Engineering Design Presentation-G3

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PROBLEM STATEMENT

“ MINING HAT OPTIMISATION FOR HAZARDOUS CLIMATES IN MINES AND TOXIC ATMOSPHERE AND MONITOR THE HEALTH OF MINERS

Working in mines is very dangerous. Workers are exposed to toxic gases, high temperatures and thousands of other potential hazards at any moment. Smart helmet is one of the systems that prevents damage to mine workers. The purpose of this system is to protect the health of miners and prevent explosions in mines. There are 7 types of gas in mines, two of which (hydrogen and methane) cause blasts in mines

PROBLEMS IN MINING

- MINE DUST
- AIR PURITY
- HEALTH MONITORING
- AMBIENT LIGHTING

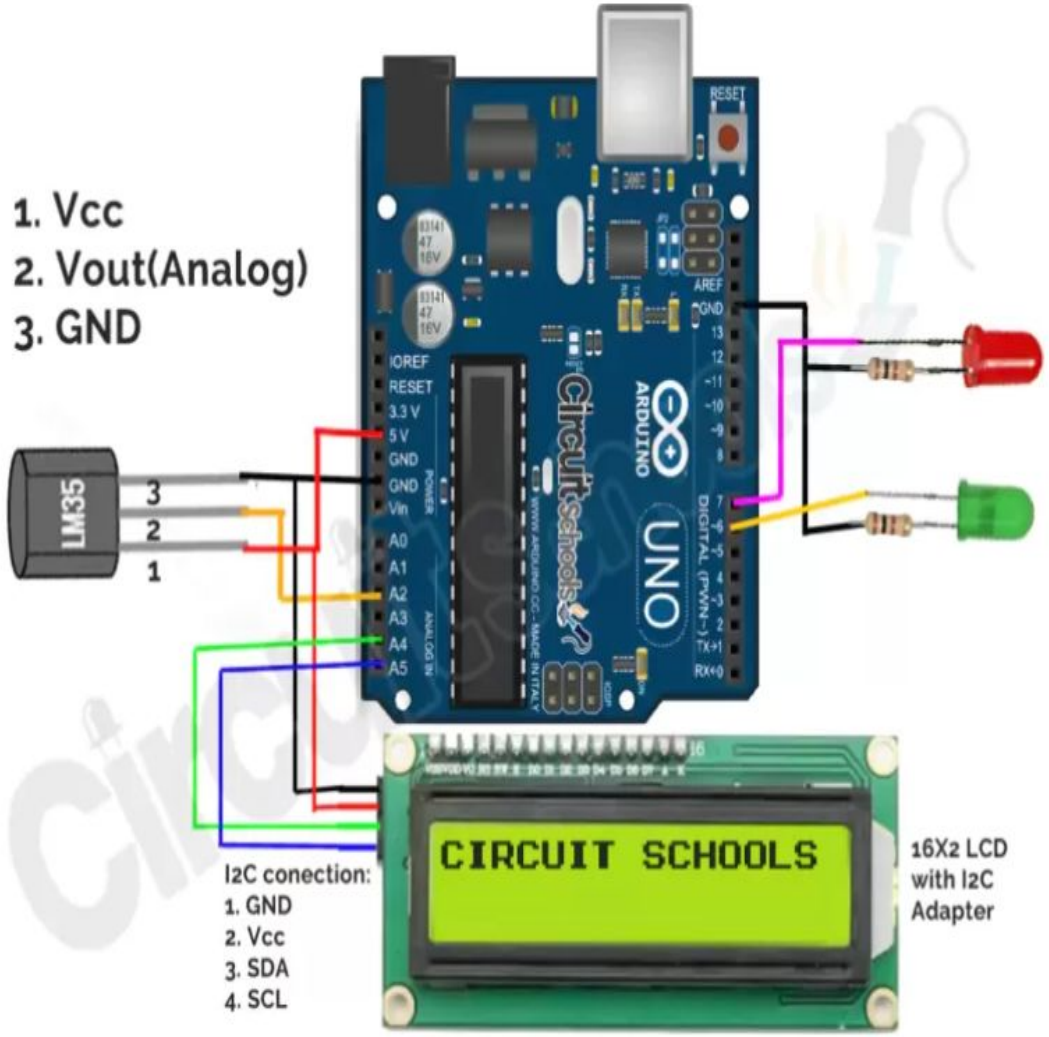
PARTS AND MECHANISM OF THE PROPOSED MODEL

