Real Time Weather Prediction Embedded System using IOT and Machine Learning

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***Abstract:*** Now a day, we are more focused towards IOT and Machine Learning ,technologies which have intelligence. ESP8266 is a WiFi module, it is one of the leading platform for Internet ofThings implementation. It can transfer data to IoT cloud.

Using Internet of Things (IOT), any electronic equipment can be controlled in homes and industries. Moreover, data can be read from any sensor and analyse it graphically seated anywhere in the world. Here, we can read temperature and humidity data from DHT11 sensor and light intensity using LDR, upload it to a ThingSpeak cloud server using NodeMCU

and ESP8266-01 module and can be shown on Html webpage.

If we put this standalone device in a room it measures all the above said parameters The main part of this paper depends on machine learning and serial communication .Arduino takes values using nodemcu (temperature,humidity,light density) and then the values have transfer to the jupyter notebook (python) .Using machine learning we are training the data and then prediction has been done for that particular value by blinking the led connecting to bread board.

**Keywords: Nodemcu, Jupyter Notebook, DHT11, ThingSpeak,**

**LDR.**

# Introduction

Will it rain and again give us disappointment that the match got dismissed? How can you determine that the conditions are suitable for conduction of cricket match or not? Even after all

the modern equipments we can still predict with ease using this device.

IoT is a concept that connects all the devices to the internet and let them communicate with each other over the internet.

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IoT is a giant network of connected devices – all of which gather and share data about how they are used and the environments in which they are operated.

NodeMCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. The term "NodeMCU" by default refers to the firmware rather than the development kits.

Machine learning is the study of algorithms and mathematical models that systems use to progressively improve their performance on a specific task.

Using Internet of Things (IOT), we can control any electronic equipment in homes and industries. Moreover, you can read data from any sensor and analyse it graphically seated

anywhere in the world. Here, we can read temperature and humidity data from DHT11 sensor and light intensity, presence of object using IR sensor and LDR, upload it to a ThingSpeak cloud server using NodeMCU and ESP8266-01 module.

ESP8266 is a WiFi module, it is one of the leading platform for Internet of Things implementation. It can transfer a data to IoT cloud.

Literature Review

**Jitcha Shivang at al**. developed a simulated system to predict weather condition of Indian subcontinent using Machine Learning .they collected data for training from data.gov.in, ncdc.noaa.gov and UCI machine learning data repository.

They use linear regression algorithm for data training .[1].

**Mark Holmstrom, Dylan Liu at al.** concluded that linear regression did not perform as well as professional weather forecasting methods but in the longer run differences in their performances decreased, suggesting that over a longer period of time, As a result, only eight features were used: the maximum temperature, minimum temperature, mean humidity, and mean atmospheric pressure for each of the past two days.They collected data for training from Weather Underground [2].

**Aditya Grover, AshishKapoor and Eric Horvitz at al**. made a weather prediction model that predicts by considering the joint influence of key weather variables. They also made a kernel and showed that interpolation of space can be done by using GPS with such a kernel, taking into account various weather phenomena like turbulence. They also performed temporal analysis within a learner based on gradient tree and augmented the system using deep neural network [3]

**Radhika, Y., and M. Shashi. at al.**

This paper presents an application of Support Vector Machines (SVMs) for weather prediction. Time series data of daily maximum temperature at a location was analyzed to predict the maximum temperature of the next day at that location based on the daily maximum temperatures for a span of previous n days referred to as order of the input. Performance of the system is observed over various spans of 2 to 10 days by using optimal values of the kernel function. Non linear regression method was used to train the SVM for this application[4].

**DivyaChauhan, Jawahar Thakur at al**. In this paper they used Data mining , a tool that predicts behaviours and future trends, allowing businesses to make proactive decisions. It can answer questions that traditionally were very time consuming to resolve. Therefore they can be used to predict meteorological data that is weather prediction .This paper presents the review of Data Mining Techniques for Weather Prediction and studies the benefit of using it. The paper provides a survey of available literatures of some algorithms employed by different researchers to utilize various data mining techniques, for Weather Prediction[5].

**Conclusion : After study all these papers I found that all are using data from any website. But in this paper the data used by me is not from any website.All data was measured in different conditions at different light density,different temperature ,different humidity. In this paper we also use two sensors forbetter prediction Ldr,Dht11 which measures temperature,humidity,light density. The model was based on linear regression .**

# Components And Softwares Required

ESP12/NODE MCU (CP2102)-Nodemcu is an arduino updated version with inbuilt wifi chip .it is cheaper than other module performing the same function .



