TECHNICAL ANSWERS OF REAL-WORLD PROBLEMS (EEE3999)

PROJECT REPORT

PROJECT TITLE:

INTELLIGENT HELMET FOR COAL MINERS.

Faculty : PROF. ARULMOZHIVARMAN P.

Submitted By:

NILADRI SAHOO (17BEE0048) - ROLE - HARDWARE

PRAMIT PAUL (17BEE0345) - ROLE – HARDWARE IMPLEMENTATION

ABHINAV PIYUSH (17BEE0230) - ROLE - DESIGN IDEA

SHIVAM SINHA (17BEE0329) – ROLE – SOFTWARE INTERFACING

SOUMYA RANJAN (17BEE0134) – ROLE – SENSORS

WHAT'S INSIDE THIS REPORT

(CONTENTS IN DETAIL)

VIT®
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

SCHOOL OF ELECTRONICS ENGINEERING

CERTIFICATE

This is to certify that the project work entitled " INTELLLIGENT HELMET " by Abhinav Piyush (17BEE0230), Pramit Paul(17BEE0345), Niladri Sahoo(17BEE0048), Shivam Sinha(17BEE0329) and Saumya Ranjan(17BEE0134) submitted to Vellore Institute of Technology University, Vellore, in partial fulfillment of the requirement for J component of the course titled Technical Answers Of Real-World Problems (EEE3999) is a work carried out by us under my supervision. The project fulfills the requirement for J component as per the regulations of this Institute and in my opinion meets the necessary standards for submission.

Prof. Arulmozhivarman P.
Subject Faculty
Prof. / SELECT
VIT

VIT®
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

SCHOOL OF ELECTRONICS ENGINEERING

ACKNOWLEDGEMENT

We would like to take this opportunity to thank VIT University for encouraging us and giving the opportunity to perform this project. We could never have proceeded with our project if we did not get the correct resources.

We would also like to thank our Project Guide, Prof. Arulmozhivarman P. for guiding us through every step of this project.

Lastly, we would like to thank our family and friends for their unconditional support towards us.

PROBLEM DESCRIPTION

In recent days coal mining has been a very dangerous activity that can result in a number of adverse effects on the environment for example during mining operations methane, a known greenhouse gas, may be released into the air. Underground mining hazards include suffocation, gas poisoning, roof collapse and gas explosions. Keeping all these aspects in mind design a system, i.e. used for monitoring the hazardous gases, abnormal temperature conditions and the humidity levels in the air.

PROJECT GOAL

Our main goal is to ensure the safety of the coal miners which is a major issue in the mining industry. Our project focuses on the safety of the miners by sensing the conditions inside the coal mine. The improved safety features in our system will dramatically increase the life expectancy of the coal miners by alerting them about the hazards.The helmet will be useful in the mining industries for ensuring the safety of the miners' lives. Communication is the most vital key factor today, to monitor different parameters such as temperature, increasing humidity level, and carbon monoxide gas continuously using sensors such as LM35, gas sensor MQ2 and humidity sensor to take necessary actions accordingly to avoid any types of hazardous conditions and gives an alert. To achieve safety in underground mines, a suitable communication system must be created between workers, moving in the mine, and a fixed base station. The wired communication network technology system will be not so effective. For the successfully data transmission, in this work a low-cost ZigBee is utilized in routers. A cost-effective based mine supervising system with early warning security system on carbon monoxide, temperature, humidity in mining area is proposed.

PROJECT OBJECTIVES

This project focuses on a mine supervising system which is based on the cost effective IOT (ZigBee) system. Our project aims at developing a sensor networks, realized real-time surveillance with early-warning intelligence on harmful gases, temperature, humidity in mining area and used ZigBee communication to reduce potential safety problems in coal production using a ZigBee technology. All these three parameters are detected continuously by temperature sensor, gas sensor, humidity sensor and if they cross the pre-defined limit, then the user gets information about all three sensors. With a Zigbee positioning devices the system might be easily extended. The values of different sensors are continuously transmitted by ZigBee transmitter to the remote monitoring unit.

