ANALYSIS OF ENVIRONMENTAL FACTORS FOR PLANT GROWTH

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ABSTRACT: **This document is intended to present the goal of the project i.e. to create a fully automated IoT device to analyze the factors for plant growth. The general idea is to capture information from a plantation, as temperature, relative air humidity and soil humidity and based on those data decide the right amount (and when) the plantation should receive heat and water. We will use the sensors to analyze the factors and take the threshold values and then provide detailed information on the factors that are responsible for plant growth/development or even limitation of its growth.**

Keywords- Environmental Factors, Analysis of factors, Sensors, IoT.

I. INTRODUCTION

The factors like light, temperature, water, humidity, soil moisture and nutrition etc affect the plant growth to a large extent. It is our responsibility to understand how these factors affect plant growth and development. Farming in India is done in very mundane ways. Most of our farmers lack proper knowledge and a large portion of farming and agricultural activities are based on the predictions which fail at times. We believe that our concept will be helpful in the agribusiness due to its reliability and remote monitoring. Our idea was to digitalize farming and agricultural activities so that the farmers can check on the requirements of the crops and accurately predict their growth. Our project is mainly for the farmers and for agriculturists.

Now-a-days farmers are facing a big problem due to the change in nature because they are unaware of the fact that on which season, which crops or plants are suitable to cultivate and under what climatic conditions. Despite combating challenges like extreme weather conditions, rising climate change, and farming's environmental impact, the demand for more food has to be met. To meet these increasing needs, agriculture has to turn to new technology. There are various factors associated with crop yield and the risks involved with farming. The four most important factors that influence crop yield are soil fertility, availability of water, climate, and diseases or pests. These factors can pose a significant risk to farming when they are not monitored and managed correctly.

II. SYSTEM DESIGN

1) Phase-1

In our project we are taking the factors such as temperature, humidity and soil moisture to analyse and help the farmers to create an environment where they can grow their plants with the help of the analysis of this data collected by the sensors.
The below block diagram shows the main components as well the connectivity of the module.

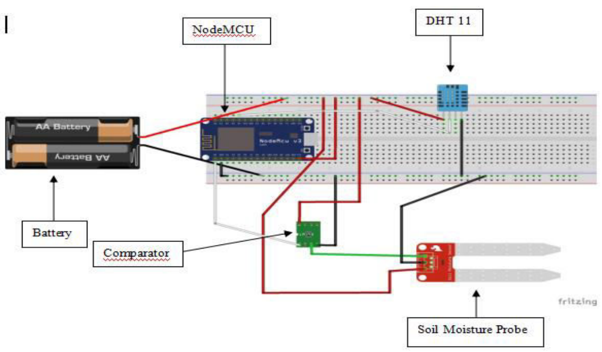

Fig:1 Virtual Circuit Diagram

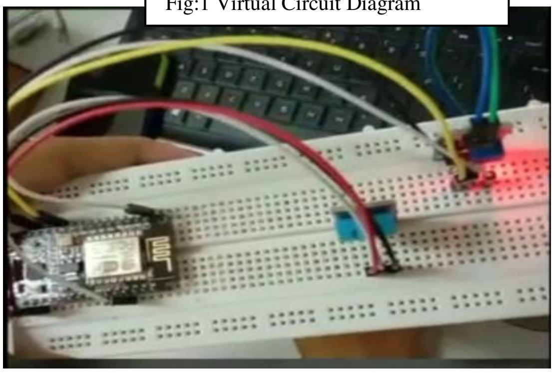

Fig:2 Real diagram of the circuit

A. COMPONENTS AND FUNCTIONS

In the above diagram we have created the module for a remote setup, so for that we have used battery for the power supply. If we use the module locally then we supply the power to the module through USB.

We have used the following components in the development of this system.

- Board Used
  a. NodeMCU ESP8266
- Sensor Used
  a. DHT11 as Temperature and Humidity sensor.
  b. Soil Moisture Sensor
- Other Components
  a. Lithium Battery Charger with Protection Module, 5V
  b. Lithium Battery (3.7V)
  c. Jumper Wires
  d. Breadboard
- Software Used
  a. Arduino IDE
- Cloud Details
  a. Blynk Server

B. NodeMCU

NodeMCU is an open source development board that collects all the readings from the sensors and sends to web application. ESP8266 is basically a Wi-Fi module inbuilt with NodeMCU used for remote notifications.

C. DHT11

DHT11 is the digital relative sensor that is used to read the values of temperature and humidity. It should be powered between 3.3V and 5V.

D. Soil Moisture Sensor

The Soil Moisture Sensor uses capacitance to measure the water content of soil. Simply insert the rugged sensor into the soil to be tested, and the volumetric water content of the soil is reported in percent.

E. TP 4056 Lithium Battery Charger

This module is made for charging rechargeable lithium batteries using the constant-current/constant-voltage (CC/CV) charging method. It also provides necessary protection required by lithium batteries.

III. METHODOLOGY/IMPLEMENTATION

Step 1: Downloaded and installed the latest version of Arduino from arduino.cc site.
Opened Arduino IDE and navigate to File->Preferences. Then entered this URL "http://arduino.esp8266.com/stable/package_esp8266com_index.json" in the "Additional Boards Managers URLs" textbox. Then click "OK".

Step 2: Installed all the required libraries for esp8266, dht11 and soil moisture sensor. It is necessary to install the libraries as it contains all the functions that temperature and humidity sensor readings can be retrieved.

Step 3: Connected the sensors with the NodeMCU with their respective pins.
For DHT11:

Table I: DHT11 NodeMCU connection

DHT11 pin	NodeMCU Pin
VCC	3V3
Data pin	D3
GND	GND

For Soil Moisture Sensor:

Table II: Soil Moisture Sensor & NodeMCU connection

Soil Moisture pin	NodeMCU pin
AO pin	AO pin
VCC	3V3
GND	GND

Step 4: Compiled the code of both the sensors and check for errors. If no error, uploaded it to the board and opened the serial port monitor to check the result.

