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Weather monitoring and alert system using IoT

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Abstract –The system proposed is an advanced solution for weather monitoring that uses IoT to make its real time data easily accessible over a very wide range. The system deals with monitoring weather and climate changes like temperature, humidity, wind speed, moistureand even carbon monoxide levels in the air; using multiple sensors. These sensors send the data to the web page and the sensor data is plotted as graphical statistics. The data uploaded to the web page can easily be accessible from anywhere in the world. The data gathered in these web pages can also be used for future references. The project even consists of an app that sends notifications as an effective alert system to warn people about sudden and drastic weather changes.This project can be of great use to meteorological departments, weather stations, aviation and marine industries and even the agricultural industry.

Key words: Internet of Things (IoT), ThingSpeak, NodeMcu

1.INTRODUCTION

In thsesday innovations in technology mainly focus on controlling andmonitoring of different devicesover wirelessly over the internet such thatthe internet behaves as a medium for communication between all thedevices.Most of this technology is focused onefficient monitoring and controlling ofdifferent devices.An efficient environmental monitoring system is requiredtomonitor and assess the weather conditions in caseof exceeding theprescribed level of parameters (CO concentration and Humidity levels).A system is considered as a smart system when the device equipped withsensors, microcontrollers and various software applications and becomes aselfprotectingand self monitoring system.

When the objects like environment equipped with sensor devices, microcontroller andvarious 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.

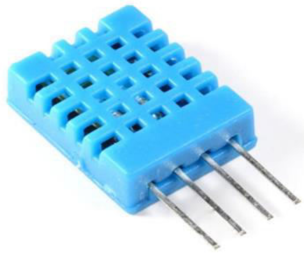
Initially the sensor devicesare deployedin environment to detect the parameters (e.g., Temperature, Humidity,Pressure, LDR, noise, CO and radiation levels etc.) while the dataacquisition, computation and controlling action (e.g.,the variations in thenoise and CO levels with respect to the quantified levels). Sensor devices arepositioned at different locations to collect the data toforecast the behavior ofa particular area of interest. The main aim of this paper is to design andimplement a resourceful weather monitoring system throughwhich the requiredparameters are monitoredremotely using internet and the data gathered fromthe devices are stored in the cloud and to project the predictable trend on theweb browser. 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.

2.SYSTEM OVERVIEW

The implemented system consists of a Node Mcu which is used as the main processing unit for the entire system and all the sensor and devices can be connected with this microcontroller board. The sensors can be operated by theNode Mcu to retrieve the data from them and it processes that data. Let us discuss about the sensors and board used in our model one by one.

DHT 11: The DHT11 is a commonly used Temperature and humidity sensor. The sensor comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data. The sensor is also factory calibrated and hence easy to interface with other microcontrollers.

The sensor can measure temperature from 0°C to 50°C and humidity from 20% to 90% with an accuracy of ±1°C and ±1%.

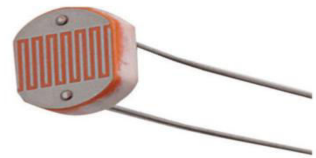


DHT11 Humidity Sensor consists of 4 pins: VCC, Data Out, Not Connected (NC) and GND. The range of voltage for VCC pin is 3.5V to 5.5V. A 5V supply would do fine. The data from the Data Out pin is aserial digital data.

MQ 7:Carbon monoxide (CO) is a very dangerous gas which is odorless, colorless, and tasteless, so it cannot be smelt, seen, or tasted. CO is measured in parts per million (ppm).This Carbon Monoxide (CO) gas sensor MQ 7 detects the concentrations of CO in the air and outputs its reading as an analog voltage. The sensor can measure concentrations of 10 to 10,000 ppm.The sensor can operate at temperatures from -10 to 50°C and consumes less than 150 mA at 5 V.

There are four pins in this sensors:+5V, AOUT, DOUT, and GND.The +5V and GND leads establishes power for the alcohol sensor.The other 2 leads are AOUT (analog output) and DOUT (digital output). How the sensor works is the terminal AOUT gives an analog voltage output in proportion to the amount of carbon monoxide the sensor detects. The more CO it detects, the greater the analog voltage it will output. Conversely, the less CO it detects, the less analog voltage it will output. If the analog voltage reaches a certain threshold, it will send the digital pin DOUT high. Once this DOUT pin goes high, the arduino will detect this and will trigger the LED to turn on, signaling that the CO threshold has been reached and is now over the limit. How you can change this threshold level is by adjusting the potentiometer to either raise or lower the level.

LDR: A Light Dependent Resistor (LDR) is also called a photoresistor or a cadmium sulfide (CdS) cell. It is also called a photoconductor. It is basically a photocell that works on the principle of photoconductivity. The passive component is basically a resistor whose resistance value decreases when the intensity of light decreases. This optoelectronic device is mostly used in light varying sensor circuit, and light and dark activated switching circuits. Some of its applications include camera light meters, street lights, clock radios, light beam alarms, reflective smoke alarms, and outdoor clocks.



