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Soil characteristics analysis using IoT RM

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***Abstract*—**With the advance in IOT and Sensors have influenced Agriculture in better environment monitoring and rise in yields. Farmers need to know the field environment conditions before sowing during anyseason. Mixed farming and Crop rotation are practiced widely. In different part of the season the soil fertility characteristics would vary. Farmers facing several challenges related to knowing the nutrients of soil. In this work experiment existing models are reviewed and proposed a modelto demonstrate how soil characteristics can be instantly measured to accurate using sensors and monitored in real time. We have used IOT solutions using affordable sensors that reports Air temperature, Soiltemperature, Soil moisture and Water sensors. The collected data is automatically uploaded to cloud using Wi-Fi connectivity. Data analytics is carried out in cloud server and the report can be viewed in real time using Mobile application

***Keywords*—**IOT, Smart Agriculture, Cloud,Node MCU,

I. INTRODUCTION

In current practice of agriculture in every season the crops are changed to maintain the soil quality and also mixed crop is employed wheretwo crops are grown in same field in a season. Decision on crop rotation or mixed cropping is based on the environmental conditions of soil and weather. To know the soil nutrients the sample of soil need to be collected and sent to remotely located laboratory. The delay caused in collecting sample and sending to laboratory may influence the accuracy of the soil report. The evaluation of the soil may require frequently to fertilize the soil. Since there is delay in getting the laboratory report or the laboratory is remotely located to send the soil sample then farmers may tend to makeconvention decision for applying fertilizers. But it may happen that the applied volume of fertilize in appropriate to the crop.Hence accurate measuring the environmental conditions including soil characteristics influencing the crop production is essential.

Smart Agriculture involves the precise measurements of various soil indicators or parameters using Internet of Technology and Real Time Monitoring (IoT RM). The availability of sophisticated sensors and IOT infrastructure facilitates the precision agriculture. In this paper we have worked on prototype model for real time monitoring of Soil related Measurements.

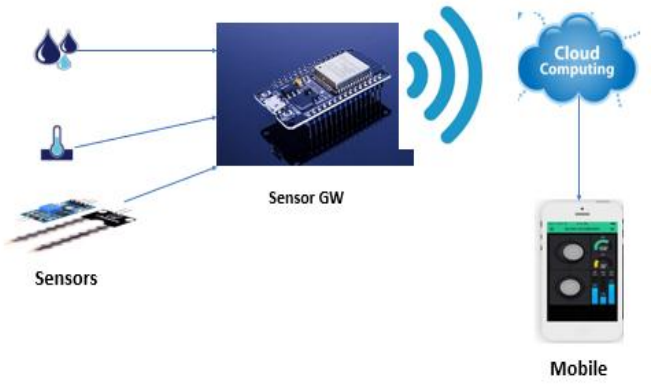

Figure 1.IoTRM System using Sensors and Node MCU

The rest of paper is organized as follows, related work is covered in section II. In section III we made concept of model using Node MCU, Sensors and Blynk IoT platform. Using this IoT RM we measure soil and environment related key metrics. Section IVhas results and discussion of the outcome which is followed by Conclusion and future work in section V.

II. RELATED WORK

As agriculture is the backbone on Indian economy there are several researches on how to adapt modern technology to replace primitive methods in agriculture field.

In many proposed solution Bluetooth or GSM/3G is used as mode of communication. Data from sensors through gateway are collected onMobile handset using one of these technologies. From mobile the data is uploaded to internet or cloud for next level of analysis. Theanalyzed data can be viewed through the websites.

Several experiments have been carried out for intelligence agricultural system basedon the Internet [1]. There have been surveys [2] comparing wireless networking available and IOT cloud platforms. There is a proposal of remote sensing of agriculture parameters for greenhouse [5]. Evaluations have made on networking and power cost for agriculture monitoring [6]

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III. METHODOLOGY

The following components are used to realize IoT RM.

