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Design of An Underground Mine Safety Using Embedded IOT And ThingSpeak

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Abstract: Underground workers of coal mines are prone to several hazardous conditions during their work. These may lead to serious injuries and at times loss of life. These incidents have direct and indirect effects on employees and employers. Accidents in underground mines can often have disastrous consequences. Risk assessment depends on efficiency of hazard identification and hence an innovative approach is required that focuses on these safety issues and the improvement in productivity and cost reduction in underground mines. This study presents a design that can effectively detect underwater using different sensors. Sensors are used to indicate Gas Side-scan LIDAR detection and Leakage detection which are then indicated with the help of LED, Buzzer, Playback device, Voice recording, and dial-up logic. These indicators suggest the proper functioning of the sensors. This study brings about a unique technique in which telephones will be used to monitor such sensors. The situation of the house can be known using any telephone. Mechanism being that, if any mishappening takes place at home, the sensor attached to the mobile will be switched on automatically and it will initiate the redial button of the telephone. The redialed number will then receive a voice message regarding the event. The IoT(Internet of Things) interface is used to fetch the real time data to the cloud for further analysis. Experimental results have shown to visualize the performance of the system which is dome by using ThingSpeak.

Keywords: Detection, Monitoring, Pre-recorded message, Volatile memory, Internet of Things(IoT), ThingSpeak.

1. INTRODUCTION

In recent decades, considering the safety of the workers in coal mines, the underground mining remains very challenging with safety and well-being status. It is mainly due to the diversified new techniques and novelty applied in that areas while extracting the minerals. The risks involved and the depth of the mine are directly proportional. In coal mines, the safety measures prevailed are still sparse. In order to address the issues mentioned above, novel safety techniques are in great demand when mining the coal and other minerals. Comparing with the pit mining, coal mining involved high risks due to the factors like

reduced ventilation and amount of potential deformations. In addition, due to the activities such as loading heavy machinery and measures taken during excavation pose to various types of risks in all stages of mining. But modern mines adopt safety techniques like well-expertise workers, safety legislations and laws, and other standards that results in considerable changes and enhancements in open and underground mining. It is a known fact that the coal is the primary resource of energy across the country which plays a major role in the industry and manufacturing areas. Coal is the main source of the energy production and its importance is always vital and indispensable. In some cases, the unpredictable byproduct generation may be a potential threat to the nation and mainly the person working in that areas. Hence, the proposed work is a valid attempt for analyzing the causes and potential threats when designing a real-time model for monitoring and detecting using the communication technologies. Also, the proposed system infers the high-availability due to its minimal cost and energy. Furthermore, the system is useful by sharing the current status of the machineries from the remote locations. Industrial safety is a major concern with the increase in temperature due to the global warming and hence all stakeholders needs to protect their resources against intrusions and natural hazards. The proposed system employs GSM technology and Dial-up where the workers can monitor the factory against the gas leaks and high temperature. Thus, the proposed system acts as the secured system for manufacturing sectors. Here, 8051 microcontroller plays a central part of the proposed system by controlling the input and the output. The main scope of the proposed system is two-folded. First, to actuate the leakage detection and to sense the gas leakage using Gas-side scan LIDAR. This sensing model are provided with real time data acquired from the sensors integrating with the interfaces to connect with the outer world. In this proposed system, AT8951 microcontroller is used which exhibits the following features: Flash-4K bytes, RAM of 128 bytes, 32 input output lines, and dual 16-bit counters.

