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TRAFFIC MANAGEMENT BY MONITORING WEATHER PARAMETERS AND POLLUTANTS REMOTELY BY USING RASPBERRY PI

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Abstract—Clean and fresh air is a basic need for any creature on this planet. The increasing count of motor vehicles mainly in urban areas have become prominent reason for unhealthy environment and causing illness due to pollution. Systematic flow of vehicles will help in reduction of pollution. Use of technology is a solution in handling traffic, sensing pollutants like carbon dioxide and carbon monoxide in the pathway of transit will help in decision making for the traffic authorities as well as to the commuters. The proposed method is a stand-alone IoT system to measure few weather parameters at a dense location with heavy traffic and provide the corresponding live data. The system uses a low-power mini-computer Raspberry Pi fourth generation. The various sensors are used to sense different parameters like temperature, light intensity, carbon dioxide, carbon monoxide and humidity. The data collected by the Raspberry Pi is sent to the cloud and stored which can be viewed by anyone and anywhere at any time. Future measures can be taken using available recorded-data if there are unhealthy readings measured by the system set up at a location.

Keywords— Air pollution, Thingspeak, Raspberry Pi, sensors, Traffic management.

I. INTRODUCTION

Around 1.4 billion people in urban areas are living with air pollution above recommended air quality. According to the reports of the World Health Organization (WHO) and about 7 million people die due to air pollution every year [7]. The uneven rise and fall in weather parameters and pollutants is affecting climatic seasons. This has made people more cautious about air pollution in and around them. The exposure of living creatures to polluted air could cause cardiovascular diseases [13]. And could also cause irritation and infection in respiratory track, bronchitis, lung diseases, asthma [14]. This would result in short life of living beings with painful deaths [15]. The pollution is increasing to the danger level affecting the lifestyle of the people. The mankind across the world is worried about the sudden changes in the climate. To control air pollution first step is to monitor it well. Exponential increase in number of motor vehicles on road is leading to air pollution, contaminating the environment because of harmful gases, particles emitted during combustion. In urban cities there is problem of heavy traffic due to poor management of traffic which results in release of more pollutants and making the air toxic at many locations. Such locations with heavy traffic movement should be on the observatory radar. Meteorological Department has

setup various high-cost weather and air quality monitoring units all over India to measure various weather parameters and pollutants, but each unit is separated by hundreds of kilometres. The existing approach use Arduino along with different set of sensors where a separate component for internet connection is necessary for data transfer to the cloud [7]. The proposed approach is used for Traffic management and also helps in easy traffic movement and keeping the environment clean by less combustion of fuel. The proposed system is used to measure various parameters like temperature, Light intensity, carbon monoxide, carbon dioxide and humidity at selected locations [11]. If the measured values are above safe level, then authorities can take required steps in diverting the traffic through other routes [12]. This helps in traffic management and allows the rider to take the safe healthy route and diverting the traffic results in stabilizing and reversing the various parameters back to safe level. The system helps in having a reasonably good quality of air for the people on the streets and around [13].

This paper is organized into six sections. Section I give the introduction and purpose for making this system.

Section II describes the hardware architecture, description of various components used in the system and the software requirement. Section III contains the explanation of implementation of the proposed system. The real-time results of the system are shown in Section IV. Section V concludes the proposed work. Section VI future scope of the proposed work.

II. SYSTEM DEVELOPMENT

A. Hardware Architecture

Raspberry Pi is the brain of the system which is called as minicomputer. The sensors DHT11, MQ2, and MQ135 are used to measure weather parameters temperature and humidity, light intensity and carbon dioxide. These sensors are connected to the Raspberry Pi through GPIO pins available on the Pi [8].

