IoT based Smart Helmet used in Mining Industry

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***Abstract*—Internet of Things (IoT) has been expanded across the different applications which brought a huge attention to its construction.In the mining field,where a noisy industrial environment can take place in. The main objective of this research is to design and develop a smart helmet system for mining industry application. Where the provided system will keep on monitoring the hazardous events such as temperature , humidity, gas, removal helmet of the miner and obstacle damage to the helmet. The finalized design was built and enhanced with real environmental testing took place in GuaTempurung cave located at Gopeng Malaysia. the power of the designed helmet system circuit was evaluated with respect to a previous work. The programming and troubleshooting were evaluated on mainly two sections, helmet section and control room section. Based on the preliminary calculation the outcome results were obtained.**

Keywords— Smart helmet, Industrial application, Detection system, Wireless communication.

I. INTRODUCTION

Mining Industry can be categories as the most essential application for any developed country. It provides extraction and discovery of the underground materials. From Iron , gold , coal and diamond. Internet of Things is an information and communication Technology (ICT) used to represent Wireless Sensor Network (WSN) communications, using the defined protocol IEEE 802.14.5 that enables Low Rate- Wide Area Network (LR-WAN) to communicate using specific modulation technique.

The basic examples are ZigBbee,LORA and Sigfox network and more. Each of them has its own benefits and disadvantages, depending on the project application and requirements the protocols are shortlisted.

LR-WAN is the defined protocol to be used for technique which provides long transmission range[1].

After that, the sensors are deployed to sense and identify the level of sensed gas. In addition, whenever the sensed gas exceeds the specified amount an alarm trigger will occur alerting the miners and preventing an upcoming incident, proposed a smart helmet model for the mining industry to identify that occurs with dangerous events. The proposed system is able to measure humidity and gas using sensors. Gas is determined by the demarcation level of carbon monoxide as well as humidity sensor to detect the humidity in the environment.

An IR sensor used to detect the removal helmet from the minor's head. And pressure sensor is placed in the helmet by fixing the neck injury criteria to 34 PSI. It is considered as hazard events when it overcome the value. Where the system consists of two sections helmet and bike.

The researches developed the system with ARM processor and communicated with the ZigBee protocol to and retrieve send the data. Latha priya Dhanalakshmi (2017)proposed a new smart and safety system that is capable of providing the environment information such as, Temperature, pressure and alert the control room when a collision happens or helmet is being removed by the minor.

Panic switch button is applied to provide supportive methods for the minor in case of emergency situations.

The underground mine is not fully discovered yet. Hence, their critical work in the underground may result in dangerous events that can increase the concentration of the harmful gasses. Hazardous gasses and surrounding climate may change significantly without being noticed by them are the first problem that may cause death to them. Moreover, the complex structure of the mine can trigger obstacles to fall down on the miner's head that may result in serious injuries was considered the second problem to the miners.

II. RELATED WORK

There have been a few instances of similar investigations done in this region of IoT appliances. A smart home appliance like a smart helmet and others with cutting edge technologies like AI and big data technologies have come to use.

Nagaraja and Jagadeesh, et al. presented a review on how a smart helmet would function, a higher level overview of a smart helmet [2].

Abdulla R, Abbas Mk provided a more AI based solution to the smart helmet appliances. A unique feature of this solution is that on the basis of the sentiment of the user it will display a screen according to it using face recognition[3].

Huang,et al. wrote a literature review on various applications of the already existing smart mirror solutions[4].

Hazarika pranjal, et al. have provided a comprehensive review on the IoT based smart home solutions. This review consists of all the information on how the architecture, connectivity and software of an IoT based smart home appliance should function together [5].

III. PROPOSED SYSTEM

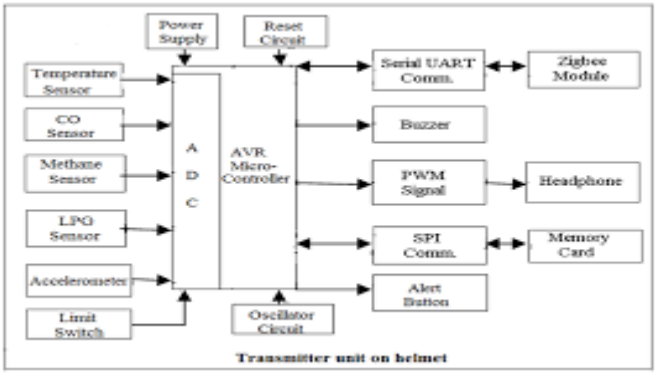
Four goals guide the development of the proposed system:

- The system is developed in two main sections. Where the first section is the helmet section used for Sensor networks connected with RF transceiver modules, Temperature and humidity, IR, Pressure and gas sensor to sense the environmental .

