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Intelligent Control for Detection of Hazardous Event in Mining Industry Through Helmet

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***Abstract:* -- A smart helmet has been developed that is able to detect of hazardous events in the mines industry. In the development of helmet, we have considered the three main types of hazard such as air quality, helmet removal, and collision The first is the concentration level of the hazardous gases such as CO, SO2, NO2, and particulate matter. The second hazardous event was classified as a miner removing the mining helmet off their head. IR sensor was then used to successfully determine when the helmet is on the miner's head.**

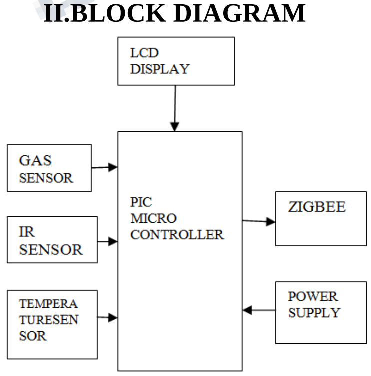
The third hazardous event is defined as an event where miners are struck by an object against the head with a force. An accelerometer was used to measure the acceleration of the head and the HIC was calculated in software. Tests were successfully done to calibrate the accelerometer. The experimental prototype consists of three sensors namely gas, infra red and proximity sensor for their usage and the sensor data are monitored in pc via zigbee transceiver unit.

***Keywords:* Air quality, safety, wireless sensor network and zigbee.**

I. INTRODUCTION

In earlier days, LED type helmets are extensively deployed in large and medium-sized coal mines because of their flexibility of light weight and low power. Meanwhile Zigbee based wireless sensor networks arerecently investigated due to their remoteenvironment monitoring capabilities. Such a network can easily collect sensor data and transmit by radio. By integrating these two advantages we design a new smart new helmet, which can be enable as a mobile node of Zigbee wireless sensor networks, gathering parameters from underground timely and quickly. Moreover miners can also exchange information from control centre through wireless communication. It is convenient for centralized management to build real time surveillance on environment parameters, so potential safety problems can be avoid by early warning intelligence.

II.BLOCK DIAGRAM



2.1GAS SENSOR

In current technology scenario, monitoring of gases produced is very important. From home appliances such as air conditioners to electric chimneys and safety systems at industries monitoring of gases is very crucial. Gas sensors spontaneously react to the gas present, thus keeping the system updated about any alterations thatoccur in the concentration of molecules at gaseous state. The gas sensor module consists of a steel exoskeleton under which a sensingelement is housed. This sensing element issubjected to current through connecting leads. Thiscurrent isknownas heating current through it, the gases coming close to the sensing element get ionized and are absorbed by the sensing element. This changes the resistance of the sensing element which alters the value of the current going out of it. The connecting leads of the sensor are thick so that sensor can be connected firmly to the circuit and sufficient amount of heat gets conducted to the inside part. They are casted from copper and have tin plating over them.

2.2 Infrared Object Detection Sensor

The parts used are typically the same parts found in most consumer electronic remote controls, and are widely available. If you have an old TV or other IR remote device, you have the makings of a nice IR detection system.IR Sensors work by using a specific light sensor to detect a select light wavelength in the Infra-Red (IR) spectrum. By using an LED which produces light at the same wavelength as what the sensor is looking for, you can look at the intensity of the received light. When an object is close to the sensor, the light from the LED bounces off the object and into the light sensor. This results in a large jump in the intensity, which we already know can be detected using a threshold. Since the sensor works by looking for reflected light, it is possible to have a sensor that can return the value of the reflected light. This type of sensor can then be used to measure how "bright" the object is. This is useful for tasks like line tracking.

2.3 Temperature sensor

Temperature sensors include both analog and digital temperature sensor ICs. Both types are suitable for use in a wide range of applications, such as industrial, consumer, medical and computer market segments. The analog temperature sensors feature low power consumption and good linearity, and can operate over a temperature range as wide as -55 to +130 °C. The digital temperature sensors feature low power consumption, up to 12-bit resolution and can operate over a temperature range as wide as -55 to +125 °C.

