IOT BASED SMART HELMET FOR INSPECTING AND REPORTING AIR QUALITY AND HAZARDOUS EVENT DETECTION FOR MINING INDUSTRY

PHASE II REPORT

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in partial fulfillment for the award of the degree of

BACHELOR OF TECHNOLOGY
IN
INFORMATION TECHNOLOGY

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APRIL 2023

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BONAFIDE CERTIFICATE

Certified that this project report **"IOT BASED SMART HELMET FOR INSPECTING AND REPORTING AIR QUALITY AND HAZARDOUS EVENT DETECTION FOR MINING INDUSTRY "** is the bonafide work of "**KRITIKA MAHESWARAN(191001036), KUZHALI S(191001037) , KEERTHANA G(191001034), LAKSHMI PRIYA R(191001038)"** who carried out the project work under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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INTERNAL EXAMINER

EXTERNAL EXAMINER

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ACKNOWLEDGEMENT

Initially we thank the Almighty for being with us through every walk of our life and showering his blessings through the endeavor to put forth this report. Our sincere thanks to our Chairman **Mr. S. MEGANATHAN, B.E, F.I.E.,** our Vice Chairman **Mr. ABHAY SHANKAR MEGANATHAN, B.E., M.S.,** and our respected Chairperson **Dr. (Mrs.) THANGAM MEGANATHAN, Ph.D.,** for providing us with the requisite infrastructure and sincere endeavoring in educating us in their premier institution.

Our sincere thanks to **Dr. S.N. MURUGESAN, M.E., Ph.D.,** our beloved Principal for his kind support and facilities provided to complete our work in time. We express our sincere thanks to **Dr. PRIYA VIJAY** Professor and Head of the Department of Information Technology for her guidance and encouragement throughout the project work. We convey our sincere and deepest gratitude to our internal guide, **S.USHA** Department of Information Technology, Rajalakshmi Engineering College for her valuable guidance throughout the course of the project. We are very glad to thank our Project Coordinator, **B.SAROORAJ** Department of Information Technology for his useful tips during our review to build our project.

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ABSTRACT

A classic model of the smart helmet will be 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 sensors namely gas, infrared, MEMS, GPS and pressure sensor for their usage and the sensor data are monitored in pc via wifi transceiver unit.

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CHAPTER 1

INTRODUCTION

1.1 GENERAL

For years, safety has been a major concern in the mining industry, especially in sub-surface mining. Mining accidents occur during the process of mining minerals or metals. Thousands of miners die from mining accidents each year, especially in the process of coal mining and hard rock mining. Collapsing of mining slopes is one of the main cause of most these accidents.

Most of the collapse of mining slopes is not always fatal. Immediate first aid can help the injured miners. However, it is not easy to identify that a certain miner is in trouble in dark underground mines. Therefore, we need a system to monitor the well-being of individual miners in these mines.

One accessory that all miners use is the safety helmet. So, we can use this helmet to detect the well-being of the person using it and help pass the information to the central office outside the mines. This project attempts to do the same using internet of things.

Sensor Devices are placed on each helmet that the miners use. This sensing unit is connected to a force sensor which checks if there is any dangerous load that theminer is experiencing on his head. If the load is too heavy, the miner may be in danger and may need immediate care. So, the motes try to contact the fixed Room Manager mote which has a connection with the Center and the adjacent Room Manager motes. Corresponding Room Manager of the distressed mote tries to inform the Center about the occurrence of such an accident. It also asks miners from adjacent rooms/sectors to voluntarily find and help the miner in danger. As soon as the Center gets to know that a certain miner is in trouble, they can send in a team to help. If there are more miners in trouble, the room can be declared dangerous and the Center can turn on the siren at the entrance of the room. Thus, the miner from the adjacent room can be informed to not enter that room. In this way, we can reduce the number of casualties. Providing immediate help and declaring a certain region dangerous are two additional novel ideas presented in this project.

1.2 OBJECTIVE

1. The main objective is to Monitor the miners
2. To reduce the number of casualties
3. To providing immediate help are the main goals of this project

1.3 EXISTING SYSTEM

There is no implementation of smart helmet in the real-time mines but some research projects proposed the concept of the same with Bluetooth technologies were Bluetooth have several disadvantages of connectivity and power supply.

- Not more accurate
- Hazardous gases affects the human

1.4 PROPOSED SYSTEM

The system provides real time monitoring of mines from base station. The transmitter unit is placed on helmet of worker and receiver unit placed on the base station. The IOT based wireless technology is used for data transmission from coal mines to the base station. The node mcu communication network provide two way communication means from base station to mines and from mines to base station. The transmitter unit consists of air quality sensor, helmet removal sensor and person fall detection sensor If any abnormal action are detected gps location will send to iot web server.

- 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
- More accurate

CHAPTER 2

LITERATURE SURVEY

1.TITLE

Smart Helmet Using RF and WSN Technology for Underground Mines Safety

AUTHOR

Shabina.S

DESCRIPTION

The underground mines all over the world are adversely affected by various hazards including gaseous explosions, landslides, fire hazards, etc. This leads to the significance of safety for the mine workers. A better communication technology has to be employed for an intelligent sensing and warning system. For this, RF technology is chosen for the communication inside the mines. The wireless sensor network is provided for the sensing of adverse working environment conditions. Combining both these technologies, a new smart helmet module is developed. The wireless sensor network consisting of various sensors senses mine environment parameters like temperature, pressure, humidity, gases like methane, carbon monoxide, etc. The measured parameters are processed and are used for an early intelligence warning system with the help of programmed alarm sounds, if there is any serious deviation from the normal parameter value range. The RF technology is also used as locating system, which helps in locating the mine-workers. This RF based wireless sensor network is reliable with easy installation and fast sensing and locating system. The design provides three modules, namely helmet module, localizer module, and control room module. The helmet module comprises of various sensors, microcontroller, antennas, encoders, decoders, etc. The helmet module acts as an intelligent, low power node in the wireless sensor network. The control room module contains antennas, PC, decoder, etc. The sensors are used to measure the variations in the temperature, humidity, pressure, fire and take decisions for required actions based on the measured data to ensure the safety of the underground mine workers. The RF technology also ensures the localization of the mine workers for their safety in a dangerous working platform. Thus the proposed system ensures safety and a reliable wireless communication inside the underground mines.

2.TITLE

Implementation of Smart Safety Helmet for Coal Mine Workers

AUTHOR

Pranjal Hazarika

DESCRIPTION

This paper presents implementation of safety helmet for coal mine workers. This helmet is equipped with methane and carbon monoxide gas sensor. This sensor sense the gas and the data is transmitted to the control room wirelessly, through a wireless module called X-Bee connected with the helmet. When the methane or carbon-monoxide gas concentration is beyond the critical level, controller in the control room triggers an alarm and keeps the plant and the workers safe by preventing an upcoming accident.

3.TITLE

Smart Helmets for Safety in Mining Industry

AUTHOR

RohithRevindran

HansiniVijayaraghavan

Mei-Yuan Huang

DESCRIPTION

The mining industry is pivotal to the world's economy. However, it is not one of the safest industries to work in. The life of miners is always at stake. This project attempts to help the miners in distress so that they receive immediate help. The helmet used by the miner can be improved by adding a wireless sensor mote and necessary sensors, which will help in monitoring the health condition of the miner. In doing so, a network of wireless sensors can be formed. This wireless sensor network (WSN) can be used to monitor the well-being of all the miners who are at work. The routing protocol developed for this project is based on

Distance vector routing (DVR) and finds the best path based on shortest hop. The protocol is also robust to deal with failures. It does not require synchronization of the nodes. The protocol is pro-active to minimize delays. Whenever the load felt on the force sensor on the helmet is more than a threshold value, the mote in the helmet attempts to send a distress message to its Room Manager through the saved route. When a miner sends a distress message via its Room Manager, officials from Center can send in a medical team. The miners in the neighboring rooms are also informed so that they can help voluntarily. At times, the mote may not have a route to its Room Manager. In such cases a failure recovery procedure is carried out. The functioning of the project was successfully tested.

4.TITLE

An Occupational Health and Safety Monitoring System

AUTHOR

S.A. Ngubo
C.P. Kruger
G.P. Hancke
B.J. Silva

DESCRIPTION

Hazardous environments at the workplace are a significant contributor to injuries due to accidents as well as chronic diseases. There are many occupational health and safety (OHS) systems, but they are costly or not flexible. This paper presents a low-cost OHS. It consists of various sensors that can be used to monitor whether a safety helmet is being worn, the worker is mobile and safety boots are being worn. The system interfaces with a wireless sensor network and is suitable for operation in environments such as underground mines and sawmills.

5.TITLE:

Experimental Design of Gas Monitoring System in Mine Safety helmet Based on Wireless Sensors Networks

AUTHOR:

Chunlong Ma ˈJinmingHuo
Xiaohui Yang

DESCRIPTION:

In order to solve such problems of the mine cable gas monitoring system as high costs, inconvenient maintenance, hindering wiring and unmovable monitoring information points, a mine safety helmet is designed, based on wireless sensors networks, which studies the hardware design, gas concentration calculations and its dynamic compensation algorithm, as well as the experimental design of gas monitoring system in mine safety helmet so as to ensure the correct calculation of the gas concentration. The innovative point of this essay is the combination of the ordinary LED cap lamp and the wireless sensors networks, which ensures a real-time, dynamic collection ofthe information of the gas concentration around the workers.

6.TITLE

Smart Helmets for Safety in Mining Industry

AUTHOR

Mei-Yuan Huang
Rohith Revindran
Hansini Vijayaraghavan

DESCRIPTION

This wireless sensor network (WSN) can be used to monitor the well-being of all the miners who are at work. The routing protocol developed for this project is based on Distance vector routing (DVR) and finds the best path based on shortest hop. In such cases a failure recovery procedure is carri

7.TITLE

Zigbee Based Intelligent Helmet For Coal Miners

AUTHOR

Pulishetty Prasad
Dr.K.Hemachandran
H.Ragupathy

DESCRIPTION

An Intelligent Helmet For Coal Mines Based On Zigbee Wireless Communication, Their Main Idea Is To Detect The Humidity Level, Methane Concentration And The Temperature Of The Mining Area. These Sensed Data Will Be Transmitted To The Ground Station Wirelessly Through Zigbee

CHAPTER - 3

SYSTEM DESIGN

3.1 GENERAL

Design is a very important part of development of a project and it represents the meaning of the model that is to be built. Software design is a process through which the requirements are translated into representation of the software. Design is the place where quality is rendered. Design is the means to accurately translate customer requirements into finished products.

3.1.1 SYSTEM FLOW DIAGRAM

<u>Workflow for gas sensor</u>

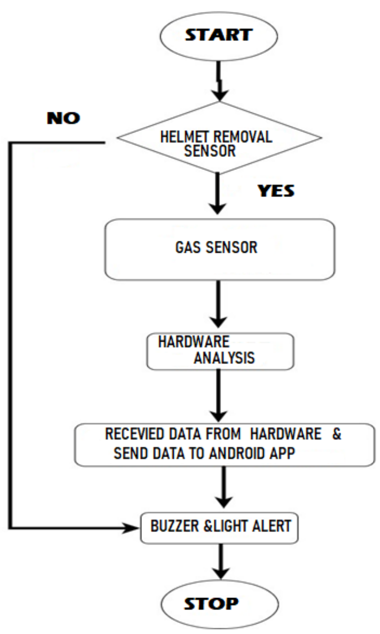


Fig.3.1.1 System flow diagram

Workflow diagram for location

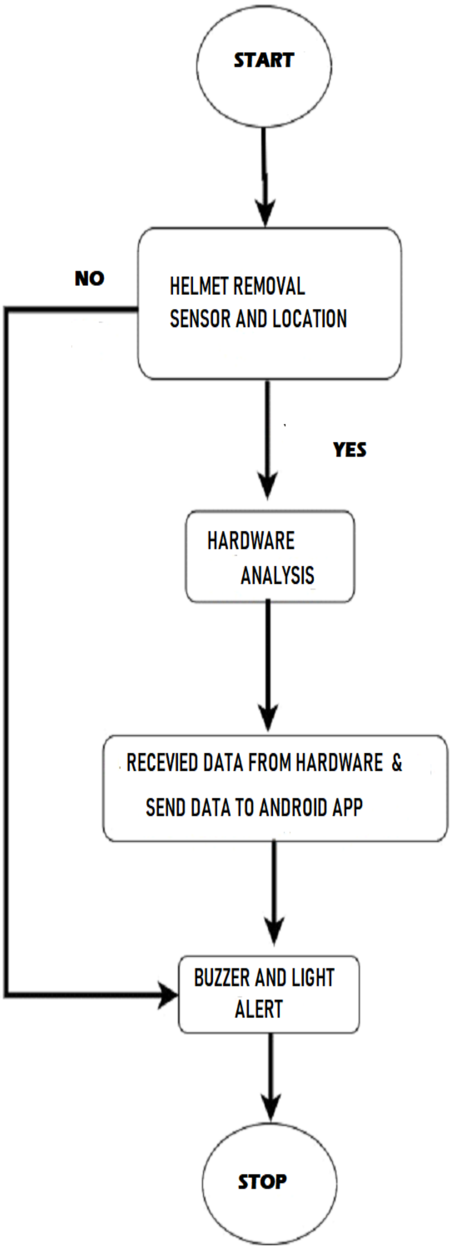
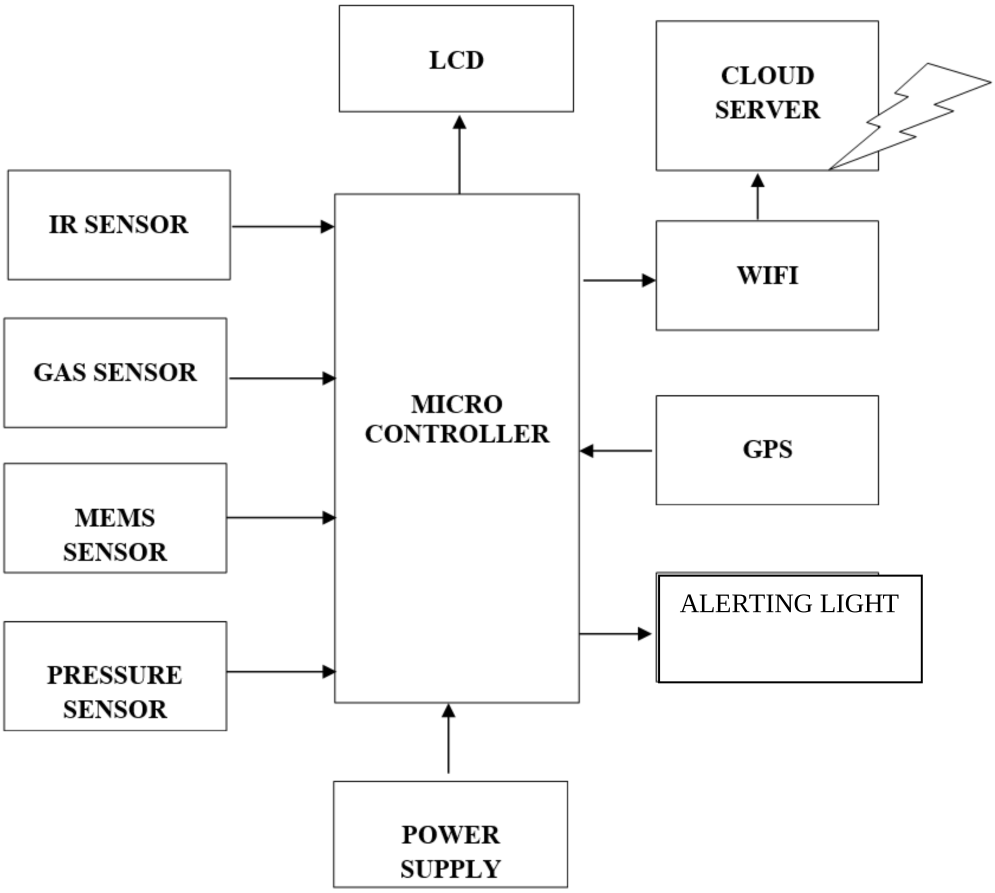


Fig.3.1.1 System flow diagram

3.1.2 SYSTEM ARCHITECTURE

TRANSMITTER



RECEIVER

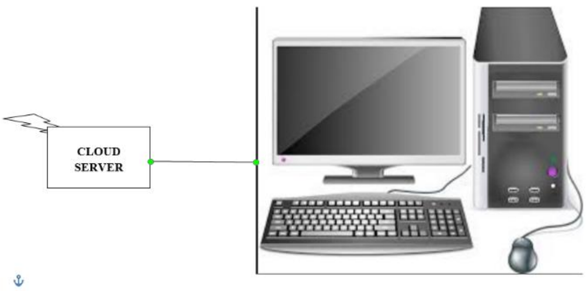


Fig.3.1.2 System Architecture

3.1.3 USE CASE DIAGRAM

The main purpose of a use case diagram is to portray the dynamic aspect of a system. It accumulates the system's requirement, which includes both internal as well as external influences. It invokes persons, use cases, and several things that invoke the actors and elements accountable for the implementation of use case diagrams. It represents how an entity from the external environment can interact with a part of the system.

