Modern Irrigation System Using Advanced Embedded System Platforms: A Review

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Abstract:
In the current century, technology is becoming more prevalent in smart farming. The importance of automation in smart farming is crucial. In several fields, automation is becoming more prevalent daily. It uses resources effectively and shortens workdays. Due to the scarcity of global water resources, adopting an optimal irrigation system has become essential. The present review article is give a general overview of automatic irrigation systems to the researchers. This review also provides the kinds of techniques that are now being implemented. In the irrigation system various types of technologies now a days implemented. The technologies like microcontroller, sensors, transducers, GPS, GSM, IoT, wireless sensor networks, Arduino, and other advanced embedded system platforms. Many sensors are utilized to keep track of variables like as humidity, soil moisture, temperature, tank water level, and many others. To monitor different parameters of irrigation system, the IoT based devices were used as well as internet term like websites and Android apps are being developed to support remote irrigation monitoring and control.

Keywords- *smart farming, transducers, irrigation system, microcontrollers.*

1. Introduction:

The term Modern Irrigation System (MIS) can be defined as the irrigation system in which various parameters as well as water distribution in the farm can be control and monitor using advanced electronics devices and internet technology, called as Modern Irrigation System. These days, many systems make use of technology to streamline and automate and shorten the time spent watering plants. Such systems have extremely limited control, and a lot of resources are still being squandered. One of these resources that is overused is water. The technique that is employed to water the plant is massive irrigation. Together with the excessive cost of water, labor costs are also rising [1, 2].

In the modern era, farmers in India have been adopting irrigation techniques through manual control, periodically irrigating the land. There are occasions when this method involves more water. According to direct soil water measurements, automatic irrigation scheduling routinely outperforms manual irrigation in terms of water use effectiveness. Plant irrigation is typically a labor-intensive task that must be completed in a reasonable amount of time and calls for a sizable workforce. The conventional method was for humans to carry out each stage. After doing research in this area, studies revealed that agriculture's yield is declining steadily. The use of technology in agriculture performs a significant role in improving productivity as well as in lowering the need for more labor, irrigation, and fertilizers. Precision farming will transform the agricultural economy by utilizing multiple embedded system platforms applications on fields, posing significant challenges to farmers. It is now feasible to monitor soil fertility, water irrigation, weather conditions, pest and disease forecasting, and more due to recent technologies [2, 3].

2. Literature survey

The review by Abioye et al. (2020), presents information on irrigation monitoring and sophisticated control systems, with a focus on recent studies. Recent studies on monitoring and advanced control techniques for precision irrigation is given attention. This research paper is intended to be a useful

resource for readers interested in learning more about monitoring and advanced control options for irrigated agriculture. It will also hopefully help researchers identify areas for future research in this area as well as highlight any gaps that may exist [4].

As an option to relying on natural rainfall for plant water, crop farming heavily utilizes the regulated system of irrigation. According to Oborkhale et al. (2015), the irrigation system is a crucial agricultural technique where water is artificially delivered to the soil to provide the controlled amount of water that plants need for growth and expansion [5]. In a traditional irrigation system, farmers evenly irrigate every area of the farm without contemplating the field's variations or the crop's specific water requirements. As a result, this strategy is less capable of conserving water and may result in some agricultural areas being over-irrigated while others are under-irrigated, which could generate unfavorable water crisis on the crops [6] reported by Kumar et al. (2017).

Using a Raspberry pi, authors build an intelligent irrigation monitoring system. The focus will be on variables like soil moisture and temperature. This approach will replace the current farming techniques. They could build a system that will enable a farmer to monitor the condition of his fields from anywhere in the globe, including at home [7]. For the farming areas, an automatic irrigation system is suggested by Chate et al. (2016).

Wei Li et. al. (2020) emphasizes the design of an automated irrigation system that uses portable wireless sensor networks and decision-support techniques to remotely measure environmental factors in an agricultural area. The environmental factors such as soil moisture, temperature, humidity, and light intensity are recorded via radio satellite, mobile phones, sensors, internet-based communication, and microcontrollers. IoT technology uses direct communication with the cloud server to relay the data learned from the sensors. Via a gadget with internet access, users from anywhere in the world can see them. Modern agriculture is made more efficient by precision agriculture farming and the advancement of sensor-based applications, which can be both expense and efficient [8].

