INTRODUCTION

IoT is nothing but the devices communicating with each other by using the internet. IoT applications vary on a large scale. European Research Cluster on the Internet of Things classifies major IoT applications as smart buildings, smart transportation, Smart energy, smart industry, smart health and the smart city as major areas. IoT is a trend-setting innovation in which all the data from sensors is stored in the cloud where it can be easily accessed from the cloud. Sensors and actuators for gathering the data and sending across the internet are also included in this advancement. We use cloud not only to store data but also for data analysis, gathering, visualization. In India, we have 493 coalmines present. Coal is the most vital asset in the world. These petroleum products are natural assets of the earth which help create power and for some, purposes. Coal is a non-sustainable source which can't be supplanted commonly by humans, there are numerous coalmine mischance happening in the mines, and the diggers are putting their lives in hazard by working in the coal mines, even once in a while they wind up losing their lives in the coal mines which is an unfortunate part. Mainly these mishaps are happening as a direct result of the old hardware and the wired systems, resulting in the terminate mischance's, spillage of the noxious gases in the coal mines are presenting immense dangers to the excavators inside the coalmines. They can't leave the mine if there is no legitimate lighting which coming about them to harm the mineworker's vision because of working under low lighting area. So, to stay away from this issue we have structured the coalmine security framework. In our work, we have tackled the issues by checking every one of the types of information gathered by the sensors which we have utilized and the observing is finished utilizing the Things platform. The microcontroller here in the work we have utilized is Arduino Uno.

BACKGROUND

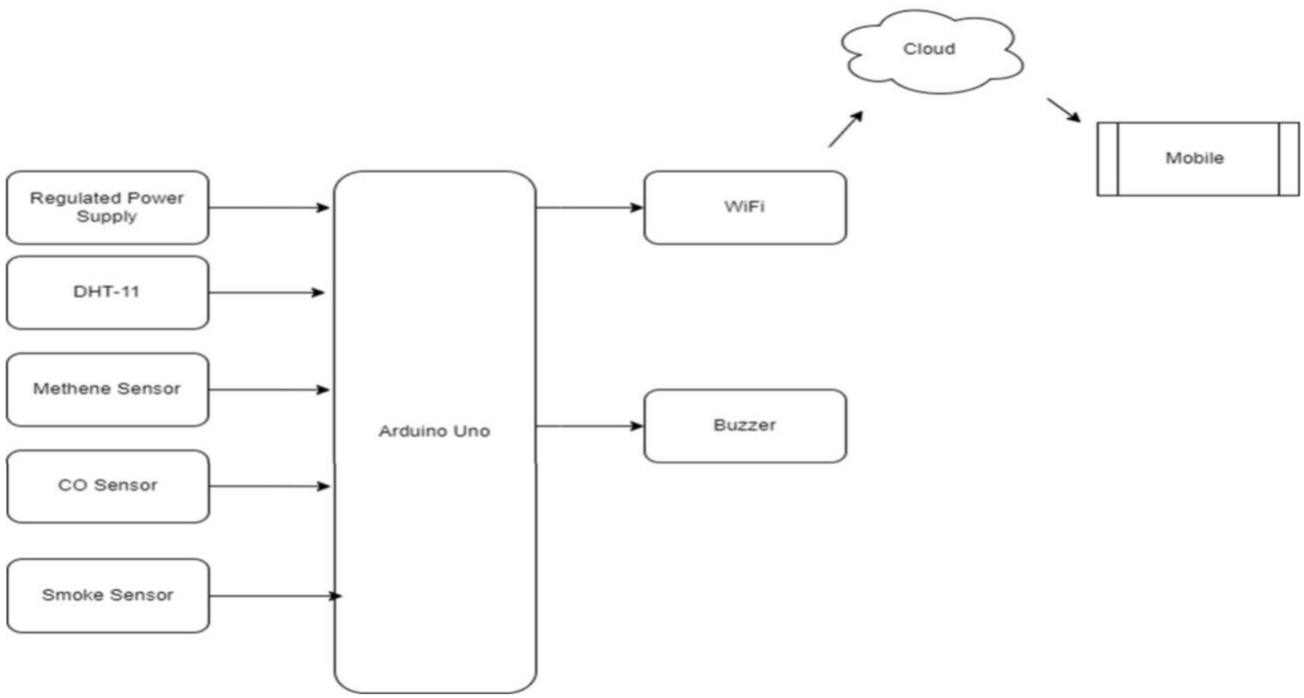
Safety measures in port operations are primarily concerned with the protection of working machinery, with sensors and switches used to ensure worker safety. Port worker observation and control are not possible with current technologies due to their high mobility and risk. A manhole cover online monitoring system is suggested. This scheme offers active, in-the-moment analysis of labour on the field in the event of a threat. This paper investigated the smart data observing device's network topology, the data processing machine, along with the remote administration and surveillance facility. For underground coal miners, a smart sensor system tracks extremely risky conditions like humidity, temperature, and airborne gas constituents like sulfur dioxide and methane in real time. Drowning, gas poisoning, flooding, mine collapses, or explosives will occur if these parameters surpass a certain threshold. This technique enables buzzers to measure these variables and sends a warning about the condition to ground control and the crew.

