

Helper Robo



A
Project Report
Submitted
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For The Degree Of
B.Tech [ECE] 6th Semester

Mentor

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CERTIFICATE

This is to certify that, Akshita Gupta, Shambhavi Mishra, Shivani Pathak and Shivanshi Gupta of VI Semester, B.Tech (Electronics & Communication Engineering) 2019-20, has presented a project titled “Helper Robo” in partial fulfillment for the award of the degree of Bachelor of Technology under Banasthali Vidyapith, Rajasthan.

Date: May 16th, 2020

Mr. Hemant Kumar
(Mentor)

Candidate Declaration

I hereby declare that the work, which is being presented in the Project, entitled “Helper Robo” in partial fulfillment for the award of Degree of “Bachelor of Technology” with Specialization in Electronics and Communication Engineering and submitted to the Department of Electronics, Banasthali Vidyapith, Rajasthan is a record of my own investigations carried under the guidance of “Mr. Hemant Kumar”, Department of Electronics, Banasthali Vidyapith.

I have not submitted the matter presented in this report anywhere for the award of any other Degree.

Name and Signature of Candidates:

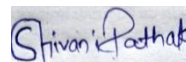
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1. Introduction :

Air pollution is a major concern of new civilized world which has serious toxicological impact on human, health and environment. Air pollution control technologies have continuously advanced in recent decades but prevention is preferable to control. This device helps to prevent a variety of different pollutants both gaseous and solid from entering the atmosphere primarily out of industrial smokestack. Through this project we want to seek attention of society towards basic problem mankind is facing nowadays of Air pollution. This project idea will act as remedy by measuring the pollution rate in environment as well as protecting the humans from harmful chemicals and toxicants. It will not only save time but also protect our environment.

2. Project Objective :

Through this project, we aim to develop a clean air environment by detecting the percentage of carbon monoxide, Sulphur dioxide, alcohol, benzene and nitrogen. These all gases are like toxicants in the environment. This project has uniqueness as; it is able to detect the source of toxicants present in the atmosphere with the approximate percentage. It has been observed from a survey that 72% new industries have been developed and the graph is increasing rapidly. Among all the industries, Thermal Power plants, Cement plants, Petrochemical plants and Metallurgical industries are the major cause of toxicants present in the atmosphere. This device can be send at those places where human beings are unable to go to detect toxic gases as they are harmful for human beings. Our device is in budget device; it is easily affordable for common people and is able to bring a huge change in society. Today holds the tomorrow and development of such type of devices can add a cure to rising air pollution hence benefiting the society and nation.

3. Methodology :

Analysis –

Basic function ability of this project is due to these components mentioned below:

- **Gas Sensors (MQ-7 and MQ-135) :**

Uses- MQ-7 is used in gas detecting equipment for carbon monoxide (CO) in family and industry or car. MQ-135 is used in air quality control equipments for buildings or offices.

Quality- MQ-7 has high sensitivity to carbon monoxide. MQ-135 is simple drive circuit, has high sensitivity and gives fast response. Both sensors have wide detecting scope, are stable and have long life.

Impact- Both sensors can detect toxic gases such as CO, air quality which includes gases like NH₃, alcohol, benzene, smoke and CO₂ at a wide range with amount of gas present (measurement in ppm) which helps to reduce air pollution.

- **Camera Sensor (OV-7670) :**

Uses – It is a low voltage CMOS image sensor that provides the full functionality of a single-chip VGA camera capable of operating at up to 30 frames per second (fps) with complete user control over image quality, controlled through the Serial Camera Control Bus Interface.

Quality – It has onboard regulator of 3.3V single supply needed, high sensitivity for low-light operation, has an Image Signal Processor which reduces noise reduction, defect correction.

Impact – As it is night vision enabled sensor, it is helpful in those areas where light does not reach properly or dim light areas for detection of chemicals and toxicants. It also helps in providing live location of device and surroundings.

- **TFT LCD Shield :**

Uses – Thin Film Transistor Liquid Crystal Display is a transmissive type color active matrix that uses amorphous silicon TFT as a switching device.

Quality – 2.4 TFT shield is one of the most widely used graphic screens. It has ability to display 18-bit 262,000 different color shades.