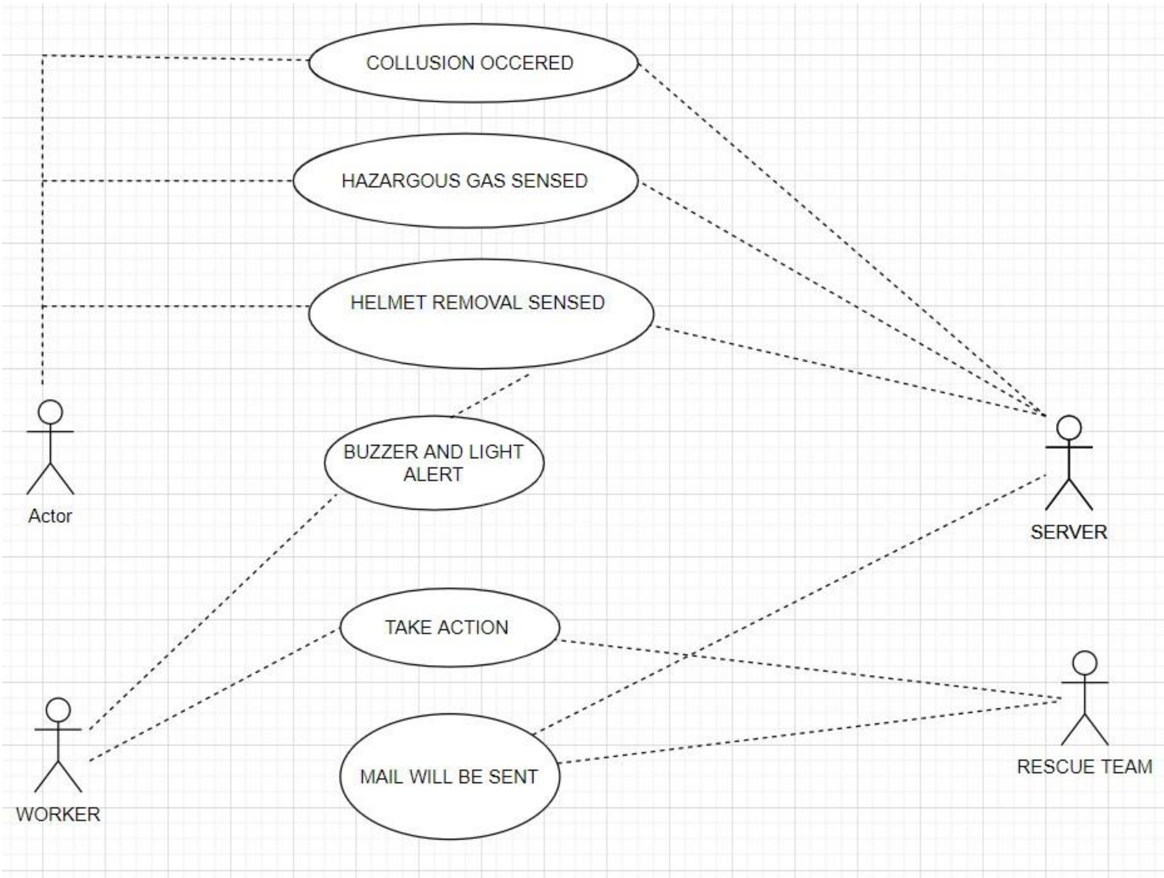


Fig.3.1.3 Usecase diagram

3.1.4 SEQUENCE DIAGRAM

The sequence diagram represents the flow of messages in the system and is also termed as an event diagram. It helps in envisioning several dynamic scenarios. It portrays the communication between any two lifelines as a time-ordered sequence of events, such that these lifelines took part at the run time. In UML, the lifeline is represented by a vertical bar, whereas the message flow is represented by a vertical dotted line that extends across the bottom of the page. It incorporates the iterations as well as branching.

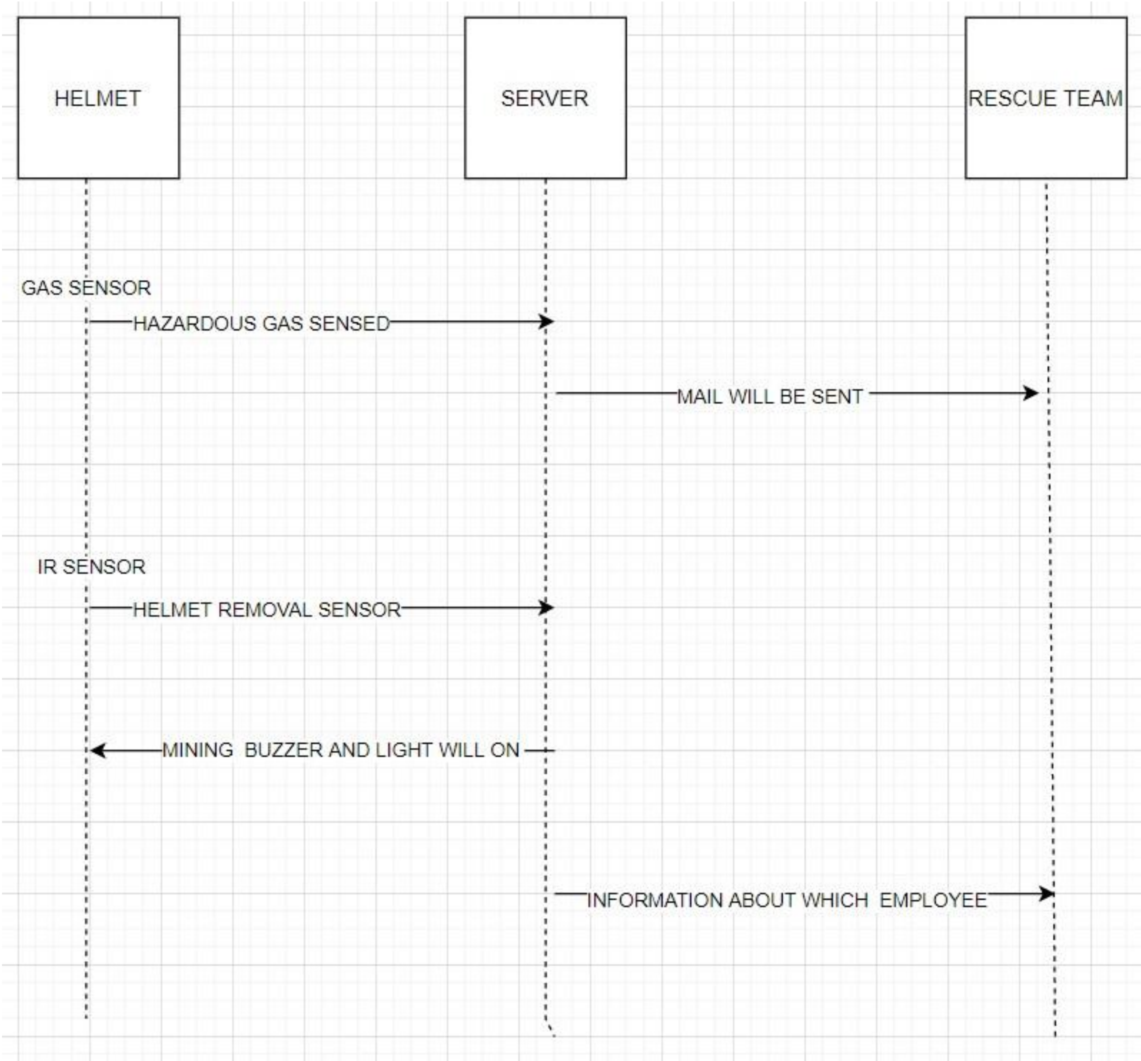


Fig.3.1.4 Sequence Diagram

3.1.5 COMPONENT DIAGRAM

The component diagram is a special purpose diagram, which is used to visualize the static implementation view of a system. It represents the physical components of a system, or we can say it portrays the organization of the components inside a system.

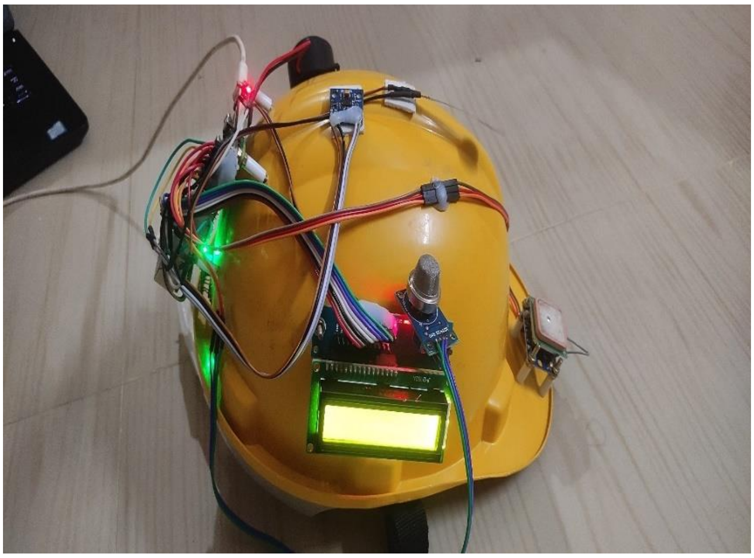


Fig.3.1.5 Component Diagram

CHAPTER 4

PROJECT DESCRIPTION

4.1METHODOLOGIES

- Helmet module
- GPS module

4.1.1 HELMET MODULE

As the helmet is the only safety gear miners tend to keep on, this is where the new safety equipment was added on to. Three sensors were used, an accelerometer, air quality and an Infra-red (IR) sensor. These were used either to detect if a miner has experienced a bump to the head or removed his helmet and surrounding air quality. The three sensors were connected to a ZigBee module. This module does all the processing and also controls the wireless communication between separate helmets through the Contiki operating system (OS). The whole system was analyzed throughout the design process in order to keep the power consumption to a minimum as the system is running on battery power. Different sensors were considered for each separate component in order to keep the power level as low as possible. In order to explain the entire system and the alternatives of each component, the system will be explained component by component. The system consists of six components, helmet remove sensor, collision sensor, air quality sensor, data processing unit, wireless transmission and alerting unit.

HARDWARE REQUIRMENTS

- MICRO CONTROLLER-RASPBERRY PI
- GAS SENSOR – MQ2
- IR SENSOR
- MEMS SENSOR
- BATTERY

- CONNECTING WIRES
- SOLDERING KIT
- HELMET

SOFTWARE REQUIRMENTS

- THONNY IDE
- PYTHON
- PHP-MYSQL

GAS SENSOR (MQ2)

DESCRIPTION

Gas detectors can be used to detect combustible, flammable and toxic gases, and oxygen depletion. This type of device is used widely in industry and can be found in locations, such as on oil rigs, to monitor manufacture processes and emerging technologies such as photovoltaic. They may be used in firefighting.

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 that occur in the concentration of molecules at gaseous state. The gas sensor module consists of a steel exoskeleton under which a sensing element is housed.

Fig 4.1.1 Gas sensor (MQ2)

This sensing element is subjected to current through connecting leads. This current is known as 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.

FEATURES

- Analog and Digital output
- Good sensitivity to Combustible gas in wide range
- High sensitivity to LPG, Propane and Hydrogen
- Operation voltage: 5VDC
- Simple drive circuit
- Long life and low cost

APPLICATIONS

- Domestic gas leakage detector
- Industrial Combustible gas detector

PRESSURE SENSOR

DESCRIPTION

A pressure sensor is a device which senses pressure and converts it into an analog electric signal whose magnitude depends upon the pressure applied. Since they convert pressure into an electrical signal, they are also termed as pressure transducers.

Fig 4.1.2 Pressure sensor

A pressure sensor is a device which senses pressure and converts it into an analog electric signal whose magnitude depends upon the pressure applied. Pressure sensors can also be used to measure other variables such as fluid/gas flow, speed and altitude. They are also designed to measure in a dynamic mode for capturing very high speed changes in pressure.

A pressure sensor measures pressure, typically of gases or liquids. Pressure is an expression of the force required to stop a fluid from expanding, and is usually stated in terms of force per unit area. A pressure sensor usually acts as a transducer; it generates a signal as a function of the pressure imposed. Pressure sensors can vary drastically in technology, design, performance, application suitability and cost.

Pressure sensors that are designed to measure in a dynamic mode for capturing very high speed changes in pressure. They are used in measuring combustion pressure in an engine cylinder or in a gas turbine. These sensors are commonly manufactured out of piezoelectric materials such as quartz.

FEATURES

- Operating voltage: 5v
- Output: analog(0-5v)
- 2.5% Maximum Error over 0° to 85°C
- Temperature Compensated from Over -40° to +125°C
- Thermoplastic (PPS) Surface Mount Package\

APPLICATIONS

- Touch Screen Devices
- Bio Medical Instrumentation
- Aviation
- Marine Industry

IR SENSOR

DESCRIPTION

An infrared sensor is an electronic device, that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measures only infrared radiation, rather than emitting it that is called as a passive IR sensor.

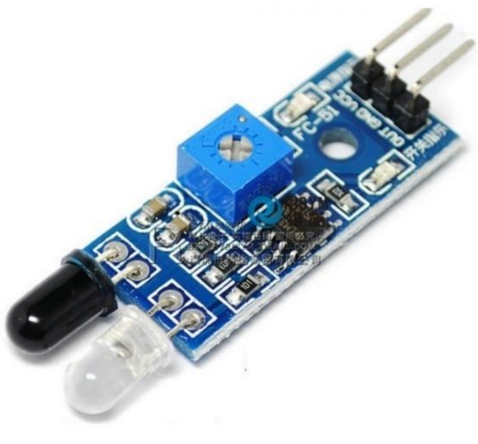


Fig4.1.3 IR Sensor

An infrared sensor is an electronic device, that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measures only infrared radiation, rather than emitting it that is called as a passive IR sensor. Usually in the infrared spectrum, all the objects radiate some form of thermal radiations. These types of radiations are invisible to our eyes, that can be detected by an infrared sensor.The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, The resistances and these output voltages, change in proportion to the magnitude of the IR light received.

FEATURES

- Input voltage : 3.3v
- Output : analog

APPLICATION

- Radiation Thermometers
- Flame Monitor
- Moisture Analyzers
- Gas Analyzers

RASPBERRY PI 4

DESCRIPTION

The Raspberry Pi 4 Model B is the third generation Raspberry Pi. This powerful credit-card sized single board computer can be used for many applications and supersedes the original Raspberry Pi Model B+ and Raspberry Pi 4 Model B.

Whilst maintaining the popular board format the Raspberry Pi 4 Model B brings you a more powerful processer, 10x faster than the first generation Raspberry Pi. Additionally it adds wireless LAN & Bluetooth connectivity making it the ideal solution for powerful connected designs.

The Raspberry Pi 4 is the third generation Raspberry Pi. It replaced the Raspberry Pi 2 Model B in February 2016. The Raspberry Pi 4 has an identical form factor to the previous Pi 3 (and Pi 1 Model B+) and has complete compatibility with Raspberry Pi 1 and 2.

