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IoT Based Weather Station

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Abstract: *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. Hence, this device 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 we can calculate other data parameters, such as the dew point. In addition to the above mentioned functionalities, we can monitor the light intensity of the place as well. We have also enabled to monitor the atmospheric pressure of the room. We can also monitor the rain value. 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). Whenever these values exceed a chosen threshold limit for each an SMS, an E -mail and a Tweet post is published alerting the owner of the appliance to take necessary measures.*
Keywords: *BMP180, DHT11, ESP8266, LDR, E -mail, SMS.*

I. Introduction

With the advent of high speed Internet, more and more humans around the globe are interconnected. Internet of Things (IoT) takes this a step further, and connects not only humans but electronic devices which can speak amongst themselves [1]. With falling costs of Wifi enabled devices this trend will only gather more momentum. The main concept behind the Internet of Things(IoT) is to connect various electronic devices through a network and then retrieve the data from these devices (sensors) which can be distributed in any fashion, upload them to any cloud service where one can analyze and process the gathered information. In the cloud service one can utilize these data to alert people by various means such as using a buzzer or sending them an e-mail or sending them an SMS etc.

As mentioned earlier, IoT enables not only Human-Human interaction, but also Human-Device interaction as well as Device-Device interaction. This particular development in the shape of new avenues of interactions will impact essentially every industry such as transportation and logistics, energy, healthcare etc. For example, in the case of energy, IoT is being applied to create Smart Grids which can detect and respond to changes in local and broader level changes in energy consumption, which is going to be an integral part of any nations energy policy.

Looking beyond the aforementioned energy example, there are many areas of interests where IoT can make a meaningful impact such as, Smart Homes, which involve IoT to heighten the degree of automation; Wearable technologies such as smartwatches and fitness bands; One of the biggest areas of potential in IoT is connected healthcare.

Many global electronics behemoths have already invested deeply in the Internet of Things infrastructure. With players like Intel, Rockwell Automation, Siemens, Cisco and General Electric the market is on the cusp of an explosion, with analysts predicting there will be 26 Billion connected devices, more than 4 per human on the planet, and the industry is projected to bring in $19 Trillion, in costs savings and profits with firms like Samsung and Google leading the pack.With this new technological platform however, comes its own set of challenges and obstacles, such as what to do with the enormous amounts of data which is collected.

This project as well measures environmental parameters such as temperature, humidity, pressure, light intensity etc. and uploads these values to a cloud service, IBM Bluemix.[2] In the cloud the data are analyzed and if the retrieved datas are above or below a certain threshold limit, depending on the value, an e-mail, an SMS and a twitter post is published at the exact moment[3].

Earlier people staying in home and busy in their household chores or people busy in their offices workload had no idea about the environmental parameters outside their home or office. They have no idea if the temperature outside is quite high or quite low or normal or if it is raining outside or not or what is the value of the humidity in the outside environment. This device can come in quite a handy in these situations. It will notify us whenever the temperature is too low or too high through an e-mail, an SMS and a twitter post. It will also automatically notify whenever there is a downpour in the surrounding and remind us to carry an umbrella or a raincoat [4]. It will also greet us with good morning and good evening messages as it also has an LDR which measures the light intensity of the surrounding environment[5]. The core of the project is the ESP8266 based Nodemcu which is a low cost wifi module and all the other sensors are connected to this device. The C code is written in arduino IDE and uploaded to the ESP8266 through a serial bus. Once the code is uploaded then the board is connected to a Wifi and the device starts working. The code has to be uploaded only once.