A. Node MCU (ESP32S)

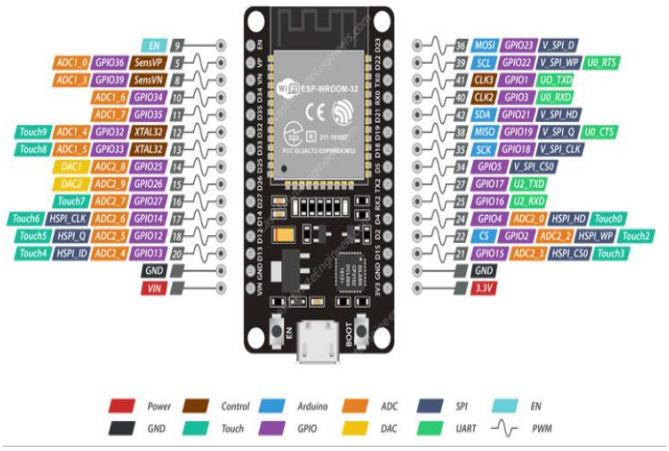
B. Humidity and temperature sensor (DHT11)

C. Soil Moisture Sensor (YL-69)

D. Water Sensor

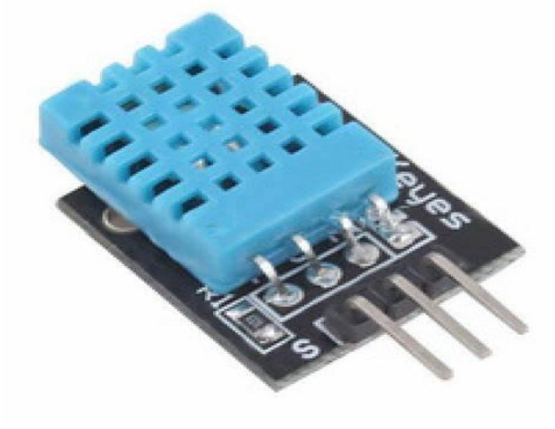
E. Blynk Application in mobile phone

A. Node MCU (ESP32S)



ESP32 is a single 2.4 GHz Wi-Fi-and-Bluetooth combo chip designed with the TSMC ultra-low-power 40 nmtechnology. It is designed to achieve the best power and RF performance, showing robustness, versatility andreliability in a wide variety of applications and power scenarios. It is programmed using Arduino IDE to collect data (Analog/Digital) from sensors and to connect to Wi-Fi for internet connection.

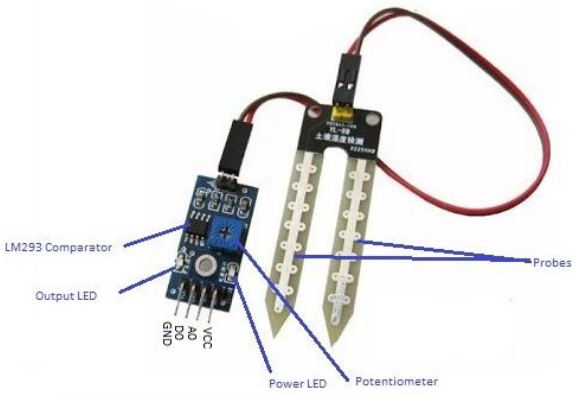
B. Humidity and Temperature Sensor (DHT11)



Humidity sensors detect the relative humidity of the immediate environments in which they are placed. They measure both the moisture and temperature in the air and express relative humidity as a percentage of the ratio of moisture in the air to the maximum amount that can be held in the air at the current temperature. As air becomes hotter, it holds more moisture, so the relative humidity changes with the temperature.

Most humidity sensors use capacitive measurement to determine the amount of moisture in the air. This type of measurement relies on two electrical conductors with a nonconductive polymer film laying between them to create an electrical field between them. Moisture from the air collects on the film and causes changes in the voltage levels between the two plates. This change is then converted into a digital measurement of the air's relative humidity after taking the air temperature into account

C. Soil Moisture Sensor (HC-05)



This sensor can be used to test the moisture of soil, when the soil is having water shortage, the module output is at high level, else the output is at low level. 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 voltage that the sensor outputs changes accordingly to the water content in the soil. When the soil is: Wet: the output voltage decreases Dry: the output voltage increases

D. Blynk Application on Smartphones

Blynk is a Platform with iOS and Android apps to control Arduino and the likes over the Internet. It is a digital dashboard where we can build a graphic interface for.Blynk is 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 things.

