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C-Aqua Irrigator: A Cloud Based Irrigation System For Adopting Smart Irrigation

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Abstract
C-Aqua Irrigator refers to smart irrigation. It allows to reinvest for improving reliable, smarter and sustainable irrigation over time. The minimal wastage of water and the supply of controlled amount of water helps in the healthy growth of plants. The transition of manual process of irrigation to automated irrigation system with C-Aqua Irrigator provides an approach to use the sustainable resources judiciously. Considering the change in environmental factors like light, temperature, wind, soil moisture, humidity we can decide the right amount of water the crops requires. By recognizing the relation between the environmental factors and it's affects we can even estimate the productivity accordingly. The concept of using 'Internet of Things' makes the idea of E-Irrigation factual. The process of drawing connections between the Cloud storage and the setup helps us to store the data of farms and based on the data, we evaluate the actual need of water for the crops. The incomparable advantages of cloud storage have captured our choice of storage thereby providing strong infrastructure for the system to work efficiently and effectively. This paper focuses on a smart irrigation system which is cost effective and automatic.

Keywords: *Arduino, microcontroller, morphological, resources, sensors, yield*

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I. Introduction

The traditional method of growing crops has many problems regarding the use of resources, quality of yield crops, productivity and more. The increase of population and environmental concerns has increased the need to save water. The specific landscape needs are met by the smart use of C-AQUA IRRIGATOR. For example, according to the site's outdoor temperatures increase or rainfall decreases, the C-AQUA IRRIGATOR consider on specific variables, such as soil type, sprinklers' application rate, etc. to adjust the watering times.

The automatic decision making paradigm makes the farmer carefree as the system independently manages and controls the requirement of the site. Over- or under-irrigating a landscape can possibly increase the risks. The proposed system maximizes irrigation efficiency by reducing water waste, while maintaining plant health and quality. Incorporating smart irrigation technology in the landscape can potentially reduce outdoor water consumption.

This technology is appropriate for small, residential landscapes as well as large, managed landscapes. The complexity of operating the traditional irrigation system at night and extreme weather condition is resolved. The self-regulating irrigation process starts and stops exactly when required. "Grow more with less" has to be practiced while the demand for food continues to grow exponentially. The goal of modern agricultural measures has to do more with maximizing the yield of every crop planted with less and making the best use of natural resources. The worldwide step-change in farm productivity has resolved problems like cost of production, effective utilisation of natural resources and achieving growth of an economy. The implementation of C-AQUA IRRIGATOR settles concerns of smallholders eventually. The benefits created by the proposed system is global, not local.

In this paper we present an overview about the requirement, working, cost analysis, and various components used in the proposed system. The advantageous features of the system after installation makes it more convenient to practice sustainable farming.

A. Smart Irrigation

Smart irrigation systems tailor watering schedules and run times automatically to meet specific landscape needs. These controllers significantly improve outdoor water use efficiencies.

B. Environmental Factor

An environmental factor, ecological factor or eco factor is any factor, abiotic or biotic, that influences living organisms.

C. Cloud Computing

Cloud computing is a model for on-demand access to a shared pool of configurable resources (e.g., computers, networks, servers, storage, applications, services, software) that can be provisioned as Infrastructure as a Service (IaaS) or Software as a Service (SaaS).

D. Internet of Things (IoT)

The IoT facilitates the development of myriad industry-oriented and user-specific IoT applications. Whereas devices and networks provide physical connectivity, IoT applications enable device-to-device and human-to-device interactions in a reliable and robust manner.

E. Over Irrigation

The application of excessive water to land to assist in the production of crops is termed an over irrigation. It is mainly done where the land is dry

F. Under Irrigation

The application of insufficient water to land is termed as under Irrigation. It mainly leads to wilting and stops photosynthesis.

G. Drought Stress

Drought stress is a multidimensional stress and cause changes in the physiological, morphological, biochemical, and molecular traits in plants. It is caused by atmospheric conditions.

II. Proposed System

The manual irrigation system implemented on a field requires constant check-ups, and maintenance. The proposed system uses sensors for testing the moisture, temperature, humidity of and intensity that helps the system to find out whether the water supply needs to be activated or deactivated. The user is well informed about the status of the field. Messages are sent to the registered number that keeps the user updated even if they are away from the field too. The farmer can set the values according to the type of crop they are cultivating in a particular farm.

The simplicity of the mobile app is formulated to make it popular among farmers and to encourage them to shift from manual irrigation system to smart irrigation systems. The application supports various local languages that helps local farmers to handle the system in a better way.

III. Novel Feature of the Proposed Work

The accessibility of data about the field condition and details of environment is easy and simple. The advantage of accessing anytime and from anywhere has helped farmers to maintain the crops remotely. The environmental condition changes the water output automatically thereby leaving no chances of drought stress nor overwatering. The properly installed and programmed irrigation systems like C-AQUA IRRIGATOR not only saves your money but also help in water conservation. The reliability of the system increases convenience for farmers who travel. The changes that the proposed system is not only beneficial for the producers but for consumers altogether.

IV. System Components

Hardware used Node MCU – Arduino board, DHT – 11 Humidity and Temperature sensor, Soil Moisture Sensor, Water Motor, Relay Module, IR Sensor.

Software used Arduino, Android Studio, Java, Firebase

A. NODE MCU: Node MCU stands for Node MicroController Unit. The NodeMCU is an open source software and hardware development environment build by an inexpensive System-on-a-chip (SoC) called the ESP8266. The ESP8266 is designed and manufactured by Espressif Systems. It consists of all important elements of the modern computer like CPU, RAM, networking (wifi), and a modern operating system and SDK (Software Development Kit).

