A RETROSPECTIVE STUDY ON CROP DEPENDENT DRIP IRRIGATION SYSTEM

Arunima C V[1], Gowry Nair S[2], Krishna Gadha S Kumar[3], Santy Sajan[4], Ajith Ravindran[5]

[1-5]*Department of Electronics and Communication Saintgits College of Engineering Kottayam, India*

Abstract*: The aim of this paper is to develop a cheap crop dependent drip irrigation system using Raspberry Pi. Soil moisture is the primarily focused area. This system will be a substitute for traditional farming system. The main aim of the proposed system is to help the farmer in identifying the requirements of crops by sitting in home. The proposed system is mainly to reduce the water wastage. This new technology will be very helpful to the farmers in time saving and energy reduction. Its a cheap system as the main component is raspberry pi and it controls the whole system. Here the appliances are controlling automatically. The objective of the paper is to control the water flow for the crops automatically thus monitor the plant growth.*

Keywords: **Raspberry pi, Automation, Irrigation**

1. INTRODUCTION

Agriculture is the most important and inevitable food supplier in our Asian countries. As the primary source of livelihood, almost 75% of Indian population depends on agriculture. As we all know India is an agricultural country and it's an inevitable part of our culture. The main reason for the current technologies is green revolution.

As proper watering is the way to improve the growth and yield, irrigation is an important one. As per some surveys, the existing farming system has some drawbacks [1][2]. The usage of water is very high and the lack of methods to understand the exact watering and fertilizing requirements are some of that drawbacks. In India as per studies, more than 80% of the water is consumed for agriculture. However, globally about 69% of the water is consumed. Fresh water is commonly used for irrigational purposes. We know that only 2.5% of the total water covering the planet is fresh water [3]. Hence the arises the problem of water capacity.

So, to reduce the water consumption drip irrigation system is introduced. In this method a substantial amount of water is saved [4]. In this drip irrigation system, a network of pipes and valves are used through which the required amount of water is supplying to the crops. This method will also increase the crop yield [5]. Also, there is a minimized use of nutrients and fertilizers due to localized application. So, the main objective is to create cost effective advanced automated crop dependent drip irrigation system [6].

2. WATER CONSUMPTION OF DIFFERENT PLANTS

Different plants are consuming different amount of water every day and they need different climate conditions for their growth. Here we are discussing the different climatic and nutrient condition of different crops.

I. Chilly

Chilly is a popular crop that valued all over the world because of its color, flavor spice and its nutritional value. Chilly is most adapted to hot weather and it doesn't get fruits when temperature exceeds 240C. The suitable temperature for the growth of chilly is in between200Cand300C. The most critical factor the affect the growth of chilly is temperature. If temperature falls below 150 C or exceeds 320C that will affect the growth and yield of chilly [7]. Different varieties of chilly are Jwala, Jwalasakhi, Jwalamukhi, Manjari, Ujwala and Anugraha. Chilly plants are shallow rooted shallow rooted and have less tolerance to drought. Provide uniform soil moisture through irrigation. As chilly can't tolerate flooding the soil should be drained properly. They can stand in water for 48hrs.

II. Brinjal

Brinjal otherwise known as eggplant. It is one of the common vegetables grown in our country. Brinjal is a warm season crop, it also can be grown in rainy season and summer season [8]. It can also be grown on all types of soils

some of the different varieties of brinjal are Surya, Swetha, Haritha, Neelima etc. A light irrigation is given on the first and third day after transplanting. Irrigate the crops at three or four-days intervals during summer season for better growth and yield.

III. Cabbage

Cabbage is a leafy green crop grown as an annual vegetable. Cabbage is a good source of vitamin K and vitamin C and dietary fiber. Cabbage weights generally 500 gm to 1000 gm [9]. Smooth leafed, firm headed green cabbages are the most common. Cabbage takes 2 years to complete its life cycle. Some of the varieties are Pride of India, Green challenger, Green hero, Rare ball. First irrigation is given soon after transplanting the seedlings. Optimum moisture should be maintained by frequent irrigation during the period of head formation.

IV. Pea

Pea is the most common crop all over the country and can be of Green yellow or purple color [10]. It is a cool season crop grown in many parts of the world. Planting can take from winter to early summer depending on location. Giving two irrigation is highly beneficial foritsgrowth,15daysaftersowingandduringthetime of flowering. Varieties of peas are generally known as field peas. Peas are mostly cultivating crop in Kerala. Peas require medium level of water for irrigation.

