International Research Journal of Education and Technology
ISSN 2581-7795

Automatic Irrigation System using Arduino Microcontroller

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Abstract - *India is a predominantly agricultural country. Agricultural harvesting was the sole source of income for our forefathers. Agriculture is a major source of income for the majority of Indians and has a significant impact on the country's economy. Irrigation becomes difficult in dry locations or when rainfall is insufficient. As a result, it must be automated for optimal yield and managed remotely to ensure farmer safety. The need for greater water management is highlighted by rising energy prices and declining water resources. Irrigation management is a difficult decision-making process that involves determining when and how much water to apply to a growing crop in order to achieve specified management goals. If the farmer is far away from the farmland, he will be unaware of the current situation. So, efficient water management plays an important role in the irrigated agricultural cropping systems. This project investigates the creation of an Arduino-based automatic irrigation system. The goal of this embedded project is to design and construct a low-cost feature for a water irrigation system that is based on an embedded platform. In this project the water quantity present in agriculture is detected using temperature and soil moisture sensors The project makes use of an Arduino microcontroller, which acts as a data processor. Because India's population has surpassed 1.2 billion people and is growing at a rapid rate, there will be major food shortages in 25 to 30 years; as a result, agricultural development is required. Farmers are currently suffering from a lack of rain and a scarcity of water. The major goal of this project is to develop an automatic irrigation system, which will save the farmer time, money, and energy. Traditional farmland irrigation methods necessitate human intervention. Human intervention can be reduced with irrigation equipment that is automated. When the temperature and humidity of the environment change, these sensors detect the change and send an interrupt signal to the microcontroller.*

Key Words: Arduino microcontroller, Irrigation management, Auto-Irrigation

1. INTRODUCTION

Agriculture is a vital sector in every country, but notably in emerging countries like India. Agriculture contributes more to the economy of the country than any other sector. Agriculture is the country's economic backbone. In our country, agriculture employs the majority of the population. Agriculture is the most significant industry for economic growth in India, and it is also the only occupation in which more than 50% of the population works directly in agriculture. Agriculture accounts for 65 to 70 percent of the Indian economy, making it the country's backbone. It generates 17% of GDP and 10% of total commodity output from 60.3 percent of agricultural land. Agriculture employs 60% of the population. It enhances the overseas market, but farmers suffer from a lack of awareness of the required output due to a variety of factors. Computer processes are used to overcome crop production hurdles such as yield prediction and advancement risks. The methods are used to analyze a large amount of agricultural raw data in order to extract useful information and trends. More than half of all crop kinds are monsoon-dependent, and yield varies accordingly. As a result, farmers are curious about the forecasts. With India's expanding population, agricultural expansion is critical to meet demand; hence, computer-assisted research is critical. Factors such as the atmosphere, temperature, rainfall, and geographical topography, among others, have a significant impact on crop productivity. India is a village-based country, and agriculture is critical to the country's prosperity. Agriculture in our country is reliant on the monsoons, which are in short supply. As a result, irrigation is utilised in the agricultural sector. Water is delivered to plants in an irrigation system based on the soil type. In agriculture, two things are critical: first, obtaining information on soil fertility, and second, measuring the humidity content of the air. Different solutions are now available for irrigation, which are utilised to lessen the reliance on rain. Electrical power and on/off scheduling are the primary drivers of this strategy. .A temperature and humidity sensor is put near the plant and near the module in this methodology, and the gateway unit processes the sensor data and transmits it to the controller, which controls the flow of water through the pump. A farmer can save up to 50% of water by employing the concept of a modern irrigation system. This approach is based on two irrigation technologies: traditional irrigation methods like as overhead sprinklers, and flood type feeding systems, which wet the plants lower leaves and stems. As a considerable amount of water is consumed by flood-type methods, the region between the crop rows becomes dry, leaving the farmer to rely solely on incidental rainfalls. The leaf mould fungi infect the crops because the soil surface remains damp and saturated after watering is completed. To overcome these problems, new irrigation systems have been adopted, in which little amounts of water are applied to various sections of a plant's root zone. Plant soil moisture stress is avoided by giving the needed amount of water resources often or regularly daily, ensuring that the soil's moisture state is maintained. Traditional irrigation methods, such as sprinklers or surface irrigation, consume roughly half of all available water. Plants can be given even more precise amounts of water. Plant damage from disease and insects will be reduced as long as the foliage remains dry, lowering the operating cost even further. During the irrigation procedure, the dry rows between plants will cause continuous federations. Fertilizers can be applied with this technology, and the cost of doing so will be reduced as well. When compared to overhead sprinkler systems, current solutions significantly reduce soil and wind erosion. The shape of dripping nature in the root zone of a plant that gets moisture is determined by soil properties.

