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Smart Irrigation System Techniques using Artificial Intelligence and IoT

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Abstract- Combining hardware, software, and firmware with diverse technologies including the Machine Learning and Artificial Intelligence, Internet of Things, creates an intelligent machine. People value and need it because it produces positive outcomes and makes efficient usage of resources. Effective equipment must be used to improve water quality, monitor humidity and increase crop yields. This article describes the latest technologies in agriculture for smart water systems using Artificial Intelligence and IoT. This article presents different equipment, modern irrigation systems, various comparisons and needs. Finally, various issues, problems and future directions for smart water management research are presented.

Keywords: *Artificial Intelligence, Smart irrigation system, Challenges, IoT, Future of Irrigation system.*

Abbreviations: AI, artificial intelligence; CSR, corporate social responsibility; LoRa, long-range; IoT, internet of things; GSM, Global System for Mobile communication; R&D, research and development; MQTT, message queuing telemetry transport; WSN, wireless sensor networks; WS, water stress; SDG, sustainable development goals.

I. Introduction

Efficient use of resources is important and desirable for water management in smart agriculture. According to the World Bank, agriculture in the future will require up to 70% of fresh water [1]. For this reason, optimization of water use in agriculture and efficient use of water is an important study that takes into account the use of different tools. Currently, smart machines are a good idea for the use of resources in many areas, especially agriculture, where smart machines play a crucial part in variables like plumbing, disease prediction, decision making, management along with utility. Intelligent systems consist of a combination of information, control, automation, analysis and decision making for a variety of automated tasks [2].

Automation based on various new technologies, network processing, sensing and artificial intelligence. Thus, thanks to smart machines, water can be used efficiently and profits can be increased. Advanced technology agriculture and smart irrigation reduce fresh water use. Data from several different sensors may be centrally stored, processed, and analysed using decision-making processes thanks to intelligent systems incorporating IoT and machine learning technologies [3]. The irrigation system refers to the process of producing or distributing water in the agricultural system.

To regulate humidity and temperature, this irrigation system is exclusively utilised in locations where it is not raining. Artificial irrigation may also be used to aid in the control of weeds and unwelcome plant growth in agricultural settings. Traditional irrigation systems and contemporary irrigation systems are the two kinds of irrigation systems. watering systems for pools include cans, buckets, and canals. Basin, strip, furrow, and basin irrigation are the primary traditional techniques, and using the information is not recommended. The irrigation system costs a lot of money. Contemporary irrigation systems are irrigation systems that have expanded widely thanks to modern technology. There are three different kinds of irrigation systems available today: drip irrigation system, pot irrigation system, and sprinkler irrigation system [4].

Modern irrigation systems are also divided into other areas of use. According to the air evaporation-perspiration controller, it can perform signal control, background control, on-site weather monitoring, water level, etc. According to soil moisture sensor control, it is divided into two as delayed irrigation system and irrigated irrigation system. Water as needed. These are some of the main sections depending on usage of products and products. Different controls and measurements of today's smart water devices are depicted in Figure 1.

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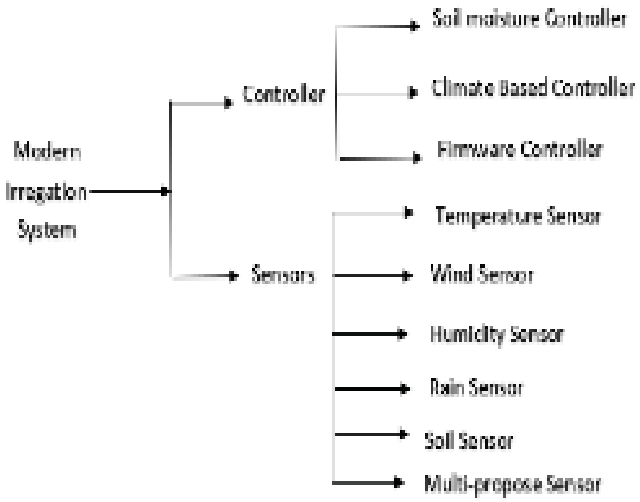