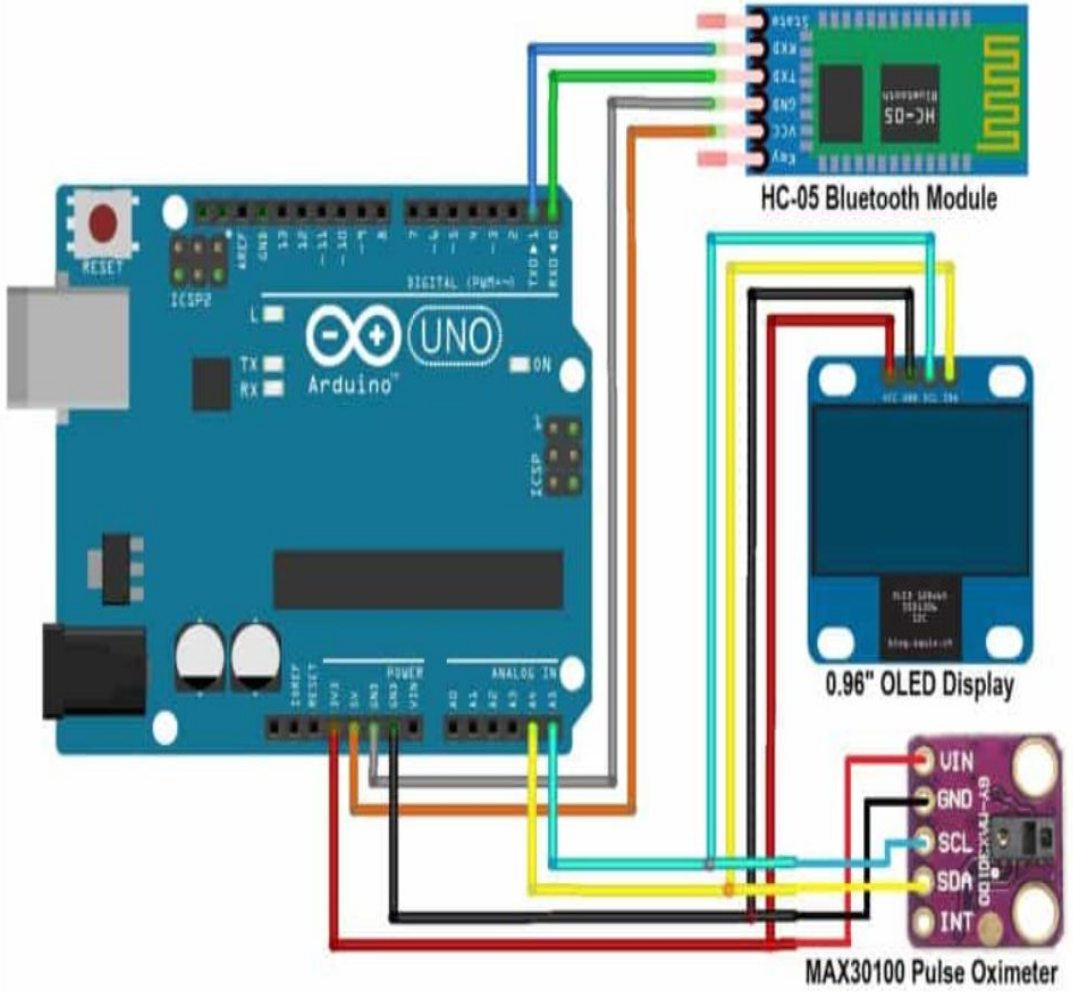
Heartbeat and Temperature sensor

The hat will be of similar shape , light weighted and equipped with a flashlight as usual. The top peak will be mounted by a GPS to find the location of the miners in heavily dense caves and miners and to find the ones in need of medical support.

Heartbeat sensor and the Temperature Sensor will detect the heartbeat and Body temperature of workers in regular intervals and will report it to the main office in case the heartbeat falls below a certain threshold.

Circuit Diagram





Principle

Heartbeat Sensor

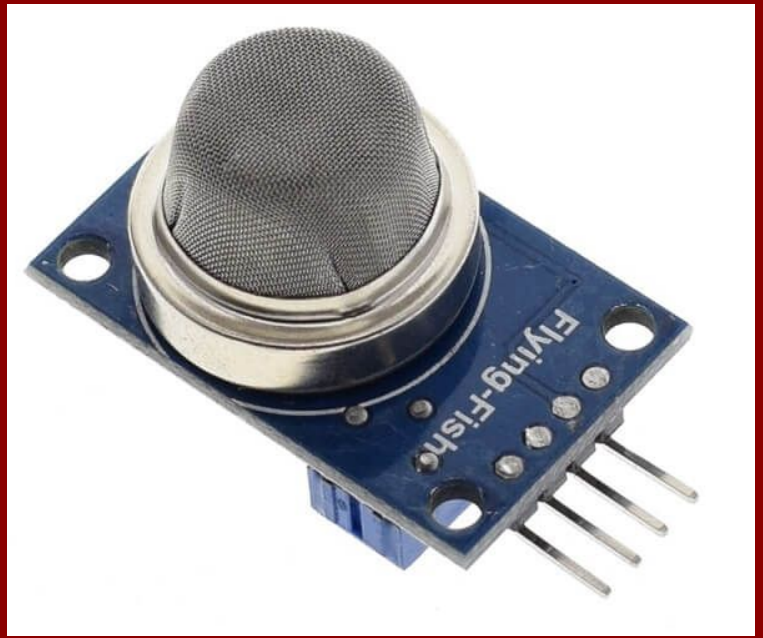
1. Works on the principle of Pulse Oximeter
2. Lightweight and efficient
3. Budget Friendly
4. Use GPS to transfer the recorded Data.

Temperature Sensor

1. Works on the principle of digital Thermometer
2. Lightweight and efficient
3. Budget Friendly
4. Use GPS to transfer the Temperature recorded

