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IoT Based Pollution Monitoring System for Smart City

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ABSTRACT: Smart cities growing across the world having various challenges. One of the prominent challenges is pollution in cities. This paper briefly focus on the pollution in cities in terms of hazardous gasses, sensing the gasses and send its levels to monitoring section by the use of IoT. The gas sensors like MQ4, MQ6 and temperature sensors are used for taking the environment parameters. The values are processed in microcontroller and send them to internet by the use of Wi-Fi module. Thing speak online platform is used to show the graphical view of this parameters. The data generated here is accessible globally through use of internet.

KEYWORDS: Smart City, IoT, MQ4, MQ6 Wi-Fi module.

I. INTRODUCTION

Now a day's the air pollution, climate changes and its impacts are very serious concern to the scientists working in environment and climate related area. Terrestrial as well as marine life is getting adversely affected due to the poisonous gasses emitted by industries as well as vehicles. Most of the peoples in the world are moving to the urban and which results into climate of urban area is not livable [4]. Health issues are become more prominent due to poor air quality and chances of strokes, heart diseases, lung cancers, and respiratory diseases like asthma are increased. The life of small children's, pregnant women's and elder persons is in danger due to this air quality. Report of WHO shows that millions of premature death cases are occurred due to poor air quality worldwide every year. Hence study of air quality in recent years must be done all over the world and it is necessary to constantly monitor and take actions on the air quality index of the city to make it really smart and good to live.

All over the world governments are constructing the smart cities to keep a track on the various problems and provide a healthy life for the peoples. The Indian government is in process to build 100 smart cities up to 2050. These cities will be full of advanced communication networks, WSNs, and intelligent systems to solve future challenges and create new services [4]. Some of the Indian cities like Delhi have installed real-time air quality monitoring systems with low cost IoT enabled Wireless Network Technology which will cover in all other cities of the world in upcoming days.

Environment parameters like air quality and temperature are real time monitored and which requires the live data transfer between the sensing devices over the internet and it is connected to the android or other applications for better visualization. It results into reduction in mobilization of the system hardware at different locations among the cities and which is solution to cost on real time installation of the equipment's by the use of Internet of Things (IoT) based applications. Arduino with its wide specification is the heart of the system. It gathers a data from the node sensors and with the help of Wi-Fi module it sends recorded data to the ThingSpeak. ThingSpeak is an open source cloud platform on which data can be stored and retrieved with the help of hypertext transfer protocol (HTTP) over the internet. ThingSpeak is a platform to store real time sensor data and also used to plot the graphs, charts also create plugins and apps for collaborating with web services, social network and other application program interface (API) [4].

It is open source platform once you signed in, a channel is created with unique channel ID. For each channel there is eight fields for data storage, out of it three fields are to store latitude, longitude and elevation and one field to write a short message about description of data. Once the channels are created in ThingSpeak, the data can be implemented and alternately one can process and visualize the information through various resources and platform, one of them being on an Android Application, designed in Android Studio. The increased demand for service over the internet has necessitated the data collection and exchange in an efficient manner. IOT has promised the ability to

provide the efficient data storage and Exchange by connecting the physical devices and vehicles via electronic sensors and internet [4].

Use of IoT provides lot of advantages due to its specification and due to which machine to machine interaction can be possible. If the sensor nodes installed at industries and connected to remote location with help of IoT the pollution at industry can monitor constantly if malfunctioning is detected then necessary action can be taken by passing message immediately to the controlling unit and further problems can be avoided. The complete system is automated and labour cast and time is saved. This IoT system comprises three broad components namely sensors, a processing unit and cloud platform. Sensors collect the information and pass it to processing unit processed information is sent to the cloud for analysis.

II. SYSTEM SETUP

This Section consists of information about hardware and software used to set up the system. Fig. 1 shows the block diagram of the system developed for the implementation.