The best part about all this is that the Pi 4 keeps the same shape, connectors, and mounting holes as the Pi 2.Dual Core Video Core IV® Multimedia Co-Processor. Provides Open GL ES 2.0, hardware-accelerated Open VG, and 1080p30 H.264 high-profile decode.

FEATURES

- A 2.4 GHz 64-bit quad-core ARMv8 CPU
- IEEE 802.11 Wireless LAN
- Bluetooth 5.0
- Bluetooth Low Energy (BLE)
- 4GB RAM
- 40 GPIO pins
- Ethernet port

APPLICATIONS

- Server/cloud server
- Security monitoring
- Environmental sensing/monitoring (e.g. weather station)
- IOT applications
- Robotics
- Wireless access point
- Print server

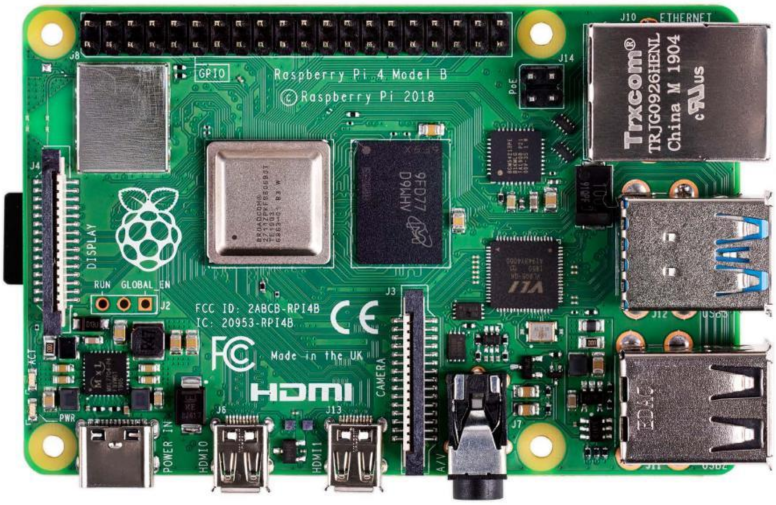


Fig4.1.4 Raspberry Pi 4 Model B

BROADCOM BCM 2711 PROCESSOR

DESCRIPTION

The Broadcom BCM2711 SoC (System of a chip)used in the first generation Raspberry Pi is somewhat equivalent to the chip used in first generation smart phones (its CPU is an older ARMv6 architecture), which includes a 700 MHz ARM 7 Core processor, Video Core IV graphics processing unit (GPU), and RAM. The Raspberry Pi is a series of small single-board computers developed in the United Kingdom by the Raspberry Pi Foundation to promote the teaching of basic computer science in schools and in developing countries. The original model became far more popular than anticipated, selling outside of its target market for uses such as robotics. Peripherals (including keyboards, mice and cases) are not included with the Raspberry Pi. Some accessories however have been included in several official and unofficial bundles

Fig4.1.5 Broadcom Bcm 2711 Processor

GPIO PINS

DESCRIPTION

General-purpose input/output (GPIO) is a generic pin on an integrated circuit or computer board whose behavior including whether it is an input or output pin is controllable by the user at run time. GPIO pins have no predefined purpose, and go unused by default.

Serial Peripheral Interface (SPI) is an interface bus commonly used to send data between microcontrollers and small peripherals such as shift registers, sensors, and SD cards. It uses separate clock and data lines, along with a select line to choose the device you wish to talk to.

The I2C bus was designed by Philips in the early '80s to allow easy communication between components which reside on the same circuit board. Philips Semiconductors migrated to NXP in 2006. The name I2C translates into “Inter IC”. Sometimes the bus is called IIC or I²C bus. I2C is a serial protocol for two-wire interface to connect low-speed devices like microcontrollers, EEPROMs, A/D and D/A converters, I/O interfaces and other similar peripherals in embedded systems. It was invented by Philips and now it is used by almost all major IC manufacturers. Selecting between I2c and SPI, the two main serial communication protocols, requires a good understanding of the advantages and limitations of I2C, SPI, and your application. Each communication protocol will have distinct advantages which will tend to distinguish itself as it applies to your application. The key distinctions between I2C and SPI are:

- I2C requires only two wires, while SPI requires three or four
- SPI supports higher speed full-duplex communication while I2C is slower
- I2C draws more power than SPI
- I2C supports multiple devices on the same bus without additional select signal lines through in-communication device addressing while SPI requires additional signal lines to manage multiple devices on the same bus
- I2C ensures that data sent is received by the slave device while SPI does not verify that data is received correctly
- I2C can be locked up by one device that fails to release the communication bus
- SPI cannot transmit off the PCB while I2C can, albeit at low data transmission speeds
- I2C is cheaper to implement than the SPI communication protocol
- SPI only supports one master device on the bus while I2C supports multiple master devices
- I2C is less susceptible to noise than SPI
- SPI can only travel short distances and rarely off of the PCB while I2C can transmit data over much greater distances, although at low data rates

The lack of a formal standard has resulted in several variations of the SPI protocol, variations which have been largely avoided with the I2C protocol

BATTERY

DESCRIPTION

Batteries are a collection of one or more cells whose chemical reactions create a flow of electrons in a circuit. All batteries are made up of three basic components: an anode (the '-' side), a cathode (the '+' side), and some kind of electrolyte (a substance that chemically reacts with the anode and cathode).

When the anode and cathode of a battery is connected to a circuit, a chemical reaction takes place between the anode and the electrolyte. This reaction causes electrons to flow through the circuit and back into the cathode where another chemical reaction takes place. When the material in the cathode or anode is consumed or no longer able to be used in the reaction, the battery is unable to produce electricity. At that point, your battery is "dead."

Batteries that must be thrown away after use are known as **primary batteries**. Batteries that can be recharged are called **secondary batteries.**

9-volt battery, in its most common form was introduced for the early transistor radios. It has a rectangular prism shape with rounded edges and a polarized snap connector at the top. This type is commonly used in walkie talkies, clocks and smoke detectors. They are also used as backup power to keep the time in certain electronic clocks.

This format is commonly available in primary carbon-zinc and alkaline chemistry, in primary lithium iron disulfide, and in rechargeable form in nickel cadmium, nickel-metal hydride and lithium-ion. Mercury oxide batteries in this form have not been manufactured in many years due to their mercury content.

9V battery has a rectangular prism shape with rounded edges and a polarized snap connector at the top. A zinc–carbon (6F22) battery is a dry cell battery that delivers a potential of 1.5 volts between a zinc metal electrode and a carbon rod from an electrochemical reaction between zinc and manganese dioxide mediated by a suitable electrolyte.

It was introduced for the early transistor radios. It is usually conveniently packaged in a zinc can which also serves as the anode with a negative potential, while the inert carbon rod is the positive cathode. An advantage is that several nine-volt batteries can be connected to each other in series to provide higher voltages.

FEATURES

- Output voltage: 12v
- Current capacity: 400mAh
- Approximate Volume: 0.2 cu. in. (3.3 cu. cm.)
- Approximate Weight: 0.4 oz. (11 gm.)

APPLICATIONS

- Walkie talkies.
- It is used to assorted electronics projects.
- Use a 9V battery clip to easily connect your 9V battery to your Arduino.
- The "9V clip" is also used on some batter holders of assorted voltages.

MEMS SENSOR

DESCRIPTION

Micro electromechanical system (MEMS, also written a micro-electro-mechanical, Micro Electro Mechanical or Micro Electronic and micro electro mechanical systems and the related micro mechatronics) is the technology of microscopic devices, particularly those with moving parts.

The accelerometer is a low power, low profile capacitive micro machined Accelerometer featuring signal conditioning, a 1-pole low pass filter, temperature Compensation, self test, 0g-Detect which detects linear freefall, and g-Select which Allows for the selection between 2 sensitivities Zero-g offset and sensitivity is Factory set and requires no external devices. This includes a Sleep Mode that makes it ideal for handheld battery powered

.

Fig4.1.6 Mems sensor

You can use an accelerometer's ability to sense acceleration to measure a variety of things that are very useful to electronic and robotic projects and designs:

- Acceleration
- Tilt and tilt angle
- Rotation
- Vibration
- Gravity

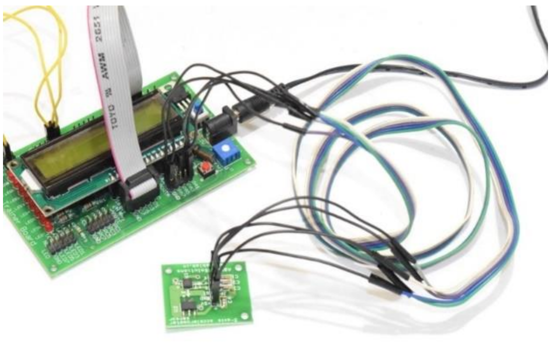


Fig4.1.7 Sensor Interface With Controller

Acceleration is a measure of how quickly speed changes. Just as a speedometer is a meter that measures speed, an accelerometer is a meter that measures acceleration.

Accelerometers are useful for sensing vibrations in systems or for orientation applications. Accelerometers can measure acceleration on one, two, or three axis. 3-axis units are becoming more common as the cost of development for them decreases. You can use an accelerometer's ability to sense acceleration to measure a variety of things that are very useful to electronic and robotic projects.

FEATURES

- Low Current Consumption: 400 ma
- Sleep Mode: 3µA
- Low Voltage Operation: 2.2 V – 3.6 V
- High Sensitivity (800 mV/g @ 1.5g)
- Selectable Sensitivity (±1.5g, ±6g)
- Fast Turn on Time (0.5 ms Enable Response Time)
- Self Test for Freefall Detect Diagnosis

APPLICATIONS:

- Self balancing robots
- Tilt-mode game controllers
- Model airplane auto pilot
- Car alarm systems
- Crash detection/airbag deployment

4.1.2 GPS MODULE

GPS MODULE

DESCRIPTION

The Global Positioning System (GPS), originally Navstar GPS, is a space-based radio navigation system owned by the United States government and operated by the United

States Air Force. It is a global navigation satellite system that provides geo location and time information to a GPS receiver anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites.

The GPS system does not require the user to transmit any data, and it operates independently of any telephonic or internet reception, though these technologies can enhance the usefulness of the GPS positioning information. The GPS system provides critical positioning capabilities to military, civil, and commercial users around the world. The United States government created the system, maintains it, and makes it freely accessible to anyone with a GPS receiver.

Fig4.1.7 GPS Module

The Global Positioning System (GPS) is a global navigation satellite system that provides location and time information in all weather conditions. The GPS operates independently of any telephonic or internet reception, though these technologies can enhance the usefulness of the GPS positioning information. GPS satellites transmit signal information to earth. This signal information is received by the GPS receiver in order to measure the user’s correct position.

The GPS concept is based on time and the known position of specialized satellites. GPS satellites continuously transmit their current time and position. A GPS receiver monitors multiple satellites and solves equations to determine the precise position of the receiver and its deviation from true time. At a minimum, four satellites must be in view of the receiver for it to compute four unknown quantities.

Each GPS satellite continually broadcasts a signal (carrier wave with modulation) that includes a pseudorandom code (sequence of ones and zeros) that is known to the receiver and a message that includes the time of transmission (TOT) of the code epoch and the satellite position at that time.

FEATURES

- Supply voltage: 12v DC
- Interface: UART RS232
- Optional T-TL UART also available
- Precision: 5 meters
- Automatic antenna switching function

APPLICATIONS

- GPS trackers
- Automated vehicle
- Robotics
- Fleet tracking

ALERTING UNIT

Alerting miners in a mine can be a difficult process bearing in mind the everyday working conditions that are encountered in a mine. Underground mines are very dark places and therefore the miners use safety helmets with built-in or attachable mining lights. The equipment used in underground mines can create a lot of noise and vibrations, which are compounded by the cramped conditions in the underground tunnels. The problem associated with the noise is that warning a miner with a speaker or an alarm system when a fellow miner is experiencing a hazardous event would most probably be in vain as the miner would not hear the alarm. A second option was considered with the use of a vibrating unit within the mining helmet. Warning a miner with a vibrating helmet would work. However when a miner is working with one or close to equipment that creates a lot of vibration, the miner most probably would feel or misinterpret the vibration as part of the vibration created by the equipment. This will allow the system to only work in specific conditions. The aim would be for the system to work under all conditions. Using light-emitting diodes (LED's) placed on the cap of the mining helmet was also considered as it would be a visual way of alerting the miner. It was then decided that adding LED's to a mining helmet that is already equipped with a big light connected to the helmet would mean not using the available resources. It was therefore decided to implement a system that will warn the miner by flashing the mining light a few times. Using this warning method has the added benefit of using the mining helmet light of the miner who is experiencing the hazardous event. Flashing the light constantly simultaneously show who is experiencing the problem as well as indicate the location of the miner.

SOFTWARE DETAILS:

THONNY IDE:

Thonny is a free development program for PC that was made by an independent dev who goes by the same name. It is an open-source integrated development environment (IDE) that can be used to create various applications using the Python programming language.

Thonny, like Visual Studio or NetBeans IDE, makes it far easier for programmers to code with along with all the necessary tools, libraries, and dependencies. This IDE was created to focus on Python and to help novices learn to write and create programmers with it.

PROGRAMMING LANGUAGE:

Python is an interpreter, object-oriented, high-level programming language with dynamic semantics. Its high-level built in data structures, combined with dynamic typing and dynamic binding; make it very attractive for Rapid Application Development, as well as for use as a scripting or glue language to connect existing components together. Python's simple, easy to learn syntax emphasizes readability and therefore reduces the cost of program maintenance. Python supports modules and packages, which encourages program modularity and code reuse. The Python interpreter and the extensive standard library are available in source or binary form without charge for all major platforms, and can be freely distributed.

Often, programmers fall in love with Python because of the increased productivity it provides. Since there is no compilation step, the edit-test-debug cycle is incredibly fast. Debugging Python programs is easy: a bug or bad input will never cause a segmentation fault. Instead, when the interpreter discovers an error, it raises an exception. When the program doesn't catch the exception, the interpreter prints a stack trace.

A source level debugger allows inspection of local and global variables, evaluation of arbitrary expressions, setting breakpoints, stepping through the code a line at a time, and so on. The debugger is written in Python itself, testifying to Python's introspective power. On the other hand, often the quickest way to debug a program is to add a few print statements to the source: the fast edit-test-debug cycle makes this simple approach very effective. It ranges from simple automation tasks to gaming, web development, and even complex enterprise systems. These are the areas where this technology is still the king with no or little competence: Machine learning as it has a plethora of libraries implementing machine learning algorithms.

Python is a one-stop shop and relatively easy to learn, thus quite popular now. What other reasons exist for such universal popularity of this programming language and what companies have leveraged its opportunities to the max? Let’s talk about that. Python technology is quite popular among programmers, but the practice shows that business owners are also Python development believers and for good reason. Software developers love it for its straightforward syntax and reputation as one of the easiest programming languages to learn. Business owners or CTOs appreciate the fact that there’s a framework for pretty much anything – from web apps to machine learning. Moreover, it is not just a language but more a technology platform that has come together through a gigantic collaboration from thousands of individual professional developers forming a huge and peculiar community of aficionados. So what is python used for and what are the tangible benefits the language brings to those who decided to use it? Below we’re going to discover that. Productivity and Speed It is a widespread theory within development circles that developing Python applications is approximately up to 10 times faster than developing the same application in Java or C/C++. The impressive benefit in terms of time saving can be explained by the clean object-oriented design, enhanced process control capabilities, and strong integration and text processing capacities. Moreover, its own unit testing framework contributes substantially to its speed and productivity.

INTERNET OF THINGS (IoT):

The Internet of things (IoT) describes the network of physical objects “things” that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the Internet.

