International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2018): 7.426

Smart Irrigation Control System

Sumeet Sarode

Computer Engineering Department, Vivekanand Education Society's Institute of Technology, Mumbai, India

Abstract: ***Around 38 percent of the total land area of the planet is categorized as cultivable land or Agricultural land. Due to this, a large fraction of people earn their living through farming and take agriculture as their primary source of income. But the produce from this land depends mainly on proper irrigation which is suitable to the ambient climatic and atmospheric conditions. Irrigation can be defined as artificially supplying water to the land which is to be cultivated. Lack of proper Irrigation system can result in significant deterioration of the yield. Smart technologies can be used to automate the irrigation process based on the surrounding conditions. Smart Irrigation system automates the irrigation process and thus help in increasing the yield. This can be achieved using Internet of Things (IoT). IoT is the result of numerous advancements in Information and Communication Technology (ICT). It is a multidisciplinary concept that undertakes a wide range of technologies and is used to automate various processes which required humans to take actions. Automated control features with latest electronic technology using microcontroller which turns the pumping motor ON and OFF on detecting the dampness content of the earth and GSM phone line is proposed after measuring the temperature, humidity, and soil moisture. This can also be achieved by placing various valves which are responsible for the flow of the water and its direction.***

Keywords: Internet of things, irrigation system, modern irrigation, Watering farms, temperature, Information and Communication Technology, Wireless Sensor Network (WSN), Local Shortest Path

1. Introduction

Agriculture is one of the largest and the most essential occupation in the world. With the world population increasing above 7 billion, the demand for agriculture production in increasing many folds. To meet this ever-increasing demand, there is a pressing need to monitor and control the surroundings for getting desired results. Irrigation, which is one of the most important deciding factors for a good yield, needs to be controlled according to the various factors in the environment. Traditionally, drip irrigation, ditch irrigation, sprinkler system are the most widely used irrigation system[1]. These irrigation methods supply water uniformly in all the directions irrespective of the factors such as soil moisture, temperature, time, and humidity. These methods work well when there is sufficient water supply but fail in a scarce water supply. Also, these methods are very time-consuming and a huge amount of water is wasted. The farmers need to check the fields from time to time[2]. Managing irrigation according to the crop being cultivated is very important when it comes to farming. It is to be changed with the change in environmental conditions such as temperature, soil conditions, and humidity. A threshold value is set with the ideal conditions required by the crop. If the values of the above-mentioned factors goes above or below the threshold value, the controller module will decide to turn the system ON or OFF. The changes and the decisions are notified to the farmer on the registered mobile number with the help of IoT [3].

2. Related Work

There is plenty of research work which has been done to improve the performance of the agriculture field. In paper [5], Joaquin Gutierrez (2013) proposed a gateway unit which is responsible for handling the sensor information, and it triggers the actuators and then transmits the data to a web application. It is powered by photovoltaic panels and it has a communication link which is duplex based on cellular internet interface and which is responsible for data inspection and it allows irrigation scheduling to be programmed through the web page.The WSN is integrated with ZigBee to transmit soil moisture level and temperature values. This data is then transmitted to a web server using GPRS through a cellular network.

Agriculture System (AgriSys) [4] inputs the data by using temperature, pH, humidity sensors and the fuzzy inference. The system is responsible for monitoring the sensors information on LCD and PC.

Indu et al. (2013) [6] mainly focuses on reviews in the field of remote monitoring and control, the technology used for an automated irrigation system and their potential advantages for the system. This paper proposes an innovative GSM/Bluetooth based remote controlled embedded system for irrigation. The system depends on the temperature and humidity readings from sensors and type of crop with the help of which it sets the irrigation time and it can automatically irrigate the field when the field is unattended. The SMS on GSM network is responsible for exchanging the information between far end and designed system. The main microcontroller chip is interfaced with a Bluetooth module which eliminates the SMS charges within the limited range of a few meters of the user to the designated system. The system also informs users through SMS on GSM network or by Bluetooth about various conditions like increased temperature, the water content in soil and smoke, the status of electricity, dry running motor.

