Visvesvaraya Technological University
Belagavi, Karnataka-590 018

A Project Report
On

"SMART ENVIRONMENTAL MONITORING WITH SOLAR ENERGY CHARGING SYSTEM"

Submitted for partial fulfillment of the requirement for the award of the degree

Of

Bachelor of Engineering
in
Electrical and Electronics Engineering

Submitted by

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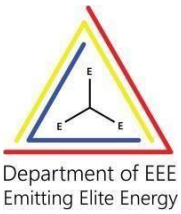

CERTIFICATE

This is to certify that the project report entitled **"SMART ENVIRONMENTAL MONITORING WITH SOLAR ENERGY CHARGING SYSTEM"** is a bonafide work carried out by **MOHAMMED SUHAIL: 4AD18EE019, MANOJKUMAR K S:4AD18EE017, MADHU GOWDA H K: 4AD18EE015, VINOD H V: 4AD18EE028,** in partial fulfillment for the award of **Bachelor of Engineering** in **Electrical and Electronics Engineering**, of the **Visvesvaraya Technological University, Belagavi -590 018** during the year 2021-2022. It is certified thatall corrections/suggestions indicated for the Internal Assessment have been incorporated in the report deposited in the departmental library. The Project report has been approved as it satisfies the academic requirements in respect of work prescribed for the said Degree.

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DECLARATION

We, **MOHAMMED SUHAIL: 4AD18EE019, MANOJKUMAR K S:4AD18EE017, MADHU GOWDA H K: 4AD18EE015, VINOD H V: 4AD18EE028** students of VIII semester, **Department of Electrical and Electronics Engineering, ATME College of Engineering, Mysuru-570028** declare that the project work titled **"SMART ENVIRONMENTAL MONITORING WITH SOLAR ENERGY CHARGING SYSTEM"** has been successfully completed. This work is submitted to **Visvesvaraya Technological University, Belagavi-590 018,** in partial fulfillment of the requirements for the award of Degreeof **Bachelor of Engineering in Electrical and Electronics Engineering** during the academic year 2021-2022. Further the matter embodied in the project report has not been submitted previously by anybody for the award of any degree to any university.

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ABSTRACT

The level of pollution has increased with times by lot of factors like the increase in population, increased vehicle use, industrialization and urbanization which results in harmful effects on human wellbeing by directly affecting health of population exposed to it.

In order to monitor quality of air, a Wireless sensor network (WSN) based new framework is proposed which is based on data acquisition and transmission.

The parameters of the environment to be monitored are chosen as volume of CO, temperature detection, humidity of atmosphere and purification of air. The values of these parameters are transmitted by using Bluetooth to the remote monitoring area.

The value of air quality are transmitted over Bluetooth also so that every person in the range of the system can check it over their smart phones and laptops as these parameters hold importance to everyone.

Keywords: Pollution, Solar Panel, Bluetooth, Sensor, Air Quality, Carbon Monoxide.

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CHAPTER-1
INTRODUCTION

1. INTRODUCTION

1.1. Air pollution problem

Outdoor air quality of the cities of developed countries improved considerably in recent decades. Air pollution is the biggest problem of every nation, whether it is developed or developing. Health problems have been growing at faster rate especially in urban areas of developing countries where industrialization and growing number of vehicles leads to release of lot of gaseous pollutants.

Harmful effects of pollution include mild allergic reactions such as irritation of the throat, eyes and nose as well as some serious problems like bronchitis, heart diseases, pneumonia, lung and aggravated asthma. According to a survey, due to air pollution 50,000 to 100,000 premature deaths per year occur in the U.S. alone whereas in EU number reaches to 300,000 and over 3,000,000 worldwide.

Fig 1.1. Air pollution

Indoor and outdoor air pollution is known to cause many health problems. In order to improve air quality, it is essential to monitor relevant parameters and identify sources of pollutants.

Various kinds of anthropogenic emissions named as primary pollutants are pumped into the atmosphere that undergoes chemical reaction and further leads to the formation of new pollutants normally called as secondary pollutants.

1.2. Monitoring system.

The equipment used for detection is the heart of the work. The monitor system devices are installed in different places. Sometimes it is not easy to install equipment in some areas for many reasons such as lack of access to power or unable to connect to signal wiring. In addition, tools used for measurements are very expensive. To resolve this problem, a wireless sensor network can be implemented to help in data communications. The advantages of using a wireless network are: using less energy, no need for hardwiring, and high transmission distance.

Fig. 1.2. Monitoring System

For instance, according to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), nearly all climate-altering pollutants either directly or indirectly (by contributing to secondary pollutants in the atmosphere) are responsible for health problems. Almost every citizen spends 90% of their time in indoor air.

In contrast to this, indoor air quality degraded during this same period because of many factors like reduced ventilation, energy conservation and the introduction to new sources and new materials that cause indoor pollution.

The design of buildings for lower power consumption resulted in decrease of ventilation which further decreases the quality of air inside the building. This increases the need for indoor air quality (IAQ) monitoring Due to this fact and use of new building materials, IAQ often reaches to unacceptable levels.

1.3. Carbon Monoxide (CO).

Carbon monoxide (CO) is an important criteria pollutant which is ubiquitous in urban environment. CO production mostly occurs from sources having incomplete combustion. Due to its toxicity and appreciable mass in atmosphere, it should be considered as an important pollutant in AQI scheme. CO rapidly diffuses across alveolar, capillary and placental membranes. Approximately 80-90% of absorbed CO binds with Hb to from Carboxy hemoglobin (COHb), which is a specific biomarker of exposure in blood.

The affinity of Hb for CO is 200-250 times than that of oxygen. In patients with hemolyticanemia, the CO production rate was 2–8 times higher and blood COHb concentration was 2–3 times higher than in normal person (WHO 2000).

The initial symptoms of CO poisoning may include headache, dizziness, drowsiness, and nausea. These initial symptoms may advance to vomiting, loss of consciousness, and collapse if prolonged or high exposures are encountered and may lead to Coma or death if high exposures continue. A US study estimated that 6 per cent of the congestive heart failures and hospitalizations in the cities were related to an increase in CO concentration in ambient atmosphere (WHO 2000).

Reduction in the ability of blood to transport oxygen leads to tissue hypoxia. The body compensates for this stress by increasing cardiac output and the blood flow to specific areas, such as the heart and brain.

As the level of COHb in the blood increases, the person suffers from effects which become progressively more serious. CO has both 1 hr and 8 hr standard. CO level and percent of COHb in blood.

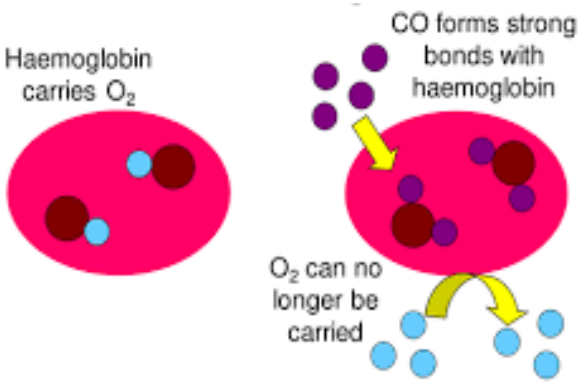


Fig. 1.3. Effects of Carbon monoxide

The symptoms associated with various percent blood saturation levels of COHb After giving due consideration to INAQS for CO, two categories - Good (sub-index: 0-50 at half level of standard) and Satisfactory (51-100 at air quality standard) for attainment of INAQS are considered.

For concentration of 10 mg/m3 , percentage COHb level could be about 2%. This may be just a beginning to slightly effect the people having lung or heart diseases, therefore, this AQI category can be taken as moderate. The next stage of categories has been taken as perthe USEPA criteria. The details of breakpoints and that of USEPA, China and EU.

1.4. Solar PV Panel in Environment Monitoring.

Photovoltaic solar panels absorb sunlight as a source of energy to generate direct current electricity. A photo voltaic (PV) module is a packaged, connected assembly of photovoltaic solar cells available in different voltages and wattages. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications.

The most common application of solar energy collection outside agriculture is solar water heating. From systems a solar cell to a PV system. Photovoltaic modules use light energy (photons) from the Sun to generate electricity through the photovoltaic effect. Most modules use wafer-based crystalline silicon cells or thin-film cells. The structural (load carrying) member of a module can be either the top level or the back layer.

Fig. 1.4. Solar PV Panel in Environment Monitoring.