Related Work

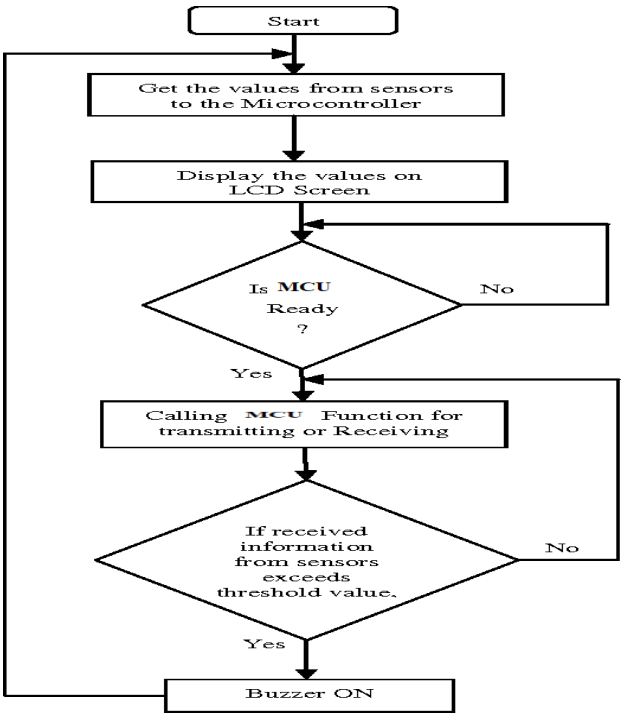
A diverse concept is introduced to minimize the chances of frequency failures. This concept helps to improve the accessibility for communications and positions and also increase the accuracy of the location.[1] Today, due to many challenging techniques like TOA/ TDOA, AOA, a concept named CIR (channel impulse response) is being introduced. This uses artificial neutral network or artificial intelligence matching algorithm to localize fingerprints associated with the wireless receiver.[2] Fingerprints are formed by receiving signatures and the position is estimated with the help of multiple neutral network techniques. Efforts have been made to reduce the limitations of GPS system and hence another suitable approach to find the position is developed by using localization and mapping techniques. This system applies concept of placing RF Identification (RFID) tags in the known locations. These placements will provide information regarding the first position of parked or motionless vehicle in the SLAM algorithm. Accelerometers and gyroscopes can be used as proprioceptive sensors to obtain relative position information and ground based laser range finder (LiDAR) can be used as exteroceptive sensor which will provide absolute position information. [3] Furthermore, localization algorithm in WSN is broadly categorized as: range-based and range-free schemes. Range based method assesses the interval between transmitter and receiver using received signal strength indication (RSSI). The algorithm uses signals received from RSSI and the mobile node in order to reduce the frequency of diffraction, reflection and attenuation. The nodes closer to the router and mobile nodes are given preference and hence the location is determined.[4] An approach to overcome the fluctuations in WSN is indicated. Hip mounted initial measurement unit (IMU) carried by a

person is used as a source for data collection in the ongoing movement. RSS position estimation is stabilized using Kalman filter.[5] Recent studies have shown that this method proves effective to improve RSS localization. Barriers of traditional system such as RFID can be overcome by an innovative monitoring system that localizes mine personnel. The real time and accurate location of miners can be traced using this system. [6]This is achieved using Zigbee wireless communication technology. Moreover, a prototype was also developed to track the miners in indoor locations using ultrasonic sensors and Time Difference of Arrival Techniques (TDOA). These indicate the practicality and precision of indoor system. TDOA functions by calculating the time lag between the receiver nodes signals and the absolute position of nodes. A hyperbola is determined between the time difference between arrival and receiver nodes, on the transmitter location. A minimum of three TDOA measurements are enough to indicate the fixed location, where the hyperbolas intersect.[7] In relation to the gas concentration monitoring system, a new design was introduced. Also, its low cost, low power wireless interface software system will contribute to background development, structural protocols and technological features. It will also help in the complex development of Bluetooth Host Controller Interface (HCI).[8]

Proposed System

Design of Monitoring System for Underwater Mine Safety Based on Side-scan LIDAR Network and Embedded IoT is proposed. The proposed system outlines a monitoring system for underwater safety of mines based on technologies such as IOT wireless communication and Embedded IoT network[9]. This project presents the design of an effectively functional security alarm system that can assess and monitor underwater using two significant sensors. This can be achieved by assessing the leakage accident and Gas Slide- scan LIDAR using sensors and indicators such as LED. The LED determines the proper functioning by confirming that the sensors are activated and that the sensor writing is in order[10]. An alarm is used to control a siren and auto dialing system. The arrangement of the sensors is such that the AT89C51 is placed at the centre of the Gas Side-scan LIDAR sensor and Leakage sensor alarm. AT89C51 is a microcontroller from Atmel that deliver all the functions of the alarm detection[11]. A new signal will be processed by the microcontroller program only if it detects an unchanged input for 30 milliseconds. This input and processing of new signals can be changed by enabling changes in the source code. The process flow of the proposed system is shown in figure 1.