Archana and Priya (2016) have proposed a paper in which the root zone of the plant is placed with humidity and soil moisture sensors. Based on the sensed values by the root of the plant, the supply of water to the field is controlled with the help of the microcontroller [7].

3. Methods of Irrigation

Irrigation can be considered as the replacement or supplementation of rainwater with another source of water. The main idea behind irrigation systems is that plants are maintained with the minimum amount of water required.

Licensed Under Creative Commons Attribution CC BY

Water is a fragile natural resource and so there is a need to incorporate methods to conserve it and not overuse it. The implementation of an irrigation system will help conserve water, and it will also help to save our time, money, preventing weed growth and increasing the growth rate of our plants and crops.

a) Ditch Irrigation

It is a traditional method, where seedlings are planted in rows by digging and creating the ditches. In between the rows of plants, canals or furrows are placed to water the plants. The water from the main ditch to the canals is moved by using Siphon tubes. This type of an irrigation system was very popular in the USA, but it is has now been replaced with modern systems.

Figure 1: Ditch Irrigation

Figure 2: Terraced Irrigation

b) Terraced Irrigation

In this method of irrigation, the land is cut into steps and then retaining walls are used for support due to which it is a very labor-intensive type of irrigation. For planting flat areas are being used, so that while watering each plot the water flows down each step. Thus for planting crops it allows the use of steep land.

c) Drip Irrigation

In this method of irrigation water is used most efficiently. In a dripping motion, water drops right near the root zone of a plant. We can steadily reduce the loss of water by installing the system properly and through the methods of runoff and evaporation.

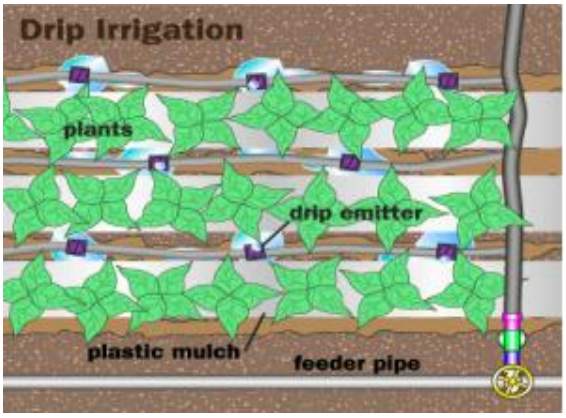

Figure 3: Drip Irrigation System

Figure 4: Sprinkler Irrigation System

d) Sprinkler System

This system of irrigation is installed on permanent risers and it is based on overhead sprinklers, sprays or guns. There is an irrigation system which is very popular and used for golf courses and parks in which the system is buried underground and when the water pressure rises, the sprinklers rise up.

e) Rotary Systems

For larger areas and where the sprinklers can reach distances of up to 100 feet are best suited with such method of irrigation. The mechanical driven sprinklers moving in a circular motion are indicative of the word “Rotary”, which are responsible for reaching greater distances. This system with small amounts of water waters a larger area over a longer period of time.

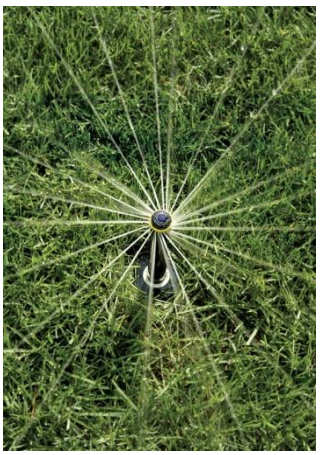

Figure 5: Rotary Irrigation System

Licensed Under Creative Commons Attribution CC BY

Figure 6: Center Pivot Irrigation

f) Center Pivot Irrigation

This is a type of overhead irrigation. Pipes of steel or aluminum are joined together, supported by trusses and are then mounted on wheeled towers. The sprinklers move in a circular motion and are situated on the length of the tower.