Cells must be protected from mechanical damage and moisture. Most modules are rigid, but semi-flexible ones based on thin-film cells are also available. The cells are connected electrically in series, one to. another to a desired voltage, and then in parallel to increase amperage. The wattage of the module is the mathematical product of the voltage and the amperage of the module.

CHAPTER-2

EXISTING SYSTEM

2. EXISTING SYSTEM

2.1. Problems of Existing Systems.

The commercial meters available in the market are Fluke CO- 220 carbon monoxide meter for CO, Amprobe CO2 meter for CO2, Forbix Semicon LPG gas leakage sensor alarm for LPG leakage detection. The researchers in this field have proposed various air qualitymonitoring systems based on WSN, GSM and GIS. But they all lack cloud enabled andcloud data recording functionalities.

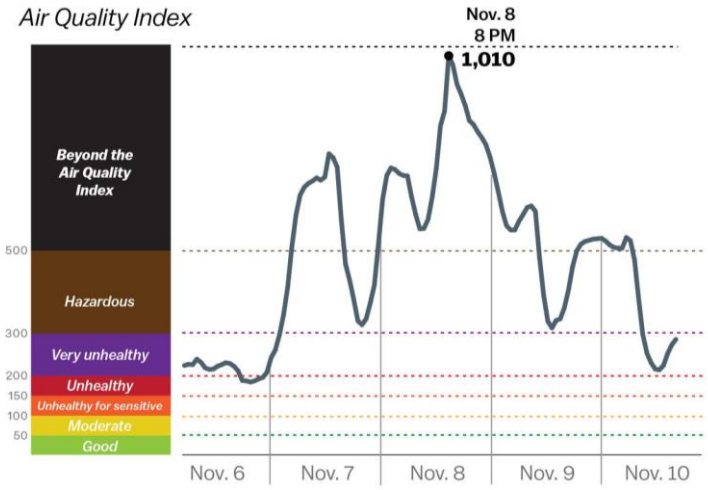


Fig. 2.1. Problems of Existing Systems.

2.2. Disadvantages:

- Maintains bad environment and bad pollution
- More dieses spreading for people
- More people suffering from lot of dieses
- Fire or short circuit in the industries and property damage from dangerous chemicals in the pollution or in the industries
- Not more Secure
- More expensive to Maintain
- More complex...etc

CHAPTER-3
PROBLEM STATEMENT
&
PROJECT OBJECTIVE

3.1. PROBLEM STATEMENT

During past decades, as result of civilization and urbanization there is a huge growth in Polluting industries, open burning of refuse and leaves, massive quantities of construction waste, substantial loss of forests and vehicles (particularly diesel-driven cars) on roads that give rise to health endangering pollution.

People working in mining area are at a risk sudden exposure to high level of co and co2 which is un noticeable. Therefore, it is necessary to regularly monitor and report the hazardous impacts from air pollution.

To monitor the quality of air, a new framework is proposed that monitors the parameters of the environment around us such as CO, presence of smoke, temperature and humidity, light intensity with the help of Bluetooth and cloud mobile app.

Fig 3.1 Problem statement

3.2. PROJECT OBJECTIVE

Objective 1: "Sensing and Measurement".

To measure the Atmospheric parameters such as Temperature, Humidity, Atmospheric Pressure, Air Quality, Level of Carbon Monoxide using related sensors with help of Arduino Uno.

Objective 2: "Display the data".

To monitor the parameters using LCD screen and Bluetooth App.

Objective 3: "Improving the Quality of Air"

To improve the quality of degraded air using Air Purifier.

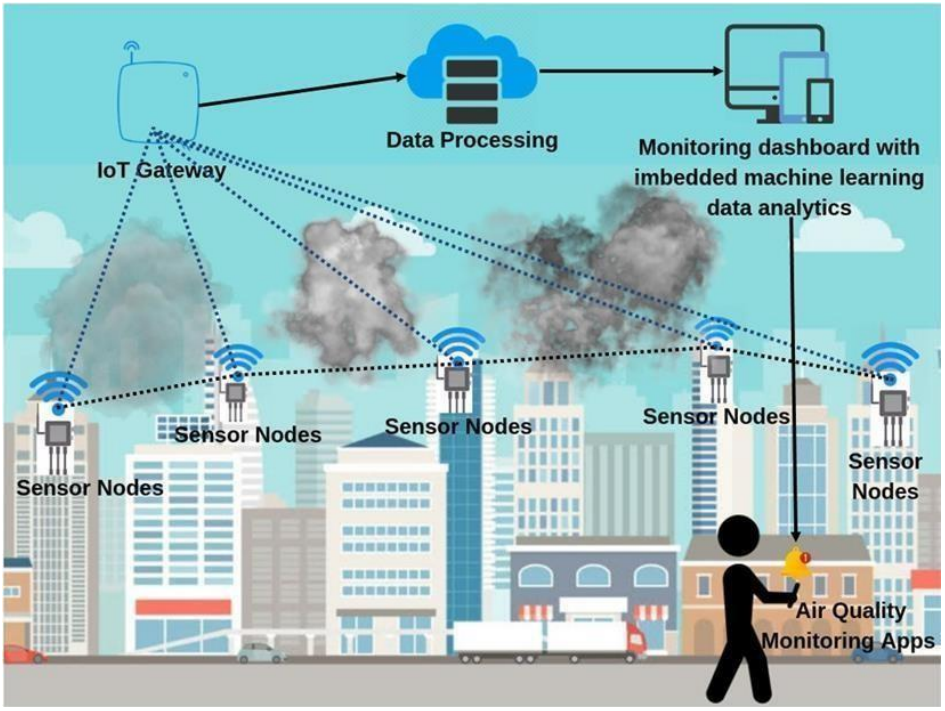


Fig 3.2. Project Objective

CHAPTER-4
LITERATURE SURVEY

4.1. Literature Review

[1] Aishwarya R.Hujare,Namrata C, Rutuja M.Salokhe **"Monitoring Smart City Application Using Raspberry PI based on IOT"** published in 2018. At 8th NATIONAL CONFERENCE ON "Emerging trends in Engineering and Technology" (NCETET- 2018).

- This paper focuses on design and implementation of an IOT based smartcity using raspberry pi.

[2] Mihai T. Lazarescu, **"Design of a WSN Platform for Long-Term Environmental Monitoring for IOT Applications"** published in 2019. IEEE JOURNAL ON EMERGING AND SELECTED TOPICS IN CIRCUITS AND SYSTEMS, V.

- This paper presents the functional design and implementation of a complete WSN platform that can be used for a range of long-term environmental monitoring IOT applications. The application requirements for low cost, high number of sensors.

[3] Cholatip Yawut, Sathapath Kilaso. **"A Wireless Sensor Network forWeather and Disaster Alarm Systems"** published in 2011. At 2011 International Conference on Information and Electronics Engineering IPCSIT vol.6 (2011) © (2011) IACSIT Press, Singapore.

- In this system, a wireless sensor network based on Zigbee/IEEE802.15.4 standard isutilized as a weather station network sending weather information and disasters' alerts. The weather information is analyzed byusing decision tree techniques to announce the disasters alerts.

[4] Siavash Esfahan,Piers Rollins, Jan Peter Specht, Marina Cole Julian W. Gardner **"Smart City Battery Operated IoTBased Indoor Air Quality Monitoring System"** published in 2020 at School of Engineering, University of Warwick, Coventry, UK.

- This paper presents the design and development of a low-cost, portable Internet of Things (IoT) Indoor Air Quality (IAQ) monitoring system with 30hours of battery life. The unit is intended for the monitoring of total VOCs, CO2, PM2.5, PM10, temperature, humidity and illuminance.

[5] Rohan Kumar Jha. **"Air Quality Sensing and Reporting System Using IoT"** published in 2020 at Proceedings of the Second International Conference on Inventive Research in Computing Applications (ICIRCA-2020) IEEE Xplore Part Number: CFP20N67-ART; ISBN: 978-1-7281-5374-2

- The system presented in this paper is an advanced real time air quality reporting system supported with Internet Of things(IOT) architecture. Degrading air qualityhas been a matter of concern nowadays and real time monitoring of air quality helps us to keep a check on it.

[6] Marin Berov Marinov, Dimitar Iliev Iliev. **"Portable Air Purifier with Air Quality Monitoring Sensor"** published in 2019 at International Scientific Conference Electronics - ET2019, September 12 - 14, 2019, Sozopol, Bulgaria.