V. Spinach:

Spinach is a leafy green flowering crop [11]. It is an annual plant. For proper germination the soil shouldn't be warm than 210C.In northern climate they are harvested linearly spring before cold weather. For spinach, it requires six weeks of cool climate from seedling to harvest. Different varieties of spinach are Bloomsdale long standing, Anna, crocodile, Avon, Renegade. Keeping the soil moisture is important when growing spinach. Surface soil should be kept constantly damp.

VI. Tomato:

Tomato is an edible plant commonly known as tomato plant. Numerous varieties of tomato are grown in environment with moderate rainfall across world [12]. They are perennials in native but cultivated as annuals. Varieties of tomato are cherry tomato, sun gold, black cherry, sunrise, bumblebee. Tomato seed germinate readily in constant temperature of 68 to 500C. Tomato needs consistent moisture to produce even growth and ripe juicy fruits. In order to grow to a specific height using stakes, they could support with plant ties.

3. COMPONENTS DESCRIPTION

3.1 RASPBERRYPI

Raspberry Pi is a small credit card sized, portable computer. This device helps to learn about the basic computing in schools.

The Raspberry Pi 3 Model B+ is an upgraded version of Raspberry Pi 3 Model B. The main advantage is that it has high processing power in a compact board.

Fig 3.1.1 Raspberry pi

Also, it has many interfaces like HDMI, multiple USB, Ethernet, on-board Wi-Fi and Bluetooth and many GPIOs, USB powered etc.

3.2 MOISTURE SENSOR

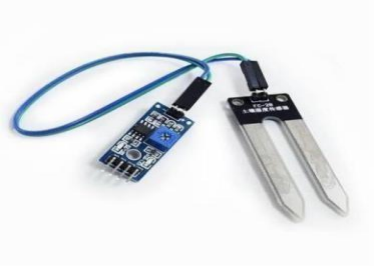

Fig 3.2.1: Moisture sensor

Soil moisture sensors are used to measure the water content(moisture) in soil. When the soil is having less water content, the module output is at high level, else the output is at low level. This sensor reminds the user to water their plants. The working voltage is 5V and working current is less than 20mA. Measuring soil moisture is important for agricultural applications to help the farmers manage the irrigation systems more efficiently. Knowing thee x act soil moisture conditions on their fields, farmers are also able to increase yields and the quality of the crop by improved management of soil moisture during critical plant growth stages.

3.3 SOLENOID VALVE

A solenoid valve is used to regulate the flow of water. Solenoid valve is control unit which, when will be electrically energized or de energized, either shut off or allow fluid flow. It consists of an actuator that takes the form of an electromagnet. After energized, a magnetic field is built up that pull's plunger or pivoted armature against the action of spring. When de- energized, the plunger or pivoted armature is then returned to its original position by spring action.

In a direct-acting valve, electric current activates the solenoid, which in turn pulls a piston or plunger that would otherwise block air or fluid from flowing.

Fig 3.3.1: Solenoid valve

3.4 ANALOG TO DIGITALCONVERTER(ADC)

Fig 3.4.1: Analog to Digital Converter

Analog-to-digital converter (ADC, A/D, or A-to-D) is a system that converts an into a digital signal. For example: a sound that picks up by the microphone or light is an analog signal and on entering into a digital camera is converted into a digital signal. An ADC also provides an isolated measurement such as an electronic device that converts an input analog voltage or current to a digital number representing the magnitude of the voltage or current.

4. RESULTS AND DISCUSSION

The results are shown as follows: We are analyzing the water consumption rate of the crops based on the intervals of 10days.The results are interpreted graphically as shown below. We have three graphs here. Fig 4.1. Is a graph showing the water requirement for the first 25 days and second graph Fig 4.2. Shows the water consumption for the next 25 days. And the third graph is Fig 4.3. Which is a comparison graph between water consumption in drip irrigation and normal irrigation. Here the graph is plotted for an interval of 10 days up to 50 days on X- axis and the water consumption in ml in the Y- axis. As we can see in the third graph Fig 4.3., the actual water consumption is shown in red color and drip irrigation in blue color.

A generalized fact is graphically represented i.e., the amount of water consumed is much less than that of the actual water consumption.