Impact – It provides live locations of device and its surroundings, so that we can control speed and direction through Bluetooth if any obstruction occurs.

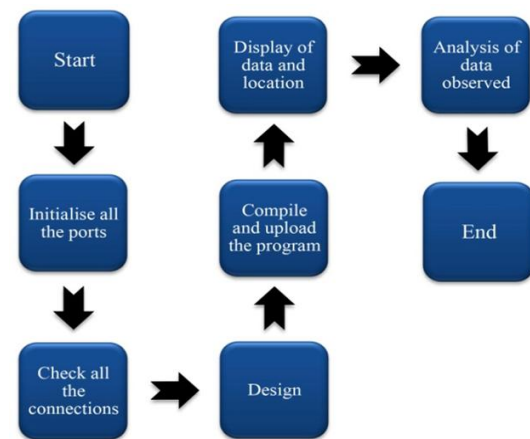


Fig. 3.1: Flowchart - Methodology

4. Circuit Diagram :

4.1 Movement of the robotic car / chassis :

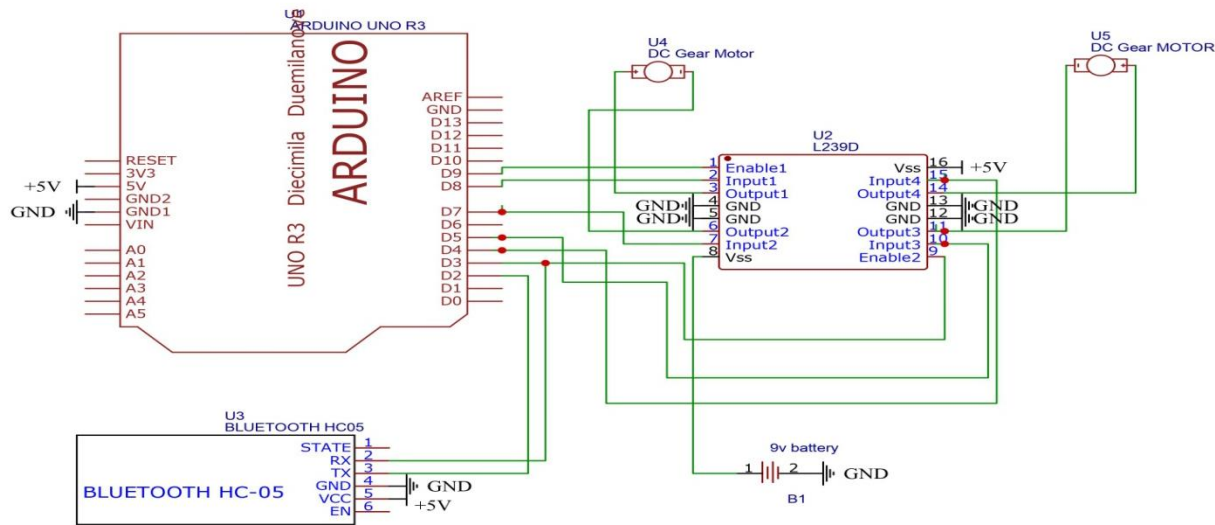


Fig. 4.1.: Schematic Diagram

HC-05 is used in the given above circuit diagram. It is Bluetooth module used for controlling the devices such as controlling speed and direction of the device through Bluetooth as shown in this circuit. Bluetooth module has 6 pins, used for sending data as well as for AT commands such as changing password, name, etc. Pin 1(State) and pin 6 (Enable) are used for AT commands. Pin 4 (Ground) and pin 5 (+5V) are for power supply. Pin 2 (Rx) is Receiver of Bluetooth module, works as transmitter for Arduino UNO, which is connected to digital pin D3. Similarly, pin 3 (Tx) is Transmitter of Bluetooth, works as receiver for Arduino UNO, which is connected to digital pin D2. We have used L239D Motor Driver IC here, whose output pins are connected to DC Gear Motors (500 rpm). L239D is a 16 pin IC, also known as **dual channel H-bridge motor driver**. This IC can deliver upto 600 mA. 16 pins comprises of 4 output pins (3, 6, 11, 14), 4 input pins (2, 7, 10, 15), 4 ground (4, 5, 12, 13) in respective of input and output, 2 enable pins (1, 9), Vcc +5V pin (16) and 1 pin for external supply (8). Input pins are used to control the rotational or spinning direction of dc motors at the same time with technique of H-bridge. Enable pins are used to control the speed of dc motors with the technique of PWM (Pulse Width Modulation). Arduino UNO R3 is a microcontroller board and can be used by beginners as it is known as prototyping shield. Arduino UNO R3 comprises of analog input pins (A0-A5), digital input pins (D0-D13), Digital ground (GND), Analog Reference voltage (AREF) and power supply pins (+5V, +3.3V, GND1, GND2, Vin for external power supply and Reset pin).

