13. Smart Irrigation System with Alert

Abhijeet Kumar, Electronics and Communication Engineering B.I.T. SINDRI DHANBAD, INDIA abkr012@gmail.com
Abhishek Kumar Singh, Electronics and Communication Engineering B.I.T. SINDRI) DHANBAD, INDIA abhiksingh97@gmail.com
Anubhav Kumar Choudhary, Electronics and Communication Engineering B.I.T. SINDRI DHANBAD, INDIA acanubhav.001@gmail.com
Arvind Kumar, Electronics and Communication Engineering B.I.T. SINDRI DHANBAD INDIA aksingh738@gmail.com

ABSTRACT

The paper is inspired by the Smart Irrigation System Scheme of Government of India. The economic contribution of agriculture to India's GDP is steadily declining and agricultural growth in India is slow because of the poorly maintained irrigation system. The major problem is the absence of a cheap and reliable system for monitoring of soil's condition and this causes improper irrigation and wastage of water. This paper proposes a smart alert and irrigation system which monitors soil moisture and temperature using sensors and NodeMCU is used to send this data to the IoT platform and real-time monitoring can be done using smart phone or computer. The IoT platform analyses the data collected and send alert messages and controls the irrigation system according to the pre-set conditions

Keywords— *IoT, NodeMCU, ThingsBoard, TE215 sensor, DS18B20 sensor, MQTT*

INTRODUCTION

Irrigation is one of the most important steps in agriculture. Each and every crop needs water for its growth. Around 70% of the Indian economy is dependent on agriculture. Hence, advancement and implementation of new technology in this field can benefit a major part of society [1]. Digitization will also reduce human effort making the whole cultivation process more convenient. The proposed system involves figuring out the methods to measure the moisture content and temperature of the soil [2] and sending data to the cloud server for processing [3] and sending alert messages [4] to the farmer and activating irrigation system. The IoT technology comes to our solution where microcontroller and sensors like soil moisture sensor and temperature sensor are used [5]. IoT messaging protocol is used to send data read by the sensors to the IoT platform. IoT platform processes the data at the server end and appropriate instructions are executed. The benefit of the project is that it can be installed at any agriculture field or garden and realtime monitoring [6] of the soil's condition can be done and this will help us to stop wastage of water caused due to overirrigation and water logging. Thus, proper irrigation methodology can be developed and further machine learning can be implemented to enhance the growth of the plant in the coming future. This type of agricultural system is termed as Precision Agriculture [7].

LITERATURE SURVEY

The existing system uses Arduino Nano as microcontroller which requires separate Wi-Fi module also this system is a high-power consuming [8] and just does the monitoring [9] but the proposed methodology is using Node MCU which has inbuilt Wi-Fi module to connect with the server. This will reduce the total cost of equipment required as Node MCU is itself cheaper than the Arduino Nano board and additional Wi-Fi module is also not required. Node MCU also has less power consumption, which makes it more energy-efficient [9].

PROPOSED SYSTEM

The proposed system uses NodeMCU as a microcontroller, TE215 (Moisture sensor), DS18B20 (Temperature Sensor) and ThingsBoard as IoT Platform [10] and MQTT as IoT messaging protocol to send data to the cloud server [11]. The system generates alert messages and controls the irrigation system (On/Off of water pump) based on the analysis done by the ThingsBoard on the readings collected by the sensor in accordance to the pre-set conditions.

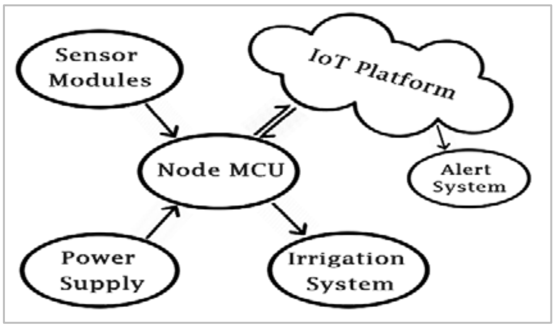

Figure 13-1 System Overview

A. The Circuit

The following diagram shows the connection of various components used in the system:

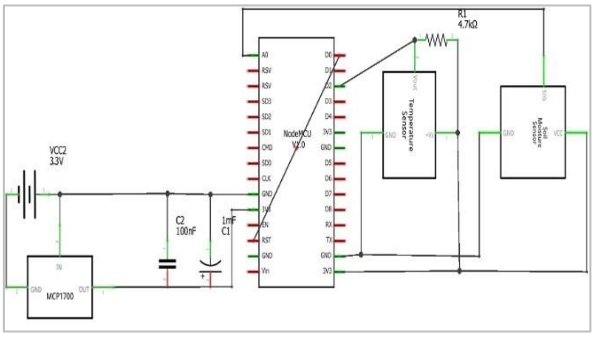

Figure 13-2 Circuit Connections for the System

B. NodeMCU

Node MCU is an open-source IoT platform. It includes firmware, which runs on the ESP8266 Wi-Fi SoC from Expressive Systems, and hardware, which is predicated on the ESP-12 module. The term "Node MCU" by default refers to the firmware instead of the dev kits. The firmware uses the Lua scripting language. The programming code is being written for ESP8266 Wi-Fi chip using Arduino IDE, for which installation of ESP8266 library is required.