- This study presents the development and implementation of an innovative portableair purifier. The device can be used to improve air quality in small spaces

CHAPTER-5

PROPOSED SYSTEM

5.1. Details of Proposed System

The proposed system to monitor various parameters of environment using Arduino microcontroller, Bluetooth and Embedded Technology is proposed to improve quality of air.

With the use of technologies like Bluetooth and Embedded System enhances the process of monitoring various aspects of environment such as air quality monitoring issue proposed in this project.

The detection and monitoring of dangerous gases is taken into account in a serious manner and related precautions have been considered and displayed in LCD.

It is estimated that this system will have a great acceptance in the market as it is a centralized system for a complete monitoring function. It uses real time Bluetooth wireless protocol devices with smart phone.

This monitoring system can be enhanced by adding wireless network card for storage of values from sensors attached to microcontroller as well as more gas sensors could be used like, CO2, SO2 & LPG etc. Another aspect of measuring particulate matter can be introduced to more advanced.

5.2. Advantages of Proposed System:

- Maintains good environment and good pollution
- Avoid diseases spreading for people
- Save human life from hazardous poisonous gas leak.
- Save property damage from dangerous chemical in the pollution
- More Secure
- Easy to Maintain
- Low cost.
- Reprogrammable……etc

CHAPTER-6
BLOCK DIAGRAM
and
DESCRIPTION

6.1. BLOCK DIAGRAM

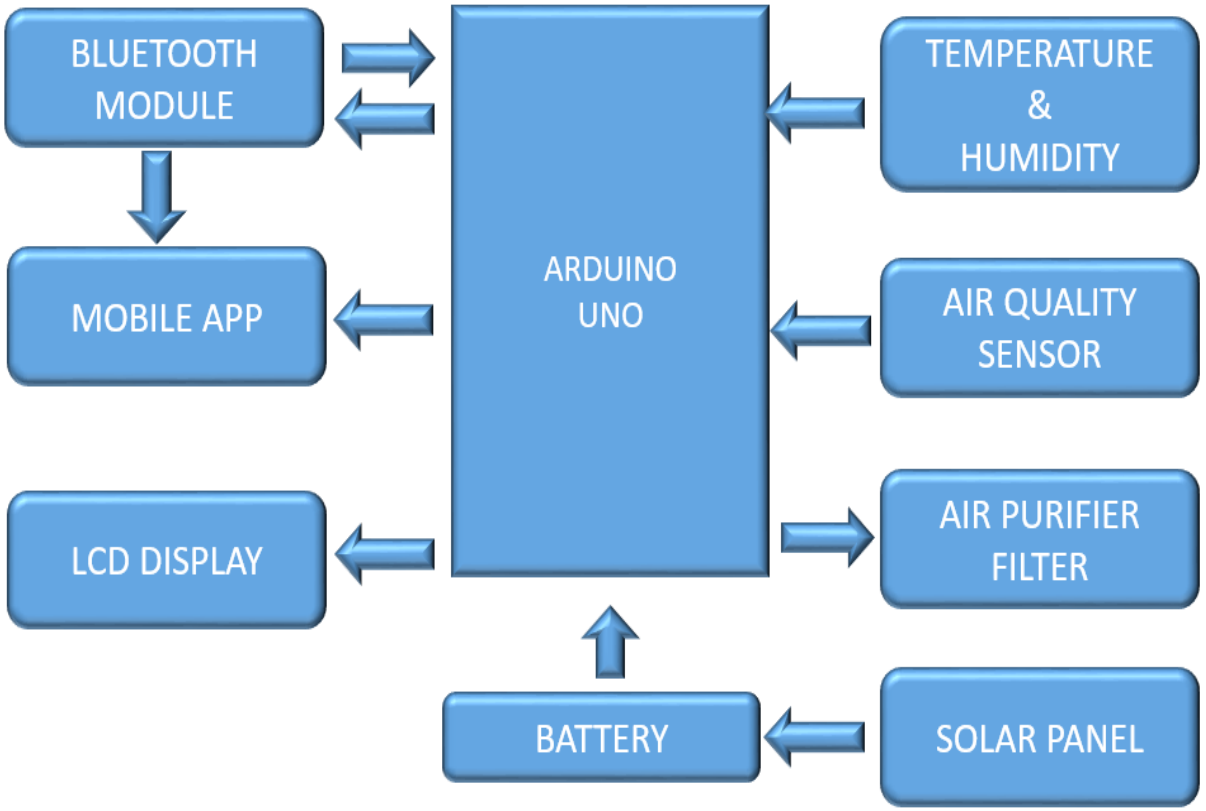


Fig. 6.1. Block Diagram

COMPONENTS DESCRIPTION

6.2. ARDUINO UNO:

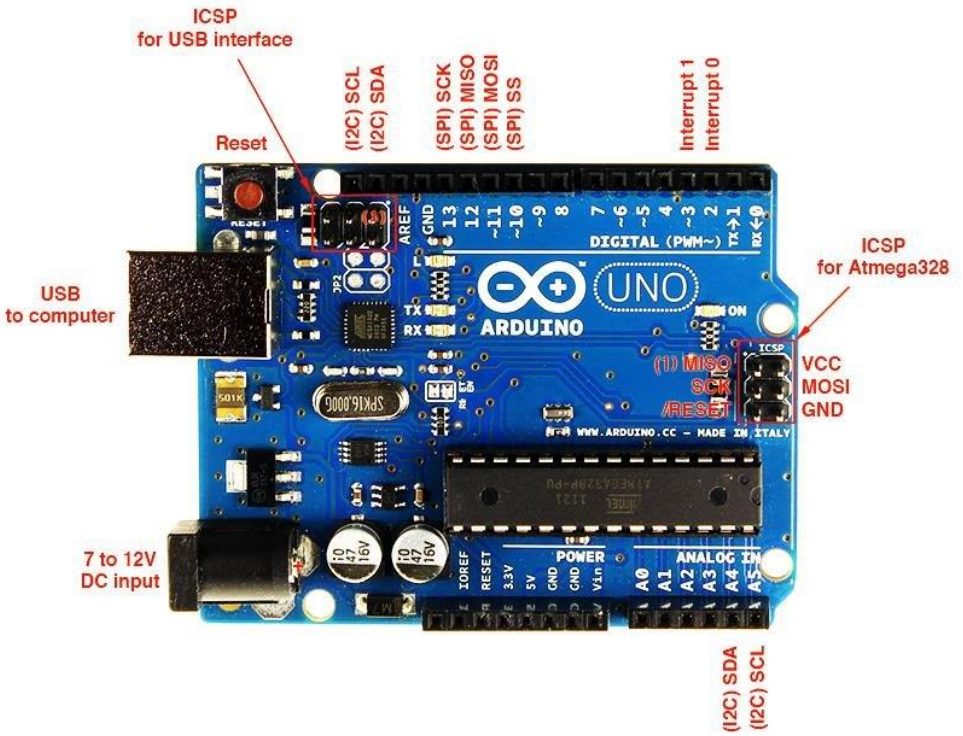


Fig. 6.2. Arduino Uno

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable. It can be powered by the USB cable orby an external 9-volt battery, though it accepts voltages between 7 and 20 volts. It is similar tothe Arduino Nano and Leonardo.

While the Uno communicates using the original STK500 protocol, it differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it usesthe Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

6.3. BLUETOOTH MODULE HC-06:

Fig. 6.3. Bluetooth Module HC-06

HC-06 is the popular Bluetooth module. This HC06 module is slave mode only. It's very easy to add wireless serial connectivity for your device with this module. Examples for Arduino and other boards are available. Once you pair with other Bluetooth devices you work like with normal UART to exchange data.

This module has built-in 3.3V voltage regulator and helps to break out the important pins (Vcc, Gnd, Txd, Rxd). Based on CSR BC4 chip, Bluetooth V2.0 + EDR. You can set the baud rate, name and pair password by AT commands when there is no Bluetooth connection. This module is a slave- it can be paired with Computer- Bluetooth master- mobile phone- PDA- PSP and so on.

6.3.1. Features:

- Bases at CSR BC04 Bluetooth technology.
- with build-in 2.4GHz PCB antenna
- It's at the Bluetooth class 2 power level.