Because dripping reduces large water losses while also lowering labour costs and boosting yields, it has become a popular approach. When the components are turned on, they all read and provide an output signal to the controller, which then displays the information to the user (farmer). Because the sensor readings are analogue in nature, the ADC pin in the controller converts them to digital representation. The controller will then access information, which will be shown on the LCD Panel when the motors are turned on or off.

2. Problem Statement

Plant irrigation is typically a time-consuming task that necessitates a big number of human resources to complete in an acceptable length of time. Traditionally, humans carried out all of the steps. Some systems now make use of technology to reduce the number of personnel or the amount of time it takes to water the plants. Control is severely limited in such systems, and significant resources are still wasted. One of these resources that are used extensively is water. One of the strategies for watering the plant is irrigation. Because the amount of water delivered exceeds the plant's needs, this strategy results in huge losses. The excess water in greenhouses is drained through the pores in the pots, or it percolates through the soil in the fields. Water is now thought ofas a free, renewable resource that may be used in large quantities. As a result, it's plausible to expect it to become an extremely expensive resource in the near future. Aside from the rising cost of water, labor is becoming increasingly expensive. As a result, if no attempt is made to optimize these resources, more money will be spent in the same process. Technology is most likely a solution for lowering expenses and preventing resource waste, and this project can be a powerful technique to deal with such a circumstance.

3. LITERATURE REVIEW

We performed the following survey on various topics before to the start of the Project. The following are the details.

3.1. GSM based Agriculture Monitoring and Controlling System

The fundamental idea is to use Wireless Sensor Network (WSN) technology to create an agricultural environment monitoring framework for verifying data about the outside. The proposed rural environment observation server framework uses WSN-based ecological and soil sensors to collect natural and soil data from the outside. This project employs moisture and temperature sensors to assist the field in controlling the water level as well as the temperature. They employed a GSM (Global System for Mobile Communication) wireless sensor network in their experiment (R. Suresh, 2014)

3.2. Plant Monitoring System

The major goal of this project is to keep track of the plant's hydration, light, and temperature. Various sensors are employed here, such as a moisture sensor to capture the moisture of the soil, a temperature sensor to capture the temperature of the plant as well as the proximity of the plant, and a light sensor to capture the data of the light (Siddaramaiah, 2016).

3.3. Plant Moisture Monitoring System

The technology keeps track of the soil's moisture level in real time. If it is discovered while monitoring that the soil moisture level is lower than recommended, an audio-visual alert will be triggered. A visual alarm is provided by an LED, while an auditory alarm is provided by a buzzer to the plant's caretaker. So, using a simple combinational circuit and a sensor, we can help save a plant by maintaining the moisture level of the plant's soil and thus keeping the plant healthy in this project. This alarm is then received by the plant's caretaker. The alarm goes off when the plant is watered, and the monitoring cycle continues (Nevon Project, 2015)

3.4. Agriculture Monitoring System

This system uses an electronic device and an Android phone to demonstrate a smart agriculture monitoring system. This technology assists landlord plantations in monitoring and managing their plants in order to maximize productivity and enhance quality at various agricultural locations. There are several sensors here, such as moisture and temperature sensors, whose values are recorded in the cloud. The field is also managed using a mobile application. The data of the selected area will be displayed on a mobile application, and the user will be able to order water, which will be inconvenient for the uninformed and uneducated planter (N. M. Z. Hashim, 2016).

3.5. Comparison

The evaluation is carried out in this area with a similar system and project. The first project was a GSM-based Agriculture Monitoring and Controlling System, in which the GSM module sent a message to the user saying that the moisture level was low and that the plant needed to be watered. So, this system is costly since transmitting messages after and after is costly, and the second project is the Plant Monitoring System, where only plants are monitored and no irrigating facilities are accessible. This project simply checks for moisture, and no other facilities are accessible, thus it isn't very effective. The third project, Plant Moisture Monitoring System, is a moisture monitoring system with no further features. At last, Agriculture Monitor System has the same features as previous systems, but it also has a mobile application that allows the user to get warning messages. However, in my project, all kinds of features are monitored, such as moisture, temperature, and light, and a self-irrigating system is added, in which the plant will irrigate itself if the moisture level falls below a certain level, and the temperature, moisture, and LDR values are displayed accordingly.

