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Investigation of Indoor and Outdoor Air Quality Sensor for Asthma Management

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***Abstract*- The main objective of this paper is to develop an efficient and low-cost solution in the Hardware form that would detect the areas which prone highly to pollution and preventing the people who are suffering from lung diseases like Asthma, Pneumonia and so on. This will help the patient to identify the pollution-prone area and helps them by preventing their entry into that area. This is achieved by using the Air Quality Monitoring sensors getting integrated with an Electronic controller.**

Keywords: Lung diseases, Air Quality Monitoring sensors, Electronic controller.

I. INTRODUCTION

We see a lot of Vehicles in roads and various industries that emit gases which contain many chemical components such as Carbon-di-oxide, Carbon monoxide, Sulphur gases that would cause various Lung Diseases such as Asthma, Pneumonia and many. So the people whom all are affected by this dangerous Lung Diseases are needed to keep away from the pollution affected areas.

So we developed a Hardware that would help us to detect the level of pollution present. This hardware uses various pollution measuring sensors to detect the levels of pollution present in the air. If the value measured by these sensors exceeds the normal level or pre-determined level, the hardware will indicate the danger automatically by starting the alarm and at the same time. It also sends a message to the relatives of that people about their entry in that pollution prone area. We can also make the Hardware to send the message to any Pollution controlling authority about the higher level of pollution I air in that area.

II. BLOCK DIAGRAM

The Block Diagram of the Hardware is shown in Figure 2.1. It consists of Various Air Quality measuring Sensors interfaced with Arduino. A Power Supply Circuit powers the entire Hardware.

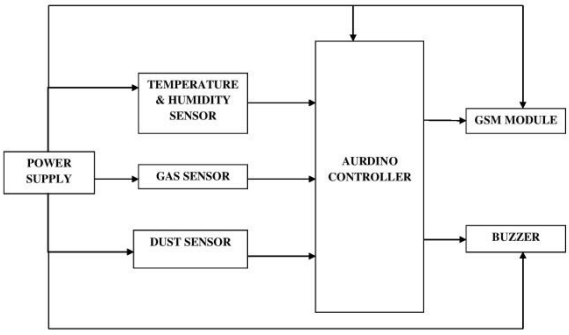

Figure 2.1 Block Diagram of the Hardware

III. COMPONENTS USED

The following are the components used in Hardware.

3.1 Temperature and Humidity Sensor

The Temperature and Humidity sensor DHT11, shown in Figure 3.1, is used to detect the Temperature value and Humidity Level in the air. The Humidity sensing component has two electrodes with a substrate between them. If the Humidity Level in air changes, the resistance between the Electrode changes. This resistance change is measured and processed by the Integrated Circuit(IC) present in the sensor which makes it ready to process by the Controller. For measuring the Temperature Thermistor is used. Its resistance varies with temperature and the resistance change is gets calibrated to an electrical quantity by the IC.

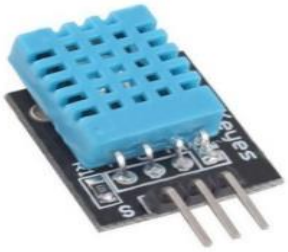

Figure 3.1 Temperature and Humidity sensor

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3.2 Gas Sensor

The Gas Sensor MQ6, shown in Figure 3.2, employed to detect the level of various gases in the air. The Sensitive material in this sensor changes its conductivity with respect to gas concentration and the change in conductivity can be converted into equivalent electrical quantity by using the simple circuit.

Figure 3.2 Gas Sensor

3.3 Dust sensor

The Dust sensor GP2Y1010AU0F, shown in Figure 3.3, has an infrared emitting diode and a phototransistor in a diagonally arranged manner. This arrangement detects the dust concentration by the light reflected by the dust particles.

Figure 3.3 Dust sensor

3.4 Arduino Uno Controller

The Arduino Uno Controller, shown in Figure 3.4, acts as the brain for this Hardware. It is a programmable one which can be programmed according to the application. Here, it is used to perform the analysis of the data received from the various sensors and take necessary action according to the algorithm. It has various pins for a verity of use. It accepts both Analog and Digital input and it is provided with inbuilt Analog to Digital converter. Along with this, the controller is provided with separate pins for transmitting and receiving the external signals.