PROBLEM DEFINITION

Safety is a paramount concern in coal mining operations due to the inherent risks associated with working in underground and open-pit environments. The major goal of this project is to include IoT in a coal mine safety monitoring and warning system based on hazards.

Underground mining issues such as methane gas, high temperatures, fires, and other conditions must be monitored on a regular basis. Coal Mine Safety is still a problem, with deaths as a result. It is very dangerous for rescuers to enter a coal mineshaft without first paying attention to the surroundings, due to the threats that will almost certainly surface at any moment. We might employ Wi-Fi Modules in Coal Mines to enhance a variety of safety processes.

PROPOSED SYSTEM BLOCK DIAGRAM



OBJECTIVES

- Methane Gas Monitoring
- Temperature and Humidity Sensors
- Water Presence Detection
- Wireless Connectivity
- Real-time Data Monitoring
- Alert and Notification System

METHODOLOGY

6.1 Hardware Components

1. Arduino Uno
2. Methane Sensor
3. Temperature And humidity sensor
4. Water sensor
5. Light Sensor
6. Regulated Power Supply
7. LCD
8. Buzzer
9. Wi-Fi module

10. PCB
11. Connecting wires

6.2 Software Components

1. Arduino IDE
2. Arduino-C programming language
3. Firebase Cloud
4. Mobile App

6.3 ARDUINO UNO

Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB to serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter.

6.4 GAS SENSOR

The **MQ-2 Gas sensor** can detect or measure gasses like LPG, Alcohol, Propane, Hydrogen, CO and even methane. The module version of this sensor comes with a Digital Pin which makes this sensor to operate even without a microcontroller and that comes in handy when you are only trying to detect one particular gas. When it comes to measuring the gas in ppm the analog pin has to be used, the analog pin also TTL driven and works on 5V and hence can be used with most common microcontrollers.

So if you are looking for a sensor to detect or measure gasses like LPG, Alcohol, Propane, Hydrogen, CO and even methane with or without a microcontroller then this sensor might be the right choice for you.

The MQ-135 Gas sensors are used in air quality control equipment's and are suitable for detecting or measuring of NH3, NOx, Alcohol, Benzene, Smoke, CO2.

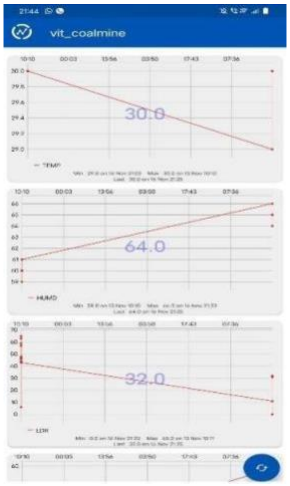
6.5 TEMPERATURE AND HUMIDITY SENSOR

The **DHT11** is a commonly used **Temperature and humidity sensor.** The sensor comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data. The sensor is also factory calibrated and hence easy to interface with other microcontrollers.

The sensor can measure temperature from 0°C to 50°C and humidity from 20% to 90% with an accuracy of ±1°C and ±1%. So if you are looking to measure in this range then this sensor might be the right choice for you.

