

# “SIRASTRANA”- An Application of Smart Helmet in Mining Industry

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**Abstract:-** This paper explains the necessity of smart helmet in mining industry to detect hazardous events. Due to hazards people working in the mining industry suffers various health problems. There are three different types of hazards physical, chemical and biological hazards. In the establishment of helmet, we have considered the three main types of hazard occurs in mining industry, such as air quality, helmet removal, and collision occurs when miners are struck by an object. The first phase is focusing on the air quality hazardous gases such as CO, SO<sub>2</sub>, NO<sub>2</sub>. In second phase, hazardous event was classified as a miner removing the mining helmet off their head. The IR sensors are used for this purpose. The third hazardous event is describe as an event where miners are struck by an article against the head with a force distance a value of 1000Hz on the Head Injury Criteria. An accelerometer was used to measure the acceleration of the head and the HIC was calculated in software. This paper gives the solution for the mining people when they are in mining industry.

## I. INTRODUCTION

South Africa is known for its extensive and diverse mineral resources and large mining industry [1]. Supervisors are held responsible for all injuries sustained under their supervision, and should therefore be aware of potentially risky situations. The problem addressed in this paper was the improvement of a mining helmet in order to ensure more safety awareness between miners. When working with noisy equipment, being aware of one's surroundings can sometimes be challenging. In the mining industry miners tend to remove some of their safety gear because the gear is too heavy, warm or uncomfortable to work with. However, miners generally do not remove their helmets. Presently mining safety helmets only have the purpose of protecting the miner's head against potential hazardous bumps. The safety helmets do not have any technology added to it to let miners know when a fellow miner has encountered a hazardous event. Therefore the purpose of the project described in this paper was to modify an existing mining safety helmet to make the helmet even safer by adding a wireless sensor node network. The task was extended to designing the system small enough to fit into the safety helmet and last long enough while running on battery

events are defined as hazardous events. Thirdly, dangerous gases need to be detected and announced. In the area of mining automation, real-time monitor and control of mine hazard are more complex. Mine safety modules are compose communicate to ground control or a central station. A real critical controversy in mines is hazardous gases. Systems used in a mine can create intense throbbing and increase the level of hazardous gases such as CO, SO<sub>2</sub>, NO<sub>2</sub> and particulate matter. The working case can be very chattering and miners don't watch each other constantly. Miners tend to stay in groups and will be no more than 5 meters (m) from each other. A warning system needs to be integrated that will warn miners within a 5 m radius that a miner is appreciate a hazardous event. This system needs to process and transmit the event within 1 second (s). These systems measure the climate around the miner with gas sensors and are then used to equipment evacuations. These do not alert the miner at all or only active the miner in an detectable way. These systems warn miners, but when a miner is congest or damaged, an external input is required from ground control.

## II. LITERATURE REVIEW

The various people worked in this area to give a solution to mining people. Mining is the back bone of South African country. The major source of various environmental and social problems related health are addressed in [1]. Virtual reality technology is used to give safety training to mining people in the South African mining industry [2]. The application followed ZigBee wi-fi technology to build wireless sensor networks, found out actual-time surveillance with early-warning intelligence on temperature, leakage of gas in mining place, and alerting the control station the usage of wireless zigbee technology [3]. Long with zigbee technology, ARM processor is used maintain the safety in mining industry [4]. The necessity of packet controlled network in mining industry is addressed here [5]. Computer controlled mine monitoring system is used to evaluate hazards in mining industry [6].

A methodology for identifying safety hazards inherent in underground monitoring and control equipment will be given. Under a US Bureau of Mines contract, a methodology has been developed for detecting the legacy drawing items that affect safety hazards. In monitoring or controlling items located in underground coal mines the hardware reliability of a system is seldom recognized as a potential safety hazard. Because of the developing methodology, a set of design guidelines has been developed to ensure that known system design difficulties can be identified from the outset for designers of new mine

power. An author challenge was to adjust the helmet without inconstant its physical structure. The added weight had to be kept to a minimum range. A mining helmet needs to be adjusted to update miner defense by adding intelligence to the helmet. When a miner deletes his helmet he needs to be warned. If an article falls on a miner even when wearing his helmet he can become unconscious or immobile. The system must determine whether or not a miner has sustained a life-threatening injury. These two

monitoring/control systems. This technique could prove valuable to other system design engineers as well.

### III. METHODOLOGY

A smart helmet has been developed that is able to detect of hazardous events in the mines industry. The mining safety helmets only have the purpose of protecting the miner's head against potential hazardous bumps. It has various advanced features such as fast response time low, portability, and low cost with precisely acceptable accuracy. 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). It had been shown in Fig 1(a) and Fig 1(b).

