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Air and Sound Pollution Monitoring System using IoT

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***Abstract*—** In this paper, an effective implementation for Internet of Things is used for monitoring atmospheric conditions of environment like air pollution and sound pollution. This paper presents a conceptual architecture for a versatile, flexible and cost efficient for monitoring the air and sound quality of a particular site. In the description about this integrated network architecture and the connected mechanisms for reliable and accurate measurement of parameters by sensors and transfer of information or data is done with the help of internet. This system is able to provide a mechanism for the operations of the devices to do better in monitoring stage. This monitored data can be obtained from remote location without actually visiting it due to the access of internet. The framework of this monitoring system is based on combination or collaboration of affective distributed sensing units and information system for data composition. The role of IoT is the new concept used in air and sound pollution measurement, which allows data access from remote locations.

Keywords- *Internet of things, air pollution, sound pollution, sensors, monitoring system.*

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I. INTRODUCTION

As modernization is growing rapidly internet technologies and wireless sensor networks are advanced, a new trend in the era of omnipresence is being realized. The increase in the number of internet users and application on the internetworking technologies enable networking of everyday objects requiring human-to-human or human-to-computer communication. Internet of Things allows an exchange of information to and from a device or thing. It can be anything such as refrigerators, watches, fans, air conditioner, automobiles, or anything. It is a communication between human and machine or machine and machine. Due to flexibility and low cost Internet of things (IoT) is getting popular day by day. With the urbanization and with the increase in the vehicles on road the atmospheric conditions have considerably affected. Also, there has been the growth of industries and infrastructure which has caused increase in pollution in atmosphere like air and sound pollution. Air pollution and sound pollution are major constituents for having adverse and harmful effects on environment as well on human beings. To monitor this pollution is a very difficult task. Traditionally, authorities like data loggers were used to collect the data of the site to be analyzed. They had to visit the site to be analyzed every time they wanted the data. This was a lengthy, time consuming and expensive task. Due the use of sensors collaborated with internet can make pollution monitoring less complex, less time consuming and flexible. The data can be obtained from remote location without having to visit the location due the internet. Also, an accurate data with indexing capabilities will be able to obtain. Monitoring gives measurements of air pollutant and sound pollution concentrations, which can then be analyzed interpreted and presented. This information can then be applicable in many ways. Analysis of monitoring data allows us to assess how bad air pollution and sound pollution is from day to day.

II. OVERVIEW OF THE SYSTEM

To design an IoT based Air and Sound pollution monitoring system which can be accessed with the help of Wi-Fi module and to analyze the pollution level of a particular place or site. To pick up the data from the atmosphere or contents of atmosphere various sensors are used .In this system air pollutants will be measured are carbon monoxide, carbon dioxide, cooking fumes, smoke and temperature.For the measurement of sound levels sensor used. Air pollution sensors measure the quality of air while sound pollution sensors measure the sound levels. Data from these sensors are basically analog signals. These signals are converted to its equivalent digital form. A Wi-Fi module is also integrated in the system to transfer the data to another location or to access the data from remote location. Also, to display data on the system a 16x2 LCD is connected to the microcontroller. System uses air sensors to sense presence of harmful gases/compounds in the air and constantly transmit this data or information to microcontroller. Also, this system constantly measures sound level and reports it to the online server over IOT. The sensors interact with microcontroller which processes this data and transmits it over the internet. This allows the authorities who want the data of different areas to monitor air pollution in different areas and take action against it.

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III. SYSTEM ARCHITECTURE

The hardware consists of power supply used for providing supply to the components and the microprocessor. The power supply gives 5V and 3.3V output. The 5V is used by sensors and processor while 3.3 V is required for Wi-Fi module. The 5V is obtained by using IC7805 while 3.3 V is further obtained by IC317.The sensors which are gas and sound are connected the processor through analog to digital converter. Also display is provided on the system and Wi-Fi module is connected to the microprocessor.

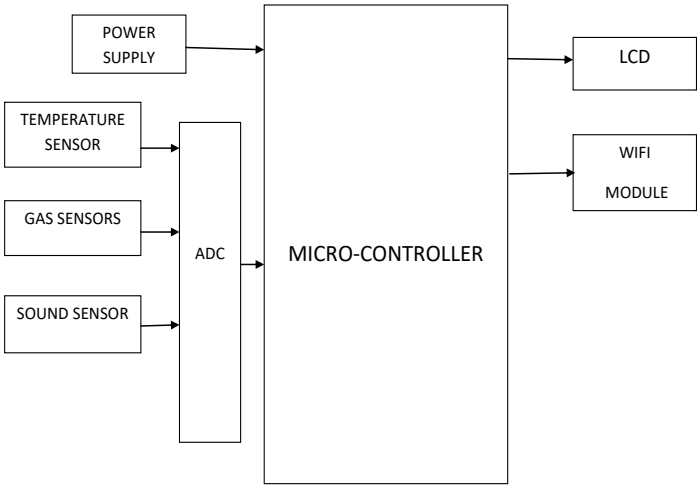

Figure 1: Block diagram for IoT based air and sound pollution monitoring system

IV. OPERATION

System consists of the sensors used for acquiring required data from the atmosphere. Sensors used for measuring air pollutants are MQ7, MQ6, MQ135 and LM35 are used to measure carbon monoxide, smoke and cooking fumes, carbon dioxide and temperature respectively. For the measurement of sound levels a sound sensor module- mic is used. Air pollution sensors measure the quality of air while sound pollution sensors measure the sound levels. Data from these sensors are basically analog signals. These analog signals are converted to its equivalent digital form. The data can be displayed on the 16x2 LCD connected to the microcontroller. To send data to a remote location the data from system is sent to the Wi-Fi module (ESP8266). Wi-Fi module is connected to the microcontroller using MAX 232.The Wi-Fi module interacts with microcontroller using two ports i.e. transmitter and receiver provided on it. The measured data is sent from the module to any location within its range from the data can be fetched using a laptop /mobile. For that we have to give module the Wi-Fi details to connect to internet, and then provide the IP address of the website.