RESULT AND DISCUSSION

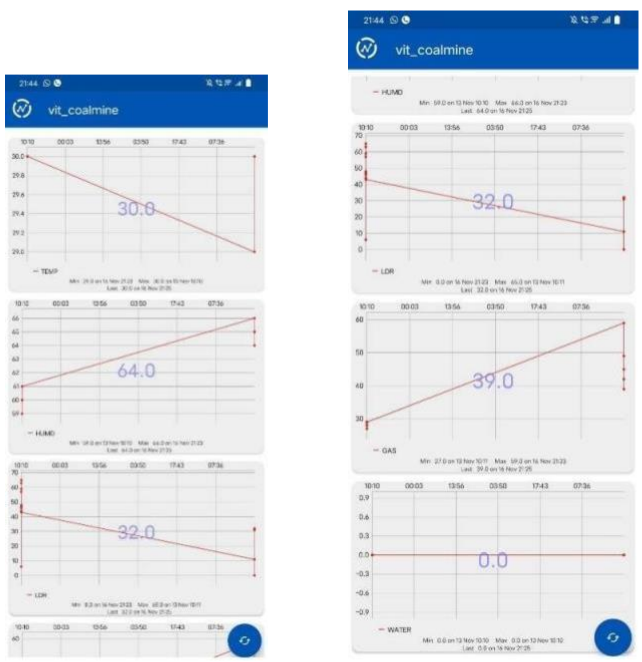
We used an APP named 'Things view' which is based on IOT Security. It gives us the resulting graphs of Coal mine Temperature , Humidity,LDR,GAS,Watervalues in detail. This is the APP Interface which we had used for our project. And we had created a channel in that PP called "VIT_coalmine with channel no: "248930"



Link: https://thingspeak.com/channels/2489

So, in this APP we can able to see the updated values of the Temperature, Humidity, LDR GAS, Water values with graphs w.r.t to date and it also displays the details of the MAX, LAST values of sensor. It also gives the details of Last update Time for our convenience. From Fig 7.1 We can observe the App Interface that's showing all the Graphs according to the date in greater Detail.

