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A SURVEY OF WIRELESS COMMUNICATION MODELING FOR UNDER GROUND MINING

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ABSTRACT: Mining and mineral exploration play important roles in the global economy. In mining operations, communication systems play vital roles in ensuring personnel safety, enhancing operational efficiency and process optimization. Over the period 1920-2012, this article surveys the evolution of wireless communications in underground mines, the developments of the underlying technology, and progress in understanding and modeling the underground wireless propagation channel. Current and future trends in technology, applications and propagation modeling are also identified. About ninety relevant references have been reviewed that consider: 1) the emergence of technology and applications, 2) analytical, numerical and measurement based propagation modeling techniques, and 3) implications of the physical environment, antenna placement and radiationcharacteristics on wireless communication system design. Affected systems include narrowband, wideband/ultra-wideband(UWB) and multiple-antenna systems. The paper concludes by identifying open areas of research

Key words:
Temp sensor , Zigbee, Rfid, Motors, Ethernet, Pc

INTRODUCTION

The mining industry plays a vital role in the global economy. The current estimated market capitalization of global mining companies is about $962 billion. A large portion of these operations are underground and involve specialized equipment and processes. Communication systems play an increasingly important role in ensuring personnel safety and optimizing the mining process. The estimated size of underground mining equipment market alone is currently about $45 billion [3], a small but important portion of which is allocated communications systems. Although interest in deploying wireless communication systems in underground mines dates back to the 1920's, the first wide deployment didn't take place until the early 1970's when the mining industry began to deploy very-high-frequency (VHF) radios and leaky feeder distribution systems [6]-[10].

The modern era of underground communications began in the early 2000's as the mining industry sought to take advantage of considerable advances in ultra-high-frequency (UHF) technology, especially cellular phones, wireless-local-area-network (WLAN), UWB and radio-frequency-identification (RFID). Although the mining industry is inherently conservative and reluctant to invest incostly new technologies, high profile accidents often prompted regulators to require that the mining (and mining communications) industry devote increasing attention to safety and safety communications. Recent interest in deploying next generation wireless communications technology in underground mines has stemmed from recent advances in short-range wireless communications technology and commercial-off-the shelf WLAN, wireless-personal-area-network (WPAN), UWB, RFID, radar devices, and (2) the potential to increase mine efficiency and productivity through more effective voice communications, better access to management information systems and automated dispatch.

In an underground mine, there are three possible mechanisms for communication signaling: through-the-earth(TTE) at extremely-low-frequency (ELF)/very-low-frequency(VLF)/low-frequency (LF) bands, through-the-wire (TTW) at medium-frequency (MF)/VHF/lower-UHF (e.g., leaky feeders) and through-the-air (TTA) at upper-UHF/super-high- frequency(SHF) . Each has been developed for different applications and each requires specified propagation channel modeling and design. Most of the recent wireless systems fall under the TTcategory and briefly considered.

I. The Hardware System

Micro controller: This section forms the control unit of the whole project. This section basically consists of a Microcontroller with its associated circuitry like Crystal with capacitors, Reset circuitry, Pull up resistors (if needed) and so on. The Microcontroller forms the heart of the project because it controls the devices being interfaced and communicates with the devices according to the program being written.

ARM7TDMI: ARM is the abbreviation of Advanced RISC Machines, it is the name of a class of processors, and is the name of a kind technology too. The RISC instruction set, and related decode mechanism are much simpler than those of Complex Instruction Set Computer (CISC) designs.

