Smart Helmet to Refuge Miners From Hazardous Event in Mining Industry

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Abstract: **A clever helmet has been superior to help the miners operating withinside the mining industry. Industrial safeties are one of the crucial elements of industry. Miners helmet is now no longer un standard area and compulsorily used in particular in mining industries but it does now not impose safety of miners. In coal mining is risky as it includes suffocation, fuel line poisoning, object fall, fuel line explosion and removal of helmet. So, this smart helmet has been developed and it includes communication detection of the damaging gases. It furthermore presents actual time tracking of unstable gases like CO, CH4 and LPG and furthermore temperature. The crucial purpose for death of miners is that, due to any purpose if miners fall apart and losses interest and moreover if proper treatment isn't always supplied to them at that factor to triumph over this hassle the tool provides emergency alert to the supervisors, if person fall apart or withinside the occasion that they neglect carrying helmet. A restrict transfer is used to decide whether or not or now no longer or now not mines has eliminated or not through the usage of ZigBee generation for transmission of records from underground mine to base station. This device makes use of Global System for Mobile Communication (GSM) module for transmission of records from underground mine to base station.**

Key words: GSM module; Helmet Removal; Realtime Monitoring.

I. INTRODUCTION

Mining is a way of extraction of minerals from the earth. The cloth received from mining which includes aluminium, copper, lead, zinc, gold, diamond, metals, coal etc. Mining employer is having immoderate safety danger because of complications such as mine ventilation, hazard from unstable gases, incidents like rock fall and head accidents [1]. It includes numerous danger factors which influences the health of miners. In underground mining, disaster is a totally excessive issue. In underground mines, worker safety accidents frequently get up, resulting from collision amongst tool and pedestrians or one-of-a-kind tool. There are a few small incidents frequently arise withinside the mining organisation however vital mining risks that passed off in India lead us to do not forget the safety of miners greater deeply. The Chas Nala mining disaster killing 372 miners [7]. And the Jharkhand coal mine incident that killed 11 miners and trapped over 50 miners [2]. Under the mines, due to the complex of tunnels it is inconvenient to use compelled verbal exchange tool. Also, withinside the path of the troubles like fire, rock fall, and explosion conventional compelled verbal exchange tool is unreliable, so we required a wireless sensor community. In mining helmet, it can be modified to boom the safety of miner with the useful resource of the use of which embody generation to the helmet. Sensor circuit is located in a helmet of each miner is probably sensing the environmental modifications and transmit them to applicable manipulate unit at radio frequencies [4]. The exposure to risky gases wherein miners are exposed to risky gases like carbon-di-oxide, methane, sulphur-di-oxide withinside the path of mining. Collision detection is takes vicinity at the same time as miner is hit withinside the pinnacle with the aid of using an item at a stress that might cause injury [6]. A vibration sensor turns out to be used to measures the stress inflicting the vibration of the top with which the HIC (Head Injury Criteria) turn out to be calculated. A temperature sensor is likewise brought due to the truth in case of any occasion there may be a shocking exchange in temperature [8] To use ZigBee primarily based totally definitely surely wi-fi sensor tool community because of its far-flung surroundings tracking capability [3]. This is a charge powerful, actual time surveillance device with portability and accuracy that could keep away from protection problems with the aid of using early warning. Project goals to designing a smart helmet for risky event detection, monitoring the surrounding environment conditions and updating statistics like vicinity and sensor facts to the applicable console for clean tracking and presenting oxygen nutritional dietary supplements to avoid inhaling of poisonous gases. This secures the life of many miners in mining industries. Earlier Cables and harassed networks have been used to talk with Base Station. Therefore, a wi-fi sensor community are used to speak at instances of such occasion. The powerful answer for transmitting from base station to underground mine is wi-fi communication [10]

