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Review on Various Approaches of Automatic Drip Irrigation Systems for smart Agriculture

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Abstract

"If the farmer is rich, then so is the nation" – agriculture plays significant part in the advancement of the country. Water is a fundamental factor for the growth of plants in cultivation, irrigation or agriculture. These days, for the irrigation system, various methods were available which were utilized to decrease the dependency of rain and agriculture is one of the significant fields in which new advancements need to be actualized to decrease the burden of farmer. In this paper, different arising strategies were identified related to drip irrigation systems in agriculture. The basic drip irrigation system uses a micro-controller and a variety of sensors like temperature, humidity, moisture of the soil etc., to sense the vital parameters of the soil and gathers information, and produce results. Based on these sensor values land gets water automatically controlled by the switch of motor and these results were showed to the farmers employing the web or on a cellular mobile phone by SMS. Accordingly the farmer precisely determines the farm land requires water or not.

Keywords: Agriculture, Drip irrigation system, Micro-controllers (Arduino and Raspberry pi), and Soil sensors.

1. Introduction

Water is considered as the essential need of living beings. Agriculture is one of the major significant occupations of numerous individuals around the world. In India, agriculture relies upon the monsoons. Agriculture is one of the fields where water is needed in colossal amounts. These days, water deficiency is getting probably the most serious issue on the planet. So wastage of water is a significant issue in agriculture since it restricts the inclusion of the cultivable territories. Various sorts of water system plans were utilized for better protection and the executives of water in farming.

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1.1 Drip Irrigation

The drip irrigation system is otherwise called trickle irrigation and includes trickling water onto the soil at low rates (2-20 litres/hour). A typical automated drip irrigation system has been shown in figure 1. The system consists of a Micro controller which is powered up through solar power or normal power. The sensors for temperature and soil moisture have been implanted in the field at respective places. The inputs taken from different sensors to estimate the Field status are interfaced to the micro controller. Based on the conditions set by the farmer for switching on the water drip system, Micro controller sends the ON/OFF signal to the motor of the pump through relay.