A. Arduino uno

This is microcontroller used in this research work. Use of sensors alone cannot able to process the data by its own and thus require a processing unit to handle the data efficiently. For the prototype of the system we have used slow speed device and hence the Wi-Fi module to send data over the internet is connected externally to the Arduino board. Arduino Uno board is used for this purpose. After that Arduino check all sensor value. Arduino then process the values and gives the signal to the webpage. This system is based on the Arduino and all the



Fig. 1: Arduino Uno Board

Processing is takes place in Arduino only. Arduino Uno is a microcontroller board based on the ATmega328P It has 14 digital input/output pins 6 analog inputs, a 16 MHz quartz crystal, a USB Connection, power jack, an ICSP header and a reset button

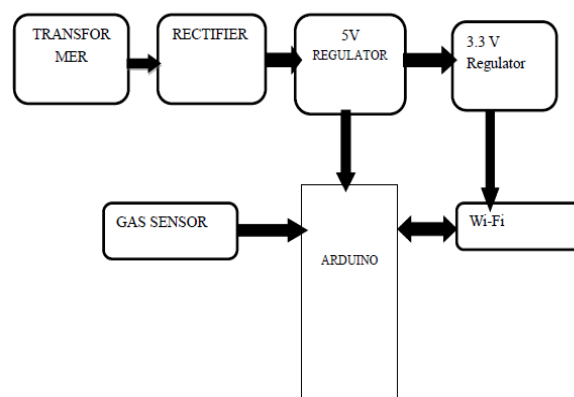


Fig. 1 Block Diagram of Proposed system

B. Sensors

System can detect the harmful gases. This system is new concept which can detect both Air pollution. The sensor we are using here is MQ135 as air sensor. Sensor MQ135 is air quality sensor which is used to detect the harmful gases like NH₃, CO, CO₂ and SO₂. The MQ135 sensor senses the condition and gives the signal to the system.



Fig.2: MQ135 sensor

The air and sound pollution monitoring system consists of Gas sensor (MQ135), Sound sensor, Arduino microcontroller, ESP8266 Wi-Fi module and cloud etc.

Temperature sensor LM35- The LM35 device is rated to operate over a -55°C to 150°C temperature range, while the LM35C device is rated for a -40°C to 110°C range (-10° with improved accuracy).



Fig. 3: LM35 Temperature sensor

C. Wi-Fi Module

ESP8266 is a very low cost Wi-Fi enabled chip. ESP8266 offers a complete and self-contained Wi-Fi networking solution, allowing it to either host the application or to offload all Wi-Fi networking functions from another application processor.



Fig.4: ESP8266 Wi-Fi Module

The ESP8266 is a low-cost Wi-Fi chip with full TCP/IP stack and MCU (microcontroller unit) capability. It runs on 3.3V and gives our system access to Wi-Fi or internet.

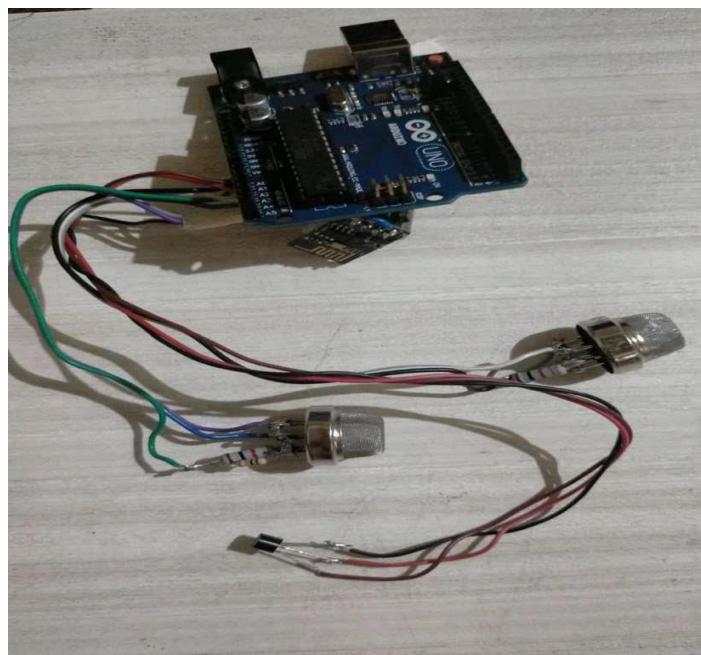


Fig. 5: A Complete Hardware Setup

D. IoT and ThingSpeak

The Internet of Things (IoT) is the internetworking of physical devices, vehicles, buildings and other items embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

III. RESULTS AND DISCUSSION

The MQ135 sensor can sense CO₂ and some other gases, so it is perfect gas sensor for our Air Quality Monitoring Detection System Project. When we connected it to Arduino Board then it senses the gases, and we get the Pollution level in PPM (parts per million). MQ135 gas sensor gives the output in form of voltage levels.



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