II. LITERATURE SURVEY

C.J. Behr, A. Kumar and G. P. Hancke introduced “A Smart Helmet for Air Quality and Hazardous Event Detection for Mining Industry” [1] this is capable of stumble upon the risky activities withinside the mining industry. In this work, no collision detection and helmet elimination scheme is employed. A P Squelch proposed “Virtual Reality for mine safety training in South Africa” to provide safety training to humans running

withinside the South African mines [2].
Ge Bin, LI Huizong, "The Research on ZigBee- Based mine protection Monitoring System" [3] has researched and elaborated. The mine protection tracking device on ZigBee-Technology. In 2000, Martine Lienard and Pierre Degauque proposed- "Natural wave propagation in Mine Environment". Here wave propagation naturally is employed for the mobileular localization and channel nature determination. They have used the frequency sort of 150MHz- 900MHz [4].
In 2004, Jose Vasquez, Victor Rodriguez and David Reagor proposed-"Underground Wireless Communication the usage of High-Temperature Super Conducting Receivers" [5].They have advanced a conversation of low frequency range thru using a immoderate temperature superconducting materials and DSP's.
Ruff and Hession-Kunz [6] advanced an RFID-based totally completely collision warning system to offer a proximity warning to operators. Andre de Kock, et al advanced the scheme in particular for health, safety and productivity of South African Coal mining Industry [7].
Tanmoy Maity proposed a fee efficient, flexible solution of safety for underground mining workers. They have used MEMS based totally completely sensors foe environment monitoring and automating improvement of records with the immoderate accuracy [8].
Y. P. Zhang, G. X. Zheng completed Radio propagation in underground coal mines. They completed measurements at 900MHz on each Horizontal and Vertical polarization [9].
Shabina.S proposed the "Smart Helmet the use of RF and WSN Technology for underground mines safety". She determined on RF technology for conversation inside the mines. For terrible running environmental situation, a wireless network is provided for sensing purpose [10].

III. METHODOLOGY

SYSTEM REQUIREMENT SPECIFICATION:

A. Hardware Requirement Specification:

1. Air Quality Sensor:

Figure 1: Air Quality Sensor

The MQ6 sensor is a main sensing issue this is applied in fuel line detection appliance. The senser consist of a sensing material which ionizes the gases which comes in which contact. As a result, the ionization method of the gases changes the resistance at some point of the circuit.

Features:
- High sensitivity to LPG, iso-butane, propane
- Small sensitivity to alcohol, smoke
- Fast response
- Stable and prolonged life
- Simple pressure circuit

Applications:
- Particulate matter monitoring
- Gas leak alarm
- Gas detector

Advantages:
- Effective Air Monitoring
- Toxic Gas Detection
- Human Health

2. Buzzer:

Figure 2: Buzzer

A buzzer is a small device however inexperienced problem to characteristic sound features to our project/ system. This buzzer can be used by absolutely powering and it using a DC strength supply beginning from 4V to 9V. A clean 9V battery to boot is also used, however it' miles inspired to use a regulated +5V or +6V DC supply. The buzzer is generally companion with a shift circuit to reveal ON or shut down the buzzer at require time and need interval.

Pin Configuration:

Table1: Pin configuration of Buzzer

Pin Number	Pin Name	Description
1	Positive	Found through (+) image or longer terminal lead. Ca
2	Negative	Found through quick terminal lead. Schematically linked to the floor of the circuit

Features:
- Frequency range is 3300Hz
- Operating voltage range is from 3V to 24V DC
- Operating temp. ranges from -20^0 C to $+60^0$ C
- The input current is less then 15mA

3. Accelerometer:

Figure 3: ADXL 335 sensor

ADXL 335 may be a MEMS "Micro Electro Mechanical System" based mostly completely undoubtedly accelerometer, employed for tilt sensing. it's 3 axis sensing devices [8]. It's having a coffee power requirement, outstanding temperature stability and information measure adjustment capability. it's applicable in -40deg to 85deg an logist temperature vary and 10000g marvel survival [4]. It will be terribly little in length and moderate weight device. Measuring system measures the static acceleration of gravity in tilt-sensing packages and dynamic acceleration thanks to motion, wonder, or vibration.

Pinout:

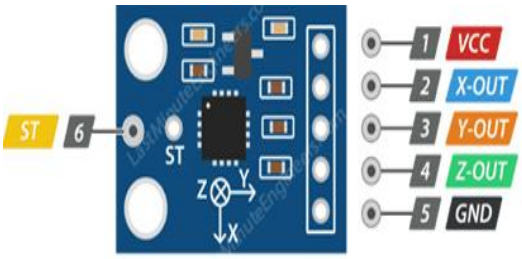

Figure 4: Pinout of ADXL 335 sensor

• VCC pin offers energy for measuring device that will involving 5V at the Arduino.
• X-Out pin is outputs analog voltage proportional to acceleration applied on X axis.
• Y-Out pin outputs analog voltage proportional to acceleration applied on Y axis.
• Z-Out pin outputs analog voltage proportional to acceleration applied on Z axis.
• GND pin is hooked up to GND on Arduino.