4.2 Display of data :

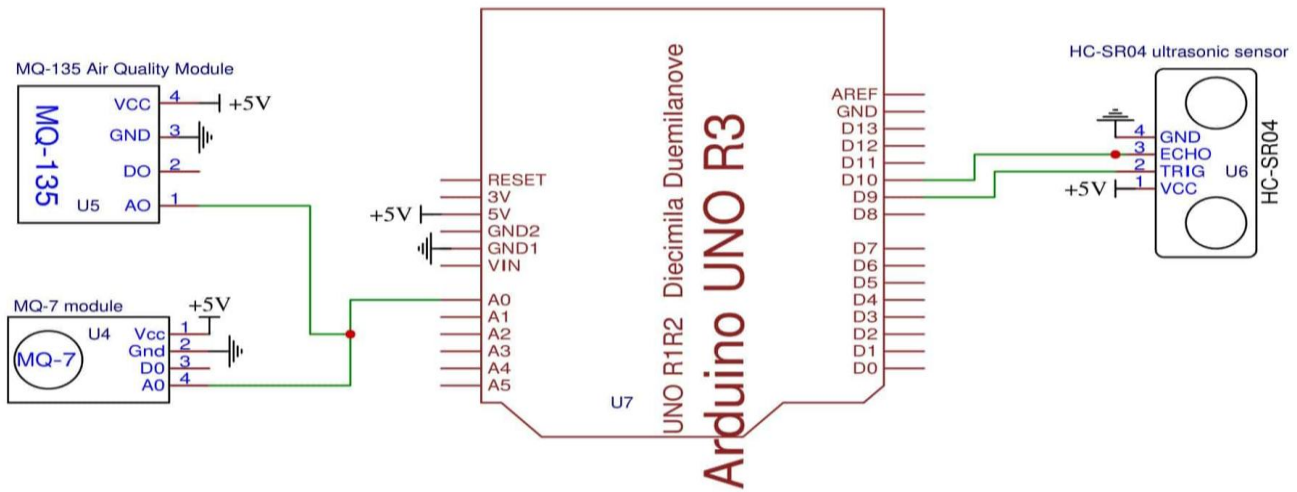


Fig. 4.2: Display of data from sensors – Schematic Diagram

In the above given circuit, Gas sensors module (MQ-7 and MQ-135) and Ultrasonic Sensor module (HC-SR04) are used. MQ-7 is used for detection of carbon monoxide in environment. MQ-7 comprises of sensor, heater and 4 pins of power supply (Vcc and Ground), analog output (AO) and digital output (DO). In both the gas sensors, AO pin outputs (0-5V) analog voltage based on the intensity of the gas. DO pin is used to get digital output from this pin, by setting a threshold value using the potentiometer. Both gas sensors include 2 H pins, 1 A pin and 1B pin. MQ-135 also comprises of sensor, heater, 4 pins, that is, power supply and AO, DO pins. MQ-135 heater is also used with same method, as in MQ-7, for detection of air quality including various gases like benzene, smoke, ammonia, etc, with high and low temperatures. So, we have connected AO of both the sensors to analog input A0 pin of Arduino UNO R3. Ultrasonic Sensor Module (HC-SR04) is used for detecting obstruction and distance between obstruction and device. It has inbuilt feature of calculating distance by the formula ($\text{distance} = \text{speed} * \text{time}$). We can set the unit of distance by programming. It comprises of 4 pins, pin 1 and 4 of power supply (Vcc and Ground), pin 2 of Trigger and pin 3 for Echo. Trigger act as transmitter and Echo as receiver in ultrasonic sensor module. Trigger is behaving as input pulse and echo as output pulse.