Liquid-crystal display (**LCD**) is a flat panel display, electronic visual display that uses the light modulation properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

I. Design of Proposed Hardware System

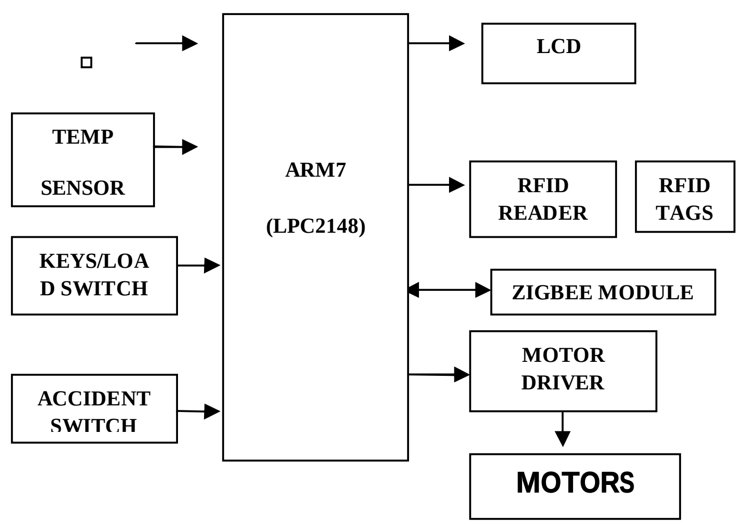

Fig.1.Block diagram

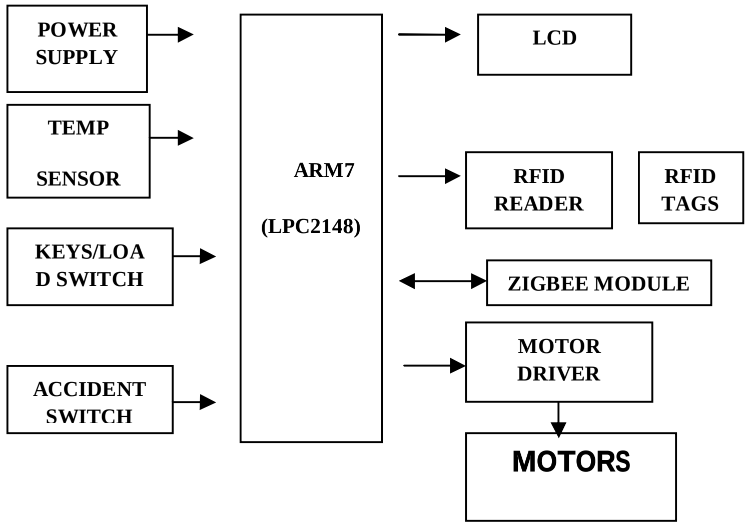

Fig.2.Block diagram

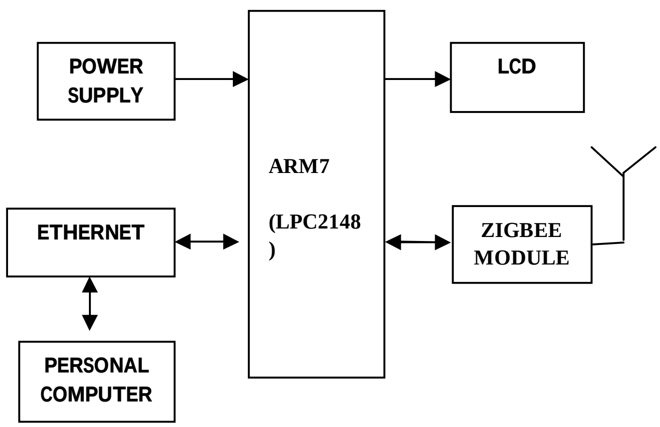

Fig.3.Block diagram

The information getting from the different route members were difficult. If any problem is occurred to them, knowing that problem and solving that problem very difficult. Then got loss of manual power and cost. These are the disadvantages of existed system. We can overcome above disadvantage by using our proposed system. It is having the different information of different route members by using the RFID readers and Tags. In one different route is having one robot i.e., vehicle that is having temperature and pressure sensor of the driver. By using these two sensors, we can know about the information about the persons in different route area in Underground Mines and vice-versa in other routes.

IV.Board Hardware Resources Features

Ethernet

Networking is playing vital role in current IT era where data distribution and access is critically important. As the use of communication between two or more entities increases the networking technologies need to be improved and refurbished over time. Similarly the transmission media, the heart of a network, has been changed with the time improving on the previous one. If you know a little bit about networking you surely have heard the term Ethernet which is currently the dominant network technology. Wide spread of the Ethernet technology made most of the offices, universities and buildings use the technology for establishment of local area networks (LANs).

