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Internet of Things (IOT) based Weather Monitoring System

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ABSTRACT: The system proposed in this paper is an advanced solution for monitoring the weather conditions at a particular place and make the information visible anywhere in the world. The technology behind this is Internet of Things (IOT), which is an advanced and efficient solution for connecting the things to the internet and to connect the entire world of things in a network. Here things might be whatever like electronic gadgets, sensors and automotive electronic equipment. The system deals with monitoring and controlling the environmental conditions like temperature, relative humidity and CO level with sensors and sends the information to the web page and then plot the sensor data as graphical statistics. The data updated from the implemented system can be accessible in the internet from anywhere in the world.

KEYWORDS*:* Internet of Things (IOT) Embedded Computing System; Arduino Software, ESP8266, Smart Environment.

I. INTRODUCTION

The internet of Things (IOT) is viewed as an innovation and financial wave in the worldwide data industry after the Internet. The IOT is a wise system which associates all things to the Internet with the end goal of trading data and conveying through the data detecting gadgets as per concurred conventions. It accomplishes the objective of keen recognizing, finding, following, observing, and overseeing things. It is an augmentation and extension of Internet-based system, which grows the correspondence from human and human to human and things or things and things. In the IOT worldview, many articles encompassing us will be associated into systems in some shape. It is a current correspondence paradigm that envisions a near future, in which the objects of regular day to day existence will be outfitted with microcontrollers, handsets for computerized correspondence, and reasonable convention stacks that will make them ready to speak with each other and with the clients, turning into a vital piece of the Internet. The IOT idea, consequently, goes for making the Internet much more immersive and unavoidable. Moreover, by empowering simple get to and association with a wide assortment of gadgets, for example, for example, home apparatuses, reconnaissance cameras, checking sensors, actuators, showcases, vehicles, et cetera, the IOT will encourage the advancement of various applications that make utilization of the possibly gigantic sum and assortment of information created by such questions give new Administrations to subjects, organizations, and open organizations. Present innovations in technology mainly focus on controlling and monitoring of different activities. These are increasingly emerging to reach the human needs. Most of this technology is focused on efficient monitoring and controlling different activities. An efficient environmental monitoring system is required to monitor and assess the conditions in case of exceeding the prescribed level of parameters (e.g., noise, CO and radiation levels). When the objects like environment equipped with sensor devices, microcontroller and various software applications becomes a self-protecting and self- monitoring environment and it is also called as smart environment. In such environment when some event occurs the alarm or LED alerts automatically. The effects due to the environmental changes on animals, plants and human beings can be monitored and controlled by smart environmental monitoring system. By using embedded intelligence into the environment makes the environment interactive with other objectives, this is one of the application that smart environment targets. Human needs demands different types of monitoring systems these are depends on the type of data gathered by the sensor devices. Event Detection based and Spatial Process Estimation are the two categories to which applications are classified. Initially the sensor devices are deployed in environment to detect the parameters (e.g., Temperature, Humidity and CO etc.) while the data acquisition, computation and controlling action (e.g., the variations in the temperature and CO levels with respect to the specified levels).

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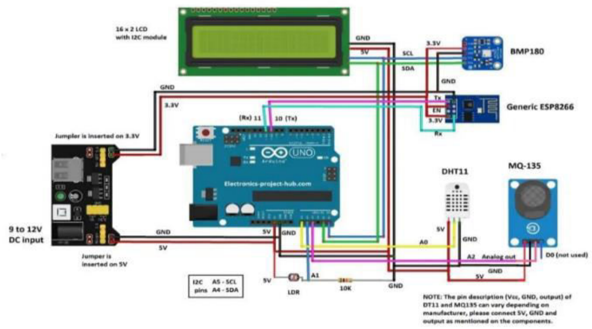
Sensor devices are placed at different locations to collect the data to predict the behavior of a particular area of interest. The main aim of the this paper is to design and implement an efficient monitoring system through which the required parameters are monitored remotely using internet and the data gathered from the sensors are stored in the cloud and to project the estimated trend on the web browser. A solution for monitoring the temperature, humidity and CO levels i.e., any parameter value crossing its threshold value ranges, for example CO levels in air in a particular area exceeding the normal levels etc., in the environment using wireless embedded computing system is proposed in this paper. The solution also provides an intelligent remote monitoring for a particular area of interest. In this paper we also present a trending results of collected or sensed data with respect to the normal or specified ranges of particular parameters. The Embedded system is an integration of sensor devices, wireless communication which enables the user to remotely access the various parameters and store the data in cloud.