Features:
• operational Voltage :1.8V-three.6V
• operational Current :350µA (typical)
• Sensing Range: ±3g (Full Scale)
• Temperature Range: −forty to +85°C
• Sensing Axis :3axis
• Sensitivity :270 to 330mV/g (Ratio metric)
• Shock Resistance: Up to 10,000g

4. Temperature Sensor:

Figure 5: LM35 Temperature Sensor

The LM35 collection are precision covered circuit temperature sensors, whose output voltage is linearly proportional to diploma Celsius temperature [4]. The advantage of LM35 over thermistor is, it does now not require any outdoor calibration. The sensitivity of LM35 is 10mV in keeping with degree Celsius.

Pin Configuration:

Table2: Pin configuration of Temperature sensor

Pin Number	Pin Name	Description
1	Input	Provides electricity to LM35, linked to 5V on Arduino
2	Output	Outputs analog voltage proportional to instant temperature, linked to analog pin on Arduino
3	GND	Connected to floor on Arduino

Limit Switch:

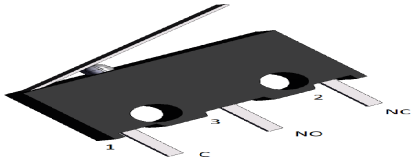

Figure 6: Limit Switch

The restrict switch is type of a 1 NO + 1 NC push button. The push button is operated by hand even as the restrict switch is operated mechanically. The predominant function of the restrict switch is to close or open an electric powered power circuit while physical restrict of the operation of the controlled device has reached. In our challenge restrict switch is used for helmet removal detection, while the switch is pressed helmet is worn else the helmet is removed.

Pin Configuration:

Table3: Pin configuration of Limit switch

Pin Number	Pin Name	Description
1	Com	Connected to GND pin on Arduino
2	NC	Connected to virtual pin on Arduino
3	NO	Connected to 5V pin on Arduino

5. APR33A3VoiceKit:

Figure 7: APR33A3 Voice Kit

APR33A3 is an 8 Channel Voice Record & Audio Playback Board covered with APR33A series IC that could be a strong audio processor alongside aspect high-average overall execution of audio analog- to-digital converters (ADCs) and digital-to-analog converters (DACs). The APR33A series is specifically modeled for the clean key trigger.

Specifications:
• Voltage input or output Range: 3V ~ 6.5V
• No separate ICs needed
• 680 sec. (eleven Minutes) Voice Recording Length withinside the APR33A3-C2
• Low Power-Down Current: 15Ua
• inherent Audio-Recording mike Amplifier.

6. *GSM Module:*

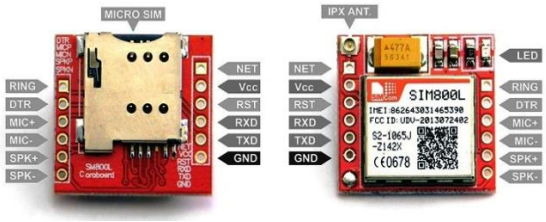

Figure 8: GSM Module

GSM module put together to GSM modem with popular communique interfaces like RS232, USB etc., so it may be with out issues related with a pc or a microcontroller-based totally completely system. The power offer circuit is likewise created in module that may be brought on with the employment full resource of the use of employing a probable adaptor. The SIM800L could be a miniature mobileular module that permits for GPRS communication, causing and accepting SMS and creating and accepting. voice calls. Low value and tiny footprint and quad band frequency facilitate and create this module exceptional answer for any task that need prolonged vary connectedness. After the connection module starts, search for the mobile network and log in automatically. There were some membership status screens on board (no network coverage - fast flashing, logged in - slow flashing).

7. *Arduino Uno:*

Figure 9: Arduino Uno

The Arduino is an AVR processor strolling specific with code that lets us use the Arduino environment. AVR's can be used themselves with some more assisting components. Arduino is combination of every AVR (chip) and breadboard. AVR is a single chip, and will requires a breadboard. Arduino Uno is microcontroller board build on ATmega328P. it's fourteen digital input or output pins (of that half-dozen may be worn on as PWM – pulse width modulation outputs), 6 Associate in Nursing log inputs, and a sixteen MHz quartz crystal, a USB linked, and a energy jack, and an ICSP header and a reset button.

