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RESEARCH ARTICLE OPEN ACCESS

Design and Implementation of Solar Powered Compact Atmospheric Sensor

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ABSTRACT
The driving of intelligent remote sensors without a lasting electrical association might be a typical issue that is regularly tackled by receiving elective power sources. One among the principal generally utilized sources is sun-oriented force utilized by solar panels and charging circuits. However, it's difficult to search out arrangements in business sectors for activity in precarious climate where the energy intensity of the sun isn't so high. This reality drives us to the occasion of using solar panel boards and circuits upgraded for solid power supply of remote sensors. A reliable linear charging circuit for Lithium-Ion batteries and adapter circuit for adjustment of remote sensor working voltage was developed and improved for low energy utilization and high effectiveness. The proposed framework utilizes an ESP8266-FX microcontroller based WeMos D1 Mini V2 and it is executed on Arduino stage which is utilized to store and recover the information from the cloud. The primary target of this paper is to see climatic states of any area and permits admittance to the current information
Keywords **-** ESP8266-FX, Linear, Lithium-Ion, Sensor, WeMos D1 Mini V2

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I. INTRODUCTION

Remote sensors are as of now broadly utilized for the estimation of different factors (temperature, light mugginess, and so on) These sensors are frequently positioned in outside conditions without power associations. In those cases, it is reasonable for controlling remote sensors by a discretionary power supply. There are a few current elective force sources. Notwithstanding, wind power isn't appropriate for fueling reduced measured remote modules due to mechanical and estimate issues, just as its wrongness in a group of urban areas. Such execution, individually, is exceptionally hard to intensely change a particularly current to remote inserted frameworks regarding power the board, security issues, and framework obstruction needs [1]. Notwithstanding these sources, power sources likewise exist for remote inserted frameworks that are undeniably more appropriate. It is energy gathering from sources dependent on the rule of piezoelectric, vibrational, warm, acoustic or sun based. From the choice of named sources, it is sunlight-based force energy that is most appropriate as far as force thickness and force remote sensors. Contrasted with different sources, for example, piezoelectric, vibrational, thermoelectric, or acoustic, the energy thickness of sun powered cells creates around mW/cm3, which supplies μW/cm3. There are a few norms for remote sensors, where IEEE 802.15.4 is most appropriate for low force utilization just as the alternative to rest state mode. This affirms the appropriateness of this norm in mix with the utilization for sending substitute force sources and intermittent information. The recurrence of sending information can be two times a day, and for the remainder of the time the remote module is in a condition of low force utilization. The power utilization of these gadgets is 120 mA as a matter of course for the communicate mode. The accepting mode assimilates from 30 to 70 mA, while in rest mode it changes to 2.6 μA. Contingent upon the past part, it is feasible to work the remote sensor for quite a while in case of ideal plan of the circuit for charging, battery and converter [2].

II. LITERATURE REVIEW

Fourth International Conference on Digital Manufacturing and Automation [3] presents on temperature and humidity checking frameworks. A bunch of programming is gathered by the LabVIEW language. The program works efficiently. It can show the continuous information of hubs and record it. At the point when the information surpasses the cut-off, the caution showing the light will be

splendid. Temperature and humidity are checked consequently. This framework is helpful to utilize, great interface, agreeable activity.

An International Conference on Cloud Computing, Data Science and Engineering [4] manages the plan of an instrument that actions the three generally significant and essential boundaries for plant development, viz. That dirt dampness, temperature and humidity. The FC28 hygrometer sensor and DHT11 temperature and humidity sensor estimates soil dampness, temperature and mugginess separately. The sensor reads and process the information with the help of micro controller board. The board at that point cycles and guides the information as per the code, lastly shows it on the LCD unit.

2. DESIGN OF THE PROPOSED SYSTEM

The overview Block Diagram of the proposed system for the real time compact atmospheric weather monitoring system is shown in Fig.1

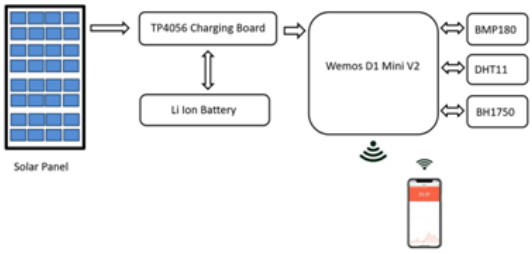

Figure 1 Block Diagram of the Proposed System

2.1 HARDWARE AND IMPLEMENTATION

Constant atmospheric condition checking framework is carried out with Wemos D1 scaled down V2 which has ESP8266 Wifi chip etched on it. Three sensors BMP 180, DHT11 and BH1750 are connected to 3V3 positive power supply voltage and the ground GND. SDA and SCL of BMP180 are connected to the I2C pins GPIO1 and GPIO2 of Wemos board respectively.