To understand what actually Ethernet is, we need to know about IEEE first which is a short of Institute of Electrical and Electronics Engineers. IEEE is a part of International Organization for Standardization (ISO) whose standard IEEE 802.3 is defined for Local Area Network. The standard 802.3 commonly known as ETHERNT defines the communication standards for how data is transferred from one network device to another in a local area network. Since the limit for Ethernet cable is few hundred meters Ethernet is commonly deployed for networks lying in a single building to connect devices with close proximity. The same standard for Ethernet enables manufactures from around the earth to manufacture Ethernet products in accordance with the ISO standards that are feasible for all computing devices worldwide.

Zigbee

Zigbee modules feature a UART interface, which allows any microcontroller or microprocessor to immediately use the services of the Zigbee protocol. All a Zigbee hardware designer has to do in this ase is ensure that the host's serial port logic levels are compatible with the XBee's 2.8- to 3.4-V logic levels. The logic level conversion can be performed using either a standard RS-232 IC or logic level translators such as the 74LVTH125 when the host is directly connected to the XBee UART. The below table gives the pin description of transceiver. The X-Bee RF Modules interface to a host device through a logic-level asynchronous Serial port. Through its serial port, the module can communicate with any logic and voltage Compatible UART; or through a level translator to any serial device.

Data is presented to the X-Bee module through its DIN pin, and it must be in the asynchronous serial format, which consists of a start bit, 8 data bits, and a stop bit. Because the input data goes directly into the input of a UART within the X-Bee module, no bit inversions are necessary within the asynchronous serial data stream. All of the required timing and parity checking is automatically taken care of by the X-Bee's UART.

PC

Keyboards on an OEM basis to leading global PC manufacturers for use in desktop and notebook PCs and also supplies for retail keyboard OEMs.

Features:

- Internal Sourcing of almost all of main Parts

Almost all components - frame, key switches and membrane sheet - other than connecters and cord are manufactured in-house, giving Minebea an un-matched advantage in terms of quality, supply capabilities, cost-competitiveness and speed of delivery.

Especially, these products capitalize on Minebea's ultra-precision machining technology of components.

- Efficient Production System

Plant in China which supplys the global market employs the Minebea's vertically integrated manufacturing system, whereby all process, from machining components to final assembly are conducted in-house.

Rfid:

Many types of RFID exist, but at the highest level, we can divide RFID devices into two classes:active and passive.

Active tags require a power source i.e., they are either connected to a powered infrastructure or use energy stored

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in an integrated battery. In the latter case, a tag's lifetime is limited by the stored energy, balanced against the number of read operations the device must undergo. However, batteries make the cost, size, and lifetime of active tags impractical for the retail trade.

Passive RFID is of interest because the tags don't require batteries or maintenance. The tags also have an indefinite operational life and are small enough to fit into a practical adhesive label. A passive tag consists of three parts: an antenna, a semiconductor chip attached to the antenna and some form of encapsulation. The tag reader is responsible for powering and communicating with a tag. The tag antenna captures energy and transfers the tag's ID (the tag's chip coordinates this process). The encapsulation maintains the tag's integrity and protects the antenna and chip from environmental conditions or reagents.

Thermistor

A **thermistor** is a type of resistor whose resistance varies significantly with temperature, more so than in standard resistors. The word is a portmanteau of thermal and resistor. Thermistors are widely used as inrush current limiters, temperature sensors, self-resetting overcurrent protectors, and self-regulating heating elements.Thermistors differ from resistance temperature detectors (RTD) in that the material used in a thermistor is generally a ceramic or polymer, while RTDs use pure metals. The temperature response is also different; RTDs are useful over larger temperature ranges, while thermistors typically achieve a higher precision within a limited temperature range, typically −90 °C to 130 °C.

CONCLUSION

The need for wireless communication in the underground mining industry has evolved from basic emergency signaling, to person-to-person voice communication and to high speed real-time data transmission.