EXISTING TECHNOLOGY

Led Type Helmets

Led type helmets are usually powered by three or four AA or AAA batteries. Systems with heavy batteries (4xAA or more) are usually designed so that the light emitter is positioned near the front of the head, with the battery compartment at the rear of the head. The headlamp is strapped to the head or helmet with an elasticized strap. It is sometimes possible to completely disconnect a headlamp's battery pack, for storage on a belt or in a pocket. Lighter headlamp systems are strapped to the user's head by a single band; heavier ones utilize an additional band over the top of the user's head. White LEDs were quickly adopted for use in headlamps due to their smaller size, lower power consumption and improved durability compared with incandescent bulbs.

To regulate power fed to the LEDs, DC-DC converters are often used in 1W+ lights, sometimes controlled by microprocessors. This allows the LED to provide brightness that is not affected by a drop in battery voltage, and allows selectable levels of output. Following the introduction of LEDs for headlamps, sometimes combinations of LED and halogen lamps were used, allowing the user to select between the types for various tasks.

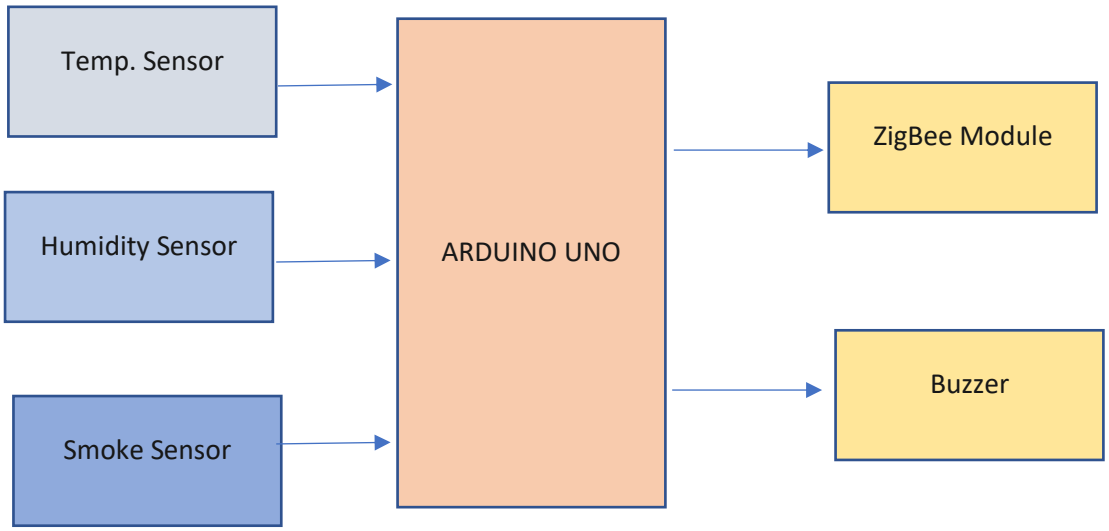
PROPOSED METHOD

INTELLIGENT HELMENT USING ZIGBEE

Keeping all these drawbacks in led type helmets, design a system, i.e.; smart helmet using zigbee technology. Meanwhile ZIGBEE based wireless sensor networks are recently investigated due to their remote environment monitoring capabilities. Such a network can easily collect sensor data and transmit by radio. By integrating these two advantages we design a new smart helmet, which can be enable as a mobile node of zigbee wireless sensor networks, gathering parameters from underground timely and quickly. Moreover, miners can also exchange information from control centre through wireless communication.

BLOCK DIAGRAM OF OUR MODEL

It contains transmitter and receiver sections the below figure shows the transmitter block diagram of Intelligent Helmet for Coal Miners using ZigBee Technology.



Block diagram of our proposed model.

