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Smart Irrigation System Using IoT

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Abstract: A smart automated irrigation system for supplying water for farming is presented in this work, as an attempt to augment traditional irrigation management approaches. The concept of the Internet of Things (IoT) has been implemented to design an appropriate low-cost solution to continuously monitor the moisture level in the soil via a mobile application. In this system, soil moisture detectors mounted near the root of the plants are employed to make measurements which the system then conveys to the base station. It notifies the user as the water level goes below the set point. As it detects low moisture, a message is passed between Node MCU and Blynk App and it automatically starts the motor to irrigate the farmlands. A low cost and economically viable irrigation solution for sustainable farming is hence illustrated in this paper, which is competitive in terms of its cost and the available benefits, in comparison to the similar solutions commercially available in the market at present.

Keywords: Irrigation Systems, Internet of Things (IoT), Node MCU ESP8266, Blynk MobileApp, Soil Moisture Detector.

I. INTRODUCTION

Traditional irrigation systems are based on manual irrigation of farmlands by farmers. These processes take longer with wastage of available resources like manpower, available water resources and others. On the other hand, irrigation is a necessary activity which requires care to allow healthy development of plants, which traditionally requires laborious continuous surveillance of fields. Low-cost smart systems using the concept of IoT automation can be used to mitigate these issues, which can also increase productivity [1][2][3][4][5]. Such smart systems can be remotely synchronized with electronic gadgets or mobile applications [6][7]. Implementation of such automated irrigation systems for agriculture allow more profitability to farmers in terms of time saving and accurate usage of water without wastage [8].

In today's digital world, automatization of the systems makes tasks easy, comfortable, fast and efficient [9]. In this context, Internet of things (IoT) is one of the leading concepts in the field of control and monitoring of systems for automation [10][11][12]. IoT targets integration of multiple diverse systems present in modern society under a common framework, allows seamless management, and also continuously keeps users updated with the present state of such systems[13][14][15].

II. WORKING PRINCIPLE

This smart irrigation technique comprises of three separated sub-modules. In first module, Blynk Application is employed to get the status of the garden or farm, whereas second module aggregates different sensors such as moisture sensor to gauge the soil moistness level, and lastly the third module comprises of a microcontroller acting as a central system that communicate with different system via Wi-Fi. The microcontroller is additionally interfaced with relay module to control the water siphon or motor at gardens or farms. From sensors, various data are fetched, and based on those values, user are notified on smart phones, tablets or on web via defined user interface, by using an ESP8266 as the private sensor. Basically, control of water pump is dependent on artificial intelligence concept for automatic switching between on and off states. Using relay, NodeMCU automatically issues appropriate commands for switching the water pump on or off in the garden or farm.

The proposed system can be operated using two threshold modes: programmed set on NodeMCU and in manual mode, which user can set utilizing BLYNK Application. When it is set at programmed mode farms and garden are automated to operate based on measurements by the sensors. Then again, when it is set at manual mode, the user can control every one of the gardens or farms by means of their mobile phone or from computing device, whether in proximity of the systems, or via a remote screen with interface. The block diagram of the system is presented in Figure 1, which follows.

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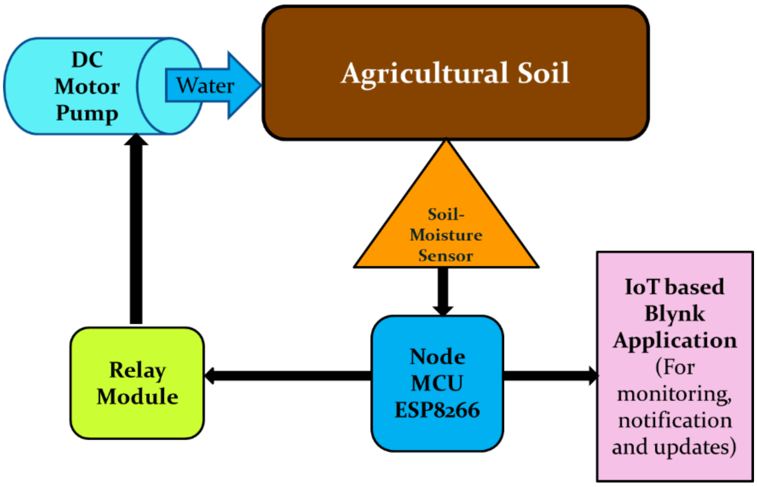

Fig 1: Block Diagram

To achieve proper results, the steps need to be followed for operation of the system.

1) Step: To activate NodeMCU, sensors and other devices, switch the power ON of the system.
2) Step: Execute the operation of hardware devices such as, sensors, ESP8266 Wi-Fi module and relay.
3) Step: Read system information from the configuration file and execute programme accordingly.
4) Step: Read and analyze results fetched from moisture sensor to check water needs of farms or gardens.
5) Step: If the moisture level gets decreased from the set point, the water pump will automatically start.
6) Step: Communicate with user using ESP8266, by transferring data and wait for user response.
7) Step: As garden or farm receives sufficient water, motor/pump automatically stops and water/energy are saved.