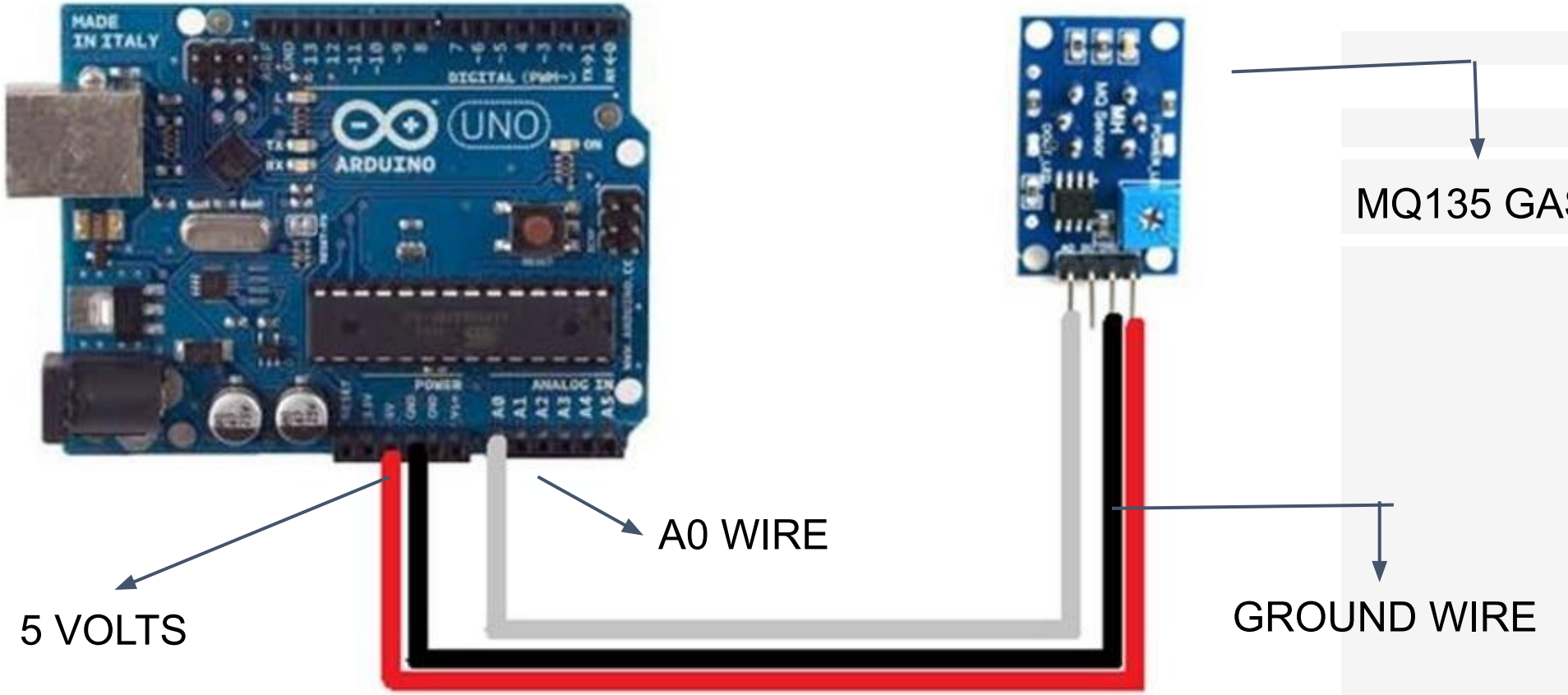
AIR PURITY SENSOR

- The Major Impurities That We Have Are So2, No2 And Heavy Metals, So The Sensors Must Alarm Us When The Concentration Goes Beyond The Allowed Level.
- Exposure of more than 5 ppm of SO2 can cause airway resistance in healthy individuals.So, the sensor will alarm us for a conc of 5 ppm
- For NO2, the sensor will alarm us when the concentration reached 5 ppm and if the miner is an asthmatic, 0.1ppm
- For heavy metals, the sensor will alarm us for a concentration of 118.9 micro g m(-3)



