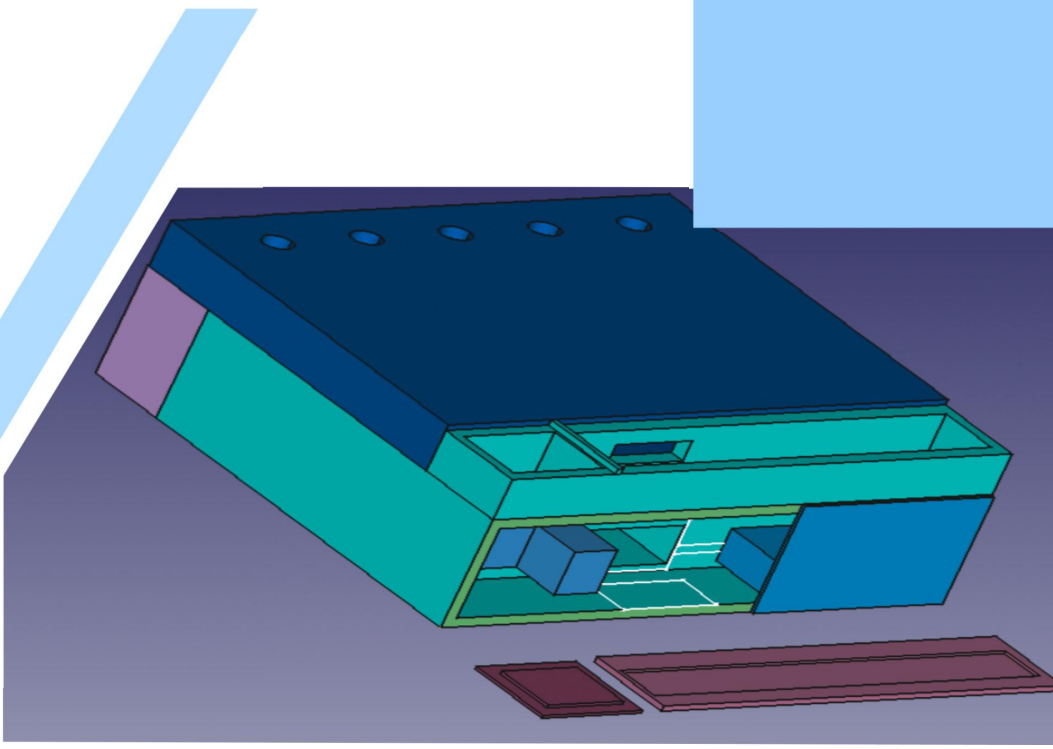
Open IIT Product Design 2021-22

Report

D'Blaze



Team 262
Team (Name)

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INTRODUCTION

Problem Statement

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Motivation

Many common people are killed due to a lack of knowledge about large fire ragings in an apartment or a warehouse. Countless heroic lives are lost when an inexperienced individual tries to combat the fire, often worsening the fire. No doubt that firefighters are the bravest of heroes. But often it is too late for them to arrive on time. There are no other similar products to solve this problem in the existing market, making it essential to bring this product to the firefighters who sacrifice so much for us in their line of duty and the first responders.

Aim of the Product

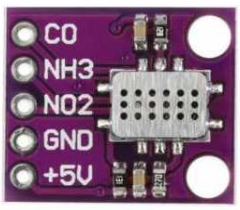
The device that we have come up with identifies the type of fire and provides information on combatting it. With this information in hand, it will ease the process of stopping the fire, saving lives and property from being lost. This information will also help combat the fire by the first responders and minimise the fire's size.

PARTS OF THE PRODUCT

1. Arduino UNO

Arduino UNO is an easy-to-use programmable open-source microcontroller board that can be integrated into various electronic projects. This board contains a USB interface, and Arduino IDE software is used to program the board.
Dimensions of standard Arduino UNO board: 68.6 mm x 53.4 mm
Net mass = 25g

2. MiCS 6814 Sensor



The MiCS-6814 is a compact MOS sensor with three fully independent sensing elements on one package. The MiCS-6814 includes three sensor chips with independent heaters and sensitive layers that detect oxidising gases (OX), reducing gases (RED), and NH3.
Dimensions of standard MiCS 6814: 5 x 7 x 1.55 mm.