4.3 Live location display :

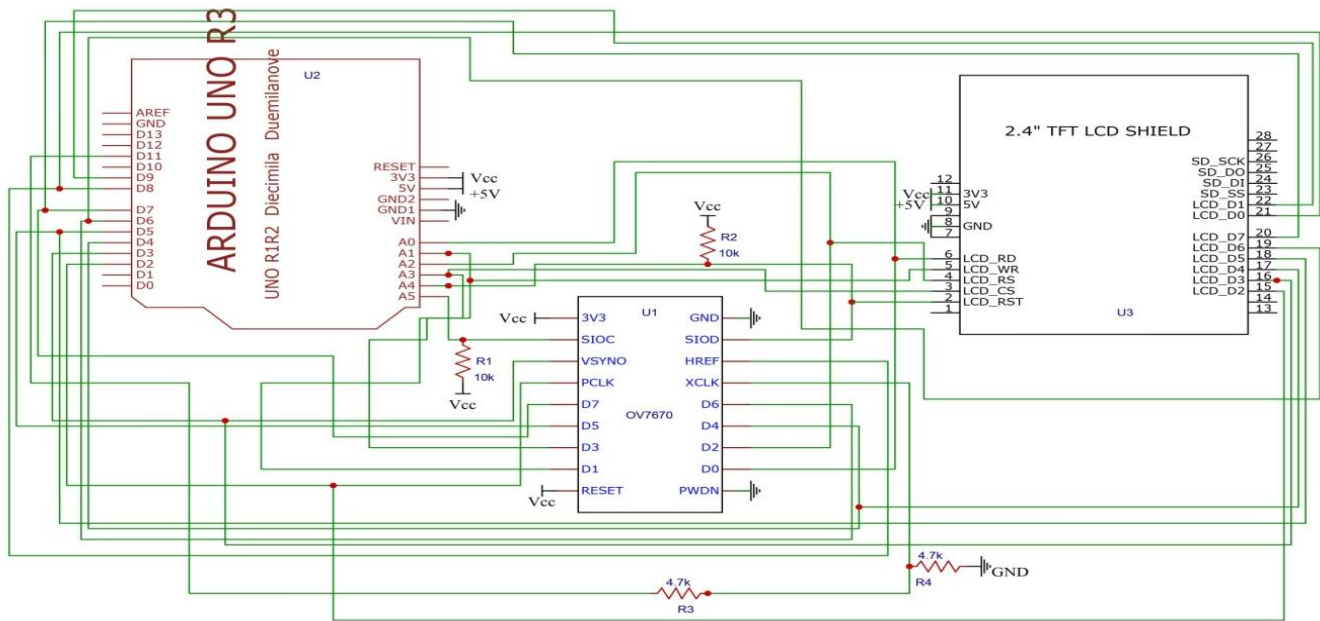


Fig. 4.3: Live location display – Schematic Diagram

In the above given circuit, OV7670 Camera Sensor, 2.4 inch TFT LCD Shield are used, connected with Arduino UNO R3. Thin Film Transistor Liquid Crystal Display Shield is used for various purposes such as calculator, touch screen drawing, video live location and SD Card can also be used for display of bitmap images. It supports VGA, CIF, image sizes. TFT Module consists of LCD data pins (LCD_D0 – LCD_D7), LCD command pins (LCD_RST, LCD_CS, LCD_RS, LCD_RD, LCD_WR), SD Card data pins (SD_SS, SD_DI, SD_DO, SD_SCK) and power pins (3.3 V, 5V, GND). If we have to use SD card, then only we will connect SD card data pins to Arduino UNO R3. LCD data pins are connected to digital input pins of Arduino, command pins are connected to analog pins. OV7670 camera sensor module is also connected to Arduino. Camera sensor is used for taking images of location around device and it can be used in those areas where light doesn't reach properly as it is night vision enabled. It is 18-pin module consists of power supply (Vcc and ground), SIOC, SIOD and XCLK are input pins and are connected with resistors of 10k and 4.7k. Rest all the pins are output pins, except reset and PWDN (power down mode). Master clock into sensor (XCLK) pin transmits data to sensor, and various output pins like, when VSYNC (vertical synchronization) is active high, it indicates active frame. HREF (horizontal reference) indicate active pixels when pin is active high. PCLK indicates pixel clock output from sensor. Pins D0-D7 is used for pixel data output.