II. PROPOSED CIRCUIT DIAGRAM FOR IOT BASED WEATHER MONITORING SYSTEM:



- **The above circuit consists of the following modules:**

  - 5V / 3.3V Power supply regulator.
  - Arduino Uno.
  - 16 x 2 display with I2C adapter module.
  - DHT11 temperature & humidity sensor.
  - MQ-135 sensor air quality sensor
  - BMP180 – Barometric sensor.
  - Light depend resistor (LDR).
  - Generic ESP8266 Wi-Fi module.

The implemented system consists of a microcontroller (ESP8266) as a main processing unit for the entire system and all the sensor and devices can be connected with the microcontroller. The sensors can be operated by the microcontroller to retrieve the data from them and it processes the analysis with the sensor data and updates it to the internet through Wi-Fi module connected with it.

- **Block Diagram**

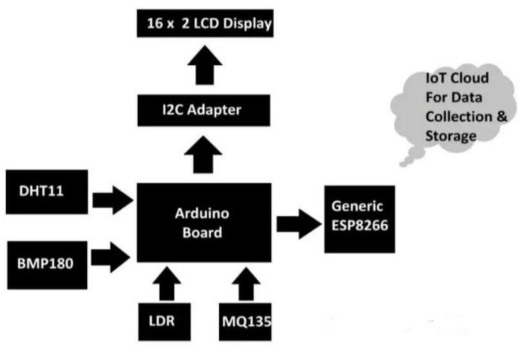


Fig. 1 Block Diagram of the Project

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- **Wi-Fi Module**

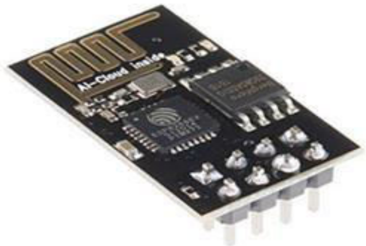

Fig 2.ESP8266

Here we used ESP8266 Wi-Fi module which is having TCP/IP protocol stack integrated on chip. So that it can provide any microcontroller to get connected with Wi-Fi network. ESP8266 is a preprogrammed SOC and any microcontroller has to communicate with it through UART interface. It works with a supply voltage of 3.3v. The module is configured with AT commands and the microcontroller should be programmed to send the AT commands in a required sequence to configure the module in client mode. The module can be used in both client and server modes.

- **Sensors:**

The system consists of temperature and humidity sensor (DHT 11) and CO sensor (MQ 6). These 2 sensors will measure the primary environmental factors temperature, humidity and the CO levels. All this sensors will gives the analog voltage representing one particular weather factor. The microcontroller will converts this analog voltage into digital data.

- **Temperature sensor and humidity sensor:**

The DHT11 is an essential, ultra-minimal effort computerized temperature and humidity sensor.

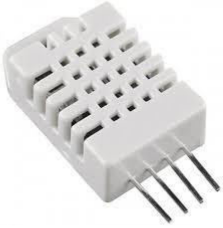

Fig. 3 Temperature and Humidity Sensor DHT 11

It utilizes a capacitive humidity sensor and a thermistor to gauge the surrounding air, and releases a digital data on the data pin (no analog information pins required). The main genuine drawback of this sensor is you can just get new information from it once every 2 seconds, so when utilizing our library, sensor readings can be up to 2 seconds old. It works on 3 to 5V power supply. Good for 20- 80% humidity readings with 5% accuracy and for 0-50°C temperature readings ±2°C accuracy.

- **Carbon Monoxide (CO) sensor:**

Carbon Monoxide (CO) sensor, suitable for sensing CO concentrations in the air.

