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SMART IRRIGATION SYSTEM BASED ON SOIL MOISTURE USING IOT

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Abstract - *Agriculture remains the sector which contributes the highest to India's GDP. But, when considering technology that is deployed in this field, we find that the development is not tremendous. Now a day's there is huge enhancement in technologies which have a significant impact on various fields like agriculture, healthcare etc. Agriculture is the primary occupation in our country. India's major income source is depending on agriculture therefore the development of agriculture is important. In today also most of the irrigation system are operated manually. The available traditional techniques are like drip irrigation, sprinkler irrigation etc. These techniques are need to be combined with IoT so that we can make use of water vary efficiently. IoT helps to access information and make major decision making process by getting different values from sensors like soil moisture, water level sensors, water quality etc. This paper focuses primarily on reducing the wastage of water and minimizing the manual labor on field for irrigation so that you can saving time, cash and power of the farmer.*

***Key Words*: Water Management, Agriculture, Irrigation, Water quality, IoT, Arduino.**

1. INTRODUCTION

Agriculture is the strength of Indian Economy. However, for agriculture water consumption is more than rainfall every year. Improving farm yield is essential to meet the rapidly growing demand of food for population growth across the world. By considering and predicting environmental circumstances, farm yield can be increased. Crop quality is based on data collected from field such as soil moisture, ambient temperature and humidity etc. Advanced tools and technology can be used to increase farm production. Developing IoT technologies can help to collect large amount of environmental and crop recital data.

"IoT encompasses many new intelligent concepts for using in the near future such as smart home, smart city, smart transportation, and smart farming" [1]. The technique can be used for application of accurate amount of fertilizer, water, pesticide etc. to enhance productivity and excellence. Sensors are hopeful device for smart agriculture. The real-time environmental parameters like soil moisture level, temperature and tank water level have continuous influence on the crop lifecycle. By forming sensor network, good monitoring of water regulation in the agriculture field can be achieved.

This paper presents irrigation monitoring and controlling system. The system was developed to monitor the environmental conditions such as temperature, soil moisture content, humidity of the air and water level of agriculture land for controlling the irrigation. The real time conditions sensed data is send to the cloud server for storing and decision making and controlling actions for future also.

2. RELATED WORK

Plenty of research work has been done to improve the performance of agriculture field.

In [1] the system uses arduino technology to control watering and roofing of the green house. It uses statistical data acquired from sensors (like temperature, humidity, moisture and light intensity sensors) compared with the weather forecast for decision making. Kalman filter is used to eliminate noise from the sensors.

Agriculture System (AgriSys) [2] uses temperature, pH, humidity sensors and the fuzzy inference to input the data from sensors. The system monitors the sensors information on LCD and PC.

Muhammad (2010), [3] Proposed a simple approach to "Automatic Irrigation control problem using Artificial Neural Network Controller". The proposed system is compared with ON/OFF controller and it is shown that ON/OFF Controller based System fails miserably because of its limitations. On the other hand ANN based approach has resulted in possible implementation of better and more efficient control. These controllers do not require a prior knowledge of system and have inherent ability to ANN based systems can save lot of resources (energy and water) and can provide optimized results to all type of agriculture areas.

Sanjukumar (2013), [4] Proposed "Advance Technique for Soil Moisture Content Based Automatic Motor Pumping for Agriculture Land Purpose" was developed and successfully implemented along with flow sensor. Salient features of the system are: Closed loop automatic irrigation system, temperature and water usage monitoring. User can easily preset the levels of the Moisture and is regularly updated

about current value of all Parameters on LCD display. In future, other important soil parameters namely soil pH, soil electrical conductivity will also be incorporated in the system.

In [5] Wireless sensing Network with ZigBee technology helps to control air humidity, soil moisture and temperature. System is implemented with components as soil moisture sensor, humidity sensor, temperature sensor, water pump, fan, relay and buzzer.

In paper [6], wireless sensor network is integrated with ZigBee to transmit soil moisture level and temperature values. The data is transmitted to a web server using GPRS through cellular network. The data monitoring can be achieved via internet using graphical application.

Chetana (2012), proposed "The Automated Wireless Watering System" is a user friendly system, which notifies the user about its status. The 2 modes of operations provide the user with the option of automatic and manual process. The system also provides the log file of the events carried out.

In [8] the paper explains wireless sensor network for sensing soil moisture level, temperature and relative humidity values. Network lifetime of the node is increased by using sleep - wake up plan. The system in this paper implements clustering of nodes. Graphical user interface (GUI) is designed in MATLAB for data handling.

All the systems discussed above are similar in the context of wireless sensor node. The difference lies regarding the communication technologies and the storage of data collected from the nodes. Generally systems use one or more servers to store the collected data. When the quantity of nodes is increased, servers will need more space for storage, resulting in increased cost.

3. PROBLEM STATEMENT

In India, agriculture is the need of most of the Indians livelihood and it is one of the main sources of livelihood. Agriculture also has a major impact on economy of the country. The consumption of water increases day by day that may leads to the problem of water scarcity. Now a days not only for crops outdoor plants in home becoming quite difficult for them.

