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IOT Enabled Agriculture in Smart Drip Irrigation System

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***Abstract*—At present, the water requirements for the irrigation system are serious these days. There is a proper irrigation system required that is in a situation to save the proper amount of water consumption. In this world, water and food as a pair of an important resource, that creates agriculture crucial to humanity. Due to development in the technology fields in the agricultural sector, the IOT technology gives a prominent result, which is an easier and quick progression for this smart irrigation. A microcontroller NODEMCU with Wi-Fi enabled device is used to exact the data from the server. Using an android or web application farmers can view or control the microcontroller device. Using this application, we can control the water level by checking the soil moisture condition and data collected from the microcontroller used in the garden. This can be obtained by combining the sensors appropriately to observe the soil status, humidity in the framer land, and temperature of the ground, all this information in sequence goes to the microcontroller and ESP8266 for the necessity of essential water supply to the harvest.**

***Index Terms*— IOT, Smart Drip Irrigation, Agriculture, NodeMCU and Moisture.**

I. Introduction

Agriculture plays the main role in India for cultivating crops, Due to the increase in population; the production rate in the agricultural fields should increase. The amount of water in the agriculture system will always increase to ensure a better output rate. According to reports, the agricultural sector currently accounts for 83 percent of India's overall water use. Accidentally, water use is not a planned process, so it is water waste. This shows that there is a vital need for systems to be built that avoids water wastage without placing mental force on farmers. The rest of the Methods of irrigation are run manually and a wide area takes a lot of time. Some automated and semi-automated methods are used for irrigation of large areas. These methods are not against traditional methods but they provide alternative methods similar to traditional methods. A number of the traditional methods like drip farming, sprinkler farming etc. Using the automated method of irrigation, the other agricultural works can also be done at the same time that will save the manpower also. Here Internet of things plays an important role in the industry that is based on agriculture like motor production industries, starters production industries. Through web connection sensors can able to communicate with each other and transmit signals. With this Internet of things, smart agriculture helps in reducing usages like duration, manpower, and sources which help in increased productivity within a certain amount of time and also in a proper method, this smart system of irrigation is built

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for looking the production using sensors like soil moisture detector, humidity sensor, and temperature detector. The data collected from the sensors are stored in the database with a cloud system. With the help of a soil moisture sensor, the soil moisture content is checked constantly. When the sensor notices any changes in soil like moisture level, humidity in the atmosphere, temperature varies, sensors start acting on changes and send the data to the microcontroller, that collected data is retrieved through android or web application. So irrigation systems are going to be operated accordingly, this system of irrigation uses the internet and its process applications. In order, the user gets some information about the crops by monitoring through the developed application. This type of irrigation system is often uses the real-time data provided from sensors that are installed in fields or gardens. The most advantages for this type of irrigation system are automation which reduces manpower is easy to adapt, cost reliability, and low consumption of power [4]. By using IoT can farm the agricultural lands. Smart drip irrigation helps a lot of farmers for better production of crops. As a part of this project we referred to a few papers and also we served few farmers with smart drip irrigation systems that we get to know that most of the farmers are not much familiar with this technology (i.e. IoT).

The main purpose of this irrigation is to use the technology in an agricultural field, and also by using the Internet of Things technology we can obtain more crop production with less utilization of water and power. A monitoring system is designed to stop wasted water and minimize labor costs, which will be managed anywhere via Smartphone. This paper's key contributions concentrate on the following issues.

- Creation of an integrated system of drip irrigation to monitor soil moisture conditions.
- Develop a web application based on IoT for the management and monitoring of the plants.
- Communication and storage of information in the cloud for analytics.
- The cell phone visualizes soil moisture, temperature and humidity.