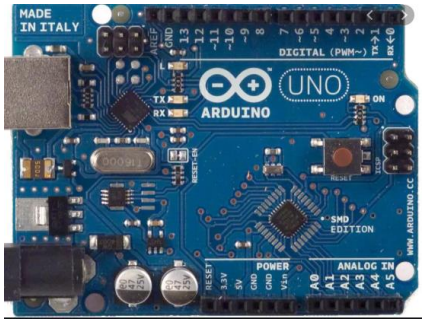
WORKING OF OUR MODEL

As shown in above block diagram, helmet unit consist of microcontroller (AT328P), Zigbee communication module, temperature sensor (LM35), humidity sensor (DHT11), gas sensor (MQ2), power supply (adaptor 12v). Three sensors (temperature, humidity, gas) which are connected to microcontroller AT328P. These three sensors are connected to the adc ports of microcontroller to convert the analog values into digital form. The sensors available in the helmet collect the temperature, humidity and gas information and send this information to the remote monitoring unit. Low rate Zigbee is used for data transmission. When the control centre detects the parameters are sends remote control area. A temperature sensor (LM35) shows the present temperature every 10 min it plots the graph with respect the values in Thing speak site. Similarly, remaining sensors senses respective values and post controlling area.

IMPORTANT COMPONENTS

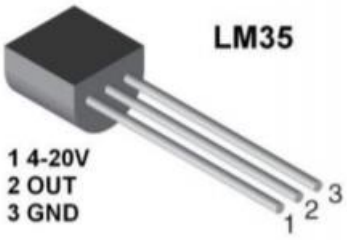
ARDUINO UNO

The Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. Simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.



TEMPERATURE SENSOR (LM35)

We use LM35 Precision Centigrade Temperature Sensors whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1/4°C at room temperature and ±3/4°C over a full -55 to +150°C temperature range.



SMOKE SENSOR (MQ - 5)

The Gas Sensor (MQ5) module is useful for gas leakage detection (in home and industry). It is suitable for detecting H2, LPG, CH4, CO, Alcohol. Due to its high sensitivity and fast response time, measurements can be taken as soon as possible. The sensitivity of the sensor can be adjusted by using the potentiometer.

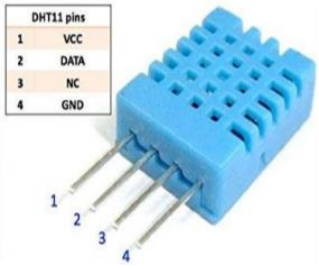
FEATURES:

- High sensitivity to LPG, natural gas, town gas
- Small sensitivity to alcohol, smoke.
- Fast response
- Stable and long life
- Simple drive circuit

HUMIDITY SENSOR (DHT11)

A humidity sensor senses, measures and regularly reports the relative humidity in the air. It measures both moisture and air temperature. Relative humidity, expressed as a percent, is the ratios of actual moisture in the air to the highest amount of moisture air at that temperature can hold.

The warmer the air is, the more moisture it can hold, so relative humidity changes with fluctuations in temperature.

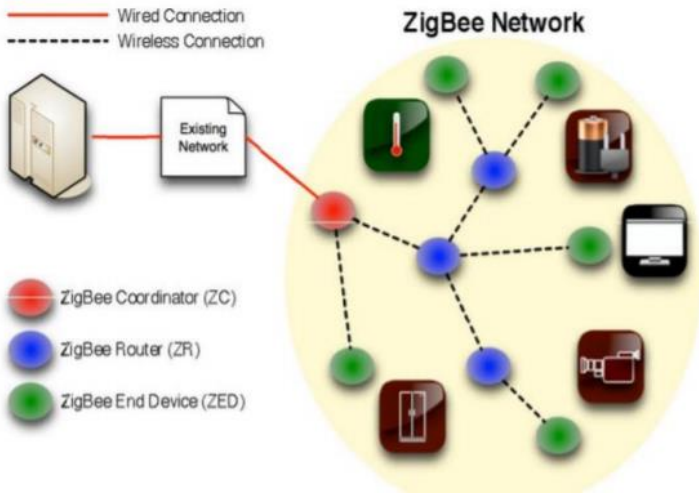


ZIGBEE MODULE

Zigbee is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios, such as for home automation, medical device data collection, and other low-power low-bandwidth needs, designed for small scale projects which need wireless connection.