Accordingly, the supporting technologies have emerged from through-the-earth transmission, to radiating cables, to point-to-point and multi-point radios. Applications utilizing these technologies include voice communication, video surveillance, tele-operation of mining equipment (tele-mining), wireless sensors networks, geo-location and tracking of personnel and assets. To develop and evaluate these technologies appropriately, wireless propagation and channel models are essential. Measurement and theoretical approaches to channel modeling are increasingly seen as complementary; many channel modeling studies employ both methods. Analytical and numerical models based on waveguide theory, geometrical optical ray-tracing and other methods have been developed by many researchers.

While the single-mode waveguide model is simpler and requires fewer inputs about the physical environment, it is not very effective in predicting propagation for near-field and too short tunnels with complex geometries at higher frequencies. Ray-optical models on the other hand, provide more detailed prediction for higher frequencies and complex geometries at the price of requiring detailed information about the physical environment, and computational burden which increases significantly if the area under study is prolonged. A recent theoretical model, multimodewaveguide, offers more accurate and realistic model with reasonable runtime, which can also characterize small-scalefading statistics. The main advantage of this model is theability to accurately characterize both the near-zone and farzone of the tunnel.

REFERENCES

[1] "Mining." [Online]. Available: http://en.wikipedia.org/wiki/Mining

[2] "Mine 2010: Back to the boom," Price Waterhouse Coopers, 2010.

[3] "World mining equipment: Industry forecasts for 2013 and 2018,"Freedonia Group, 2009.

[4] D. G. Large, L. Ball, and A. J. Farstad, "Radio transmission to and from underground coal mines-Theory and experiment," IEEE Trans. Commun., vol. 21, pp. 194–202, 1973.

[5] R. S. Nutter and M. D. Aldridge, "Status of mine monitoring and communications,"IEEE Trans. Ind. Appl., vol. 24, pp. 820–826, 1988.

[6] P. Delogne, "The INIEX mine communications systems," in Proc.Radio: Roads Tunnels Mines, Apr. 1974, pp. 129–136.

[7] J. Murphy and H. E. Parkinson, "Underground mine communications,"in Proc. IEEE, Jan. 1978, pp. 26–50.

[8] D. J. R. Martin and R. Webster, “The use of radio in British coal mines,”in Proc. Radio: Road Tunnels Mines, Apr. 1974, pp. 110–128.

[9] D. J. R. Martin, “Leaky-feeder radio communication: A historical review,” in Proc. IEEE VTC, May 1984, pp. 25–30.

[10] P. Delogne, “EM propagation in tunnels,” IEEE Trans. Antennas Propag., vol. 39, pp. 401–406, 1991.

[11] “Underground coal mining disasters andfatalities-U.S. 1900-2006.” [Online]. Available: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5751a3.htm

[12] L. K. Bandyopadhyay, S. K. Chaulya, P. K. Mishra, and A. Choure,“Wireless information and safety system for underground mines,” inProc. URSI, Aug 2008, pp. 9–16.

[13] K. Srinivasan, M. Ndoh, and K. Kaluri, “Advanced wireless networksfor underground mine communications,” inProc. IEEE ICWCUCA, Jun.2005, pp. 51–54.

[14] W. H. Schiffbauer and J. F. Brune, “Coal mine communications,”American Longwall Mag., 2006.

[15] P. Laliberte, “Summary study of underground communicationstechnologies-Final project report,” CANMET, 2009.

[16] “OMSHR.” [Online]. Available:http://www.cdc.gov/niosh/mining/works/publicationlist.html

[17] S. Yarkan, S. Guzelgoz, H. Arslan, and R. Murphy, “Underground mine communications: A survey,”IEEE Commun. Surv. Tutorials, vol. 11, pp.125–142, 2009.

[18] T. Sarkar, Z. Ji, K. Kim, A. Medouri, and M. Salazar-Palma, “A survey of various propagation models for mobile communication,”IEEE Trans.Antennas Propag., vol. 45, pp. 51–82, 2003.