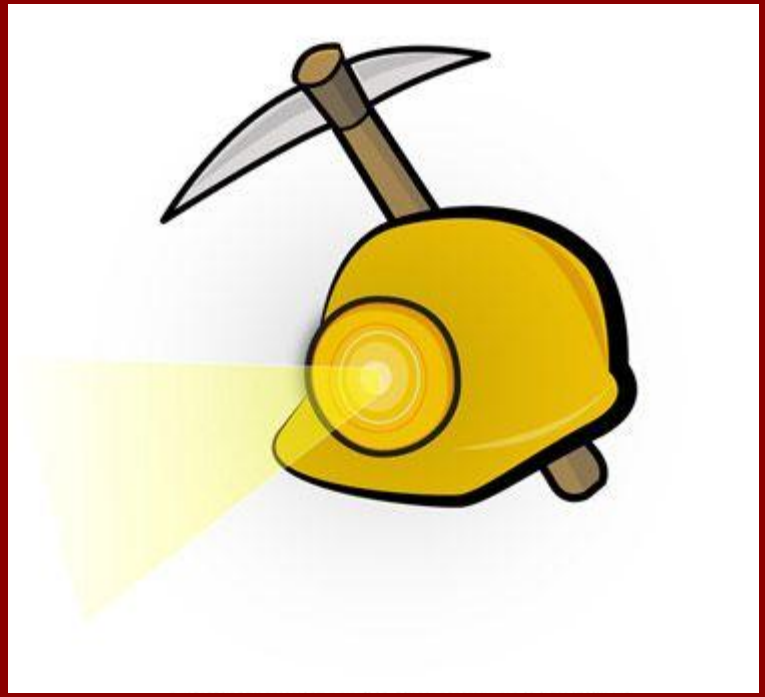
MQ135 AIR QUALITY SENSOR

CIRCUIT DIAGRAM



PRINCIPLE

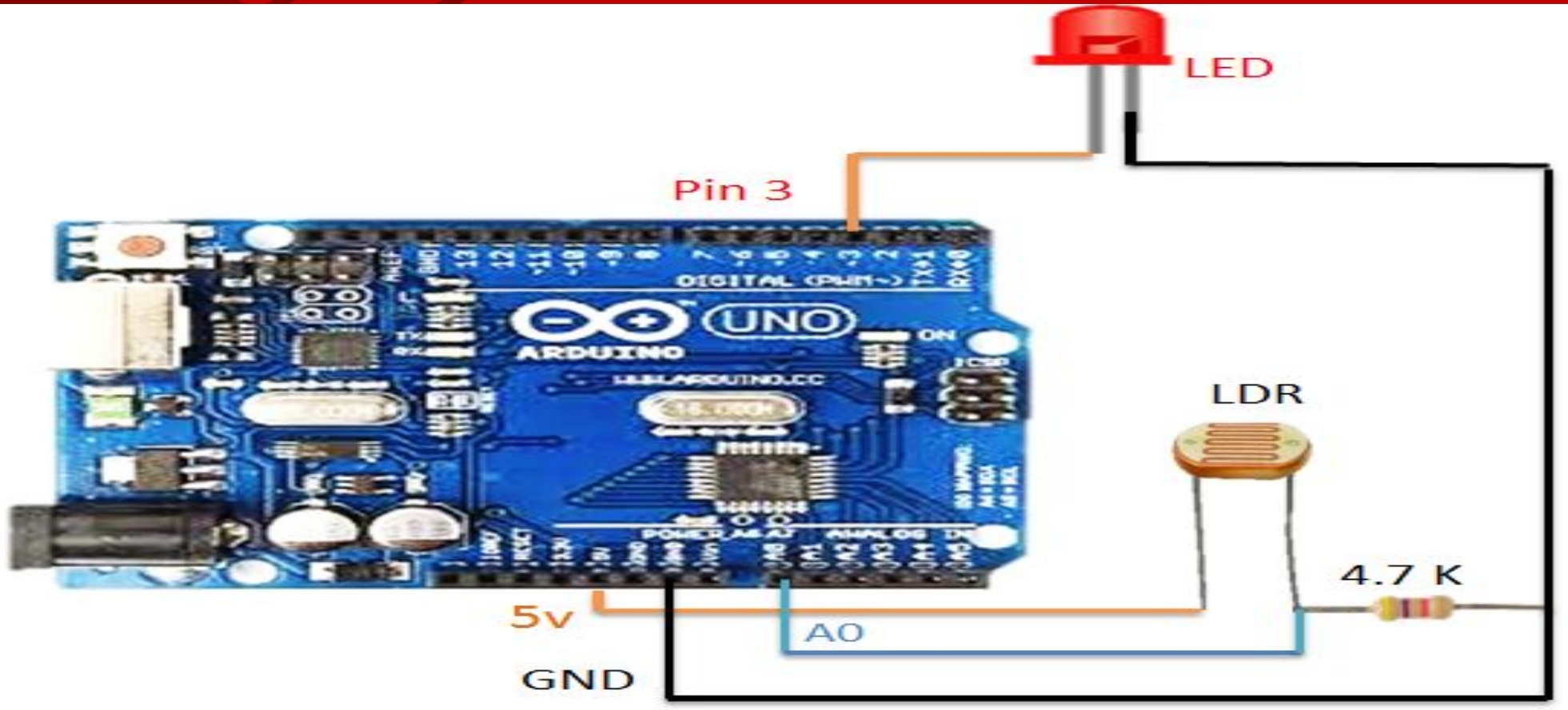
- Works on the modified principle of MQ135 gas sensor in a circuit type mechanism.
- Senses and alarms us the allowed concentrations of SO_2, NO_2 and heavy metals
- Lightweight and efficient
- Cost-effective and durable
- Easily portable



LIGHTNING CONTROL

Lighting is vitally necessary underground, and it is very important to ensure that there are no failures and the lamp used is efficient as possible

CIRCUIT DIAGRAM



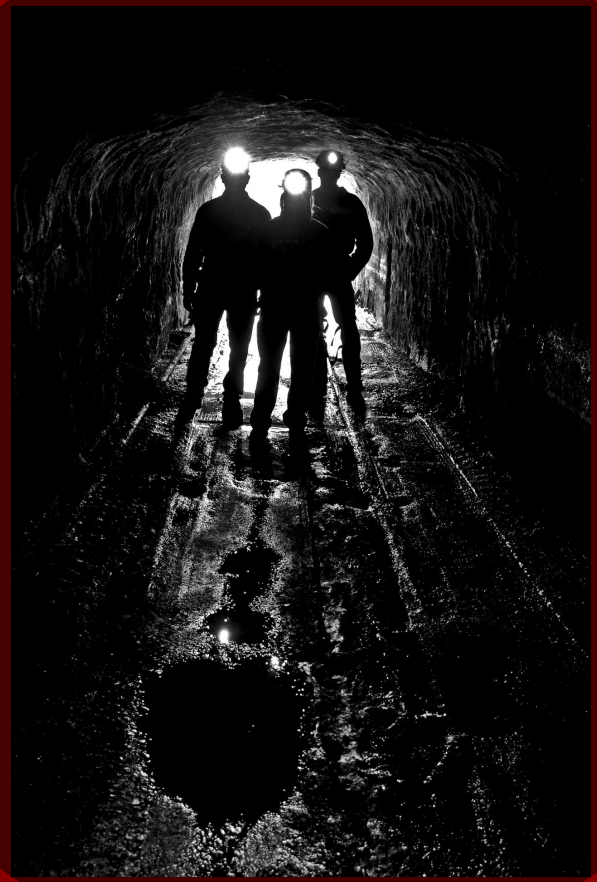
Light Detection using LDR and Arduino

STRUCTURE AND REQUIREMENTS

For this we will need:

- An LDR (a.k.a. Photo-resistor).
- Arduino UNO.
- 10K Resistor

The LED will be off in complete brightness, and as the brightness in the surrounding decreases, the LED begins to glow brighter.