WORKING OF ZIGBEE MODULE

Zigbee system structure consists of three different types of devices such as Zigbee coordinator, Router and End device. Every Zigbee network must consist of at least one coordinator which acts as a root and bridge of the network. The coordinator is responsible for handling and storing the information while performing receiving and transmitting data operations. Zigbee routers act as intermediary devices that permit data to pass to and fro through them to other devices. End devices have limited functionality to communicate with the parent nodes such that the battery power is saved as shown in the figure. The number of routers, coordinators and end devices depends on the type of network such as star, tree and mesh networks.



IMPLEMENTATION

ALL THE COMPONENTS AT A PLACE

First, we gathered all the components. Then we started interfacing each sensor like temperature sensor, humidity sensor, smoke sensor with Arduino.

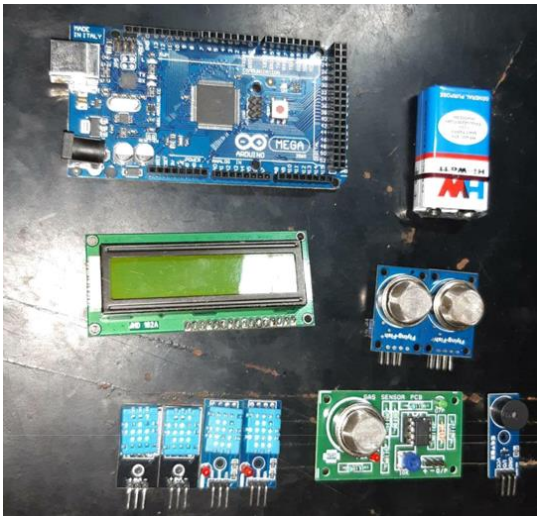


Figure 1 - required components

CONNECTING SENSORS WITH THE ARDUINO

The below figure shows the hardware kit to implement the smart helmet for coal miner's safety purpose. The kit consists of Arduino UNO board , the temperature sensor(LM35), ,the humidity sensor(DHT11), and the gas sensor (MQ-2),and the Zigbee transmitter and the Zigbee receiver. After implementation of code successfully, we see the results in readings in serial monitor with their respective values.

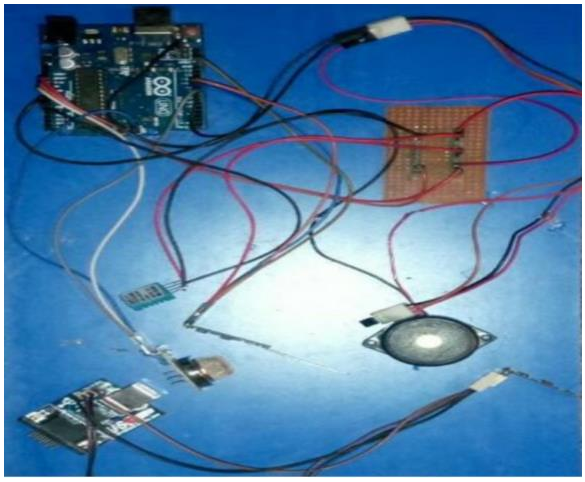


Figure 2- Arduino connected with different sensors.

FINAL PROJECT LOOK (EXPECTED)

