SMART WORKING HELMET SYSTEM USING ARDUINO

Report of Design & Development of the Project

by

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DECLARATION

I hereby certify that this project report and all the artifacts associated with it is my own work and it has or been submitted before nor is currently being submitted for any other degree program.

Name of the Student: ……...

Registration Number: …….

Signature: …… Date: ……

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I owe my thanks goes to my colleagues who always motivate me by giving me support and guidance for innovative ideas.

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PREFACE

This report contains an introduction of the existing system, system design, implementation and testing. That is this report provides a brief description about the project, aims and objectives of the project and details of proposed system in the system analysis part. For Code implementation this project used Arduino IDE.

1. Introduction and motivation

1.1 Introduction

Workers in dangerous areas are frequently facing dangerous situations. Mostly miners are the ones who face high temperature, dangerous Gases and darkness. In this project A working helmet was developed as a smart helmet to detects the dangerous situations by using the Arduino and sensors.

1.2 Motivation

Safety has long been a concern in the mining business, especially in sub-surface mining. On March 10, 1904, a *Courrières mine disaster* in Europe, the deadliest mining industry in Europe, which killed 1,099 miners, was hit by a severe mines in Europe. On April 26, 1942, in the city of Benshih Collier, defeated the destruction, killing 1549 miners. Mining has been significantly protected over the past few decades, but there are still ongoing warnings. According to government statistics, 5,000 miners in China each year are in a crash, with another 20,000 more reported. Mining accidents continue worldwide, including accidents causing dozens of fatalities at a time such as the 2007 *Ulyanovskaya Mine disaster* in Russia, the 2009 *Heilongjiang mine explosion* in China, and the 2010 Upper *Big Branch Mine disaster* in the United States. Identification of strategies for intervening in issues relating to Occupational Health and Safety and the National Industrial Safety Organization (NIH) as the main industrial division of National Occupational Safety Policy (NORA) of National Occupational Results Research Program (NORA). The Mines Safety and Health Administration (MSHA) were established in 1978 to "prevent mines, work for disease and injury and work for safe and healthy work for US miners." It was implemented in 1978, with 242 miners dead in 1978, up to 28 miners in 2015.

From these details it proved that the danger was not ended but reduced. For more safety, with collaboration of IoT this Smart Working Helmet was developed with Arduino and some sensors which can detect High Temperatures ,gases and darkness.

2. Problem identification

Workers in mines, construction areas and in other dangerous working areas, are risking their health and life every day. In this project it mainly concern about Mining workers. Mining is one of the most dangerous trades in the world. Mining techniques can be divided into two types: surface mining and sub-surface (underground) mining. Sub-surface mining consists of digging tunnels or shafts into the earth to reach buried ore deposits.For processing, and waste rock, for disposal, are brought to the surface through the tunnels and shafts. Sub-surface mining

can be classified by the type of access shafts used, the extraction method or the technique used to reach the mineral deposit. Drift mining utilizes horizontal access tunnels, slope mining uses diagonally sloping access shafts, and shaft mining utilizes vertical access shafts. Mining in hard and soft rock formations require different techniques. Miners deal every day with dangerous gases and high temperature levels in a dark environment. With dangerous gases the works can have breathing problems and without knowing the gases can be spread inside the human body. It will cause many diseases and can have side effects also. When it's dark around, the danger can be happened without knowing and seen. When the surrounding temperature is higher than the body temperature,it may also cause death as well as the burns. So in this project, with the help of Arduino , designed and developed a Smart Working Helmet that can save their lives, if something happens as given above.

3. Proposed solution with diagrams

3.1 Solution

Helmets are the objects that protecting heads from danger .The Arduino Smart Helmet is using the Arduino board to read values from gas sensor, temperature sensor, Rechargeable battery , Buzzer and light sensor. It has three main abilities:

If the worker is approaching to a dangerous gas, the helmet will inform him with a warning sound from the buzzer. If the environment is too noisy, he will know that he is in danger by the red blinking led in the front of the helmet. The warning sound and the red led will repeated faster as he is approaching closer to a dangerous environment.

If the environment temperature becomes higher than the worker's body can withstand (e.g. 45 ºC), the helmet will inform him with a different warning sound from the buzzer. If the environment is too noisy, he will know that he is in danger from the red blinking led in the front of the helmet.