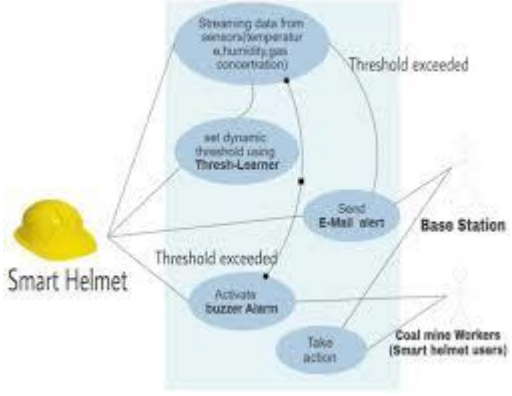
- The second section is the control room section which consists of an RF module, IOT and GUI system.
- The wireless communication used is ZigBee due to its robustness in closed areas. Clearly, WiFi or Bluetooth protocols will not be a sufficient solution for underground systems.
- Make it easier for the user to control appliances using the Arduino.

(Temperature and humidity, IR, Pressure and Gas sensors) that will be collecting data from the surrounding environment of the helmet and will transfer each data to Arduino Mega which is considered connected with 1 channel Relay circuit that is used as a switch to turn on or off the power supplied to Solenoid Valve. However, Solenoid Valve operates on a given small pressure of input gas approximately 3 PSI. Arduino is communicating with XBee Transmitter in UART ports where Tx is continuously sending the information to the Rx through Digi mesh topology.

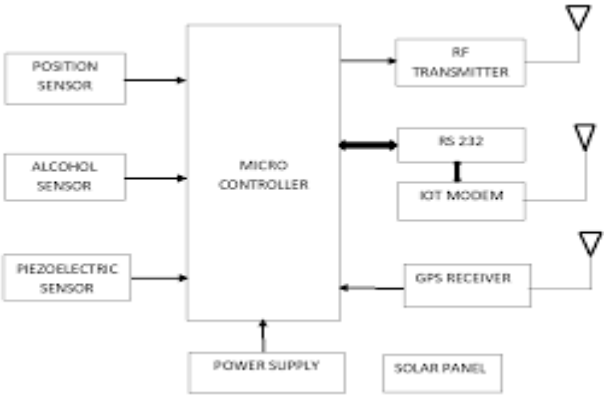
GUI was created by Node Red and the GPIO of the Raspberry Pi are used to trigger the buzzer based on the force sensing resistor data received. The data received by XBee Rx are sent through the serial communication with Raspberry Pi. GUI was created by Node Red and the GPIO of the Raspberry Pi are used to trigger the buzzer based on the force sensing resistor data received.



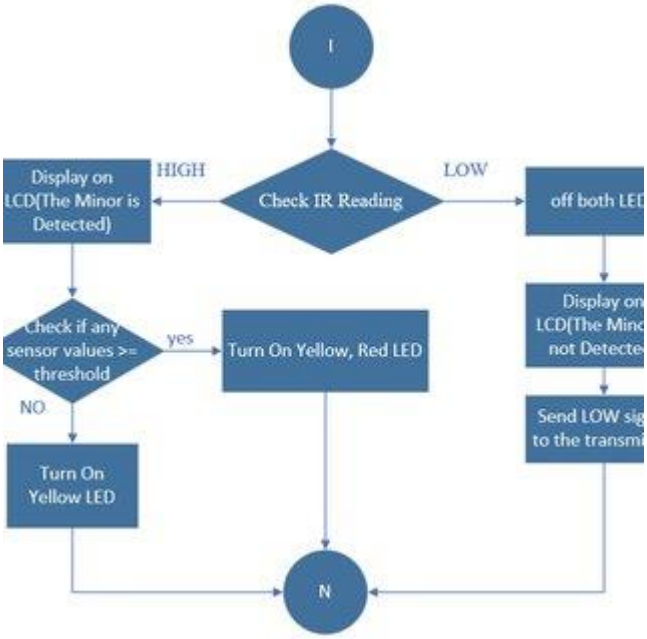
LED and LCD are used to specify the status of the miner condition weather he is safe, in danger or needs rescue team. On the output side a GSM module is used to send the message and was configured in Node Red with JavaScript code.



Flowchart detailing the implementation of data collection-based authentication for smart helmet,



Here if a user has an account then he or so would be recognized by the system and relavent user data would be shown to them and they will be redirected to application menu screen. If a user doesn't exist in the system or they would want to register then the system will setup for a new user and then show menu screen. Our menu screen will be operated using voice commands and would function as per this flowchart



Displays the initializing point of the microcontroller, microprocessor and IoT platform. A decision is made based on the detection of the IR data if it is low then the sensor detects the miner's head and will proceed to the three different systems (TH which stands for Temperature and Humidity, F which is Force and G which is gas) otherwise the signal will be directed to I (which stands for IR) connection. N is stated and used to represent Node-Red platform as Each of the connection nodes specified above will be directed to a sub flaws as shown.

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CONCLUSION

In this paper the proposed project was introduced with a literature review, methodology, system limitations, findings and testing were explained. From the summary points it is seen that the aim related to the project are successfully achieved by designing Automated system that detects the hazardous gas surrounded by the miner's helmet was achieved, designing a monitoring system to update the control room with real time data was achieved and to integrate both design systems and evaluating the power consumption of the proposed system was integrated and achieved.

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