4. Methodology Used

Unlike the traditional methods of irrigation such as channel system, sprinkler system, drip system which were user operated, a smart irrigation system is controlled by various sensors. It doesn't require workers for operating, and can also operate even with a very acute supply of water when compared with the three traditional methods.There were many pipes laid in all directions with electromagnetic valves installed in them. These valves were turned ON and OFF using the Raspberry Pi. The status of the system and the farm was notified to the farmer on his registered number.Allthe soil moisture sensors that were randomly placed in the field and were connected with a wireless network device. The Wireless Sensor Network (WSN) was controlled using Local Shortest Path (LSP) algorithm. In this algorithm, each WSN device calculates the least cost and the least distance to the nearby WSN based on a predefined weight function[9].

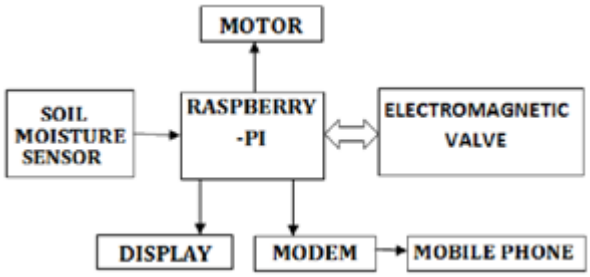

Figure 7: System based on electromagnetic valves placed in the pipes [9]

In order to achieve cost reduction, and ensure maximum resource utilization, an Arduino module could be used along with humidity and temperature sensors. The system checks for the soil humidity and temperature levels. These observations were compared with the predefined range of soil moisture and temperature. Based on the comparison results, the water pumps were turned ON or OFF [12].

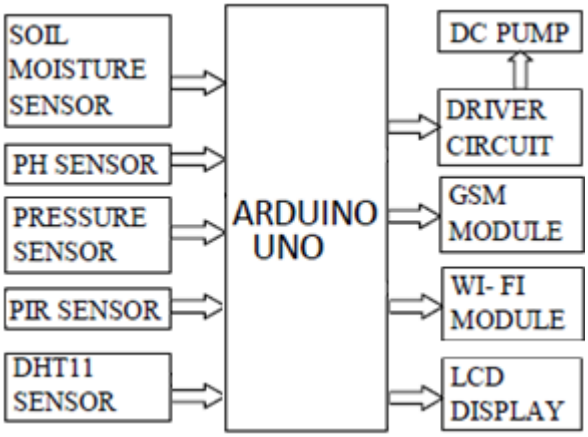

Figure 8: Arduino Based Smart Irrigation System [12]

To improve the yield from the farms, Zigbee modules were used along with sensors which are used for sensing ambient temperature and humidity values, soil moisture value and the water level of the tank from the field. The Zigbee module was responsible for controlling the water supply. The observations from the various sensors formed the basis for the decisions taken by the Zigbee module[8].

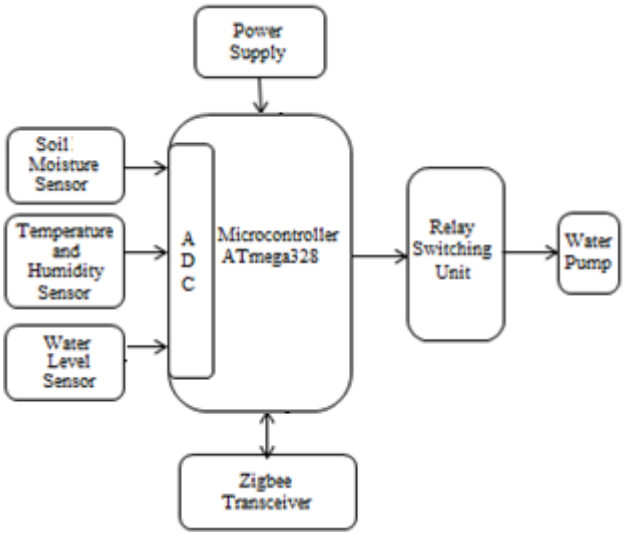

Figure 9: Smart Irrigation using Zigbee module [8]

To make the irrigation system fully automated, machine learning algorithms were also be employed in it. A variety of crops were grown and the various factors were regularly checked. The moisture content of the soil was monitored using the moisture sensors after the seeds germinated. The data from various sensors such as temperature sensor, rain sensor, and the current sensor was given as input to the microcontroller through the input ports. The controlling action was mounted on Raspberry Pi using various software processing tools. The threshold values used by the microcontroller was approximated based on the data collected over a long period of time using Regression Algorithm. The threshold value was used by the microcontroller for taking the actions. The input values of the microcontroller were stored in cloud storage using Wi-fi module[2].