Prasad et. al. (2011) reported the most recent method for gathering data using several satellite sensor technologies is remote sensing. This method entails a detailed inspection of large-scale aerial photography images and photos of vast land areas, followed by the interpretation, recognition, and mapping of various agricultural resources and water information related to forests, water bodies, villages, roads, crop areas, soil types, and land types. Optical or visual remote sensing is one of the most frequently used in the agriculture sector. This collects images from Earth's surfaces by reflecting characteristics from the target area's surface using different bands, such as NIR and SWIR sensors [9].

Jha, K. et. al. (2019) reported many advanced techniques used in modern farming including IoT, wireless connectivity, machine learning, artificial intelligence, and deep learning are some examples of diverse automation techniques. Crop diseases, poor storage management, insecticide misuse, herbicides, inadequate irrigation, and poor water management are just a few of the issues affecting the agriculture industry. All of these issues can be resolved using the many approaches stated above. Deciphering concerns including the use of dangerous pesticides, supervised irrigation, pollution management, and environmental consequences on farming techniques are urgently needed nowadays. It has been demonstrated that automating farming procedures increases soil productivity and improves soil fertility [10].

The benefits of artificial neural networks over conventional systems have led to their frequent incorporation in the agricultural industry. Neural networks' primary advantage is their ability to anticipate and forecast using parallel logic. Neural networks can be learned in place of meticulous programming. To discriminate between weeds and crops, Gliever et al. (2001) employed artificial neural networks [11].

Benzekri et al. (2006) designed and implemented of a microprocessor-based interrupt-driven control for an irrigation system. The designed system to help users of automated irrigation systems better regulate irrigation water and protect crops from frost. To do this, authors devised an approach that combined the micro processing and agrohydrological components of irrigation. Measurements of the soil's water potential are used by the system to regulate how much water is applied to the area. The programming allows the device to continually measure the soil moisture content and environmental factors on-site using the input interface. Additionally, it executes calculations and other user-defined operations and outputs instructions to activate the necessary actuators like solenoid valves, pump motors. To communicate with the controller and show the overall status of the irrigation system, a user-friendly graphical user interface (GUI) was established [12].

Kumbhar, et al. (2013) microcontroller based controlled irrigation system for plantation. A remote watering system with microcontroller control has been developed for agricultural plantations. When the soil humidity falls below the set-point value, the devised system is installed in a remote area and supplies the plantation with the necessary water. The output from the humidity sensor is proportional to the change in humidity when it is compared to the set-point, and the data is collected through the channel. If the set-point data is high, the motor will turn on and provide the plant with water until the humidity exceeds the set-point value. The motor is turned OFF and the next channel is scanned after the humidity level has beyond the set-point value. This offers the proper amount of water at the proper moment [13].

Hassan, et al. (2019) designed an automated irrigation using open source microcontroller which is Arduino based cost effective system and it was implemented in a farm or average home garden. The designed system uses the Arduino as its central processing unit to water the plants automatically when the soil moisture sensor detects that there is not enough water in the soil. The completely functional prototype of the automated irrigation system includes a soil moisture sensor, an LCD display that shows the moisture % and pump operation, a relay module that controls the water pump's on/off switch, and a water pump. In any case, the relay module will immediately turn on the water pump to begin the watering process when the soil moisture sensor detects dry soil and displays the moisture level on the LCD display [14].

Prasojo, et al. (2020) Designed of automatic watering system based on Arduino. Arduino is open source embedded system platforms which is implemented in many automations areas. Authors reported food plants often do not require watering during the rainy season, but during the dry season, watering requirements must be adjusted based on soil moisture levels. In order to avoid poor growth, farmers typically do not produce food plants during the dry season. Because of the farmer's reliance on the weather, production suffers, which is a barrier to the program's goal of achieving food self-sufficiency. In order to solve the issue, a farming device based on information and communication technology is required. The goal of the research was to create a programmed controller chip that would autonomously manage irrigation based on soil moisture gauged by a household soil moisture sensor. This tool determines if the soil is dry. Farmers are not required to manually irrigate their crops. The gadget can be deployed on farms, seeds nursery, urban parks, resorts, workplaces, and residences with parks that require routine watering in addition to assisting farmers [15].