6.4. MQ135 Air Quality Sensor

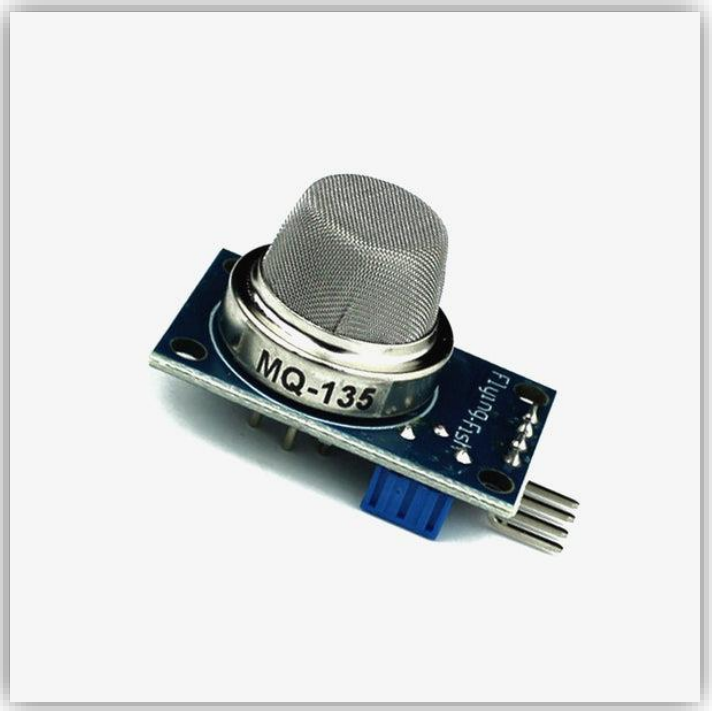


Fig. 6.4. MQ135 Air Quality Sensor

- The **MQ-135 Gas sensor** can detect gases like Ammonia (NH3), sulfur (S), Benzene, CO, and other harmful gases and smoke.

- When the level of these gases goes beyond a threshold limit in the air the digital pin goes high. This threshold value can be set by using the on-board potentiometer.

- The **MQ135** air quality sensor module operates at 5V and consumes around 150mA. Itrequires some pre-heating before it could actually give accurate result

6.4.1. Technical Specifications of MQ135 Gas Sensor:

- Operating Voltage: 2.5V to 5.0V.
- Power consumption: 150mA.
- Detect/Measure: NH3, NOx, CO2, Alcohol, Benzene, Smoke.
- Typical operating Voltage: 5V.
- Digital Output: 0V to 5V (TTL Logic) @ 5V Vcc.
- Analog Output: 0-5V @ 5V Vcc.

6.5. DHT11 - Temperature and Humidity Sensor Module:

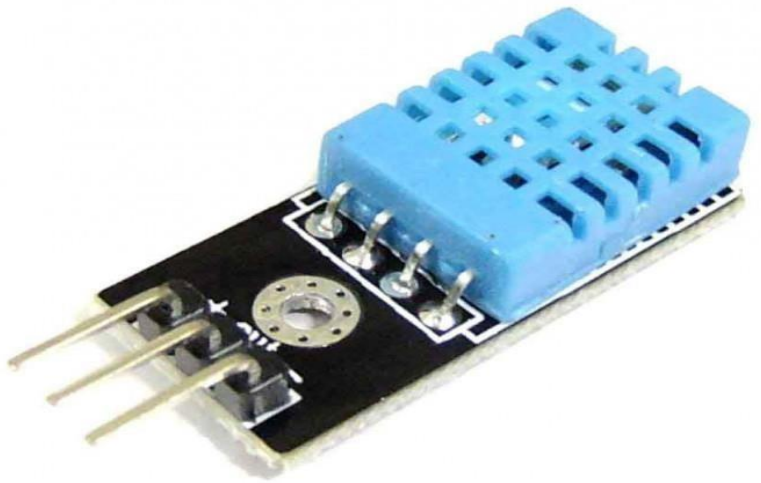


Fig. 6.5. DHT11 - Temperature and Humidity Sensor Module

- DHT11 is a Humidity and Temperature Sensor, which generates calibrated digital output.
- DHT11 can be interface with any microcontroller like Arduino, Raspberry Pi, etc. and get instantaneous results. DHT11 is a low-cost humidity and temperaturesensor which provides high reliability and long-term stability.
- It uses a capacitive humidity sensor and a thermistor to measure the surroundingair, and outputs a digital signal on the data pin (no analog input pins needed). It'svery simple to use, and libraries and sample codes are available for Arduino
- This module makes is easy to connect the DHT11 sensor to an Arduino or microcontroller as includes the pull up resistor required to use the sensor. Onlythree connections are required to be made to use the sensor - Vcc, Gnd and Output.
- It has high reliability and excellent long-term stability, thanks to the exclusive digital signal acquisition technique and temperature & humidity sensing technology.

6.5.1. Specifications:

- Power Supply： 3.3~5.5V DC
- Output： 4 pin single row
- Measurement Range： Humidity 20-90%RH， Temperature 0~50℃
- Accuracy： Humidity +-5%RH， Temperature +-2℃
- Resolution： Humidity 1%RH， Temperature 1℃'
- Interchangeability： Fully Interchangeable
- Long-Term Stability：<+/-1%RH/Year.

6.5.2. Pin Description:

Pin 1: Power +Ve (3.3VDC to 5.5VDC Max wrt. GND)

Pin 2: Serial Data Output

Pin 3: Power Ground or Power –Ve

6.6. MQ 02 Carbon Monoxide Detection Sensor

Fig. 6.6. MQ 02 Carbon Monoxide Detection Sensor

- This is a robust Gas sensor suitable for sensing LPG, Smoke, Alcohol,Propane, Hydrogen, Methane and Carbon Monoxide concentrations inthe air.

- If you are planning on creating an indoor air quality monitoring system.

- Breath checker or early fire detection system, MQ2 Gas Sensor Module is a great choice.

6.6.1Specification Of MQ 02 Sensor:

- Operating voltage - 5V
- Load resistance - 20 KΩ
- Heater resistance - 33Ω ± 5%
- Heating consumption - <800mw
- Sensing Resistance - 10 KΩ – 60 KΩ
- Concentration Scope - 200 – 10000ppm
- Preheat Time Over -24 hour

6.7. AIR PURIFIER

Fig. 6.7. Air Purifier

- It has tapered design with an H13 HEPA filter and Smart Negative Ions feature which makes this device perform better and it comes with an effective CADR of 16.2 m^3/h.
- It works continuously for more than 48 hours with a 20,000 mAh power bank.
- It is equipped with H13 HEPA FILTER which can efficiently remove 99.97% of dust.
- It is rated highly energy-efficient product and consumes up to 70% less energy.

6.7.1. Specification of Air Purifier

- Operating voltage - 5V.
- Maximum Speed – 2800 rpm.
- Fan Segment – 70mm.
- Air Intake – 360 degrees.

- Noise Level – 35dB.
- Filter Type - High Efficiency Particulate Air filter.

6.7.2. Advantages Of Air Purifier

- Larger FAN intake.
- Innovative tapered design.
- Aromatherapy function.
- High clean delivery rate.
- 360-degree Air intake.
- Low cost.

6.8. RELAY

This is a 5V, 10A 2-Channel Relay interface board. It can be used to control various appliances, and other equipment's with large current. It can be controlled directly with 3.3V or 5V logic signals from a microcontroller.

Fig. 6.8. Relay

6.8.1. Specifications:

1. High current relay, AC250V 10A, DC5V 10A
2. 2 LEDs to indicate when relays are on
3. Works with logic level signals from 3.3V or 5V devices
4. Op-to isolation circuitry.

6.9. SIM800A Quad Band GSM Module

Fig. 6.9.SIM800A Quad Band GSM Module

The SIM800A modem has a SIM800A GSM chip and RS232 interface while enables easy connection with the computer or laptop using the USB to the Serial connector or to the microcontroller using the RS232 to TTL converter. Once you connect the SIM800A modem using the USB to RS232 connector, you need to find the correct COM port from the Device Manager of the USB to Serial Adapter.

6.9.1 Specifications:

1. Quad-band 850/900/1800/1900MHz.
2. GPRS class 2/10.
3. Control via AT commands
4. High-Quality Product (Not hobby grade).
5. 5V interface for direct communication with MCU kit.