PARTS OF THE PRODUCT

3. Micro Servo Motor SG90

The micro servo motor SG90 is a tiny, lightweight, three pole servo motor with high output power but have less torque. It can rotate 180º, with a torque of 1.80 kg-cm. It has a shaft diameter of 4.5mm and has analog modulation.
Dimensions of the motor: 22.2 x 11.8 x 31 mm
Net Mass = 9g

4. MQ-2 Gas Sensor

MQ-2 gas sensor has a high sensitivity to LPG, Propane and Hydrogen. The sensor could also be used for Methane and other combustible steam. It is low cost and suitable for different applications. It can detect flammable gas in a range of 300 - 10000ppm. It has good sensitivity to Combustible gas in a wide range.
Dimensions: 32 x 22 x 27 mm

5. MQ-3 Gas Sensor

MQ 3 – This alcohol sensor is suitable for detecting alcohol concentration on your breath, just like your common breathalyzer. It has high sensitivity and a fast response time. The sensor provides an analog resistive output based on alcohol concentration. The sensor can detect alcohol with different concentrations. It is low cost and suitable for different applications.
Dimensions: 20 x 10 x 5 mm

6. MAX6675 Sensor

The MAX6675 is a temperature sensor which works in the temperature range of 0 to +1024 °C. It makes use of the Maxim MAX6675 K-Thermocouple to digital converter IC to provide a microcontroller compatible digital serial interface (SPI compatible) for giving an accurate temperature.
Dimensions are 15mm x 25mm x50cm

7. **TCS230 Color Sensor Module**:

The TCS230 Color Sensor is a complete color detector that can detect and measure an almost infinite range of visible colors. The module consists of 4 white leds which light up the object, making it usable in the dark too. The dimensions of the module is 32mm x 24.7mm and has a weight of 4.17g.