II. Problem Analysis

Developing is an automatic device for an irrigation system that could be operated by an application. Control and water wastage can be managed to decrease the number of employees in a crop field and helps to limit the use of energyy. It minimizes the growth of weed plants in fields and decreases the water's salinity. Growing the use of sufficient quantities of water in agricultural production at the appropriate times would lead to reducing manual interference in watering operations. Raspberry Pi can usually be used for this mission, but it is expensive. Node MCU (ESP8266) is a microcontroller that helps to develop the low-cost productivity project.

III. Literature Survey

Previously many researchers performed implements on IoT based practices for the automation of irrigation [1-2]. Kansara et al [6] Concentrated on evaluating some of the automatic systems for irrigation along with the IOT, while conventional farm-land irrigation techniques are often discussed along with manual involvement. Bedekar et al. [7, 8] in software development for precision irrigation systems using IoT, consisting development of networking and hardware structures, where the initial finding indicated that this model can be practically applicable and usable. Siddagangaiah [9] has found a monitoring system for plant's health using the Internet of things in which environmental parameters such as humidity level, temperature, light intensity, etc. It can be checked by this system. It also restored the state of the soil moisture. All modified information is distributed to the IoT platform cloud network via Arduino UNO development boards. If there is some difference in the data stored in the sensor, users can receive a warning notification from their device. Rajalakshmi et al. [10] have concentrated on internet of things based framework for tracking crop fields using sensors, and the irrigation automatically also carried out. Kranthi kumar et al. [11] used Wi-Fi connectivity to establish an integrated irrigation system where the internet of things is used for small garden areas and farmland irrigation. This model is connected with a soil moisture detector and a temperature detector. At the root of the plants, the soil moisture sensor is fixed. To achieve optimum irrigation for continuous water level control, Sukriti et al. [12] have concentrated on lowering the water wastage. Agarkhed [13] implemented the Wireless Sensor Network for irrigation that converts rapidly compared to conventional agriculture, while Rawal [14] has built a system where that system collects the data from soil moisture sensor and the device also continue to update on a website where farmers can validate the on/off state of the water sprinklers. Nandhini et al [15] based on an automated irrigation method using the Arduino microcontroller for the effective arrangement of water where the condition of all sensors used are measured and displayed. An intelligent internet of things based automatic irrigation method has been attempted by shehar et al. [16] to estimate water to irrigate the soil where machines communicate with sensors and controllers and data is modified using the IoT framework. A time-based method for irrigation was developed by Govardhan et al. [17] in this paper use GSM modules. To maximize water use for farming applications, Khan et al. [18] have developed an automatic drip system. Distributed wireless network architecture was used to build the model.

Verma et al. [19] have identified an effective irrigation system to reduce water usage that allows the sequencing of irrigation system to be controlled via remote control devices. Sivakumar et al. [20, 24] attempted an automated irrigation system for agriculture using IoT technology where all data was sent via the Arduino and noticed. Alves et al.[21] have attempted to introduce a digital twin by sensing differences in Brazil's smart water control programs. In addition, to increase the efficiency of plants, we suggest the smart irrigation sensing and monitoring system based on the internet of things. The paper on the development of smart, sustainable agriculture (SSA) was presented by Alreshidi[22] and offers an IOT-based architecture for the development of a SSA network[3,5]. Upadhya et al. [23-25] use a fuzzy logic control system in which soil temperature and humidity are the input parameters that are used and the crisp yield of vegetables is obtained. Integrated drip irrigation is the basis of the internet of things technology architecture that will be managed by web/android mobile phones.

IV. PROPOSED METHOD

In agricultural areas, owing to the scarcity of water supplies, water conservation is a big concern. The intelligent irrigation system is built to mitigate the problem, and a schematic diagram is shown in Figure.1 shows the design layout of IoT based smart irrigation system. It collects all data combined with the microcontroller system for measuring and regulating water during the construction of this model. Environmental parameters such as soil humidity level, the temperature of the atmosphere, and humidity will be observed where to set the threshold value for pump working. The pump will be automatically turned off/on as per the water need. This will also explain the actual water status of the field and updates will also be submitted to the Internet and cell phone site page URL. The biggest benefit of this device is that the consumer can monitor the crop and the status of the field remotely.

