

Design and Development of Automatic Micro Controller based Weather Forecasting Device

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Abstract: The entailment for weather forecasting to take the essential pre-cautious measures in our regular routines and elude the unwanted fatalities has made this more attractive area of research. Particularly in the rural areas the weather forecasting enables the farmers to have an effective crop management, avoiding the destruction in the crops and increasing the yield. In order to have a real time weather forecasting the proposed method in the paper tries to develop an automatic weather forecasting device based on the microcontroller. The proposed method utilizes the sensors to monitor the weather changes and engages the raspberry pi to process the information gathered and convey it to the end user. The proposed system was tested by implementing it in the Indian delta districts and the accuracy, precision and flexibility in the forecasting was evinced by the data output observed over and done with the Thinkspeak .Web

Keywords: Weather Forecasting, Raspberry Pi, Ethernet, Cloud, Wireless Sensors

1. Introduction

The weather information's play a significant role as they deliver the climatic conditions of an area and provide an in advance particulars of the natural calamities, enabling the public to get prepared eluding the unnecessary uncertainties'. The weather forecasting is very essential in the rural and the delta areas to reduce the destruction and the risks caused over the vegetation's and the human lives. The technological advancements that are introducing more and more sophistication in the daily routines of the people have increased the demand for the accurate weather forecast. The continuum that is need of the weather forecasting ranges from the general public to diverse groups such as, agriculture, airlines. In most of the countries that are well developed even the buildings designs and the facilities provided in the industry rely highly on the thorough insights of the atmosphere. The author Iseh, et al., 2013 defines weather forecasting

as an “Act of predicting future weather conditions or an attempt to indicate the weather conditions which are likely to occur”

The forecasting procedure of the weather is an application of science and technology to envisage the conditions of the atmosphere at a particular location. The human beings have tried to forecast the weather formally and informally till the nineteenth century. But to have accurate predictions of weather humans utilized many modes that are expertise in pattern recognition, model with the performance based insights etc., but the atmosphere’s disordered nature, measurement faults, improper understanding about the atmospheric processes results in less accurate predictions of the weather. As the weather warnings are very essential to plan the daily routines around and as well safeguard the life and the property of the people accurate prediction of the weather also becomes very essential. Ever since the invention of the very first instrument to measure the atmospheric changes the weather forecasts methodologies and the instrument have gone through much advancement. More reliable and detailed records of weather have been observed engaging latest communication device, highly equipped observers, and sophisticated instruments. To have a more accurate real-time weather prediction the paper puts forth an automatic weather device employing the sensors to measure and record the meteorological parameters and microcontroller to process and direct the sensed information’s to the thinkspeak web through the cloud.

The paper profiling the design and the development of the automatic weather forecasting device is arranged with the section 2, providing the details of the similar works and their limitations, section 3 providing the particulars about the devised method for weather forecasting, the section 4 providing the details of the results observed and section 5 providing the conclusion.

2. Related works

The Iseh, A. et al [1] speaks about the models that are required in creating the weather forecasts; it provides the particulars of the procedures involved in predicting the weather forecasts. But the proposed method utilizes the sensors and the microcontrollers to monitor the changes in the atmosphere and the forecast the weather. So the related works section presents similar works existing and their limitations in monitoring the weather changes. Kodali et al [2] proposes an internet of things based weather forecasting. Employing the micro controller ESP8266X-FX, this is capable of processing only small scale data’s

Noordin, et al [3] employs the PIC16F877A microcontroller to build a low cost weather monitoring system. This system is used only for the monitoring and recording of the sensed data based on the weather prevailing

and does not forecast the weather. The system in the paper conveys the information to the PC and requires additional process to make the information available to the public.

Devaraju, et al [4] utilizes the “wireless portable microcontroller based weather monitoring station employing the sensors to monitor the changes the atmosphere and utilizes the Xbee Pro radios to transmit the information to the base station. Popa et al [5] the author proposes the weather station equipped with sensors and micro-controllers and utilizes SMS services of the mobile phones to regulate the operation in the station.

