An IoT based Plant's Physical Condition Monitoring System - "SmartPlant"

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Abstract— This IoT based project SmartPlant is developed for monitoring physical conditions around a plant remotely and in real time. There are various new hybrid plantations which are experimented in greenhouses and how they can sustain in various physical conditions, this project will help in making this work efficiently. Its low cost make it possible to use in small plantations efficiently. The physical conditions which are monitored are Temperature, Humidity, Soil moisture around plants.

Keywords: SmartPlant, IoT, Arduino Uno

I. Introduction

[1]Greenhouses allow for greater control over the growing environment of plants. Depending upon the technical specification of a greenhouse, key factors which may be controlled include temperature, levels of light and shade, irrigation, fertilizer application, and atmospheric humidity. Greenhouses may be used to overcome shortcomings in the growing qualities of a piece of land, such as a short growing season or poor light levels, and they can thereby improve food production in marginal environments. In soil science, hydrology and agricultural sciences, water content has an important role for groundwater recharge, agriculture and soil chemistry. If the moisture content of a soil is optimum for plant growth, plants can readily absorb soil water. Not all the water, held in soil, is available to plants. Much of water remains in the soil as a thin film. Soil water dissolves salts and makes up the soil solution, which is important as medium for supply of nutrients to growing plants.[2]

The solution to get data in real time and in any remote location is provided by this project SMARTPLANT.

II. Literature review

Rain in general and water in particular poses a major problem for the farmers. This is due to dissimilar climatic conditions. Hence, there is a need to use optimal water for the plant/crop in order to utilize the available water resources effectively without affecting the yield. The IoT and Cloud computing technologies can effectively be used in such a scenario by supplying water to the plant(s) till the soil around it attains the required moisture level and then stopping the supply of water by switching the motor off from the remote area. Reading the moisture level and switching the motor off can be accomplished by a smartphone. Several papers have appeared in the literature which discusses measurement and monitoring the agricultural parameters by using different controllers and sensors. The work carried out by some researchers related to soil moisture measurement is as follows:

[8]Archana and Priya (2016) proposed a review paper in which the humidity and soil moisture sensors are placed in the root zone of the plant. Based on the sensed values the microcontroller is used to control the supply of water to the field. This system doesn't intimate the farmer about the field status.

[9]Sonali D.Gainwar and Dinesh V. Rojatkar (2015) proposed a Research paper in which soil parameters such as pH, humidity, moisture and temperature are measured for getting high yield from soil. This system is fully automated which turns the motor pump ON/OFF as per the level of moisture in the soil. The current field status is not intimated to the farmer.

[10]Chandan Kumar Sahu proposed a low cost smart irrigation control system. This system includes the sensor nodes and control nodes. In this system the agriculture field is partitioned into small squares and soil moisture sensor is placed in each square. The sensor sends the moisture level of the soil to the Arduino uno board through wireless sensor network. The control node is used to start or stop the irrigation process based on values. The existing system monitors the moisture level in the soil but in our proposed paper we are also testing for the temperature, humidity and water level in tank in addition to the moisture level in the soil.

III. Hardware/software used

A. Arduino Uno:

[3]The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc.The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable. It can be powered by a USB cable or by an external 9 volt battery, though it accepts voltages between 7 and 20 volts. It is also similar to the Arduino Nano and Leonardo.

Pins : LED , VIN , 5V , 3V3 , GND , IOREF , Reset, Serial , External Interrupts , PWM , SPI , TWI , AREF

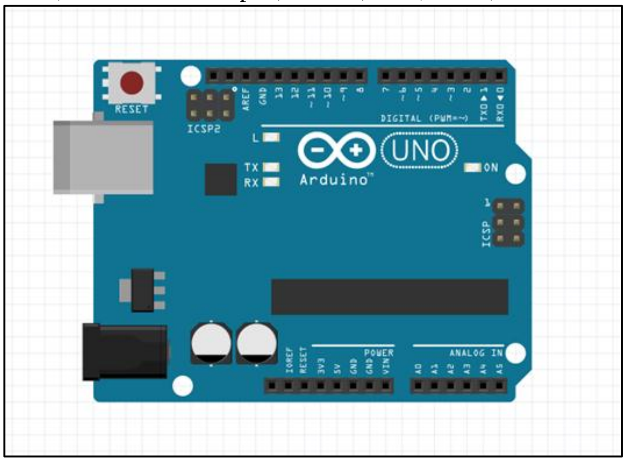

Fig. 1: Arduino Uno

B. WIFI Module - ESP8266:

[5]The ESP8266 is a low-cost WiFi microchip with full TCP/IP stack and microcontroller capability produced by manufacturer Espress if Systems in Shanghai, China. The chip first came to the attention of western makers in August 2014 with the ESP-01 module, made by a third-party manufacturer Ai-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at first there was almost no English-language documentation on the chip and the commands it accepted. The very low price and the fact that there were very few external components on the module, which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, chip, and the software on it, as well as to translate the Chinese documentation. The ESP8285 is an ESP8266 with 1 MiB of built-in flash, allowing for single-chip devices capable of connecting to WiFi.