A. Conventional Irrigation Methods

The conventional irrigation methods like overhead sprinklers, flood type feeding systems usually wet the lower leaves and stem of the plants. The entire soil surfaces saturated and often stays wet long after irrigation is completed. Such condition promotes infections by leaf mold fungi. On the contrary the drip or trickle irrigation is a type of modern irrigation technique that slowly applies small amounts of water to part of plant root zone.

Water is supplied frequently, often daily to maintain favourable soil moisture condition and prevent moisture stress in the plant with proper use of water resources. Drip irrigation saves water because only the plant's root zone receives moisture. Little water is lost to deep percolation if the proper amount is applied. Drip irrigation is popular because it can increase yields and decrease both water requirements and labour.

Drip irrigation requires about half of the water needed by sprinkler or surface irrigation. Lower operating pressures and flow rates result in reduced energy costs. A higher degree of water control is attainable. Plants can be supplied with more precise amounts of water. Disease and insect damage is reduced because plant foliage stays dry. Operating cost is usually reduced. Federations may continue during the irrigation process because rows between plants remain dry.

B. Problems in Traditional System

In the case of traditional irrigation system irrigation is done manually by farmers. Since, the water is irrigated directly in the land, plants under go high stress from variation in soil moisture, therefore plant appearance is reduced. The absence of automatic controlling of the system result in improper water control system. The major reason for these limitations is the growth of population which is increasing at a faster rate. At present there is emerging global water crisis where managing scarcity of water has become a serious job. This growth can be seen in countries which have shortage of water resources and are economically poor. So this is the serious problem in Traditional Irrigation System.

Limitations of existing system:

- Physical work of farmer to control drip irrigation
- Wastage of water
- Wastage of time
- As water sits in irrigation channels malarial mosquitoes can breed.

C. Smart Irrigation System

Smart irrigation systems offer a variety of advantages over traditional irrigation systems. Smart irrigation systems can optimize water levels based on things such as soil moisture and weather predictions. This is done with wireless moisture sensors that communicate with the smart irrigation controls and help inform the system whether or not the landscape is in need of water. Additionally, the smart irrigation controlled receives local weather data that can help it determine when a landscape should be watered.

The Smart Irrigation System is an IoT based device which is capable of automating the irrigation process by analysing the moisture of soil and the climate condition (like raining).Also

the data of sensors will be displayed in graphical form on BOLT cloud page.

The advantages of these smart irrigation systems are wide reaching. The smart irrigation system will help you have better control of your landscape and irrigation needs as well as peace of mind that the smart system can make decisions independently if you are away.

You will save a significant amount of money on your water bills because through intelligent control and automation, your smart irrigation system will optimize resources so that everything gets what it needs without needless waste. Additionally, we have all seen many places in the country that have experienced droughts and we know that our water resources are precious. With smart irrigation systems we can be better stewards of our resources which is better for the environment.

The opportunity to save dramatically, have better control and be more eco-friendly while maintaining a lush and beautiful landscape are just a few of the advantages a smart irrigation system provides and would make a wonderful addition to any home.

Smart Irrigation System uses valves to turn irrigation ON and OFF. These valves may be easily automated by using controllers and solenoids. Automating farm or nursery irrigation allows farmers to apply the right amount of water at the right time, regardless of the availability of labour to turn valves on and off.

Benefits of Smart Irrigation are

- Save water and money
- Save your customers money
- Make maintaining yard easy and convenient
- Minimize the infrastructure to store and carry water
- Protect the water resources for future generations

This paper proposes irrigation system which describes the combination of the IoT communication technology and cloud server to accomplish performance of system and data storage. The proposed system provides remote monitoring and automated controlling of irrigation with real time sensing of atmospheric and soil conditions like air temperature, humidity and soil moisture. IoT based irrigation improves farm production without any human interloping.

4. PROPOSED SYSTEM

The system has three major parts; humidity sensing part, control section and the output section. The soil humidity was detected using YL-69 soil sensor (a resistance type sensor). The control unit was achieved using ATMega328 microcontroller based on arduino platform. The output is irrigation system which is controlled by the control unit by switching it on and off depending on the soil moisture contents. Two stages of design were undertaken; **hardware** and **software.**

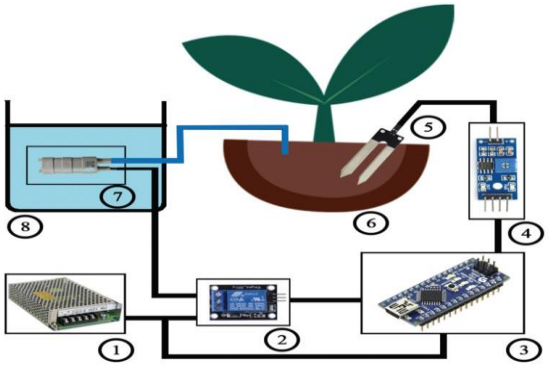

Figure 1 System Flow Diagram

1. Power Supply	5. Amplifier circuit
2. Relay module	6. Plant
3. Arduino Uno	7. Water pump
4. Soil moisture Sensor	8. Water Tank

Figure.1 shows the connection of all above mentioned materials in the system. In our experiment, we connected all required materials exactly as shown in Figure. 1 above.