The “microcontroller based meteorological station was put forth in Rosiek, S et al [6] the paper by engaging the Atmega 16 microcontroller, to process the sensed information and Campbell and HOBO H8 to perform the data0-acquisition . Duraipandian, M et al [7] has proposed the association of the internet of things with the cloud to enhance the security provision and electricity conservation in the automated home system. Bestak et al [8] in his paper puts forth the big-data analytics in the smart cloud based applications and elaborates the particulars of the sensors that lay as the basic equipment in gathering the information’s to be processed or stored. Pandian,

A. Pasumpon et al [9] though the paper concentrate in developing a smart ware house and logistics using the artificial intelligence, the sensors lays as the basic equipment in monitoring the changes in the ware house as well as the delay caused in the logistics paving way for the automation. Pandian, M. Durai et al [10] describes the involvement of the EEG sensor in observing the sleep pattern of the elderly by monitoring the EEG signals. Raj, J.S et al [11] proffers the employment of the sensor technology in enhancing the automation process in the green house environment.

Smys, S., et al [12] in his paper presents the involvement of the sensor technology that is very basic requirement in the IOT, the big data analytics and the cloud computing to have a proper on health care facility in the rural areas. so all the papers above puts forward the capability of the wireless sensors in diverse fields, The weather forecasting put forth in this paper also utilizes the grove of sensors to monitoring the changes in the environment around and utilizes the Raspberry Pi to forecast the weather in a particular place.

3. Proposed Weather Forecasting Model

The proposed model develops a weather monitoring device to measure the meteorological parameters by employing the sensors the , the sensors employed measures every minute changes in the atmosphere and

conveys it to the web server for the direct access of the users, proffering an accurate forecast of weather. For the weather forecasting put forth, paper employs the weather Pi ArduinoV3 w/Grove that is equipped with the on board barometer, temperature sensors and can be extended to support multiple connections such as the lightning detector, humidity sensors, anemometer, wind vane, and rain bucket, the weather Pi ArduinoV3 w/Grove is enabled with the software's to support the sensors for all the supported I2C devices. The figure .1 below shows the block diagram of the proposed weather forecasting.