Fig 1: Various sensors and controllers in Smart irrigation system

The main benefits of smart water use today are less water use, money and increased productivity. Automated smart irrigation systems use many modern systems like ML, AI, IoT, Big Data, WSN and cloud computing [5-8]. The technology, "sensors, automated controllers, satellite data, flow metres and valves, WSN, batteries, etc. are the major elements of the smart water system." Figure 2 represents the general description of the modern irrigation systems, with components: (a) real-time Data collection, (b) Application Technology; (c) Classification and Estimation; (d) manage and decide.

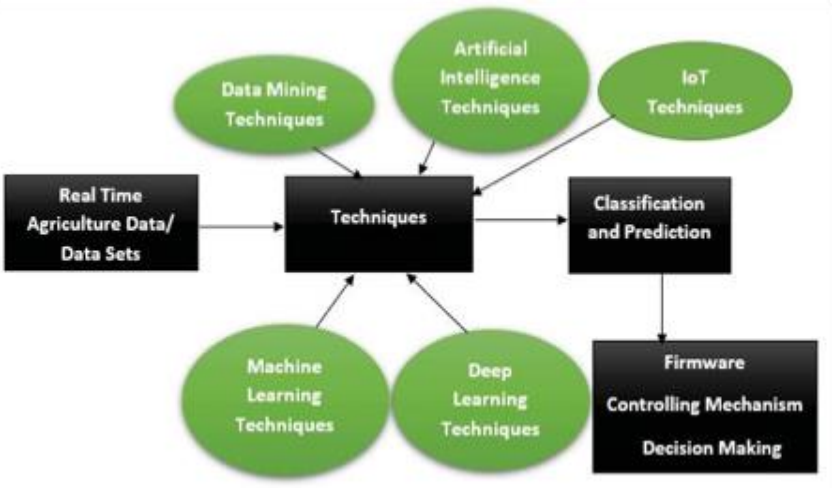

Fig 2: Modern irrigation system

The organization of this document, Part 2 contains various comparisons, Part 3 various water technologies using AI and IoT, Part 4 the problems, challenges and comments prophecy and finally conclusion.

2. Various Parameters Of Smart Irrigation

Smart irrigation system efficacy is evaluated using a variety of criteria. Water management and Soil management are both features of intelligent irrigation systems. Numerous variables, including soil temperature, soil hydration, soil disease, and soil dryness, affect soil management. Evapotranspiration, dew point temperature, air temperature, and humidity are only a few examples of the factors that affect water management.

Other than these parameters, data transfer rate, efficiency, estimation accuracy, are other considered parameters for a smart business model. Below mentioned are the criteria for water management and land management: [10]

Soil content = (soil moisture - volume of dry soil) / (dry soil volume - dry soil) soil moisture volume content = water volume / soil volume.

Soil moisture = soil moisture weight - dry soil weight / dry soil weight.

Different models and equations are used to derive, among other things, sums, averages, and estimates of current and future results.

3. Various Irrigation Technologies

Irrigation management involves the application of several technologies and techniques. Artificial Intelligence, IoT, deep learning, and ML are the foundations of new smart irrigation technologies. Weather, fuel management, water management and many other things cannot be controlled with this technology. This chapter provides a brief overview of the literature on various aspects of water systems forecasting and management.

A sprinkler irrigation system powered by IoT was suggested by the authors of [11]. In this setup, the water metre and solar panels are integrated with the tank. A study methodology for water management employing temperature, humidity, and pH is presented by the authors of [12]. Tiny farms and small lots should use this app. The authors of [13] put up a concept for using IoT devices to regulate water pipelines.