OUR PRODUCT

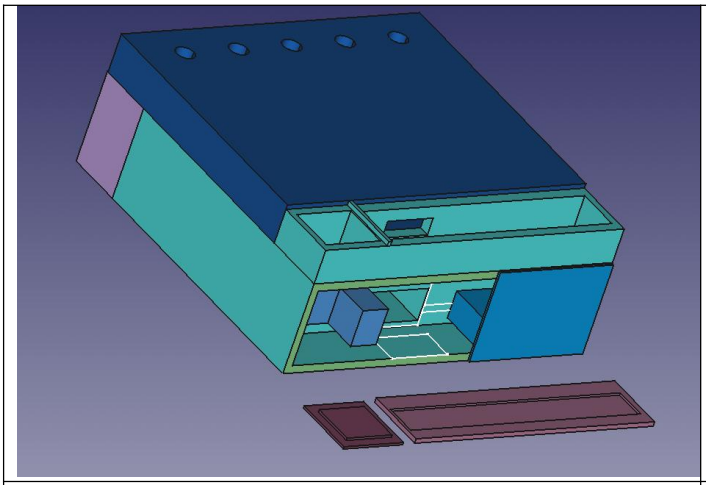
Working Principle

- The product consists of servo motors, temperature sensors, gas sensors and colour sensors to allow for the intake, cooling and assessment of fumes to detect the type of fire.
- The product has two temperature sensors and two micro servos, which are a part of the cooling mechanism.
- The first temperature sensor senses hot fumes near the opening of the product and opens the gate through the servo motor.
- The fumes then enter the cooling module, where the gas is cooled down to a temperature of 50ºC using water. Also, the CaO coating inside the chamber absorbs all the CO_2 while the gas cools down.
- The second temperature sensor senses the temperature of the gas inside the chamber and opens the gate to the sensor module of the product when the temperature reaches 50ºC.
- Cooling the gasses is essential since the sensors stop working at a high temperature.
- The sensor module has two parts. Some of the fumes pass into the section having a purple litmus solution. The colour sensor then detects the colour of the litmus solution.
- The other part of the sensor module has three sensors - MQ2, MQ3 and MiCS 6814.
- Now, we can use the collected data to find the appropriate compounds in the fumes.
- If the litmus turns blue and there is no NH_3 in the fumes, we can confirm that the fumes consist of metallic oxides. Most metallic fires start due to the combustion of sodium, potassium, lithium, magnesium, calcium, titanium, uranium or plutonium. All these metals have basic oxides. The presence or absence of NH_3 is checked using the MiCS 6814 sensor.
- If the litmus solution turns deep red and there is no NO_2 in the fumes, we can conclude the presence of HCl, which is a byproduct of burning insulation (PVC). Now, since we absorb the fumes as soon as it reaches the product, we can absorb the fumes that evolved when the fire started burning. PVC burning right at the start of the fire indicates an electrical fire.
- If the gas sensors MQ2 or MQ3 are stimulated, it tells us the fire started due to liquid flammables.
- To check for type A fires, we use the CO pin of the MiCS 6814 detector. If carbon monoxide is released in the fire and the fire is not electrical, we can conclude that the fire is a type A fire.

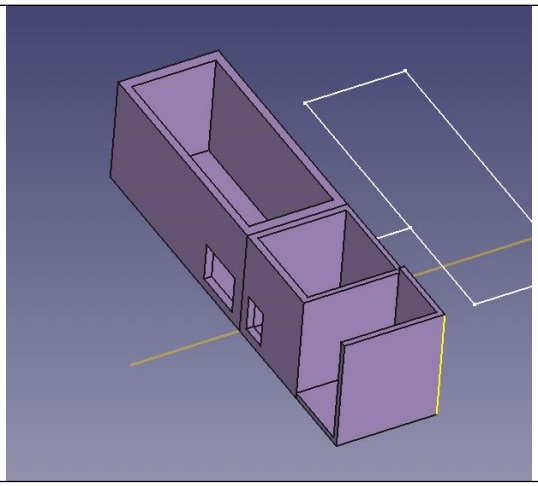
- After the dtection is done the appropriate led is turned on and the buzzer is activated to inform the user about the fire.

