An Intelligent Smart Farming Using AI and IOT

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ABSTRACT: An automated irrigation system for efficient drip water management system has been proposed. Soil Parameters like soil nutrients and temperature are measured and the sensed values are displayed in LCD. The IOT module has been used to establish a communication link between the farmer and the field. The current field status will be intimated to the farmer through mobile. For water management we proposed pumping mechanism to individual crop. As well as Nutrition pump can driven by the crop status. The farmer can access the server about the field condition anytime, anywhere thereby reducing the man power and time.

Keywords— PIC microcontroller,Irrigation, Sustainability

I-INTRODUCTION

When defining the objectives of the UAE's Centennial 2071 strategic Plan, the leadership of the country gave careful consideration to issues of food security and sustainability in light of the country's rapidly increasing urbanization and potential effects of climate change [1]. Water has always been an essential component of any plan for producing food. Regrettably, there is already a shortage of fresh water both locally and worldwide. Water conservation has long been a global effort. The national and local water authorities have launched a campaign to promote efficient water

It is commonly known that irrigation uses up to 70% of the freshwater on Earth [2]. Nowadays, a lot of people employ efficient irrigation to use less water. It is distinguished by providing water straight to the plant and giving the farmer autonomy over the amount, timing, and location of water application. Efficient irrigation can reduce water use and greenhouse gas emissions by up to 25% and 40%, respectively, as compared to traditional irrigation techniques [3]. Additionally, effective irrigation can reduce soil erosion, food production costs, and crop productivity [4]. Technology advancements have optimized water use generally and irrigation water utilization specifically [5].

As a result, cutting-edge technologies are currently frequently applied to optimize irrigation water consumption efficiency. Irrigation systems that are completely automated have long been studied and improved. In accordance with these viewpoints, irrigation water systems have already employed a few computerized and semi-robotized approaches [6]. A significant percentage of the conventional irrigation system procedures have already been substituted by computerized frameworks [7].

Thoughts turned to using smart controllers in the design and operation of fully automated irrigation systems (smart) as the automation concept evolved [8]. These systems have every component configured to communicate without the need for human involvement [8]. A significant amount of research has been done to support smart irrigation systems. Several completely automated water systems (smart) were put to the test [5]–[12]. Nearly all of these studies have come to the same conclusion: the performance of automatic irrigation systems has been greatly improved by technological advancements, systems management advancements, and improvements in programming abilities.

Developing a comprehensive national system based on enabling sustainable food production through the application of modern technologies is one of the goals of the UAE's national food security policy 2051 [13]. Here, an environmentally friendly, completely automated, and remotely controlled irrigation system is introduced in accordance with the UAE strategic plan. The design, construction, and testing of a smart irrigation system prototype are the main objectives of this project.

II- MATERIALS AND METHODS

A. *Smart Irrigation Technology*

The sophisticated techniques created to conserve irrigation water are made easier to use thanks to advancements in smart irrigation technology (Fig 1). Regulators and sensors have been employed in smart water systems to improve irrigation system efficiency (lower water consumption). This invention is available as a sensor or regulator that can be integrated into an

B. *Need identification*

It was necessary to choose which irrigation system the suggested technology would be tested on in order to meet the overall objective (optimize irrigation water utilization). There are four different kinds of irrigation systems that are now in use worldwide. Specifically, drip, sprinkler, ditch, and basin. Following thorough investigation, the trickling system was chosen. It was discovered that the trickle system was appropriate and helpful in achieving the project's overall purpose, which was to maximize the efficiency of the water application. Among irrigation systems, the trickle system is distinguished by its high application and water use efficiency. In addition, it competes in both domestic and foreign markets and conforms with the rules established to guarantee water sustainability. Drip irrigation has application effectiveness of up to 90%, making it the most efficient system when compared to other irrigation techniques [14]. It significantly lowers the wastage of water. Water is gradually dripped to the plants using the system. As a result, there is very little water loss due to evaporation or overwatering. Furthermore, because the device provides the water at very low pressure, it uses very little energy. A section of a drip irrigation system is depicted in picture 2 below:

C. Design options evaluation and selection

The evaluation process ensures that the greatest ideas are gathered and chosen, and it also understands any challenges or complexities that may be present in any creative idea and looks for ways to address them during the phases of assembly and testing. Nonetheless, the designs were assessed based on the needs (requirements) of the client. Three factors that were taken from the needs of the customer were taken into consideration when evaluating the two design possibilities. The three primary standards for evaluation were:

1. Design that achieves the overall goal of the project.
2. Design that is user friendly
3. Design with reasonable and affordable cost

Fig. 1. Drip Irrigation

The proposed Design:

An automation-based framework is created in the suggested system to monitor the irrigation water demand by measuring soil moisture, humidity, and temperature using a variety of electronic sensors. The microcontrollers get a signal from the moisture sensor updating the progressions whenever there is a change (drop) in the soil's moisture content. Then, to apply water, the microcontrollers communicate with the system's other parts (the pump, valves, and timers) (flow chart). The main advantages of an automation-based water system are its adaptability, stability, energy efficiency, and low cost. Figure 3 depicts the planned irrigation system's component structure and flow chart.