System	Moisture Sensor	Temperature Sensor	LDR
GSM based Agriculture Monitoring and Controlling System	Yes	No	No
Plant Monitoring System	Yes	Yes	Yes
Plant Moisture Monitoring System	Yes	No	No
Agriculture Monitoring System	Yes	Yes	No
Plant Communicator based on Arduino	Yes	Yes	Yes

4. METHODOLOGY

4.1. BLOCK DIAGRAM

The circuit will be implemented in this manner. Different sensors make up the first section of the block diagram, while an LCD panel and water-supply motors make up the second. The following hardware components are required: an Arduino processor, a motor, various sensors, and an LCD panel

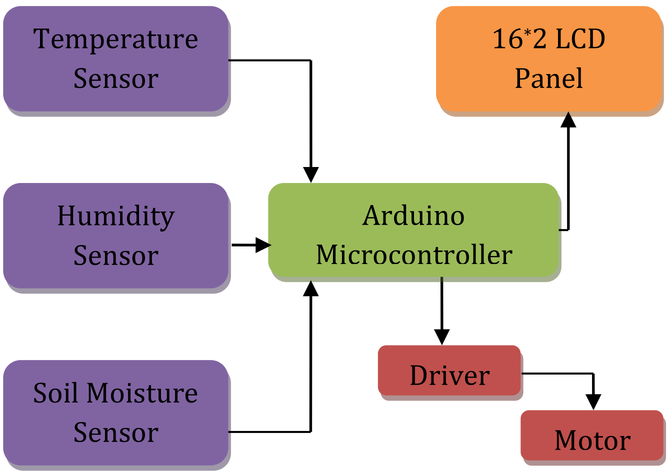

Figure 1: Block Diagram of System

4.2. WORKING PRINCIPLE

This technology is used to automatically turn the valves ON or OFF based on the water requirements of the plants. This system functions as a sensing, monitoring, controlling, and communication system. Various sensors are used to measure various soil factors such as moisture, temperature, and humidity. The Arduino Microcontroller will take the appropriate action based on the sensors' output. Depending on the moisture content, the moisture sensor output will help determine whether or not to irrigate the area. The output of the temperature sensor, in addition to the moisture sensor, can be taken into account when irrigating the land. If the moisture content of the soil is low and the temperature is high, plants will require irrigation; however, the time for which irrigation will be provided varies depending on the temperature range. Because when the temperature is very high, the evaporation rate is also quite high, we must deliver more water for a longer period of time to achieve the required moisture level in the soil. As a result, the area will be irrigated for varying time intervals depending on the temperature range and moisture content level in the soil. Working principle of entire process is shown in Figure 1.

4.3. FUTURE SCOPE

The field of electronics is rapidly expanding and has had a significant impact on humans. The project that will be executed is an automatic irrigation method with a lot of room for growth in the future. The project can be expanded to include greenhouses where manual supervision is scarce. The concept can be used to completely automated gardens and farmlands. When combined with the principle of rainwater collection, it has the potential to save a lot of water if used correctly. This methodology can be successfully utilized to achieve remarkable outcomes with most types of soil in agricultural fields with significant rainfall shortages. A farmer can boost his profit by constructing a Smart Wireless Sensor and employing cutting-edge approaches to solve various challenges that he encounters in his daily life. Also, to use an Arduino-Controller to capture video of the crop position using an MMS facility while simultaneously sending video to the farmer.

5. CONCLUSION

Farmers and gardeners who don't have enough time to water their crops/plants are the principal beneficiaries of this endeavor. It also covers farmers who waste water while irrigating their crops. Water supplies are becoming scarce and dirty, necessitating more effective irrigation to reduce water use and chemical leaching. Recent advancements in soil water sensing have enabled commercial application of this technology to automate vegetable irrigation management. However, research shows that various sensor types operate well in all settings, with no detrimental influence on crop yields and water use reductions of up to 70% when compared to traditional methods.

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