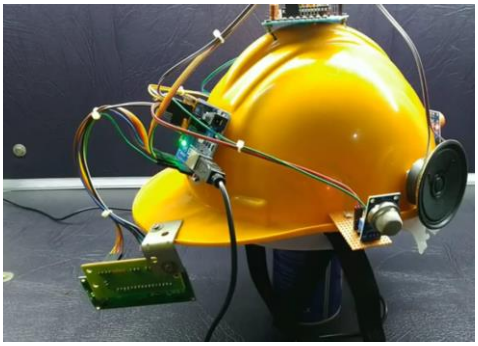
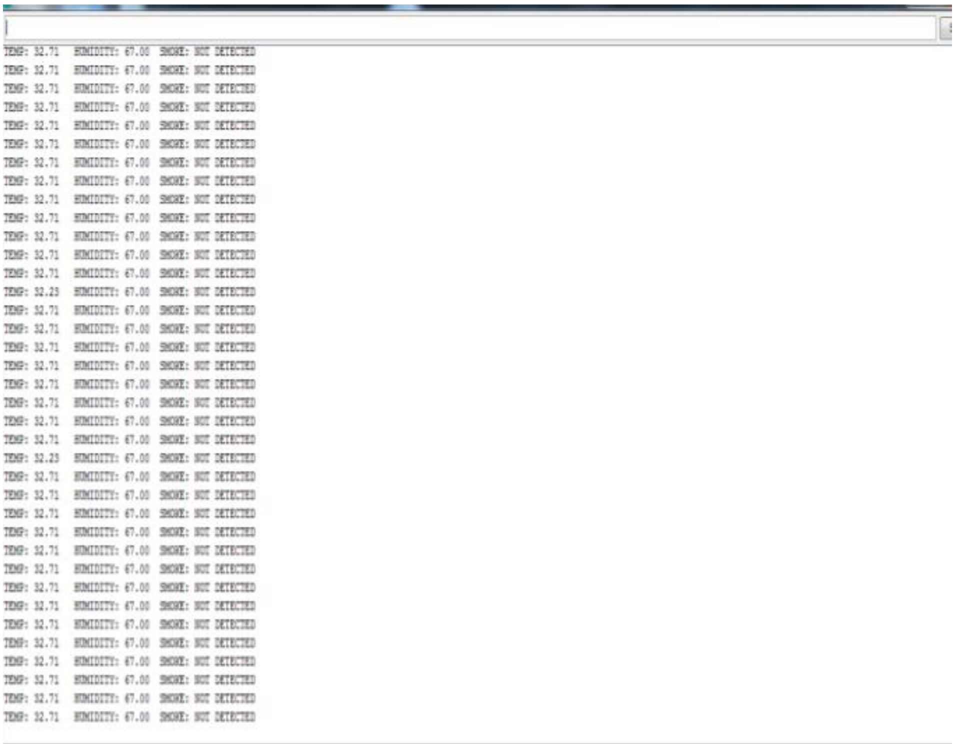
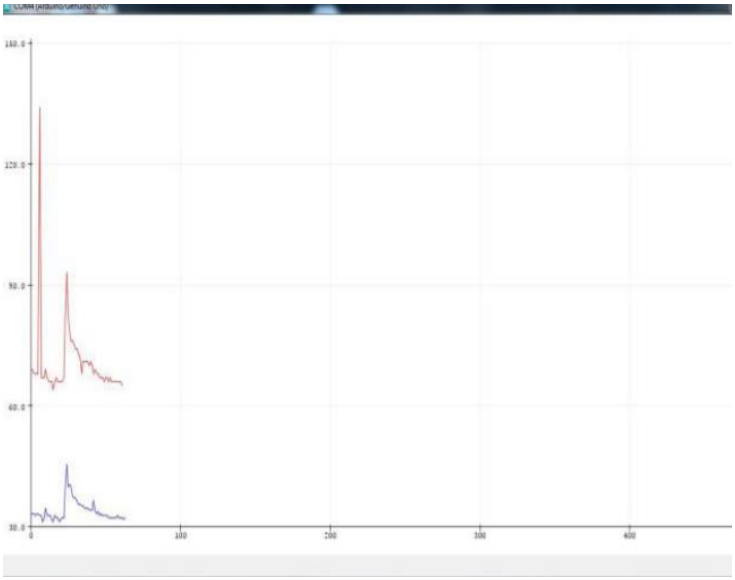


Figure 3 - Expected project output

OUTPUT WE GOT



```
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.23   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.23   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
TEMP: 32.71   HUMIDITY: 67.00  SMOKE: NOT DETECTED
```



ADVANTAGES

Using ZigBee in our project gives us advantage over the technology that is used now-a-days.

Some of them are listed below:

- Safety monitoring of the environment.
- Improved services in coal mining.
- Providing wireless connection security.
- Zigbee based wireless sensor networks are recently investigated due to their remote environment monitoring capabilities, such a network can easily collect sensor data and transmit by radio.
- Quick searching of the coal miners working under the earth and can be able to give the warning in hazardous situation.
- Here we using the Zigbee technology, we reduce the cost of the helmet also compared to wi-fi technology.