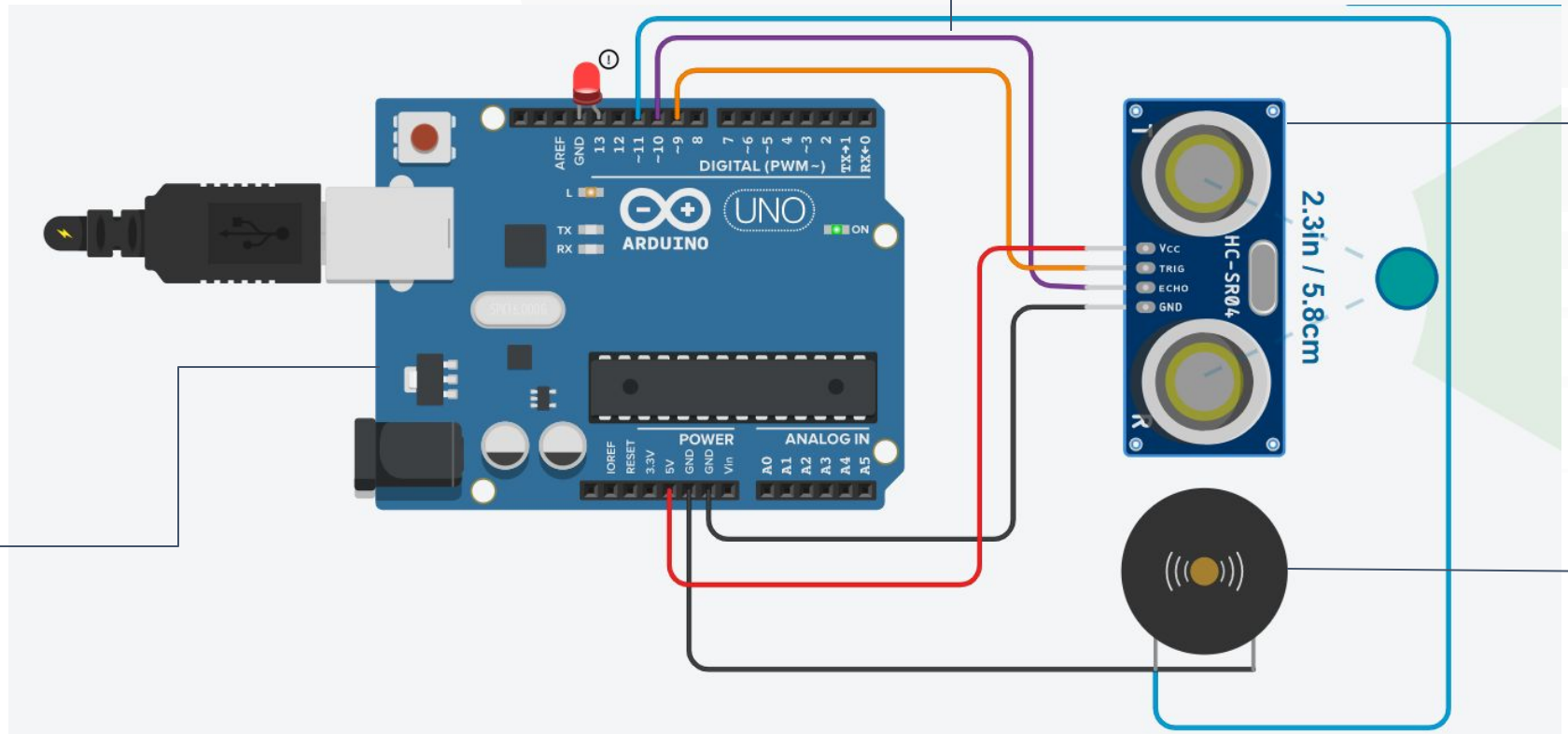
Height determination sensor

Used to detect distance between the helmet and the ceiling of mine.

Height determination sensor-Why do we need them?

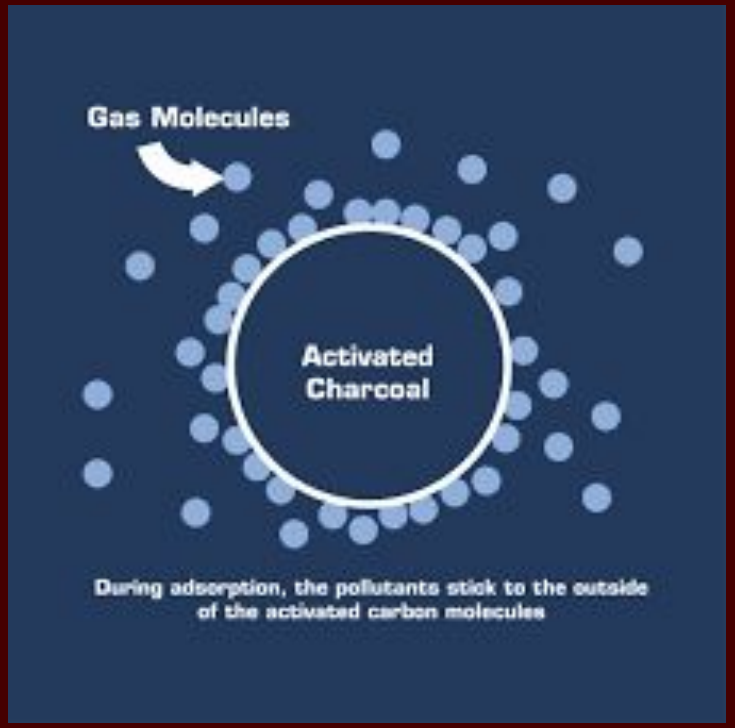
- Sometimes miners have to work in very congested and low heighted mines.
- Due to lack of proper illumination inside the mines, miners may sometimes misjudge the height of the mine and this may end up in accidents which lead to injuries.
- To solve this problem we have designed an ultrasonic distance alarm which rings out a tone of 330 Hz when the distance between the helmet and the mine's ceiling is very less(around 40 cm).

