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**International Journal of Research Publication and Reviews**

Journal homepage: www.ijrpr.com ISSN 2582-7421

# IOT BASED WEATHER FORECASTING SYSTEM USING ARDUINO BOARD

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**ABSTRACT**

The Internet of Things (IoT) is a modern innovation in today's world of the Internet, establishing an interconnection between devices and individuals and exchanging information through a shared platform. This project proposes a low-cost weather station based on IoT that can provide critical weather information in real time, such as temperature, humidity, pressure & altitude. The use of low- cost but reliable controllers from ESP8266 and Arduino UNO makes it accessible for a wide range of clients. The availability of information on a ThingSpeak web server guarantees the authorized person to access data from anywhere in the world. The DHT11 digital temperature and humidity sensor is used for the measurement of temperature and humidity. The BMP180 barometric pressure sensor is used for the measurement of pressure and altitude. With the aid of a circuit, all weather data was de-bounced, and this de-bounced data was uploaded directly to the ThingSpeak server. This proposed design will solve the problem of the unavailability of weather information at different locations. Low-cost design, while ensuring reliableand accurate measurements, will encourage the use of the proposed design in many research and educational institutions as well.

***Keywords***: *Internet of Things (IoT), Arduino UNO, Temperature, Humidity, Pressure, Altitude, ESP8266 WiFi module, ThingSpeak, DHT11, BMP180.*

## 1. INTRODUCTION

People since nineteenth century became able to predict the environmental conditions. The only difference between the primitive and the modern system is that the advancement of technology. The measuring instrument has become miniaturized, efficient, reliable and more accurate to provide instant weather report without manpower. Weather being a natural phenomenon always change with the change of different atmospheric parameters. Still, the average or mean condition can be predicted which ultimately gives the climate of a geographical area for a long-time consideration. The most important parameters that affect the atmospheric conditions are air pressure, temperature and humidity. All these parameters are subject to change with change of altitude, day length (intensity of sunlight changes), environmental components (tropical zone, or temperate zone etc.), sun angle at particular spot etc.

In modern system of weather forecasting, the environmental data are sent to a computer-based system through a Data Acquisition Systems (DAS). Multiple parameters are multiplexed and finally proceeding through a single channel to the computer to show the data. For Broadcasting, the data taken by the sensors are recorded in IoT based system which communicates through wireless data transmission system.

**NECESSITY**

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., temperature, humidity and pressure 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 applications that smart environment targets. Human need demands different types of monitoring systems these aredepends on the type of data gathered by the sensor devices.

The weather station is a hub to provide weather information and forecast the weather conditions by analyzing the climate data with the help of various technical methods. A weatherstation offers valuable weather information about a region or community on a regular basis and enables one to research the climate of that region.Many industries, such as irrigation, aviation, hydrometeorology, climate research, need to know the phenomena of weather and calamity from time to time.

**OBJECTIVE**

The aim of weather monitoring system is to detect, record and display various weather parameters such as temperature, humidity, pressure and altitude. This system makes use of sensors for detecting and monitoring weather parameters and then this collected information is sent to the cloud which can be accessed using the internet. The data displayed as an output can be observed and forecasted. The system engages an Arduino UNO board, sensors, WIFI Module which sends data to cloud computing services. A web page is also created which exhibits the data and displays it to users.

## 2. LITERATURE REVIEW

Weather Monitoring System Using Arduino Uno, by Vaishnavi Gotmare, Rajesh Kolte, Rutwik Thengodkar [1]. This project presents a design of weather monitoring system. It stores data collected at some pre-determined sampling interval, with date and time stamps for later retrieval with real-time notifications for supervision and analysis of different environmental parameters like temperature, humidity, atmospheric pressure, wind speed, wind direction, air quality, light intensity, amount of rainfall and co-ordinates of the location. It consists of an Arduino UNO (micro-processor) which acts as a gateway to collect data and information through different probes

Weather Forecasting using Arduino Based Cube-Sat, by M. Rahaman Laskar, R. Bhattacharjee, M. Sau Giri and P. Bhattacharya [2]. They have designed an autonomous small cube satellite which provides the weather information without using any internet network. The limitations of this system are that it may not communicate to a long distance without powerful transceivers section, there may be problem in recording data at higher altitude with the help of gas balloon. The components have no protection from rain so they may get damaged even due to long time use.