APPLICATIONS

- It can be used to the persons who are working in the underground at coal mines.
- It can used at any weather conditions such as any harmful gases, temperature variations and humidity level increases.
- It can be used to locate the person where he is working under the earth in coal mines.

CONCLUSION

As the system requirement and the required components can be easily made available this project can be implemented easily. It will provide the safety to coal miners and change the way of their working as well as system controlling the various environmental changes in mines. It has been presented the original design of the low power Zigbee sensor system with an extremely reduced cost. It is reliable system with quick and easy installation. The system might be easily extended. It will improve system scalability and extend accurate position of underground miners in future.

FUTURE SCOPE

The system also can be easily extended with Zigbee image transmission facility in future. It will improve scalability of underground environment and extend accurate position of miners. In future, with the help of Zigbee module and GUI (software part), we can avoid railways accidents, road accidents, submarine accidents etc.

REFERENCES

WEB

https://circuitdigest.com/microcontroller-projects/arduino-xbee-module-interfacing-tutorial

https://www.hackerearth.com/blog/developers/arduino-programming-for-beginners/

https://www.elprocus.com/zigbee-based-projects-ideas-engineering-students/

PAPERS

https://ieeexplore.ieee.org/document/4127535

https://ieeexplore.ieee.org/document/6895036

APPENDIX

The following section contains the code that we had used to interface different sensors with Arduino and ZigBee:

LM35 AND ARDUINO INTERFACING

```
const int sensor=A1; // Assigning analog pin A1 to variable 'sen sor'
float tempc;                  //variable to store temperature in degree Celsius
float tempf;                  //variable to store temperature in Fahreinheit
float vout;                  //temporary variable to hold sensor reading
void setup()
{
pinMode(sensor,INPUT); // Configuring pin A1 as input
Serial.begin(9600);
}
void loop()
{
vout=analogRead(sensor);
vout=(vout*500)/1023;
tempc=vout; // Storing value in Degree Celsius
tempf=(vout*1.8)+32; // Converting to Fahrenheit
Serial.print("in DegreeC=");
Serial.print("\t");
Serial.print(tempc);
Serial.println();
Serial.print("in Fahrenheit=");
Serial.print("\t");
Serial.print(tempf);
Serial.println();
delay(1000); //Delay of 1 second for ease of viewing
}
```

HUMIDITY SENSOR INTERFACING WITH ARDUINO

```
// Code for DHT11 Temperature and humidity sensor.

#include " DHT.h "

#define DHTPIN 2 // Selecting the pin at which we have connected DHT11   #define DHTTYPE DHT11 // Selecting the type of DHT sensors.


void setup ( ) {

Serial.begin ( 9600 ) ;

dht.begin ( ) ;  // The sensor will start working

}

void loop ( ) {


   //    Reading temperature or humidity may take about 2 seconds because it is a very slow sensor.
   //    float humidity = dht.readHumidity ( ) ; // Declaring h a variable and storing the humidity in it.
float temp = dht.readTemperature ( ) ; // Declaring t a variable and storing the temperature in it.


  //    Checking if the output is correct. If these are NaN, then there is something in it. if ( isnan ( t ) || isnan ( h ) ) {

     Serial.println ( " Sensor not working " ) ;

   }

 else

{

Serial.print ( " Temp is " ) ;

Serial.print ( temp ) ;          // Printing the temperature on display.

Serial.println ( " *C " ) ;                    // Printing “ *C ” on display.

Serial.print ( " Humidity in % is : " ) ;

Serial.print ( humidity ) ; // Printing the humidity on display

Serial.print ( " % \t " ) ; // Printing “%” on display

   }

 }
```

INTERFACING GAS SENSOR WITH ARDUINO

```
Int sensor =7;
Int gas_value;
Void setup()
{
pinMode(sensor INPUT);
Serial_begin(9600);
}
Void loop()
{
gas_value = digitalRead(sensor);
Serial_println(gas_value)
}
```

INTERFACING ZIGBEE WITH ARDUINO

```
Void setup()
{
Serial.begin(9600);  // baurdrate is set to 9600
}
Void loop()
{
While(serial.available())
{
Serial.write(serial.read());
}
}
```