Circuit Diagram

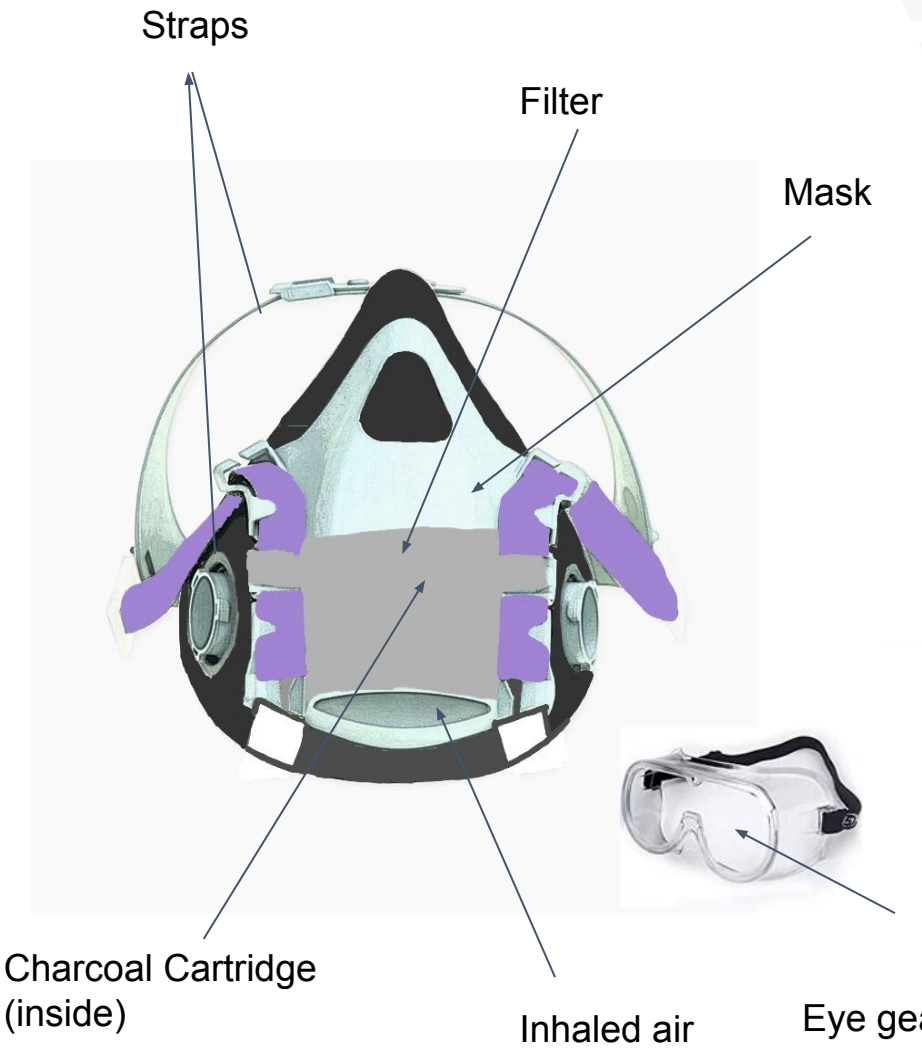


Charcoal Air Filter and Eye Protection

Mask and an Eye gear



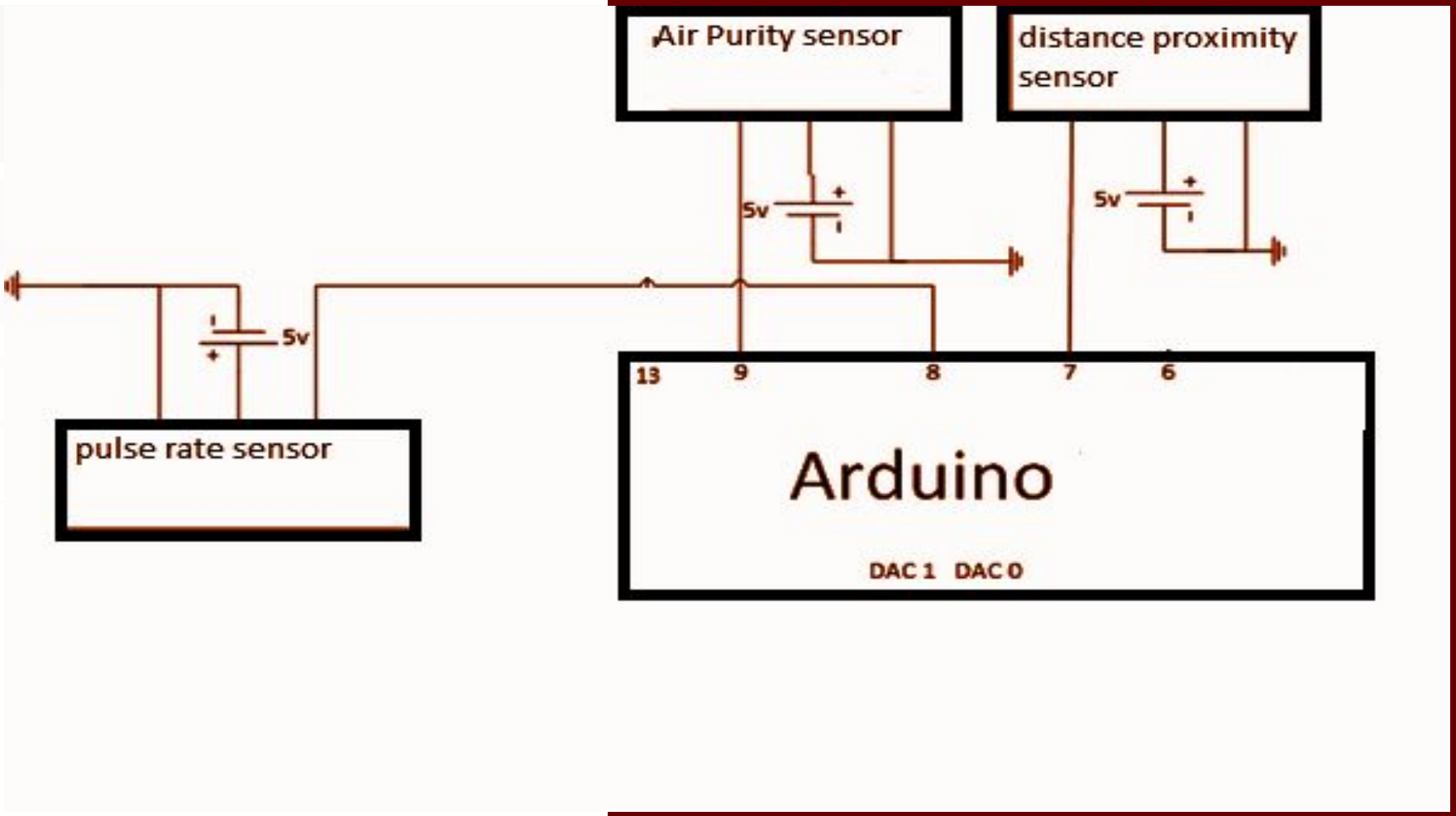
MODEL DESIGN



- **PHYSICAL DESIGN**
- Design to be chosen such that can be used with the hat.
- Additional , eye gear
- Compact , comfortable , flexible