CHAPTER-7
HARDWARE and SOFTWARE COMPONENTS

7.1. Hardware Requirements:

SI.NO	HARDWARE	QUANTITY
1	Arduino Uno micro controller	1
2	Air Quality Detection Sensor	2
3	DHT-11	1
4	LCD Display	1
5	DC Power Supply Board	1
6	Bluetooth	1
7	Air Purifier	1
8	Relay	1
9	Solar Panel	1
10	Smart Phone	1
11	GSM Module	1

Table 7.1. Hardware Requirements

7.2. Software Requirements:

SI.NO	Software
1	Arduino Software
2	C++

Table 7.2. Software Requirements

7.3. Arduino Software

Arduino ide is the software used to write-compile-upload program to Arduino. It's an open source software.

7.3.1. Procedure to Install Arduino Software (IDE)

Step 1 − First we must have an Arduino board and a USB cable. In case we use Arduino UNO, Arduino Duemilanove, Nano, Arduino Mega 2560, or Diecimila, we will need a standard USB cable (A plug to B plug)

Step 2 − Download Arduino IDE Software.

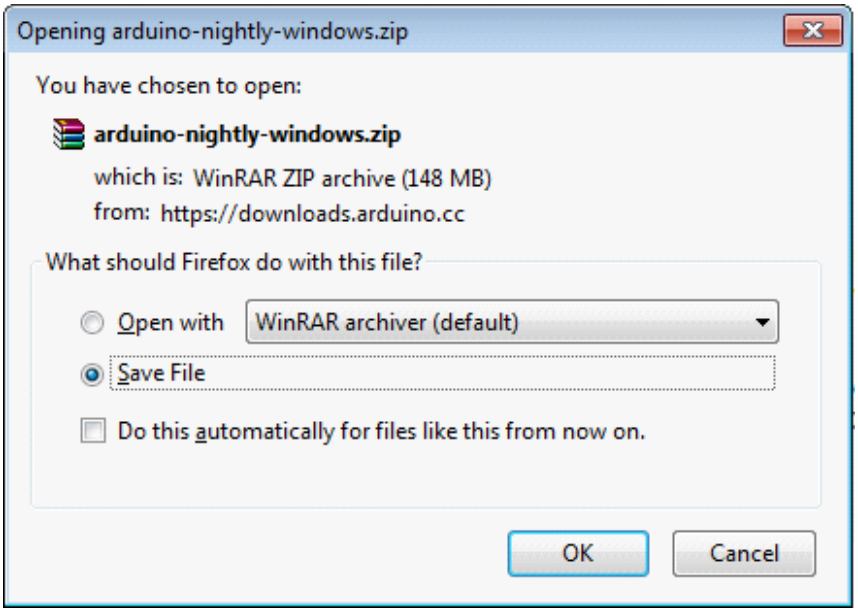


Fig. 7.3.1 Downloading Arduino IDE

One can get different versions of Arduino IDE from the Download page on the Arduino Official website. We must select our software, which is compatible with our operating system (Windows, IOS, or Linux). Unzip the file, after downloading it completely.

Step 3 − Power up your board.

The Arduino Uno, Mega, Duemilanove and Arduino Nano automatically draw power from either, the USB connection to the computer or an external power supply

Connect the Arduino board to computer using the USB cable. The green power LED (labeled PWR) should glow.

Step 4 − Launch Arduino IDE.

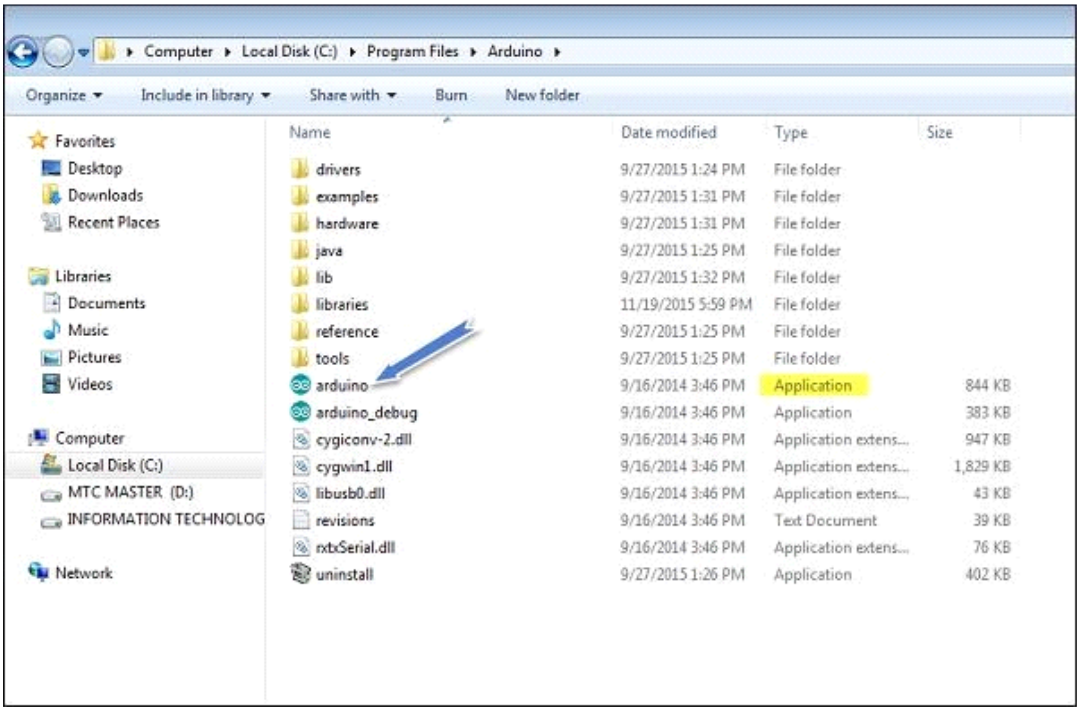


Fig. 7.3.1(a) Launching Arduino IDE

After your Arduino IDE software is downloaded, you need to unzip the folder. Inside the folder, you can find the application icon with an infinity label (application.exe). Double-click the icon to start the IDE.

Step 5 − Open your first project.

Once the software starts, we have two options:

- Create a new project.

  To create a new project, select File →**New,** as shown in Fig. 3.1.5.5 (a).

- Open an existing project example.

  To open an existing project example, select File → Example → Basics → Blink, asshown in Fig. 3.1.5.5 (b).