2.4 LCD Display

LCD (liquid crystal display) is the technology used for displays in notebook and other smaller computers. Like light-emitting diodeand gas-plasma technologies, LCDs allow displays to be much thinner than cathode ray tube technology. LCDs consume much less power than LED and gas-display displays because they work on the principle of blocking light rather than emitting it.An LCD is made with either a passive matrix or an active matrix display display grid. The active matrix LCD is also known as a thin film transistor (TFT) display. The passive matrix LCD has a grid of conductors with pixels located at each intersection in the grid. A current is sent across two conductors on the grid to control the light for any pixel. An active matrix has a transistorlocated at each pixel intersection, requiring less current to control the luminance of a pixel. For this reason, the current in an active matrix display can be switched on and off more frequently, improving the screen refresh time.

2.5 Power Supply

Power supply is also called a *power supply unit* or *PSU*, the component that supplies power to a computer. Most personal computers can be plugged into standard electrical outlets. The power supply then pulls the required amount of electricity and converts the AC current to DC current. It also regulates the voltage to eliminate spikes and surges common in most electrical systems. Not all power supplies, however, do an adequate voltage-regulation job, so a computer is always susceptible to large voltage fluctuations. Power supplies are rated in terms of the number of watts they generate. The more powerful the computer, the more watts it can provide to components.

2.6 PIC Microcontroller

This powerful (200 nanosecond instruction execution) yet easy-to-program (only 35 single word instructions) CMOS FLASH-based 8-bit microcontroller packs Microchip's powerful PIC® architecture into an 40- or 44-pin package and is upwards compatible with the PIC16C5X, PIC12CXXX and PIC16C7X devices. The PIC16F877A features 256 bytes of EEPROM data memory, self programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital (A/D) converter, 2 capture/compare/PWM functions, the synchronous serial port can be configured as either 3-wire Serial Peripheral Interface (SPI™) or the 2-wire Inter-Integrated Circuit (I²C™) bus and a Universal Asynchronous Receiver Transmitter (USART). All of these features make it ideal for more advanced level A/D applications in automotive, industrial, appliances and consumer applications.

III.LITERATURE SURVEY

In recent years, harvesting technology has played an important role in the area of mine applications. The literature on mines technology is available but very limited. Nutter, et al. proposed a methodology for identifying safety hazards inherent in underground monitoring and control. They also designed potential safety hazard equipment. They developed methodologies based on analytical electronics and computer-based hardware/software systems. Kock, et al. developed the technology in terms of health, safety, and productivity for the South African coal mining industry. They also investigating the coal interface detection (CID), productivity, communication channels (infrared, power line, optical fibers, and radio) . Misra et al. presents a case study for mines. They reviewed on communication techniques such as through the wire (TTW), through the air (TTA), and through the earth (TTE) .

The survey of wireless propagation in tunnels and underground mines with a focus on current wireless channel modeling, technologies, and applications [11]. The Internet-of-Things, where all devices are smart and interconnected, are increasingly being used in more industrial applications [12], [15], and it is therefore also a principle that can make a difference in mining safety with smarter equipment. The literature alsoshows that despite some attractive solutions; very few have been implemented and testedin the real-world, identifying the existence of a gap between theory and real world application at scientifically accepted level. In this paper smart helmet in compliance with IEEE 21451 standards is presented. It has various advanced features such as fast response time low, portability, and low cost with precisely acceptable accuracy.

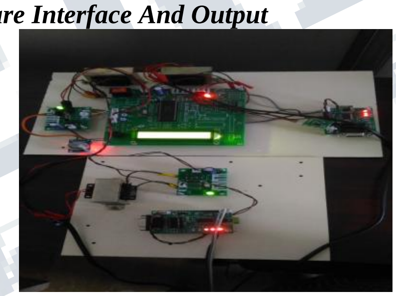
IV.PROPOSED SYSTEM

A smart mining helmet was developed that is able to detect three types of hazardous events such as danger level of hazardous gases, miner helmet removing, and collision or impact.In order to explain the entire system, the system is divided into six units. Helmet remove sensor, which is used to detect the miner, is wearing the safety helmet or not this is achieved through the IR sensors. Collision sensor, which is used to detect and identify whether any objects fall over the miner and this is achieved through accelerometer. Air quality sensor, which is used to detect Air pollutionfrom coal mines. It is mainly due to emissions of particulate matter and gasesinclude methane (CH4) and carbon monoxide (CO). Data processing unit the microcontroller which is used to get all the data from the above all sensor and concludeswhether need any intimation to wireless unit or the user wearing it. Wirelesstransmission and alerting unit is used to transfer the data obtained from theprocessing unit. It is achieved through Zigbee.