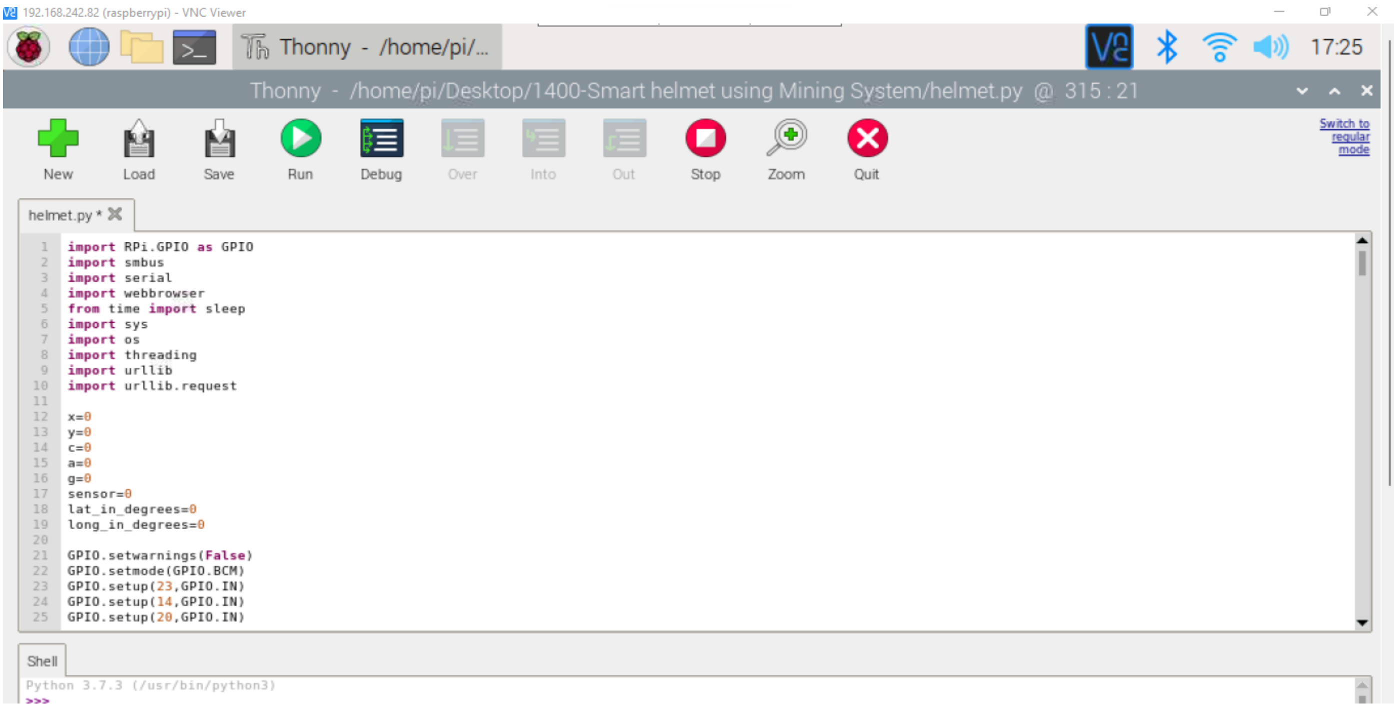
Things have evolved due to the convergence of multiple technologies, real-time analytics, machine learning, commodity sensors, and embedded systems. Traditional fields of embedded systems, wireless sensor networks, control systems, automation (including home and building automation), and others all contribute to enabling the Internet of things. In the consumer market, IoT technology is most synonymous with products pertaining to the concept of the "smart home", including devices and appliances (such as lighting fixtures, thermostats, home security systems and cameras, and other home appliances) that support one or more common ecosystems, and can be controlled via devices associated with that ecosystem, such as smart phones and smart speakers. IoT can also be used in healthcare systems.

The IoT is the strategy for gadgets that encase hardware, and network, which enables these devices to fix, act together and switch information. IoT incorporates broadening Internet beneficial than standard gadgets, for example, work areas to any decision of generally non web get to material gadgets and on a day by day source objects. Inserted through innovation, these gadgets can banter and coordinate over the Internet, and they can be a little checked and restricted.

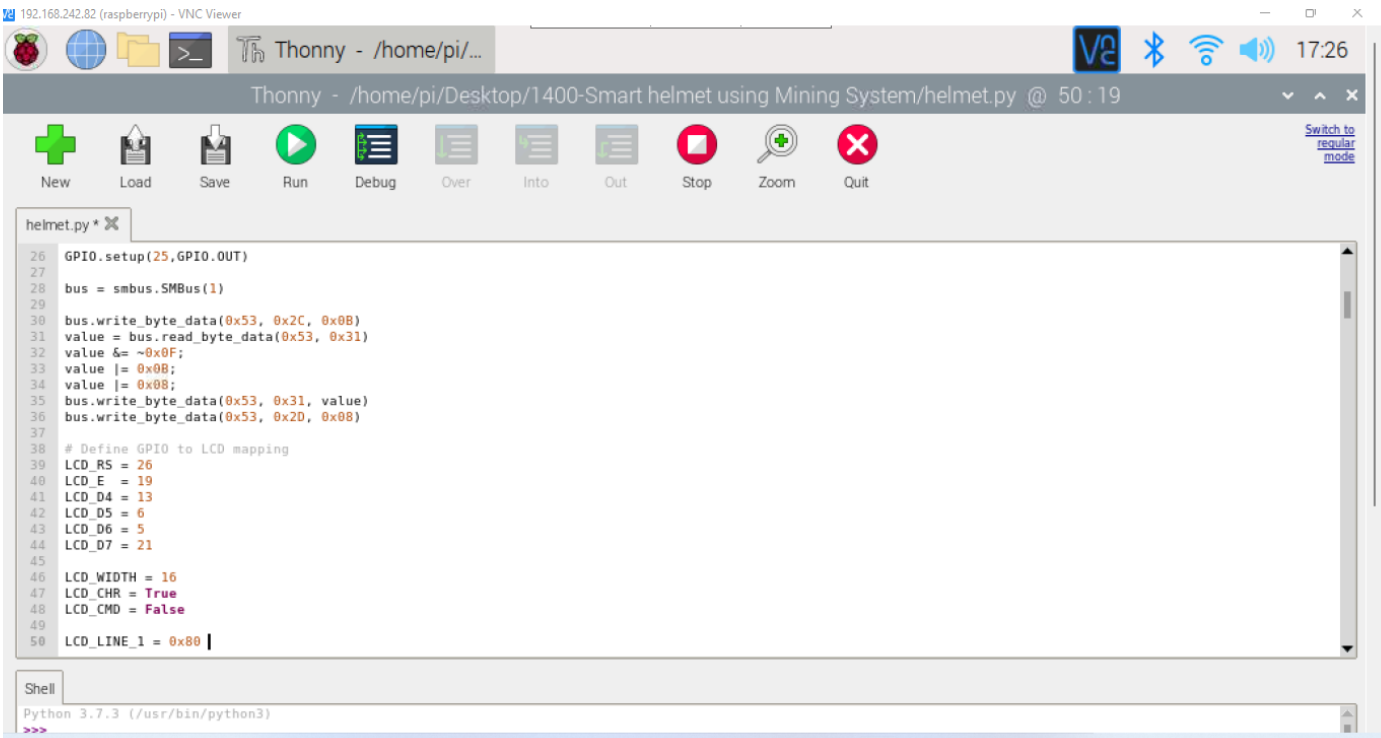
Fig 1: IoT in health care

CHAPTER-5
IMPLEMENTATION

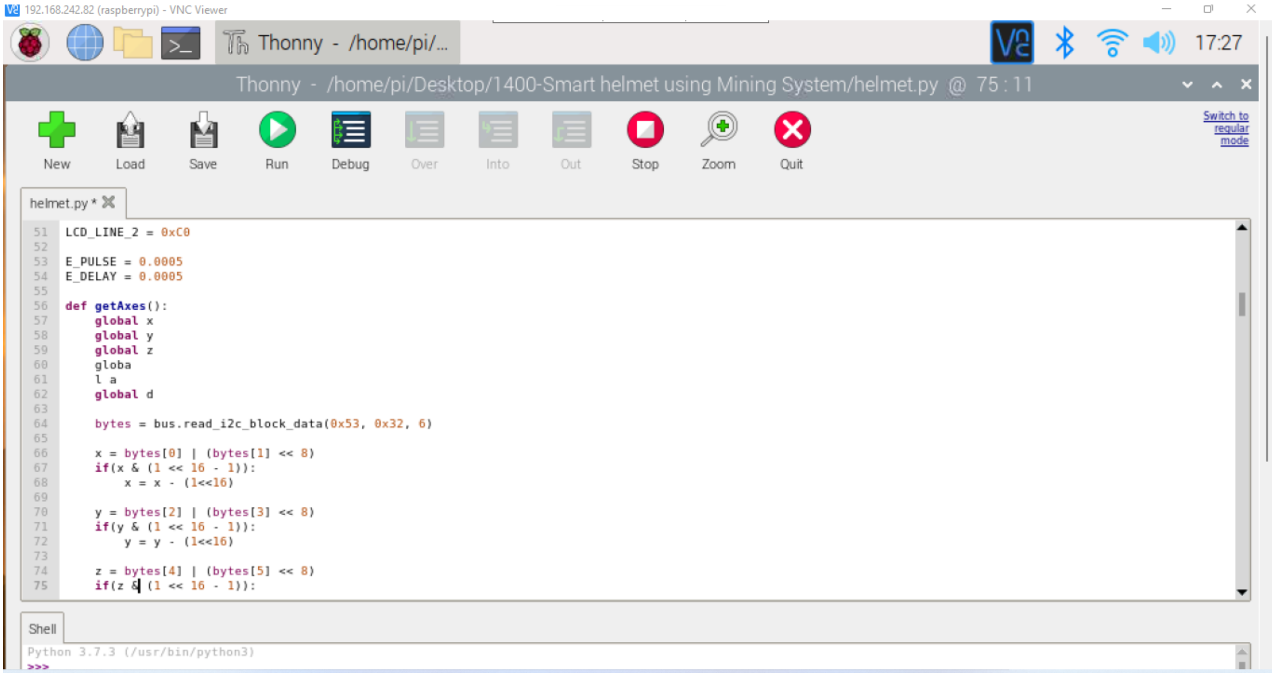
5.1 CODE

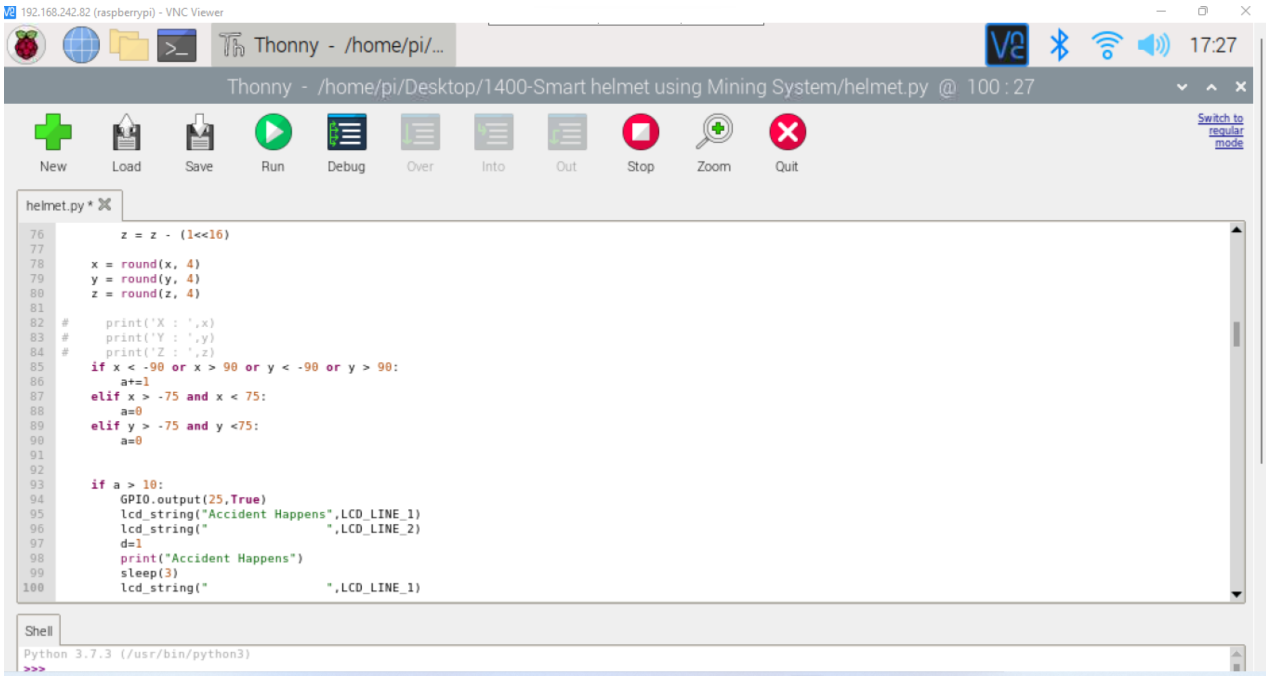


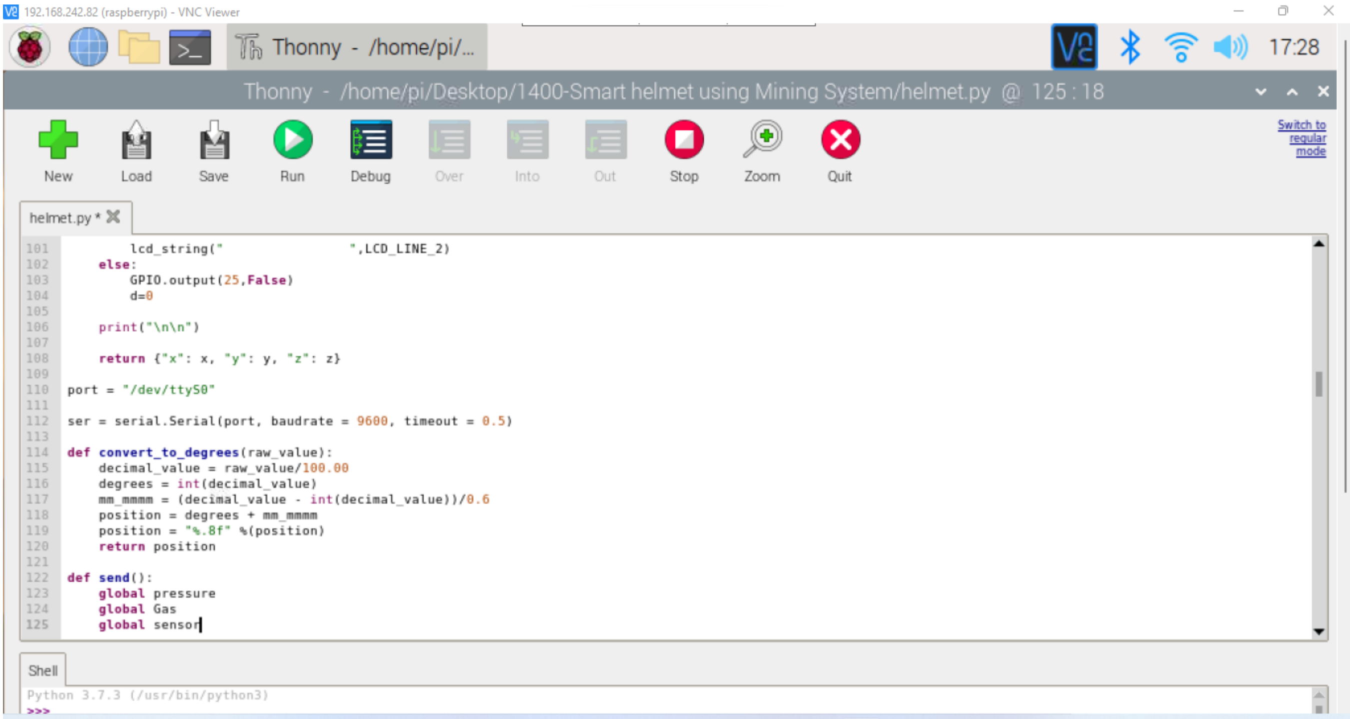
```
import RPi.GPIO as GPIO
import smbus
import serial
import webbrowser
from time import sleep
import sys
import os
import threading
import urllib
import urllib.request

x=0
y=0
c=0
a=0
g=0
sensor=0
lat_in_degrees=0
long_in_degrees=0

GPIO.setwarnings(False)
GPIO.setmode(GPIO.BCM)
GPIO.setup(23,GPIO.IN)
GPIO.setup(14,GPIO.IN)
GPIO.setup(20,GPIO.IN)
```