The proposed system is implemented using Node MCU due to its cost effectiveness and ease of development. In this method, all the sensors are connected to the Node MCU board and the results can be seen in Smart phone via a Blynk app.

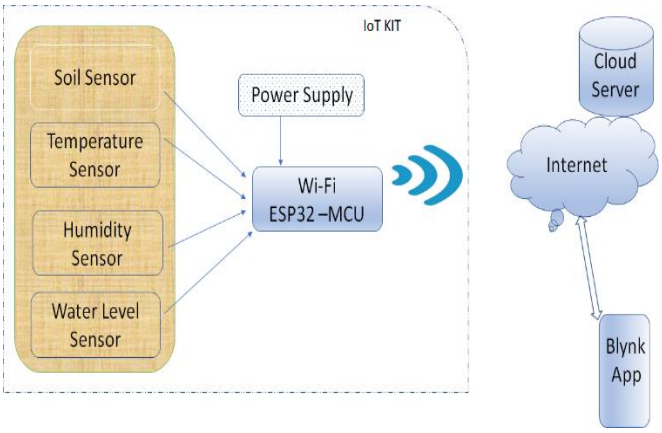
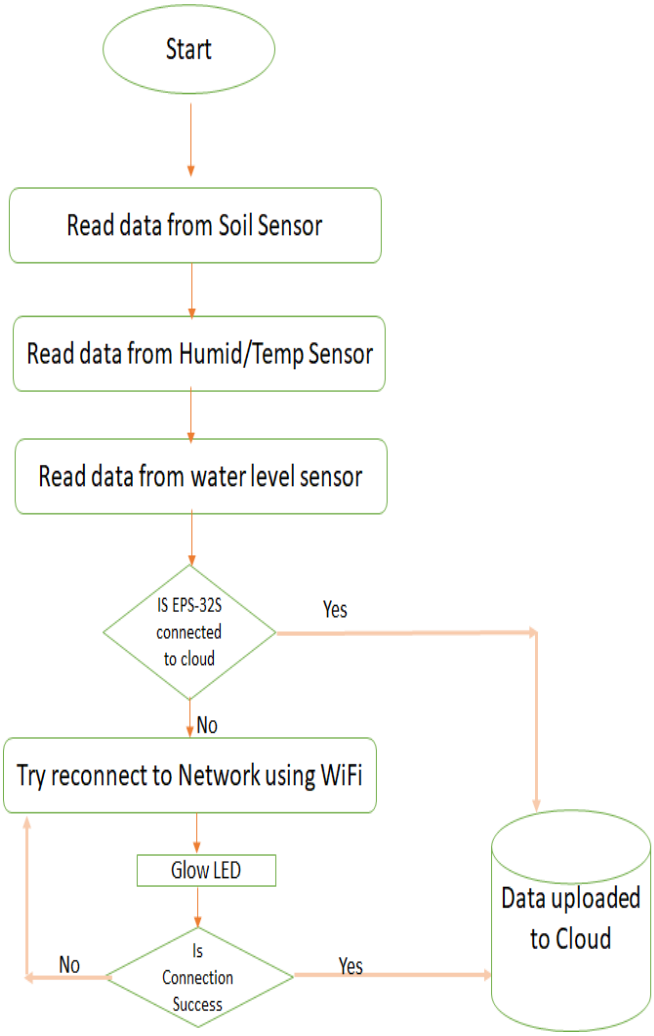


Figure 2.Proposed System block diagram

As shown in fig 2, Sensors measuring soil indicators are connected to Node MCU (ESP32s). MCU is powered with 5V power supply. Here the source of power could be a battery cell or the solar panel. Sensors, MCU together form IoT KIT are portable to fields. Sensors can be placed above or beneath the surface to read soil related measuring metrics. Sensors measured data is transferred to MCU. Data from the sensor can be analog or digital or both. The sensors we employed can send both analog and digital. At MCU the ports are programable to receive analog or digital readings. Analog or digital format is chosen based on the granularity of the measurement is required. Connected pins with sensors are programmed to receive the data at MCU.Data is read at interval of 2secs.