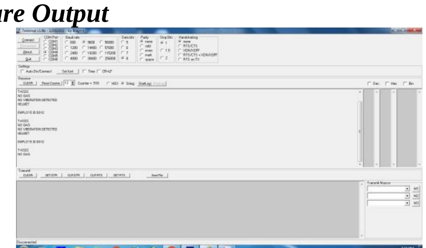
V. RESULTS AND DISCUSSIONS

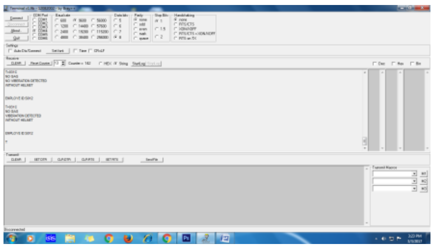
A smart mining helmet was developed that is able to detect three types of hazardous events such as danger level of hazardous gases, miner helmet removing, and collision or impact (miners are struck by an object). The hazardous events were classified as a miner removing the mining helmet off their head. An off-the-shelf IR sensor was then used to successfully determine when the helmet is on the miner's head. hazardous event is defined as an event where miners are struck by an object against the head with a force exceeding a value of 1000 on the HIC (Head Injury Criteria). An accelerometer was used to measure the acceleration of the head and the HIC was calculated in software. The layout of the visualisation software was completed. PCB's that were design included a breakout board and a prototype board. A whole software implementation was done in order to do the control of the measuring of sensors and of calculations done with the measured values. The system was extensively tested in order to determine whether or not the system works to the requirements. The distance might still want to be limited as it would be impractical to warn miners that are too far awayto find the miner who is experiencing a hazardous event. The processing speed of the system can be improved to allow for more accurate accelerometer measurement. The IR sensor can be improved to work within the helmet by not triggering because of reflections. Node hopping can be implemented to allow transmissions to the supervisor or even a central control station. This can be done by adding stationary nodes that are programmed to onlybounce any signal that is received. The system can be improved by adding more measuring devices to check the miner's blood pressure and heart rate. Gas concentrations can be measured as well. In future, it could also be considered if such modules can also be used for secondary services, such as localization of workers relative to each other .

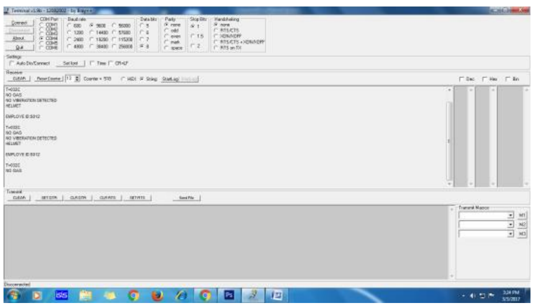
5.1 Hardware Interface And Output



5.2 Software Output







REFERENCE

[1] G.Sathya,Nikitha.S.Paulin,S.Saranya published journal on “Glass Climbing Robot for Glass wall cleaning” in International Educational Scientific Research Journal, vol.2, issue 12,ISSN:2455- 295X,December 2016.

[2] G.Sathya published journal on “Pick and place robot using accelerometer sensor”in InternationalJournal of Scientific Research in Science, Engineering and Technology,vol.2,issue 6,ISSN:2395-1990,November 2016.

[3] C. Qiang, S. Ji-ping, Z. Zhe and Z. Fan, “ZigBee Based Intelligent Helmet for Coal Miners,” *IEEE World Congress on Computer Scienceand Information Engineering (WRI 2009)*, 31 Mar. -2 April 2009, vol.3, pp. 433–435, 2009.

[4] H. Hongjiang and W. Shuangyou, “The application of ARM and ZigBee technology wireless networks in monitoring mine safety system,” *IEEE International Colloquium on Computing,Communication, Control, and Management (ISECS 2008)*, 3-4 Aug.2008, Guangzhou, pp. 430–433, 2008.