Light intensity was measured by using a resistor in series with each LDR making a voltage dividing circuit as shown in Fig. 6. Whenever the intensity of light on LDR changes, its resistance and hence the output voltage are changed; change in intensity is translated into a change in voltage.

Node Mcu: NodeMCU is an open source firmware for which open source prototyping board designs are available. The name "NodeMCU" combines "node" and "MCU" (micro-controller unit).[8]. The term "NodeMCU" strictly speaking refers to the firmware rather than the associated development kits.Both the firmware and prototyping board designs are open source.

The firmware uses the Lua scripting language. The firmware is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjsonand SPIFFS. Due to resource constraints, users need to select the modules relevant for their project and build a firmware tailored to their needs. Support for the 32-bit ESP32 has also been implemented.

The prototyping hardware typically used is a circuit board functioning as a dual in-line package (DIP) which integrates a USB controller with a smaller surface-mounted board containing the MCU and antenna. The choice of the DIP format allows for easy prototyping on breadboards. The design was initially was based on the ESP-12 module of the ESP8266, which is a Wi-Fi SoC integrated with a Tensilica Xtensa LX106 core, widely used in IoT applications.

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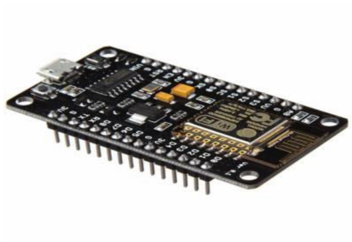


ThingSpeak:It is a platform providing various services exclusively targeted for building IoT applications. It offers the capabilities of real-time data collection, visualizing the collected data in the form of charts, ability to create plugins and apps for collaborating with web services, social network and other APIs.The core element of ThingSpeak is a 'ThingSpeak Channel'. A channel stores the data that we send to ThingSpeak and comprises of the below elements:

- 8 fields for storing data of any type - These can be used to store the data from a sensor or from an embedded device.
- 3 location fields - Can be used to store the latitude, longitude and the elevation. These are very useful for tracking a moving device.
- 1 status field - A short message to describe the data stored in the channel.

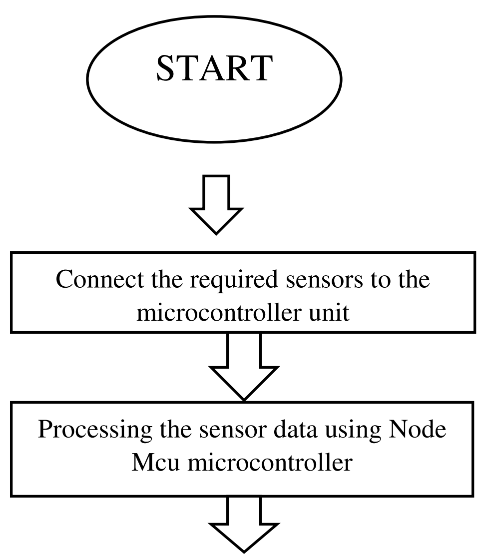
Rain sensor:-A rain sensor or rain switch is a switching device activated by rainfall. There are two main applications for rain sensors. The first is a water conservation device connected to an automatic irrigation system that causes the system to shut down in the event of rainfall. The second is a device used to protect the interior of an automobile from rain and to support the automatic mode of windscreen wipers. An additional application in professional satellitecommunications antennas is to trigger a rain bloweron the aperture of the antenna feed, to remove water droplets from the mylar cover that keeps pressurized and dry air inside the wave-guides.

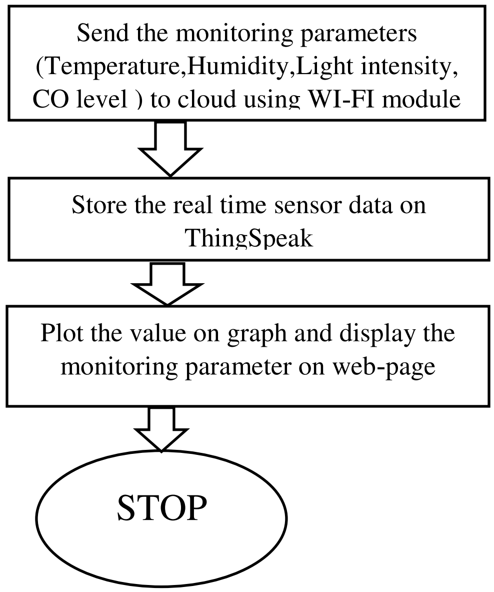
The rain sensor module/board is shown below. Basically, this board includes nickel coated lines and it works on the resistance principle. This sensor module permits to gauge moisture through analog output pins & it gives a digital output while moisture threshold surpasses.

SIM800l:-

The SIM800L module supports quad-band GSM/GPRS network, available for GPRS and SMS message data remote transmission. The SIM800L communicates with microcontroller via UART port, supports command including 3GPP TS 27.007, 27.005 and SIMCOM enhanced AT Commands.

3.FLOW CHART





4.OPERATION

To operate this proposed model successfully our first challenge was to gather the various data related to weather constraint. For this we used various sensors like DHT 11 for measuring temperature and humidity, MQ7 for measuring CO (Carbon Monoxide) concentration present in atmosphere and LDR sensor to detect the intensity of light at particular time.