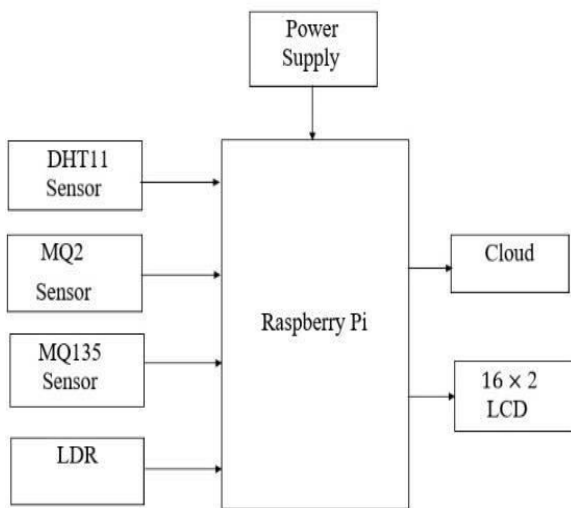


Fig. 1. Block diagram

B. Raspberry Pi

This Raspberry Pi 4 is integrated with a 64-bit quad core cortex- A72 ARM v8, Broadcom BCM2711 and runs at a speed of 1.5GHz. Form Factor: Nano-ITX. The new Raspberry Pi product is equipped with bluetooth 5.0, BLE, gigabit ethernet and has 802.11ac wireless at 2.4GHz and 5GHz. It provides faster data transfer with two USB 3.0 ports, two USB 2.0 ports, micro-SD slot for data storage and loading operating systems.

The Raspberry Pi 4 has 2 micro-HDMI ports (supports 4k@60p), 2 lane MIPI DSI display port, 2 lane MIPI CSI camera port and 4-pole stereo audio and composite video port.

C. Sensors

In proposed system four Sensors are used of which two are air quality sensors, MQ2 and MQ135. Tin

dioxide is used as sensing material in these semiconductor sensors. When monitoring gas comes in contact with the sensor then there occurs a chemical reaction which changes the electrical resistance of the semiconductor. The change in resistance is the proportional to the gas concentration. MQ2 sensor can detect and measure carbon monoxide gas present in the atmosphere. MQ135 sensor detects NH₃, NO_x, alcohol, benzene, smoke, carbon dioxide. Libraries of these sensors have to be installed onto the Pi. DHT11 is a Temperature and humidity sensor. It uses thermistor and capacitive type humidity sensor.

LDR sensor module is a low-cost digital sensor as well as analog sensor module, which is capable to measure and detect light intensity. This sensor also is known as the Photoresistor sensor. This sensor has an onboard LDR (Light Dependent Resistor), that helps it to detect light. The measured digital atmospheric pressure value is sent to Pi through GPIO pin. The sensors used are of low-cost, easy to use and small in size which makes the system size compact [9].

D. Software requirement

The Raspberry Pi needs to be booted with an operating system to make it a stand-alone device. There are many OS available on internet such as NOOBS, Raspbian, Ubuntu, Windows10 IoT core and many others that can be downloaded and installed [10]. The Pi used in the system is installed with Raspbian OS. It is required to download the system updates, library files to use available components on Pi and externally connected components. Python or C programming languages can be used to write the code. The code and the supporting libraries should be placed in a same location.

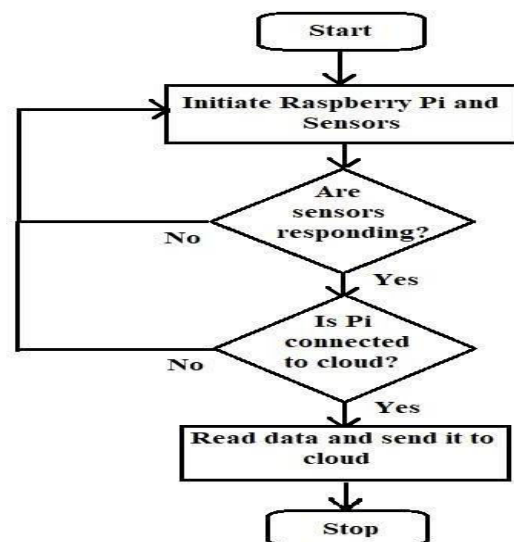


Fig. 2. Flow Chart

E. Cloud

Thingspeak is used as cloud for experimental purpose. It is an IoT platform that serves you to pile up, envision and analyze the real-time data streaming in the cloud. It facilitates to have separate channels to store data received from systems placed in different locations. Each channel has a unique Read and Write Application Program Interface key abbreviated as API key, which are used to fetch and upload data to the channel respectively. The data stored in the cloud can be fetched anytime anywhere on any device shown in Fig.2.

III. PROPOSED SYSTEM

Fig. 3 shows the proposed system. The Raspberry Pi and other components are rigged up using connecting-wires and are powered with compatible external power supply. A display unit is connected to Pi temporarily for programming. Pi is connected to wireless local area network (WLAN) so that it can upload data to the cloud. While writing the code it is necessary to install libraries of all the components onto the Pi. The complete setup without the display unit can be placed in any location, because of its compact size, wherever the experiment has to be carried out. When the system is powered and execution of the program begins, expecting no errors in connection, the sensors start reading the values of parameters which they are meant to and send it to the Pi.