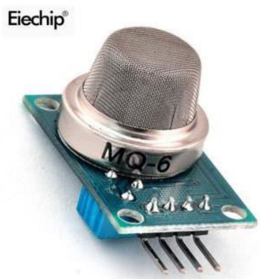

Fig. 4 Carbon Monoxide (CO) sensor MQ 6

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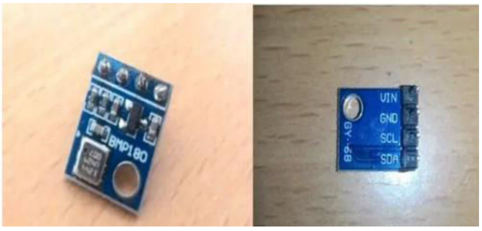
Carbon monoxide sensor, suitable for sensing CO concentration in air. The MQ-6 can sense CO-gas concentration somewhere in the range of 20 to 2000ppm. This sensor has a high affectability and quick reaction time. The sensor's yield is analog resistance. The drive circuit is exceptionally straightforward; you should simply control the heater curl with 5V, include a load resistance, and associate the output to an ADC. The standard reference strategy for the estimation of carbon monoxide concentration in air depends on the ingestion of infrared radiation by the gas in a no dispersive photometer. This technique is reasonable for stable establishments at fixed site monitoring stations. All the more as of late, convenient carbon monoxide analyzers with data- logging have turned out to be accessible for individual presentation observing. These estimations depend on the electrochemical responses between carbon monoxide and de- ionized water, which are detected by exceptionally planned sensors. These days the determination, strength and affectability of the electrochemical analyzers are inside the details of the reference technique and, together with the data.

- **BMP180 barometric sensor:**



The above illustrated module is a barometric sensor which is capable of measuring atmospheric data; it can give out data like, atmospheric pressure at ground level, atmospheric pressure at sea level and altitude.

- **Light depend resistor – LDR:**

LDR is responsible for collecting data about the intensity of light at your surroundings and it is a passive analog sensor.

The LDR is essentially a resistor that is sensitive to the light, when higher intensity light falls on the photosensitive surface its resistance drops and when less light is received its resistance increases.

In other words, the resistance is inversely proportional to the intensity of the light on the photosensitive surface of LDR.

This concludes all the modules and sensors used in the circuit systems, they fit into a little rucksack or even a.

- **Conversion factors:**

1 ppm= 1.145 mg/m3
1 mg/mg = 0.873 ppm

- **Thing Speak:**

According to its developers, "Thing Speak" is an open source Internet of Things (IOT) application and API to store and retrieve data from things using the HTTP protocol over the Internet or via a Local Area Network. Thing Speak enables the creation of sensor logging applications, location tracking applications, and a social network of things with status updates".
Thing Speak has integrated support from the numerical computing software MATLAB from Math Works allowing Thing Speak users to analyze and visualize uploaded data using mat lab without requiring the purchase of a mat lab license from Math works.

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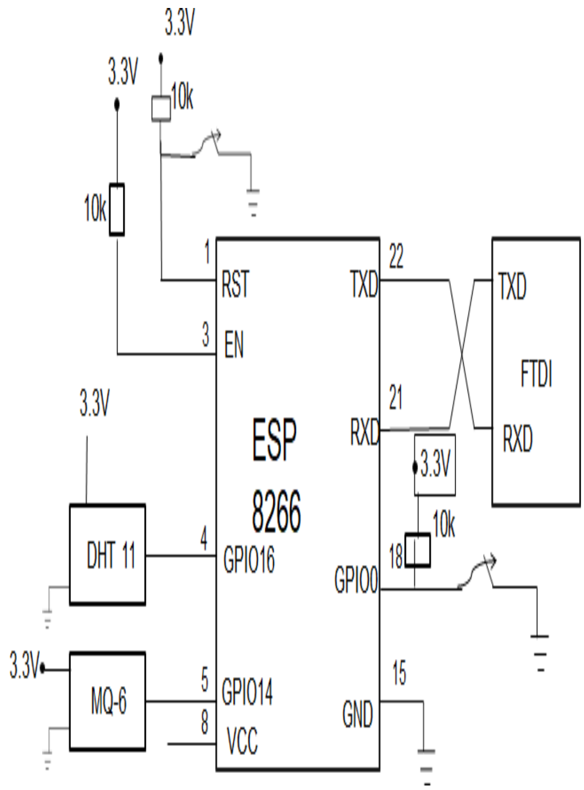