Arduino Based Weather Monitoring System by Jitendra Singh, Rehan Mohammed, Mradul Kankaria, Roshan Panchal, Sachin Singh, Rahul Sharma [3]. They have presented an automated system for weather monitoring which uses different sensors like DHT11, Light dependent resistor and Rain sensor.

Implementation of Weather Monitoring System by Kiranmai Nandagiri and Jhansi Rani Meetu [4]. The authors have proposed a system which senses the temperature and humidity of a particular room. The system cannot be operated from anywhere and the data collected is not accessible.

Wireless Arduino Based Weather Station by Amber Katyal, Ravi Yadav, Manoj Pandey [5]. The authors have described a system with Arduino which functions using a Wi-Fi shield and different sensors like DHT11, BMP 185, Rain sensor, soil moisture sensor, etc. They used ThingSpeak in order to use MATLAB to get knowledge from the information obtained from the readings on the server.

Design of Weather Monitoring System Using Arduino Based Database Implementation by Sarmad Nozad Mahmood Forat Falih Hasan [6]. The R language is used to evaluate results and reveal outputs. They have setup a control unit which can operate other appliances like a.c, heater, fans etc.

## 3. SYSTEM MODELLING

### INTRODUCTION

This proposed system is simple to design. Here, two different sensors are used which are temperature & humidity sensor (DHT11) and barometric pressure sensor (BMP180). The data processing unit is an Arduino Uno which is a low-cost embedded system platform. The data can be recorded and analyzed in a personal computer or in a simple android based mobile phone with Arduino application installed. The collected data from all the sensors is displayed on OLED display unit which connected at the output of microcontroller. To transmit the data, from Arduino Uno to the Thing-Speak cloud platform, the ESP8266 wi-fi module is used.

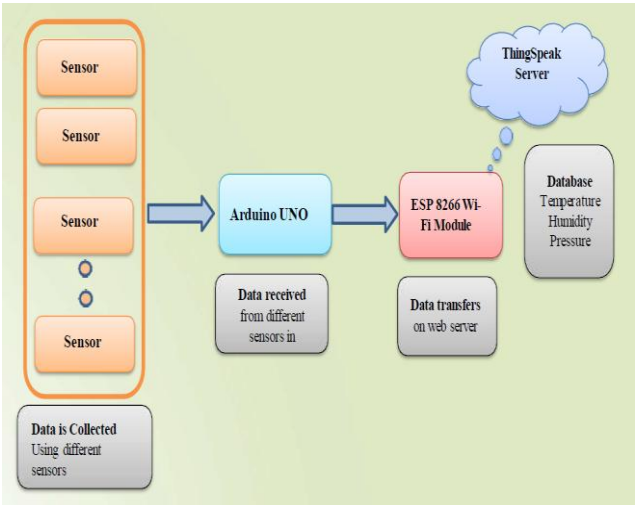


**Fig.1: Block Diagram**

## SYSTEM MODULES

### a) Arduino UNO Board

Arduino UNO is a Micro-chip Atmega-328p microcontroller which is open-source, it consists of a physical program control board and a software which can be installed on your computer, you can program code in the computer and then upload it on the physical board. It is an IDE (Integrated Development Environment) it has resources like, source code editor, automation tools and a debugger.

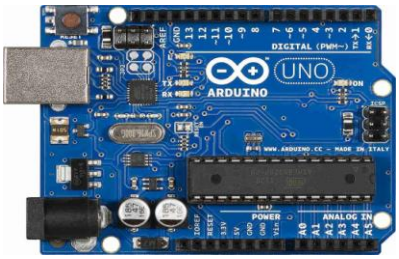


**Fig.2: Arduino UNO Board**

### b) DHT11 Temperature & Humidity Sensor

Temperature / Humidity sensor (DHT) measures the values of temperature & humidity periodically based on the period with digital signal output. The Temperature / Humidity sensor (DHT11) is given by 3 pins identified as VCC connected to the 5V of Arduino, GND connected to Arduino GND, and DATA pin connected to the digital pin of Arduino board. DHT sensor is constructed of resistive type element that reads humidity and negative temperature coefficient NTC element. It uses a capacitive humidity instrument and a thermistor to measure the surrounding air. The sensor demonstrate sensitivity, reliability, stability, high response and can be found in a low cost.