OUR PRODUCT

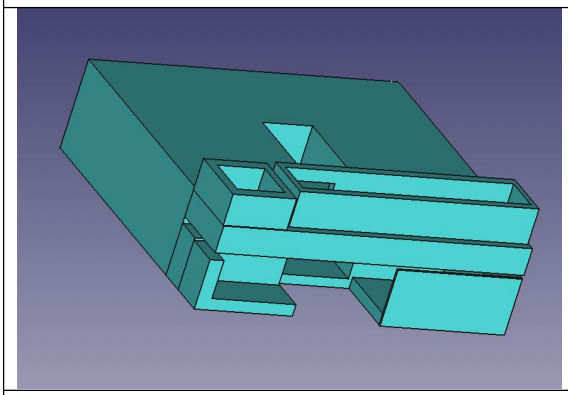
Images of the CAD Model



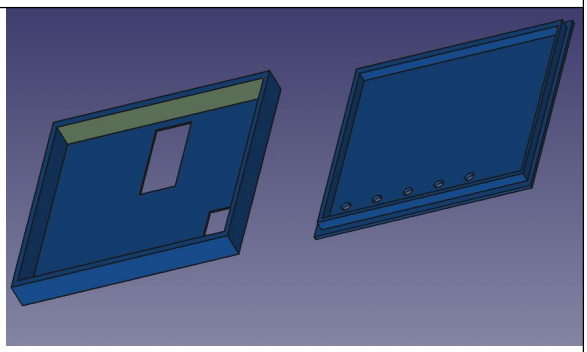
The Full Product



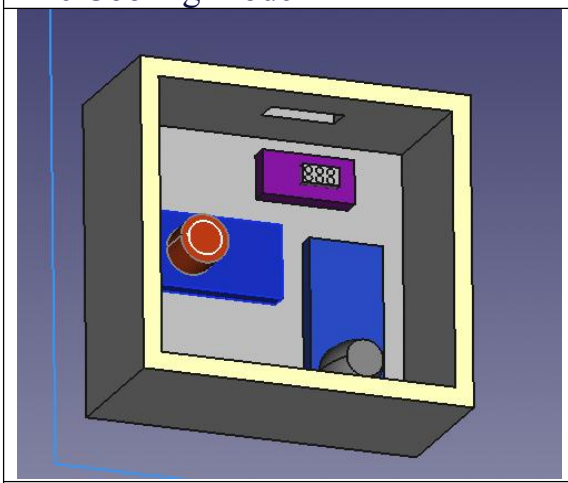
The sensor module



The Cooling Model



The Arduino Module



Sensors

Detachable Stick

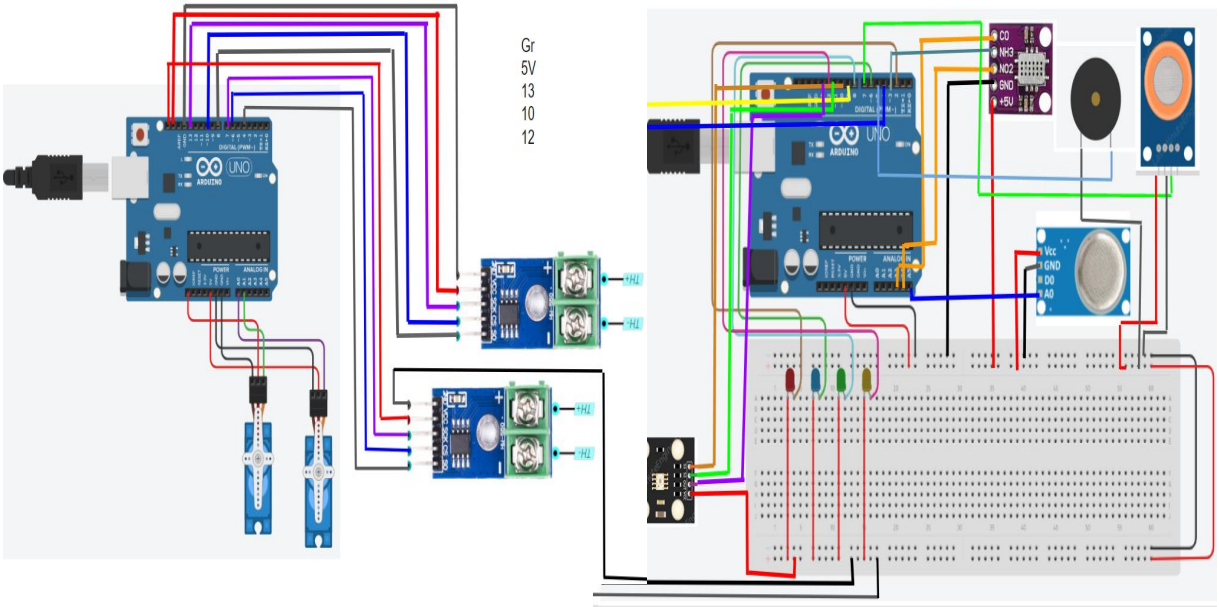
FUTURE PROSPECTS

1. We would be enabling the device to communicate with the fire department, updating them on the case.
2. We would make the replenishable components easy to change, i.e., litmus.
3. We would improve the overall accuracy of the product and also detect class K fires.

References

1. https://wiki.freecadweb.org/Tutorials
2. https://www.tutorialspoint.com/arduino/index.htm

Circuit



ANNEXURE

Annexure A

Calculations
Assumptions
Water temperature stays constant = 25C .
The values of air have been taken as a approximation.
Let
Initial temperature of fumes be 200 C .
Final temperature of fumes be 50 C.
Conduction across ABS

$$\frac{d\Theta}{dt} = \frac{KA\,(T_{gas} - 25)}{d}$$

$$d\Theta = PVC_v\,dt$$

$$\frac{dt}{(T_{gas} - 25} = \frac{KA\,dt}{dPVC_P}$$

area and volume can be taken from CAD model

A=0.1113m^2 , V= 64.26 micro meter cube, C= 718J/kgK , P = 1.225kg/metercube
d (width of inner wall) = 0.5 centimeter , K (ABS) = 0.21