Fig. 5 Circuit Diagram of the system

III. SIMULATION RESULTS

After sensing the data from different sensor devices, which are placed in particular area of interest. The sensed data will be automatically sent to the web server, when a proper connection is established with sever device. The web server page which will allow us to monitor and control the system. The web page gives the information about the temperature, humidity and the CO level variations in that particular region, where the embedded monitoring system is placed. The sensed data will be stored in cloud (Google Spread Sheets). The data stored in cloud can be used for the analysis of the parameter and continuous monitoring purpose. The temperature and humidity levels and CO levels in air at regular time intervals. All the above information will be stored in the cloud, so that we can provide trending of temperature and humidity levels and CO levels in a particular area at any point of time.

IV. CONCLUSION

By keeping the embedded devices in the environment for monitoring enables self-protection (i.e., smart environment) to the environment. To implement this need to deploy the sensor devices in the environment for collecting the data and analysis. By deploying sensor devices in the environment, we can bring the environment into real life i.e. it can interact with other objects through the network. Then the collected data and analysis results will be available to the end user through the Wi-Fi. The smart way to monitor environment and an efficient, low cost embedded system is presented with different models in this paper. In the proposed architecture functions of different modules were discussed. The temperature, humidity and CO value can be monitored with Internet of Things (IOT) concept experimentally tested for monitoring three parameters. It also sent the sensor parameters to the cloud (Google Spread Sheets). This data will be helpful

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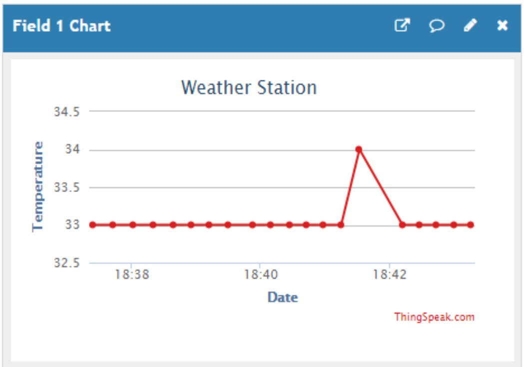

Fig.6 (a) Simulation of Temperature v/s Time

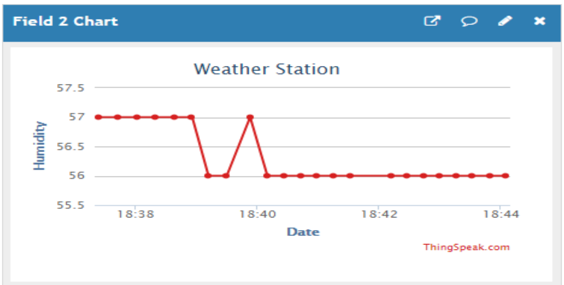

Fig.6 (b) Simulation of Humidity v/s Time

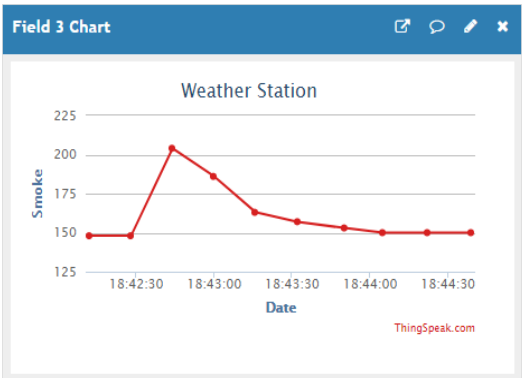

Fig.6(c) Simulation of Smoke content v/s Time

V. FUTURE SCOPE

One can implement a few more sensors and connect it to the satellite as a global feature of this system. Adding sensors to monitor other environmental parameters such CO2, Pressure and Oxygen Sensor. In aircraft, navigation and the military there is a great scope of this real-time system. It can also be implemented in hospitals or medical institutes for the research & study in "Effect of Weather on Health and Diseases", hence to provide better precaution alerts.