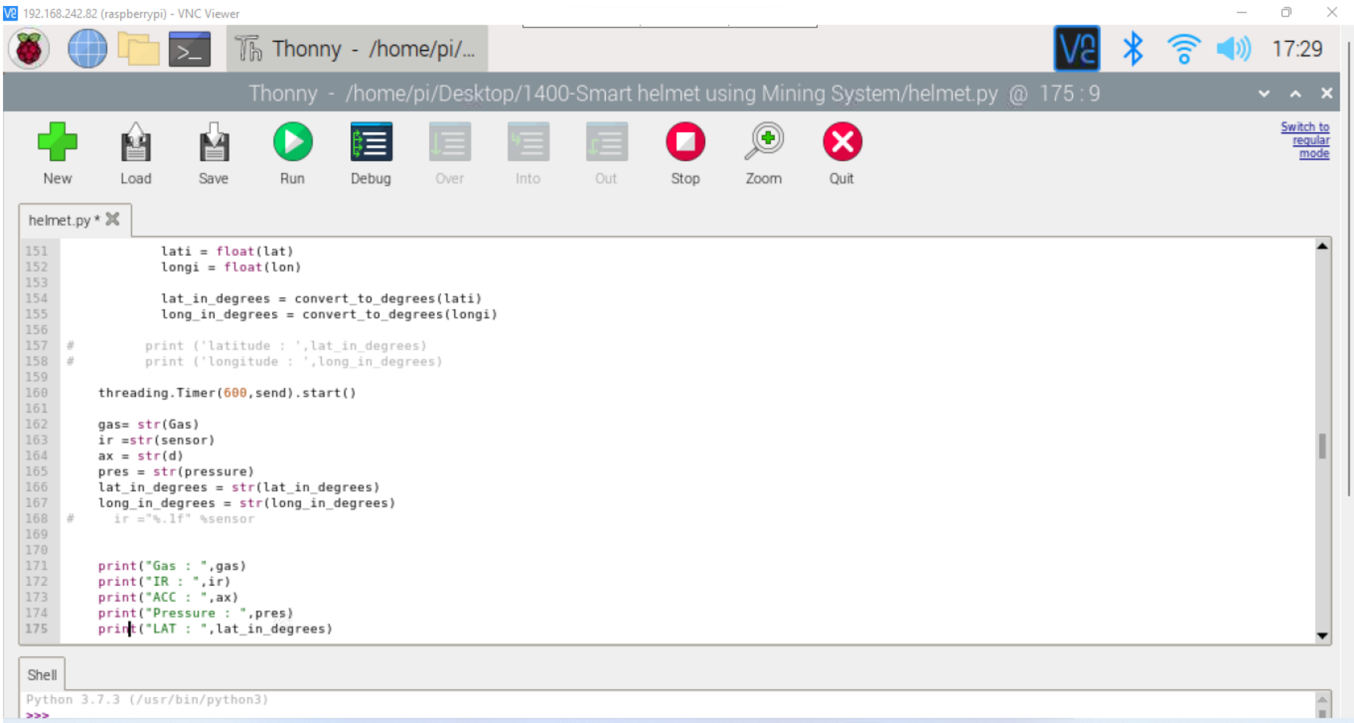


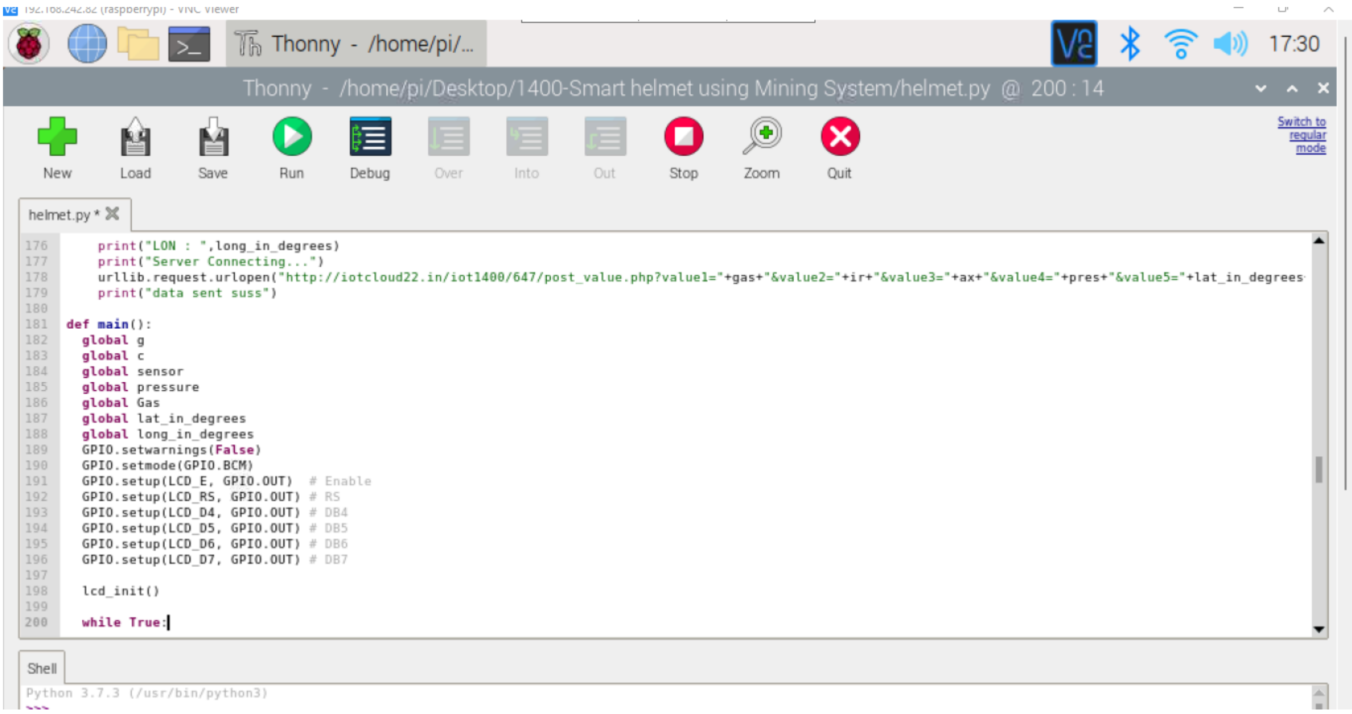
```
GPIO.setup(25,GPIO.OUT)

bus = smbus.SMBus(1)

bus.write_byte_data(0x53, 0x2C, 0x0B)
value = bus.read_byte_data(0x53, 0x31)
value &= ~0x0F;
value |= 0x0B;
value |= 0x08;
bus.write_byte_data(0x53, 0x31, value)
bus.write_byte_data(0x53, 0x2D, 0x08)

# Define GPIO to LCD mapping
LCD_RS = 26
LCD_E  = 19
LCD_D4 = 13
LCD_D5 = 6
LCD_D6 = 5
LCD_D7 = 21

LCD_WIDTH = 16
LCD_CHR = True
LCD_CMD = False

LCD_LINE_1 = 0x80
```

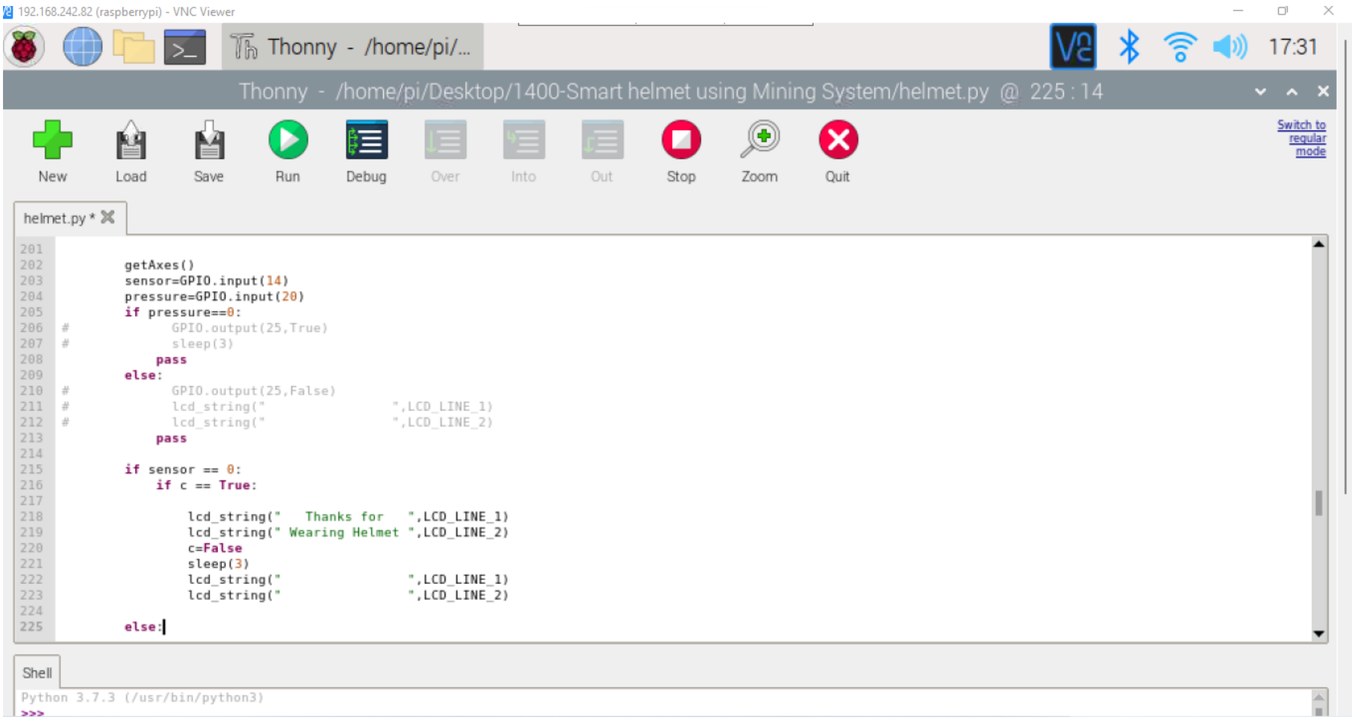

192.168.242.82 (raspberrypi) - VNC Viewer
Thonny - /home/pi/...
17:27
Thonny - /home/pi/Desktop/1400-Smart helmet using Mining System/helmet.py @ 75 : 11
New
Load
Save
Run
Debug
Over
Into
Out
Stop
Zoom
Quit
Switch to regular mode
helmet.py *
LCD_LINE_2 = 0xC0
E_PULSE = 0.0005
E_DELAY = 0.0005
def getAxes():
    global x
    global y
    global z
    globa
    l a
    global d
    bytes = bus.read_i2c_block_data(0x53, 0x32, 6)
    x = bytes[0] | (bytes[1] << 8)
    if(x & (1 << 16 - 1)):
        x = x - (1<<16)
    y = bytes[2] | (bytes[3] << 8)
    if(y & (1 << 16 - 1)):
        y = y - (1<<16)
    z = bytes[4] | (bytes[5] << 8)
    if(z & (1 << 16 - 1)):
Shell
Python 3.7.3 (/usr/bin/python3)
>>>

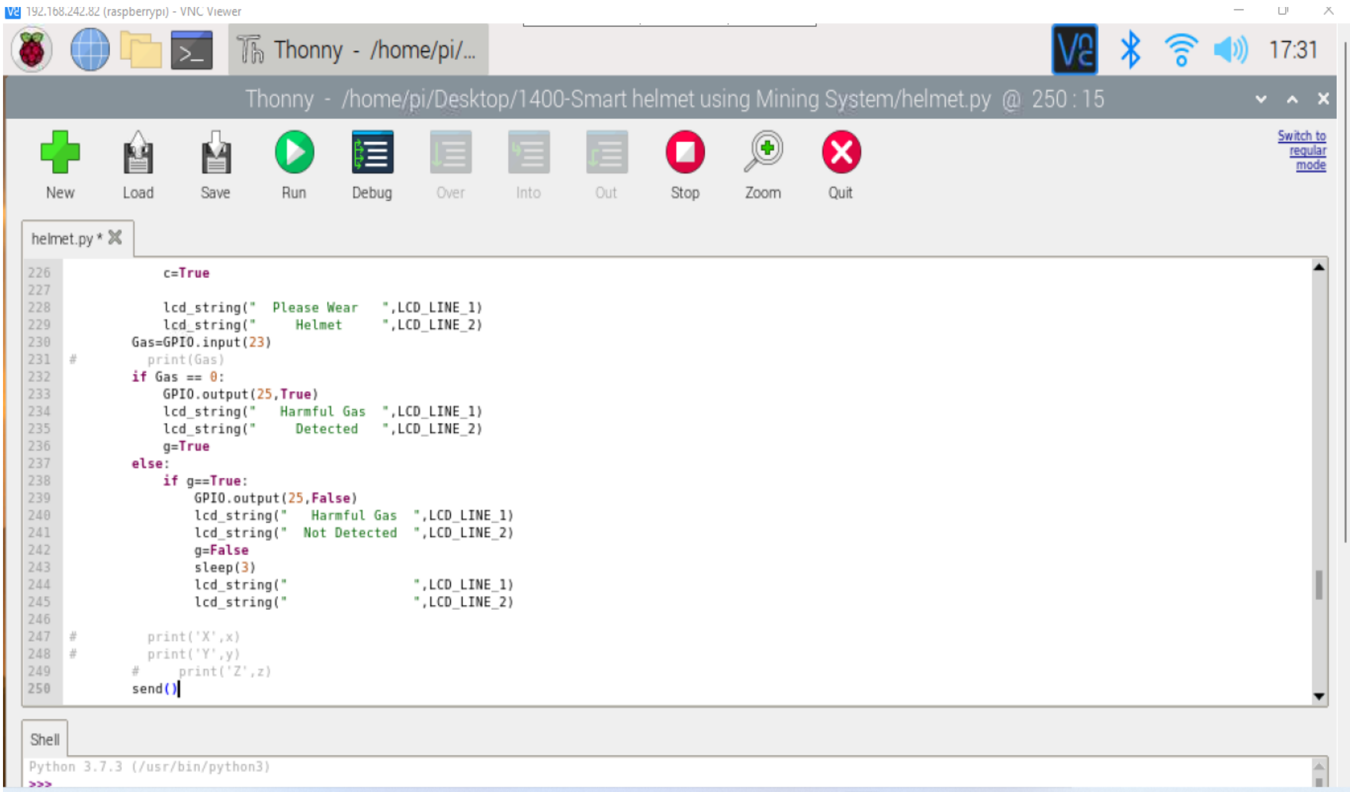

192.168.242.82 (raspberrypi) - VNC Viewer
Thonny - /home/pi/...
17:27
Thonny - /home/pi/Desktop/1400-Smart helmet using Mining System/helmet.py @ 100 : 27
New
Load
Save
Run
Debug
Over
Into
Out
Stop
Zoom
Quit
Switch to regular mode
helmet.py *
        z = z - (1<<16)
    x = round(x, 4)
    y = round(y, 4)
    z = round(z, 4)
#   print('X : ',x)
#   print('Y : ',y)
#   print('Z : ',z)
    if x < -90 or x > 90 or y < -90 or y > 90:
        a+=1
    elif x > -75 and x < 75:
        a=0
    elif y > -75 and y <75:
        a=0
    if a > 10:
        GPIO.output(25,True)
        lcd_string("Accident Happens",LCD_LINE_1)
        lcd_string("   ",LCD_LINE_2)
        d=1
        print("Accident Happens")
        sleep(3)
        lcd_string("   ",LCD_LINE_1)
Shell
Python 3.7.3 (/usr/bin/python3)
>>>


192.168.242.82 (raspberrypi) - VNC Viewer
Thonny - /home/pi/...
17:28
Thonny - /home/pi/Desktop/1400-Smart helmet using Mining System/helmet.py @ 125 : 18
New
Load
Save
Run
Debug
Over
Into
Out
Stop
Zoom
Quit
Switch to regular mode
helmet.py *
        lcd_string("   ",LCD_LINE_2)
    else:
        GPIO.output(25,False)
        d=0
    print("\n\n")
    return {"x": x, "y": y, "z": z}
port = "/dev/ttyS0"
ser = serial.Serial(port, baudrate = 9600, timeout = 0.5)
def convert_to_degrees(raw_value):
    decimal_value = raw_value/100.00
    degrees = int(decimal_value)
    mm_mmmm = (decimal_value - int(decimal_value))/0.6
    position = degrees + mm_mmmm
    position = "%.8f" %(position)
    return position
def send():
    global pressure
    global Gas
    global sensor
Shell
Python 3.7.3 (/usr/bin/python3)
>>>