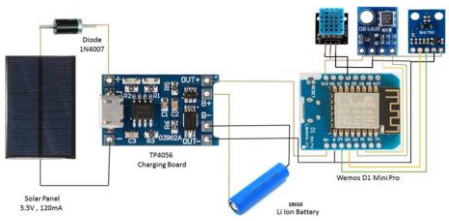

Figure 2 Schematics of the Proposed System

DHT11 data pin is connected to DPIO6 of Wemos board and BH1750 Serial information pin and sequential clock pin are associated with GPIO4 and GPIO5 of the Wemos D1 Mini V2 load up.

2.2 SOFTWARE REALIZATION

Presently, we are good to go up and we are prepared to present our environment information on the cloud. In this proposed framework we are utilizing an Arduino code written in the Arduino IDE to refresh and recover information from cloud administrations and PDAs. For arranging the gadget, we need to set the accompanying segment in the Arduino code:

1. For Wi-Fi, we need to set the ss-id name and secret key of Wi-Fi network with our secret password.

2. In the Time-Client Settings area, we need to change our nearby time region balance contrasted with the UTC time region.

3. In the Ubidots segment, it peruses the API key and the channel ID should be refreshed. Subsequent to setting the code and installing it on board we can effectively store and show the information on our mobile phones.

3. HARDWARE DESCRIPTION

The Hardware components used in the proposed system is shown below.

3.1 WEMOS D1 MINI V2

The Wemos D1 is a small Wi-Fi Internet of Things (IoT) module dependent on the ESP-8266EX microcontroller and gives 4MB flash memory. Its 9 GPIO pins make this board reasonable for enormous IoT target crowds. It has a wonderful Micro controlling unit which will be modified with either Arduino IDE or Node-MCU. It has a miniature USB

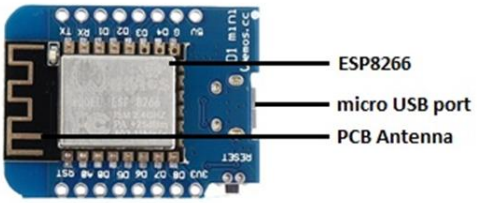

Figure 3 Wemos D1 Mini V2

for programming and can likewise be modified utilizing OTA. It is additionally viable with Android and iPhone. It can utilize CP2104 USB for outside radio wire and UART IC. The specialized detail of Wemos D1 Mini V2 is appeared in TABLE 1 underneath.

Table 1 Technical Specification of Wemos D1 Mini

Microcontroller Used	ESP8266-FX
Required Operating Voltage	3.3 Volts
Digital Input Output Pins	11
Analog Inputs Pins	1

Clock Speed	80MHz/160MHz
Flash memory	4M bytes

In this proposed framework of the Wemos board is associated with a station with a SSID and secret password that will get to the Ubidots of cloud services and recover information and show it on smart phones. This framework is financially savvy and weighs around 8 grams.

3.2 BMP180

The BMP180 sensor is Bosch Sensor Tech's new digital barometric pressure sensor with truly greater performance. It contains a sensor based on Piezo Resistive material, ADC converter and ADC converter-unit with E2PROM and a sequential I2C communication protocol. E2PROM stores 176 bits of singular adjustment information. Pressure factor information and temperature information are to be made up for by the aligning the BMP180's E2PROM. In the wake of sending a beginning data

Figure 4 BMP180 Pressure Sensor

succession to start a pressure factor and/or temperature estimation and its transformation, the outcome esteem (pressure and/or temperature) is regularly perused the I2C interface. In this way, the computation of temperature in ° C and pressure factor in HPA, adjustment information has been utilized. These information are frequently perused from the E2PROM through the I2C protocol. The example rate is regularly expanded to 128 reference each second (Regular mode) for productive estimations [5]. It is a minimal expense, little gadget that catches three mechanical natural information boundaries, for example, temperature between - 40 C to +85 C, pressure range somewhere in the range of 300 and 1100 hPa, and gives exact change from referred height. It additionally works in the low supply range 1.8 V to 3.6 V Direct Current as per the particular manual of this item [6].

3.3 TP4056

The TP4056 is a steady current/consistent voltage linear charging circuit for Li-Ion /Lithium-Polymer batteries. We have used 1 Li Po battery, 3000mAh. The purpose of the TP4056 charging module is to charge those batteries and provide protection circuits from over-charging the batteries. There are two modules, one to charge the battery and the other to draw power from the battery. The solar panel of the 1W output is connected parallel to the TP4056 charging module and that module is connected to the 3000 mAh Lithium-Ion battery.