Figure 3.4 Arduino Uno Controller

3.5 Liquid Crystal Display

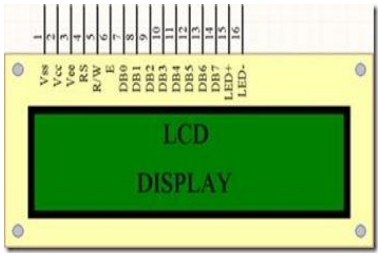

Figure3.5 Liquid Crystal Display

Liquid Crystal Display (LCD), shown in Figure 3.5, is used to display the values of various measured parameters. It receives an input signal from the Arduino Uno controller. It can display all types of characters include Numbers, Alphabets and Special characters. As it is easily programmable it finds a verity of applications. The pin description of LCD is shown the Table 3.1.

Table 3.1 Pin Functions of LCD

Pin number	Name	Function
1	VSS	Ground voltage
2	VEE	+5V
3	VCC	Contrast voltage
4	RS	Register select 1-Data register 0-Instruction register
5	R/W	Read/Write mode, to select read/write mode 0-write mode 1-read mode
6	E	Enable 0-Start to latch data to LCD character 1-Disable
7	DB0	Data bit 0 (LSB BIT)
8	DB1	Data bit 1
9	DB2	Data bit 2
10	DB3	Data bit 3
11	DB4	Data bit 4
12	DB5	Data bit 5
13	DB6	Data bit 6
14	DB7	Data bit 7 (MSB)
15	BPL	Black Plane Light (+5V) or lower (optional)
16	GND	Ground voltage (optional)

3.6 Buzzer

It is an audio signaling device used for alerting purpose. It receives the input signal from the Arduino controller. It is shown in Figure 3.6.

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Figure 3.6 Buzzer

3.7 GSM Module

The GSM Module, shown in Figure 3.7, is used to send a message to input mobile number saved in the Arduino controller if the patient enters into the pollution-prone area. It is controlled by the Arduino Controller.

Figure 3.7 GSM Module

IV. HARDWARE DESIGN

4.1 Circuit of the power supply

The following figure 4.1 shows the Circuit of a power supply capable of producing 5V DC and 12V DC. The input 230V AC is first stepped down to 12V AC and the same is given to the Bridge Rectifier Circuit. This circuit performs the Rectification process and gives output as pulsating 12V DC. This is converted to pure DC by means of using Filter circuit consists of capacitors and the Voltage regulator.

Figure 4.1 Circuit of Power Supply

4.2 Circuit of Senor Interfaced with the Controller

The following figure 4.2 shows the Circuit of Sensors interfaced with the Arduino. It consists of Dust sensor, Temperature and Humidity sensor, and Gas sensor interfaced with the Arduino. An LCD display is used to show the values measured by each sensor. This LCD is also interfaced with the same Arduino board.

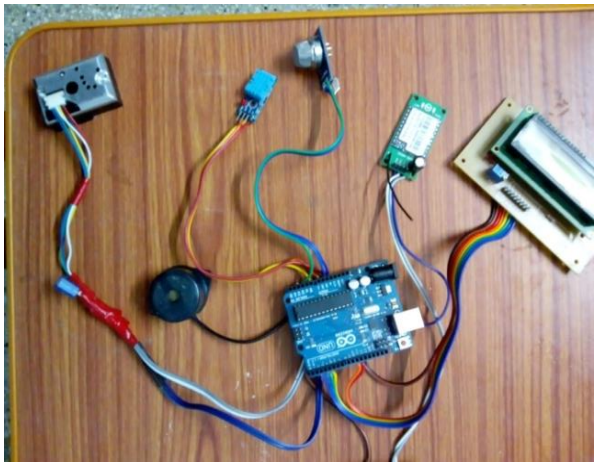

Figure 4.2 Circuit of sensors interfaced with Controller

4.3 Threshold Values

The following table 4.1 shows the Threshold or Acceptable values used for this Hardware. These are horizontal average values can vary according to place and physical health condition of the person.