FIG:7.1



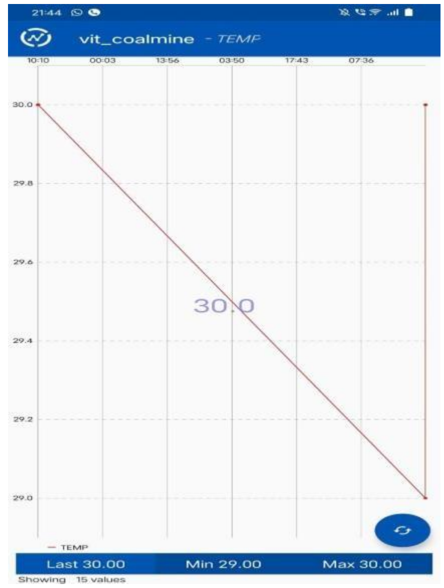


FIG 7.2 TEMPERATURE

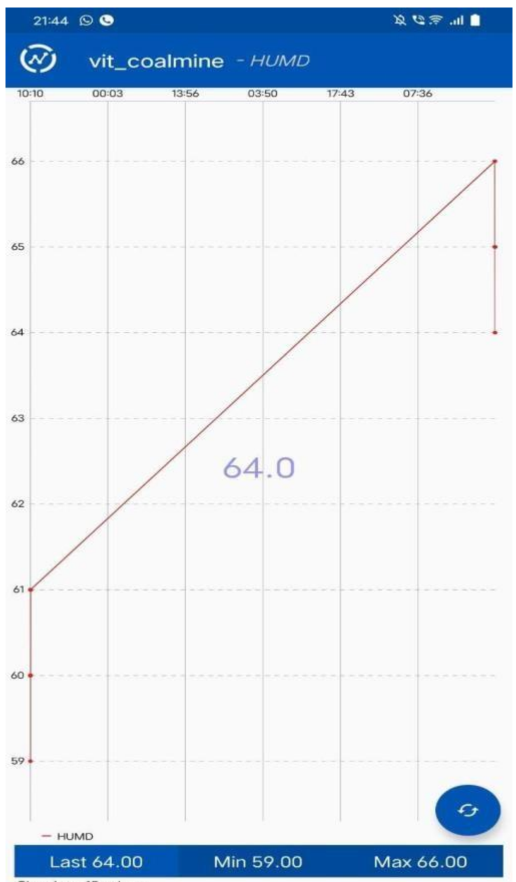
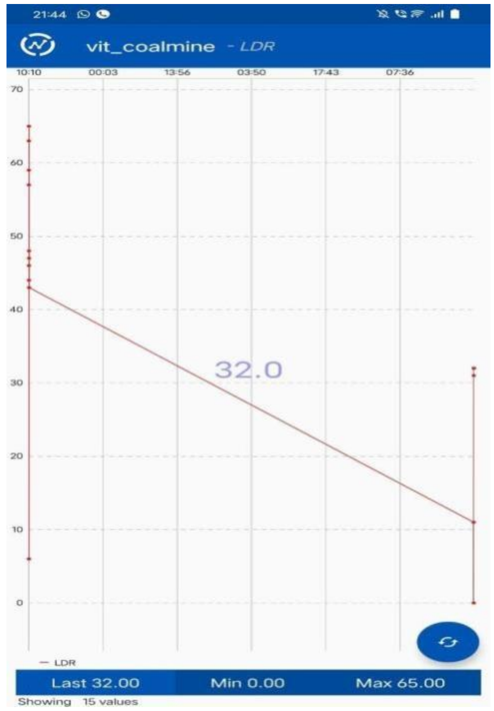