V. SENSORS

A. Temperature

Temperature plays an important role in the analysis of the atmospheric condition. The temperature of atmosphere can be detected by this sensor. These are widely used for measurement, instrumentation and control systems.

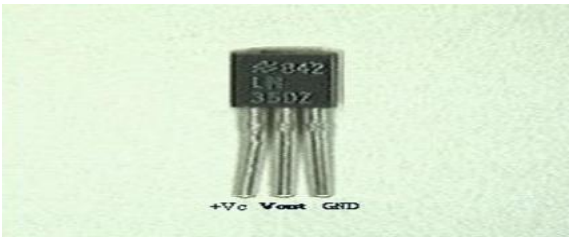

Figure 2 . Temperature Sensor

It is convenient in many applications to use temperature sensors that produce readily interpretable temperature readings in a digital format. Such smart temperature sensors combine a sensor and interface electronics on a single chip, and are preferably manufactured in a low standard CMOS process.

In this project we are using a semiconductor material based LM35 sensor to measure and sense the temperature. The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature in ^{o}C. The sensor circuitry is sealed and not subjected to oxidation, etc. The LM35 generates a higher output voltage than thermocouples and may not require that the output voltage be amplified. It is rated in the temperature range from -55^{o} to +150^{o}.The accuracy guaranteed by LM35 is 0.5^{o}.As due to the system proposed, we can get the monitored data from remote location therefore we are using this sensor in the proposed system as it is best suitable for remote application .Also due the low cost available due to wafer- level trimming it is preferred here.

Gas sensors

Air pollution consists of various constituents which are harmful for human beings. Out of several constituents here carbon monoxide , smoke and cooking fumes and carbon dioxide are detected .The sensors used are MQ7, MQ6 and MQ135 respectively. The concentration level of these toxic gases is continuously sensed by their respective sensors. The measured value is displayed on the LCD continuously. The sensor requires 5V input which is given by the power supply in the system. The sensor is calibrated with the processor such that it gives output in the percentage of the level of concentration of carbon monoxide in the atmosphere. The particular threshold value is set at the load resistance. When the value exceeds threshold value then the authorities will come to know that the pollution level has increased of that particular site.

B. Sound sensor

In order to monitor sound pollution in the areas a sound sensor module is used. To detect the presence of the sound, mic sensor module is used.

We are using mic as sound sensor in the proposed system. This sensor operates on 3.3V to 5V dc. It provides digital output on the display. It detects sound from the atmosphere and output digital trigger signal. This sensor is calibrated such that it gives the readings in percentage. It has a sound set point adjust, to adjust the threshold value. So if the reading goes beyond the threshold value authority will able to know the sound pollution is at high level of that particular place. It has a led which indicates power and output signal. This is preferred as it is available and due to the low cost of the sensor.

Figure 3. Mic sensor module

C. ESP8266 Wi-Fi Module

To transmit the measured value or monitored from remote location to the another location a network of internet is required. To enable this a Wi-Fi module is used in the system. There are different modules available but here we are using the module ESP8266.It is basically a SOC which helps to meet user's continuous demands for efficient power usage, compact design and reliable performance in the industry of internet of things. It has 802.11 protocol support and Wi-Fi direct support. It operates on 3 to 3.6V input. As it is a soc it can be programmed accordingly to the user requirements and used. The main advantage provided by it is small in size .It is used to connect processor to internet. In the system for the transmission of the monitored data from the area to be monitored and to another location Wi-Fi module is used. It basically connects the system to internet. The IP address of the particular website is provided to the module and then it send the stored data to the website which can be fetched by using laptop or mobile.

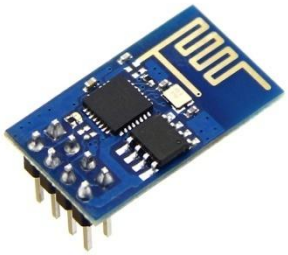

Figure 4. ESP8266 Wi-Fi module

VI. WORK DONE

For creating the system, first we did the research based on the system about IoT and various sensors. Sensors of air and sound based on availability and economical price were selected. For the interaction of internet with the system we are using a Wi-Fi module which is connected to the microcontroller through the serial port. So, the measured data is sent from the module to any location with its range from the data can be fetched using a laptop /mobile. We have tested this system at various places. We have used it at the places where standard devices for the measurement of pollutants are installed to compare those measured values with our system output values.

For example we visited M.G road Pune for the testing of the system. A standard device with display is installed at M.G road. So we tested our system and obtained values approximately close to the standard device mentioned in Table 1.

VII. EXPECTED RESULT

We describe a real-time monitoring system for the monitoring of concentration of air pollution and sound pollution in the environment. For this purpose, a hardware system is designed to detect the carbon monoxide, carbon dioxide and smoke concentration. The output of the system obtained from the sensor and processor collaboration is in digital form. A network using Wi-Fi technology can transmit the information of sensor modules to the another location. The proposed system is supposed to measure the pollution levels of various places or sites so that the authorities will be able to control the pollution caused by taking necessary precaution and measures.

Table 1.Following readings are of M.G road, Pune.

Pollutants	Standard value (%)	Observed value (%)
CO	63	44
CO_2	60	48
Temperature	36	34.1
Gas	68	70
Sound	40	36

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