IoT Based Automatic Plant Watering System Through Soil Moisture Sensing—A Technique to Support Farmers' Cultivation in Rural India

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IoT Based Automatic Plant Watering System Through Soil Moisture Sensing—A Technique to Support Farmers' Cultivation in Rural India

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Abstract Agriculture and Cultivation of paddy, wheat and vegetables basically takes place in Rural areas where technology isn't available to that extend where this kind of huge production of grains and vegetables can be automated to help farmers. Farmers spend most of their time in the Agriculture field for watering the crop by leaving other works. Hence to help farmers from staying on the field whole day, we came up with a project which senses soil moisture and based on the data this system automatically turns ON the water pump into the field, and when the soil reaches enough moisture level, then water pump automatically gets turned OFF. Hence this concept may provide a long term solution to the farmers for a maintenance free agriculture where farmers don't have to stay on the field breathing toxic chemicals and spoiling their health. The proposed project also have other features like sensing the Ambient temperature and humidity in the Agricultural field, sensing daylight intensity and rainfall detection on the field. Hence this inexpensive project can provide a solution for many agricultural and health related problems. To implement this project in a ease of access and updated way, we have incorporated IoT platform where the farmer can monitor all these field parameters over internet on their smart phone application. Therefore this could be a milestone in rebuilding the future.

Keywords Nodemcu · DHT11 · IoT · Blynk · Soil moisture · Relay

1 Introduction

The Internet of Things (IoT) has transformed the way we live in this world [1]. Now we have Smart connected homes, cars, more integrated industries, smart cities, smart villages [2] all these because of IoT systems.

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Our Earth will reach a population of 9.2 billion by 2048. Hence to feed this huge population, the old agricultural practices needs to be combine with IoT [3]. The dramatic change in climate and weather has left a environmental impact on farming, hence smart farming through the use of IoT will help farmers to reduce waste and increase productivity [4–6].

IoT application help farmers to collect data regarding health and condition of their crop [7]. By using internet of things (IoT) and sensors network technology we can control water wastage by adapting green farming methods in irrigation [8].

Every second, the field conditions like soil moisture, rainfall, humidity, temperature and light intensity are sensed and this data is sent to IoT cloud server and will get updated on smart phone of the farmer, so that the farmer can monitor the field without being present on the field [9].

This IoT system will be very helpful in solving a wide range of human related problems in upcoming days [10].

2 System Design

The designed system consists of microcontroller (nodemcu) which has both WiFi and microcontroller capabilities and is a best suit for IoT application projects. The representation of such a system is shown in Fig. 1

The system further consists of bunch of sensors like soil moisture sensor to sense the moisture level in soil, DHT11 sensor for temperature and humidity monitoring, LDR sensor for light intensity and finally a raindrop sensor for rainfall detection. Depending upon the moisture content in soil, AC water pump is switched ON/OFF by a relay which is inturn controlled by NodeMCU. A logic level converter is added because NodeMCU (microcontroller) is a 3.3 V device which cannot drive or receive

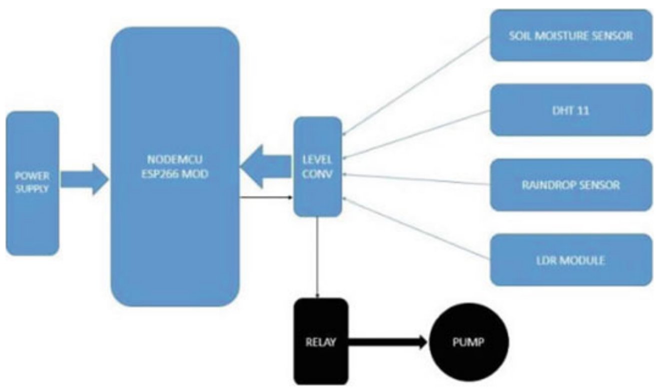


Fig. 1 Block diagram representation of system design

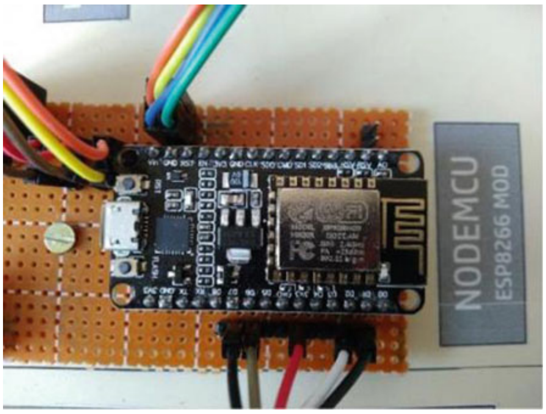


Fig. 2 NodeMCU module

data from a 5 V device. Hence to convert 5 V logic level to 3.3 V we used a 4 channel logic level converter.

3 Hardware Requirements in Implementation of Module

The following components are used for the Implementation of project.