5. Working of Project :

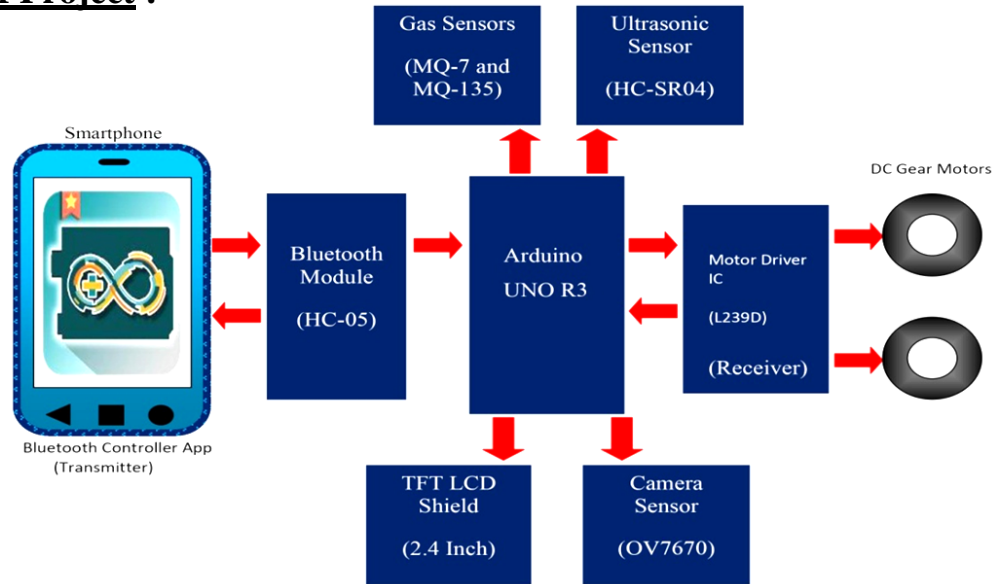


Fig. 5.1: Working – Block Diagram







- This device is bluetooth controlled through smartphone which act as transmitter and L239D IC act as receiver for bluetooth. When we send command through bluetooth controller app, bluetooth receives it and further transmits to L239D IC and makes motors spin clockwise to move forward and anti-clockwise to move backward. So, through bluetooth we can control spinning or rotational direction and speed of device. HC-05 Bluetooth module has an on-board LED to check whether device is connected or not and to check whether bluetooth is ON/OFF. So, if LED is not blinking, then device is not connected and connections can be loose. If LED is blinking, then device is connected. If LED is blinking frequently, then bluetooth module is connected but bluetooth is off but if it is blinking twice for couple of seconds, then bluetooth is on and connected to other bluetooth able device.
- Gas sensors (MQ-7 and MQ-135) uses SnO₂ as sensitive material which has lower conductivity in clean air. Gas sensors consists of heater inside sensor which uses a method of high and low temperatures (heated by 1.5 V) to detect gases like carbon monoxide, carbon dioxide, ammonia, benzene, etc. The sensor's conductivity gets higher along with the CO gas concentration rising. At high temperature, (heated by 5.0 V), it cleans the other gases adsorbed at low temperature. Ultrasonic sensor is used to detect distance between object (obstruction for device) and device. It has inbuilt feature of calculating distance. All components are programmable and data can be observed on serial monitor of Arduino IDE. Gases are measured with unit of ppm (parts per million). Gas sensors must be preheat for 20 seconds after module is ON.

- Camera sensor and TFT lcd shield both are connected to arduino UNO. For live location of path of device and its surroundings to control speed and spinning of device if any obstruction occurs. OV7670 is night vision enabled which helps device in detection of toxicants in low light area or underground mines, industries where light doesn't reach properly. TFT lcd shield is used for live location to know the areas where harmful gases has been detected, so that we can reduce those gases particularly in those areas easily such as landfill sites, industries, power plants, etc. OV7670 has an inbuilt feature of noise reduction and defect correction. OV7670 has mounted with high quality F1.8 / 6mm lens, supports scaling, lens shading correction and de-noise level auto adjust. The camera module is powered from a single +3.3V power supply. An external oscillator provide the clock source for camera module XCLK pin. User need to buffer a entire frame before read them out with low speed MCUs. TFT module is composed of a TFT LCD module, a driver circuit, and a back-light unit. The resolution of a 2.4" contains 240 (RGB)X320 dots and can display up to 262k colors.