Table 4.1 Threshold values

Name of the parameter	Threshold value
Temperature	35°C
Humidity	80%
Gas	250 ppm
Dust	0.15 mg/m^3

V. WORKING AND OUTPUT OF THE HARDWARE

When the hardware is energized by the power supply, the sensors connected to the Arduino Uno controller start to measure the value of temperature, the percentage of humidity and concentration of dust and gas present in the atmosphere. The electrical output signal from these sensors is given to the controller. After the processing of these signals, according to the algorithm in which the controller is programmed, the outputs are displayed in the LCD. The value of Temperature, Humidity, Gas content and Dust content in the air is indicated by the letters TP, HM, GS and DS respectively and their corresponding values will be displayed below. The flowchart of the working of the hardware is shown in figure 5.1

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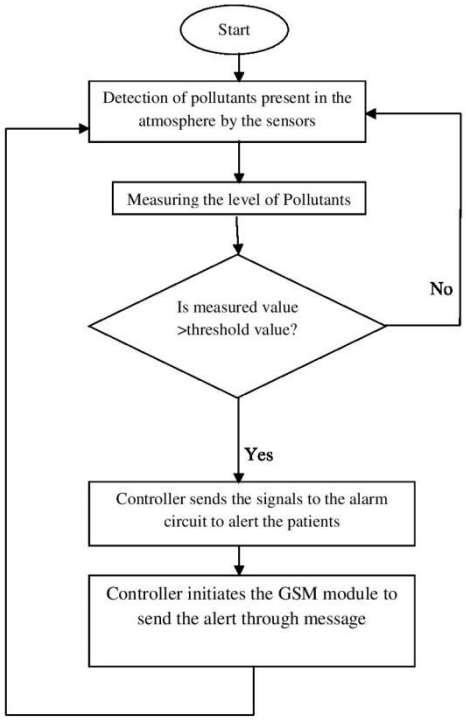

Figure 5.1 Flow Chart

For example, a patient who carries the hardware enters in the pollution-prone area and one of the monitoring parameter values exceeds the Threshold value. Then there comes an Asterisk (*) near the letter corresponding to the exceeded parameter in LCD and the Buzzer starts to ring to alert that person. At the same time, a message about the entry of the patient into the polluted area will be sent to the input mobile number through the GSM. The Mobile number can be given as input to the Arduino controller during programming.

Figure 5.2 shows the output when the detected value of Humidity sensor exceeds the threshold value. As explained earlier, there comes an Asterisk (*) near the letter HM and the Buzzer starts to ring. In a similar way, if the threshold value of any other sensor exceeds means output will display in LCD.

Figure 5.2 Output of the project in LCD

Figure 5.3 shows the message recevied to the input mobile number from the Hardware. In previous figure, the LCD shows the output when Humidity exceeds the threshold value. The same values are recevied as a message as shown in the figure.

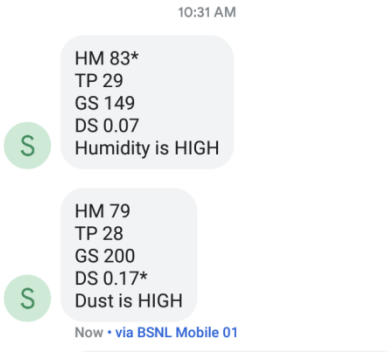

Figure 5.2 Output of the Hardware as message to the input mobile number

VI. CONCLUSION

From this paper, we provided the solution in the form of hardware for protecting the people from entering into the pollution-prone areas and monitoring them from the same. This will help them to prevent the further complications which may come if they enter into that polluted areas. This can also be used to find the places which are affected highly by the dangerous air pollutants. This will help us to take some necessary actions in order to reduce the level of pollution in that particular area. Since the manufacturing cost of this project is very low (comes around Rs.6000), the hardware will be available for a cheap price and all people can buy and use this irrespective of their Economic status.

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