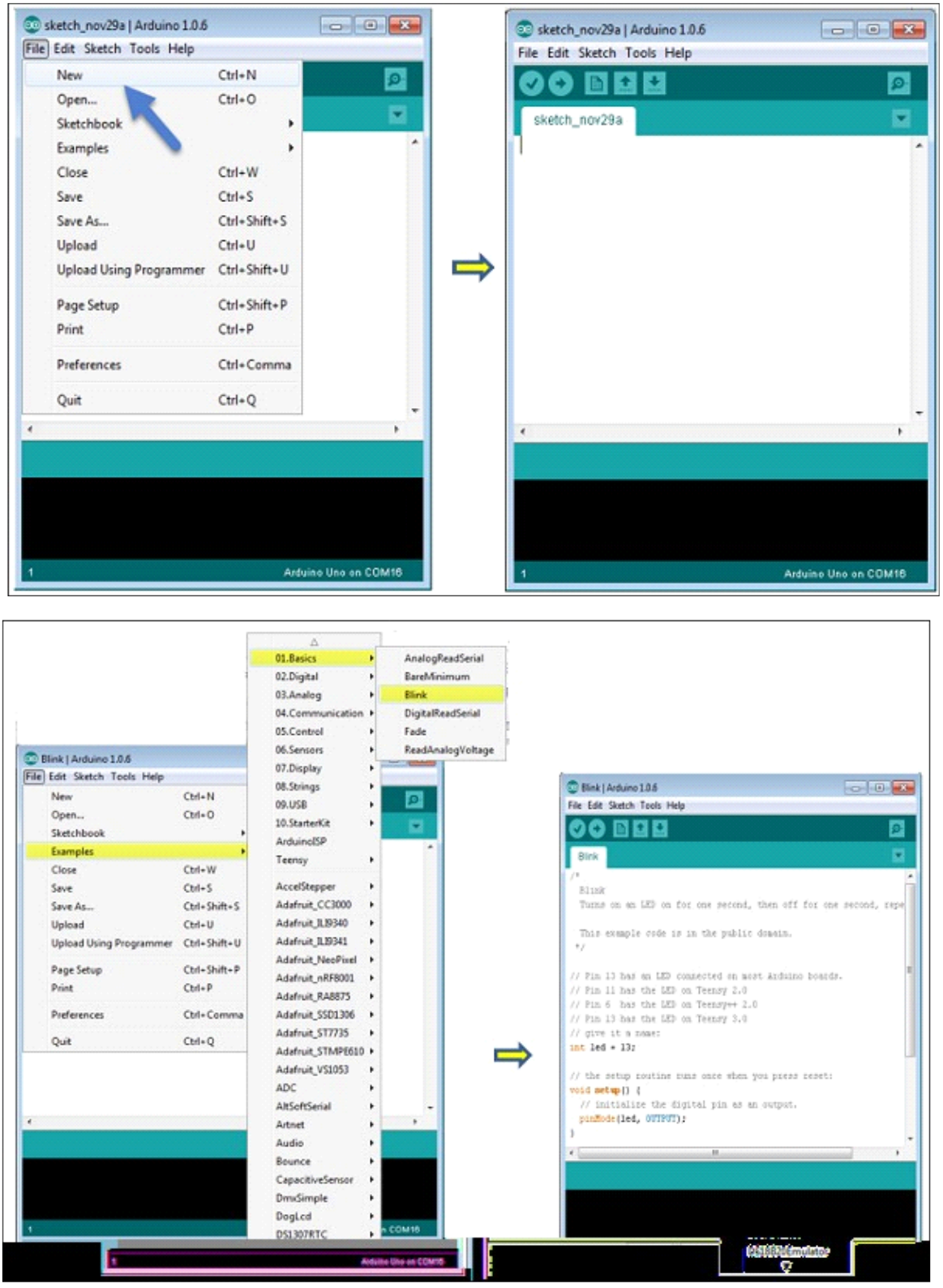


Fig. 7.3.1(b) Opening an Existing Project

Here, we are selecting just one of the examples with the name **Blink**. It turns the LED on& off with some time delay. We can select any example from the list.

Step 6 − Select the respective Arduino board.

To avoid any error while uploading our program to the board, we must select the correct Arduino board name, which matches with the board connected to our computer.

Go to Tools → Board and select the board.

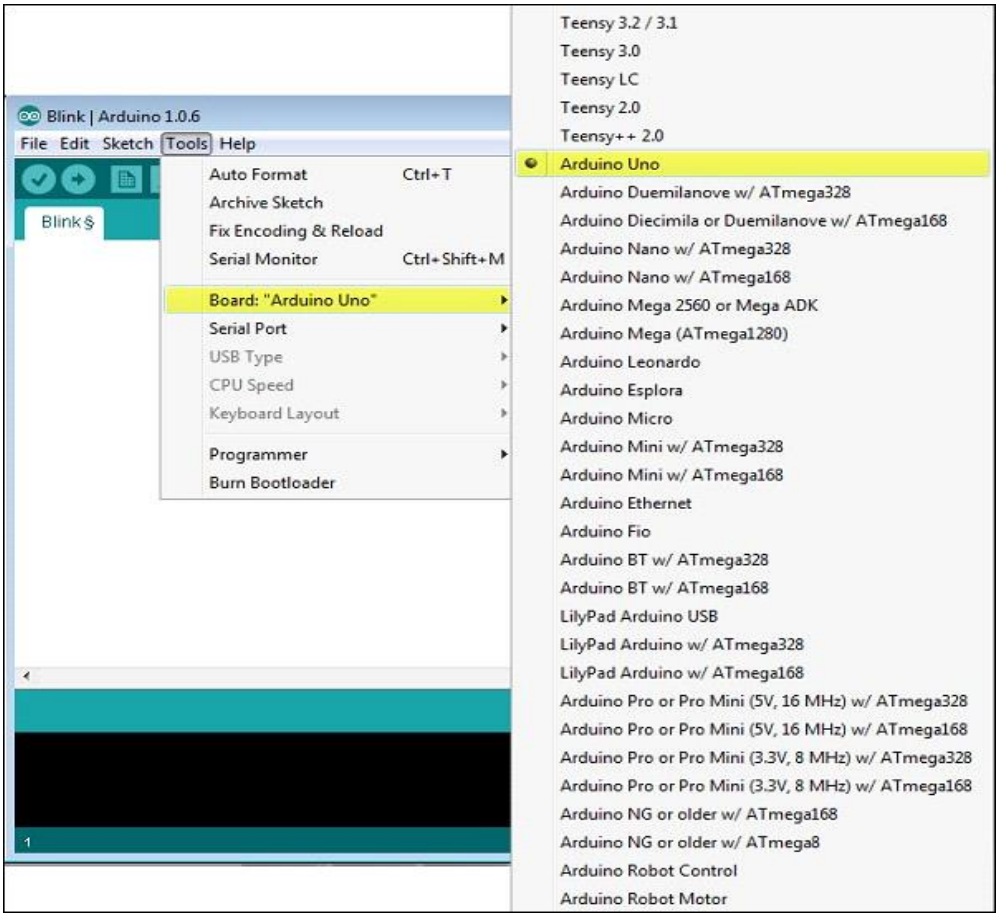


Fig. 7.3.1(c) Selecting the Arduino Board

Step 7 − Select the serial port.

Select the serial device of the Arduino board. Go to **Tools → Serial Port** menu.

This is likely to be COM3 or higher (COM1 and COM2 are usually reserved for hardware serial port) To find out, you can disconnect your Arduino board and re-open the menu, the

entry that disappears should be of the Arduino board. Reconnect the board and select that serial port.

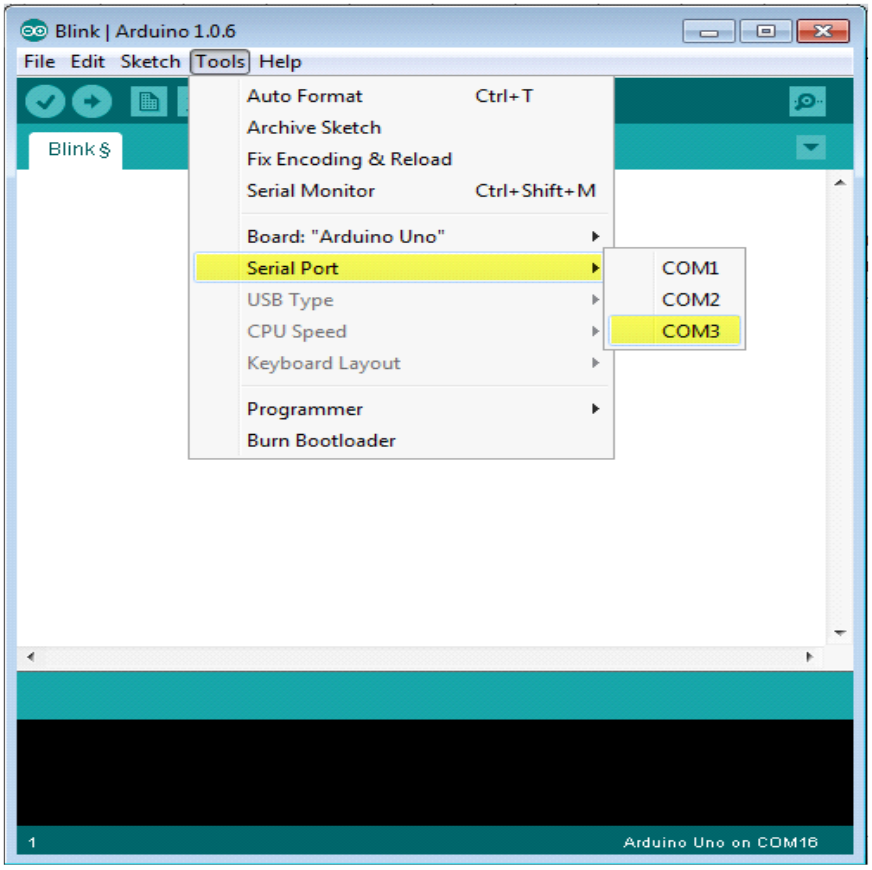


Fig. 7.3.1(d) Selecting the Serial Port

Step 8 − Upload the program to the board.

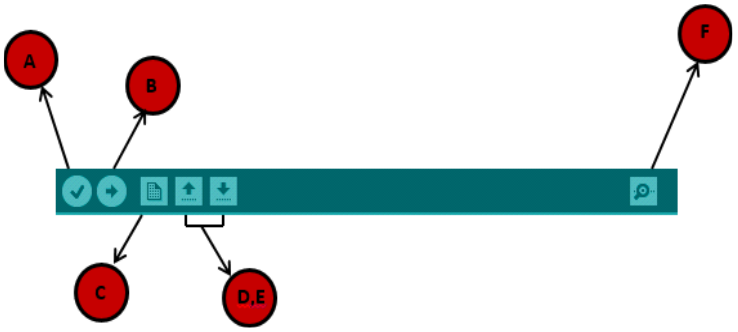


Fig. 7.3.1(e) Arduino IDE Toolbar

Before explaining how to upload our program to the board, we should know the function of each symbol appearing in the Arduino IDE toolbar.

