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, light intensity 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 UNO; Arduino Software, ESP8266, Smart Environment.

1. Introduction: A personal weather station is a set of weather measuring instruments operated by a private individual, club, association, or business (where obtaining and distributing weather data is not a part of the entity's business operation).

Personal weather stations have become more advanced and can include many different sensors to measure weather conditions. These sensors can vary between models but most measure outdoor and indoor temperatures, outdoor and indoor humidity, barometric pressure etc. The quality, number of instruments, and placement of personal weather stations can vary widely, making the determination of which stations collect accurate, meaningful, and comparable data difficult. There are a comprehensive number of weather sensor devices are placed at different locations to collect the data to predict the behavior.

There are a comprehensive number of weather sensor devices will be used in this process. 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. The system is basically integration on the sensor devices, wireless communication which enable the user to remotely access the various parameters for their own purpose.

2. Literature Review: Weather forecasting stations are systems that allow forecasting of daily, weekly or monthly weather conditions. These systems, which are used by meteorology in our country, can be both difficult and costly for individual use. Smart weather stations are being developed that can be used individually in order to get rid of such problems. In [1], a smart weather station has realized for the monitoring of weather conditions when changing during the day. The data that received from the temperature, humidity, pressure and rain sensors in the air station, are processed by an Arduino-based processor and then estimated weather information has been given to users. The study results have been compared with results obtained from meteorology and the results have been seen to be close to each other.

Furthermore, weather forecasts serve to incline individual behaviors and interactions, commercial intentions and organizational efforts. A normal user is usually indifferent to weather statistics and corresponding value predictions but obtains an approximate idea from the average weather conditions. Forecasts justifying overall conditions for a duration which is usually rely on previous observations. Correspondingly, they extend the probability of inducing incorrect predictions as relatively insignificant variations consequently compound to substantial errors. As such, long term predictions are usually limited and unreliable. An attempt to bridge this gap has been made in [2] by adopting a range specific approach to a probabilistic markov model (PMM). To develop a certainty in availability, we employ a cloud server to house for the analytics. We have achieved a considerable rise in accuracy in the results, along with a simplistic convenience for the user as compared to other available state-of-the-art methods.

In [3] , the authors have developed and tested a hardware module based on Arduino Uno Board and Zigbee wireless technology, which measures the meteorological data, including air temperature, dew point temperature, barometric pressure, relative humidity, wind speed and wind direction. This information is received by a specially designed application interface running on a PC connected through Zigbee wireless link. The proposed system is also a mathematical model capable of generating short time local alerts based on the current weather parameters. It gives an on line and real time effect. We have also compared the data results of the proposed system with the data values of Meteorological Station Chandigarh and Snow & Avalanche Study Establishment Chandigarh Laboratory.

A weather station can be described as an instrument or device, which provides us with the information of the weather in our neighbouring environment. For example it can provide us with details about the surrounding temperature, barometric pressure, humidity, etc. In [4], the authors havce developed a device that basically

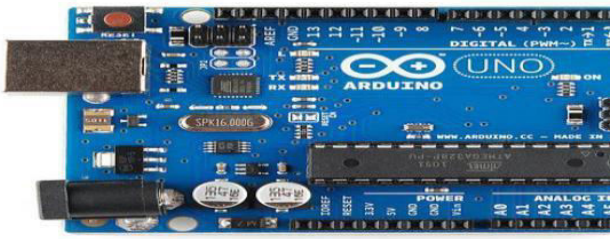
senses the temperature, pressure, humidity, light intensity, rain value. There are various types of sensors present in the prototype, using which all the aforementioned parameters can be measured. It can be used to monitor the temperature or humidity of a particular room/place. With the help of temperature and humidity other parameters have been calculated, such as the dew point. In addition to the above mentioned functionalities, light intensity can be monitored as well. Furthermore, the atmospheric pressure of the room has also been monitored and the true rain value can be determined as well. The brain of the prototype is the ESP8266 based Wi-fi module Nodemcu (12E). Four sensors are connected to the NodeMCU namely temperature and humidity sensor(DHT11), pressure sensor(BMP180), raindrop module, and light dependent resistor(LDR).