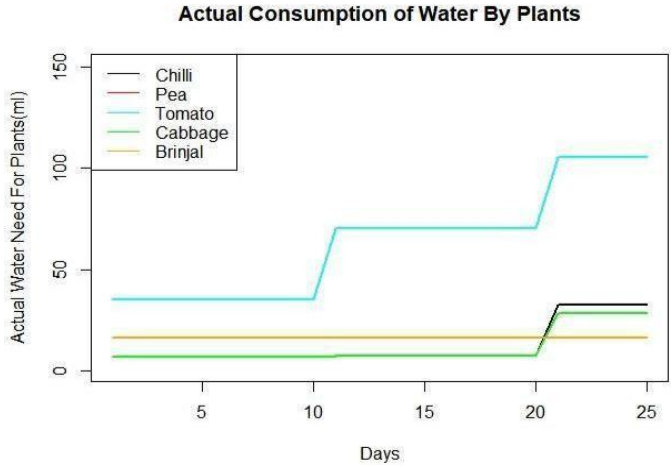

Fig 4.1. Graph for actual water consumption of plants for first 25 days

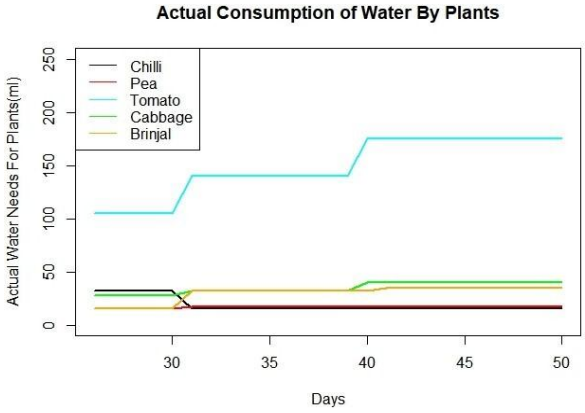

Fig 4.2.Graph for water consumption of plants for 25-50 days

From Fig 4.1graph it is clear that for the first 10 days cabbage, brinjal, tomato and pea require below 50 ml water per day. For tomato, it needs more water after 10 days and then after 20 days it consumes around 100 ml water per day. Cabbage and pea require very less water till 20th day from the day of planting and after 20 days it requires around 40 ml water per day. But it's clear that Brinjal requires the same water content till the 25^{th} day.

From Fig 4.2 graph it shows that from 25 to 30 days they require100 ml of water later consumption increase for next 10 days by 145ml and during later phase 40^{th} to 50^{th} day they require 160ml. In case of pea it requires only about 20 ml throughout the period [13]. For cabbage during 30^{th} day they require about 30 ml of water and later it does not require much water and the they only need during 40^{th} day to last phase. Chilli requires water till 30^{th} day since they mainly need during flowering later it drops; only minimal water is required. For Brinjal consumption increase at 40^{th} day later 40 day an amount of 40 ml and then it stays constant till 50^{th}.

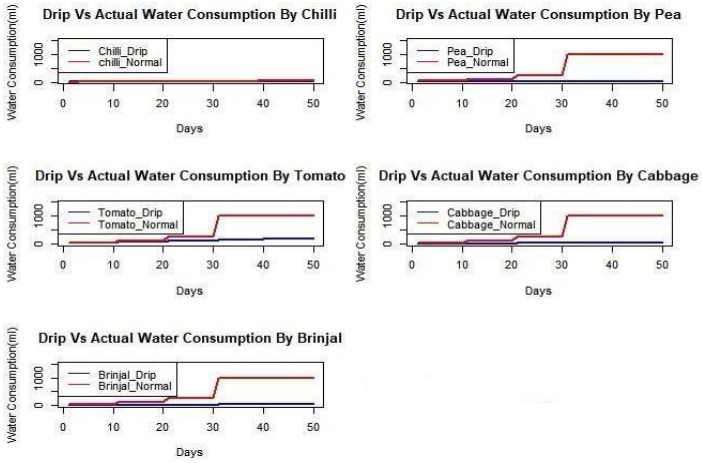

Fig4.3: Thermal image of a pest detected leaf.

In the first graph, there is the comparison of the water consumption by chilly where we can see that in both drip irrigation and normal irrigation method, same amount of water is used till first 40 days which is 7ml water for first 10days, 7.4ml for next 10days, 32.77ml for 20-30 days, and 16.38 ml for 30-40days. After 40 days, the water consumption rate is less for drip irrigation [14].