Proposed System helps:

- 1) In measuring weather parameters and pollutants remotely at locations with heavy traffic.
- 2) Commuters to take safe, healthy, less congested routes.
- 3) In managing and routing the traffic flow in systematic way which saves fuel and helps in reduced emission of pollutants.
- 4) Development authorities to look for long term and permanent solution.

IV. EXPERIMENTAL RESULTS

Fig. 4 and Fig. 5 show the real-time recorded results of temperature, humidity, carbon dioxide, carbon monoxide and light intensity, The recorded readings vary timely depending on the weather and on the number of pollutants that are produced during combustion in moving vehicles.

If there is stillness or slowness in the flow of vehicles due to traffic then this causes more emission of pollutants causing readings go high which is evident by the graphs. Same procedure is repeated for different locations to know the number of pollutants emitted during other time intervals in day, as density of vehicles vary from time to time in a day. So the concentration of carbon particles would increase if there is heavy slow-moving traffic,

causing health issues for people travelling regularly by this route.

It was also observed that increase in pollutants was analogous to the weather parameters like temperature and humidity. The measured values of carbon dioxide and carbon monoxide, on an average from the graphs, show that they are within the safe levels. But there are many other locations with heavy traffic the concentration of pollutants, on an average, may go above safe level mark for which the system developed will help to have a clean, fresh and decent air.

The system will help in managing traffic. When the values go beyond safe level mark the authorities could come into action fuel too.

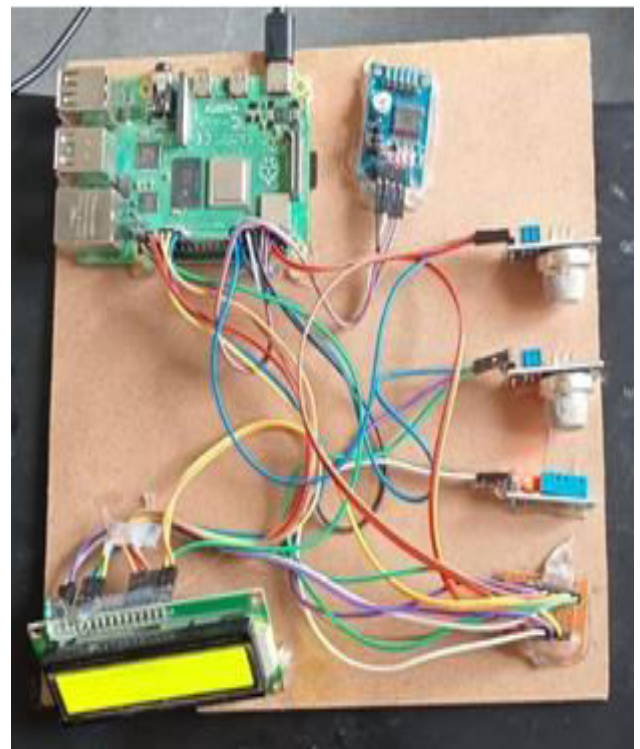


Fig. 3. Weather Parameters and



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Fig. 5. Weather Parameters and Pollutants in Location 2

V. CONCLUSION

A low-cost, reliable, compact, low maintenance system is designed to monitor the various weather parameters and pollutants remotely. The system helps in improving the quality of lives of living creatures and will be a support for 2-tier and 3-tier cities to make them smart in managing the pollution and traffic which are very concerning. The

proposed kind is need of an hour. When such systems are setup around the city then it could be easy to know the safe routes for the movement of public and to cut down the carbon particles in the affected area so that as soon as the values become normal the traffic movement could be restored.

VI. FUTURE SCOPE

IOT weather reporting system has an application to farmers as well. The weather forecasting plays a very important role in the field of agriculture. Global Journal of Engineering and Technology Advances. IOT weather monitoring project proves helpful for monitoring weather at places like a volcano, rain forests. It is quite difficult for a human being to stay for a longer time at such places. Or even areas that are exposed to radioactive leakage. IOT weather monitoring system project using IoT supporting controller is fully automated. It does not require any human attention. You can get a prior alert of the weather conditions. Suppose you are planning to visit a place and you want to know the weather parameters over that place, then you can just visit a website IoT portal.

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