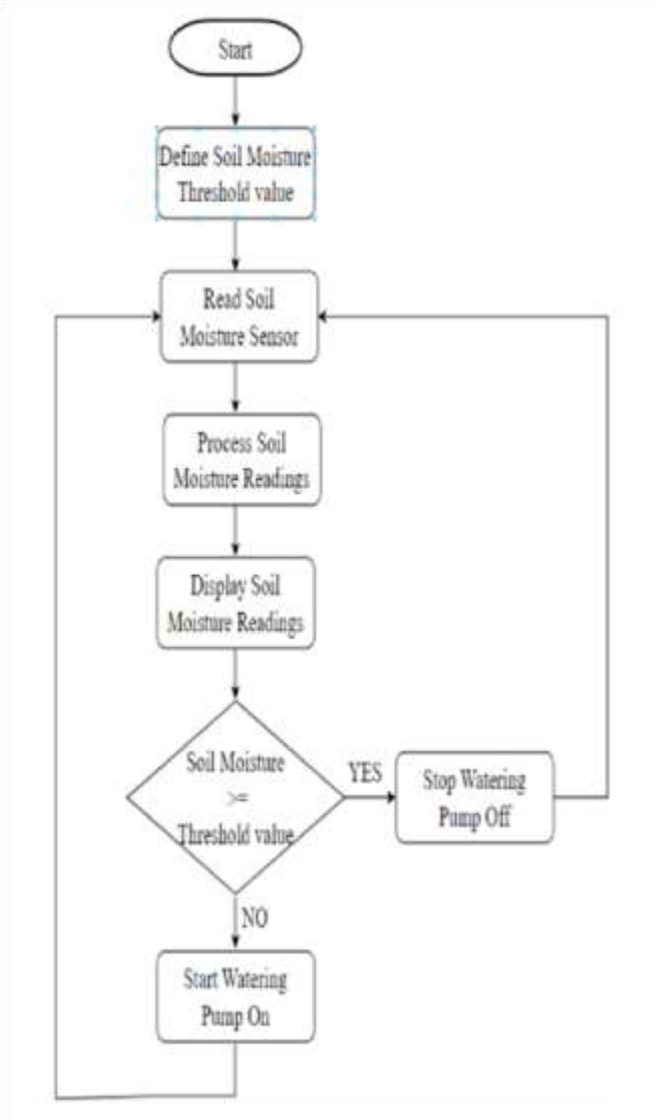

Fig.2. Layout and flow chart of the proposed irrigation system

D. Experimental Setup

At a workshop located on the Higher Colleges of Technology campus in Dubai, students construct every component made of electronics, including sensors, PIC microcontroller, relays, boards, and pumps. This section provides an explanation of every component used in the system's manufacturing. Then, a 30 cm by 60 cm small-scale agricultural field was built especially to test the smart system (Fig 6).

1. PIC-Controller: This board is a programmable microcontroller (Fig 3). It is simple to use, adaptable, and open-source. As a result, it is frequently utilized in many different automated systems. After a code has been programmed into it, runs the code and networks with inputs and outputs like motors and sensors. An output signal is sent by sensors in a smart irrigation system to indicate the measurement or detection of soil moisture. To adjust the soil moisture level, controllers receive the output signal, process it, display it, and then send a signal to the pump telling it to start or stop.

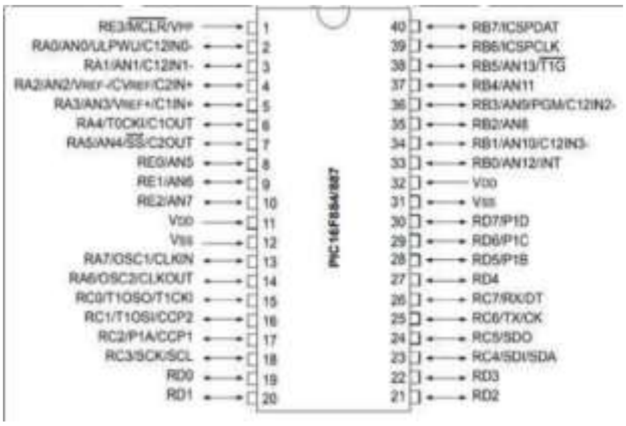

Fig. 3. PIC – microcontroller

2.Soil moisture sensors are instruments that quantify the amount of moisture in the soil (volumetric water content). By detecting the electrical conductivity of the soil, soil moisture sensors determine the water content in an indirect manner (Fig 5). It is necessary to calibrate the relationship between soil moisture and electrical conductivity in order to guarantee the accuracy of the sensor's measurements.

The sensors' values are compared to the real moisture content that is accurately measured in the laboratory as part of the calibration process.

3.The water pump is typically fitted with an automatic relay in smart irrigation systems, which are electrically powered switches that open and close circuits in response to signals from the controller. The relay that turns on and off the pump is managed by the PIC microcontroller.