Fig.1. Flowchart of the proposed system



Implementation

In the Gas Side-scan LIDAR sensor, we use IC 555 along with the sensor as the key element. The positive supply is connected to Pin no 4 and Pin no 8, however Pin no 1 is connected to negative voltage. For the purpose of noise cancellation, a capacitor is grounded from Pin no 5. The output is then made available to pin no 3. Pin no 2 is connected to the sensor. Whereas, for Gas Side-scan LIDAR sensor, pin no 2 will be negative bias through 33k ohm resistor and pin no 3 will be positive bias (Figure 2).

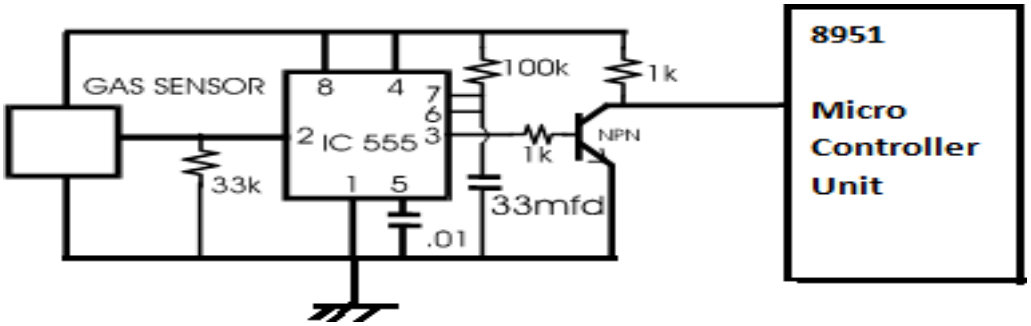


Fig .2. Gas Side-scan LIDAR Sensor with MCU

At normal stage, heat is detected by the sensor, pin no 2 will be positive biased. Since pin no 2 is positive hence negative output is available to pin no 3. At temperature , pin no 2 gets voltage from 33k ohm resistor. If pin no 2 becomes negative then output is shifted to pin no 3. When the positive output is available on pin no 3 this voltage is used to switch ON NPN transistor and thus it provides a negative voltage as a pulse to the microcontroller. Microcontroller allows an auto dial- up using the relay and it also allows sending an ON signal to APR 9600 which will start to play recording message in few seconds for Gas Side-scan LIDAR. In that mid-time hands-free dials last redialed number of mobile phones which provides info to the concerned people. Likewise, the fire sensor with MCU is shown in figure 3.

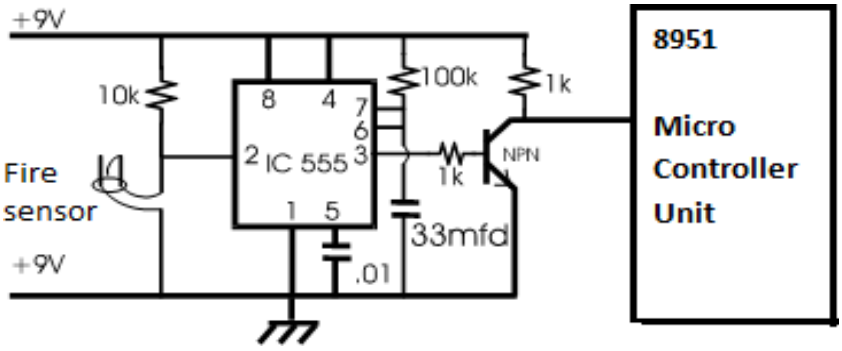


Fig.3. Leakage Sensor with MCU

With the growth of technology, devices such as digital voice recording chips that include various features such as coding technology for decompression of speech and processing are easily accessible from several semiconductor manufacturers. Implementation of voice processing algorithms include various steps such as code-excited linear prediction and adaptive differential pulse code modulation, which are done using latest chips like Texas instrument TMS320C31. A law (specified by California Council for international trade), micro law (defined by California Council for international trade), micro law (defined by Bell telephone), and vector sum excited linear prediction. Contrastingly, APR9600, APLUS integrated circuit device is a single chip voice recorder playback device that makes use of systematic analog technique with the help of flash non- volatile memory process. This enables each cell to store maximum of 256 voltage levels. **APR 9600** is a fine quality stand-alone device with voice recorder properties, non-volatile storage and play back capacity ranging from 5 to 60 seconds. It effectively records and plays numerous messages both in pattern and random mode. It also allows the user to choose the convenient number of message rates with its corresponding standards and time of recording. Additional features of APR 9600 include microphone amplification, automatic gain control (AGC) circuits, internal anti-aliasing filter, integrated output amplifier, and message management (Figure 4).