Figure 13-3 NodeMCU

C. Sensors

Soil moisture sensor (TE215) and Temperature sensor (DS18B20) are used in this system. The Soil Moisture Sensor measures the water content of soil using capacitance (by measuring the dielectric permittivity of the soil). While DS18B20 is a one-wire digital temperature sensor which can measure temperature from -55˚C to +125˚C with an accuracy of ±5%.

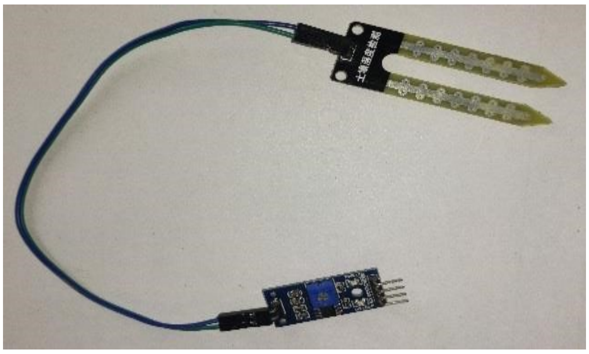

Figure 13-4 Soil Moisture Sensor (TE215)

Figure 13-5 Temperature Sensor (DS18B20)

D. Power Supply

The NodeMCU was supplied 3.3V as input using 3 AA Alkaline battery (2400mAh) along with LDO regulator and electrolytic and ceramic capacitor to maintain a stable input voltage. NodeMCU remains in sleep mode, activates for a few seconds, connects to internet hotspot and sends the reading of the sensor to the IoT platform and again goes into the sleep mode, thus leading to efficient utilization of power source.

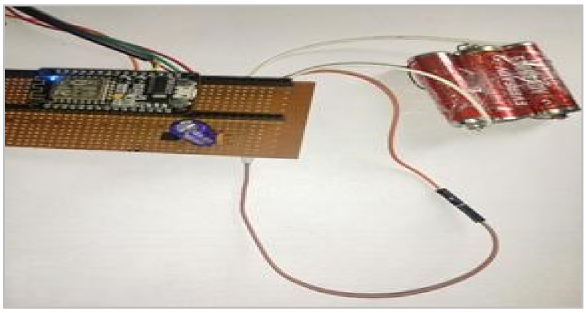

Figure 13-6 Power Supply Circuit

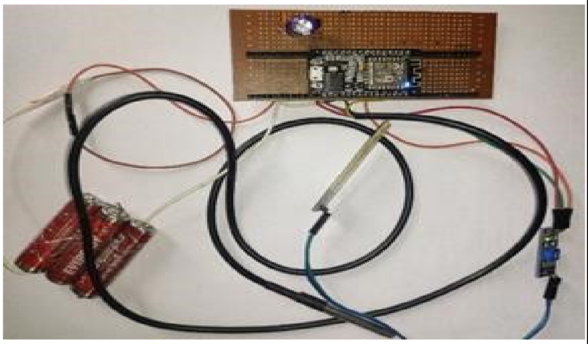

Figure 13-7 System Circuitry Setup

E. Water Pump

It is used to pump water to the desired location in the field according to the data from the sensors.

F. ThingsBoard IoT Platform

ThingsBoard is an open-source IoT platform for device management, data collection, processing and visualization of our IoT project. It supports both cloud and on-premises deployments and enables device connectivity via industry standard IoT protocols - MQTT, CoAP and HTTP. ThingsBoard combines scalability, fault-tolerance and performance and hence the chance of data loss is minimal.

G. Working

The sensors are placed at different locations in the field and these are connected to the NodeMCU. The whole system is placed in an internet hotspot zone and ESP8266 Wi-Fi SoC module in NodeMCU get connected to it. The NodeMCU sends the data to the IoT platform and real-time sensor reading is monitoring using a smartphone or computer. Whenever the pre-set conditions according to the crops are not fulfilled then alert messages are sent to the farmer through e-mail, text message and on Telegram app and NodeMCU also controls the irrigation system (On/Off of Water Pump).