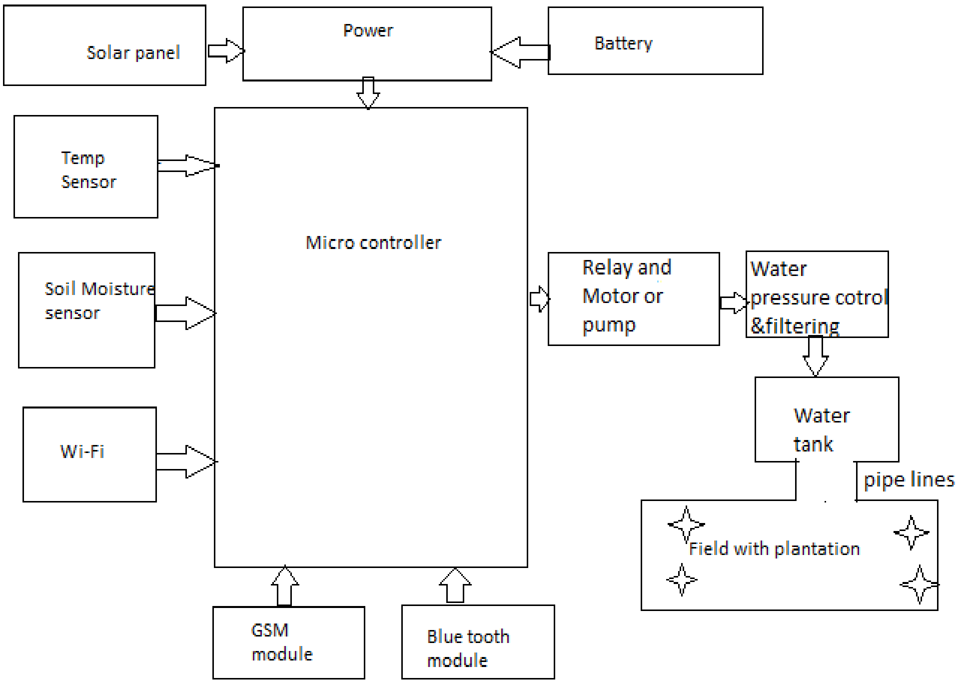

Figure 1. General block diagram of automated drip irrigation system

The trickle water scheme is the ideal method for enhancing the movement structure for to facilitate harvests which is demonstrated in figure 2 [1,30]. Water and manures are conveyed across the field in pipes called 'dripper lines' high lighting more unobtrusive units known as 'drippers', as in figure 3 [2].

Each dripper releases drops containing water and manures, achieving the uniform use of water and fertilizers clearly too each plant's root zone, across the entire field, in ideal aggregates and at the ideal time, so that each plant precisely gets what it needs and when it needs, to grow in a perfect environment. Due to the dribble water framework, farmers can convey better returns while getting a good deal on the water similarly as composts, energy, and even harvest affirmation things [3].

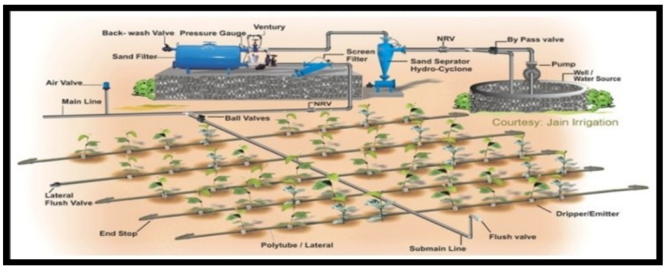

Figure 2. Drip Irrigation System Layout

Figure 3. Dripper

1.2 Need for automatic irrigation system

- Easy to introduce and organize.
- Saving energy and resources, that it might be utilized suitably.
- Farmers can have the alternative to spread the ideal proportion of water at the desired time through mechanizing water frameworks to the field.
- Evading water frameworks at some unsatisfactory period of the day, decrease flood from overwatering inundated soils which will improve crop execution.
- The computerized water framework system uses valves to turn the motor ON and OFF. Motors can be robotized viably by using controllers and no prerequisite required for work to turn the motor ON and OFF.
- It is effective to control, the human slip-up end and changing available soil dampness levels.

2. Related Work

Cultivation is very much crucial for getting high produce from the orchard. Today, by using advanced developments it is realizable to screen and regulate characteristic parameters like soil moisture, temperature, wind speed, wind pressure, saltiness, turbidity, moistness, and so forth for the irrigation. Motorized water framework is carried out by using a pump and solenoid valve. The solenoid valve operates on the electro-mechanical principle. The liquid controller is fitted with solenoid valve to allow or stop the flow of liquid. The internal coil of wire controls the current and enables an electromagnet to control the state of the valve as demonstrated by the necessity for the water framework.

I. Bennis, et al., [4] proposed a plan prototype for a dribble water organization framework using the Wireless sensor and actuator networks (WSAN), which incorporates the soil dampness, temperature, and pressure sensors to monitor the water system activities. Especially, when a structure breakdown occurs, it was found that the emitters were obstructed. However the work accomplished a high QoS execution through a satisfactory need based routing protocol.

Koushik Anand, et al., [5] proposed a programmed trickle water system framework utilizing Fuzzy rationale and versatile innovation, where various sensors gathered the ongoing information like soil humidity, temperature, and so forth, and this information was shipped to the hub where information was handled by utilizing fuzzy logic. The entire framework was provided with solar energy by photovoltaic cells and had a correspondence interface that concedes the system to be checked, restrained, and booked through cell texts. Nikhil. A and Smita. S [6], designed a Smart drip irrigation Scheme utilizing Raspberry Pi and Arduino.

Dhawan Singh and Aditi Thakur, [7] proposed another idea of a brilliant trickle water system framework for distant uneven zones, where the power and water network provided poor efficiency. The suggested framework was fed with sun oriented energy that was an improved choice than normal modified water framework structures.