If the working environment becomes darker, the helmet's front light will be turned on. It has a rechargeable battery and can be easily re-programmed to adjust values of the working environment.

3.2 Diagram

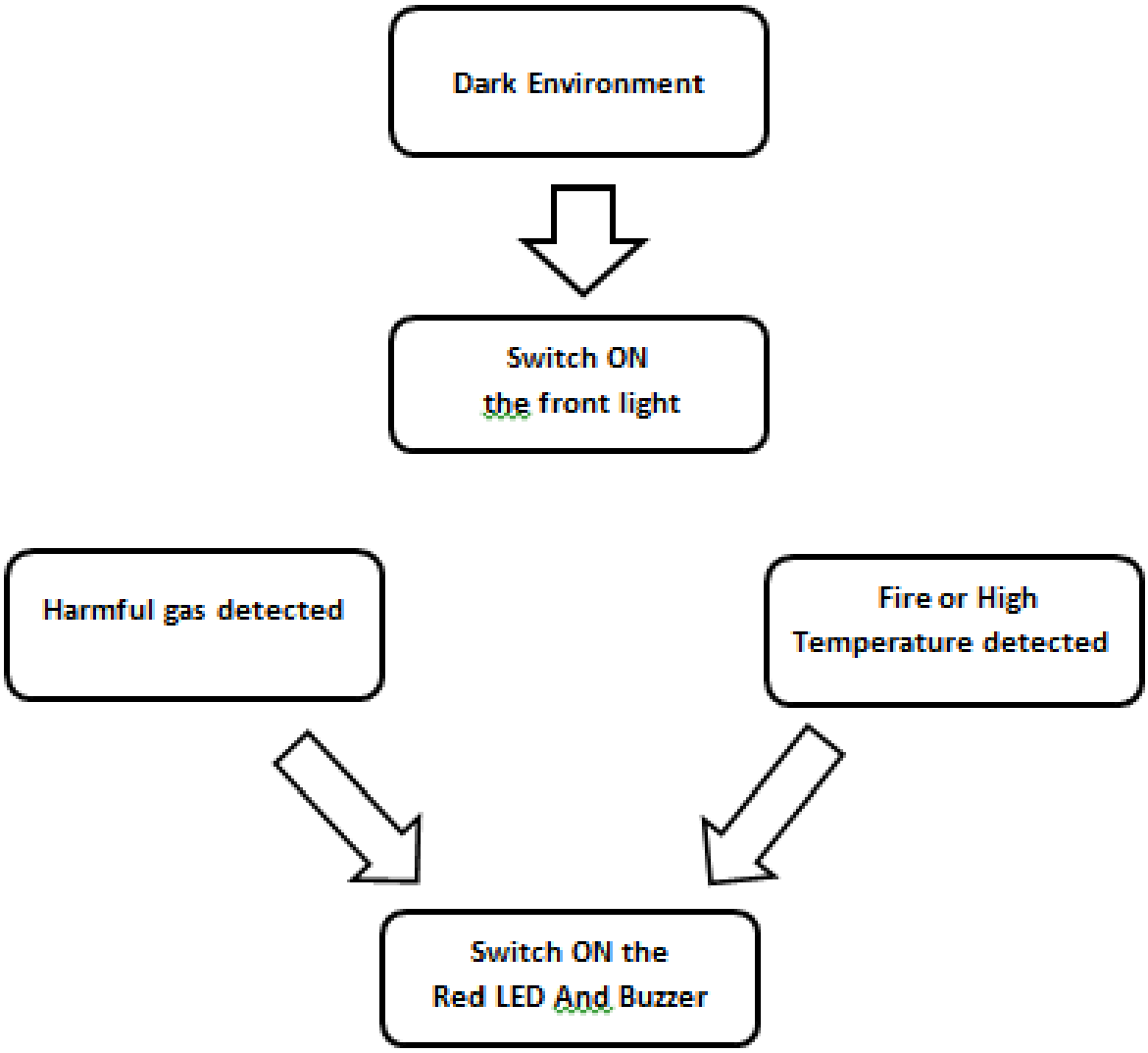

Figure 1: Project Diagram

3.3 Project Snaps

Figure 2: Overall View

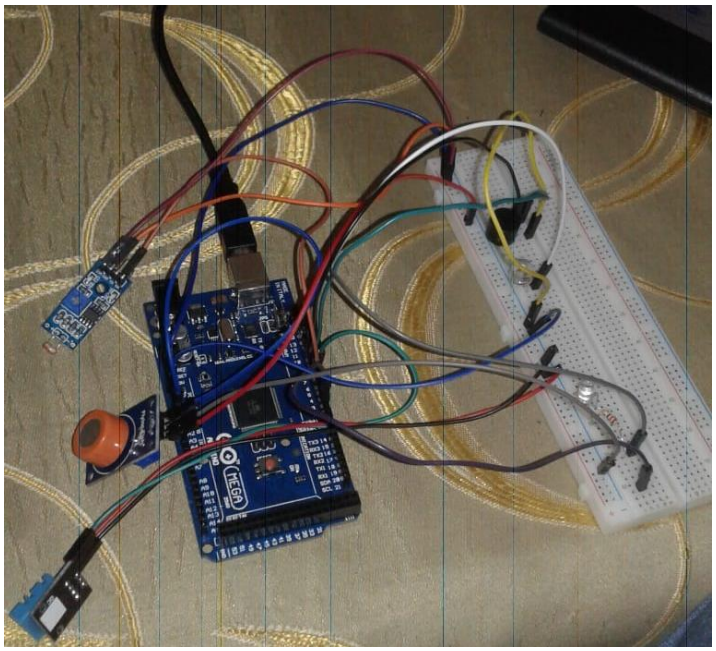

Figure 3: Circuit View

4. Technology usage and integration with code samples

4.1 Technology usage

Mainly Arduino microcontroller, IDE and sensors for sense temperature gas and light was used when developing this smart Helmet.

4.1.1 Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of *accessible knowledge* that can be of great help to novices and experts alike.

Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments.

All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular needs. The software, too, is open-source, and it is growing through the contributions of users worldwide.

4.1.2 *MQ-2 Gas Sensor-LPG sensor*

LPG sensor It is an ideal sensor to detect the presence of a dangerous LPG leak in our home or in a service station, storage tank environment and even in vehicle which uses LPG gas as its fuel. This unit can be easily incorporated into an alarm circuit/unit, to sound an alarm or provide a visual indication of the LPG concentration. The sensor has excellent sensitivity combined with a quick response time. When the target combustible gas exist, the sensor's conductivity is higher along with the gas concentration rising. LPG gas sensors change of conductivity to its corresponding output signal of gas concentration. MQ-2 gas sensor is used to sense the poisonous gas and has high sensitivity to LPG, and