RESULT AND CONCLUSION

The Soil moisture sensor (TE215) and Temperature sensor (DS18B20) sends the reading to the IoT platform at regular interval through the NodeMCU. The IoT platform- ThingsBoard stores the sensor reading and analyze it as per the pre-set conditions according to the crop and whenever the moisture content of soil goes beyond the required range, an alert mail and text message is sent to the owner and the water pump starts pumping water to the desired location on the field until it is in the required range and then the motor stops.

The alert mail and messages are sent using APIs (Twilio, SendGrid).

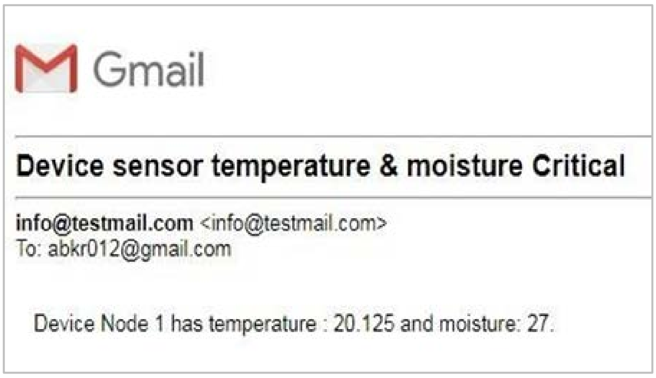

Figure 13-8 E-mail Alert

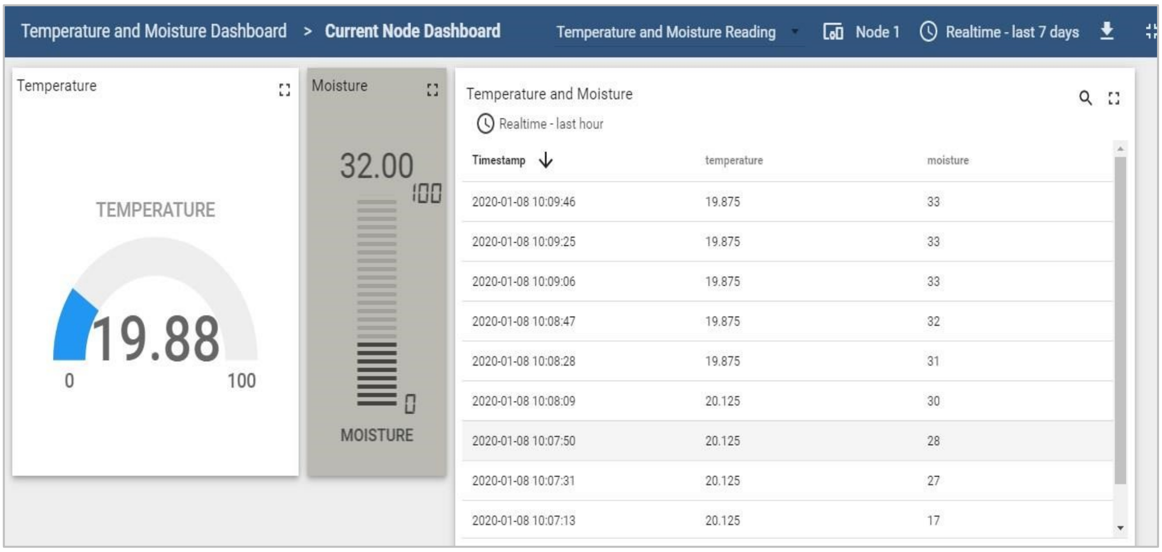

Figure 13-9 ThingsBoard-IoT Platform Dashboard showing sensor reading when the soil's moisture content is low.