II. Implementation Setup

2.1. Components required: Hardware
2.1.1 ESP8266 based wifi module Nodemcu[6]
2.1.2 Temperature and Humidity Sensor(DHT11)[7]
2.1.3 Barometric Pressure Sensor(BMP180)[8]
2.1.4 LDR[9]
2.1.5 Raindrop Module[10]
2.1.6 Mobile phone to recieve email and SMS

2.2. Components required: Software
2.2.1 Arduino IDE[11]
2.2.2 Accessible Wifi
I.2.3 IBM Bluemix[12]

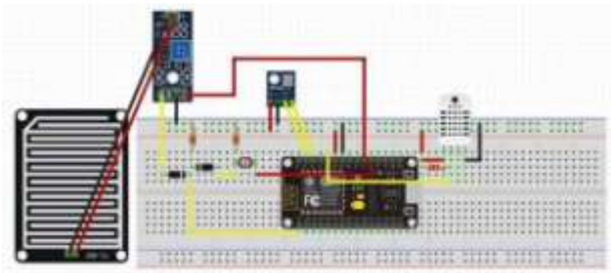

Fig. 1. The complete setup of the device.

III. Methodology

3.1 Nodemcu

It is the heart of the device. It provides the platform for IOT. Its a wifi module having esp8266 firmware within. All the other sensors are connected to this micro-controler. They send the measuered values to it and it uploads all the values to the cloud where the values are analyzed. The developer of this board is ESP8266 Opensource Community. It has an operating system called XTOS. The CPU is ESP8266(LX106). It has an in-built memory of 128 KBytes and a storage capacity of 4 Mbytes.

Fig. 2. nodemcu.

3.2. DHT-11 (Temperature Sensor)

It senses the temperature of the surrounding. Its a 4-pin device. We should connect a 10k resistor between pin 1 and pin2. Pin 1 is connected to the 3.3V. Pin 4 is connected to GND. Pin 2 is the output pin which gives input to the nodemcu pin D4. Pin 3 is left empty.

Fig. 3. dht11.

3.3 BMP 180(Pressure Sensor):

It senses the barometric pressure from the surrounding. BMP180 is an I2C standard device. Its a 4-pin device, viz, SDA, SCL, VIN, GND. Vin and GND are connected to 3.3V and GND respectively. SDA is connected to D2 pin of nodemcu and SCL is connected to D3 pin of nodemcu.

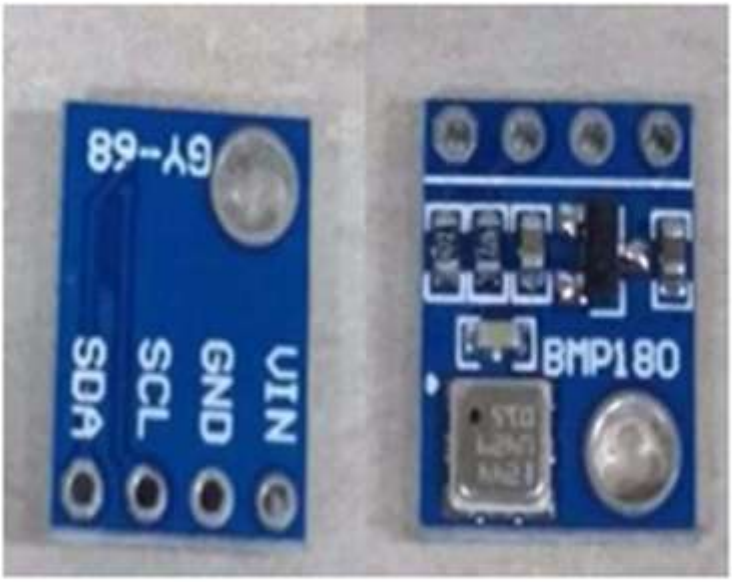

Fig. 4. bmp180.

3.4 Light Dependent Resistor(LDR)

An LDR is a variable resistor controlled by light. The increasing light intensity falling on it decreases the resistance of the LDR. It has an analog output which is an input to the A0 pin of the nodemcu.

Fig. 5. ldr.

3.5 Raindrop Module

It is used for the detection of rain. It can also be used for measuring the intensity of the rain. It has both digital output as well as analog output. This module measures the moisture through analog output pin and when the threshold of moisture exceeds too much it provides a digital output. The more water or the lower resistance means lower output voltage. Where as, the less water means higher resistance,i.e, high output voltage on the analog pin. For example a completely dry board will cause the module to output five volts. The analog output of the module is connected to the A0 pin of the nodemcu.

