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A Review on Intelligent Irrigation System

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Abstract - *Farmers in developing nations like India have relied on manual irrigation control systems. In manual irrigation system, some plants in a given region receive more water, while others get insufficient water. The unequal distribution of the water in conventional irrigation techniques results in crop damage and wastage of water. This leads to the need of an efficient irrigation system to manage and control the water resources. Intelligent Irrigation employs soil moisture sensors and microcontrollers to provide water to plants as needed without the intervention of the farmer. Intelligent irrigation is the efficient use of water systems that, by sensing the needs of plants, may eliminate all of the flaws in current irrigation systems. The Intelligent Irrigation System, when used and promoted, not only saves water but also improves farm output and efficiency. This paper contains reviews and discussion on intelligent irrigation systems.*

Key Words: irrigation, microcontroller, sensor, conventional, intelligent irrigation, sprinkler irrigation.

1. INTRODUCTION

Water is the most precious and essential natural resource for the existence of life on earth. About 70% of the earth's surface is covered by water, yet less than 1% is available for human use. This available water is declining day by day. Poor management of water resources, enlarged pollution and careless usage of water leads to the crisis of water shortage. As the world's population has grown dramatically in recent decades, so has the demand for food and water. Aside from these requirements, faulty irrigation practices result in significant water wastage in the land. A considerable volume of water is used for agricultural purposes all around the world. Agriculture already consumes 70% of all freshwater withdrawals, and this figure is predicted to rise as a result of population expansion, urbanization, and climate change.

Agriculture is critical to the economics and growth of a country like India. Indian agriculture is experiencing major issues as a result of seasonal and climatic changes across the country. Irrigation is described as the science of applying water to land or soil artificially. Farmers in our country have relied on manual irrigation control systems. During this process, a few plants in the zone receive more water, while others in the zone do not receive enough water, causing the crops to dry out. Thus, we require better water resource management and irrigation water control technologies. Intelligent irrigation is the efficient use of water, a method that can solve all of the flaws in current irrigation systems by intelligently sensing plant needs. This can be used as a complement to our current irrigation systems, including sprinklers and drip irrigation. To make the most use of water for crops, an automatic irrigation system is required. This can be used to deal with both over and under irrigation.

2. IRRIGATION

Irrigation is the technique of regularly providing a controlled amount of water to plants. Irrigation aids in the growth of agricultural crops, the maintenance of landscapes, and the vegetative growth of plants in dry places during periods of insufficient rainfall. Nutrients are also supplied in this procedure. There are different methods of irrigations developed over years to meet the need of irrigation in different regions, they are:

2.1 Surface Irrigation: Water flows across the soil by gravity in surface irrigation. Surface irrigation is frequently thought to be inefficient. It involves techniques such as furrowing, floods, and contour farming etc.

2.2 Sub-surface irrigation: Sub-surface irrigation is a type of irrigation in which water is administered beneath the soil surface. Water is supplied by ditches or underground drains to raise or maintain the water level near the plant root zone. Subsurface irrigation is rarely employed in areas that are arid or semi-arid where watering is required often.

2.3 Sprinkler irrigation: Sprinkling or spraying water from fixed or moving sprinklers is used to apply water to the soil. Water is applied in form of rain drops. Since water application is more controlled with sprinkler irrigation than with surface

irrigation, it is usually more efficient. Sprinkler irrigation in windy, hot, and humid environments can result in large water losses due to evaporation and wind drift.

2.4 Drip irrigation: In drip irrigation, water is supplied to the soil surface as drops via dripping or spraying through emitters. It enables water to trickle slowly to the root zone. In comparison to other approaches, drip irrigation has a high efficiency.

3. PROBLEMS WITH CONVENTIONAL IRRIGATION

Traditional irrigation systems are primarily operated manually and are based on farmer's observations of real-time weather and soil conditions in the field. Water schedules are determined by the farmer's experience, which is not always precise. Farmer's biggest problem is water scarcity, which is caused by lower rainfall. Crops in low-rainfall locations dry up due to a lack of water. Due to variations in water supplies, farmers may need to water the field at irregular times. Water is distributed unevenly in traditional irrigation techniques. Furthermore, because of human mistake, there is a considerable risk of overwatering and underwatering. Water logging, soil leaching, salinity, nitrogen loss, rising pumping costs, low yield, and increased weed growth are among the other issues. Agricultural activity degrades many freshwater resources by contaminating them with pesticides and fertilizers from runoff. The majority of traditional irrigation techniques are inefficient, consuming more water and hence increasing the cost.