Water is drained to soil in this method, and water management determines the difference. The authors of [14] suggest an IoT-based autonomous system that controls water pipes using a variety of gadgets, including Raspberry pi 3 computers, Wi-Fi nodes, and microcontrollers. If there is not enough water, add soil immediately. The Losant platform-based IoT approach for soil moisture monitoring was suggested by the authors in [15]. Authors in [16] designed a low-power system that uses sensors to transmit predictive data using the MQTT protocol.

Depending on humidity, the node MCU-12E controller controls the movement of the water pump. The authors of [17] present a model for monitoring and analysis of the crop environment using the Internet of Things. Using this model effectively solves the old problem and saves energy, time and money. Authors in [18] propose an M2M distribution system to manage water. M2M controls the flow.

Extract heat, moisture, and other materials from the soil. Metrological measurements are also used to determine water flow. Authors of [19] A soil management system based on automatic irrigation. As moisture is needed, the microcontroller releases water. The authors of [20] presented an Internet of Things-based automatic fertilising system.

The GUI interface in this system is shown using an SQLite database. Systems for managing automated fertilisation that include interfaces, microcontrollers, control, and communication.

REFERENCES	COMPONENTS	ADVANTAGES
[11] Johar R. et al.,	IoT and Solar system	Reduced electricity and lower water consumption.
[12] Gupta A. et al.,	Sensors and ATMega 8 microcontroller	Power and Water management
[13] Gulati A et al.,	For water management, Es-8266 WIFI module chip is used.	Water is managed using IoT
[14] Imteaj A et al.,	Raspberry Pi is used for Automated irrigation system.	When there is a water deficit, it is instantly supplied.
[15 Kodali R.K. et al.,	Moisture sensor and ESP- 8266 microcontroller for calculating soil moisture.	Real time soil moisture calculated using small circuit.
[16] Kodali R.K. et al.,	Soil sensor for water management, node MCU-12 E, ESP-8266, MQTT for transferring data.	Measuring soil moisture and water pumping.
[17] Wasson T. et al.,	Technology and sensors are used for monitoring and analyze the agricultural environment.	Saved the power, time and money.

[18] Reche A. et al.,	To manage the soil, an M2M deployment model that leverages metrological factors and attributes is implemented.	Manage the irrigation of sprinklers.
[19.] Padalalu P . et al.,	Monitoring the level of soil water based on Naive bayes algorithm and microcontroller (ATMega 328)	Supplying water based on recombination.
[20] Abidin S et al.,	For managing automated fertigation, Web- GUI, control communication system and Microprocessor are used.	Monitoring and managing farms using Mobile applications.
[21] Kris h n a K.L. et al.,	Intelligence robot and Raspberry Pi 2 are used for monitoring soil and other elements.	Several parameters are examined when monitoring the irrigation environment in the crops.
[24] Guruprasadh, J.P. et al.,	Soil related issued are monitored by ZigBee Modules.	The farmer received the alert about the soil's deficiencies.
[25] Raut R. et al.,	1185 Sun Rom colour sensor, ARM7 LPC2138 processor, Solenoid Valves and UART.	Checking three major macronutrients: potassium (K), phosphorus (P), and nitrogen (N) in soil
[27] J. Gutiérrez. et al.,	Wireless information unit, web application and Wireless sensor unit, are used in the smart irrigation system.	For water optimization, an automated system was designed.
[28] Kö ks a l, Ö. et al.,	Constrained Application Protocol and Advanced massage Queuing protocol Data distribution Service used to manage the information system at a farm.	Using data acquisition methods and processing, planning, decision making, documenting, and managing the farm procedures.
[29] Baseca C. et al.,	The Internet of Things-based application used to control and keep track of the fert-irrigation system's real-time occurrences.	Different factors like irrigation events, wind flow, pressure levels are measured and performs the decision.
[30] Amarendra Goap . et al.,	Using machine learning and IoT technologies, the relative humidity, UV light radiation, soil moisture, air and soil temperature can be measured.	Intelligent decision-making is carried out by this system of intelligence.
[31] Khoa TA et al.,	IoT and multi-sensor system	Water management