**Fig.3: DHT11 Temperature & Humidity Sensor**

### c) BMP180 Barometric Pressure Sensor

The BMP180 sensor is mainly used to measure atmospheric pressure or biometric pressure. The working principle of the air pressure sensor is very simple, it works based on the weight of air. Because the air around us has a certain weight, and this weight has a specific pressure.

**Fig 4: BMP 180 Barometric Pressure Sensor**

### d) OLED Display Module

The OLED displays are one of the most attractive displays available for a microcontroller. It has a good view angle and pixel density which makes it reliable for displaying small level graphics. Interfacing this IC with MCU can either be done using IIC or using SPI hence helps to save some pins as well.


**Fig 5: OLED Display Module**

**e) ESP8266 Wi-Fi Module**

The ESP8266 Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hostingan application or offloading all Wi-Fi networking functions from anotherapplication processor.Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much Wi-Fi-ability as a Wi-Fi Shield offers (and that's just out of the box) The ESP8266 module is an extremely cost-effective board with a huge, and ever growing, community.

**Fig 6: ESP8266 Wi-Fi Module**

## 4. IMPLEMENTATION

The implemented system consists of a microcontroller which is the most essential component in this device. The sensors can be operated by the microcontroller to get the data from them and it processes the analysis of sensor data and updates it into the internet through WIFI module. 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, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

The Arduino Uno which we have used is integrated with a Wi-Fi module called Arduino Uno Wi-Fi. The board is based on the ATmega328P with an ESP8266 Wi-Fi module consolidated TCP/IP protocol stack. In order to establish communication with the ESP8266 Wi-Fi module, microcontroller needs to use some AT commands.

The system consists of a temperature and humidity sensor (DHT 11) and Barometric Pressure Sensor (BMP180). These 2 sensors will measure the primary environmental parameters like temperature, humidity and pressure. These sensors will give the Analog voltage as an input to the microcontroller board as each analog voltage corresponds to aparticular weather factor, then the microcontroller will convert this Analog voltage into digital data.

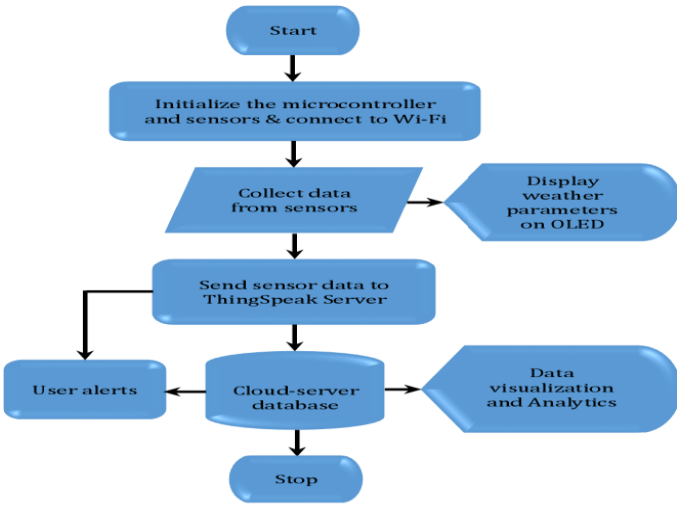


**Fig.7: Flowchart of proposed weather station**

## 5. RESULT

The experimental results show that, the proposed system designed for weather forecasting, has provided significant results in managingsensor data at ThingSpeak cloud platform, it has revolutionized the method of collecting the sensor data through Wi-Fi based application. The web GUI provided gives better clarity of the sensor data and also helps in generating reports as and when needed. The striking feature of the smart IoT based weather monitoring system is that, the administrator can access this data, anytime and anywhere. This helps the administrator to have a control over the weather management without the need of being physically present at the location.