In recent times it is seen that the climatic and weather conditions not only in India but also in other countries have become uncertain and unpredictable, which may have devastating effects on the agriculture production. India being an agricultural country, most of the farmers largely rely on monsoons and agricultural production is weather dependent. The environmental factors like temperature, humidity, moisture, precipitation and many other parameters keep on changing rapidly and unpredictably. This unpredictable nature, variability of climatic or weather conditions makes the life of farmers quite miserable as they are unable to take proper decisions at the right time. Thus, it is the need of the hour to have a real-time, local weather station.

3. System Architecture: 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.

(A). Arduino: Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board. The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board -- you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.Below is the diagram of arduino uno

board.



(B). BMP180: BMP180 is a high precision sensor designed for consumer applications. Barometric Pressure is nothing but weight of air applied on everything. The air has weight and wherever there is air its pressure is felt. BMP180 sensor senses that pressure and provides that information in digital output.

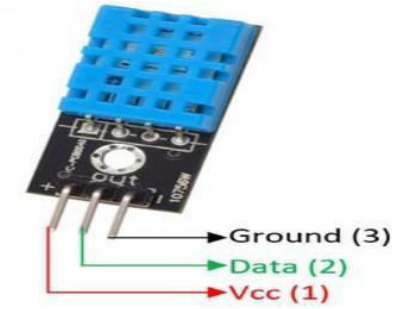
- **SCL:** Serial Clock pin (I2C interface
- **SDA:** Serial Data pin (I2C interface)
- **GND:** Connected to ground
- **VCC:** Connected to +5V
- **3.3V:** If +5V is not present.

Below is the figure present of BMP180.

(C). DHT11: It 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.

- **VCC:** Power supply 3.5V to 5.5V
- **DATA:** Outputs both Temperature and Humidity through serial Data
- **GROUND:** Connected to the ground of the circuit

In figure shows the diagram of DHT11.



(D). LDR: The Light Dependent Resistor (LDR) is just another special type of Resistor and hence has no polarity. Meaning they can be connected in any direction. They are breadboard friendly and can be easily used on a perf board also. The arrows indicate the light signals.

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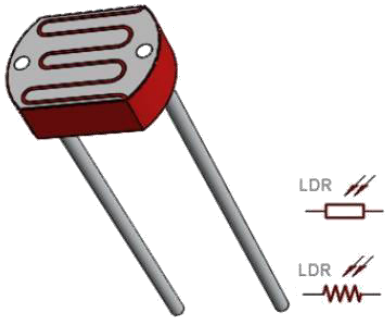
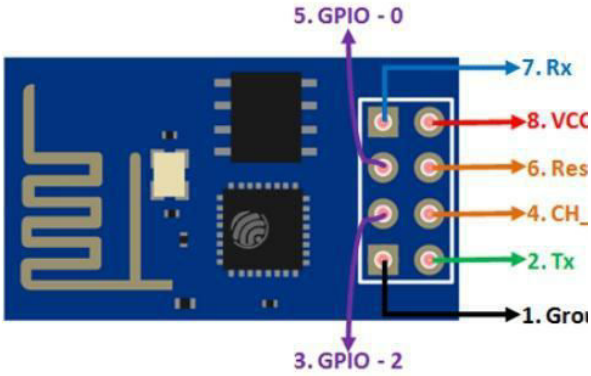
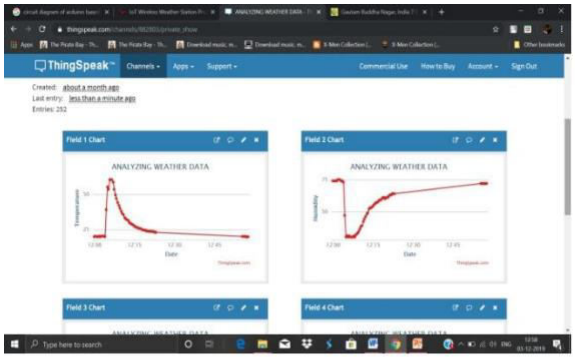
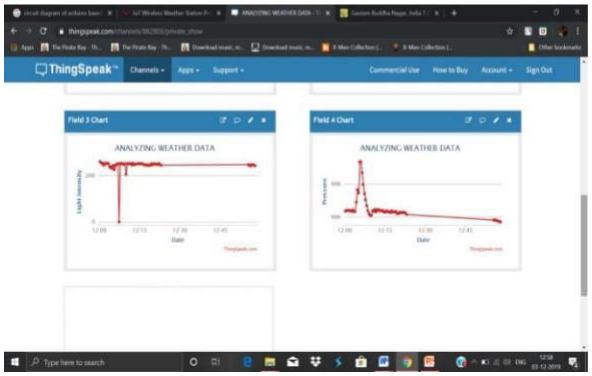