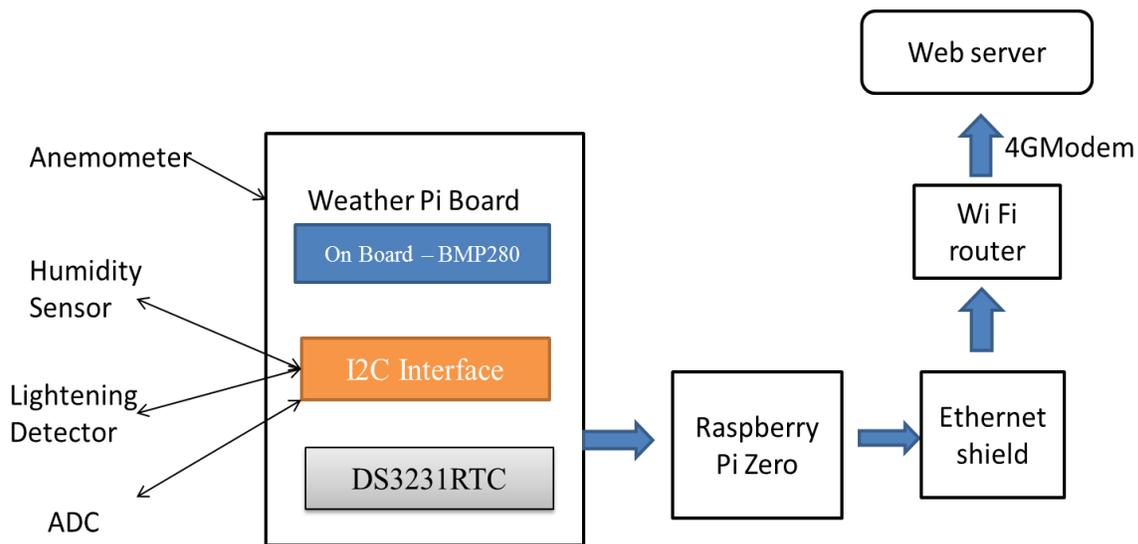


Figure.1 Weather Forecasting Block Diagram

The designing began involving the weather Pi ArduinoV3 w/Grove furnished with the sensors to forecast the and the Raspberry Pi microcontroller to process further, the proposed method starts with the weather data collection such as the particulars of the temperature wind, the air humidity, direction and the speed of the wind and the pressure in the air. The proposed weather forecasting includes sensors such as on –board BMP280 barometer an absolute barometer pressure sensor based on piezo-resistive pressure sensor technology to measure the pressure in the atmosphere, DS3231RTC – integrated with the temperature compensated crystal oscillator for time keeping when the main power is interrupted to the device, Ada-fruit HTU21D-F I2C digital temperature and humidity sensor to measure the changes in the temperature and the humidity and an anemometer to measure the wind speed and identify the direction of the wind a Raspberry Pi microcontroller to process the information sensed and Wi Fi router and the 4G cellular network modem to convey the processed information to the web server. The figure.2 below shows the printed circuit board of the weather Pi ArduinoV3 w/Grove

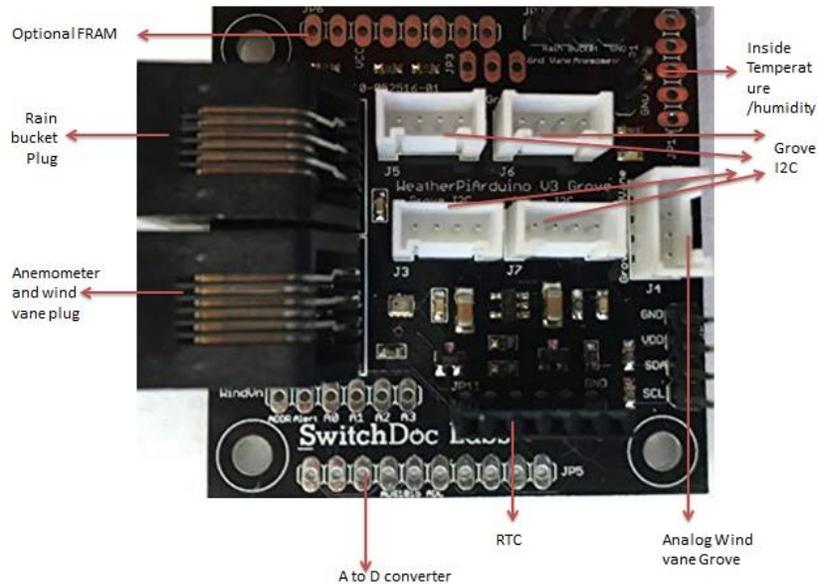


Fig.2 Weather Board W/Grove

The weather board includes the open source software for all the sensors and all the supported I2C devices, the weather board is interfaced with the Raspberry pi using the Wi Fi router and the information's sensed are transferred to the raspberry pi processor over the wireless connection. The data received are processed and sent through the cellular network using the 4G modem, The Arduino IDE software with the sensor library is used to in developing the software utilized in the design process. The power for the weather board and the raspberry pi board are controlled using an USB power control. The sensors and the weather board used in the process are configured with the tools on the think speak web that supports the Arduino based weather board and the raspberry based micro-controller. The figure.3 below shows the pin details of the raspberry pi zero.

Once the registration process is completed the thinkspeaks.com carries on developing a field that holds the sensed data, the count of the fields varies according to the number of sensors in the device. The registration of the device with the thinkspeak is indicated using the application interface keys in the raspberry pi zero.

4. Result Analysis

The weather forecasting device is tested on the delta districts of India by simultaneously monitoring the atmospheric changes using the sensors. The results of weather changes monitored are reported to the think speak web by the 4G networks and verifies the accuracy of the model developed the results displayed below is the presents the information monitored and conveyed over the thinkspeak.