Aisyah Rahma Kholifah et al., [8] planned a trickle water system structure which is operated on the emerging technology called the Internet of Things (IoT) innovation to enhance the adequacy of water with the help of renewable energy (solar). The suggested dribbling water framework structure involves gear and programming design, including system headway. The dripping water system framework could screen plant conditions continuously with genuine information. Node MCU was employed to communicate information and a modified valve controller with soil moistness as its limit. This setup helps the peasants to monitor soil humidity, value of pH, and plantation parameters.

Dipanjan Bhattacharjee et al., [9] proposed and implemented a prototype model for remote dispensary of fertilizer in a smarter style framework with the aid of ZigBee and Global System for Mobiles technology. The field station model was created with the assistance of ATMEGA 328 based embedded stages, four numbers of solenoid valves which monitor three number of distinct fertilizers and water with their related driver circuit, ZigBee, and GSM module. The planned GUI made the collaboration more easy to use and adaptable. The cross-examination of an autonomous drip cultivation system with the self regulated dispensing of fertilizers was the oddity of the framework. The whole framework was created by using fundamental equipment.

Babanna Kumbar et al., [10] portrayed a smart irrigation system utilizing the idea of IoT and used a Wi-Fi module (ESP8266-12) which associated the framework to the web. The module controlled an engine and two solenoid valves for providing water to the field on the data got from a water level marker and two soil dampness sensors. The entire framework was observed and controlled by the MQTT server (My MQTT Android App) through the web. Since it was little, conservative, lightweight, effectively programmable, and effectively installable and it had enough GPIO pins to utilize them.

K.Rajalakshmi and P.Niranjana [11], proposed a strategy for irrigation system, which comprised of a soil/moisture detector, Weather Sensor pH identifier and GSM Board, and further more developed, tested and analysed the 'GSM' based model. All the indicators detected proof were put in the Arduino microcontroller. On the off chance that these three identifiers are accomplishing the limit level of the detecting proof, the GSM will send the sensor proof to the customer. In this procedure, the referred locators and electronic gear are consolidated using Arduino Sketch-based Embedded C.

In this paper [12], a trickle water system technique dependent on a micro-controller was submitted, to monitor, screen and consequently for switching of the pump for the water supply and send back the status to the agriculturist. This work deals with the proposal of [13], i.e..dribble water framework employed with a Microcontroller, which is a real-time structure observing and monitoring all the functions of the water-drip irrigation system more productively. The water system framework supervised by using a modernized controller to switch the pumping system from one position to another position. This permits the farmers to apply the ideal proportion of water at the ideal time, with no time to the openness of the work to turn the motor from running condition to a stop. This diminished the overflow over watering immersed soils abstain from irrigation at some unacceptable time. It improved crop exhibitions and aided inefficiency in all the viewpoints.

In paper [14], the creator designed a programmed water system framework dependent on android application using a Raspberry Pi micro-controller, sensor to detect moisture of soil, and sensor to detect ambient temperature to assist a farmer with controlling and monitoring the field. This work supported the farmland water system by turning the motor switching through an android cell phone. This modified water framework system has ease and can be moderated by various Lao ranchers.

Shweta Bopshetty et al., [15] presented mechanization in the cultivating frameworks regarding distant observing and monitoring of drip irrigation system utilizing an Embedded Linux board. This framework gave a web interface to the client with the goal that the client can screen the framework distantly, by gathering climate information and sending control orders to turn on/off the water system. Arduino-Uno was utilized as an installed Linux board which makes correspondence with the soil moisture sensor and ultrasonic sensor. The Node MCU was utilized to monitor the ecological boundaries of temperature and moistness utilizing a DHT11 sensor. Because of these, the water was provided to crops according to the necessities. Accordingly, the water utilization has been decreased giving uniform water to the harvest bringing about expanded yield.