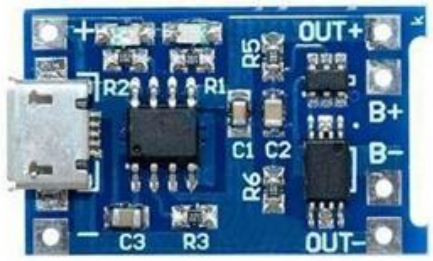

Figure 5 TP4056 Charging Board

3.4 BH1750

BH1750 is the Rohm's 16-bit Ambient Light sensor. It's a small, efficient and In-expensive ambient light sensor to detect and measure the light intensity. The BH1750 offers 16-bit light measurements in lux, which make it easy to compare the SI unit for measuring light with other values, such as references and measurements from other sensors. BH1750 can scale from 0 to 65k + lux. With some precise calibration and advanced metering time adjustment, it is even believed to measure up to 100,000 lux. The BH1750 is integrated with an accurate voltage regulator and a switching circuit, which can be used with 3.3 Volts devices such as the raspberry Pi, M4 and 5V Arduino. Instead of working with small contacts on the sensor, the PCB packs it and breaks all the pins into a standard 0.1 inch by 2.54 mm header pin. It follows I2C communication protocol [7].

Figure 6 BH1750 Ambient Light Sensor

3.5 DHT11

DHT11 has a complex of relative humidity and temperature. DHT11 sensor module with measured digital output signal is an integrated module for humidity and temperature detection that provides a measured digital output signal. DHT11 gives us the most accurate humidity value and ensures temperature reading is reliable and long-term stable. This sensor consists of resistive humidity type NTC type temperature and has an 8-bit micro controller measurement component incorporated which is faster, responsive and cost-effective and available in a 4-pin package. The DHT11 module operates on serial communications, i.e. private telegraph communication. It can send data as a block, i.e. (A series of pulses of a certain period). Before sending the data to the Arduino, a short delay requires boot commands, so the total work time is around 4ms. Simple serial interface connection makes system integration quicker and faster. It is small in size, uses little power and has a range of up to 20 meters. Signal transmission makes it an excellent choice for a variety of applications, including the most demanding applications [8].

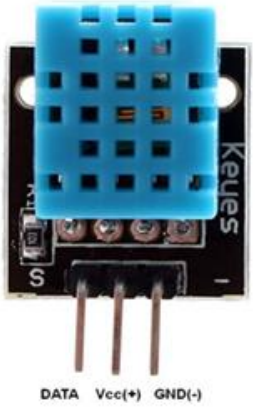

Figure 7 Temperature and Humidity Sensor

3.6 Solar Panel

The operating voltage of the solar panel is 5V – 6V, 200 mA. The dimension of the Solar panel is (99 x 69 mm). It is a Poly Crystalline panel.

Figure 8 Solar Panel

3.7 Li-Ion Battery

We have used 3000mAh Li-Ion Battery with a nominal voltage of 3.7V and the maximum discharge current of 1C.

Figure 9 Li-Ion Battery

Table 2 Technical Specification of Li-Ion Battery

Nominal Battery Voltage	3.7V
Nominal Battery Capacity	3000mAh
Minimum Battery Discharge Voltage	3V
Maximum Battery Discharge current	1C
Battery Charging Voltage	4.2V (Max)
Battery Charging Current	0.5C
Battery Charging Time	3 Hours (Approximate)

4. User Interface

Advanced smartphones and tablets have graphical interfaces planned for Android and IOS applications by establishment of chart plotter, LCD and sensor-esteem show. The client can just download the application, sign in and afterward screen and control its whole home apparatuses. Interface empowers the client to see the information of the gadgets and show them. Additionally, the UI is a web-based interface. The online interface is planned by making website pages from where client can sign in and access the status and information from the sensors through work area PCs or Laptops [9].

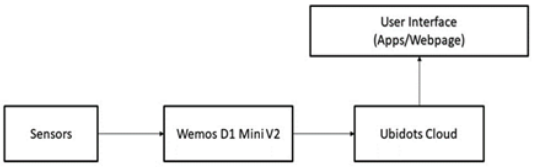

Figure 10 Working Plan of the Proposed System

5. Cloud Services

Ubidots is an open source Internet of Things (IoT) platform or application that uses the protocol named HTTP protocol in order to store or

recover information from gadgets over It produces an application programming interface key for the individual client and channel that contains 8 fields for putting away information, and makes diagrams or charts utilizing those fields. A channel for reading and writing data can be public or private. Thus, the data in this cloud service websites is highly secure.