(E). ESP8266 WIFI MODULE: The ESP8266 is a very user friendly and low cost device to provide internet connectivity to your projects. The module can work both as a Access point (can create hotspot) and as a station (can connect to Wi-Fi), hence it can easily fetch data and upload it to the internet making Internet of Things as easy as possible.



(F). 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 MathWorks allowing Thing Speak users to analyze and visualize uploaded data using Matlab without requiring the purchase of a Matlab license from Mathworks.



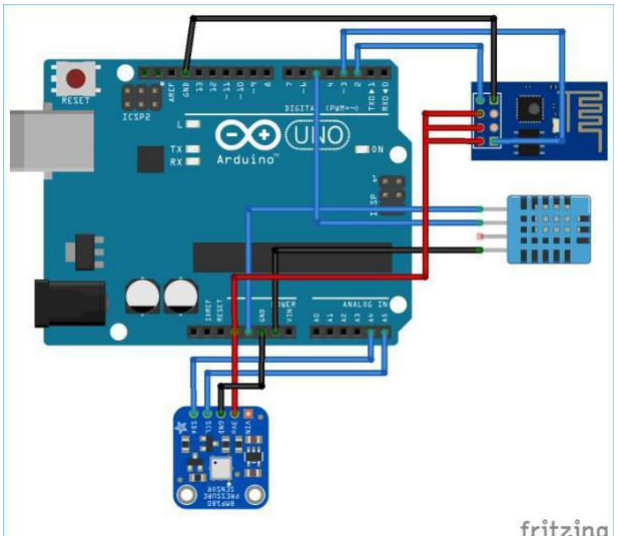


(G). Circuit Diagram: Here we are attaching image of schematic for personal weather station. Connections are fairly simple.

- BMP180 connects to A4 and A5 of arduino uno.
- LDR is connected in voltage divider

fashion with 10 KOhm resistor and junction is connects to A1 pin of arduino uno.

- DHT11 is connected to pin number 2 of arduino uno.
- ESP8266 wifi module is connected to RX and TX.
- Input of buck based converter circuit comes from 12V-2A wall adapter whichalso connects to Vin and Gnd of **Arduino uno**



4. CONCLUSION:

In this era of global warming, research in weather measurement, monitoring and forecasting are becoming more and more relevant; getting the latest weather forecast and taking the necessary precaution have become a major issue all over the world.

Weather monitoring plays an important role in human life, so the collection of information about the temporal dynamics of weather changes is very paramount.

This research demonstrates the design and Implementation of an affordable mini weather monitoring system that ensures flexibility, portability, scalability and user friendly operations which can provide data of some weather variables including temperature, humidity, and pressure.

5. REFRENCES:

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