Automated Irrigation System using Arduino and Sensors and Data Analysis for Crop Requirement

[1]Miss Leena Sardesai, [2]Miss. Priyanka Bhalerao, [3]Mrs. Vijayalaxmi Balaraju
[1,2]Post Graduate Student, [3]Asst.Professor
Department of IT,
Thakur College of Science & Commerce, Thakur Village, Kandivali (East)
Mumbai-400101, Maharashtra, India

Abstract: This project is aimed at providing water automatically to potted plants without human intervention. This is in order to utilize sufficient water and not over or under do it. Soil Moisture is the best method to determine the amount of water that a plant needs. This is because the roots of a plant are buried in the soil and they absorb water and other nutrients from it. A network system of different sensors is used in this project which consists of a soil moisture sensor, a soil temperature sensor, an ultrasonic sensor, a motor pump with a pipe attached to it to ensure adequate watering of the plant. When the water content in the soil is low, it is called as wilting point of the plant. This is when the plant begins to die. Similarly, overwatering leads to puddle formation in the soil which is also fatal for the plant. This system is powered by the Arduino UNO microcontroller board. The automated system is programmed to keep a check on soil parameters using the sensors mentioned above and accordingly turn the motor on to release water into the soil. The said parameters are all stored in a micro SD Card. The data collected was then used for analysis to determine average water used in a week by a plant.

Keywords—Arduino; Automation; Irrigation; Soil Moisture Sensor; Temperature Sensor; Ultrasonic Sensor

I. INTRODUCTION

The main aim of this project is to save water as much as possible. Saving water is crucial in this day and age. In a drought-hit city in European or American countries, water for lawns is banned or cut-off. This shows that the management wants to cut off water for our plants. The very things that provide us greenery, shade and which plays a major role in rainfall. These plants will have a hard time without water. Almost all the Indian households have one or more potted plants. Tulsi is the most common plant to be kept at home. A lot of other variety of plants is also kept. It has been observed that people tend to sometimes water the plants a little too much than needed. A human sometimes may even forget to water the plants due to the present day busy life. Also, when the members of the house go on a vacation, the house stays shut and the plants are left with no one to water them. It is very bad for the plants especially in the summer season when the heat is too much to bear. For such a situation an automated irrigation system is a good idea to solve the above mentioned problems. Of course the automated system will not save all the water in the world but it is a start and a small contribution which has the potential to have a big impact.

Usually, a human waters a plant based on his/her convenience and remembrance. It is said that a plant needs to be watered daily once or twice. However, a questions arises about the trees on the streets. Nobody waters them every day. They get watered only when it rains. How then do they survive? The answer is the ground water. The roots of the trees grow deep in the soil in search of water. This gives an idea for household plants. What if the roots of the plant also go deep in the soil and absorb water from there lasting for days? In this case maybe the plant does not need to be watered daily.