III. DESIGN AND IMPLEMENTATION

Smart irrigation system presented in this paper implement by Node MCU ESP8266, relay module, soil moisture sensor, DC motor pump and IoT based Blynk application. Implementation of the system is separated into hardware and software modules. The hardware module is used to detect the water level through soil moisture sensor, processing of data is performed by Node MCU and DC motor is employed to distribute water according to requirement. Blynk mobile application allows real-time monitoring and control of the hardware from remote location. A low cost, efficient and smart control of the irrigation system can therefore be effectuated using the Internet of things (IoT). The circuit diagram of the setup is presented in the following Figure 2.

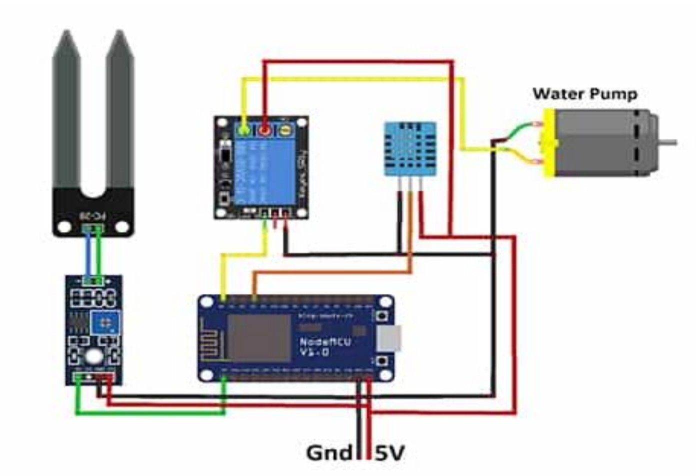

Fig 2: Circuit diagram

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COMPONENTS REQUIRED

a) Node MCU ESP8266:

NodeMCU is a system-on-chip (SoC) which incorporates a 32-bit main microcontroller, standard digitized interfaces, antenna switches, power amplifying devices, and low noise receive amplifier, channels and power the board modules into a little package. An ESP8266EX Wi-Fi module is a self-contained TCP/IP protocol that can able to access the any kind of Wi-Fi network. ESP8266 NodeMCU Wi-Fi module is extremely cost effective, with power management capabilities. It requires minimal external circuitry, and is powerful enough in terms of storing capability and on-board processing. It allows integration of different sensors through GPIO pins with minimal run time. It is integrated with on chip self-calibrated RF allowing to work under any operating conditions. The pin configuration of ESP8266 is shown in Figure 3 below.

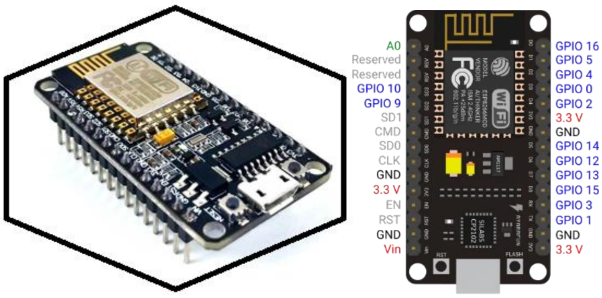

Fig 3: Pin configuration of NodeMCU ESP8266

b) Relay Module: A relay is an electrically operated switch that can be turned on or off, letting the current go through or not, and can be controlled with low voltages, like the 5V or 3.3V provided by the pins of a controller board. This relay module (Figure 4) has two channels (those blue cubes). Other models with one, four and eight channels are also available. Relay modules that are powered using 3.3V are ideal for ESP32, ESP8266, and other microcontrollers.

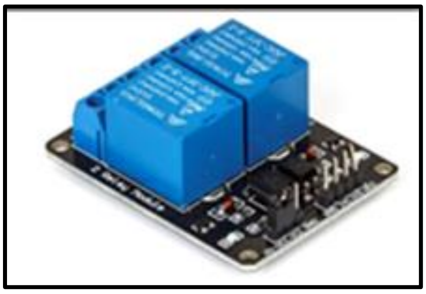

Fig 4: Relay Module

c) Soil Moisture Sensor: The soil moisture sensor uses capacitance to measure dielectric permittivity of the surrounding medium. In soil, dielectric permittivity is a function of the water content. The sensor creates a voltage proportional to the dielectric permittivity, and therefore the water content of the soil. The sensor averages the water content over the entire length of the sensor. There is a 2 cm zone of influence with respect to the flat surface of the sensor, but it has little or no sensitivity at the extreme edges. The soil moisture sensor (Figure 5) is used to measure the loss of moisture over time due to evaporation and plant uptake, evaluate optimum soil moisture contents for various species of plants, monitor soil moisture content to control irrigation in greenhouses and enhance bottle biology experiments.