[5] X. Liu, J. S. Huang and Z. Chen, “The research of ranging with timing over packet network for the mine safety application,” *Journal ofNetworks*, vol. 7, no. 7, pp. 1054–1062, Jul. 2012.

[6] R. S. Nutter, “Hazard evaluation methodology for computer-controlled mine monitoring/control systems,” *IEEE Trans. on IndustryApplications*, vol. IA-19, no. 3, pp. 445-449, May/June 1983.

[7] R. S. Nutter, “A distributed microprocessor monitoring and control system for coal mines,” *in Proc. 4th WVU Conf. on Coal MineElectrotechnology*, Aug. 2-4, 1978

[8] R. S. Nutter and M. D. Aldridge, “Status of mine monitoring and communications,” *IEEE Trans. on Industry Applications*, vol. 24, no. 5, 820-826, Sep./Oct. 1998.

[8] A. D. Kock and J. W. Oberholzer, “The development and application of electronic technology to increase health, safety, and productivity in the South African coal mining industry,” *IEEE Trans. on IndustryApplications*, vol. 33, no. 1, pp. 100-105, Jan/Feb. 1997.

[9] P. Misra, S. Kanhere, D. Ostry and S. Jha, “Safety assurance and rescue communication systems in high-stress environments: a mining case study,” *IEEE Communications Magazine*, vol. 48, no. 4, pp. 66-73, April 2010.

[10] A. E. Forooshani, S. Bashir, D. G. Michelson and S. Noghanian, “A survey of wireless communications and propagation modelling in underground mines,” IEEE Communications Surveys and Tutorials, vol. 15, no. 4, pp. 1524-1545, Nov. 2013.

[11] C. P. Kruger and G. P. Hancke, “Implementing the Internet of Things vision in industrial wireless sensor networks,” *IEEE Int. Conf. onIndustrial Informatics*, pp. 627-632, July 2014.

[12] A. Kumar and G. P. Hancke, “Energy efficient environment monitoring system based on the IEEE 802.15.4 standard for low cost requirements”, *IEEE Sensors Journal*, vol. 14, no. 8, pp. 2557-2566, Aug. 2014.

[13] D. M. Han and J. H. Lim, “Smart home energy management system using IEEE 802.15.4 and ZigBee,” *IEEE Trans. on ConsumerElectronics*, vol. 56, no. 3, pp. 1403-1410, Aug. 2010.

[14] C. P. Kruger and G. P. Hancke, "Benchmarking Internet Of Things devices," *IEEE Int. Conf. on Industrial Informatics*, pp. 611-616, July 2014.

[15] K. Gill, S. H. Yang, F. Yao and X. Lu, "A ZigBee-based home automation system," *IEEE Trans. on Consumer Electronics*, vol. 55, no. 2, pp. 422-430, May 2009.

[16] J. Byun and S. Park, "Development of a self-adapting intelligent system for building energy-saving and context-aware smart services," *IEEE Trans. on Consumer Electronics*, vol. 57, no. 1, pp. 90-98, 2011.

[17] I. F. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci, "Wireless sensor networks: a survey," *Computer Networks*, vol. 38, pp. 393-422, 2002.

[18] V. C. Gungor and G. P. Hancke, *Industrial Wireless Sensor Networks:Applications, Protocols, and Standards*, Published by CRC Press,2013.

[19] ZigBee Alliance, "Zigbee wireless standards". www.didgi.com/ technology/rf-articles/wireless-zigbeeContiki os. Available: http://www.contiki-os.org

[20] B. Silva, A. Kumar and G. P. Hancke, "Experimental Link Quality Characterization of Wireless Sensor Networks for Underground Monitoring," *IEEE Trans. on Industrial Informatics*, vol. 11, no. 5, pp. 1099-1110, Oct. 2015.

[21] R. Fisher, L. Ledwaba, G. P. Hancke and C. Kruger. "Open Hardware: A Role to Play in Wireless Sensor Networks?," *Sensors*, vol.15, no. 3, pp.6818-6844, 2015

[22] AM Abu-Mahfouz and GP Hancke. "An efficient distributed localisation algorithm for wireless sensor networks: based on smart reference-selection method", *International Journal of Sensor Networks*, vol. 13, no. 2, pp. 94-111, May 2013