B. DHT-11: A DHT-11 sensor is commonly used to measure humidity and temperature. The basic and low-cost humidity and temperature sensor comes with a dedicated NTC which measure temperature and an 8-bit microcontroller that takes output as serial data.

C. SOIL MOISTURE SENSOR: The water content in the soil varies. The soil moisture sensor helps the system to measure the water content in the soil and can be used to eliminate the amount of stored water in the soil.

D. **WATER MOTOR:** A water pump is an electromechanical machine used to increase the pressure of water to move it from one point to another. Modern water pumps are used to supply water for various purposes like agricultural, and residential, municipal, industrial uses.

E. RELAY MODULE: The relay module acts like a switch. The pump relay module acts as a set-up transformer to route power to the pump and thereafter activate it.

F. IR SENSOR: An infrared (IR) sensor is an electronic device that measures and detects infrared radiation in its surrounding environment.

V. Cost Analysis

The below table shows the components, quantity, unit cost and total cost required for designing the C-Aqua Irrigator prototype. The cost may vary according to the field coverage where the system is installed and utilised.

SL.NO	COMPONENT	QUANTITY	UNIT COST	TOTAL COST
1	Node MCU	1	□ 365.00	□ 365.00
2	DHT-11(Humidity and temperature sensor)	1	□ 160.00	□ 160.00
3	Soil Moisture sensor	1	□ 99.00	□ 99.00
4	Water motor	1	□ 150	□ 150
5	Relay module	1	□ 190	□ 190
6	IR Sensor	1	□ 145	□ 145
7	Jumper wires	1 set	□ 130	□ 130
			TOTAL	□ 1239/-

The table displays the approximate values of the used hardware in C-Aqua Irrigator System. The total approximate cost is □1239/- to □1500/- for the hardware components. The cost is feasible and in case of any component replacement, the cost is bearable.

VI. Advantages

a. Saves water- Approximately around 30- 50% less water is used than in conventional watering method.

b. Improves growth- smaller amounts of water applied thereby preventing from soil erosion and nutrient runoff.

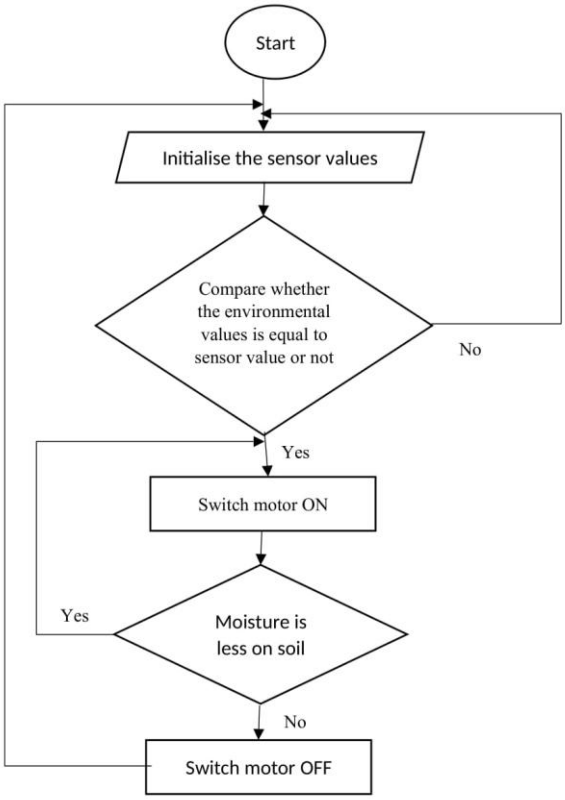
c. Saves time- Automation has helped farmers in setting and moving sprinklers after each interval.

d. Control diseases in plants- The diseases caused by moisture and wet foliage are handled well.

e. Remote care- Regular check of crops, weather condition and environmental variables from anywhere and anytime.

FLOWCHART

The below flowchart shows the flow of the proposed system. Wherein the working changes according to the conditions fitted and requirement according to the farmer's cultivation. The season, geographical area and other factors helps the farmer to decide the crop suitable for their field.



VII. Results And Discussion

The implementation of proposed system has given multiple advantages to both producers as well as consumers. The factors that has been improved by the use of C-Aqua Irrigator are productivity, health of crops, water availability, resource protection and ease for farmers. The advantages have created better results regardless of the coverage area, quality of soil, environmental factors and investments. The results produced after installation has urged farmers to manage and utilise their farms well using the system. The smartness of the proposed system is dependent on the accuracy and placement of various sensors. Thereby making it cost effective and proficient in conserving water and reducing wastage of resources.

VIII. Future Scope

In future this project will be helpful for the Agriculture Department for analysis regarding irrigation factors like Temperature, Humidity, Weather etc. With the use of machine learning, we can also predict various beneficial factors like suitable crops for an area, estimate the productivity and quality of crops using the past data. The process of analysing the data would benefit the producers and consumers equally.

IX. Conclusion

The system provides with several benefits and can operate with less manpower. The system supplies water only when required. The system's reliability, accessibility and ease of use would be profitable undoubted fully. The application of such versatile and economical system would solve the gap between limited resources and limitless wants. Thus the system is efficient and compatible to changing environment.

"No water, No Life. No Blue, No Green"- Sylvia Earle

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