Licensed Under Creative Commons Attribution CC BY

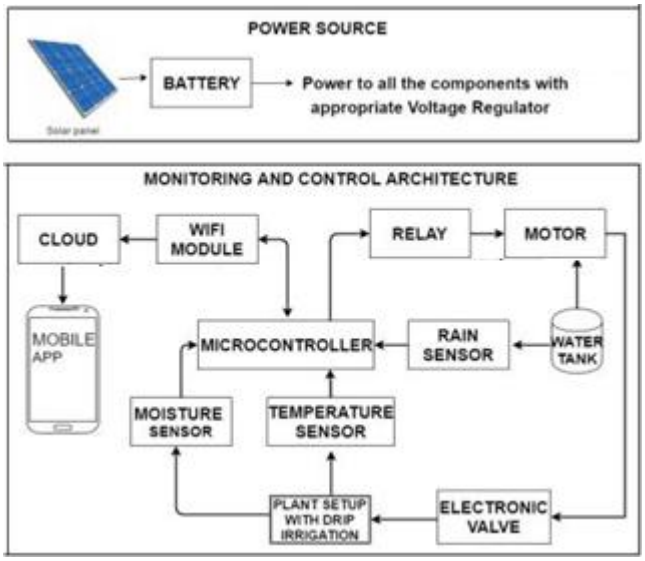

Figure 10: IoT Based Smart Irrigation Using Regression Algorithm [2]

5. Results

In this article, we present a prototype for automatic controlling an irrigation system. IoT plays an important role in everyone's life. It processes the real-time data to obtain results. The temperature and soil moisture sensor connected to the microcontroller (Arduino or Raspberry Pi) sends all the sensed data to it. The the actuator for pumping water is also connected to Arduino. The sensed data was sent to Raspberry Pi3 (control unit). Here machine learning algorithm K-NN is being used. The data set pertaining to moisture and temperature are checked in this algorithm and accordingly the prediction is made. This predicted is given to Arduino which is incharge of the water pumping action. The state of the field and the status of the irrigation system is stored in cloud web page where the farmer can access it from any place. The experimental observations of the data collected by the moisture sensor against the temperatures is plotted for the two different types of soil- dry and wet.

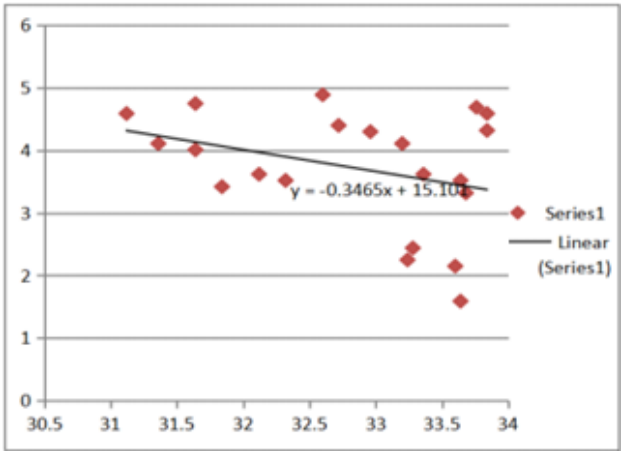

Figure 11: Moisture Sensor data against Temperature for Dry soil

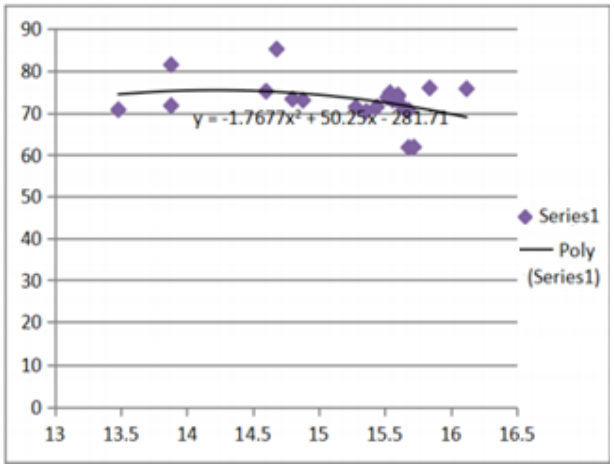

Figure 12: Moisture Sensor data against Temperature for Wet soil.