A − Used to check if there is any compilation error.

B − Used to upload a program to the Arduino board.

C − Shortcut used to create a new sketch.

D − Used to directly open one of the example sketch.

E − Used to save your sketch.

F − Serial monitor used to send and receive the serial data from the board.

7.4. Software Program

```
#include<SoftwareSerial.h>
#include <dht.h>
dht DHT;
#define DHT11_PIN 7
#include <LiquidCrystal_I2C.h>
int flamesensor =8;
LiquidCrystal_I2C lcd(0x27,16,2);
SoftwareSerial myserial(10,11);
int relay =4 ;


void setup() {


 lcd.init();   // INITIALIZE THE LCD
  lcd.backlight(); //  IT WILL TURN ON BACK LIGHT
  lcd.clear();
  pinMode(relay,OUTPUT);
```

```
myserial.begin(9600);

 // Initializing serial commmunication
  Serial.begin(9600);

}



void loop(){
   checkbluetooth();
    int chk = DHT.read11(DHT11_PIN);
int     temperature=DHT.temperature;
 int    humidity=DHT.humidity;
    delay(1000);
     chk = DHT.read11(DHT11_PIN);
  Serial.print("Temperature: ");
Serial.println(DHT.temperature);
Serial.print("Humidity: ");
Serial.println(DHT.humidity);

checkbluetooth();

lcd.clear();
lcd.setCursor(0,0); ///  TO SET WRITING POSITION ON LCD ( COL,ROW)
lcd.print("Air Quality Sensor :");
lcd.setCursor(0,1);// ("  ")
lcd.print(analogRead(A1));
Serial.print("Air Quality Sensor :");   // ("  ")
Serial.println(analogRead(A1));
delay(1000);
checkbluetooth();
lcd.clear();
lcd.setCursor(0,0); ///  TO SET WRITING POSITION ON LCD ( COL,ROW)
```

```
lcd.print("Carbon Monoxide Sensor :");   // ("  ")
lcd.setCursor(0,1);// ("  ")
lcd.print(analogRead(A0));
Serial.print("Carbon Monoxide Sensor :");   // ("  ")
Serial.println(analogRead(A0));
delay(1000);
checkbluetooth();
if(analogRead(A0)>500 || analogRead(A1) >500){
  lcd.clear();


lcd.setCursor(0,0); ///  TO SET WRITING POSITION ON LCD ( COL,ROW)
lcd.print("Harmfull Gas ");   // ("  ")
lcd.setCursor(0,1); ///  TO SET WRITING POSITION ON LCD ( COL,ROW)
lcd.print("   level");
  sms();

  }
lcd.clear();


lcd.setCursor(0,0); ///  TO SET WRITING POSITION ON LCD ( COL,ROW)
lcd.print("Temperature:");   // ("  ")
lcd.print(temperature);
lcd.setCursor(2,1); ///  TO SET WRITING POSITION ON LCD ( COL,ROW)

lcd.setCursor(0,1); ///  TO SET WRITING POSITION ON LCD ( COL,ROW)
lcd.print("Humidity   :");   // ("  ")
lcd.print(humidity);
checkbluetooth();
delay(1500);
}
void sms(){
```

```
String str = String ("Harmful Gases Detected");
myserial.println("AT+CMGF=1");    //Sets the GSM Module in Text Mode
 delay(1000);  // Delay of 1000 milli seconds or 1 second
myserial.println("AT+CMGS=\"+918904718578 \"\r"); // Replace x with mobile number
 delay(1000);
myserial.println(str);// The SMS text you want to send
 delay(100);
myserial.println((char)26);// ASCII code of CTRL+Z
 delay(5000);
}
void  checkbluetooth(){
 if(Serial.available() ){
   char bluetoothdata = Serial.read();
   if (bluetoothdata=='R'){
     digitalWrite(relay,LOW);
     }
     if (bluetoothdata=='Y'){
     digitalWrite(relay,HIGH);
     }
   bluetoothdata=' ';
   Serial.flush();
   }
 }
```

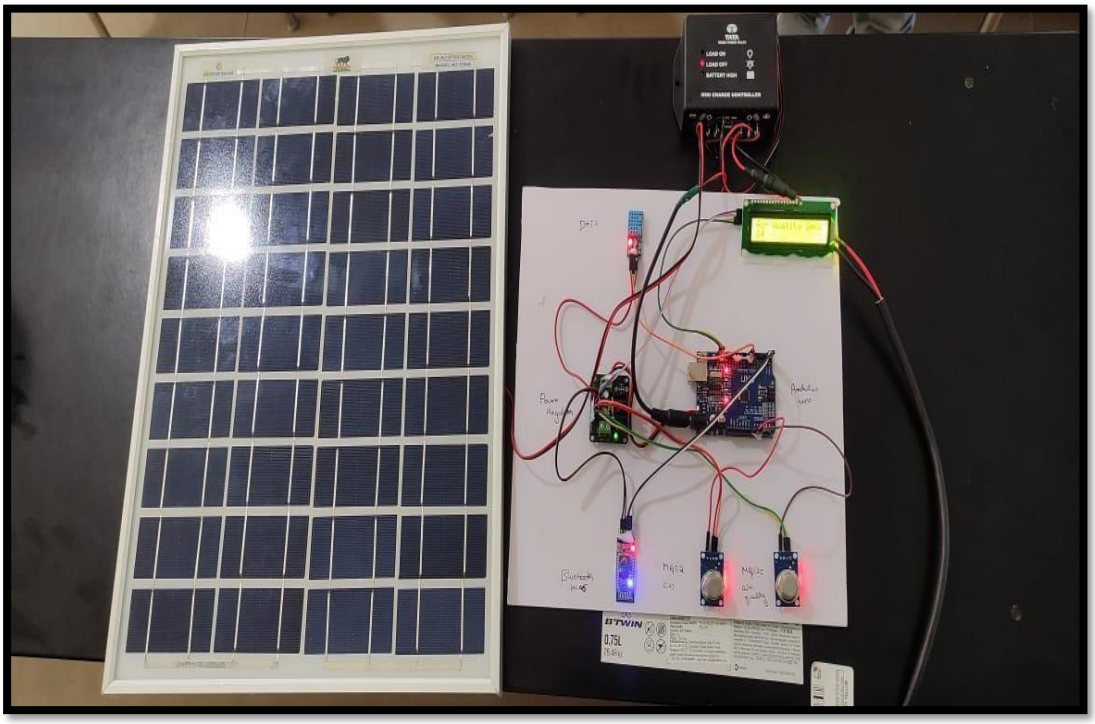
CHAPTER-8

WORKING MODEL

8.1. WORKING MODEL.

- The system is powered by solar power using solar panel, and the energy stored in the battery. Battery is connected between the panel and Power Regulator.
- Power Regulator is connect to the system to provide the rated voltage [says 5V].
- Arduino and sensors are powered up ,then the Air Quality, Temperature, pressure, carbon-monoxide levels of the Atmosphere are indicated on the LCD display and as well as in the mobile Bluetooth App.
- If the level of pollution increases, the level of Air Quality decreases then it directly display on the LCD display as “Harmful Gases Detected” and text message will send to mobile through GSM.
- To increase the Air Quality and to decreases the level of Air Pollution we deployed the Air Purifier.
- After the purification of Air through purifier the levels of parameters are monitored and displayed on the LCD as well as Bluetooth App.
- The above process will be repeated continuously.