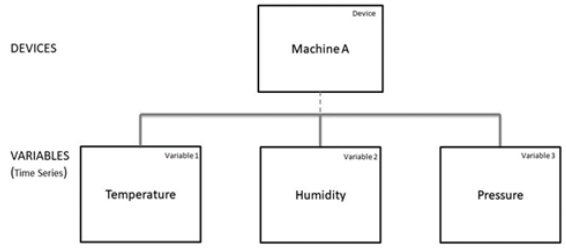

Figure 11 Simple Ubidots Data Hierarchy

6. TESTING AND RESULT

The total equipment and programming arrangement are done in the Hardware and Software Acquisition segment. A Wi-Fi network is made by the customer to access cloud administrations and microcontrollers. In the wake of updating and refreshing the proposed framework, the smartphone will begin designing the association and in the wake of refreshing the information to Ubidots, it will show the atmospheric conditions on the Smartphone. This framework is savvy and energy proficient as we are utilizing minimal expense exact sensor which lessens the expense for a more noteworthy degree. As we have tried for the climatic state of Coimbatore city, we got following outcomes in our Smartphone and Desktop PCs.

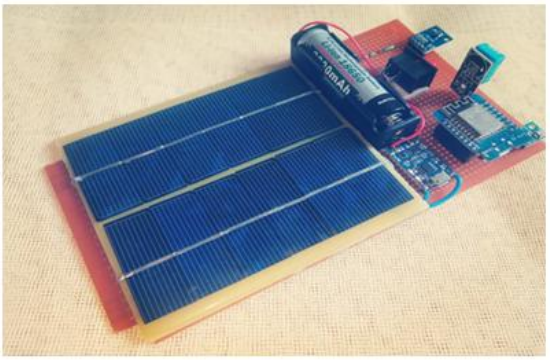

Figure 12 Hardware Snapshot

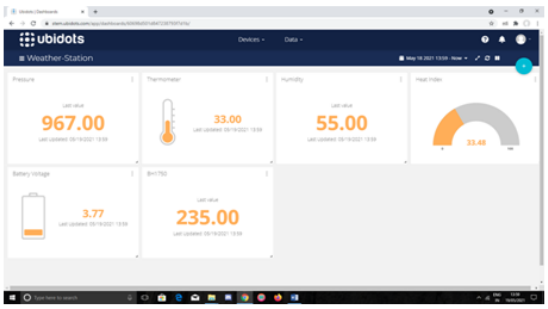

Figure 13 Display of Sensor's Output in Desktop PCs

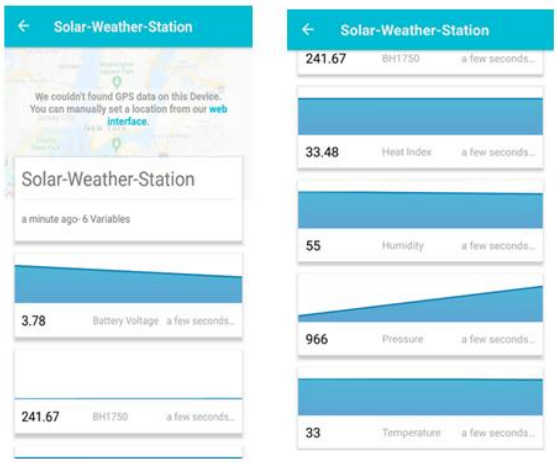

Figure 14 Display of Sensor's Output in Smart Phone

III. CONCLUSION

This project introduces the developed and improved power supply optimized for remote sensors. Because of the utilization of low-power sensors it is feasible to work full remote answers for quite a while just controlled by batteries. However, currently viable solutions for charging circuits are not intended for changing climate conditions, when daylight isn't at focused energy. The planned charging circuit (voltage controller) is an aftereffect of the parts utilized that are equipped for working with a sunlight-based board providing a low yield voltage. The proposed solution powers remote modules with greater efficiency and is also feasible. The created useful unit of the power supply permits the remote module to work outside for a period that is restricted distinctly to the lifetime of the individual segments utilized. This fact is vital due to the great sustainability of the wireless remote measuring sensors, which brings about less cash to keep up and maintain.

Even though the values can be measured wirelessly it does have a range and even though the range can be extended through external antenna it is still a limited range. Therefore, further studies have

to be made on that aspect so that it may overcome that particular limitation. In future further applications like automatic measurement through specified intervals and automatic control of the humidity, temperature and other atmospheric values that are measured through the designed product can be achieved by automating the whole system. This can be achieved since the values are stored each time they are measured. These stored values can be used as a base to identify the nominal atmospheric values and then controlling of the levels of those values can be made possible through automation.

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