ESP32S with Wi-Fi port is programmed to have continuously connected to Wi-Fi. Lost connectivity is indicated through LED Connectivity to internet is important as data collected from sensors needs to be immediately uploaded to Cloud. In agriculture field Wi-Fi source can be mobile hotspot or any ISP.Through Blynk app on user mobile the analyzed data from the cloud server can be viewed and monitored instantaneously. With instantaneous soil metric information available to farmers on mobile eliminates the need of web access and since the device is portable several set of samples can be collected and monitored over a period of time.

IV. RESULTS AND DISCUSSION

Following figures depict the visualization of the instantaneous data monitoring on user Mobile.

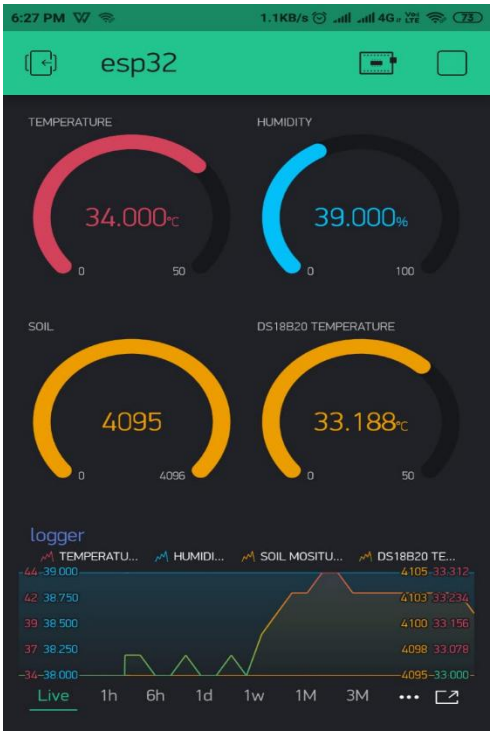
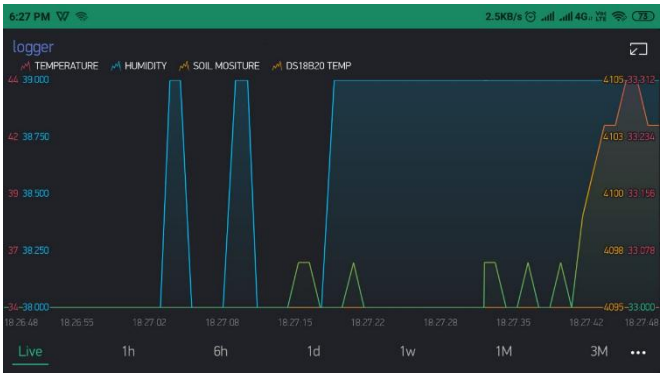


Figure 3. Report snapshot

The data collected from the sensors are instantaneously available on the Mobile app. TEMPERATURE and HUMIDITY gesture in the Fig (3) is the atmosphere temperature and humidity obtained from DHT11 Sensor. SOIL gesture is the Soil Moisture read through HC-05 sensor

And in below figure shows the data can be retrieved from cloud for period of months. This data would be helpful in analyzing the environment and predictions of crop productions for given monitored period using historical data.



V. CONCLUSION AND FUTURE SCOPE

The IOT kit is portable and it can be buried under the soil or placed on the surface of the soil and the data can be wirelessly transferred directly to cloud using hotspot or IPS. It can be widely deployed where soil nutrients moisture and temperature management are significant

Sensors and Cloud Computing: Over the years the cost of sensors have declined drastically and power efficiency increased linearly. Sensors are also becoming versatile in number of parameters it can read. Sensor read information and Satellite data can be used for accurate forecasts for open field and agri-food recommendations in greenhouse.

Mobile application to be enhanced to support multi user login. Provide Notification push on mobile screen whenever monitoring parameter is varied above or below the defined threshold. Analytic algorithms development on historical data for crop yielding predictions models

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