Fig 8.1. Working Model



8.2. Result Output in Mobile Bluetooth App

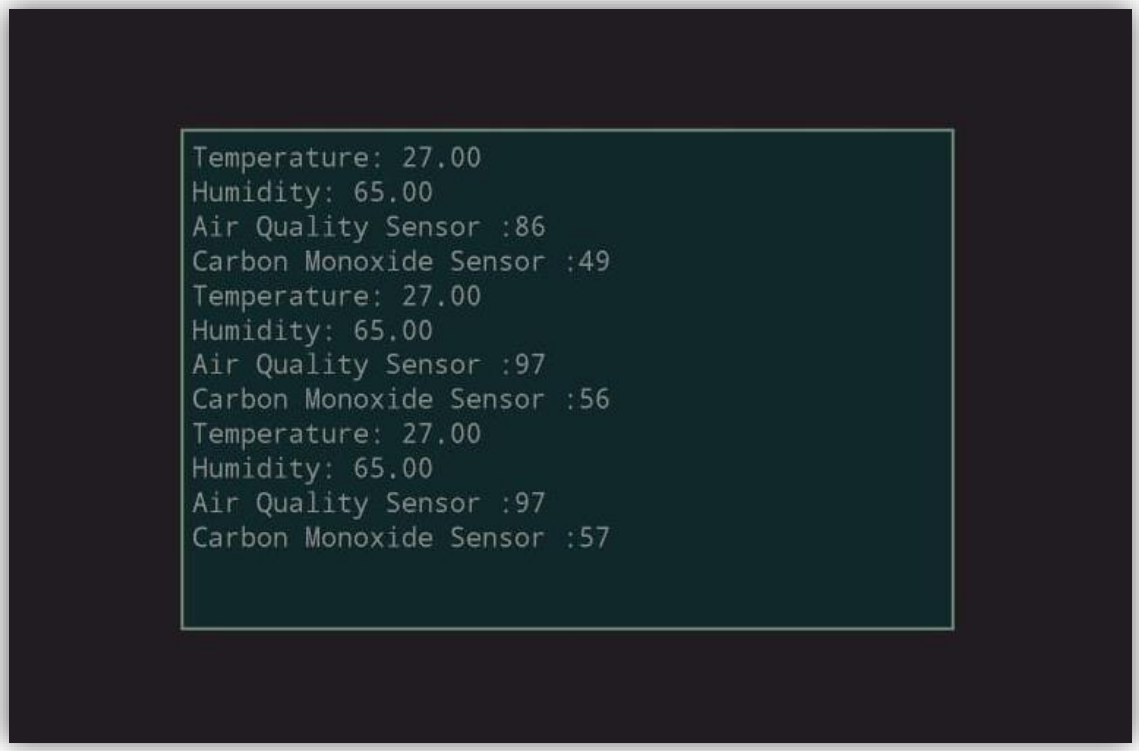


Fig 8.2. Result output in mobile Bluetooth app

8.3. Result Output on LCD Display

Fig 8.3. Result output on LCD display

8.4. Notification on Mobile through GSM

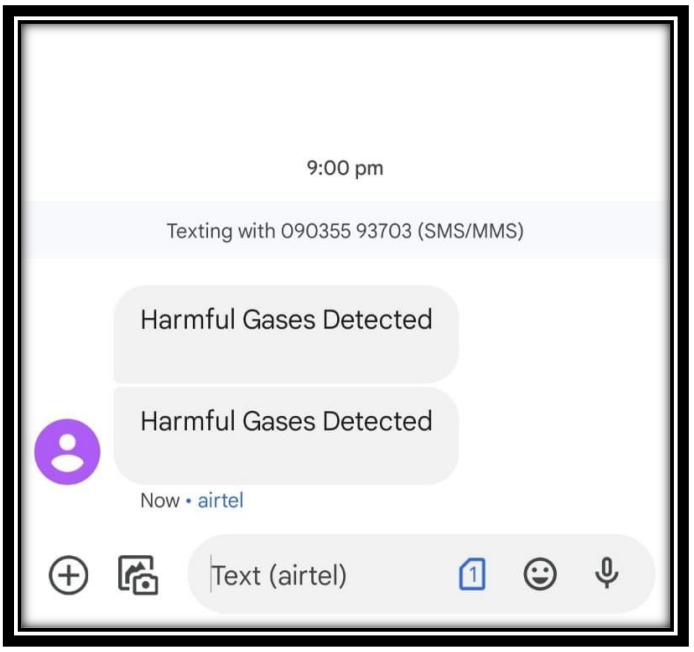


Fig. 8.4. Notification on Mobile through GSM

8.5. Final Project Model

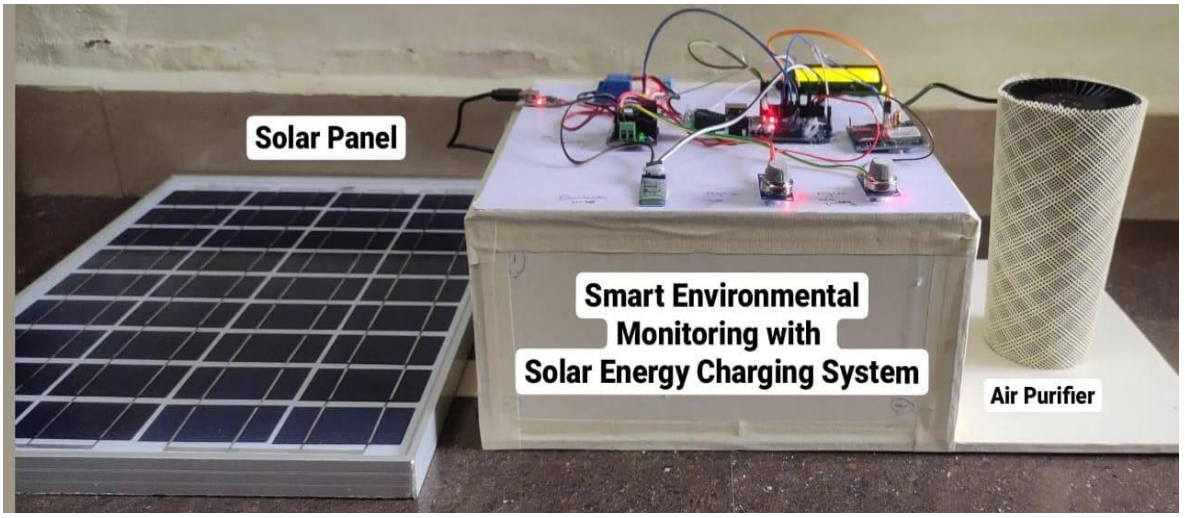


Fig. 8.5. Final Project Model

8.6. Result Tabulation

Parameters	Temperature (Celsius)	Humidity (%)	Air Quality (ppm)	Carbon Monoxide (ppm)
NORMAL	25	50	50	30
POLLUTED ENVIRONMENT	25	70	100	60
AFTER DEPLOYING PURIFIER	25	65	85	55

Table 8.6. Result Table

CHAPTER-9
ADVANTAGES and APPLICATIONS

9.1. ADVANTAGES

- Maintains good environment
- Avoid dieses spread for people
- Save human life from dieses
- Save property damage from dangerous chemical in the pollution
- More Secure
- Easy to Maintain
- Low cost.

9.2. APPLICATIONS:

- Can be used in all R & D centers.
- Can be used in all Educational Institution
- Can be used in all schools
- Can be used in all aerospace
- Can be used in all defense.
- Can be used in all navy
- Can be used in all industries
- Can be used in all hospitals. etc

CHAPTER-10
CONCLUSION and FUTURE SCOPE

10.1. CONCLUSION

- The air quality detection sensor detects the, CO, in the environment with air pollution for metropolitan cities and sends that data to the controller.
- Then the controller compares the data from different sensor input and sends that data to the LCD display & remote monitoring area via wireless Bluetooth Transceiver device.
- If the quality of air degrades with Harmful; pollutant gases the Arduino through GSM sends a text message to the user.
- The user can modify the air quality by powering the Air purifier and also can off the Purifier using the Bluetooth App.
- The Arduino Microcontroller is reprogrammable, the embedded C program is written with ATMEGA-328 IC using Arduinosoftware. In the future we can enhance it more applications by using same microcontroller.

10.2. FUTURE SCOPE

- The developed model can be upgraded for measuring the other important pollutant gases such as Methane, Sulphur dioxide, Ozone, Nitrous Oxide and so on.
- The Model can also be developed as weather monitoring system for future applications.
- The Model can be deployed throughout different junctions of the city where there is an alarming situation of Air quality monitoring.
- The strength of Air purifier can be increased for the direct application in Industries.
- Since the model is working on renewable energy it produces zero emission.

10.3. BUDGET ESTIMATION:

Sl. No	Description	Budget(₹)
1	Hardware Components	**18,000**
2	Circuit + Software	**4,000**
3	Project Report	**1,000**
4	Miscellaneous	**2,000**
	Total	**25,000**

Table 10.3 Budget estimation

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