192.168.242.82 (raspberrypi) - VNC Viewer
Thonny - /home/pi/...
17:29
Thonny - /home/pi/Desktop/1400-Smart helmet using Mining System/helmet.py @ 175 : 9
New
Load
Save
Run
Debug
Over
Into
Out
Stop
Zoom
Quit
Switch to regular mode
helmet.py *
            lati = float(lat)
            longi = float(lon)
            lat_in_degrees = convert_to_degrees(lati)
            long_in_degrees = convert_to_degrees(longi)
#   print ('latitude : ',lat_in_degrees)
#   print ('longitude : ',long_in_degrees)
    threading.Timer(600,send).start()
    gas= str(Gas)
    ir =str(sensor)
    ax = str(d)
    pres = str(pressure)
    lat_in_degrees = str(lat_in_degrees)
    long_in_degrees = str(long_in_degrees)
#   ir ="%.1f" %sensor
    print("Gas : ",gas)
    print("IR : ",ir)
    print("ACC : ",ax)
    print("Pressure : ",pres)
    print("LAT : ",lat_in_degrees)
Shell
Python 3.7.3 (/usr/bin/python3)
>>>


192.168.242.82 (raspberrypi) - VNC Viewer
Thonny - /home/pi/...
17:30
Thonny - /home/pi/Desktop/1400-Smart helmet using Mining System/helmet.py @ 200 : 14
New
Load
Save
Run
Debug
Over
Into
Out
Stop
Zoom
Quit
Switch to regular mode
helmet.py *
print("LON : ",long_in_degrees)
print("Server Connecting...")
urllib.request.urlopen("http://iotcloud22.in/iot1400/647/post_value.php?value1="+gas+"&value2="+ir+"&value3="+ax+"&value4="+pres+"&value5="+lat_in_degrees
print("data sent suss")
def main():
global g
global c
global sensor
global pressure
global Gas
global lat_in_degrees
global long_in_degrees
GPIO.setwarnings(False)
GPIO.setmode(GPIO.BCM)
GPIO.setup(LCD_E, GPIO.OUT) # Enable
GPIO.setup(LCD_RS, GPIO.OUT) # RS
GPIO.setup(LCD_D4, GPIO.OUT) # DB4
GPIO.setup(LCD_D5, GPIO.OUT) # DB5
GPIO.setup(LCD_D6, GPIO.OUT) # DB6
GPIO.setup(LCD_D7, GPIO.OUT) # DB7
lcd_init()
while True:
Shell
Python 3.7.3 (/usr/bin/python3)

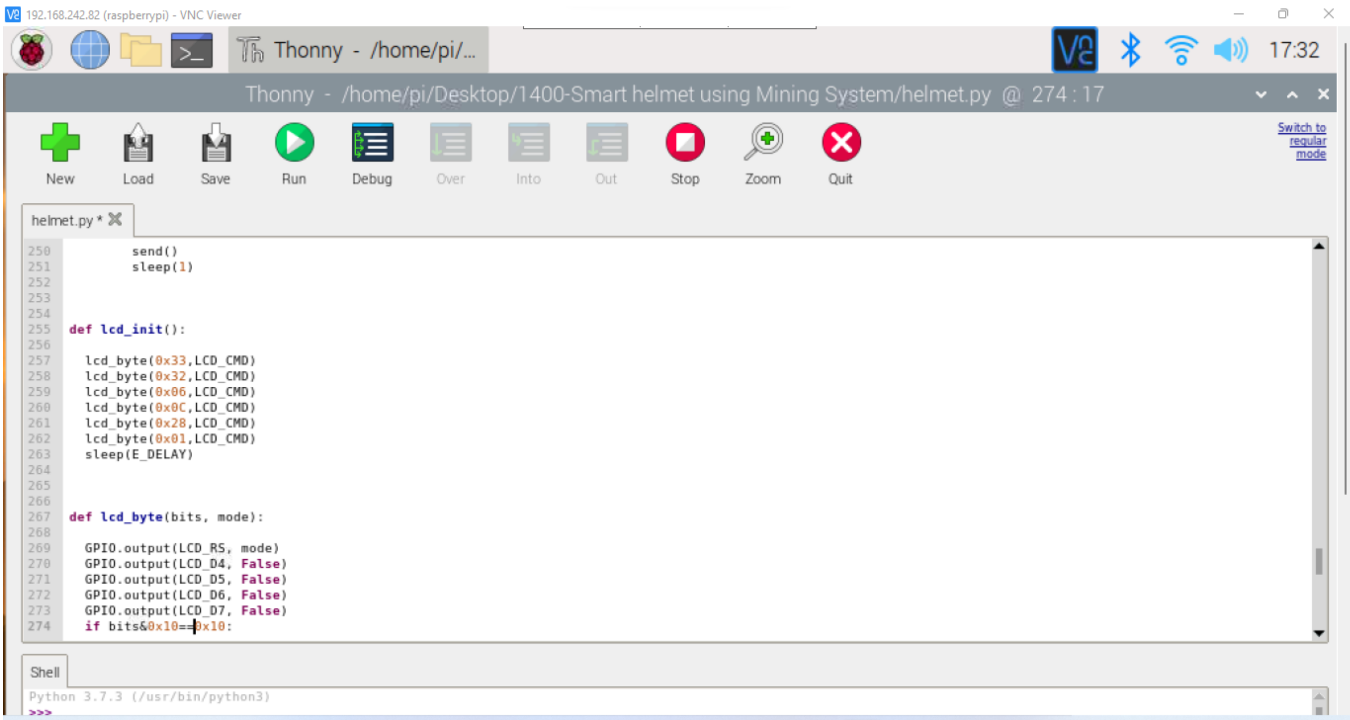

192.168.242.82 (raspberrypi) - VNC Viewer
Thonny - /home/pi/...
17:31
Thonny - /home/pi/Desktop/1400-Smart helmet using Mining System/helmet.py @ 225 : 14
New
Load
Save
Run
Debug
Over
Into
Out
Stop
Zoom
Quit
Switch to regular mode
helmet.py *
getAxes()
sensor=GPIO.input(14)
pressure=GPIO.input(20)
if pressure==0:
# GPIO.output(25,True)
# sleep(3)
pass
else:
# GPIO.output(25,False)
# lcd_string(" ",LCD_LINE_1)
# lcd_string(" ",LCD_LINE_2)
pass
if sensor == 0:
if c == True:
lcd_string(" Thanks for ",LCD_LINE_1)
lcd_string(" Wearing Helmet ",LCD_LINE_2)
c=False
sleep(3)
lcd_string(" ",LCD_LINE_1)
lcd_string(" ",LCD_LINE_2)
else:
Shell
Python 3.7.3 (/usr/bin/python3)
>>>



192.168.242.82 (raspberrypi) - VNC Viewer
Thonny - /home/pi/...
17:31
Thonny - /home/pi/Desktop/1400-Smart helmet using Mining System/helmet.py @ 250 : 15
New
Load
Save
Run
Debug
Over
Into
Out
Stop
Zoom
Quit
Switch to regular mode
helmet.py *
            c=True

            lcd_string(" Please Wear   ",LCD_LINE_1)
            lcd_string("   Helmet   ",LCD_LINE_2)
        Gas=GPIO.input(23)
#   print(Gas)
        if Gas == 0:
            GPIO.output(25,True)
            lcd_string("   Harmful Gas ",LCD_LINE_1)
            lcd_string("   Detected   ",LCD_LINE_2)
            g=True
        else:
            if g==True:
                GPIO.output(25,False)
                lcd_string("   Harmful Gas ",LCD_LINE_1)
                lcd_string(" Not Detected ",LCD_LINE_2)
                g=False
                sleep(3)
                lcd_string("   ",LCD_LINE_1)
                lcd_string("   ",LCD_LINE_2)

print('X',x)
print('Y',y)
        #   print('Z',z)
        send()
Shell
Python 3.7.3 (/usr/bin/python3)
>>>



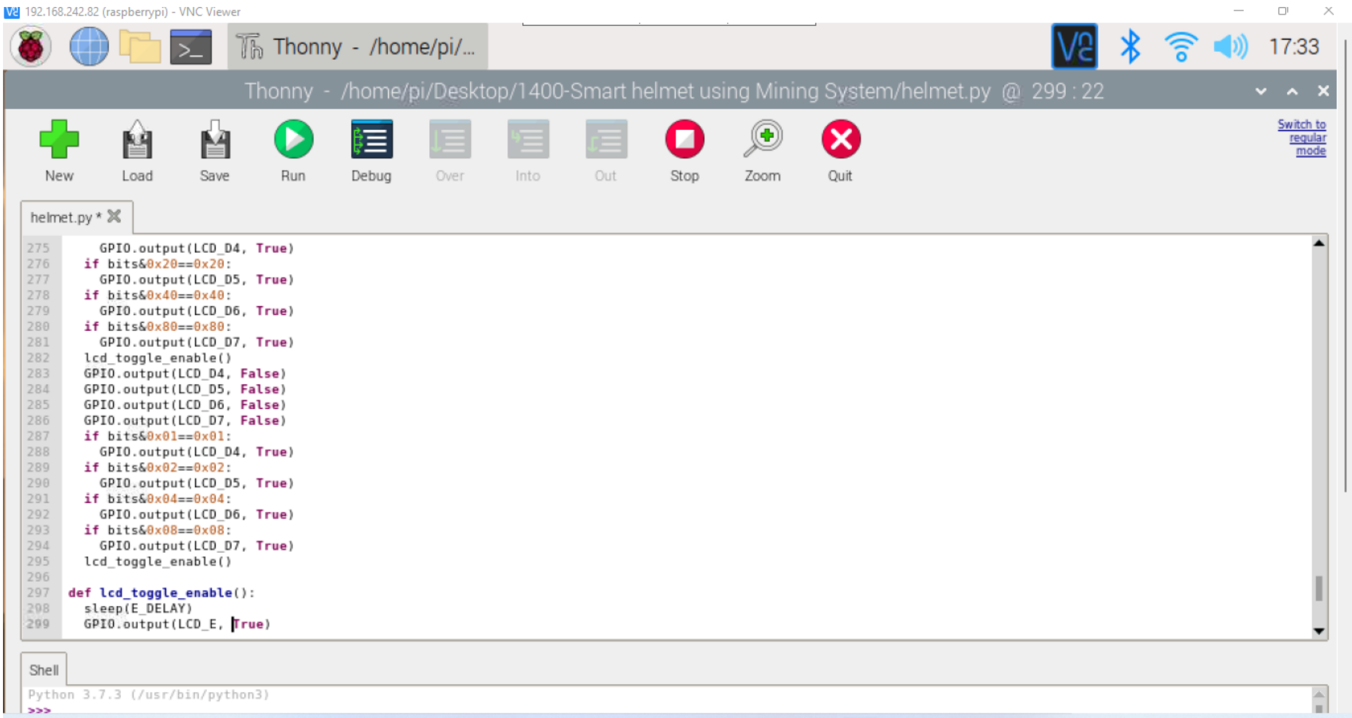
192.168.242.82 (raspberrypi) - VNC Viewer
Thonny - /home/pi/...
17:32
Thonny - /home/pi/Desktop/1400-Smart helmet using Mining System/helmet.py @ 274 : 17
New
Load
Save
Run
Debug
Over
Into
Out
Stop
Zoom
Quit
Switch to regular mode
helmet.py *
        send()
        sleep(1)

def lcd_init():

  lcd_byte(0x33,LCD_CMD)
  lcd_byte(0x32,LCD_CMD)
  lcd_byte(0x06,LCD_CMD)
  lcd_byte(0x0C,LCD_CMD)
  lcd_byte(0x28,LCD_CMD)
  lcd_byte(0x01,LCD_CMD)
  sleep(E_DELAY)

def lcd_byte(bits, mode):

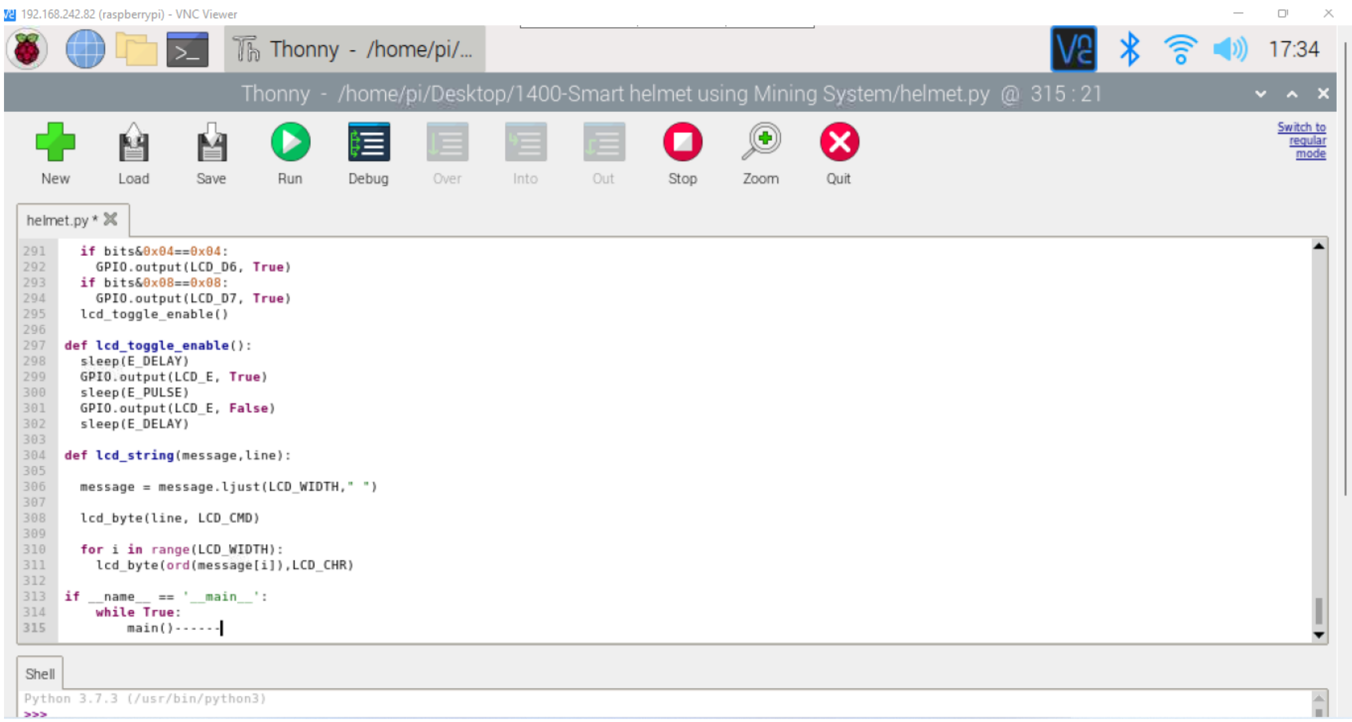
  GPIO.output(LCD_RS, mode)
  GPIO.output(LCD_D4, False)
  GPIO.output(LCD_D5, False)
  GPIO.output(LCD_D6, False)
  GPIO.output(LCD_D7, False)
  if bits&0x10==0x10:
Shell
Python 3.7.3 (/usr/bin/python3)
>>>