In the second comparison graph for pea, we can see that for the first 30 days drip irrigation requires the same amount of water i.e., 16.38 ml. However, normal water consumption takes 50ml, 100ml and 250 ml. And for the next 20 days, the water requirement is 1.75% more than the drip irrigation system. As we can see in the graph that on 30th day onwards, the water consumption is increasing rapidly and it becomes steady.

In the third comparison graph for tomato, the water consumption rate is increasing on every10 days of interval. On the initial 10 days, 35.11 ml of water is required which is very much larger than the two previous plants, chilly and pea. Then for the coming interval of 10 days, the water level gets increased on the multiples of 35.11ml. Water consumption in normal method takes much more amount of water of about 17.5% more than the drip irrigation. On the initial 10 days, it takes almost 50 ml of water. From 20-30 days, it requires 100ml, 30-40 days takes 250 ml and last 10 days require 1000ml of water.

On the next graph shows that there is an increase in the water consumption of cabbage for each interval of 10 days up to 50 days. The normal water consumption rate is 50ml, 100ml, 250 ml and 1000ml for 10-20 days, 20- 30 days, 30-40 days and 40-50 days takes water for the respectively. While the drip irrigation system less than 10ml of water for first 20 days. Then the water requirement increases to 28.2 ml and steadily increases and requires up to 40.9 ml till the harvest.

In the final graph, the normal water consumption increases on every 10 days of interval similar to the previous plants. For drip irrigation, this plant requires 16.38ml of water on the first 30 days and then increases steadily to 32.77ml to 35 ml. This is 3.5% less than of the normal water requirement.

CONCLUSION

The proposed system "Crop dependent drip irrigation system" is technologically advanced version of the existing drip irrigation system, which is automated with the help of a raspberry pi and sensors. In this model, the entire system is monitored and controlled by the credit card sized microcomputer called raspberry pi. The pi board is powered by the Linux operating system. Our main aim is to conserve water since our country is experiencing scarcity of freshwater (drought) as well excess of water (flood) at the same time [15]. So, in this system we are developing a regulated water flow with the help of moisture sensor. This helps in the increase of yield as well as quality. Also, there is the development of an android app for the smarter operation of the system [16]. This gives easiness in the operation as well as efficiency. This gives the farmers an assurance of good quality products. However, the main challenges include the measurement of moisture content in the soil where the moisture sensors are more sensitive. Even the minute changes in the soil moisture can cause a reading. So, in order to make it precise, the water consumption capacity of each plants are added and stored on to the raspberry pi board. The overall integration of model as a product is complex. To increase the accuracy of the proposed system, an upgraded version of raspberry pi can be used.

ACKNOWLEDGEMENT

There are countless individuals that deserve my sincere gratitude for helping me to complete this work. First and fore most I would like to express my sincere gratitude to our respected project guide Ass. Prof. Ajith Ravindran for his valuable guidance and help.

REFERENCES

[1] Kekane Maruti Arjun, "Indian Agriculture- Status, Importance and Role in Indian Economy "International Journal of Agriculture and Food Science Technology. ISSN22493050,Volume4, Number4(2013), pp.343-346

[2] Dr. Vidha Dhawan "Water and Agriculture in India", German Asia-Pacific Business association within the frame ofBEML2017

[3] R Wang and J Zimmerman, "Hybrid analysis of blue water consumption and waterscarcityimplicationsattheglobal, national,basinlevelsinanincreasingly globalized world", Environmental scienceandtechnology,2016

[4] Rijwana Parwin, "A study on the crop water requirement for Agriculture", International journal of water research2014

[5] D. Suresh Kumar and K.Palanisami "Impact of Drip Irrigation on Farming System: Evidence from South", Agricultural Economics Research Review, Vol. 23 July December 2010pp265-272

[6] R. Hussain, J. Sehgal, A. Gangwar, M. Riyag "Control of irrigation automatically by using wireless network". International Journal of Soft Computing and Engineering, voL3, issue1, march2013, pp.48t324-328

[7] Niaz Ahmed Wahocho, Zeshan Ahmed, Sheikh, Qamaruddin Jogi, Khalid Hussain Talpur, Shah Jahan Leghari, "" Growth and Productivityof Chilli(Capsicum Annuum L.) Under Various NitrogenLevels",

[8] Sci.Int.(Lahore).28(2),1321-1326,2016 Chilli(Capsicum Annuum L.) Under Various NitrogenLevels",

[9] Sci.Int.(Lahore).28(2),1321-1326,2016