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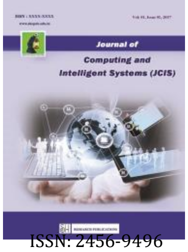

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IoT-enabled Smart Irrigation System for Crop-Field Monitoring

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Abstract — Agriculture is of critical importance to the expansion of food production across the country of India. When there are not enough other water sources, the agricultural sector in our nation is dependent on the rainy season. As a result, irrigation is utilized in agricultural settings, marking a significant step forward in developing Internet of Things (IoT) technology. The Internet of Things plays a significant part in various industries, one of which is agriculture, which, with its help, may provide food for billions of people across the world. Readings from the sensor, such as those relating to soil moisture, temperature, air humidity, and decision-making under the user's control, are taken by the sensor (farmer). When the humidity and temperature of the land begin to drop, the irrigation process begins on its own. This system will be advantageous in locations with limited access to water and will fulfil its requirements effectively.

Keywords – Smart Irrigation, Sensors, Crop, Moisture.

I. INTRODUCTION

In In India, 60-70 percent of the economy is based on agriculture and there is a need to update existing farming methods for higher output. The groundwater level is falling day by day due to uncontrolled water usage, the lack of rainfall and the scarcity of groundwater, reducing the amount of water on earth.

Water scarcity has rapidly become one of the most pressing issues facing the world. In every field, we need to have access to water. Water is also necessary for our day-to-day activities. Agriculture is one industry that uses the most water per unit of output. The most significant challenge faced by the agricultural industry is water waste. Every time, additional water is provided to the fields in excess. There are a variety of approaches that can be taken to prevent or reduce water waste in agricultural settings.

The system exists a) Reduces the use of both energy and water resources; b) Allows for both manual and automated manipulation of the system and c) Measures the volume of water. Agriculture has provided poor yields compared to population growth due to climate change and flaws in weather forecasting. For irrigation purposes, canal systems are frequently utilized. In these systems, water is pumped into the fields at predetermined intervals, but there is no information regarding the level of water present in the field [1]. This irrigation method harms crop health and results in low yields since certain plants are sensitive to the amount of water present in the soil.

A conventional irrigation system cannot control the amount of water delivered as an intelligent irrigation system does. The temperature and humidity sensor, both included in the cutting-edge irrigation system, make up the feedback mechanism of the system. Many different technologies can detect moisture, such as Evapo-Transmission (ET), thermal imaging, capacitance methods, neutron scattering systems, and gypsum blocks. Regardless of how quickly they can respond, capacitive sensors are expensive and time-consuming to calibrate because they require exposure to a wide range of temperatures and types of soil.

The Tron study's new humidity sensors are incredibly accurate, but the current radiation risks, calibration difficulty, and cost are prohibitively expensive. A sizeable agricultural field has many different areas, so measuring humidity in one spot makes little sense [2]. As a result, several distributed sensor nozzles and scattered pumping units are required to pump water to specific sensor unit-covered locations. This paper proposes an automatic irrigation unit combined with a low-cost moisture sensor.

II. BACKGROUND

A variety of compounds, including mineral and natural particles, are used to measure the amount of moisture in the soil. These compounds form gaps between water and air [3]. The kind of soil can be divided into the four categories, which is depicted in Table 1.

Clay	Silt	Sand	Gravel
0-0.002mm	0.002-0.075mm	0.075-4.75mm	4.75-80mm

Table-1: Four categories of soil

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It is very recommended that you shatter the ground to support its classification. Because the features of each taxon are distinct from one another, the range of water that a taxon can contain varies from one category to the next. When water penetrates the soil, it fills the spaces between the soil particles at the point where each location is completely submerged in water, referred to as the level sinking point shown in figure 1. This phase lasts for only a brief amount of time. As time passes, the water level in the profile decreases because of the effect of gravity, which causes the water to fall. At the same time, the short function provides the reverse force and makes adjustments to how it interacts with gravity. This level is called the field limit. Vacuum seats are loaded with water and airpacks.