192.168.242.82 (raspberrypi) - VNC Viewer

Thonny - /home/pi/Desktop/1400-Smart helmet using Mining System/helmet.py @ 299 : 22

```
    GPIO.output(LCD_D4, True)
  if bits&0x20==0x20:
    GPIO.output(LCD_D5, True)
  if bits&0x40==0x40:
    GPIO.output(LCD_D6, True)
  if bits&0x80==0x80:
    GPIO.output(LCD_D7, True)
  lcd_toggle_enable()
  GPIO.output(LCD_D4, False)
  GPIO.output(LCD_D5, False)
  GPIO.output(LCD_D6, False)
  GPIO.output(LCD_D7, False)
  if bits&0x01==0x01:
    GPIO.output(LCD_D4, True)
  if bits&0x02==0x02:
    GPIO.output(LCD_D5, True)
  if bits&0x04==0x04:
    GPIO.output(LCD_D6, True)
  if bits&0x08==0x08:
    GPIO.output(LCD_D7, True)
  lcd_toggle_enable()

def lcd_toggle_enable():
  sleep(E_DELAY)
  GPIO.output(LCD_E, True)
```



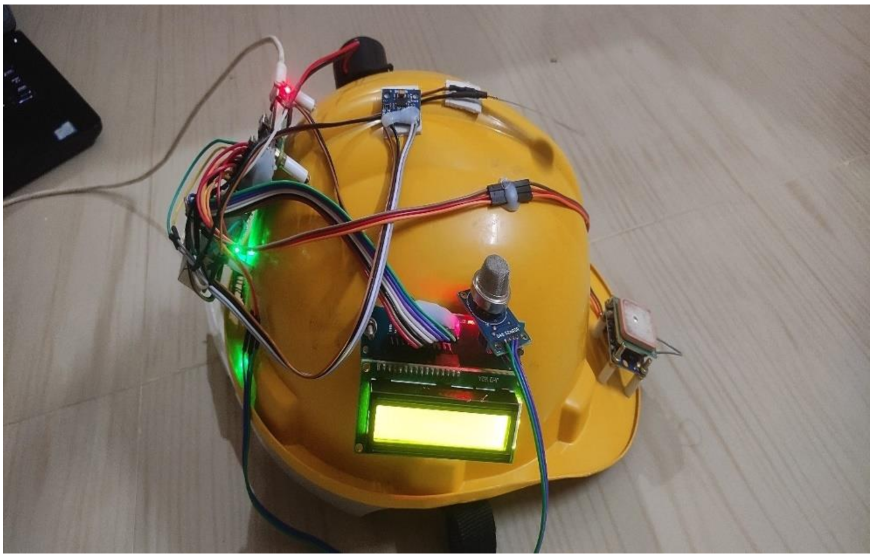
192.168.242.82 (raspberrypi) - VNC Viewer

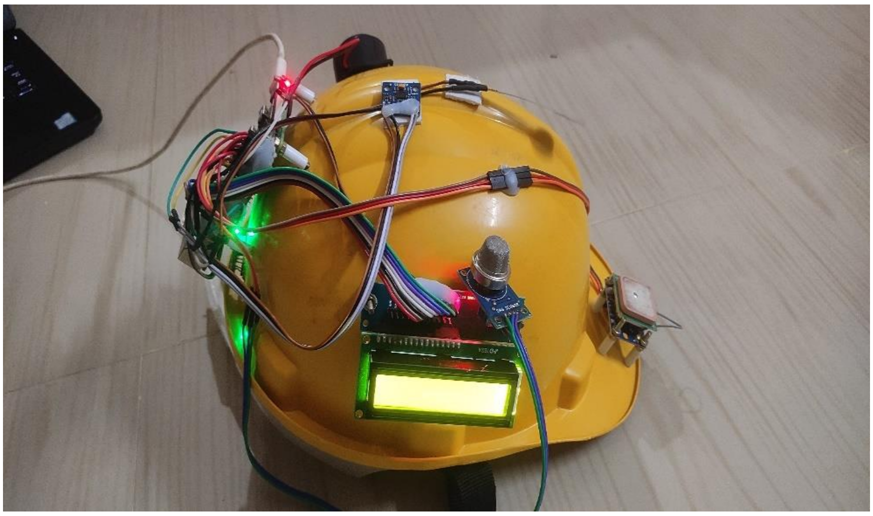
Thonny - /home/pi/Desktop/1400-Smart helmet using Mining System/helmet.py @ 315 : 21

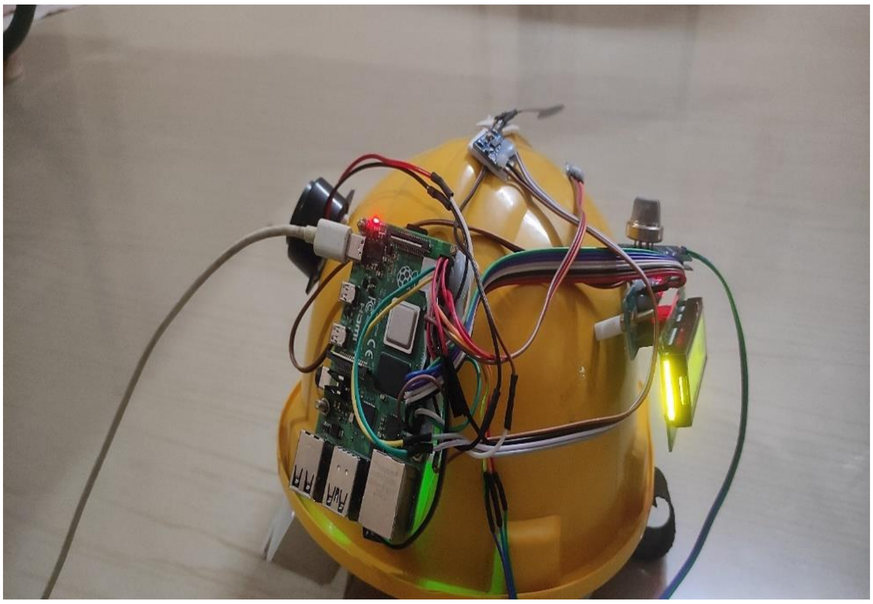
```
  if bits&0x04==0x04:
    GPIO.output(LCD_D6, True)
  if bits&0x08==0x08:
    GPIO.output(LCD_D7, True)
  lcd_toggle_enable()

def lcd_toggle_enable():
  sleep(E_DELAY)
  GPIO.output(LCD_E, True)
  sleep(E_PULSE)
  GPIO.output(LCD_E, False)
  sleep(E_DELAY)

def lcd_string(message,line):

  message = message.ljust(LCD_WIDTH," ")

  lcd_byte(line, LCD_CMD)

  for i in range(LCD_WIDTH):
    lcd_byte(ord(message[i]),LCD_CHR)

if __name__ == '__main__':
    while True:
        main()------
```

5.2 SCREENSHOTS

HELMET IMAGE







BEFORE ACCIDENT DETCTED

ACCIDENT DETECTED

CHAPTER - 6

CONCLUSION AND FUTURE ENCHANCEMENT

CONCLUSION

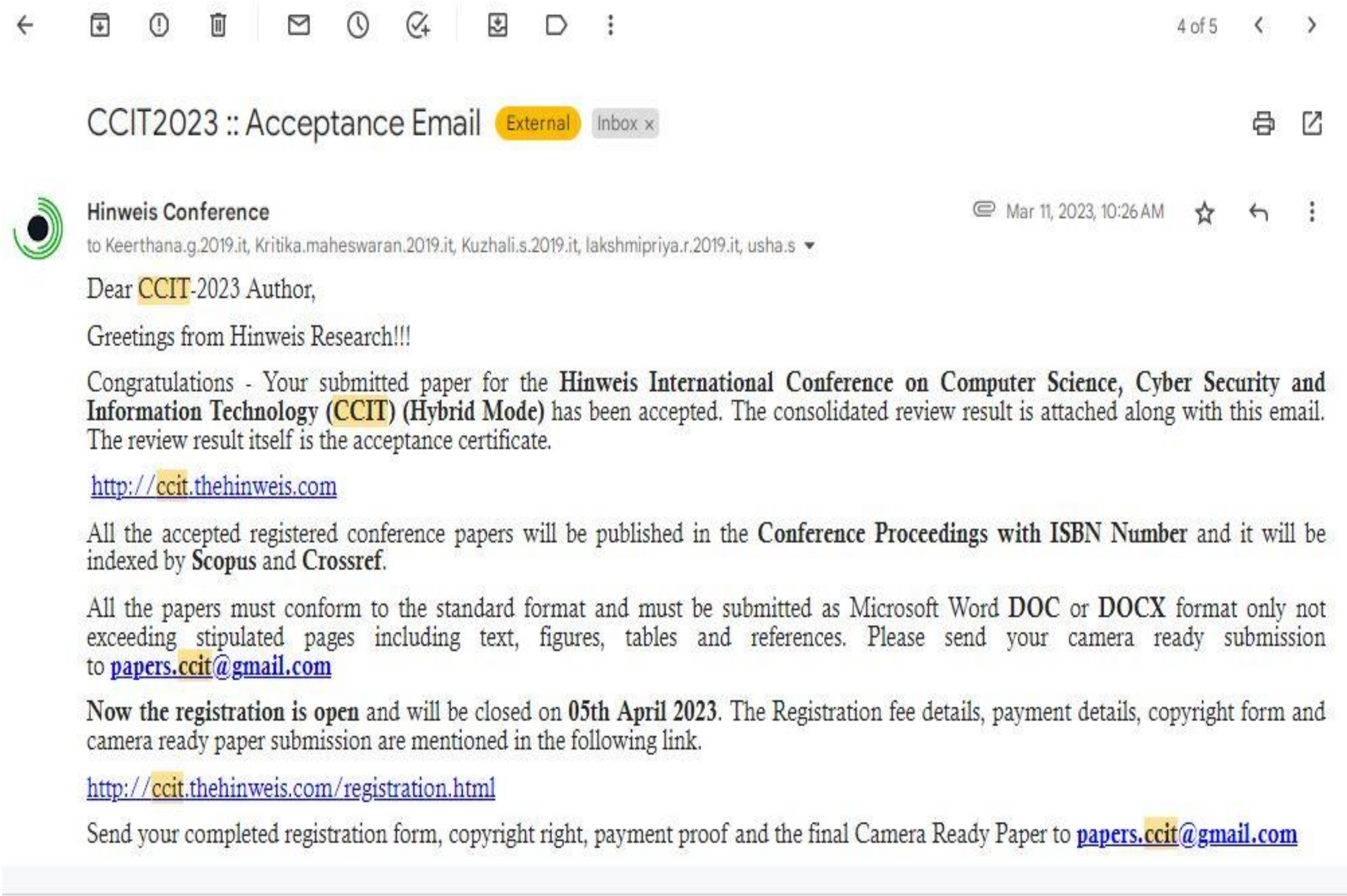
Monitoring and reduction of the number of casualties and providing immediate help to the miners in distress were the main goals of this project. Using a microcontroller and wifi on the helmet used by the miners, a wireless sensor network was formed. Pressure sensor was attached to the sensor mote to check the well-being the user. Whenever the force experienced by the helmet was more than the pre-set threshold value, the microcontroller in the helmet attempted to send a Alert via Buzzer, Cloud data to the Manager using the saved route.

FUTURE ENHANCEMENTS

In the future, it will be incorporated into the web application that all mining employees can access. The employees can examine the information by logging into their accounts.

CHAPTER -7
PAPER PUBLICATION

ACCEPTANCE SCREENSHOTS



4 of 5

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All the papers must conform to the standard format and must be submitted as Microsoft Word **DOC** or **DOCX** format only not exceeding stipulated pages including text, figures, tables and references. Please send your camera ready submission to **papers.ccit@gmail.com**

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PAPER REVIEW FORM

Hinweis International Conference on Computer Science, Cyber Security and Information Technology (CCIT)

Hybrid Mode; April 21-22, 2023

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PAPER REVIEW FORM	
Paper ID	CCIT-2023_366
Paper Title	Iot Based Mining Industry Smart Helmet For Inspecting And Reporting Hazardous Event Detection
Review Status	Accepted with Modification
Category(if accept)	Full Research Paper
Consolidated Content review comments	• Paper should strictly formatted according to the standard format • The paper could be revised with more detailed explanations to increase the understandability of the paper • Very less description is provided on proposed system and its related literature review

Sl No	OVERALL RATING: (5= EXCELLENT, 1= POOR)	5	4	3	2	1
1.	Structure of the paper		X			
2.	Standard of the paper		X			
3.	Appropriateness of the title of the paper	X				
4.	Appropriateness of abstract as a description of the paper	X				
5.	Appropriateness of the research/study methods		X			
6.	Relevance and clarity of drawings, graph and table		X			
7.	Use and number of keywords / key phrases	X				
8.	Discussion and conclusion			X		
9.	Reference list, adequate and correctly cited		X			

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CCIT2023- April 21-22, 2023; Hybrid Mode https://ccit.thehinweis.com/

JOURNAL PAPER

IOT BASED MINING INDUSTRY SMART HELMET FOR INSPECTING AND REPORTING HAZARDOUS EVENT DETECTION

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***Abstract*: A traditional smart helmet design that can recognize dangerous situations in the mining sector is being developed. Air quality, helmet removal, and collisions are three of the main types of hazards that were taken into account when developing the helmet. The first is the level of dangerous gas concentrations, such as particle matter, CO, SO2, and NO2.A miner taking off their mining helmet was considered the second hazardous event. The miner's helmet's position is successfully ascertained using an IR sensor after that. The third dangerous event is one in which a forceful object strikes a miner directly in the head. The head's acceleration and the HIC were calculated using software and an accelerometer. Tests are successfully done to calibrate the accelerometer. The experimental prototype consists of sensors namely gas, infrared, MEMS, GPS and pressure sensor for their usage and the sensor data are monitored in pc via Wifi transceiver unit.**

***Keywords*: IR Sensor, GPS, MEMS, Air Sensor**

1. INTRODUCTION

In recent years, Safety has long been a top priority in the mining sector, particularly in sub-surface mining. Mining accidents happen when minerals or metals are being extracted. Each year, mining accidents claim the lives of thousands of miners, particularly those engaged in hard rock and coal mining. One of the major factors in the majority of these accidents is the collapse of mining slopes. Most mining slope collapses do not result in fatalities. The injured miners can be helped with immediate first aid. However, in the shadowy depths of an underground mine, it is difficult to tell when a specific miner is in trouble. Consequently, there is a need for a system to track each miner's health in these situations.

mines. The safety helmet is one item that every miner wears. Therefore, in this situation, the helmet can be used to monitor the user's health and assist in relaying information outside the mines to the central office. The project uses the internet of things to try to accomplish the same thing. Each helmet worn by the miners has a sensor device. This sensing unit is linked to a force sensor, which determines whether the miner is bearing an unsafe load on his head. The miner may be in danger and may require immediate care if the load is too heavy. The motes therefore make an effort to get in touch with the fixed Room Manager mote, which is connected to both the Center and the nearby Room Manager motes. The Corresponding Room Manager of the distressed area tries to notify the Center of the occurrence of such an accident. Additionally, it requests that miners in nearby rooms or sectors voluntarily locate and aid the miner who is in danger. The Center can send a team to assist a specific miner as soon as they learn of their situation. The room may be deemed dangerous and the Center may activate the room's siren if there are more troubled miners present. Informing the miner in the adjacent room to stay out of that room is possible. It can lessen the number of casualties in this way. Another novel idea is to declare a certain area dangerous and to offer immediate assistance.

2. EXISTING SYSTEM AND ISSUES

Accidents at mining and construction sites are frequently covered in the news. In this scientific era, mining and construction both provide housing for a large number of people. These include the start of the fire, the spread of dangerous gases, etc. These accidents are fatal; they shouldn't be taken lightly. The wearing of protective helmets at such locations is now required. However, while these helmets can shield the head from hitting objects, they are powerless to stop fires and other similar accidents. The lives of those who work at those sites are gravely in danger in this situation. Most contractors and employees exercise proper caution while working at these locations. However, there are still instances where people's lives are at risk. This is a query that demands an answer. We require a technological breakthrough that makes it possible for people to feel secure at these locations in this advanced technological age. Without making additional efforts, an accident can be reported to the public using technology that can detect gaseous leaks, environmental temperature changes, and worker heartbeats. Through the use of this technology, accidents would be prevented and lives would be saved. Therefore, preventing the spread of a fire or a gas leak that is harmful to the environment is crucial to saving the lives of the employees who depend on the area for their livelihood. In this case, technology is being used to save lives, which is a crucial application of technology.