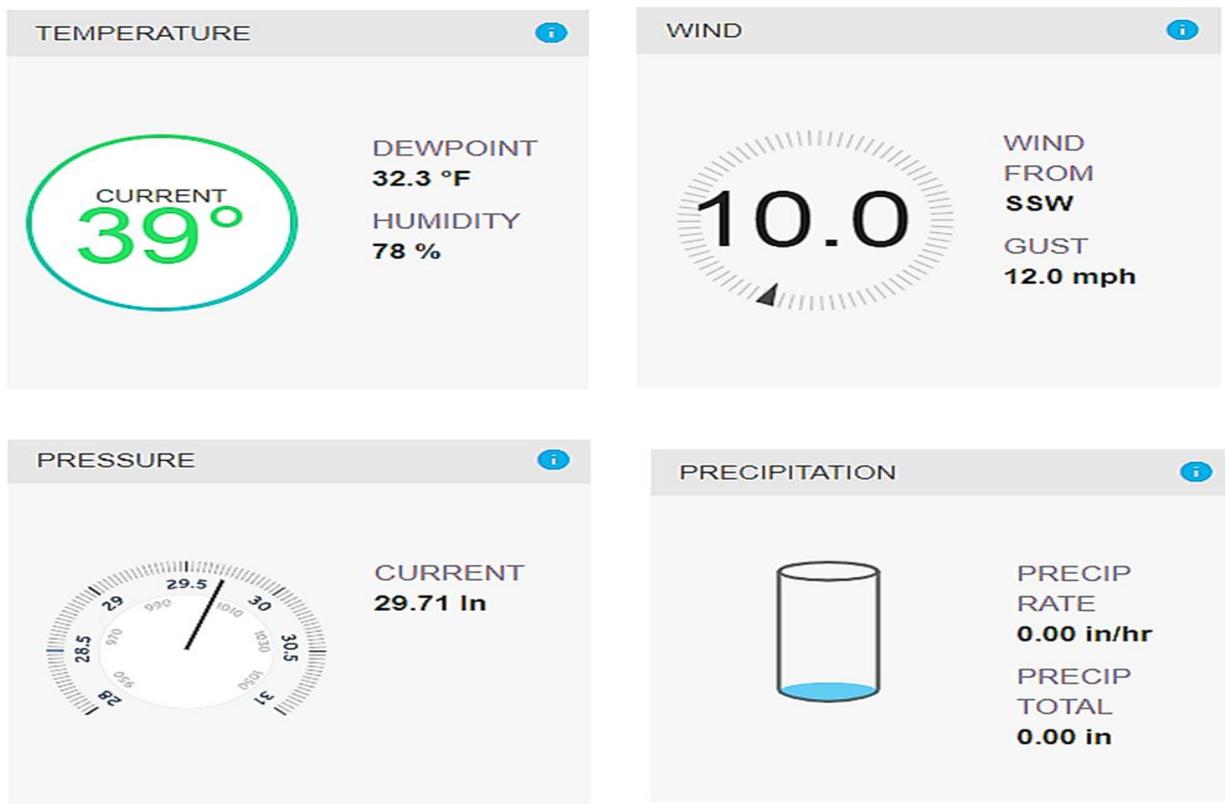


Figure.4 Results Obtained from the Thinkspeak

The figure.4 above shows the results obtained from the thinkspeak.com public view, where sensed temperature, humidity, air pressure, wind speed and direction are denoted , the graph below in fig.5 provides the temperature, pressure, wind speed and the wind direction observed different hours of a day.