also response to Natural gas. It is a portable gas detector which has long life with low cost.. Model No. MQ-2 Sensor Type Semiconductor Standard Bakelite (Black Bakelite) Detection Gas PROPANE, HYDROGEN,LPG Concentration 300-1000ppm (Hydrogen, Propane, LPG). When the target

combustible gases exist, the sensor's conductivity is higher along the gas concentration increasing.

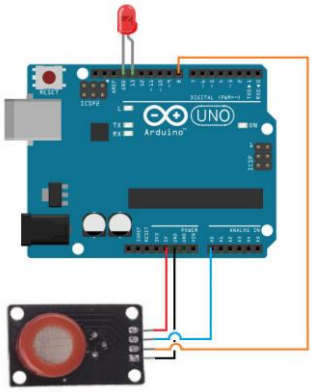

Figure 4: MQ-2 sensor circuit

Table 1:Description of MQ-2

MODEL NO	MQ-2
SENSOR TYPE	SEMICONDUCTOR
STANDARD	BAKELITE
DETECTION GAS	LPG,PROPANE HYDROGEN
CONCENTRATION	300-1000 PPM

4.1.3 DHT11 Temperature and Humidity Sensor

This DHT11 Temperature and Humidity Sensor features a calibrated digital signal output with the temperature and humidity sensor capability. It is integrated with a high-performance 8-bit microcontroller. Its technology ensures the high reliability and excellent long-term stability. This sensor includes a resistive element and a sensor for wet NTC temperature measuring devices. It has excellent quality, fast response, anti-interference ability and high performance.

Each DHT11 sensors features extremely accurate calibration of humidity calibration chamber. The calibration coefficients stored in the OTP program memory, internal sensors detect signals in the process, we should call these calibration coefficients. The single-wire serial interface system is integrated to become quick and easy. Small size, low power, signal transmission distance up to 20 meters, enabling a variety of applications and even the most demanding ones. The product is 4-pin single row pin package. Convenient connection, special packages can be provided according to users need.