FIG 7.3 HUMIDITY

FIG 7.4 LDR



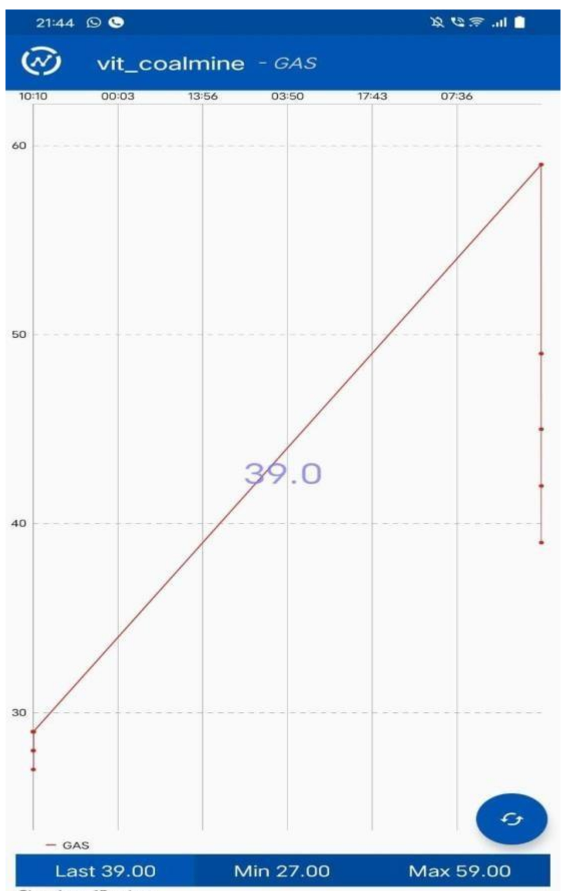


FIG 7.5 GAS

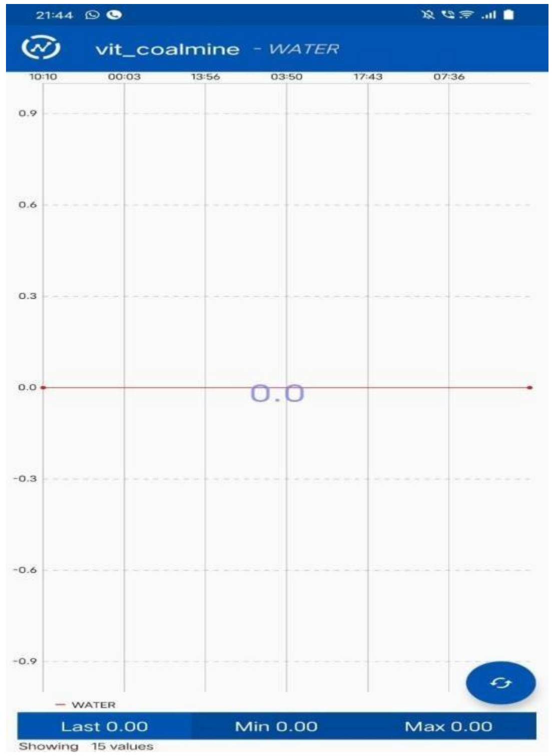
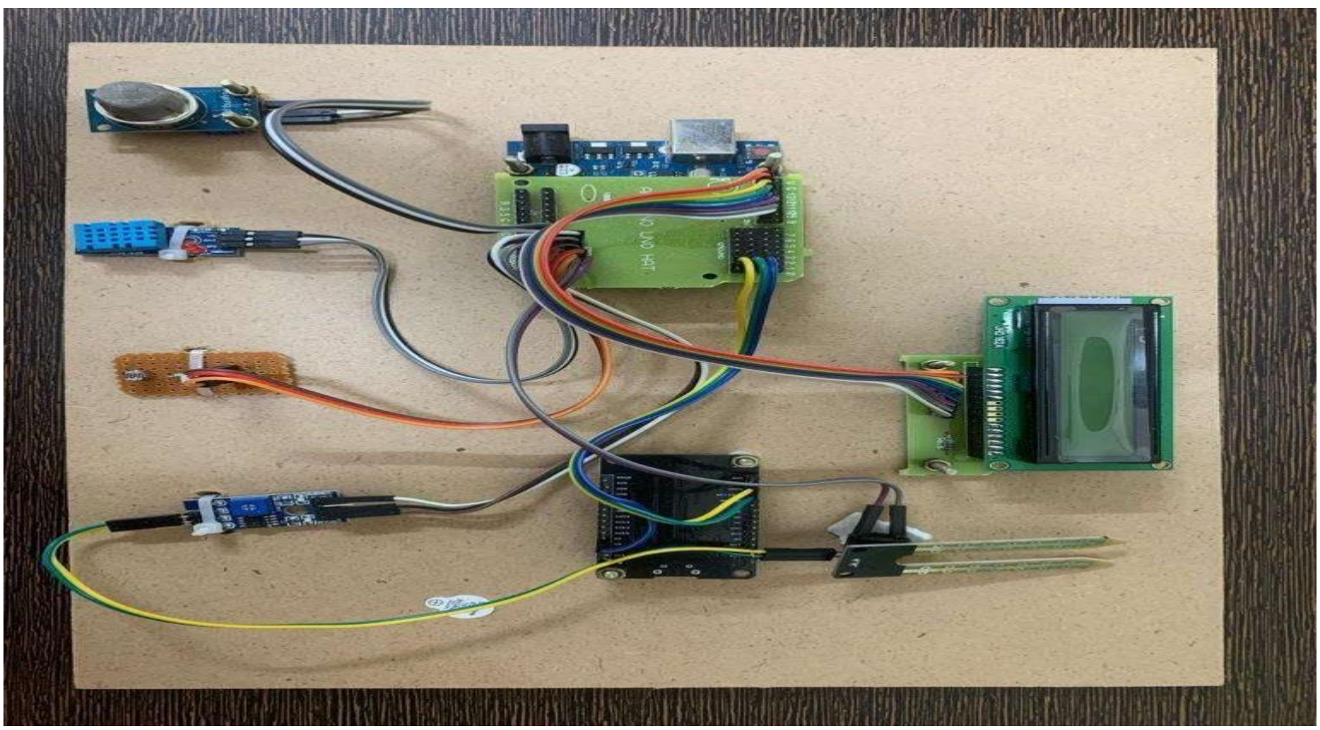


FIG 7.6 WATER

From, 7.1,7.2.7.3 we can observe all the values of Temperature,humidity,ldr,water values. We can see details of particular sensor in greater Detail by clicking on the graph of required Data. Then it gives us the details about individual sensor with Date wise Graph of MIN, MAX and Last updated values.



CONCLUSION

IoT-Based Coal Mine Safety Monitoring System is a comprehensive and proactive solution that significantly improves safety measures in coal mines and other industrial settings. It demonstrates a commitment to safety compliance, worker welfare, and the well-being of individuals working in potentially hazardous environments. This system represents a critical step toward safer and more secure coal mining operations while embracing the benefits of cutting-edge IoT technology.