II.LITERATURE REVIEW

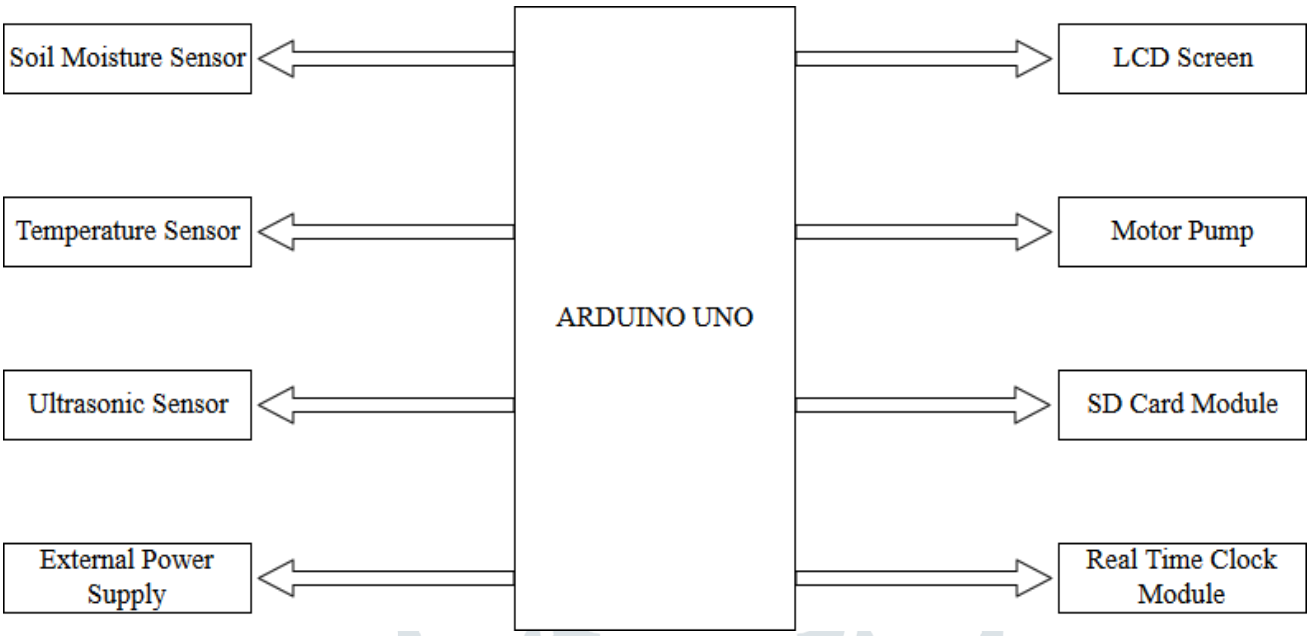
Studies have found that India is the largest freshwater consumer in the world. It is obvious that since India is an agricultural country, most of this water is being used by the agriculture sector. It is followed by domestic and industrial sectors. Groundwater provides roughly 65%-70% of the India's demand of water. Hence it plays an import role in shaping the country's economic growth. India contributes to 17% of the world's population. However, she has only 4% of the world's water resources at hand. It is tough to manage with such a less amount of water. If future economic growth is to be secured and expanded, it is crucial to distribute the water uniformly among all sectors. This has to be done by taking the limited water resources that the country has. A ray of hope is the development of irrigation systems such as drip irrigation and sprinkler irrigation which reduce the loss of water that is the result of traditional flood irrigation methods. Such methods supply water at regular intervals and volumes using apparatus such as emitters or nozzles. This results in reduced usage of energy that is needed for pumping groundwater.

A lot of methods have been implemented that help in reducing water consumption. One method made the use of the concept of thermal imaging. It was used to capture the canopy temperature of the plant. Canopy temperature is a direct measure of energy released by a plant. With the help of this technique, status of the water was monitored. Depending upon whether it was high or low, the irrigation was scheduled. [1]

Another technique implemented was that of a switching tensiometers which were combined with an ET. This ET was calculated by collecting historic weather data and automatic irrigation schemes were controlled. This method of irrigation was a highly sustainable practice due to its lower value of water utilized. [2]

Many irrigation systems developed in the last few decades implement the methods of wireless sensors and are effective in scheduled irrigation. There are systems that irrigate only when the water requirement is vital. It uses a microcontroller based rain gun irrigation system that saves a huge amount of water. However this system is very expensive. [3]

III.METHODOLOGY



III.I. COMPONENTS

III.I.I. Soil Moisture Sensor: The FC-28 has two probes which allow current to pass through the soil and it gets the resistance value to measure the moisture value. The lower the resistance the higher the moisture content in the soil. It works on the power supply of 3.3V to 5V.

III.I.II. Temperature Sensor: DS18B20 is the temperature sensor used. It is inserted into the soil to measure its temperature. It has a 12bit ADC. This sensor has two modes of operations viz. Normal and Parasite modes. For the normal mode 3-wire connection is needed. Whereas in the parasite mode it derives power from a data line.

III.I.III. Ultrasonic Sensor: The HC-SR04 is attached on the top of the container that stores water and measures the distance of the water by transmitting and receiving ultrasonic waves. It consists of two eyes like projects. These two act as a trasnmitter and receiver. The formula used in this sensor is the basic Distance=Speed x Time. It requires a power supply of 5V.

III.I.IV. External Power Supply: The Arduino UNO board is connected to an external power supply and it is kept on 24x7 for collection of data.

III.I.V. LCD Screen:A 16x2 LCD is used to display the time and readings of the sensors. Each character is displayed in 5x7 pixel matrix. It comes with 16 pins. Command and Data are the two types of registors in this LCD.

III.I.VI. Motor Pump: A DC submersible motor pump is connected to Arduino via the digital pins. A value of HIGH means turn on the pump and LOW means to turn it off. This pump can take about 120 litres of hour per hour. It consumes very less current of about 220mA.

III.I.VII. SD Card Module: The SD Card Module makes the transfer of data to and from a SD card convenient. This module comes with an SPI interface. It can work on 5V as well as 3.3V of power supply.The readings of the sensors are all stored in the a text file and are used for studying the soil behaviour.

III.I.VIII. Real Time Clock Module:The DS3231module is used to keep a track of the readings corresponding to the given time in order to determine durations and time intervals of the fluctuations in soil moisture levels. A great feature about the RTC module is that it has batter backup which keeps it running even if a power failure occurs.