The main working principle behind this system is in connecting the soil moisture sensor, which was previously embedded into the plant, to the Arduino microcontroller, which is also connected to other electronic components listed above as shown in Figure.1. Measurement of soil moisture is done by the sensor which forwards the information and parameters regarding the soil moisture to the microcontroller, which controls the pump. If the level of soil moisture drops below a certain value, the microcontroller sends the signal to the relay module which then runs a pump and certain amount of water is delivered to the plant. Once the enough water is delivered, the pump stops doing its work. Power supply has a task to power the complete system and the recommended voltage should respect the input supply range for the microcontroller, that is, from 7V to 12V.

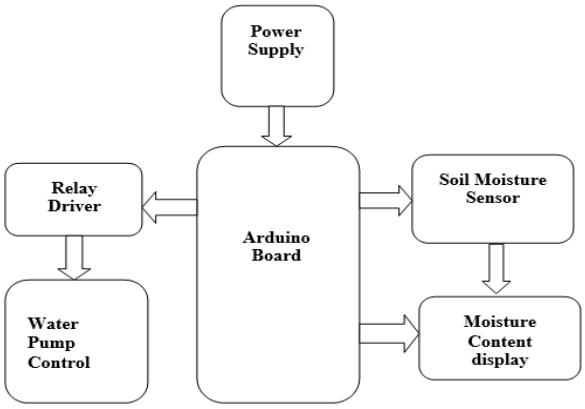

Figure 2 Block Diagram of Smart Irrigation System

Relay module is a simple circuit consisting of a single transistor, several resistors, diodes and a relay and it is controlled digitally by microcontroller. Since the complete system should be embedded in a small box, Arduino Uno is a perfect microcontroller for this purpose because of its dimensions and its work performance. Soil moisture module is consisting of the two parts: amplifier circuit and probes. The threshold is set by potentiometer. Analog output gives the real time information regarding the moisture in the plant and this output is used in the system. Water pump is connected to the relay module and it only works when the relay module gets a command from the microcontroller.

The circuit diagram of the automatic plant watering system is shown in Figure.2. The circuit comprises an Arduino UNO board, a soil moisture sensor, LCD display a motor, a 12V water pump and a motor driver IC to run the water pump. You can power the Arduino board using a 7V to 12V wall wart or plug-in adaptor or solar panel.

A. Smart Irrigation System in Action

An automatic plant watering system using Arduino microcontroller UNO R3 is programmed such that it gives the interrupt signals to the motor via the motor driver module. Soil sensor is connected to the A0 pin to the Arduino board which senses the moisture content present in the soil. Whenever the soil moisture content values goes down, the sensor senses the humidity change, giving signal to the microcontroller so that the pump (motor) can be activated. This concept can be used for automatic plant watering system. The circuit comprises an Arduino UNO board, a soil moisture sensor, a 5V motor pump, a Motor driver L293D (IC1), motor driver IC to run the water pump. You can power the Arduino board using a 5V to 9V wall wart or plugin adaptor or solar panel. You need a separate 5V to 9v battery for the pump motor.

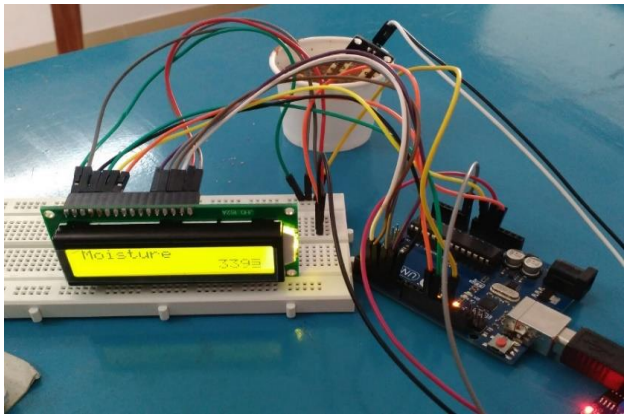

Figure 3 Measuring the Moisture Level

B. Test Case Analysis

Soil Condition	Moisture Content	Relay Status	Water Pump Status	Test Case Status
Dry	<1000 >600	ON	ON	TRUE
Damp	<600 >400	OFF	ON	TRUE
Wet	<400	OFF	OFF	TRUE

3. CONCLUSIONS

Thus the "Smart Irrigation system based on soil moisture using Arduino" has been designed and tested successfully. It has been developed by integrated features of all the hardware components used. The system has been tested to function automatically. The moisture sensors measure the moisture level (water content) of the different plants. If the moisture level goes below the desired and limited level, the moisture sensor sends the signal to the Arduino board which triggers the Water Pump to turn ON and supply the water to respective plant. When the desired moisture level is reached, the system halts on its own and the water Pump is turned OFF. Thus, the functionality of the entire system has been tested thoroughly and it is said to function successfully

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