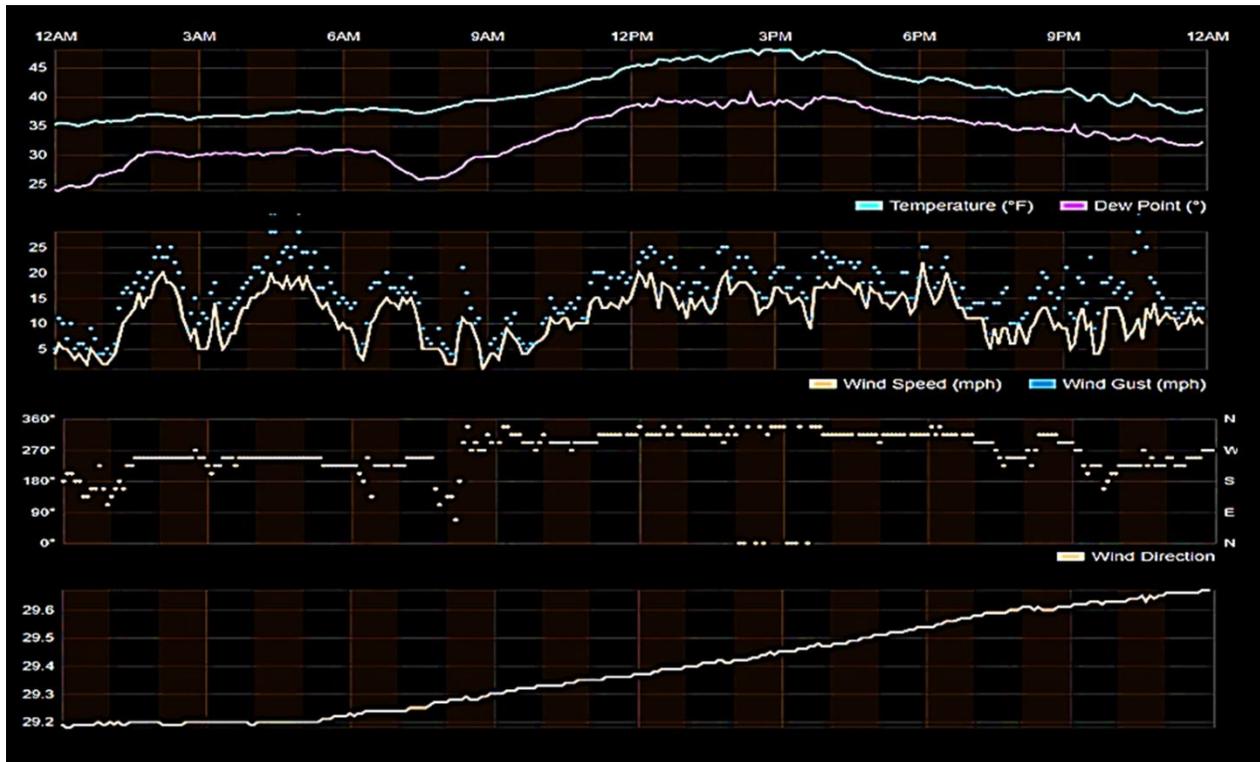


Figure.5 Weather Graph observed from the ThinkSpeak

The weather graph observed from the thinkspeak shows that the design weather monitoring enables to have even the minute changes in the atmosphere. The table.1 below summarizes the weather changes acquired using the proposed system.

	Low	Average	High
Temperature	35.04 (degree Fahrenheit)	40.12(degree Fahrenheit)	48.13(degree Fahrenheit)
Dew Point	23.82(degree Fahrenheit)	33.10(degree Fahrenheit)	40.7(degree Fahrenheit)
Humidity	62.34%	74.01%	80.23%
Precipitation	-	-	0.01 in

Wind speed	01.01mph	11.54 mph	22.01mph
Wind Gust	-	15.91mph	28.0mph
Wind Direction	-	west	-
Pressure	29.17 in	-	29.68 in

Table.1 Weather Changes Observed

Further the system developed could be improved in the future by utilizing the cloud storage to gather the information and set threshold for the each monitored data to indicate the situations of emergency through a mobile application.

5. Conclusion

The weather forecasting device proposed in the paper utilizes the weather pi board to measure the changes in the atmosphere and process them using the raspberry pi processor and conveys the information to the server utilizing the 4G modem, the proposed method seems to be provide an accurate measurement of weather forecasting and this tested by implementing the proposed method over the delta districts of India and observing the results using the Thinkspeak

5.1. Future work

At present the system providing the details of the weather to the user only when logged on the server has reduced the time and risks taken in onsite monitoring, this could be further improved in the future by utilizing the cloud storage to gather the information and set threshold for the each monitored data to indicate the situations of emergency through a mobile application.

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