A.N.Jyothipriya. and Dr. Saravanabava.T.P [16], suggested a design of a Microcontroller-based drip water system, which was an ongoing real-time feedback control framework for checking and monitoring all the exercises of the drip water system frameworks all the more proficiently. The structure relies upon PIC18F452 microcontroller, RTC DS1307, Solenoid valve, and Zigbee module and fused affirmation against single arranging, over-current, dry running. This allowed the ranchers to apply the ideal proportion of water at the ideal time. Information was exchanged by SMS (Short Message Service) between the structure and the customer cellular phones.

Rama Chidambaram RM and Vikas Upadhyaya [17], proposed the control and monitor of the trickle water system framework using IoT and Image processing strategies. The framed architecture employed a sensor to detect soil moisture to take the dampness of soil scrutinizing from the farm continuously to sprinkle the water in a robotic way by exchanging the drip administration switching using an android App. More often than not tainted plants were recognized by the adjustment in the shade of the leaves. Digital camera was utilized to capture photographs of the plant's leaves and computer vision algorithms that were realized on those got pictures for extra methods. A data base was used for assessment between the first and continuous pictures, which achieves perceiving the unhealthy plant or part of the plant.

Meo Vincent C. Caya et al., [18], dealt with the arrangement of a dribble water system framework that conforms to variable water stream input. It consolidated the hardware and programming improvement of the system, change of the sensor, testing, and connection of the water usage reliant on the structure log, and the veritable water administered. A turbine stream meter with Hall-Effect sensor was used for this system. It was derived that the structure gave a careful proportion of water yield reliant on the cut-off.

Ravi Kant Jain et al., [19], designed and developed a model - for smart drip water system using IoT embedded architecture. A micro-controller alongside a node MCU was used for sending the field status in the cloud to the worker. An application unequivocally controlled the water level by using a soil moisture sensor and micro-controller structure in the nurseries. The soil moisture level, stickiness, and temperature conditions data was sent through the smaller than normal controller and Node MCU for the prerequisite of water to the plants. Yield prosperity was checked and monitored through mobile and PCs and answered keen cultivating, farming fields, Lawns, planting, etc.

Akhil Ani and Prakash Gopalakrishnan [20], proposed a Drip system that helped the customer in noticing the Hydroponic structure and make changes on the web if significant. The water system framework structure detected the simply soil moisture and the temperatures with sensors. The system was used to record the sensor esteems and handled the manure regards when required. This work was about dribble control and applying it to hydroponic cultivating by developing an interface among individuals and programming which allows a constant screen of pH and all sensors, including the circumstance of the plant by finding using the camera and checking through the versatile application. Using tremendous data, the adaptability of supplement regards were followed and recorded.

Maksudjon Usmonov and Francesco Gregoretti [21], designed and implemented a drip irrigation system by utilizing LoRa based wireless control. The framework used LoRa modules to build up solid radio connection and tailor made information data transfer protocol that fulfils the necessities was conveyed.

Pavankumar Naik et al., [22], proposed an arrangement of various temperature detecting sensors, sensors detecting humidity and sensors detecting soil moisture which sense the various limits of the soil and subject to soil clamminess regard. The land gets irrigated by switching the motor. These identified limits and motor status appeared on the customer android application.

Dr. S. Jothi Muneeswari et al., [23], proposed a programmed irrigation system framework adopting the Arduino micro-controller equipped with moisture detecting sensors and streams of water for the chiefs. The inputs acquired from the humidity sensor were delivered off the data noticing system by Arduino board over a remote organization using Wi-Fi. At the Monitoring structure, the humidity levels were noticed and any reduction of humidity level under a limit was represented as a need for water, and the sign was raised to the entire wetness sensor unit to open the water stream. Also, the Humidity level in the farm was examined via the online interface.