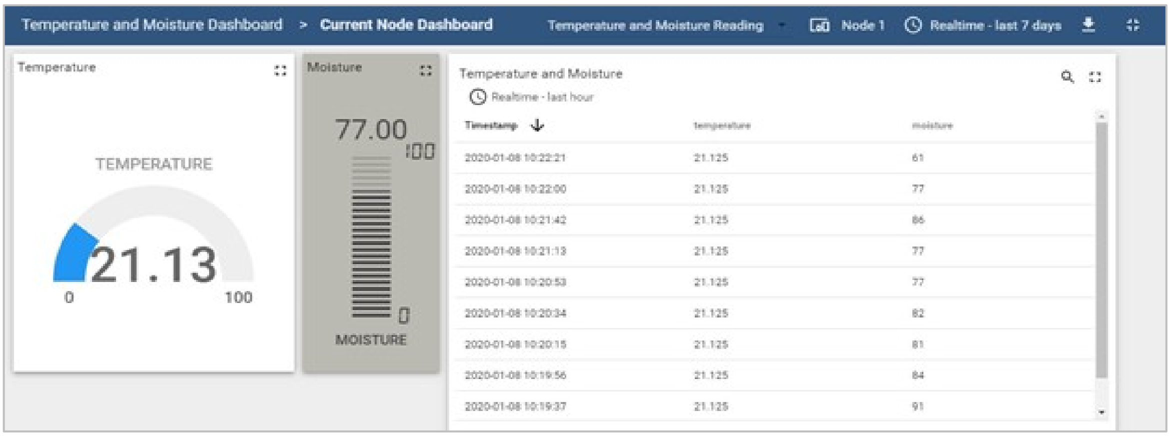

Figure 13-10 ThingsBoard-IoT Platform Dashboard showing sensor reading when the soil's moisture content is high.

The system is experimentally proven to work satisfactorily and monitors the values properly. The user not only gets real-time information but also previous data as well. It can be monitored from anywhere anytime by the authorized user.

FUTURE ASPECTS

The proposed system can be further extended to the application of drone for taking images of the crop and using image processing predicting the health of the crop and alerting the farmer about the pest affecting the crop and which pesticides to be sprayed. The drone can also replace the water pump used to irrigate the field. The concept of machine learning can be applied to the sensor's readings observed throughout the year and can predict the trend of field conditions throughout the year leading to the selection of suitable crop for the agricultural field.

REFERENCES

[1] Christopher Brewster, Ioanna Roussaki, Nikos Kalatzis, Kevin Doolin, Keith Ellis, "IoT in Agriculture: Designing a Europe-Wide Large-Scale Pilot", IEEE Communications Magazine, vol: 55, issue: 9, pp. 26-33, Sep. 2017.

[2] Olakunle Elijah, Tharek Abdul Rahman, Igbafe Orikumhi, Chee Yen Leow, MHD Nour Hindia, "An Overview of Internet of Things (IoT) and Data Analytics in Agriculture: Benefits and Challenges", IEEE Internet of Things Journal, vol: 5, issue: 5, pp. 3758-3773, Jun. 2018.

[3] Ji-chun Zhao, Jun-feng Zhang, Yu Feng, Jian-xin Guo, "The study and application of the IOT technology in agriculture", 2010 3rd International Conference on Computer Science and Information Technology, vol: 2, pp. 462-465, Jul. 2010.

[4] K. A. Patil, N. R. Kale, "A model for smart agriculture using IoT", 2016 International Conference on Global Trends in Signal Processing, Information Computing and Communication (ICGTSPICC), pp. 543-545, Dec. 2016.

[5] Gabriela Carrión, Monica Huerta, Boris Barzallo, "Internet of Things (IoT) Applied to an Urban Garden", 2018 IEEE 6th International Conference on Future Internet of Things and Cloud (FiCloud), pp. 155-161, Aug. 2018.

[6] Theerayod Wiangtong, Phaophak Sirisuk, "IoT-based Versatile Platform for Precision Farming", 2018 18th International Symposium on Communications and Information Technologies (ISCIT), pp. 438-441, Sep. 2018.

[7] Rahul Dagar, Subhranil Som, Sunil Kumar Khatri, "Smart Farming – IoT in Agriculture", 2018 International Conference on Inventive Research in Computing Applications (ICIRCA), pp. 1052-1056, Jul. 2018.

[8] K. Jyotsana Vanaja, Aala Suresh, S. Srilatha, K. Vijay Kumar, M. Bharath, "IoT based Agriculture System using NodeMCU", International Research Journal of Engineering and Technology (IRJET), vol: 5, issue: 3, pp. 3025-3028, Mar. 2018.

[9] C. Sai Kiranmal, M. Sumesh, "IoT based Smart Irrigation system using NodeMCU", International Journal of Soft Computing and Artificial Intelligence, vol: 6, issue: 1, pp. 55-57, May 2018.

[10] Thomas Lee Scott, Amma Eleyan, "CoAP based IoT data transfer from a Raspberry Pi to Cloud", International Symposium on Networks, Computers and Communications (ISNCC), pp. 1-6, Jun. 2019.

[11] Samudra Vishal Mukherji, Ritesh Sinha, Soumya Basak, Sambit Prasad Kar, "Smart Agriculture using Internet of Things and MQTT Protocol", 2019 International Conference on Machine Learning, Big Data, Cloud and Parallel Computing (COMITCon), pp. 14-16, Feb. 2019.