3.1 NodeMCU

It is an open source platform having firmware (which runs on the ESP8266 WiFiSoC) and hardware (based on the ESP-12 module). The "NodeMCU" has several features such as programable WiFi module, Arduino-like (software defined) hardware IO, PCB antenna, WiFi networking, Event-driven API. The NodeMCU board is shown in Fig. 2.

3.2 Soil Moisture Sensor

Farmers can manage their crops more effectively and efficiently by measuring the soil moisture content. This is achieved using a soil moisture sensor. This sensor measures the amount of water contained in the soil by knowing the soil properties such as 'electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content' [11]. Such a sensor is shown in Fig. 3.

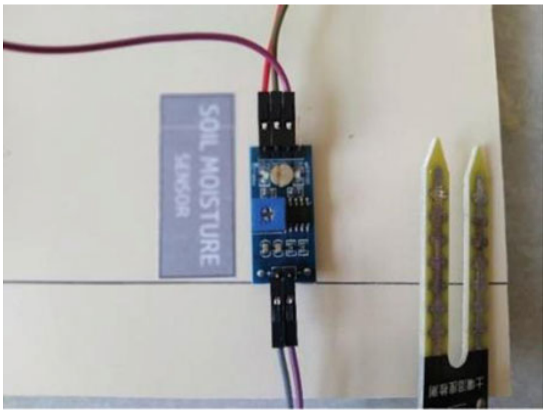


Fig. 3 Soil moisture sensor

By finding the soil moisture contents, farmers will be able to feed significant amount of water to their crops and also be able to improve the quality of the crop.

3.3 DHT11 Sensor

It is an ultra low-cost digital temperature and humidity sensor. It operates between 3 and 5 V power supply and I/O with humidity readings accuracy of 5%, temperature with ±2 °C accuracy. It measures the surrounding air humidity and temperature and gives out a digital signal. The structure of such a Sensor is shown in Fig. 4.

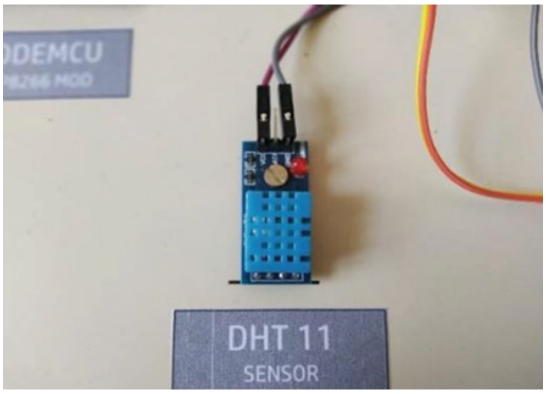


Fig. 4 DHT11 sensor

3.4 Water Pump

Water pump is used for controlling the supply of water to the field. The water pump system used in our project is shown in Fig. 5. The operation of the pump is controlled by a relay to water the crop. Whenever the field gets dried up i.e. moisture content gets reduced, the system makes the relay to operate which intern switches ON the motor till the required conditions of the soil is reached. Once the moisture level reaches the desired water for the selective crop the motor is switched OFF via the relay. The relay circuitry is shown in Fig. 6.

Fig. 5 Water pump system

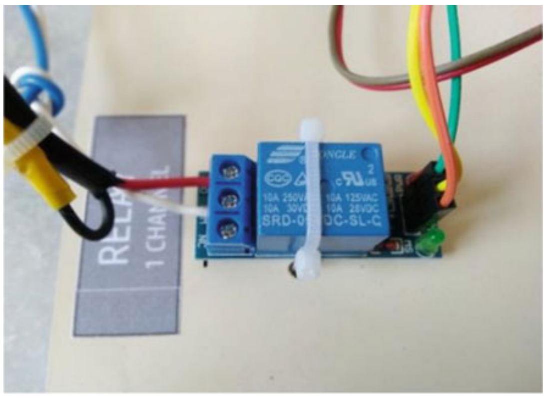
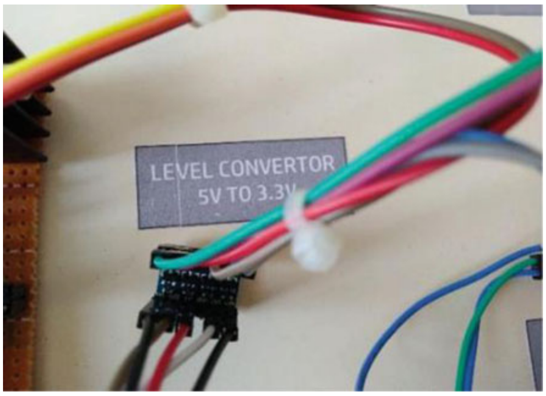


Fig. 6 Relay module for switching motor

Fig. 7 Logic level converter



3.5 Logic Level Converter

The logic level convertor is used to step up or step down the voltage levels as required for the circuit. Here SparkFun bi-directional logic level converter is used in our application. This device steps down 5 V signals to 3.3 V and or steps up 3.3–5 V at the same time. This is shown in Fig. 7.