These graphs help us to analyze the intelligence of the technology, which comes into play to predict the soil condition with the help of machine learning algorithm and thus watering the crops based on sensed and trained data set rather than periodically scheduling the irrigation without any intelligence.

By using the smart irrigation system we can optimize the irrigation methods to achieve maximum efficiency. It saves a huge man work. This system is very efficient and user-friendly. The farmer is notified about all the changes and the operation of the irrigation system. Data being used for training in the K-NN algorithm is stored in a excel(.csv) file. The machine learning algorithm appropriately predicts the amount of water required for a particular soil type as determined on the basis of the data collected from the sensors.

References

[1] Yuthika Shekhar, Ekta Dagur, Sourabh Mishra, "Intelligent IoT Based Automated Irrigation System", International Journal of Applied Engineering Research ISSN 0973-4562 Volume 12, Number 18 (2017) pp. 7306-7320.
[2] Anusha Kumar, Aremandla Surendra, Harine Mohan, Muthu Valliappan K, N. Kirthika, "Internet of Things Based Smart Irrigation Using Regression Algorithm",2017 International Conference on Intelligent Computing, Instrumentation and Control Technologies (ICICICT)
[3] Dr.M.Newlin Rajkumar, S. Abinaya, Dr.V.Venkatesa Kumar,"Intelligent Irrigation System-An IOT Based Approach",IEEE International Conference on Innovations in Green Energy and Healthcare Technologies(ICIGEHT'17)
[4] A. Abdullah, S. A. Enazi and I. Damaj, "AgriSys: A smart and ubiquitous controlled-environment agriculture system," 2016 3rd MEC International Conference on Big Data and Smart City (ICBDSC),Muscat, 2016, pp. 1-6.
[5] J. Gutiérrez, J. F. Villa-Medina, A. Nieto-Garibay and M. Á. PortaGándara, "Automated Irrigation System Using a Wireless Sensor Network and GPRS Module,"

Licensed Under Creative Commons Attribution CC BY

in IEEE Transactions on Instrumentation and Measurement, vol. 63, no. 1, pp. 166-176, Jan. 2014.
[6] Indu Gautam and S.R.N Reddy, "Innovative GSM based Remote Controlled Embedded System for Irrigation",International Journal of Computer Applications Vol. 47 –No.13, June 2012
[7] Archana and Priya, "Design and Implementation of Automatic Plant Watering System" presented at International Journal of Advanced Engineering and Global technology ,vol-04, Issue-01 , Jan-2016.
[8] Shweta B. Saraf,Dhanashri H. Gawali,"IoT Based Smart Irrigation Monitoring And Controlling System",2017 2nd IEEE International Conference On Recent Trends in Electronics Information & Communication Technology (RTEICT), May 19-20, 2017, India
[9] Chandan Kumar Sahu,Pramitee Behera,"A Low Cost Smart Irrigation Control System",IEEE Sponsored 2nd International Conference on Electronics and Communication System(ICECS 2015).
[10] Srishti Rawal,"IOT based Smart Irrigation System", International Journal of Computer Applications (0975 – 8887), Volume 159 – No 8, February 2017
[11] A.Neelima, M.V S L Sravanthi, M.L.Ramyasri, K.Yuvasri,"Sensor Based Automated Moisture Monitoring Irrigation System with IOT", International Journal of Innovative Research in Computer and Communication Engineering,Volume 6, Special Issue 1, April 2018.
[12] R.Nandhini, S.Poovizhi, Priyanka Jose, R.Ranjitha, Dr.S.Anila,"Arduino Based Smart Irrigation System using IOT",3rd National Conference on Intelligent Information and Computing Technologies, IICT '17.

Licensed Under Creative Commons Attribution CC BY