Pins: VCC, GND, RX , TX , CH_PD, RESET, GPIO 0, GPIO 2

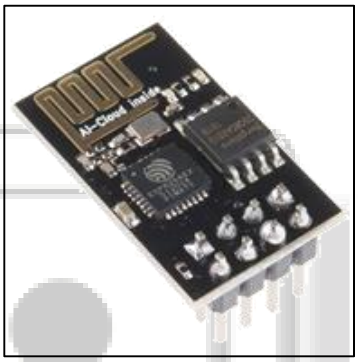

Fig. 2: ESP8266

C. Temperature and Humidity Sensor (DHT 11) :

[4]DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness. Each DHT11 element is strictly calibrated in the laboratory that is extremely accurate on humidity calibration. The calibration coefficients are stored as programmes in the OTP memory, which are used by the sensor's internal signal detecting process. The single-wire serial interface makes system integration quick and easy. Its small size, low power consumption and up-to-20 meter signal transmission making it the best choice for various applications, including those most demanding ones. The component is 4-pin single row pin package. It is convenient to connect and special packages can be provided according to users' request.

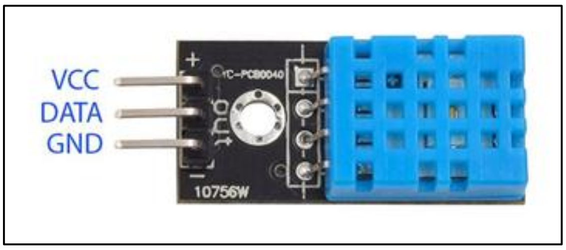

Fig. 3: DHT-11

Name	Measurement Range	Humidity	Accuracy	Resolution	Package
DHT 11	20-90%RH 0-50 ℃	±5％ RH	±2℃	1	4 Pin Single Row

D. Soil Moisture (YL - 38 + YL - 69 Sensor):

[6]The soil moisture sensor or the hygrometer is usually used to detect the humidity of the soil. So, it is perfect to build an automatic watering system or to monitor the soil moisture of your plants. The sensor is set up by two pieces: the electronic board (at the right), and the probe with two pads, that detects the water content (at the left).The sensor has a built-in potentiometer for sensitivity adjustment of the digital output (D0), a power LED and a digital output LED, as you can see in the following figure.

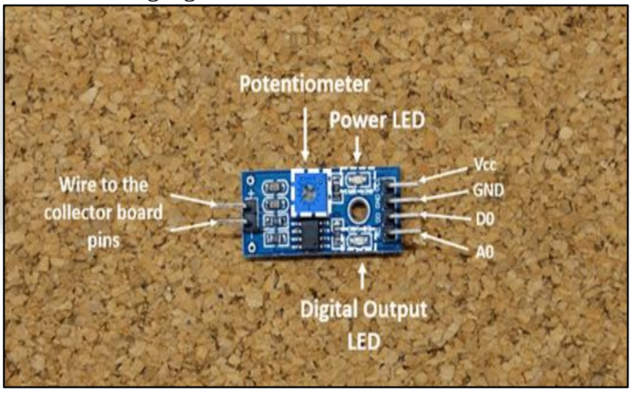

Fig. 4: YL-38+YL-69 SENSOR

E. Blynk Application:

[7]Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data, visualize it and do many other cool things.There are three major components in the platform:

Blynk App - allows to you create amazing interfaces for your projects using various widgets we provide.

Blynk Server - responsible for all the communications between the smartphone and hardware. You can use our Blynk Cloud or run your private Blynk server locally. It's open-source, could easily handle thousands of devices and can even be launched on a Raspberry Pi.

Blynk Libraries - for all the popular hardware platforms - enable communication with the server and process all the incoming and outcoming commands.