4. INTELLIGENT IRRIGATION SYSTEM

The soil moisture sensor is the heart of the intelligent irrigation system, which acts in accordance with the moisture content of the soil. A soil moisture sensor and a microcontroller are used in this system. The sensors are connected to the Arduino microcontroller's input. Depending on the kind of soil and crop, the microcontroller is setup with a threshold value. The micro controller will automatically turn on the pump if the measured value exceeds the program's threshold, and vice versa. The intelligent irrigation system's design will automatically manage the water flow in the field to keep it in good shape. This method can be thought of as an extension to sprinkler or drip irrigation.

5. WORKING

It's a real-time system that relies on a soil moisture sensor to work. Sensors, which are made of corrosion-resistant material, are buried in the soil. The moisture in the soil is detected by the soil sensor, which sends signals to the microcontroller. The microcontroller used is an ARDINUO UNO microcontroller that has been programmed to receive input signals from sensors. The Arduino software is used to program the microcontroller, and the entire system runs on it. Depending on the soil and crop type, a threshold is setup. The system will switch on the pump and deliver water to the crops when the moisture in the soil falls below the threshold value; however, once the moisture in the soil surpasses the threshold, the water supply will be cut off. The water is delivered to the fields via pipelines. A solenoid valve regulates the flow of water. When a field reaches the required level, the control valve is adjusted to close the flow to that field, and if watering is required again, the valve is adjusted to open. The system is configured to turn off the main motor once all of the fields have reached the required water levels.

6. COMPONENTS

The main components used are:

6.1 Soil Moisture Sensor: The moisture content of the soil is measured using soil moisture sensor probes. Based on the dielectric constant of the soil, soil moisture sensors determine the volumetric water content of the soil.

6.2 Microcontroller: Arduino Uno is the microcontroller used. It is an open-source platform composed of a UNO board and an Integrated Chip ATmega328P microprocessor. Arduino software is used to program the UNO board. This program controls the irrigation system. The microcontroller receives input, processes it, and then controls the output.

6.3 Solenoid Valve: It is an electromechanical valve that regulates the flow of liquids or gases. The current passing through the solenoid coil controls the valve's opening and shutting. The solenoid transforms electrical energy to mechanical energy, which opens or closes the valve mechanically.

6.4 LCD Display: It is used to display the current statistics. It displays the sensor values that have been observed and sends out alarm messages.

6.5 Software: Arduino IDE 1.8.5 is used for this system. It is a free and open-source program writing and debugging tool. It can be used to create intelligent irrigation system programs.

6.7 Pump: It is a submersible pump that is employed. It is submerged in the fluid to be pumped. It has a hermetically sealed motor attached to the pump's body. The main benefit of this sort of pump is that it can prevent the pump from cavitation.

6.8 Motor: Through the interaction of the magnetic field and the current-carrying conductor, the motor converts electrical energy into mechanical energy. When the soil is wet or dry, a motor is used to switch on/off the pump.

6.9 Sprinklers: Micro sprinklers are used in this system. The sprinkler spacing is the same as a standard sprinkler.

7. ADVANTAGES

- Prevent human Intervention
- Saves water
- Saves money
- Operated in remote areas
- Flexible- it can be added to drip or sprinkler system and also can be used for variety of crops.
- The system can also be operated at night, thus minimizes the water loss due to evaporation.
- Increases the yield
- Reduce human work load
- This system works on low power
- Reduces the growth of unwanted weeds.

8. DISADVANTAGES

- It is more costly compared to conventional technique.
- There are chances of deterioration of the plastic components in hot and arid climate.
- Routine checking is needed for proper working.

9. CONCLUSIONS

Agriculture is the backbone of our country's economy and plays a critical part in its development. Agriculture consumes a significant amount of water. The use of sophisticated technologies such as wireless sensor networks and the microcontroller to reduce water use is a promising strategy.

This system conserves water resources by continuously monitoring the state of water content in the soil, managing water flow, and preventing water wastage. Overwatering and underwatering are less of a concern with this approach. Farmers benefit greatly from this technology as it reduces human labor and labor costs.

The intelligent Irrigation system is applicable for agricultural fields, parks, green houses, vineyards, garden lawns, plantations etc. It may be used with both drip irrigation and sprinkler irrigation systems. Small house gardens, indoor gardens, and potted plants can all benefit from it. If properly developed, this system might potentially be used to grow commercial crops like sugarcane, carrots, coffee, tobacco etc. It would aid in water conservation by providing the correct amount of water to the crops, avoiding overwatering and underwatering. As a result, irrigation system automation decreases reliance on manual labor and boosts efficiency.

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