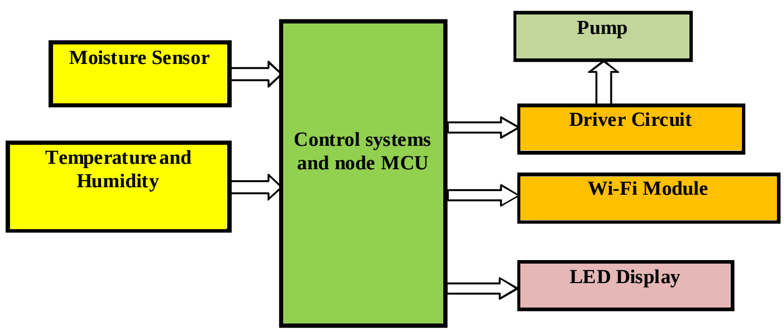

Figure 1. Design Layout of IoT based smart irrigation system

To design the system architecture for the internet of things that enables the smart irrigation monitoring model, the following tools are used:

A. *Soil Moisture sensor*

This will provide the sum of water content when it is within the soil and provides the production of the humidity level volumetrically. It contains 4 pins mainly divided as power output (VCC), analog output(A0), digital output (D0), ground output(GND) that use VCC, A0 and GND.

B. *Humidity sensor and temperature sensor*

The ambient humidity and temperature levels are determined by this instrument. Also, the input voltage is 5V. It contains 4 pins mainly divided as power output (VCC), Data out: sensor reading, the pin 3 is not used, Ground. The combination of VCC and GND by connecting them to the Arduino controller and the data reading from the sensors are taken from the pins

C. *Microcontroller module*

The ATmega32u4 and the Atheros AR9331 with Ethernet are on this microcontroller board. The ATmega has a 16 MHz processing speed. At 5V DC, the controller board runs. This board will be used to enforce both the control system and the network's data transmission

D. NodeMCU ESP8266

The wifi module NodeMCU ESP8266 is a hardware design framework that investigates the ability to communicate and work with ESP8266

E. Double Channel Relay

Switches with these relays are used to open and close the command motors. Three contactors are available: open (NO), closed (NC) and typical contactors: (COM). The COM is linked to NC at the ON input state DC 9V.

F. IoT Cloud

A network is helps to store and process the IoT data. As a "massively scalable real-time event processing engine" the IoT Cloud is defined

G. Android Studio

Android Studio is recognized as the official IDE for Android device development. This implementation is based on the concept, in which programming of Java is used for software development. Where a development tool is also available, the code is editable.

There are three layers in the IoT system architecture. The sensing layer, internet layer, and user layer are all. Both sensors are attached to the Arduino in the first sensing layer through an electricity source that creates data communication between them. To provide water pressure for the system, a submerged pump is also used. For proper activation, the Arduino is attached to a double channel relay. It provides connectivity between the open-source network and the hardware device. This type of application framework can be used for tracking and regulating systems in which the system requires to monitor and regulate the automation of agricultural parameters such as temperature and soil moisture. A web-based framework is also built wherever possible to track and manage smart irrigation systems.

From an application to the Arduino YUN microcontroller is to read sensor values. The PC command is translated and the sensors are activated /deactivated by Arduino via the optimized network, the obtained readings from various sensors are then transfers to the PC. As per the specifications, the motor pump is on and off by the Arduino according to the situation. First of all, the Arduino-based irrigation system and the PC-based monitoring system are designed for data and command sharing on the same network. For setup and link creation, the method requires some initial time.