FUTURE SCOPE

Coal mining safety monitoring and control using IoT Additional safety hazards, including as dust, landslides, fire, and vibration, can be addressed with automation. Additional sensors can be used to address these safety concerns. Water leaks, subsidence, and other mining operations can all be monitored. By making the system functional, all critical data may be delivered to the authorities, whereas cable connection may become an impediment. Because the method allows for easy access, the administrated can be controlled from the outside. When other mechanized vehicles are utilized for the other topographic zones, this framework can be applied at a high level.

REFERENCES

- [1] S.Sujitha; Dr. J. B. Shajilin Loret; Mrs. D. Merlin Gethsy “IOT based smart mine safety system using Arduino” –May-2020.
- [2] Prof. A. H. Ansari, Karishma Shaikh, Pooja Kadu, and Nikam Rishikesh, "IOT Based Coal Mine Safety Monitoring and Alerting System"-2021.
- [3] Maheswaran U, Bhuvaneeshwaran V, Hemanathan M, Jawahar K Mar-2019 – "controlling"
- [4] Dr. R. Bhuvaneswari's "Design of coal mining safety monitoring and warning system based on IoT" is due in 2021.
- [5] "coal mines safety monitoring and modifying system" – 2020, Prof. Suresh Galve1, Abhijeet Mali 2, Sagar Hande3, Saurabh Madge4, Gajanan Badade5.
- [6]”2023 International Conference on Advances in Computing, Communication and Applied Informatics (ACCAI)”
- [7]” Dange “Design of Monitoring system for Coal mine safety based on MSP430”, International Journal of Engineering Science Invention (IJESI) Volume2, Issue 7, July 2013
- [8] LiHui “Design of Monitoring system for Coal mine safety based on Wireless sensor Networks” 2008 International Conference on Mechatronic and Embedded systems and Applications (ASME).
- [8] Kumar “Design and Implementation of Portable health monitoring system using PSOC mixed signal Array chip”. International Journal of Recent Technology and Engineering (IJRTE), ISSN, 22773878, 2012
- [9] Rajkumar Boddu “Zigbee based mine safety monitoring system with GSM”, International Journal of Computer & Communication Technology ISSN (PRINT): 0975 - 7449, Volume-3, Issue-5, 201
- [10] Ashish “Coalmine safety monitoring using Wireless sensor Networks”, International Journal of Scientific Engineering and Technology (IJSET) Volume 2, Issue 10, October 2013 .

11. APPENDIX

Code:

```
#include <LiquidCrystal.h>
#include <DFRobot_DHT11.h>
DFRobot_DHT11 DHT;
#define DHT11_PIN A1
int rs = 8, en = 9, d4 = 10, d5 = 11, d6 = 12, d7 = 13;
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);
int buz=A4;
int ldr=A3;
int ws=A2;
int  gs=A0;
int cnt=0;
void setup() {
// put your setup code here, to run once:
Serial.begin(9600);
delay(200);
pinMode(buz,OUTPUT);
lcd.begin(16, 2);
lcd.print(" WELCOME");
delay(200);
}
void loop() {
// put your main code here, to run repeatedly//
int lval=analogRead(ldr)/10.23;
int gval=analogRead(gs)/10.23;
int wval=100-analogRead(ws)/10.23;
DHT.read(DHT11_PIN);
int tval=DHT.temperature;
int hval=DHT.humidity;
lcd.clear();
lcd.print("T:"+String(tval) + "  H:"+String(hval) + "  L:"+String(lval));
lcd.setCursor(0,1);
```

```
lcd.print("G:"+String(gval)+ "  W:"+ String(wval));
cnt=cnt+1;
if(cnt>15)
{
cnt=0;
Serial.print("248930,64B5G8TKFAYZMNRZ,0,0,Desktop123,1234567890,"+ String(tval) +
","+String(hval)+ ","+String(lval)+ ","+String(gval)+ ","+String(wval) +",0\n");
}

if(tval>40 || hval>80 || gval>30 || wval>30)
{
digitalWrite(buz,1);
delay(300);
digitalWrite(buz,0);
}
delay(1000);
}
```