[19] D. G. Michelson and S. S. Ghassemzadeh, “Measurement and modeling of wireless channels,” inNew Directions in Wireless CommunicationsResearch,, V. Tarokh, Ed. Springer, 2009, ch. 1, pp. 1–27.

[20] W. Pittman and R. Church, “Through-the-earth electromagnetic trapped miner location systems: A review,”Bureau of Mines, 1985.

[21] D. Hill and J. Wait, “Theoretical noise and propagation models for through-the-earth communication,” U.S. Bureau Mines, 1982.

[22] J. Durkin, “Apparent earth conductivity over coal mines as estimated from through-the-earth electromagnetic transmission tests,”U.S. Bureauof Mines, 1984.

[23] T. D. Barkand, N. W. Damiano, and W. A. Shumaker, “Through-theearth, two-way, mine emergency, voice communication systems,” inProc. IAS, Oct. 2006, pp. 955–958.

[24] C. J. Bise, R. Ferriter, J. Joy, J. A. Lamonica, D. Lauriski, J. Main, J. N. Murphy, and W. York-Feirn, “Improving mine safety technology and training: Establishing U.S. global leadership,”Mine Safety Technol.Training Commission, pp. 2–4, 2006.

[25] “Mine site technologies.” [Online]. Available: http://www.minesite.com.au/applications

[26] M. Linard and P. Degauque, “Natural wave propagation in mine environments,”IEEE Trans. Antennas Propag., vol. 48, pp. 1326–1339,2000.

[27] A. Chehri, P. Fortier, and P. M. Tardif, “UWB-based sensor networks for localization in mining environments,”Elsevier Ad Hoc Netw.,vol.7,pp. 987–1000, 2009.

[28] D. Frielos, “Xstrata mines RFID´ sbenefits,” RFID J., 2007.

[29] “Becker Varis.” [Online]. Available: http://www.varismine.com

[30] D. A. Hill, Radio Wave Propagation Ground Effects, V. Tarokh, Ed.Wiley, 2005.

[31] A. C. Tripp, R. McNearny, and C. Furse, “Prof. James R. Wait and mining production technology-An appreciation,”IEEE Trans. Antennas Propag., vol. 48, pp. 1438–1441, 2000.

[32] S. F. Mahmoud, “On the attenuation of monofilar and bifilar modes inmine tunnels,”IEEE Trans. Microw. Theory Techn., vol. 22, pp. 845–847, 1974.

[33] S. F. Mahmoud and J. R. Wait, “Theory of wave propagation along a thin wire inside a rectangular waveguide,”Radio Sci., vol. 9, pp. 417–420,1974.

[34] D. T. Updyke, W. C. Muhler, and H. C. Turnage, “An evaluation of leaky feeder communication in underground mines,”U. S. Dept. Interior,Bureau of Mines, 1980.

[35] A. G. Emslie, R. L. Lagace, and P. F. Strong, “Theory of the propagation of UHF radio waves in coal mine tunnels,” IEEE Trans. Antennas Propag., vol. 23, pp. 192–205, 1975.

[36] E. A. J. Marcatili and R. A. Schmeltzer, “Hollow metallic and dielectric wave-guides for long distance optical transmission and lasers,”Bell Syst.Tech. J., vol. 43, pp. 1783–1809, 1964.

[37] J. I. Glaser, “Attenuation and guidance of modes on hollow dielectric waveguides,”IEEE Trans. Microw. Theory Techn., vol. 17, pp. 173–174,1969.

[38] G. Emslie, R. L. Lagace, and P. F. Strong, “Theory of the propagation of UHF radio waves in coal mine tunnels,” inProc. Mines Golden Colo.,Aug. 1973.

[39] C. Nerguizian, C. Despins, S. Affes, and M. Djadel, “Radio-channel characterization of an underground mine at 2.4 GHz,” IEEE Trans.Wireless Commun., vol. 4, pp. 2441–2453, 2005.

[40] S. R. Saunders and A. Aragon-Zavala, Antennas and Propagation for WirelessCommunication Systems. Chichester, England: Wiley, 2007.