Based on the framework we have identified a suitable implementation model that consists of differentsensor devices and other modules. In this implementation model we use a NodeMCU for sensing and storing the data in cloud. Inbuilt ADC and Wi-Fi module attaches the embedded device to internet. Sensors are connected to

5.RESULTS

NodeMCU board for monitoring, ADC will convert the corresponding sensor reading to its digital value and from that value the corresponding environmental parameter will be evaluated.

In our case we have used Node Mcu as microcontroller board because it doesn’t need external interface for WiFi module instead it has inbuilt ESP8266. When signal comes from sensors to this board then it processes those signal and display that in desired format like temperature in degree celcius or gas in ppm. Of course to convert the analog signal in this format would required certain kind of algorithm and programming. The advantage of using Node Mcu is that it runs on the program which can be compiled on Arduino IDE.

While writing the sketch for module there are two main task that has to be accomplished one is to write the code for reading the sensor data and another is to sending these data on cloud in real time mode. A particular kind of algorithm is applied in case of each sensor to read its analog value and then process it to convert it into digital mode then display that digital data in desired format.

Once this data is collected our main task remains to send it to cloud. Here comes the role of ThingSpeak. It provides not only the cloud space but also gives a platform where one can display, analyze, visualize their data and can share it publicly. For this it provides each user an unique API key which they have to use while writing the code for data uploading. In that code we also have to mention the SSID and Password of local wireless internet connection. Data is sent on ThingSpeak by means of using the local internet connection and that unique API key. The data is sent on real time mode, while it is on user that on what interval they want to update data on cloud. ThingSpeak also provide the feature to keep your data private and as well as to share it publicly.

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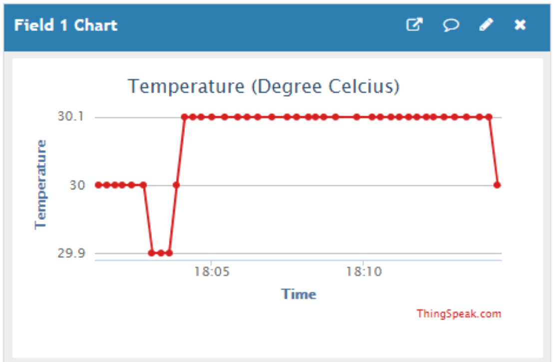

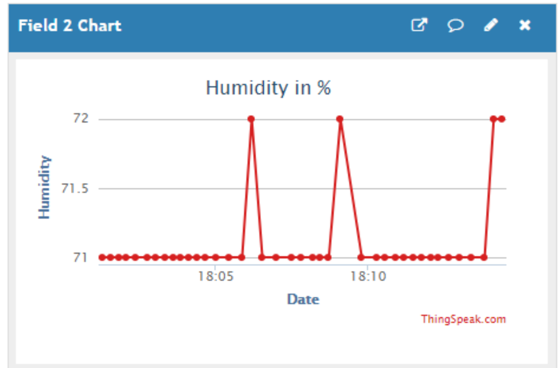

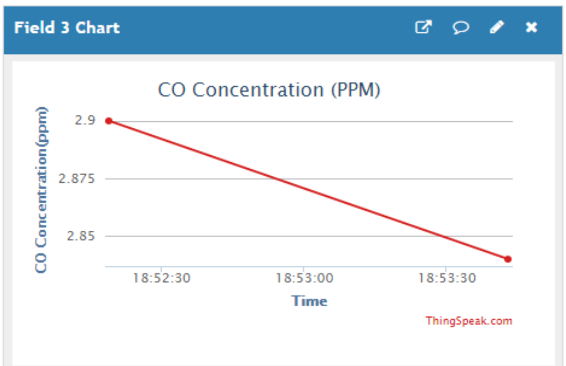

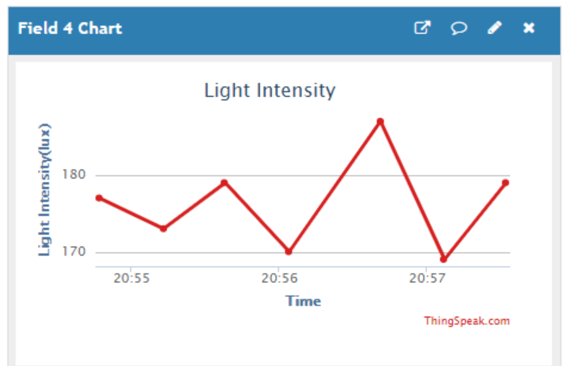

6.CONCLUSION

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 it will record real time data. It can cooperate 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 entrenched system is presented with different models in this paper. In the proposed architecture purposes of different modules were discussed. The noise and air pollution monitoring system with Internet of Things (IoT) concept experimentally tested for monitoring two parameters. It also sent the sensor parameters to the cloud . This datawill be cooperative for future analysis and it can be easily shared to other end users. This model can be further expanded to monitor the developing cities and manufacturing zones for pollution monitoring. To protect the public health from pollution, this model provides an efficient and low cost solution for unceasing monitoring of environment

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