6. Component List :

- 1) MQ-7 Carbon Monoxide gas sensor module
- 2) MQ-135 Air Quality detector module
- 3) HC-05 Bluetooth module
- 4) HC-SR04 Ultrasonic sensor module
- 5) OV7670 Camera sensor module
- 6) L239D motor driver IC
- 7) Arduino UNO R3
- 8) 2.4 inch TFT LCD Shield display
- 9) DC gear motors
- 10) Wheels
- 11) Breadboard
- 12) Jumper Wires
- 13) Resistors (10k, 4.7k)
- 14) Chassis
- 15) Hi-Watt 9V battery
- 16) Battery clip connector

7. Component Description :

S. No.	Component	Description	Image
1.	L239D motor driver IC	It is typical motor driver IC which allows the dc motor to drive on any direction. This is consists of 16 pins which are used control a set of 2 dc motors instantaneously in any direction, by using L293D IC we can control 2 dc motors.	
2.	DC gear motors	A gear motor is an all-in-one combination of a motor and gearbox. The addition of a gear head to a motor reduces the speed while increasing the torque output. The most important parameters are speed (rpm), torque (lb-in) and efficiency (%).	
3.	Wheels	The wheel is made up of high-quality rubber which gives maximum traction while operating. The wheel is strong and sturdy as it features a nylon-reinforced plastic rim. Its diameter is 65 mm and width is 27 mm.	
4.	Breadboard	It is a solderless device for temporary prototype with electronics and test circuit designs. Most electronic components in electronic circuits can be interconnected by inserting their leads or terminals into the holes.	
5.	Hi-Watt 9V battery	It is a size of battery that was introduced for the early transistor radios. It has a rectangular prism shape with rounded edges and a polarized snap connector at the top. This type is commonly used in walkie-talkies, clocks and smoke detectors.	
6.	Battery clip connector	A terminal of a connecting wire having spring jaws that can be quickly snapped on a terminal of a device, such as a battery, to which a temporary wire connection is desired.	

7. Chassis It is the basic framework of any vehicle. It is also known as the load bearing framework of an artificial object which structurally supports the object in its construction and functions.



8. Jumper wires Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. These are of three types- male to male (pins at both end), male to female (pin at one end only) and female to female (none of the ends have pin).



9. Resistors It is a passive two-terminal electrical component that implements electrical resistance as a circuit element. It is used in electronic circuits to reduce current flow, adjust signal levels, to divide voltages, terminate transmission lines and bias active elements.



8. Costing of Project :

S. No.	Component	Cost
1.	MQ-7 Carbon Monoxide gas sensor module	Rs. 275
2.	MQ135 Air Quality detector module	Rs. 299
3.	HC-05 Bluetooth module	Rs. 456
4.	HC-SR04 Ultrasonic sensor	Rs. 187
5.	OV7670 Camera sensor	Rs. 458
6.	2.4 inch TFT LCD Shield display	Rs. 565
7.	Arduino UNO R3	Rs. 442
8.	L239D motor driver IC	Rs. 176
9.	DC gear motors	Rs. 280
10.	Wheels	Rs. 190
11.	Breadboard	Rs. 195
12.	Jumper wires	Rs. 195
13.	Resistors (10k and 4.7k)	Rs. 120
14.	Chassis	Rs. 300
15.	Hi-Watt 9V battery	Rs. 20
16.	Battery clip connector	Rs. 10

9. **Applications :**

- ➡ Detection of chemicals in underground mines.
- ➡ Detection of toxicants in landfill sites.
- ➡ Detection in acid zones areas.
- ➡ Area near industries and power plants.
- ➡ Detection in areas which are devoid of sun rays.

10. Advantage and Disadvantage :

Advantage –

- ✓ It prevents human beings from infections and diseases caused by harmful gases and toxicants.
- ✓ It is time saving for measurement of amount of chemicals and gases present.
- ✓ It is easy to use, cheap and provide accurate data.
- ✓ It helps in reducing air pollution.
- ✓ It provides accurate location where the toxicants are present with their amount.