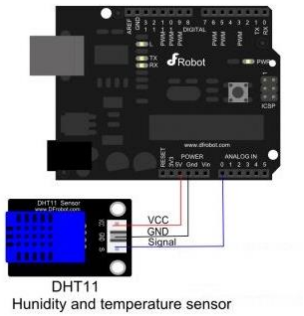

Figure 5: Circuit of DH11 sensor

4.1.4 *Light sensor module*

The Light sensor integrates a photo-resistor(light dependent resistor) to detect the intensity of light. The resistance of photo-resistor decreases when the intensity of light increases. A dual OpAmp chip LM358 on board produces voltage corresponding to intensity of light(i.e. based on resistance value). The output signal is analog value, the brighter the light is, the larger the value.

This module can be used to build a light controlled switch i.e. switch off lights during day time and switch on lights during night time.

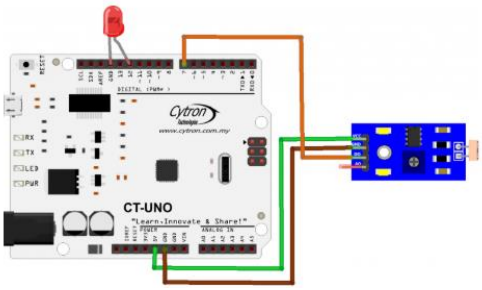

Figure 6:Circuit diagram of Light module sensor

4.2 Circuit Diagram

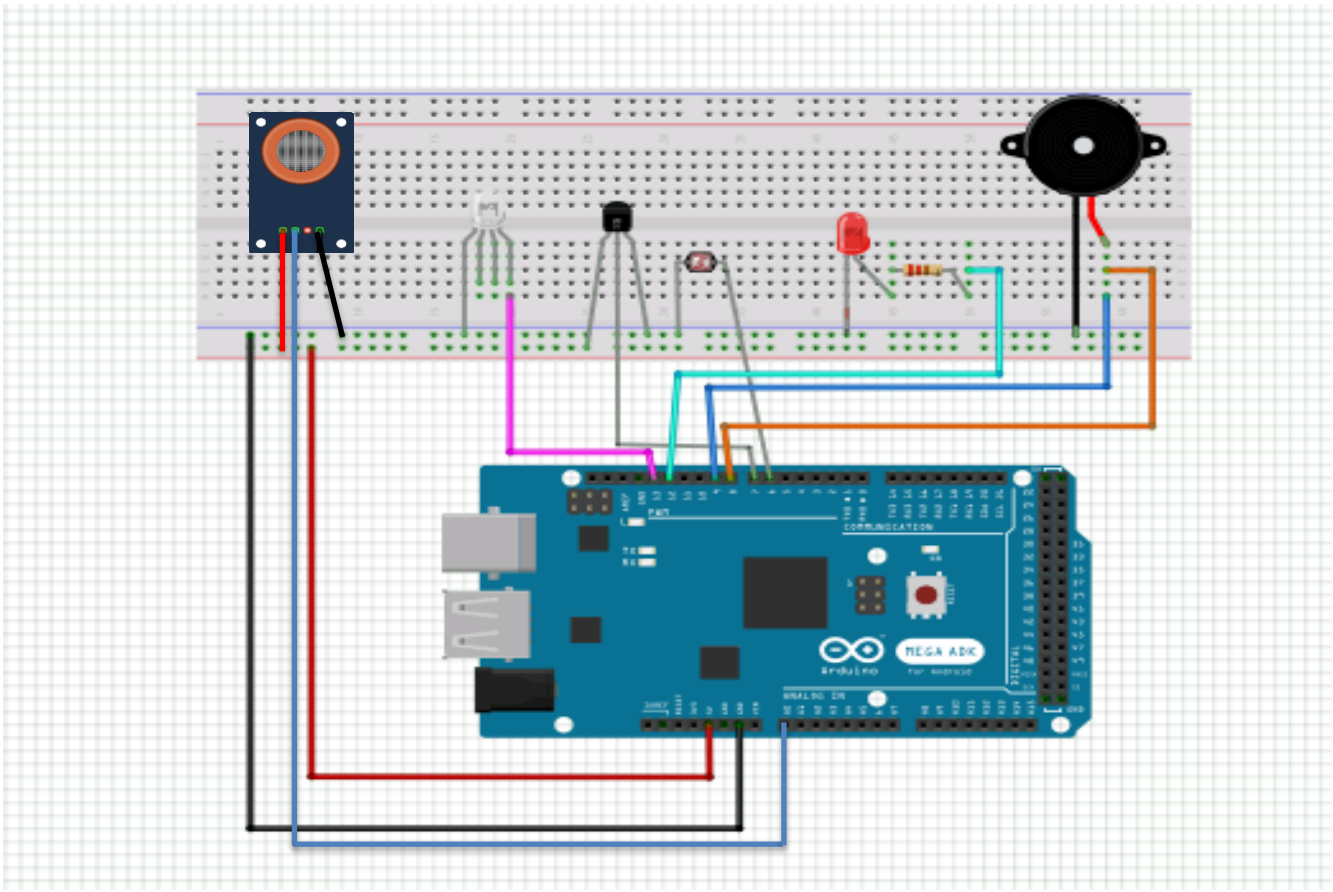

Figure 7:Circuit Diagram

4.3 Code implemented

```
#include <dht.h>
dht melani;
//temp sensor
int Buzzer1=9;
const int ledpin=12;

//gas sensor
const int MQ3=0;
const int Buzzer=8;
const int LED=12;
int value;
```

```
//Light sensor
const int ldr_pin = 6;
const int led_pin = 13;



void setup() {
  Serial.begin(9600);
  pinMode(MQ3, INPUT);
  pinMode(Buzzer, OUTPUT);
  pinMode(LED, OUTPUT);
  digitalWrite(Buzzer,LOW);
  digitalWrite(LED,LOW);

  //ldr
  pinMode(ldr_pin,INPUT);
  pinMode(led_pin,OUTPUT);

  //temp sensor
  pinMode(ledpin,OUTPUT);
  pinMode(Buzzer1,OUTPUT);
  delay(500);
}

void loop()
{
  value= analogRead(MQ3);
  Serial.println(value);

  if(value>550)
  {
    digitalWrite(Buzzer,HIGH);
    digitalWrite(LED,HIGH);
  }else{
    digitalWrite(Buzzer,LOW);
    digitalWrite(LED,LOW);
  }

  //ldr
```

```
if( digitalRead( ldr_pin ) == 1){
   digitalWrite( led_pin,HIGH);
 }
 else{
   digitalWrite( led_pin , LOW);
 }