3. Evolution of irrigation system

The figure 1 reveals the evolution of irrigation system.

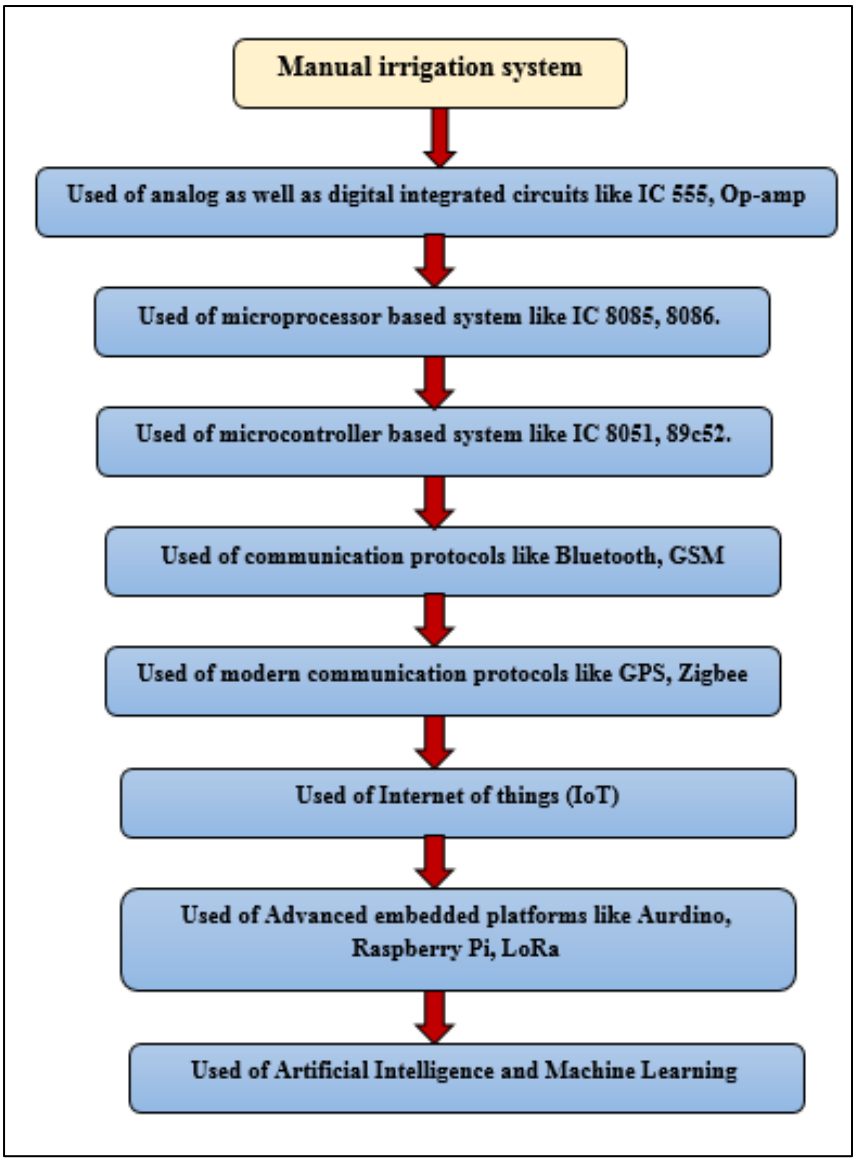

Figure 1: Evolution of irrigation system.

Conclusion and Future Scope:

This review article provide in brief information of embedded system platforms with other communication technology used in irrigation system. According to above literature survey it has been observed that many researchers are used embedded system platforms in irrigation system. So by using advanced embedded system platforms like raspberry pi, Bengal bone black, Lora board. By using such types of advanced embedded system platforms the modern advanced irrigations sophisticated system will be implemented in future. Such types of advanced system not only save the labours/ man power of the farmers but also save time and energy and gives precision output to the farmers as well as our farming will make become a smart farming.

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