Table 1: Combinations and advantages of various methods

The authors of [21] offer a method for analyzing environmental variables and soil moisture using a mobile robot. IoT and wireless sensor network applications have been suggested by the authors of [22] to increase water efficiency. So that Zigbee nodes, sensors, and green areas may operate continuously using software and hardware. A paradigm for autonomous soil and water pH measurement utilizing microcontrollers and sensors was given by the authors of [23]. For the purpose of detecting soil moisture and soil deficiencies, the authors of [24] suggested an intelligent communication system.

Using this method sends the wrong message to farmers. The author [24] proposed an Internet of Things system to detect nitrogen, phosphorus and potassium. Use these m

easures to save money, time and energy. The authors of [26] propose data collection and management activities fo r smart agricultural decision making. Project managemen t, planning and environment can be measured using this approach.

The authors of [27] propose ways to optimize water resources with various methods like wireless sensor units, wireless information units, and web applications. Authors in [28] propose various rules and equipment for managing agriculture. Authors of [29,30] presented a model for intelligent decision making for agricultural management and water management. Authors in [30] proposed an open-source framework for smart water machine learning. In this way, many activities are taken care of.

4. Challenges and Future Research Aspects

A. Challenges

Intelligent irrigation systems, development of intelligent systems, communication for data conversion, hardware integration, technology data analysis and decision making, etc. faces different problems and challenges such as This section presents various challenges in various situations such as:

- Integrating the sensors is a complex task because different types of sensors can be used in different applications. For instance, as depicted in figure 1 there are different sensors used for varying purposes. Combining data from nodes is a dif ficult task.
- IOTbased smart technology with different levels of d ata analysis, transformation, and hardware and softwa re integration. The integration process faces cost and implementation issues.
- IoTbased smart technology with different levels of da ta analysis, transformation, and hardware and softwar e integration. The integration process faces cost and implementation iss ues.
- IoTbased irrigation systems need smart automation m icrocontrollers and therefore smart irrigation infrastru cture, automatic switches, automatic pumps for better automation.
- Lack of climate (lack of soil, humidity, humidity, rai ny season andFuture Time Decline Forecasting) is an important factor to consider in smart water use
- The function of the LED indicator relative indicator a nd connected cables must be considered in the
- application.
- Decisions based on historical data and predictions of future data are important in practice.
- These are some of the problems encountered when us ing a smart water system. The main studies of the var ious studies available are shown below.
- The authors of [11-20] currently optimised methods for controlling humi dity or water.
- For water optimisation, many existing methods do no t show many nodes [31].

B. Future Aspects of Research

Current research on smart water systems needs to be furt her developed because IoT, Information Dimension, Inte lligence and Machine Learning etc. new decision-making processes are introduced.

- Predicting future data: In smart water use, predicting future data is an important task. However, most of th e previous studies [32] cited in the research paper did not mention the management of future knowledge in the smart water system.
- Infrastructure and weather forecast integration is not recommended and not used in smart irrigation.
- Using big data, IoT, and AI to analyses and predict past, present and future information about smart water, which has helped to take into account.
- Improvements should be made to secure smart irrigat ion systems.
- Frequency and new data collection formats.
- A practical framework for designing and implementing IoT irrigation system for various products.
- Both deep learning an Machine Learning can be used in the best recommunication system.

5. Conclusion

Intelligent irrigation systems are an important area of res earch because the world of the future faces water and ene rgy shortages. 70% of the fresh water in the world is use d for agriculture. For this reason, it is an important task o f smart water use to use water efficiently, save energy, sa ve money and increase efficiency. This article introduces the various components of smart water and demonstrate s the function of each layer in smart water and modern w ater pipes. Various techniques are introduced in Chapter 3 and scores are accumulated for further study.
Various challenges and future directions for research are presented at the end of this section.

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