 Serial.println( digitalRead( ldr_pin ));
 delay(100);


 //temp
int val=melani.read11(7);

 Serial.print("Temperature=");
 Serial.println(melani.temperature);
 Serial.print("\t Humidity=");
 Serial.println(melani.humidity);

if(melani.temperature>30){
 digitalWrite(ledpin,HIGH);
 digitalWrite(Buzzer1,HIGH);
 tone(9,200,2000);
 }
 delay(500);
}
```

5. Results and analysis

In this project three sensors were connected. By the experiments of the sensors and the requirements limitations can be predict and the system can use with ore accuracy.

5.1 MQ-2 Gas Sensor-LPG sensor

Table 2: Technical dataset of MQ-2 Sensor

Model No.			MQ-2
Sensor Type			Semiconductor
Standard Encapsulation			Bakelite (Black Bakelite)
Detection Gas			Combustible gas and smoke
Concentration			300-10000ppm (Combustible gas)
Circuit	Loop Voltage	V_c	≤24V DC
	Heater Voltage	V_H	5.0V±0.2V ACorDC
	Load Resistance	R_L	Adjustable
Character	Heater Resistance	R_H	31Ω±3Ω（Room Tem.）
	Heater consumption	P_H	≤900mW
	Sensing Resistance	R_s	2KΩ-20KΩ(in 2000ppm C_3H_8)
	Sensitivity	S	Rs(in air)/Rs(1000ppm isobutane)≥5
	Slope	α	≤0.6($R_{5000ppm}$/$R_{3000ppm}$ CH_4)
Condition	Tem. Humidity		20℃±2℃；65%±5%RH
	Standard test circuit		Vc:5.0V±0.1V； V_H: 5.0V±0.1V
	Preheat time		Over 48 hours

Following conditions must be prohibited

1) Exposed to organic silicon steam

Organic silicon steam cause sensors invalid, sensors must be avoid exposing to silicon bond, fixture, silicon latex, putty or plastic contain silicon environment

2) High Corrosive gas

If the sensors exposed to high concentration corrosive gas (such as H2Sz, SOX, Cl2, HCl etc), it will not only result in corrosion of sensors structure, also it cause sincere sensitivity attenuation.