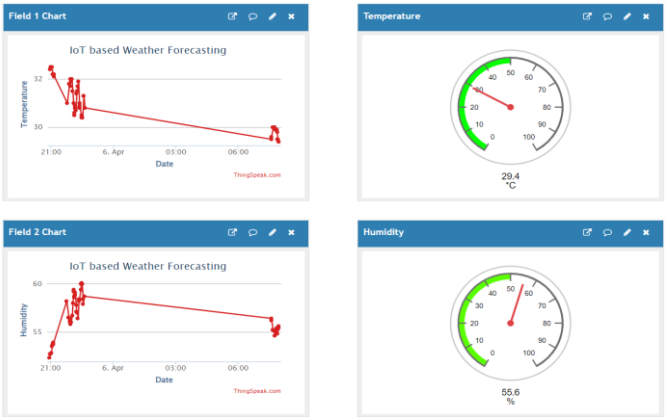


**Fig.8: GUI of ThingSpeak for Temperature & Humidity**

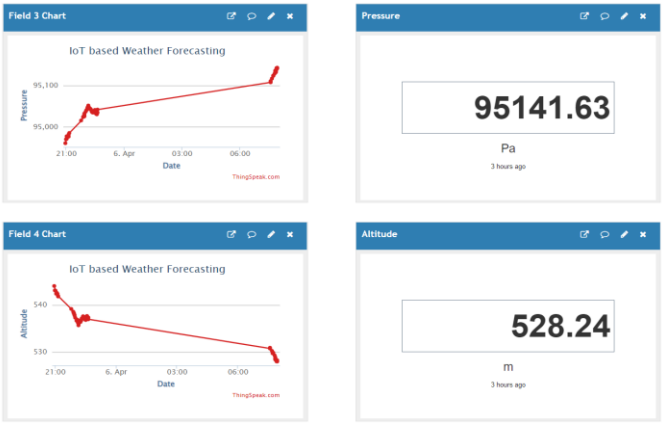


**Fig.8: GUI of ThingSpeak for Pressure&Altitude**

## 6. CONCLUSION

We have design and implemented an IoT based weather monitoring system that can provide an accurate weather update and the updated information can be accessed remotely. For its easy design, this weather station can be implemented in remote locations where weather data are not easy to get. Continuous weather data will be uploaded to a server from where anyone from around the world can access the data. This weather station can also be helpful to meteorologists to find the property of any particular area for future research. As we can take data on spot our data accuracy will be far greater than the satellite data. As this weather station design is simple and anyone can operate this so there is no need for a skilled man to operate this. This designed weather station can be carried easily to anywhere at any time that will reduce manpower and less time consumption.

## REFERENCES

[1] Vaishnavi Gotmare, Rajesh Kolte, Rutwik Thengodkar. “WeatherMonitoring System Using Arduino Uno.” International EngineeringJournal for Research & Development, Vol.5, Issue 5,2021.

[2] Laskar, M. Rahaman, R. Bhattacharjee, M. Sau Giri, and P. Bhattacharya. "Weather forecasting using Arduino based cube-sat." Procedia Computer Science 89 (2016): 320-323.

[3] Jitendra Singh, Rehan Mohammed, Mradul Kankaria, Roshan Panchal, Sachin Singh, Rahul Sharma, "Arduino Based Weather Monitoring System", International Journal of Advanced in Management, Technology and Engineering Sciences 3, vol. 8, 2018.

[4] Nandagiri, Kiranmai, and Jhansi Rani Mettu. "Implementation of Weather Monitoring System." International Journal of Pure and Applied Mathematics 118, no. 16 (2018): 477-493.

[5] Katyal, Amber, Ravi Yadav, and Manoj Pandey. "Wireless Arduino based weather station." International Journal of Advanced Research in Computer and Communication Engineering 5, no. 4 (2016): 274-276.

[6] Mahmood, Sarmad Nozad, and Forat F. Hasan. "Design of weather monitoring system using Arduino based database implementation." Journal of Multidisciplinary Engineering Science and Technology (JMEST) 4, no. 4 (2017): 7109.

[7] Meetali V. Rasal, Prof. Jaideep G. Rana. "Raspberry Pi Based Weather Monitoring System.", International Journal of Advanced Research in Computer and Communication Engineering 10, vol. 5, 2016

[8] Krishnamurthi, Karthik, Suraj Thapa, Lokesh Kothari, and Arun Prakash. "Arduino based weather monitoring system." International Journal of Engineering Research and General Science 3, no. 2 (2015): 452-458.

[9] Shubham R. Vilayatkar, Vaibhav R. Wankhade, Pranjali G. Wangekar, Nikhil S. Mundane. "IoT Based Weather Monitoring System using Raspberry Pi." International Research Journal of Engineering and Technology (IRJET) 1, vol. 06, 2019.