Mr. Galande.S.G and Dr. Agrawal.G.H. [24], built up an embedded controlled trickle water system framework. The parameter readings pertaining to moisture of soil, humidity of atmosphere, ambient temperature, and so forth were taken. These details were provided to the framework. The embedded structure monitored the opening and closing of the valves at appropriate time. The sensor-Based water framework structure has been packed in agribusiness. These sensors transmitted consistent characteristics to the micro-controller and the micro-controller communicates these characteristics to the computer utilizing consecutive correspondence [25].

The structure in [26] prescribed a judicious and user friendly Arduino-based robotized water framework system that fitted with the Android cell for the controller. The details got by the Android appeared on the Graphical user Interface [26]. The details of water consumption and the produced crop yield were accumulated and the outcome exhibited that the water use was diminished in the modernized field when stood out from the truly watered field [27].

This system described in [28] involved moisture detecting transducer and temperature detecting transducer. Atmega328 control assembles data from the recorded transducers besides the switching controls of the pump relied upon the data of the transducers. The servo motor was employed for the exact circumstance of the pump for identical scattering of the water resources to the soil.

Pushkar singh et al proposed a water system framework structure that uses Arduino as the primary controller and a couple of sensors like water stream sensors, temperature sensors, and soil moisture sensors. The data accumulated by the sensor was dealt with by the Arduino and Arduino moved this data to the website using a Wi-Fi module that was ESP8266. A website page consists of standard assessments of the various components needed by a yield. The farmers dealt with the movement of pump and sprinklers remotely [29].

Sivaganesan. D, proposed smart farming system which was operated on wireless network, based on block chain technology that optimized the signal to interference and signal and noise ratio. Overall communication throughput was improved [31].

Ponmalar et al, proposed temperature monitoring system for glass monitoring application using Fiber Bragg Grating. Because of s higher accuracy, longer stability it has and small in size, it has immunity to electromagnetic interference (EMI) and the ability to measure ultra-high and speed events makes them as best choice[32].

Sungheetha et al discussed about the issues related to social and biological issues in waste water treatment. If the sewage water is treated effectively it may affect the nature as well as human beings. This paper combines the fuzzy logic, chaos theory, whale optimization algorithm (WOA) and BAT algorithm (FCW-BAT) and created a new model for parameter estimation [33].

Suma. V, reviewed the challenges in IoT based smart agriculture like cost effectiveness, hardware optimization and minimization of cost of the software. Issues related to manpower and investments were also reviewed [34].

Thodupunoori et al proposed the monitoring of parameters of the farming vehicles of IoT system in real time. The results of experimentation showed that the framework could capture the important parameters of and sends feedback as an indication of deviation to the operator [35].

3. Discussions and Conclusions

In the systems available so far the establishment and hardware requirement are high for the farmers of medium income against the merits obtained. Another issue is with the band width of the internet and the cost involved in arranging it for a remote operation. Despite the high initial investment power issues can be resolved by using renewable energy sources like solar and wind energy. Agriculture, from the beginning of time, has held a significant part of the country's growth and economy. Irrigation is a fundamental segment of yield creation in numerous territories of the world. In this paper, regularly accessible and minimal effort based water system mechanization for sprinkler, drip, and surface irrigation system has been examined and illustrated. The use of drip water system demonstrates that the use of water, power, and farmer can be decreased extensively. The drip irrigation water system gives the ongoing observations and control of ecological, soil parameters like humidity, temperature, pH, soil moisture levels, water level statuses, etc by gathering information, and giving to the farmers through the web or on a cellular mobile phone by short message service (SMS) to make the farmer aware of the water requirement. Subsequently, a farmer saves time, cash, and water resources by using a mechanized water irrigation system.

4. Future Scope

With more prominent progress in the area of IoT anticipated in the forthcoming years, this framework might be more proficient, accelerated, and more affordable. Later on, this framework may be built as a smart setup, where the arrangement predicts customer exercises, precipitation configuration, and time to gather, as a creative gate crasher in the field. Moreover bestowing the information through pattern setting development can be completed so that the agricultural framework can be made liberated from human movement and subsequently quality and colossal amount yield can be gained.

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