Disadvantages –

- ❖ It needs constant power supply to display data and location.
- ❖ Data can also be interrupted by various atmospheric conditions.
- ❖ High power supply can damage the device.
- ❖ Uneven paths can cause device interrupted to find obstructions.
- ❖ Radioactive elements can damage the device.

11. Future Scope :

- Detection of chemicals and toxicants in rivers also for reduction of water pollution.
- Device can work in extreme (high or low) temperature and pressure.
- Detection of chemicals in human body with Human Area Networking Technology (human body is medium of transmission).

12. Conclusion :

This project holds a potential to develop a sustainable environment by creating awareness regarding pollutants in the atmosphere. Our main aim is to built a device which can reduce the problems related to air pollution due ro construction of huge factories around the globe. This device also helps to clean the air index and helps to maintain the ozone layer. This device having high range of applications which help in putting unwanted matter in proper place. Such a system offers a healthy and clean environment. This project will not only help to conquer present condition but also the future problems of mankind.

13. Appendices (Programs and Datasheets) :

Programs –

- 1) MQ-7 Carbon Monoxide Gas sensor module :

```
// select the input pin for the MQ-7 sensor
int sensorPin = A0;
// variable to store the value coming from the MQ-7 sensor
float val;

void setup()
{
    // put your setup code here, to run once:
    Serial.begin(9600); // sets the serial port to 9600
    mySerial.begin(9600);
}

void loop()
{
    val = analogRead(sensorPin); // read analog input pin 0
    Serial.print("amount of CO present is = "); //print the value of CO read from the MQ-7 sensor
    Serial.print(val);
    Serial.println(" PPM");
    delay(2000);
}
```

2) MQ-135 Air Quality detector module :

```
// select the input pin for the MQ-135 sensor
int sensorpin = A0;
// variable to store the value coming from the MQ-135 sensor
float sensorValue;

void setup()
{
  // put your setup code here, to run once:
  Serial.begin(9600); // sets the serial port to 9600
  mySerial.begin(9600);
}

void loop()
{
  sensorValue = analogRead(sensorpin); // read analog input pin 0
  Serial.print("Air Quality = "); //print the value of Air Quality read from the MQ-135 sensor
  Serial.print(sensorValue);
  Serial.println(" PPM");
  delay(2000);
}
```

a) MQ-7 Carbon Monoxide gas sensor module:

Parameter Name	Technical conditions
Circuit Voltage (Vcc)	5V \pm 0.1
Heating Consumption	About 350 mW
Using and storage temperature	–20°C to 50°C
Oxygen concentration	2% - 21% (standard condition)
Standard working condition	Relative Humidity: 65% \pm 5%

b) MQ-135 Air Quality detector module :

Parameter Name	Technical conditions
Circuit voltage (Vcc)	5V \pm 0.1
Heating consumption	Less than 800 mW
Using temperature	–10°C to 45°C
Storage temperature	–20°C to 70°C
Relative humidity	Less than 95%

c) HC-SR04 Ultrasonic sensor module :

Parameter Name	Technical conditions
Working current	15 mA
Working frequency	40 Hz
Max range	4 m
Min range	2 cm
Measuring angle	15 degree

d) OV7670 Camera sensor module :

Parameter Name	Technical conditions	
Power requirements	Active	60 mW typical
	Standby	<20 μ A
Temperature range	Operation	−30°C to 70°C
	Stable image	0°C to 50°C
Lens size	1/6 inch	
S/N ratio	46 dB	
Pixel size	3.6 μ m * 3.6 μ m	

e) 2.4 inch TFT LCD Shield display :

Parameter Name	Technical conditions
Support interface mode	MCU SPI RGB
Operating temperature	−20°C to 70°C
Storage temperature	−30°C to 80°C
Driver IC	ILI9341
Pixel size	0.153 mm * 0.153 mm

f) Arduino UNO R3 :

Parameter Name	Technical conditions	
Input Voltage	recommended	7-12 V
	limits	6-20 V
DC current per I/O pin	40 mA	
DC current for 3.3 V	50 mA	
Flash Memory	32 kB (ATmega328)	
Clock speed	16 MHz	

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