A. PROPOSED SYSTEM

The system offers base station-based real-time mine monitoring. On the worker's helmet is the transmitter unit, and the base station is the receiver unit. IOT wireless technology is used to transmit data from the coal miners to the base station. The WiFi communication network offers two-way communication channels between base stations and mines as well as between base stations and mines. The transmitter unit is made up of an air quality sensor, a sensor for when a helmet is removed, and a sensor for when a person falls. If any abnormal activity is detected, the gps location will be sent to an IoT web server.

3. LITERATURE SURVEY

1. Shishir and et al. [2] have suggested a safety helmet for miners based on ZigBee wireless technology; in this instance, they are monitoring the environment's temperature, humidity, and gas concentration. The control center receives the detected data wirelessly using ZigBee When the sensed data differs from expected values, an alert is sent via ZigBee by turning on various LEDs and sounding an alarm. This system's limitation to real-time data viewing, the lack of a data logging mechanism, and inability to pinpoint which miner is having issues make it problematic.
2. Cheng Quing and et al. [1] based on ZigBee wireless communication, has proposed an intelligent helmet for coal mines. Their primary goal is to measure the mine's temperature, methane concentration, and humidity level. The base station will receive this detected data wirelessly using ZigBee. Voice communication is used by the ground station monitor to alert the miner to an occurrence. Since the miner will be operating in a noisy environment, this implementation has a problem, it is impractical to alert him via voice communication, so someone must be assigned to the monitoring room to keep an eye on the mines and issue alerts.

4. SYSTEM OVERVIEW

All of the said problems in the existing system can be solved by using IoT technology. Let us first understand what and how these methodologies work.

a. BLOCK DIAGRAM

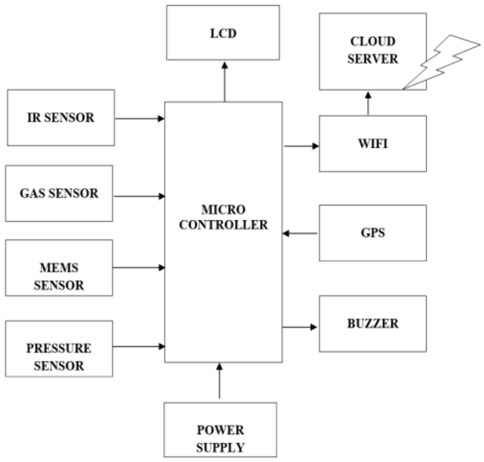


Figure 2: Block Diagram

METHODOLOGIES

Helmet Module

GPS Module

5. HELMET MODULE

The latest safety technology is now in the helmet, which is frequently the sole piece of protective gear worn by miners. We made use of an accelerometer, an IR sensor, and an air quality sensor. These were used to check for head bumps, evaluate the air quality, and determine whether a miner had removed his helmet. A ZigBee module was linked to the three sensors. Operating system access is available for this module. maintains wireless communication between several helmets, does all processing (OS). The entire system was examined during the design process to reduce power consumption because the device is battery-powered. In order to keep the power level as low as possible, various sensors were considered for each individual component. The system will be disassembled into its component parts in order to clarify each part's function as well as the accessible substitutes. The system is made up of six parts: an alerting unit, a data processing unit, a wireless transmission, a sensor that detects when a helmet is removed, a sensor that detects collisions, a sensor that detects air quality, and a sensor that detects air quality.

AIR QUALITY SENSOR

Particulate particles and gases such as carbon monoxide (CO), methane (CH_4), sulphur dioxide (SO_2), and nitrogen oxides (NO_2), are the main causes of air pollution from coal mines (CO). It is well known from numerous studies that exposure to these chemicals or pollutants by people can have a negative impact as to their health. These uneven ratios of gases that cause air pollution, including suspended particulate matter, rise cardiovascular issues and respiratory conditions like asthma and chronic bronchitis. [13].

HELMET REMOVAL SENSOR

A helmet removal technique based on an infrared ray sensor is used to determine whether or not a mine worker has taken off his protective helmet. An infrared sensor is set up to continuously deliver a signal from one end; if the signal is blocked, the miner is wearing a helmet; otherwise, he is not.

Switch found that among other ways, IR beam-based helmet-removal sensor technology was superior to analogue distance sensor and digital distance sensor. It is possible to create an IR beam that consumes little power. For this application, an IR distance detector that is readily available was used. A steady signal was supposed to be sent from one side of the helmet to the other by the IR sensor.

COLLISION SENSOR

A pressure using a sensor determine the severity of an object strike to a miner's head. According to the criteria for brain and neck injury, pressure is nothing more than force applied to an object per unit area. A moderate head injury is caused by pressure of 25 psi (pounds per square inch), while a severe head injury is caused by pressure of 34 psi.

$$HIC = \left[(t_2 - t_1) \left[\frac{1}{t_2 - t_1} \int_{t_1}^{t_2} a(t)dt \right]^{2.5} \right]_{max} \quad (1)$$

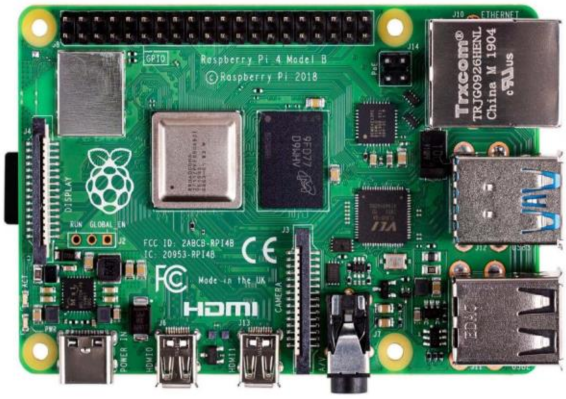
The equation is limited to impacts rather than continuous accelerations using the time constraint. It is also suggested that scull deformation may result in inaccurate accelerometer measurements. As a type of overdesign and compensation, Instead than being attached to the plastic strap that holds the head in place, the accelerometer is mounted directly to the helmet. This will enable the accelerometer in the helmet to achieve acceleration. that is higher than the miner's head's actual acceleration.

RASPBERRY PI 4

The third-generation Raspberry Pi is the Raspberry Pi 4 Model B. The powerful single board computer, the size of a credit card, will replace the Raspberry Pi 4 Model B and the Raspberry Pi original Model B+. The Raspberry Pi 4 Model B keeps the popular board format while giving you a more powerful processor that is ten times faster than the Raspberry Pi of the first generation. It is the ideal option for reliable linked designs because Additionally, it features Bluetooth and wireless LAN connectivity.

FEATURES

- A 64-bit, quad-core, 2.4 GHz ARMv8 CPU
- IEEE 802.11 Wireless LAN Connectivity
- Bluetooth 5.0
- Bluetooth Low Energy (BLE)
- 4GB RAM
- 40 GPIO pins
- Ethernet port



RASPBERRY PI

BROADCOM BCM 2711 PROCESSOR

The first-generation Raspberry Pi's Broadcom BCM2711 SoC (System of a Chip), which has a 700 MHz ARM 7.The Core processor, Video Core IV graphics processing unit (GPU), and RAM are similar to the technology used in first-generation smart phones (its CPU is an older ARMv6 architecture). The Raspberry Pi is a line of diminutive single-board computers created in the UK for use in classrooms and in underdeveloped nations by the Raspberry Pi Foundation. The initial model was promoted outside of its intended market for uses like robotics and used far more frequently than anticipated.. Keyboards, mouse, and cases are not provided with the Raspberry Pi as peripherals. However, a few official and unauthorized bundles contain some add-ons.

BATTERY

A battery is made up of one or more cells, and each of these cells undergoes chemical reactions that result in the flow of electrons in a circuit. The three components are an electrolyte, an anode (the "−" side), and a cathode essential components of every battery .

A chemical reaction happens between the anode and the electrolyte when a battery's cathode and anode are connected to a circuit. Electrons then return to the cathode and go through a second chemical change as a result of this process. The battery is unable to generate power when the cathode or anode material is depleted or becomes ineffective during the operation. Thus, battery is regarded as "dead."

GAS SENSOR

Oxygen depletion and combustible, flammable, and toxic gases can all be detected using gas detectors. This kind of instrument is commonly used in industry and is found in places like oil rigs to monitor manufacturing processes and cutting-edge technologies like photovoltaics. They could be employed in fighting fires. In the context of modern technology, monitoring the gases produced is crucial. Monitoring of gases is very important for everything from home appliances like air conditioners to electric chimneys and safety systems in industries. Gas sensors respond impulsively to the gas in the environment, informing the system of any changes in the concentration of molecules in the gaseous state. The sensing element is housed beneath a steel exoskeleton that makes up the gas sensor module.

Through connecting leads, current is applied to this sensing element. The gases that are near the sensing element become ionised and are absorbed by the sensing element when this current, also known as heating current, passes through them. This alters the sensing element's resistance, which changes the amount of current that flows out of it. The sensor's connecting leads are thick to allow for a secure connection to the circuit and adequate heat transfer to the interior component. They are plated with tin and made of copper casting.

FEATURES

- Analog and Digital outputs
- High sensitivity to LPG, Propane, and Hydrogen
- Good sensitivity for Combustible Gas over a Wide Range
- Operation voltage: 5VDC
- Straightforward drive circuit
- Long life and low cost

APPLICATIONS

- Domestic gas leakage detector
- Industrial Combustible gas detector
- Portable gas detector

GAS SENSOR

PRESSURE SENSOR

A device is a pressure sensor that detects pressure and transforms it into an analogue electric signal whose strength is dependent upon the applied pressure. They are also known as pressure transducers because they convert pressure into an electrical signal. A pressure sensor is a device that detects pressure and transforms it into an analogue electric signal whose strength is dependent upon the applied pressure. Other parameters like fluid/gas flow, speed, and altitude can also be measured using pressure sensors. They are also intended to measure dynamically to record extremely quick pressure changes. Pressure is measured by a pressure sensor, usually for gases or liquids. The force necessary to prevent a fluid from expanding is expressed as pressure, which is typically expressed in terms of force per unit area. A pressure sensor typically performs the function of a transducer by producing a signal in response to the applied pressure. The technology, design, performance, suitability for particular applications, and cost of pressure sensors can vary greatly. Pressure sensors that are intended to measure dynamically to record extremely quick changes in pressure. They are utilized to gauge the combustion pressure in a gas turbine or an engine cylinder. Typically, quartz and other piezoelectric materials are used to make these sensors.

FEATURES

- Operating voltage : 5v
- Output: analog (0-5v)
- Temperature Compensated from Over -40° to +125°C
- 2.5% Maximum Errors Over 0° to 85°CThermoplastic (PPS) Surface Mount Package

APPLICATIONS

- Touch Screen Device
- Bio Medical Equipment
- Aviation
- Marine industry

PRESSURE SENSOR

GPS MODULE

The US government owns and runs the Global Positioning System (GPS), formerly known as Navstar GPS. It is a satellite-based radio navigation system. Any place on or close to the Earth with an unobstructed line of sight to four or more GPS satellites can receive geolocation and time information from the global positioning System.

Although these technologies can enhance the usefulness of the GPS positioning data, the GPS system does not require the user to transmit any data and does not require any telephonic or internet reception. The GPS system gives users in the military, civil, and commercial sectors around the world essential location capabilities. The system, which was created, maintained, and made available without charge by the US government, can be used by anybody with a GPS receiver.

GPS MODULE

In any weather, the Global Positioning System (GPS), a network of global navigation satellites, provides location and timing data. The GPS operates without the need for any phone or internet reception, despite the fact that these technologies might increase the GPS positioning data's usefulness. Earth receives signal information from GPS satellites. The GPS receiver gathers this signal data in order to determine the user's precise location.

Time and the known placements of specialized satellites serve as the foundation for the GPS concept. Real-time position and timing information is transmitted by GPS satellites. In order to compute the receiver's precise position and its departure from actual time, a GPS receiver continuously scans for satellites and solves equations. Four satellites must constantly be visible to the receiver. Every GPS satellite transmits a signal (carrier wave with modulation) that contains a pseudorandom code continually (sequence of ones and zeros). It is sent with a message that also contains the code epoch's time of transmission (TOT), the receiver's knowledge, and the satellite's location at that precise moment

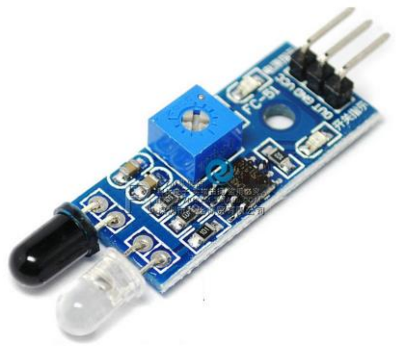
FEATURES

- Precision: 5 meters
- Interface
- UART RS232
- Optional T-TL UART
- Supply voltage: 12v DC
- Automatic antenna switching function

APPLICATIONS

- GPS trackers detection
- Automated vehicle
- Robotics

- Fleet tracking status



IR SENSOR

An electrical device known as a sensor uses infrared light to identify certain components in its environment. An IR sensor can measure an object's heat and detect movement. These kinds of sensors are referred to as passive IR sensors because they only measure infrared light. All objects typically emit some kind of infrared thermal radiation. Despite being undetectable to the human eye, An infrared sensor can pick up these radiations. The detector is an infrared photodiode, which is sensitive to infrared light of the same wavelength as that emitted by the IR LED, and the emitter is an infrared light emitting diode.

FEATURES

- Input voltage : 3.3v
- Output : Analog

APPLICATION

- Radiation Thermometer
- Flame Monitors
- Moisture Analyzer
- Gas Analyzer

6. Conclusion

The main goals of this operation were to maintain tabs on the miners who needed help, lower the number of casualties, and give them that help right away. A microcontroller and node Mcu were used to build a wireless sensor network on the miners' helmets. A pressure sensor was fastened to the sensor mote in order to keep track of the user's health. The helmet's microcontroller attempted to send an email or text message. whenever the force experienced by the helmet surpassed the pre-set threshold value, a notice message was sent to its Room Manager via the sav

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APPENDIX-I

PLAGARISM REPORT

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ORIGINALITY REPORT

18%	5%	3%	14%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to University of North Texas Student Paper	4%
2	Submitted to UNITEC Institute of Technology Student Paper	1%
3	Submitted to Durban University of Technology Student Paper	1%
4	www.researchgate.net Internet Source	1%
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APPENDIX II

CO-PO Mapping

PROJECT WORK COURSE OUTCOME (COs):

CO1: On completion the students capable of execute the proposed plan and become aware of and overcome the bottlenecks throughout every stage.

CO2: On completion of the project work students could be in a role to take in any difficult sensible issues and locate answer through formulating right methodology.

CO3: Students will attain a hands-on revel in in changing a small novel idea / method right into an operating model / prototype related to multi-disciplinary abilities and / orunderstanding and operating in at team.

CO4: Students will be able to interpret the outcome of their project. Students will take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.

CO5: Students will be able to publish or release the project to society.

PROGRAM OUTCOMES (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and

safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretationof data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Foundation Skills: Ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, web design, machine learning, data analytics, and networking for efficient design of computer-based systems of varying complexity. Familiarity and practical competence with a broad range of programming language and open-source platforms.

PSO2: Problem-Solving Skills: Ability to apply mathematical methodologies to solvecomputational task, model real world problem using appropriate data structure and suitable algorithm. To understand the Standard practices and strategies in software project development using open-ended programming environments to deliver a qualityproduct.

PSO3: Successful Progression: Ability to apply knowledge in various domains to identify research gaps and to provide solution to new ideas, inculcate passion towards higher studies, creating innovative career paths to be an entrepreneur and evolve as anethically social responsible computer science professional.

PO / PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PSO1	PSO2	PSO3
CO1	1	2	2	3	3	1	1	1	1	-	-	1	2	3	2
CO2	2	3	3	3	3	2	1	1	1	-	-	2	3	2	2
CO3	3	2	2	3	3	1	1	1	1	-	-	2	2	3	2
CO4	3	3	3	2	2	2	1	1	2	-	-	2	3	2	2
CO5	3	3	2	2	3	2	2	2	1	1	2	3	3	2	2
Avera-ge	2.4	2.6	2.4	1.8	2.6	1.6	1.4	1.4	1	0.4	0.2	0.4	2.6	2.4	1.4