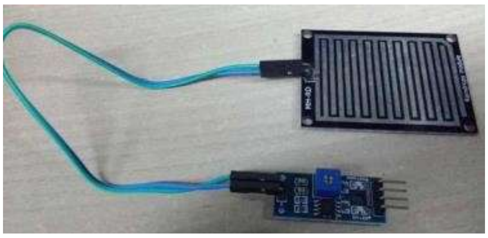

Fig. 6. raindrop module.

3.6 Working of the analog pin(A0)

The Nodemcu board has only 1 analog pin, but in this project two analog output devices,viz,LDR and Raindrop Module, are multiplexed to the A0 using two diodes. The multiplexing circuit is shown in the Fig.7 below.

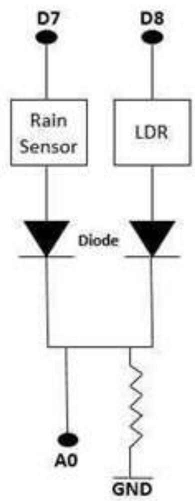

Fig. 7. multiplexing circuit.

Here the Vcc of Raindrop sensor is connected to the D7 of the nodemcu and the input of LDR is connected to the D8 of nodemcu. When D7 is High, D8 is Low making LDR off and raindrop module on. Hence the output of raindrop sensor reaches the A0 of nodemcu through the diode.

Similarly, when D8 is High and D7 is Low, LDR is on and raindrop module is off making a path for the LDR output to reach to the A0 of the nodemcu through the second diode. The 10k resistance is used to reduce the voltage drop across raindrop module and LDR. Hence, we are accomodating 2 analog devices in the nodemcu having just one analog pin.

3.7 Algorithm 1: Analog Pin Multiplexing

```
Input : LDR D8, raindrop D7;
Output : Analog pin A0
 loop {
 if (digitalRead(D7) == HIGH)
 {
A0=raindrop sensor value;
Digital Write(D7,LOW);
}
```

```
else if (digital Read(D8) == HIGH)
{
A0=LDR value;
 digital Write(D8,LOW);
}
}
```

IV. Results

After the sensor measurements are uploaded to the cloud, IBM Bluemix, the values are analyzed there and then an email, an SMS and a tweeter post is published whenever the threshold limit exceeds. Some of the sample results are as following:

Fig. 8. Email received.

Fig. 9. Message received.

Fig. 10. Tweeter post published.

4.1 Algorithm 2:E-mail, SMS & Tweeter post

Input**:** temp, humidity, press, LDR, rain;
Output : email, sms, tweet
loop {
temp=temperature value measured;
humidity=humidity value measured;
press=pressure value measured;
LDR=light intensity measured;
rain=rain value measured;
if (temp && humidity && press && LDR && rain) {
publish all the measured value to the cloud bluemix; serial.println(temp);
serial.println(humidity);

```
serial.println(press);
serial.println(LDR);
serial.println(rain);
}
else
{
serial.println("error! check the sensors.");
}
if(temp>=40)
{
email="The current temperature is" + temp;
sms="The current temperature is" + temp;
tweet="The current temperature is" + temp;
}
if(humidity>=50)
{
email="The current humidity is" + humidity;
sms="The current humidity is" + humidity;
tweet="The current humidity is" + humidity;
}
if(rain>=200)
{
email="It's raining outside. Bring your umbrella";
sms="It's raining outside. Bring your umbrella";
tweet="It's raining outside. Bring your umbrella";
}
if(LDR>=150)
{
post only once in a day
{
email="Good Morning";
sms="Good Morning";
tweet="Good Morning";
}
} }
```

V. Future scope

The proposed IoT based weather station can be modified To incorporate many more features.We can add OLED display to display the surrounding parameters into it.We can also add a GPS module in the design so that location of the surrounding also messaged to the user along with temperature,humidity,pressure etc.

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