The PC side monitoring process is started after the initialization procedures and a search is done for any important problems. When any crucial problem is detected, the buzzer is triggered and held in the same state until the problem is fixed. The test is carried out. If the plant needs to be watered, the pump is ON and held in the same condition until the recording level of moisture exceeds a healthy zone. Finally, if no termination is planned, the last search is carried out whether or not the user wishes to stop the operation, so the current data collection of the sensor are stored on the PC side and the process is repeated for some sort of problem to be continually verified. This is linked via NodeMCU which sends a message to the mobiles, delivering smart phone alerts to the user. It is sent to the smart computer again, as directed by the customer. By supplying user username and password, the data can be tracked anywhere via the webpage on the device and Smartphone. The pump can also be operated by mobile devices and the details can be modified accordingly.

V. RESULTS & DISCUSSION

ThingView is a mobile application in we view the sensor reading values. By using Channel Id and the Read API key we can connect it to the mobile. In Figure 2 shows ThingView output. By using the API key we can send the data from sensors to ThingSpeak. In Figure 2, the first one, the X-axis scale specified with Date & Time, Y-axis scale specified with Moisture. In Figure 2, the second one, the X-axis specifies with Date & Time, Y-axis scale specified with Temperature. In Figure 3 shows ThingSpeak output. In Figure 3, the first one, the X-axis scale specified with Date & Time, Y-axis scale specified with Moisture. In Figure 3, the second one, the X-axis specifies with Date & Time, Y-axis scale specified with Temperature. In Figure 3, the third one, X-axis specifies with Date & Time, Y-axis scale specified with humidity. In Figure 3, the fourth one, specified with Soil moisture. NodeMCU will update the sensor values to the ThingSpeak in every 15 seconds. The sensor information will be transfer to ThingSpeak Server in a distinct interval of time; it can be supervised from anywhere. Here the Internet plays a crucial role, the NodeMCU which is also Wi-Fi enabled whenever the Wi-Fi gets disconnect the project working will be stopped. In Thinkspeak platform has to create the channel and give the field attributes for which we would like to see as an output. In Thingspeak can able to download the sensor data weekly report and monitor.

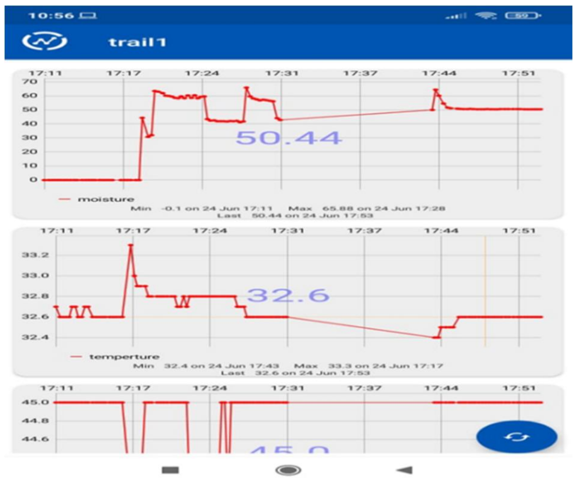

Figure 2. ThingView Output is left aligned

Figure 3. ThingSpeak Output

VI. Conclusion

A IoT powered automatic drip irrigation system is being built in this paper using a developed application is also design to track and monitor the sensors. These are linked to the cloud network system and Wi-Fi enabled microcontrollers like nodeMCU for wireless communications. In this cloud network environment, via a web-based program, the stored data can be remotely viewed. The crop health can be fetched by running an underground pump, and crop health can be tracked anywhere. It offers a viable option for access to the availability of water supplies for agricultural applications. This form of irrigation allowed by IoT helps farming to reduce the scarcity to increase water retention for acceptable applications. It is seen by developing the test setup that the Internet of Things-enabled smart irrigation system may be a successful replacement for the particular region where harvesting requires mostly needed to entail the least amount of preservation. In a range of ground, wider nurseries or open gardens, etc., this IOT-enabled drip irrigation system can be implemented. The introduction of this type of system would encourage consumers, such as farmers and gardeners, to observe and nurture crop yields and to increase overall performance. The land capability will be determined by the sensor network. Therefore, smart irrigation allowed by IoT is a favorable strategy in farming applications.

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