III.I.IX. Arduino UNO: Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online.

III.II. SYSTEM WORKING

All the above mentioned components are connected together on an Arduino UNO board to form a 'network"or a system that works in conjunction to automate the watering of a plant and to also monitor the parameters associated with it.
The Real Time Clock module displays the time continuously on the screen along with the date.
The soil moisture sensor is inserted deep into the soil; at the root level. It outputs readings in percentage and the same is displayed on the LCD screen every 5 minutes.
Along with the moisture content, the temperature is also displayed every 5 minutes.

This experiment is carried out on a mustard seed plant.
The entire system runs every 10 minutes, meaning the system will check the moisture content and if it is found to be below the threshold level the motor pump starts the water outlet.
The threshold value for moisture is set at 50%.
If the moisture is found to be low, a "LOW MOISTURE" message is displayed on the screen. After the water goes in the soil and the moisture is found to be increased, the system displays an "ALL OK" message and goes on with its normal working. At this time the system also checks the water level in the container via the ultrasonic sensor. If the water in the container is insufficient, the LCD displays a "Fill Water" message and the system halts. The reason being simply that if there is no water in the container, what will the pump let out? Once the container is filled up, the motor can pump the water and the system proceeds.
All this data of time, date, soil moisture, soil temperature, and water level in the container is stored in the SD card to analyze the behavior of the plant.

IV. RESULT

The moisture level went down as little as 10% per day and 20% in two days. Hence the motor would pump the water every 2 or 2.5 days. The water pumped out made a difference of 3cm in the distance which was equal to 200ml of water. Therefore, it can be determined that plants do not require water on a daily basis. With this system human intervention is reduced as well water usage is reduced. There is no danger of over watering the plant and making a puddle in the pot. This way the water that seeps thought the pot holes is reduced thereby avoiding overflow.

V. FUTURE ENHANCEMENT

In future more sensors can be added to acquire more data about the soil. An example could be a nutrient sensor, which reads the pH level of the soil. Also, a more effective way of alerting the user when the water is insufficient in container can be implemented. It can be done by flashing a LED or a ringing an alert sound. A humidity and temperature sensor will give data about the air surrounding the plant. This will help in analyzing how moisture level in the air affects the moisture in the soil. Various algorithms can be applied to this data for more efficient data collection in future.

VI. REFERENCES

[1] Jadhav, Suprabha, and ShaileshHambarde. "„Automated Irrigation System using Wireless Sensor Network and Raspberry Pi “." *International Journal of Science and Research (IJSR)* 4.12 (2015).

[2] Jain, Rashmi, et al. "Automatic Irrigation System for Agriculture Field Using Wireless Sensor Network (WSN)." *International Research Journal of Engineering and Technology (IRJET)* 3.04 (2016): 1602-1605.

[3] Rawal, Srishti. "Iot based smart irrigation system." *International Journal of Computer Applications* 159.8 (2017): 880-886.

[4] Dursun, Mahir, and SemihOzden. "A wireless application of drip irrigation automation supported by soil moisture sensors." *Scientific Research and Essays* 6.7 (2011): 1573-1582.

[5]Patil, Ankita, et al. "Smart farming using Arduino and data mining." *2016 3rd International Conference on Computing for Sustainable Global Development (INDIACom)*. IEEE, 2016.

[6] Rajalakshmi, P., and S. Devi Mahalakshmi. "IOT based crop-field monitoring and irrigation automation." *2016 10th International Conference on Intelligent Systems and Control (ISCO)*. IEEE, 2016.

[7]Arvindan, A. N., and D. Keerthika. "Experimental investigation of remote control via Android smart phone of arduino-based automated irrigation system using moisture sensor." *2016 3rd International Conference on Electrical Energy Systems (ICEES)*. IEEE, 2016.

[8]Navarro-Hellín, Honorio, et al. "A decision support system for managing irrigation in agriculture." *Computers and Electronics in Agriculture* 124 (2016): 121-131.

[9]Morton, T. G., A. J. Gold, and W. M. Sullivan. "Influence of overwatering and fertilization on nitrogen losses from home lawns." *Journal of Environmental Quality* 17.1 (1988): 124-130.

[10] Haley, Melissa Baum, and Michael D. Dukes. "Evaluation of sensor based residential irrigation water application." *2007 ASAE Annual Meeting*. American Society of Agricultural and Biological Engineers, 2007.

[11]Koprda, Stefan, et al. "Proposal of the irrigation system using low-cost Arduino system as part of a smart home." *2015 IEEE 13th International Symposium on Intelligent Systems and Informatics (SISY)*. IEEE, 2015.