Figure 1. water holding property of soil

Every harvest has a significant soil moisture deficit; this condition aids in keeping the dry soil past, prevents water withdrawal from the correction, and reduces yields. The removal of excess water from the soil is a withering point, as shown in Figure 2, due to the impact of surface strain on the yield to remove this as the water retains a small number of soil particles. The accessible water limit is the amount of water that a dirty plant can keep in the dirt in the field range and the amount of water kept in a speck of dirt in the long run point. The upper part of the root zone is where plants get most of their water. The potential root zone refers to the upper part of the root zone depth where 70% of the harvested water is taken. It is possible to produce several methods for estimating the amount of moisture in the soil, ranging from the direct sensing strategy to the most sophisticated electronic devices.

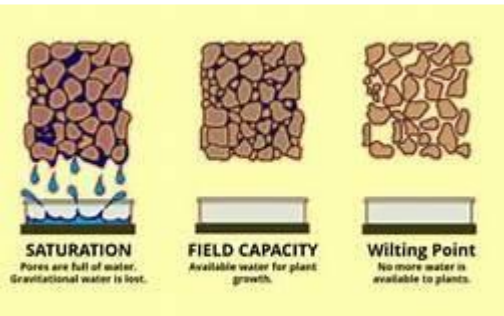


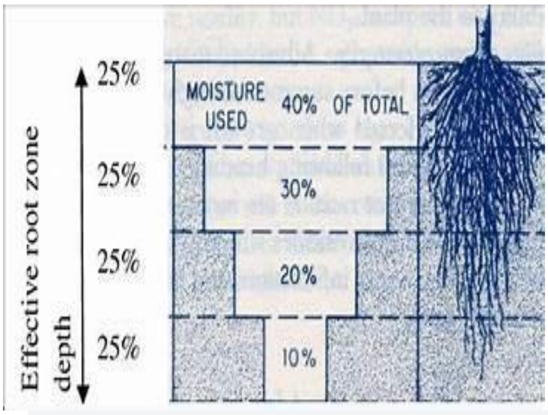
Figure 2. Effective root zone

B. Temperature Measurement Monitoring the temperature is an essential component of daily life. Similarly, it considers the crucial phase in the development of the plant, and after that, it monitors the temperature as the foundation for effective agricultural instruction. The physical properties of a working material that change with temperature can be estimated using several different standard methods. The event will include thermocouples, thermostats, RDT, pyrometers, and infrared.

C. A Quantification of the Relative Humidity There are three perspectives to consider while talking about humidity. It is a vapour measuring (water that drops a liquid to an undetectable gas). Direct humidity is defined as the actual concentration of vapour in the air at a specific time. Based on the temperature of the air, relative humidity is calculated as the ratio of the maximum amount of moisture that the air can hold to the least amount of moisture that the air can hold. For instance, warmer air will have a higher percentage of relative humidity.

1. Smart Irrigation System

The sensor allows for the automation of the irrigation system. Low-cost moisture sensors for the soil, temperature, and humidity are currently on the market. They are maintaining a vigilant watch over the playing field at all times. The sensors are connected to the Arduino board in some way. The data from the sensors are then sent to the user, who is in charge of controlling the irrigation system. The user can let the application choose for them automatically, without user intervention or manually, using the application. If the soil moisture is below the threshold value, the motor will start running; however, the motor will stop running if the soil moisture is above the threshold value. The sensors are connected to the Arduino board in some way. These talk to one another by exchanging pieces of hardware. The schematic representation of the intelligent irrigation system is shown in Figure 3.



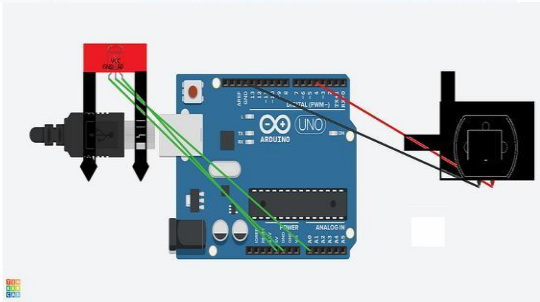


Figure 3: Circuit Diagram of the Proposed System

III. Components of Smart Irrigation System

Arduino Microcontroller

The Easy Dow hardware and software serve as the foundation for the open-source electronics platform known as Arduino. Inputs, such as a light on a sensor or a finger on a button, can be read by Arduino boards, switching on the associated outputs to control a motor or LEDs. A microcontroller is a little computer that incorporates its circuitry into its design. In today's language, it is called a "system on a chip." It has one or more central processing units and memory and programmable input/output devices. The primary application for microcontrollers is embedded systems, including the engine control systems of automobiles, compatible medical devices, remote controls, office machinery, and other embedded systems such as self-regulating products and gadgets.