3.6 LDR Module

The Light Dependent Resistor (LDR) is a light-controlled variable resistor. The resistance of a photoresistor varies with variation of light intensity falling on it. In other words, it exhibits the property of photoconductivity. A photoresistor finds applications in light-sensitive detector circuits, and light-activated and dark-activated switching circuits as shown in Fig. 8.

In the dark, a photoresistor will have a high resistance of several megohms (MΩ), while in the light a low resistance few hundred ohms.

3.7 Raindrop Module

The rain sensor module is shown in Fig. 9. The function of this sensor is to shut down the system in the event of rainfall. It consists of a water conservation device to control the water supply to the fields during rain fall. It causes the Irrigation System to automatically shut down in the event of rain. This saves power in system operation and time of a farmer.

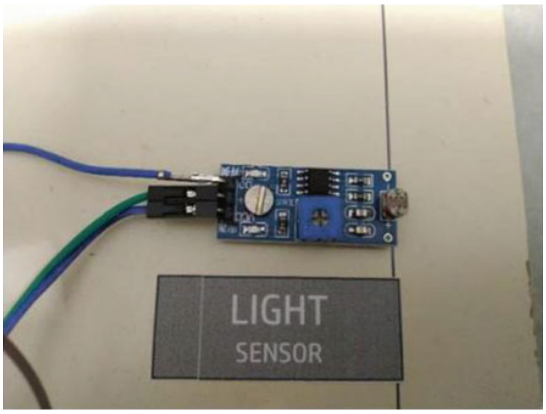


Fig. 8 LDR module to detect light sensitivity

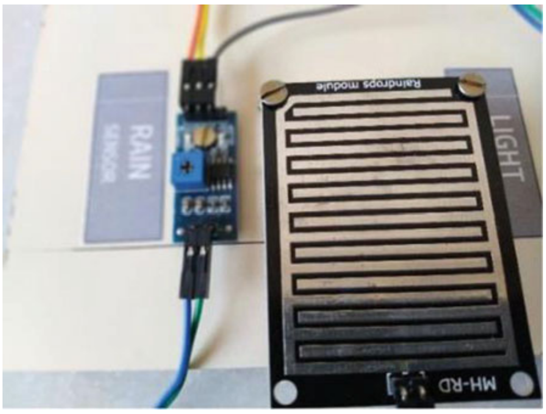


Fig. 9 Raindrop sensor circuit

4 Software Requirements in Implementation

The software used for monitoring sensors data over IoT is based on Blynk IoT Platform. It is nothing but an IoT platform with customizable mobile Apps, private cloud, rules engine, and device management analytics dashboard. The Blynk displayed on App for various conditions of soil moisture, humidity, temperature, rainfall and light intensity are shown in Fig. 10.

5 Results

The complete Test set up for Automatic Plant Watering System Through Soil Moisture Sensing is shown in Fig. 11.

Fig. 10 Blynk App display

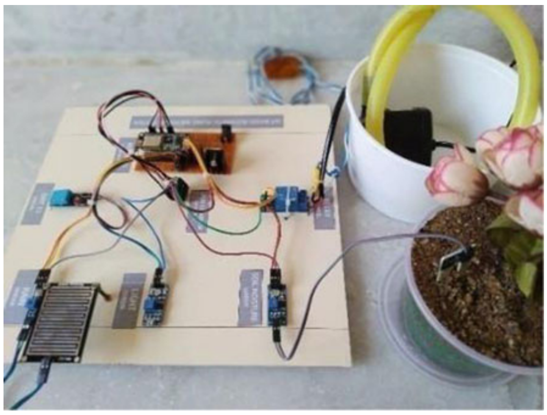


Fig. 11 Setup of the proposed system

For the project to function over IoT, Nodemcu should be provided with WiFi credentials like SSID and Password to access the cloud server. After powering everything, Nodemcu collects data from all sensors. Soil moisture sensor is an active low device which gives a low signal if the soil is wet and a high signal if the soil is dry. We also have a 1 channel relay module interfaced with Nodemcu, which is also an active low device.

When the soil in the field gets dried, the soil moisture sensor sends a high signal to Nodemcu, then according to the program, nodemcu gives a low signal to relay which turns it ON. Hence water pump starts pumping water to the field.

Now when the soil gets enough wet the soil moisture sensor sends a low signal to nodemcu which intern sends a high signal to relay which turns it OFF. Hence water pumping to the field is stopped.

All the data from sensors and the status of water pump is sent to the BLYNK cloud server, so that the farmer can monitor it from the Android Application.

6 Conclusions

Thus, IoT based automatic plant watering system has been implemented. NodeMCU collects data from all sensors and uploads to Blynk IoT server. The soil moisture sensor senses the moisture content present in the soil. If the soil is dry it sends a high signal to nodemcu which intern switches ON the water pump via the relay. If the soil gets enough wet then the sensor sends a low signal to Nodemcu, hence the water pump gets turned OFF automatically. Thus the complete system is tested. It is more efficient with affordable cost for implementation in small home gardens and can be extended for large scale cultivation of farmers.

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