- **CHEMICAL DESIGN**
- Charcoal
- Calcium Bentonite

CIRCUIT DIAGRAM



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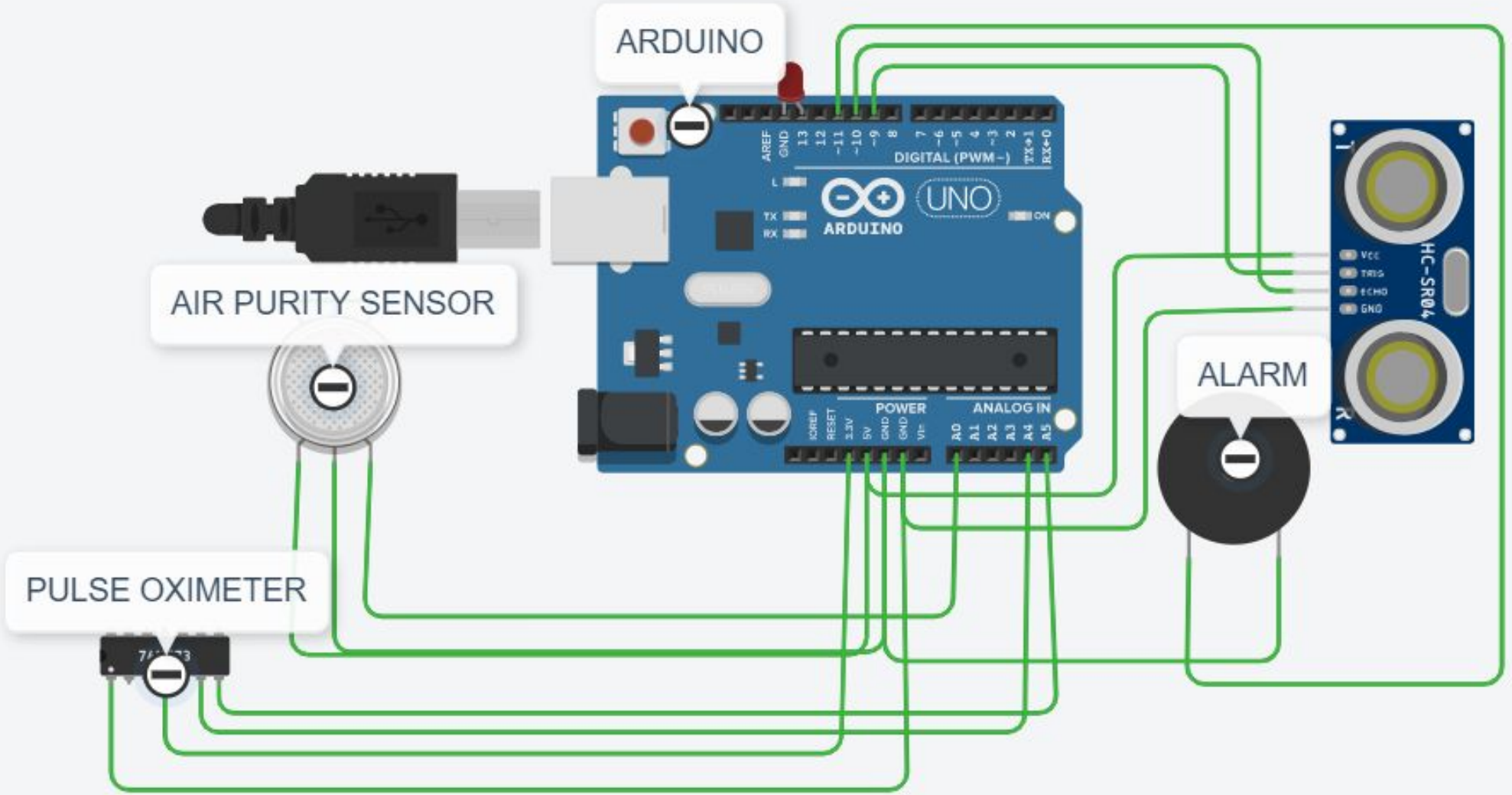
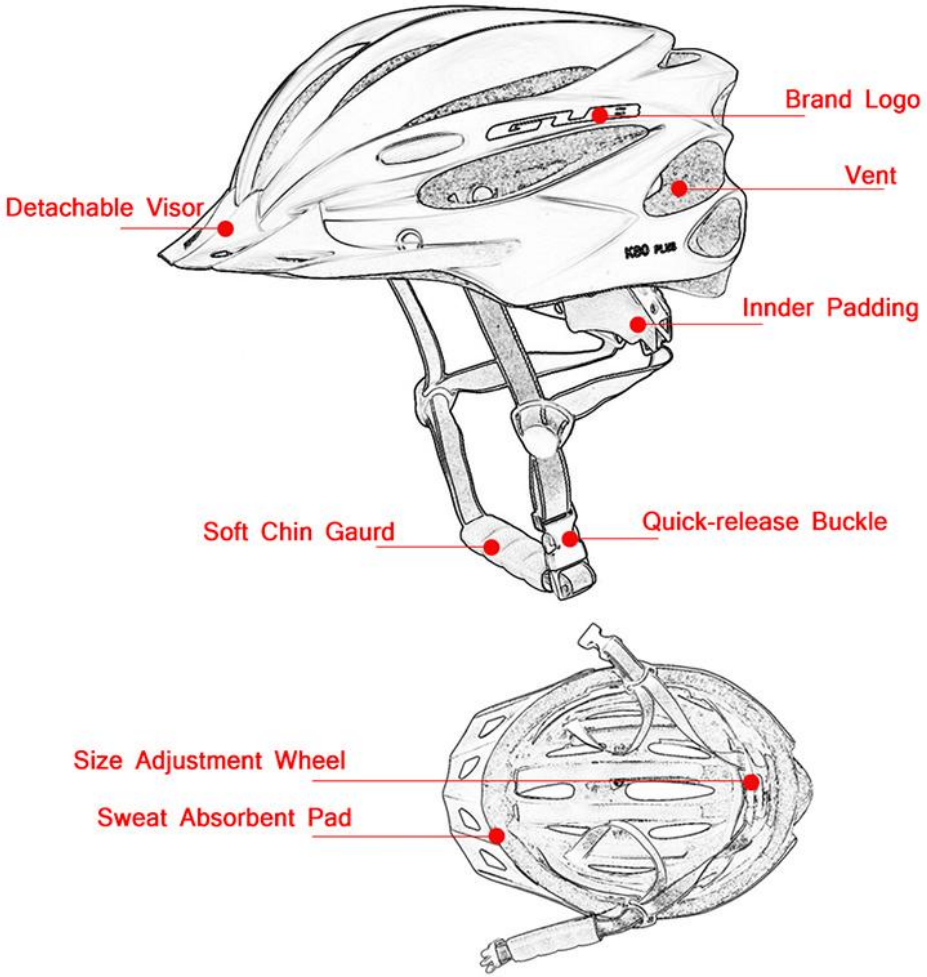
INTERNAL CIRCUIT