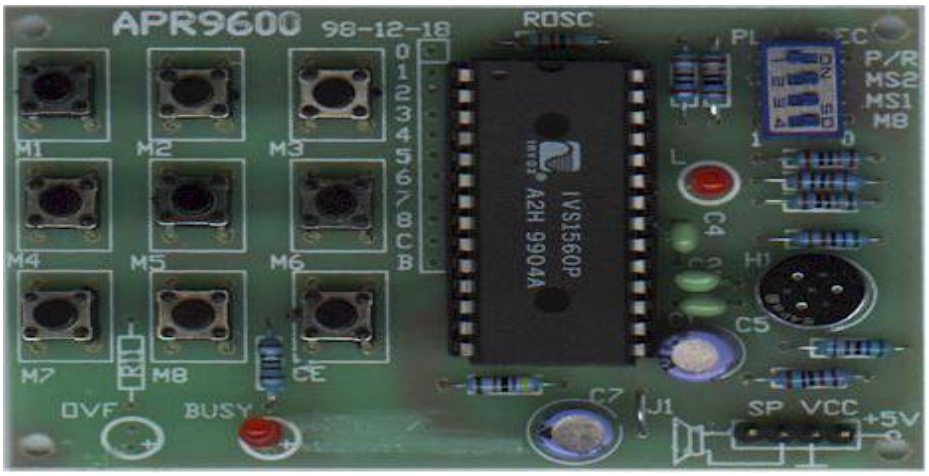


Fig.4. APR9600 Experimental Board

The IoT server regularly collects the listed measured parameter and plots on graphs concerning the date they measured. The ThingSpeak channel settings are used to visualize the temperature changes.

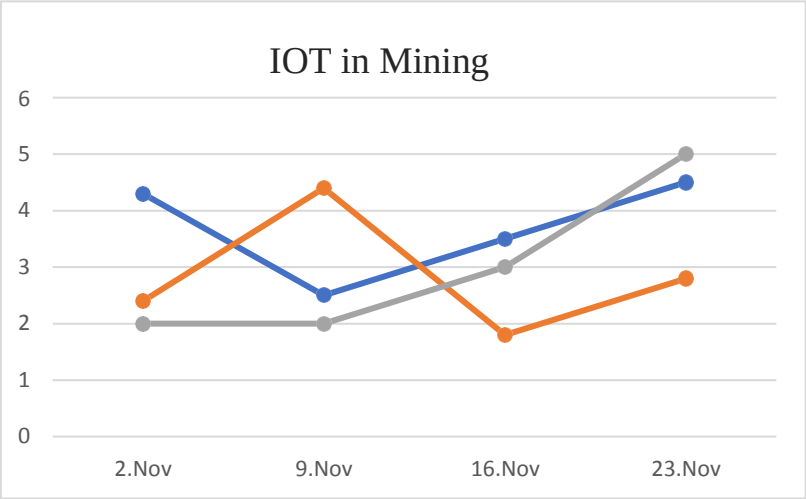


Fig.5. Temperature values plot on a graph

2. CONCLUSION

This project can be concluded that the target to develop the security system-based GSM has achieved. GSM technology capable solution has proved to be controlled remotely, provides industrial security, and is cost-effective as compared to the previously existing systems without Gas Side-scan LIDAR sensor and Leakage sensor in one product or circuit. The security system is made foolproof to the maximum extent possible. In this project, we make use of a microcontroller to control the input and the output that reaches the controller. There is a large scope in the future enhancements that can be provided along with this project like actuating a Leakage detection alarm or sensing a leakage of Gas Side-scan LIDAR etc.

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