$$ln\,\frac{(200 - 25)}{(50 - 25)} = \frac{0.21 \times 0.1113\,(t - 0)}{5 \times 10^{-3} \times 1.225 \times 64.26 \times 10^{-6} \times 718}$$

$$t = 0.0235\ sec$$

Annexure B

code

```
int blueLed= 6, redLed = 2, greenLed = 8, yellowLed =12, buzzer =5, MQ3=7, s0=4, s1=9;
int Green=0, Blue=0, Red=0, out=13, s3=10, s2=11;
void setup() {
  pinMode(s0,OUTPUT),  pinMode(s1,OUTPUT),  pinMode(s2,OUTPUT),  pinMode(s3,OUTPUT);
  pinMode(out,INPUT),  pinMode(redLed, OUTPUT) ,pinMode(greenLed, OUTPUT),pinMode(blueLed, OUTPUT);
  pinMode(yellowLed,OUTPUT),pinMode(buzzer,OUTPUT),  pinMode(A5,INPUT),pinMode(MQ3,INPUT);
  pinMode(A3,INPUT),pinMode(A4,INPUT),pinMode(3,INPUT),digitalWrite(s0,HIGH), digitalWrite(s1,HIGH);}
void GetColors(){
  digitalWrite(s2,LOW),digitalWrite(s3,LOW),Red = pulseIn(out,digitalRead(out)== HIGH?LOW:HIGH);
  delay(20),    digitalWrite(s3, HIGH),   delay(20);
  digitalWrite(s2, HIGH),  Green = pulseIn(out, digitalRead(out) == HIGH ? LOW : HIGH),delay(20);}
void loop() {
  int analogSensor = digitalRead(A5);
  int MQ3Sensor= digitalRead(MQ3);
  if (analogSensor==1||MQ3Sensor==1){
    digitalWrite(redLed, HIGH),   tone(buzzer, 1000, 200);}
  if(analogSensor==0 && MQ3Sensor==0){
    digitalWrite(redLed, LOW);
    noTone(buzzer);}
  delay(100);
  int a1 = analogRead(A3);
  int a2 = analogRead(A4);
  int a3 = analogRead(3);
  if(a1==1 || a2==1){
    digitalWrite(blueLed, HIGH);
    tone(buzzer, 1000, 200);}
  if(a1==0 && a2==0){
    digitalWrite(redLed, LOW);
    noTone(buzzer);  }
  GetColors();
  delay(1000);                //Execute the GetColors function to get the value of each RGB color
  if ((Red<Blue && Red<=Green && Red<23) &&a2==0){
      digitalWrite(yellowLed, HIGH);
      tone(buzzer, 1000, 200);}//if Red value is the lowest one and smaller thant 23 it's likely Red
  if ((Blue<Green && Blue<Red && Blue<20) &&a3==0){    //Same thing for Blue
      digitalWrite(greenLed, HIGH);
      tone(buzzer, 1000, 200);  }
  delay(2000);}
```

```
#include<Servo.h>
#include "max6675.h" // SO=Serial Out
// CS = chip select CS pin // SCK = Serial Clock pin
Servo Myservo;
Servo Myservo2;
int pos, pos2  , soPin = 8    ,csPin = 10,    sckPin = 13;
soPin2 = 4,   csPin2 = 6,       sckPin2 = 7;
float temp , temp2;
MAX6675 Module(sckPin, csPin, soPin);
MAX6675 Module2(sckPin2, csPin2, soPin2);
void setup(){
   Myservo.attach(A0);
   Myservo2.attach(A1);}
void loop(){
  temp = Module.readCelsius();
  if(temp>70){
     for(pos=0;pos<=30;pos++){
        Myservo.write(pos);
        delay(100);}
     delay(1000);  // it will allow gas to come for 1 sec
     for(pos=30;pos>=0;pos--){
        Myservo.write(pos);
        delay(30);}
     delay(1000);  }
  temp2 =Module2.readCelsius();
  if(temp2<50){
  for(pos2=0;pos2<=30;pos2++){
     Myservo.write(pos2);
     delay(100); }
  delay(5000);
  for(pos2=30;pos2>=0;pos2--){
     Myservo.write(pos);
     delay(30); }
  delay(1000);
  }
}
```