Features:

- In operation Voltage is 5V
- The recommended input voltage will range from 7V to 12V
- Digital input pins: fourteen
- Analog I/P pins: 6
- Flash Memory: thirty-two KB
- Clock Speed: sixteen Mc

a. *Block Diagram:*

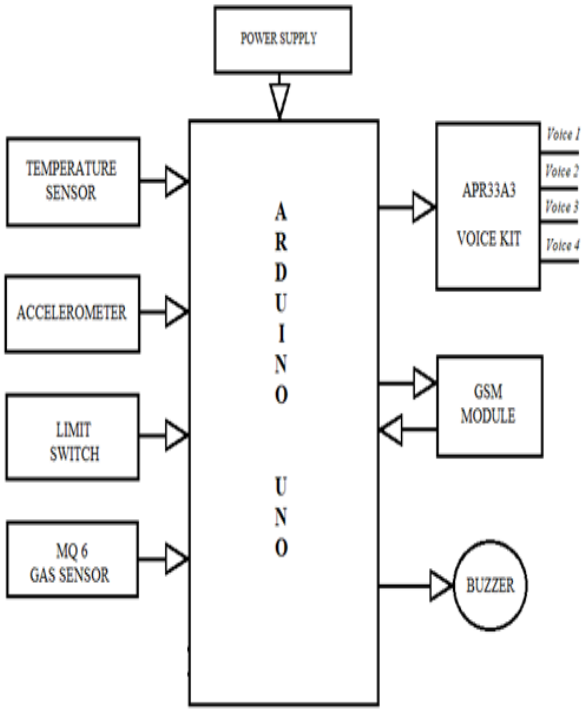

Figure 11: Block Diagram

Figure 11: Indicates the block diagram of the system. It includes air super sensor, temperature sensor, helmet elimination sensor, person fall detection sensor, GSM module related to Arduino Uno. The air amazing sensor MQ6 senses the dangerous gases like LPG and Butane. When the MQ6 sensor detects the dangerous gases, the buzzer is ON and a voice modify message saying "GAS DETECTED" is heard [1]. LM35 is used to display screen the temperature of the mining environment. When the temperature exceeds the edge level, buzzer goes HIGH alongside voice alert saying "TEMPERATURE LEVEL IS HIGH" is played [4]. Limit Switch is employed for helmet removal detection. once the switch is ironed helmet is worn else the helmet isn't worn. If the helmet is not worn beep sound of buzzer in conjunction with alert message oral communication "KINDLY WEAR HELMET" is heard. measuring system (ADXL 335) is used for man or girl fall detection. It is positioned at centre of the helmet and if it exceeds the edge value, buzzer is ON and the voice alert saying "PERSON FALL DETECTION" is played. In any of these above-mentioned ordinary conditions an alert text message (SMS) alongside the area of the miner is sent to the supervisor mobile present at base station via GSM to take the further critical action.

b. Flow Chart:

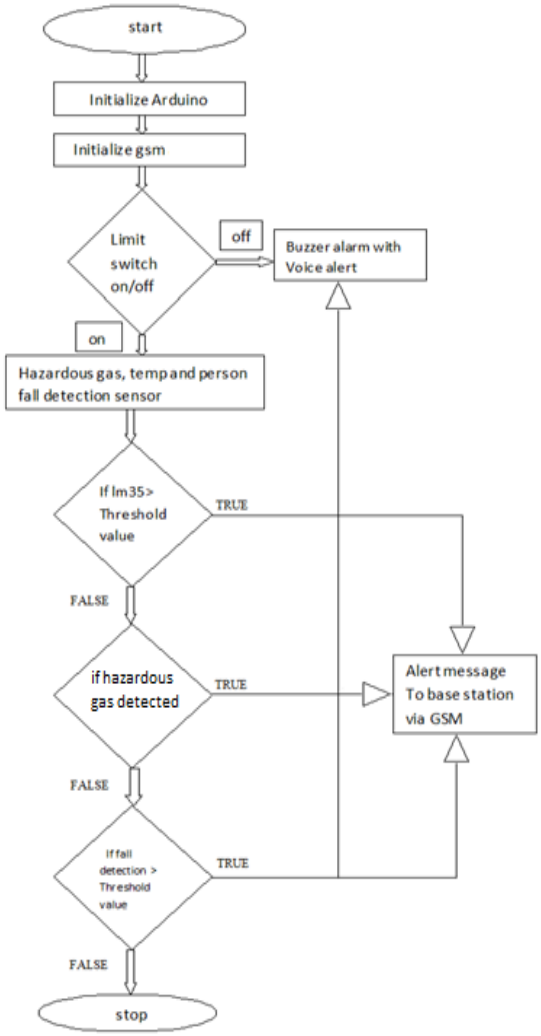

Figure 12: Flow Chart

c. Circuit Diagram:

Arduino Uno is the crucial part of the circuit to which all the special components are related. All the ones components are controlled with the useful resource of the use of Arduino Uno in step with this device dumped in it. The Limit Switch and MQ6 fuelling sensor which provides digital input are associated with the digital I/O pins of the Arduino. ADXL 335 and LM35 gives analog input and are associated with the analog pins of the Arduino. Buzzer and APR33A3 provides digital output and consequently are associated with the digital I/O pins of the Arduino. RX and TX pins of GSM are associated with the TX and RX pins of the Arduino respectively.

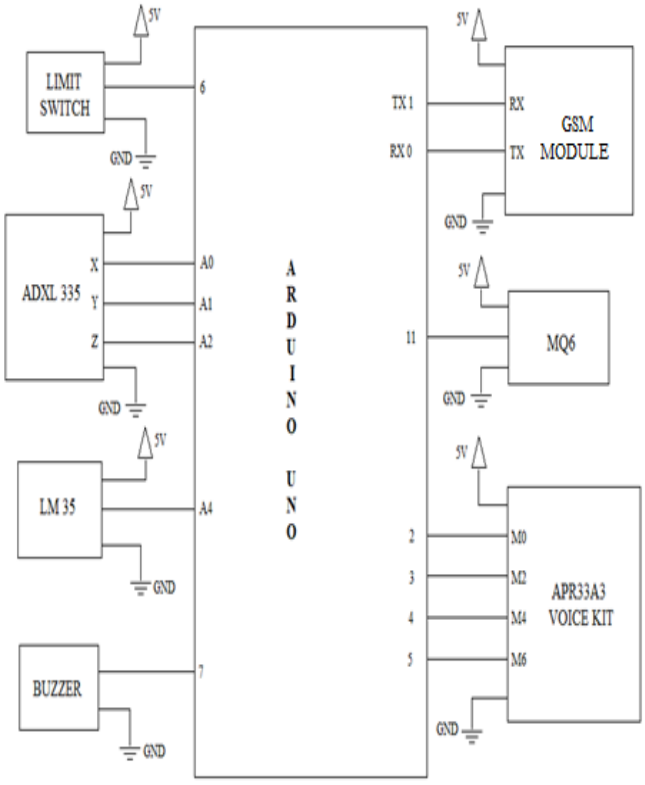

Figure 13: Circuit Diagram

IV. RESULT AND DISCUSSION

The evolved helmet is capable of stumble on the numerous dangerous activities and additionally presents alert messages so that it will lessen mining accidents. Limit Switch assessments whether or not the helmet is worn or now no longer and voice alert to put on the helmet is heard to miner. MQ6 sensor detects the presence of dangerous fuel line like LPG and Butane, Accelerometer (ADXL 335) detects the man or woman fallen and LM35 video display the temperature of the mining environment. If the temperature is above threshold, man or woman fallen is sensed via way of means of accelerometer or dangerous fuel line detected an alert message together with the area of the miner is dispatched to manager cellular through GSM whose gift at the bottom station in order that essential measures are taken earlier than the casualty occurs.

V. CONCLUSION AND FUTURE SCOPE

A clever mining helmet is capable to discover 4 forms of risky or unstable occasions which encompass presence of unstable gases, miner helmet removing, mine deliver manner and temperature upward push in mining area. In case of any of these casualties an alert message is sent to supervisor at lowest station and moreover to the miner strolling at the mines. In this way it is going to be useful to miners present withinside the mine to save their existence in advance before any casualty occurs. The helmet can be more potent via which includes more features withinside the near future.

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