Figure 4 shows the Arduino microcontroller where the Arduino board can communicate at various baud rates. Baud measures how many times the hardware can send 0's and 1's in a second. The software used by the Arduino is Arduino IDE.

3.1 Sensors

This system employs a temperature and humidity sensor and a soil moisture sensor to collect soil moisture and environmental condensate data.

3.1.1 Soil Moisture Sensor

Sensors that monitor the amount of water present in the ground are called "soil moisture sensors". Because direct gravity measurement of free soil moisture requires removing a sample, drying it, and weighing it, soil moisture sensors measure water levels indirectly by utilizing other soil properties, such as a proxy for electrical resistance contact with neutrons or contact with contact neutrons. Because of this, the sensors can measure water levels more accurately.

The soil moisture sensor depicted in figure 5 contains two probes via which current flows into the soil and then detects the soil resistance to read the moisture level. The water soils are more prone to electrical conductivity, resulting in reduced resistance in the soil; on the other hand, dry soils have higher resistance to electrical conductivity.

Figure 5: Soil Moisture Sensor

IV.MethodologySensor

The dampness content sensor and the ultrasonic sensor are part of this stage. The dampness content sensor estimates the amount of water in the dirt, converts it into an electronic sign, and sends the message to the microcontroller.

The ultrasonic sensor is located on the supply. It functions as a transducer, converting water depth in the repository (distance of water surface from the sensor) into electronic signals sent from the miniature regulator. It should be noted that the electronic signals from the two sensors are straightforward.

Control

The regulator utilized in this experiment is an Atmega 382 microcontroller on Arduino Uno. Its work is to organize all outstanding water system framework activities. The micro regulator obtains approximated values from the two sensors in the type of simple voltages and digitizes them. It at that point registers the suitable control scheme intended to carry out the water system reliant on the dirt dampness substance and level of water in the supply. The regulator yield is provided as an enhanced control to the water system syphons utilizing the transfers.

The situation with the framework, including the water level, dampness content and the syphons actuated for the water system, is presented on a Liquid Crystal Display (LCD) associated with the micro regulator. The regulator draws its force from a 12 volts D.C. source. The Arduino Integrated Development Environment (IDE) used the Arduino content programming language and transferred it to the microcontroller. The calculation empowers the framework to consequently begin/stop syphons when the dampness content arrives at present borders; decide the number of syphons to be performed at any moment, and focus on the area to be flooded, reliant on the water level in the repository.

Water Optimization

This stage guarantees that water is satisfactorily supervised during the spent water system. It leverages the ultrasonic sensor to quantify the degree of water in the supply and delivers this to the microcontroller. In light of this, the microcontroller determines which syphons to deliver to the water system at a particular time. It involves transfers, syphons, and sprinklers that supply water to the water system site. Siphons 1, 2 and 3 are designed to be feed-forward syphons, while syphon 4 is a critique syphon. It suggests syphons 1, 2 and 3 syphon water through the sprinklers to the water system site, including ranch A, ranch B and homestead C. The criticism syphon reuses the abundance of water from ranch A, ranch B and homestead C back to the source. This strategy of keeping away from water wastage and keeping up regular accessibility of water for water system needs is specified in this method. The force for the hand-off and the syphons is a 12 volts D.C. supply.

V. Conclusion and Future Work

The computerized water system framework was revealed to be feasible and clever for advancing water assets for farming creation. This water system concept permits construction in places with water constraints to increase maintainability. The water system framework assists the rancher by making his task more intelligent. As the desire for water increases, with the demand to guarantee natural sea surroundings, water protection rehearses for the water system should be feasible and affordable. As several sensors are utilized, water can be delivered specifically to the necessary land space. This framework reduces water utilization to an extreme degree. It needs little support. The force utilization has been cut without question. The yield efficiency increases and the wastage of harvests are many reduce. The expansion effort makes UI a lot less complex simply by employing SMS messages for notices and working the switches.

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