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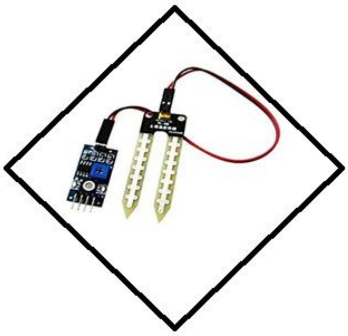

Fig 5: Soil Moisture Sensor

d) DC Motor Pump: Smaller electric water pumps, such as the kinds used in homes, usually have small DC motors. The DC motor is contained in a sealed case attached to the impeller and powers it through a simple gear drive. In the centre of the motor is a rotor with coils around it. Around those coils are magnets, which create a permanent magnetic field that flows through the rotor. When the motor turns on, electricity runs through the coils, producing a magnetic field that repels the magnets around the rotor, causing the rotor to spin around 180 degrees. When the rotor spins, the direction of the electricity in the coil's flips, pushing the rotor again and causing it to spin the rest of the way around. Through a series of pushes, the rotor continues to spin, driving the impeller and powering the pump (Figure 6).

Fig 6: DC Motor Pump

e) IoT based Blynk Application: Blynk is a platform with IOS and Android apps to control Arduino, Raspberry Pi and other similar controller boards over the Internet. It's a digital dashboard where a graphic interface for a project can be built by simply dragging and dropping widgets. The interface of the application is shown in Figure 7 below.

Fig 7: IoT based Blynk Application

In this model the demonstration is about finding the water quantity in soil, supplying water whenever required for plant and measuring water level of a reservoir. The Soil Moisture Sensor which interfaced with microcontroller gets the values from the soil where it placed. The Soil Moisture Sensor is an analog one so these values converted into digital from by inbuilt ADC of ESP8266 NodeMCU. The digital form range is 0-1023 and this digital form represents the resistance of soil. For dry soil resistance is high and wet soil has lower resistance respectively. The analog pin A0 of ESP8266 NodeMCU read the analog values form the sensors, so it connected to soil moisture sensor for reading the analog values of resistance. Similarly Ground and supply voltage pins of sensor connect to Ground and 3.3V supply of ESP8266

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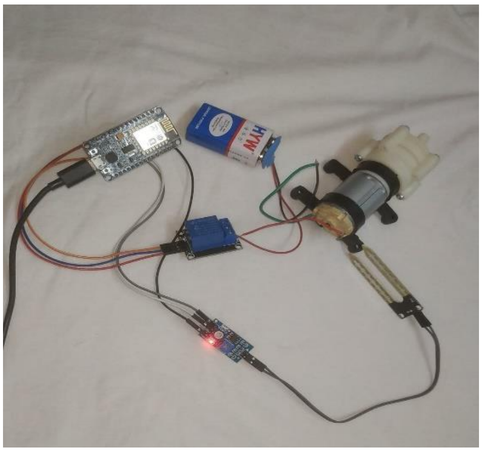
NodeMCU respectively. Likewise, moisture sensor has 4 pins. The 1st pin is connected to 3.3V supply, 2nd pin is connected to GND, 3rd pin is connected to D0, and the 4th pin is connected to A0. Relay Module has 3 pins. The 1st pin is connected to D6. The 2nd pin is connected to GND. The 3rd pin is connected to 3V3.Negative wire of Battery is connected with the negative wire of Motor Pump. Positive wires of Motor Pump and Battery are connected with closed loop of Relay Module.

IV. RESULT AND DISCUSSION

According to the circuit diagram, Node MCU, relay module, soil moisture sensor and pump are connected with each other and the IoT code is uploaded to the Node MCU and after this light blink in Node MCU which indicates that the connection is working. In order to control the soil moisture sensor device, Blynk Application is installed in our phones and a project is created and a tank and some switches are also formed by this application. The moisture level of the soil is detected by the soil moisture sensor which is shown in the moisture level tank of the BLYNK application. If the moisture level of soil is below the threshold voltage (3.3 V), a notification message comes to BLYNK application. Then the motor pump started automatically according to the requirement of soil moisture. After sometime the moisture level of soil reaches the threshold voltage (3.3 V) or above then the motor pump will stop automatically.



Implementation of Smart Irrigation System

Link: https://drive.google.com/drive/folders/1Kb6MXyc_z_Dcsf2GcUPY5OG-CbG_87d3

V. CONCLUSION

In this work we developed a smart irrigation system using IoT which helped us to fulfill the required automation in our irrigation fields and lands by synchronizing the system with BLYNK application for monitoring and control the system. moisture sensor and microcontroller in such a way that the data are transmitted with Wi-Fi module remotely and the devices are controlled through Blynk application. This transmitted information monitored and controlled by utilizing concept of IoT. The result shows us the three modules worked together to sense the moisture content of soil, analyzing the results fetched by the sensor, transferring data and communicating with user and lastly switching on or turning off the motor pump according to requirements. Such low cost, sustainable and environment friendly automated irrigation system increases productivity and reduces human effort in agriculture.

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