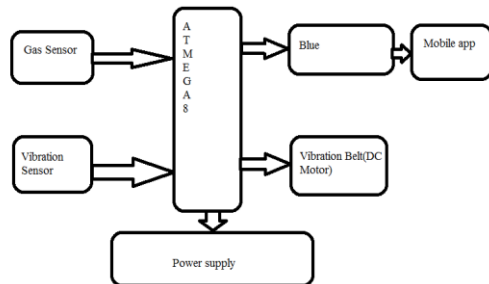


Fig. 1(a). Block Diagram

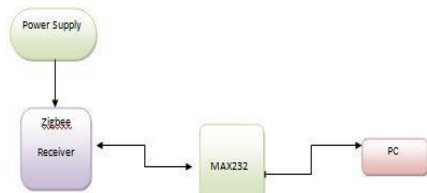


Fig. 1(b). Supervisor

The various components used in the proposed approach is explained below.

#### A. Microcontroller

Arduino is a microcontroller, the central controller for the whole unit of smart cart. Arduino based on the ATmega328. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, and a reset button. The board can be programmed with Arduino Software (IDE). The board can operate on an external supply from 6 to 20 volts.

#### B. Air Pollution Sensor

Air pollution from coal mines is mainly due to emissions of unmistakable matter and gases insert methane (CH<sub>4</sub>), sulphur dioxide (SO<sub>2</sub>), and oxides of nitrogen (NO<sub>2</sub>), as well as carbon monoxide (CO). From different studies, it is well known that when human being comes in contact these chemicals/pollutants it could have adverse effect on their health. MQ-2 gas sensor is used to detect hazardous gases, it has high flammable to Propane, Butane and LPG, also response to Natural gas. The sensor could be used to determine feedback different combustible gas, abnormally Methane, it is with low cost and advisable for different function.

#### C. Helmet Removal Sensor

For detecting the removal of the helmet a few different approaches were considered. The comparison, advantage, and disadvantage of the proposed approaches in the literature was reported in [1]-[10]. For this study, the IR beam-based helmet removal sensor technique was considered better among other

available techniques such as a switch, analogue distance sensor, and digital distance sensor. The IR beam can be designed to use low amounts of power. An off-the-shelf IR distance detector was used for this application. The IR sensor was designed to send a constant signal from the one side of the helmet to the other side with the circuit.

#### D. Transmission Technology

ZigBee was created to be a low power, low data rate and a low-cost device. ZigBee has all the same benefits as a Wi-Fi system. A ZigBee module is also more useful for construct larger mesh networks than Bluetooth and is therefore the better option when routers and access points cannot be completed. Based on the situation, other transmission technologies like wifi and lifi is used to get better results.

### IV RESULTS

The helmet removal test was done using IR sensors used in our project by using different sizes, shapes and different colors sensor given satisfactory and 100% results is obtained as shown in Fig 2 and all various kinds of testing done during performance test of helmet sensor program done in Arduino controller done using digital pins run very well displayed helmet value on PC as well as send to receiver using zig bee communication 9600bits/sec to a range of nearly 10mts with line of sight and without line of sight at constant 5v.

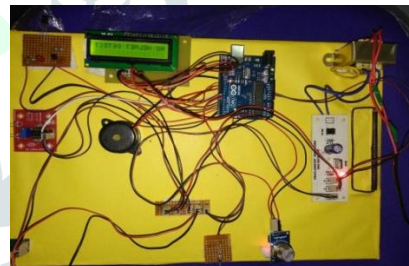


Fig. 2. No helmet detected

Gas sensor in our project used is MQ-2 measures a wide range of gases like LPG, CO<sub>2</sub>, also alcohol this sensor has been tested under extreme condition of high and low chemical and dangerous poisonous which are hazardous for human health. The sensors values are accurate when tested and proceeds and results are displayed on PC as shown in Fig:3(a), Fig:3(b) represents the design of this idea.



Fig. 3(a) Smart helmet

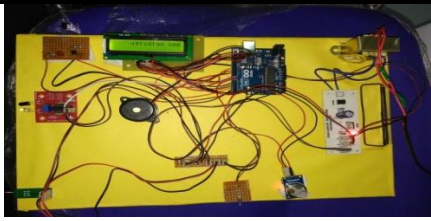


Fig. 3(b): Hazardous Gases are detected.

## V CONCLUSION

A smart mining helmet was developed to identify three types of hazardous events such as danger level of hazardous gases, miner helmet removing, and collision or impact. The hazardous events were classified as a miner deleting the mining helmet off their head. An off-the-shelf IR sensor was then used to successfully detect when the helmet is on the miner's head. Another hazardous event is defined as an event where miners are struck by an object against the head with a force exceeding a value of 1000Hz on the HIC (Head Injury Criteria). An accelerometer was used to measure the acceleration. Through this paper solution has been given for some of the problems of mining people.

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