the wind power will be shut down automatically when methane reaches a certain concentration.

(1) Use the gas sensor MZ2002 that produced by Hongtai electronic company. It is composed of high stability, catalytic sensing original, 1% methane guard concentration, working voltage is 3.5~5.5V, working current is less than 100mA.

When the methane is out of limit, the protocol designed in advance will alarm.

(2) Use temperature sensor SHT11 produced by Fumeisi Electronic technology ltd in Shanghai. It is composed of standard output temperature sensors. The sensor includes a humidity sensors and a temperature sensitive original.

(3) Use carbon monoxide sensors MQ-7 produced by Fumeisi Electronic technology ltd in Shanghai. It has high-precision for carbon monoxide monitoring.

(4) The information collected in the above step will be transmission by VoIP wireless communication protocols, the structure of the VoIP communications are shown as figure 2.

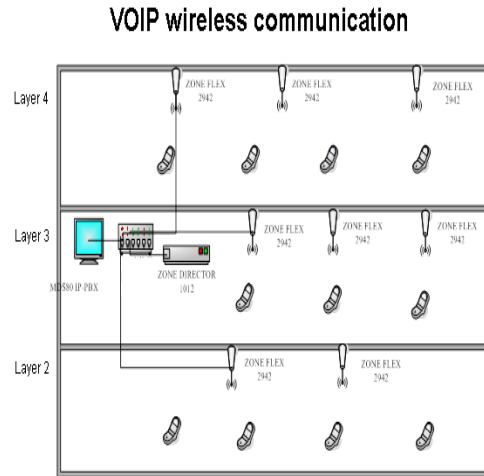


Figure 2 Voip Wireless Communications

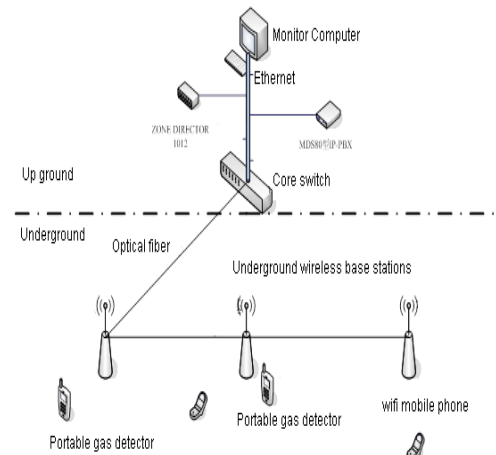


Figure 3 Wifi Gas Monitoring System

The voice image and other information will be transmission by WIFI protocol, and the position of the staffs can be located by WIFI system, too. The WIFI gas monitoring system is shown as figure 3.

3.4 The Implement Of People Tracking System

The system uses indoor AP of 2942 system produced by RUCKUS for the wireless base station, the wireless base station underground need to cover the targeted area of all personnel underground, for example: working surface, parking lots underground,



water storage and refuge chamber, etc. Through the mine fiber-optic Ethernet ring, the identification card information underground and it will be transmitted to the ground.

Identification Card send the MAC address information carried by itself to the wireless base station through WIFI protocol. The base stations transform the electrical signals into optical signals, and send it to the ground switchers through cables. Then the MAC address is send to the computer through Ethernet, and handled by the software that installed in the computer. For example, the location software installed by Changchun Dongmei can sort the data of persons or vehicles carrying identification cards (TAG) out. The monitor can display the location, residence time, action track of the identification Card. This monitoring information will be analyzed and stored by the data system.

4. CONCLUSION

This paper presented a research which based on the 802.11 protocol; we have joined up a resolution of multi-functional monitoring system which composed of voice, image and data by using 802.11 protocols. We have introduced the application of the gas monitoring system, the real-time data system of gas monitoring, and the research of wireless monitoring system.

REFERENCES:

- [1].[http://www.ieee802.org/11/IEEE standards](http://www.ieee802.org/11/IEEE_standards) Amendments, and Recommended.
- [2].http://en.wikipedia.org/wiki/Session_Initiation_Protocol IETF all right received.
- [3].Ti.com - Texas Instruments, Application Report, SLLA070D-June 2002-Revised May 2010, RS-422 and RS-485 Standards Overview and System Configurations.
- [4].<http://www.ruckuswireless.com/zonedirector/> RUCKUSWIRELESS all right received.
- [5].<http://www.ruckuswireless.com/AP/> RUCKUSWIRELESS all right received.
- [6].Guo Dongwei, Jia Chenhui. "A WSN routing algorithm using overpayment on complex network".5th International Conference on Intelligent Computation Technology and Automation, pp.324-333, 2012.
- [7].Sun Hongyu, Fang Zhiyi, Wang Tianyang, Ma Yongbo, RenNaiji. "CDHL: A hybrid range-free localization algorithm in wireless sensor networks". Proceedings - 5th International Conference onFrontier of Computer Science and Technology, pp180-183, 2010. [3] Fang Zhiyi, Liu Zhuang, Ma Yongbo, Sun Hongyu, RenNaiji. "Anew coordinate correction localization theory and its implementation mechanism in wireless sensor networks". Journal of Information and Computational Science, Vol.8, No.1, pp.23-28, 2011.
- [8].Lu Hong, Jing Yang. "An Energy-Balance Multipath Routing based on Rumor Routing for Wireless Sensor Networks" .Fifth International Conference on Natural Computation,pp. 87-91,2009.
- [9].Xiao-Bing Hun, Mark S. Leeson, Evor L. Hines. "An effective genetic algorithm for network coding". ELSEVIER, pp.952-963, 2012.
- [10].Lei, Yang, Shang, FengJun, Long, Zhaohua , Ren Yunsen. "An energy efficient multiple-hop routing protocol for wireless sensor networks". Proceedings - The 1st International Conference on Intelligent Networks and Intelligent Systems, pp.147-150, 2008.
- [11].Yang, Y., Zhong, C., Sun, Y., Yang, J. "Network coding based reliable disjoint and braided multipath routing for sensor networks". Journal of Network and Computer Applications, Vol.33, pp. 422-432, 2010.