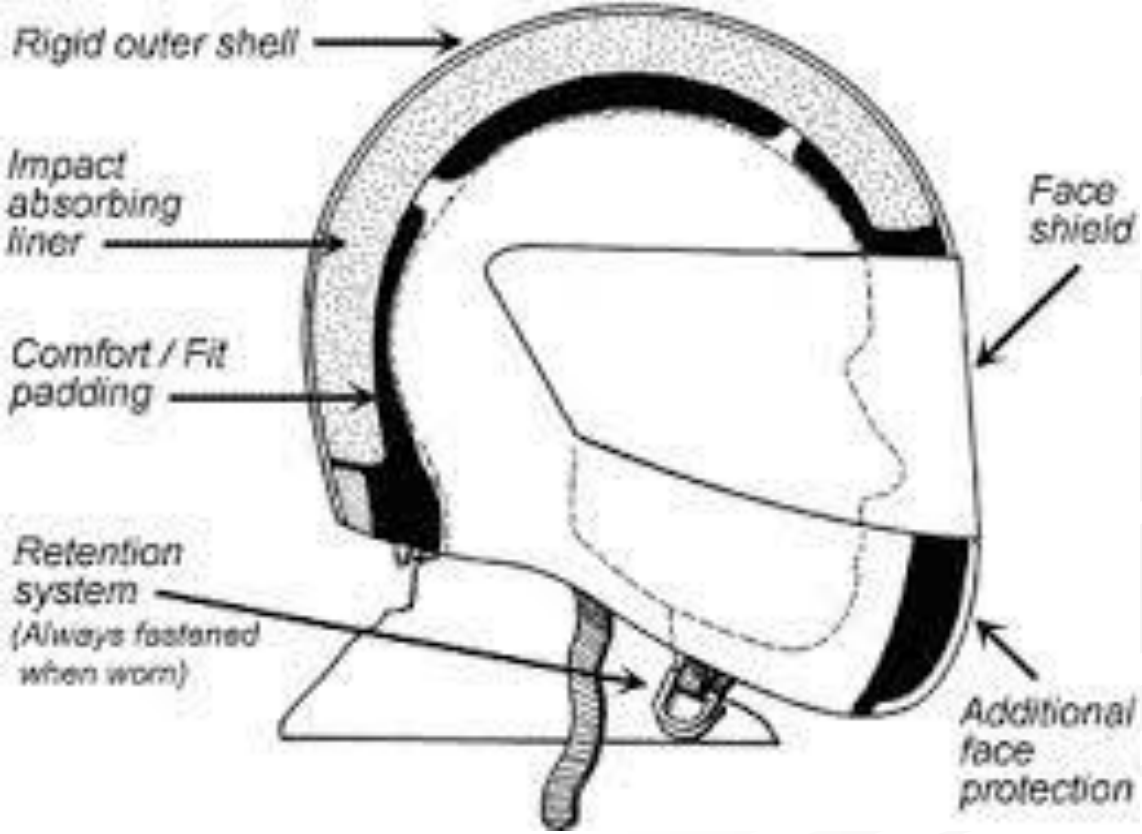
DESIGN STRUCTURE

- Sturdy and resistant to outside temperature
- Exterior parts made of carbon fibre
- Internal metal frame with networked sensors
- A digital logic hub in the interiors

INTERNAL STRUCTURE



- PROVIDE SURFACE ARE FOR PLACEMENT OF SENSORS
- OXIMETER, ARDUINO BOARD AND HEIGHT DETECTION SENSORS WILL BE PLACED
- SOFT INNER PADDING
- VENTS FOR AIR INTAKE
- WIRING AND CONNECTIONS IN THE FRAMEWORKS



EXTERNAL STRUCTURE

- LIGHT CARBON FIBRE
- OUTLET FOR AIR EQUIPPED WITH FILTERS
- FACE COVERING
- STURDY AND IMPACT ABSORBING

COST ANALYSIS

Product Name	Quantity	Price	Amount
Arduino UNO R3	1	₹ 499	₹499
Piezo buzzer(alarm)	1	₹ 25	₹ 25
Ultrasonic sensor(HC-SR04)	1	₹ 63	₹ 63
Jumper Wires	1 set with 40 pcs	₹ 65	₹ 65
Gas sensor	1	₹ 690	₹ 690
Charcoal	0.5 gms	₹ 10/kg	₹ 0.005
Pulse oximeter sensor and analog temp. sensor	1 each	₹ 369	₹ 369
Eye gear	1	₹ 250	₹ 250
Ca-Bentonite	1.8 gms	₹ 87/100gm	₹ 1.56
Design model	1	₹ 800	₹800
LDR and LED	1	₹ 20	₹ 20

Total Cost = ₹ 2783

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- http://www.safety-helmet.com/safetyhelmet/mining-helmet.html#:~:text=Mining%20helmet%20is%20a%20type,falling%20objects%20and%20other%20hazards.&text=Fiberglass%20is%20one%20of%20the,Mineral%20industries
- https://link.springer.com/referenceworkentry/10.1007%2F978-3-319-73568-9_202#:~:text=The%20most%20common%20mining%20hazards,spontaneous%20combustion%3B%20landslides%3B%20seismicity%3B
- https://academic.oup.com/occmed/article/54/5/283/1399618
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THANK YOU !!!