Step 5: Downloaded and Installed Blynk application on r Smartphone or tablet.

Step 6: Opened the app and selected Create a New Project. Wrote Project name Temperature, Humidity or any name you wish related to your module and Select NodeMCU from drop down.
Af creating an auth token will be sent to the registered email and that is required to paste in the code of the particular sensors so that we can sync the application with the arduino IDE to monitor the results in our Smartphone through this app.

Step 7: An interface is created according to the requirement by adding the required widgets and configured them. After the configuration is done uploaded the code once again and checked the result in the blynk interface that has been created.

2) Phase -2

So far, we have created a module using the NodeMCU, DHT11 and Soil Moisture Sensor to detect the temperature, humidity and soil moisture content of the plant. As we are using the module locally so we are supplying the power through USB. But we have also created a module to use remotely using lithium batteries for the power supply.

Fig:3 Lithium Battery Connection with NodeMCU & lithium battery charger

Step 1: First flash the code of the sensors to the NodeMCU with the help of USB power cable.

Step 2: Then in this module we connected the positive pole of the battery with B+ pole of lithium battery charger and negative pole to the B- pole.

Step 3: Then connected the VIN pin of NodeMCU with the OUT+ of lithium battery charger.

Step 4: And connected the GND pin of NodeMCU with the OUT- of lithium battery charger.

Step 5: The rest of the connections of the sensors with NodeMCU will remain same as earlier.

Step 6: After all the connection is set, opened the blynk app and got the results read by the sensors shown in the interface that we created.

IV. RESULTS AND DISCUSSION

After Uploading the Arduino code IDE open the serial port to see the results.

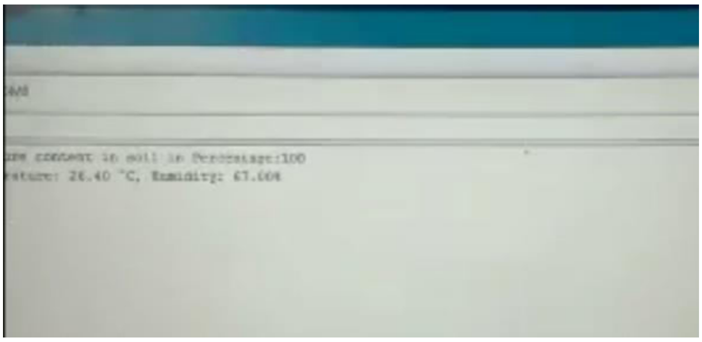

Fig:4 Result in serial monitor

Open the blynk app and press the play button on blynk app to show the output.
In our model we created an interface that will show us the current temperature, humidity, and soil moisture content and will send a notification as "Water the plants" when it is required.

Fig:5 Temperature, Humidity and Moisture data read by the sensors

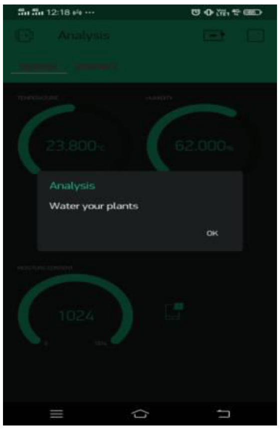

Fig:6 Message to notify

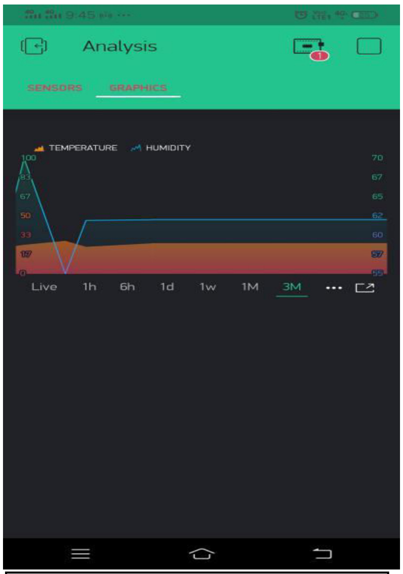

Fig:8 3 months ago data record

Here, the output of temperature and humidity is shown in Fig 5.
In Fig 6 a message is sent to notify when the water content is low in soil.

We can also generate the data in graph format. For that we need to add a graph widget and configure the settings as required.

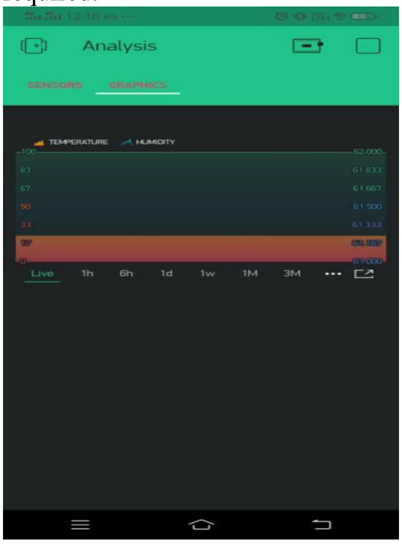

Fig:7 Live Record of the data

V. CONCLUSIONS AND FUTURE ENHANCEMENT

By the implementation of all this we tried to create a device that is going to be of helpful for the farmers or agriculturists. Also this is going to help farmers to create a favorable environment if anyone desires to carry out artificial farming. Like, for example: if we want to cultivate a summer blooming plant in winter season then we will require the conditions to create an environment in which that plant will be favorable to grow. As a future enhancement, the system can be included with more features and sensors like water level sensor, GSM model in order to access it from anywhere.

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