**Figure1 NODEMCU**

DHT sensor is a module used for measuring temperature and humidity. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air



**Figure2 DHT11**

LDR sensor is a device used for measuring light density.

It works on principle of photoconductivity.When LDR kepts in dark its value increases and when kept in light its value decreases.



**Figure 3 LDR**

Breadboard is typically a hand wired circuit using a pegboard with press in terminals. Wire wraps or hand soldered wires connect discrete components togather.

Connecting Wires/Jumpers is used to connect nodemcu to the Ldr and Dht11.

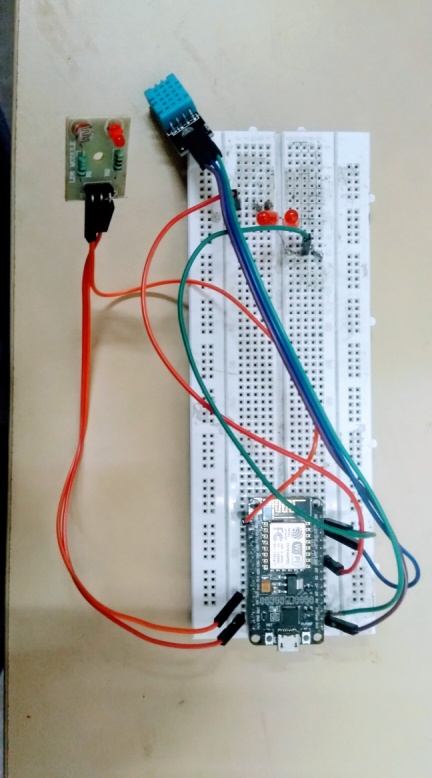
Softwares Used:

The Arduino IDE (Integrated Development Environment), put simply, is the environment where you can write Arduino code, compile it and upload it to your Arduino or Arduino compatible board.

ThingSpeak is an **Internet of Things**  platform that lets you collect and store sensor data in the cloud

An HTML web page is a plaintext document with a .html or .htm file name extension. Typically it also contains content (words, pictures, other media) and code written in HTML, CSS, and JavaScript to control the look at behavior of that content.

*Jupyter notebook is a very popular and flexible tool which lets us put our code, output of the code and any kind of visualization or plot etc. in the same document.*

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**Figure 4 BLOCK DIAGRAM**

**WORKING**

First we connect 2 different sensors with NodeMCU ESP8266 which measures temperature, humidity and light density ,LDR is connected to analog pin and remaining sensors are connected to digital pin. We also connect a battery so that LDR get proper supply because as we know NodeMCU provides only approx. 3V which is not enough for their working. Now, using NodeMCU we are sending data to our ThingSpeak cloud server (database) then Thingspeak send

data to our NodeMCU in form of a JSON file so that data is now displayed to HTML Web Page which is showing measured readings of different sensors .

Now separately with the help of google spreadsheet[4] we are taking different values of temperature,humidity and light density in the csv file format.So that we can train the data using Machine Learning ,we are taking all possible values in which a match will be possible or not.

After doing above mentioned steps we are using concept of Machine Learning in this project .We are making a model based on Logistic Regression in Jupyter Notebook(Python IDE) and trained our model on the values which had been taken by the Google spreadsheet. Now ,with the help of nodemcu we are taking the current values of temperature,humidity and light density of a particular location .After that these values are sending to the Jupyter Notebook using serial communication between nodemcu and Jupyter Notebook. With the help of the model we are

predicting will it be a match today or not? .After that value will be send by the Jupyter Notebook to the Nodemcu in ‘0’ or ‘1’ .If led blinks then match will be possible otherwise not.

Conclusion

. The future of IoT is virtually unlimited due to advances in technology and consumers’ desire to

integrate devices such as smart phones with household machines. Wi-Fi has made it possible to

connect people and machines on land, in the air and at sea. It is critical that both companies and

governments keep in ethics in mind as we approach the fourth Industrial Revolution (Pye, 2014).

With so much data traveling from device to device, security in technology will be required to

grow just as fast as connectivity in order to keep up with demands.Governments will

undoubtable face tough decisions as to how far the private the sector is allowed to go in terms of

robotics and information sharing. The possibilities are exciting, productivity will increase and

amazing things will come by connecting the world.

Machine learning approaches applied in systematic reviews of complex research fields such as

quality improvement may assist in the title and abstract inclusion screening process. Machine

learning approaches are of particular interest considering steadily increasing search outputs and

accessibility of the existing evidence is a particular challenge of the research field quality

improvement. Increased reviewer agreement appeared to be associated with improved predictive

performance.

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