3) Alkali, Alkali metals salt, halogen pollution

The sensors performance will be changed badly if sensors be sprayed polluted by alkali metals salt especially brine, or be exposed to halogen such as florin.

4) Touch water

Sensitivity of the sensors will be reduced when spattered or dipped in water.

5) Freezing

Do avoid icing on sensor' surface, otherwise sensor would lose sensitivity.

6) Applied voltage higher

Applied voltage on sensor should not be higher than stipulated value, otherwise it cause down-line or heater damaged, and bring on sensors' sensitivity characteristic changed badly.

7) Voltage on wrong pins

For 6 pins sensor, if apply voltage on 1、3 pins or 4、6 pins, it will make lead broken, and without signal when apply on 2、4 pins

5.2 DHT11 Temperature and Humidity Sensor

Do not use this product as safety or emergency stop devices, as well as due to the failure of the product could result in personal injuries to any of the other applications. The product shall not apply unless there is a particular purpose or use authorization. Before installation, handling, use or maintenance of the product to the reference product data sheets and application notes. Failure to comply with this recommendation could result in death or serious injury.

Application information as below:

1) Working and storage conditions

The proposed scope of work may result in up to 3% RH temporary drift of the signal. Return to normal working conditions, the sensor calibration status will slowly recover. To speed up the recovery process can be found in "recovery process." The use of the product will accelerate the aging process for a long time under abnormal operating conditions.

Avoid placing components on a long-term condensation and dry conditions and the following environments.

A. smoke

B. Acid or oxidizing gases such as sulfur dioxide, hydrochloric acid Recommended Storage Environment

Temperature：10~40℃

Humidity：60% RH or less

2) Effects of exposure to chemical substances

Sensing resistive humidity sensor will be disturbed chemical vapor layer, the diffusion layer in the induction of chemicals may cause drift and measurement sensitivity. In a clean environment, slowly release contaminants out. The recovery process described below to accelerate the process. High concentrations of chemical pollution can cause damage to the sensor sensing layer completely.

3) Temperature Effect

Relative humidity of the gas is largely dependent on temperature. Therefore, when measuring the humidity should be possible to ensure that the humidity sensor works at the same temperature. If you share a printed circuit board with electronic components heat released in the sensor should be installed as far as possible away from the electronic components, and installed at the bottom of the heat source, while maintaining a well-ventilated enclosure. To reduce the thermal conductivity sensor and a copper plating layer of the printed circuit board should be as minimal other portions, and leaving a gap between them.

4) Light effects

Prolonged exposure to sunlight or strong ultraviolet radiation, will reduce performance.

5) Recovery process

Placed under extreme operating conditions or chemical vapor sensors, through the following process, you can return it to the state calibration. 45 ℃ and humidity under 70% RH conditions were maintained for more than 5 hours.

6) Wiring Precautions

DATA signal wire quality will affect the communication distance and communication quality, we recommend using a high-quality shielded cable.

7) Soldering Information

Manual welding, at a temperature of 300 ℃ maximum contact time must be less than 10 seconds.

8.) *Product upgrades*

5.3 Light sensor module

Table 3: Specification of Light module

Operating voltage	3~5V
Operating current	0.5~3 mA
Response time	20-30 milliseconds
Peak Wavelength	540 nm
Weight	4 g

6. Future Implementation

For this project we have to drill the working helmet to connect the sensors and it will cause damage in the helmet and loose the warranty also. In the future it can find a solution for that and also this sensors accuracy and sensibility and be improved.

7. Discussion and Conclusion

This project is mostly helpful for the workers in the mines. When the danger occurs like harmful gas and high temperature this helmet will war by an alarm. But if the sensors exceed their limitations this will be useless. Before using this smart helmet the workers should have full manual and when the first warning comes up person should avoid the danger at once. This is a useful object to have a warn about the danger. By research about the limitations and data this project can implement for more useful one by avoiding the existing limitations .

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