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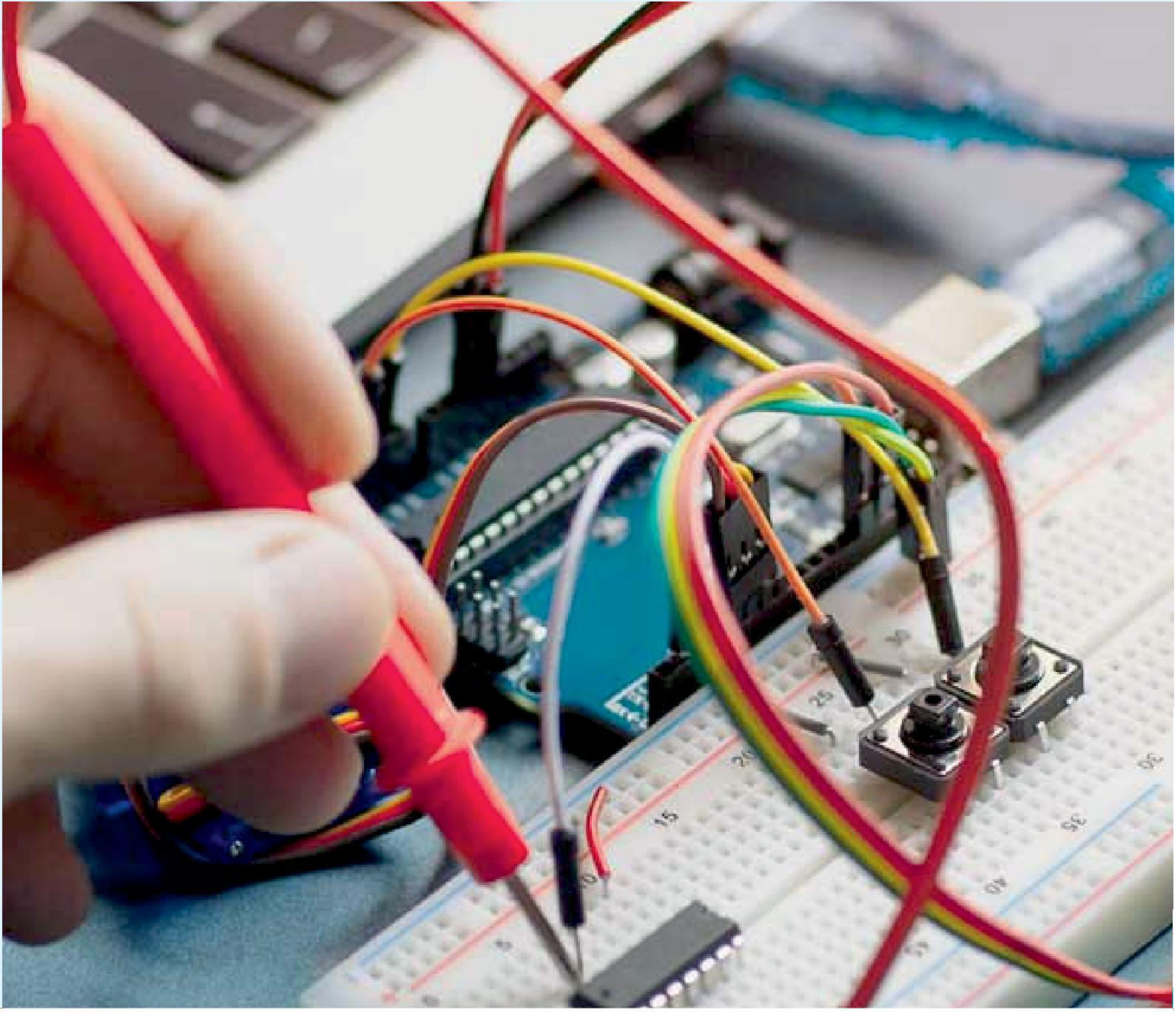

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