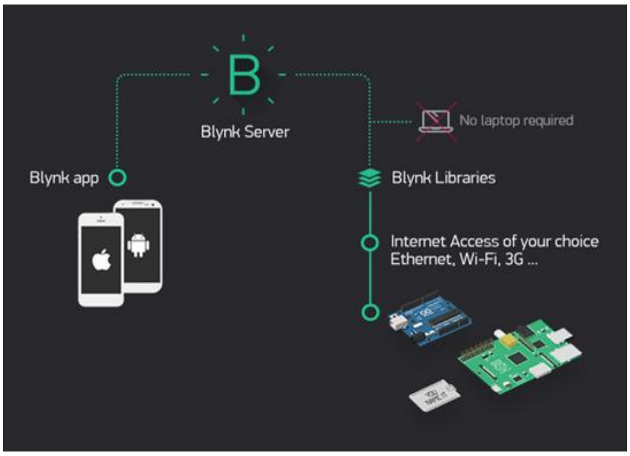

Fig. 5: Blynk Application Use Case

F. Approach

The approach followed to achieve the physical conditions of plant on the mobile application is as follows.

Initially data is given from soil moisture sensor is given to analog pin of arduino and a power of 3.3v is supplied from arduino to soil moisture sensor i.e YL-38+YL-69 , Similarly the data from temperature and humidity sensor is fed to arduino uno using data pin no. 2 , and it also supplied a power of 3.3 v from arduino . Now the arduino uno is connected to a wifi module i.e ESP8266 which is connected to specific ssid and password. The BAUD of ESP8266 is set to default value i.e 115200.

Data from sensor is fetched using methods - analogread() for getting analog value from soil moisture sensor , dht.readHumidity() for reading humidity data from dht11 sensor , dht.readTemperature() for reading temperature from dht11 sensor . Now the data is fed to the Blynk Application with the help of auth id which is generated from blynk to connect to blynk api . Blynk Application helps in connecting to IoT data in real time and data is fetched to from wifi module to virtualWrite variables of blynk application in real time, and in any remote location.

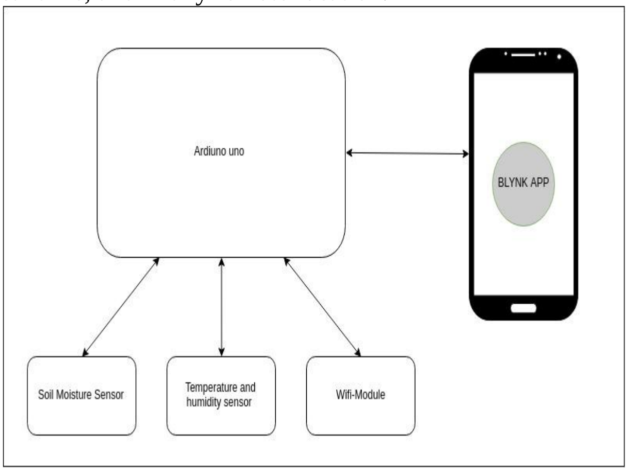

Fig. 6: Workflow

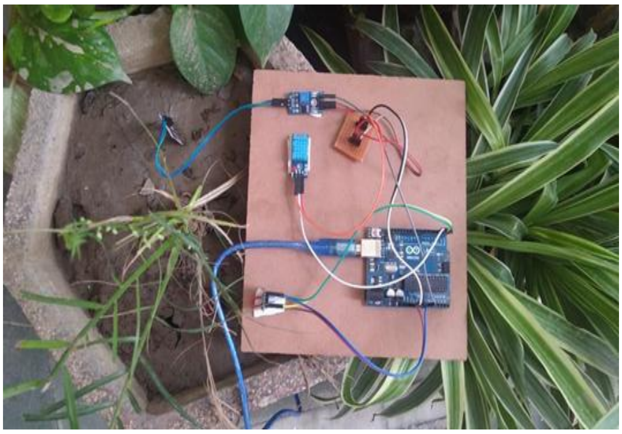

Fig. 7: Smartplant System

IV. RESULTS & DISCUSSION

The result can be explained from the example, the data from soil moisture sensor is 75%, the temperature is 29.6℃ and humidity 70 is processed with the help of arduino uno and sent to blynk application via wifi module. In blynk server the value is stored in virtualwrite variables and displayed on the blynk application in real time.

V. CONCLUSION

The smartplant project efficiently measures the physical conditions of plants which is mainly Temperature, Humidity, Soil moisture on a mobile application in real time and in any remote location.

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