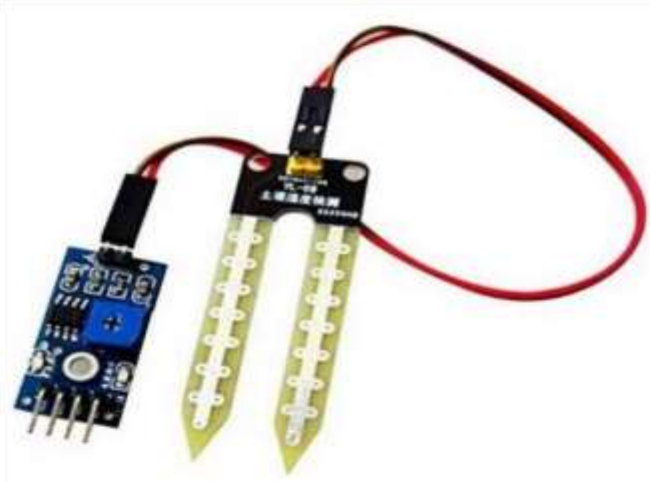

Fig. 4. Soil moisture sensor

These products maintain the health and quality of plants while decreasing water waste, which improves the efficiency of the water system. Both large-scale, supervised corporations and small-scale, private firms can benefit from this innovation. The essential parts of a smart irrigation system are assembled in Figure 6, which is an adaptation from Techatronics in Delhi, India. The information flow from the soil moisture sensors to the other components through the PIC controller is shown in the image.

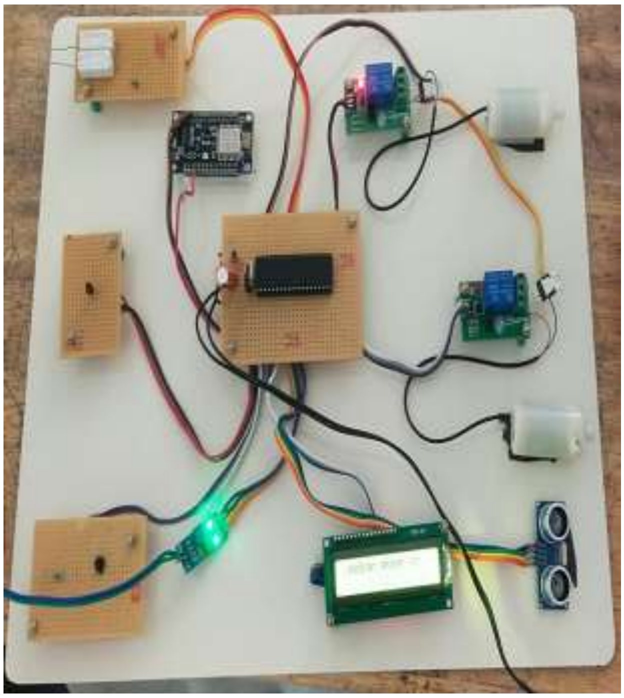

Fig. 5. Smart irrigation system-experimental setup

III- Results and Discussion

It is important to note that choosing the appropriate components that match and work well together is a laborious task. Notwithstanding the challenges faced, the intelligent irrigation system was effectively developed and evaluated. The various parts of the system were constructed, matched, and compatibility tested. An PIC microcontroller, soil moisture sensors, automatic valves, and a pump are the primary parts of this system. In order to determine how and when to water the plant, we first employed soil sensors to measure the amount of water in the surrounding area. The water pump is started for that plant if the sensor detects soil moisture below a predetermined threshold; if the soil moisture level is too high, the pump will stop. An LCD that was attached to the microcontroller displayed each and every moisture reading. The soil sensors were dispersed in several well chosen locations to cover a large region.

But the element that is essential to any smart system is the sensor. The PIC microcontroller is utilized to help the system's many components communicate with one another. The software was created, installed, and tested to make the microcontroller easier to operate. Initially, a few issues prevented the system from functioning properly. Among the issues are: improper operation of the moisture sensors, which resulted in qualitative (high/low) moisture readings. By changing the code to translate the moisture values into quantitative ones (%), the issue was resolved. Additionally, information from several sensors was not received by the microcontroller. By changing the PIC microcontroller code to allow for the receipt of readings from several sensors, this issue was resolved.

In addition, the leaky nozzles were causing the system's pressure to drop and causing the system to lurch. The leak was stopped, which physically resolved the issue. Once these issues were resolved, the system was operating without any issues.

IV - CONCLUSIONS

A PIC-microcontroller powered smart irrigation system was successfully developed and tested. A microcontroller can be used to easily control the completely automated system. It is an intelligent device that senses the moisture content of the soil and gives the plant water as needed. It was discovered that the smart irrigation system was adaptable, flexible, and efficient, as it was covered and clarified throughout the study. The system is adaptable enough to run on solar energy, a renewable energy source. The technology requires so little energy that it can run on renewable energy. The developed code's capability could be expanded to implement integrated water management techniques.

For instance, the system might apply fertilizers at the appropriate time and amount when they are combined with water. Although the system is flexible enough to be employed at bigger scales, it is created and tested at small scales (home garden or yard). The system's prospects show that it should function well and increase the efficiency of applying and using water and fertilizers. Another study endeavor is required to confirm the last claim.

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