Smart Irrigation System on Agriculture Fields Using IOT

Victor Jeyaseelan D
Department of Electronics and Communication Engineering, AMC Engineering College, Bengaluru, India.
victor.jayaseelan@amceducation.in

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Abstract - Irrigation is the process of supplying water to land and soil, which is also helpful in growing of agricultural crops, maintenance of landscapes in agricultural field. Modern technology has been improved for inadequate rainfalls and improvement of irrigation system has also justified minimizing the waste of water in which it also reduces works in agricultural fields. This also makes people to work conveniently and also reduces work load. As we know China and India have largest irrigation area that is 21.3% and 20.6% respectively. Malaysia is one of agricultural oriented country. Irrigation is taken care of agricultural fields which involve supplying water to land to assist for production of crops. Soil moisture which is nothing but the content of the soil cannot be maintained efficiently. So that automation irrigation system would be better solution for this. The soil moisture sensor which measures the content in the soil and the system will start automatically when the moisture level is low.

Keywords – Irrigation, Agriculture, Crop Sales, Community, IoT.

I. INTRODUCTION

Systems of earlier known are originated in Egypt and Mesopotamia. Before the Egypt and Mesopotamia approach, irrigation was likely done by carrying buckets of water from rivers to supply water for planting of crops. The production of agricultural was worldwide. By 2013, center pivot irrigated nearly 28 million [1]. In the year 2000, total fertile land is about 2,788,000 km square. About 68% of this area is Asia, 17% in Americans, 9% in Europe. There are also largest contiguous areas of higher irrigation level of development density to be found like Northern and Eastern India and Pakistan and also river in Egypt and Sudan. In the year of 2012, irrigation land has been increased to 3,242,917 km square. Increasing of efficiency has number of positive outcomes to the farmer, the community as well as wider environment. In global scale irrigation have found impact on fresh water supplies [2]. World's food comes from the 21% of cultivated area which has been irrigated. Value of crop sales is about 28% of harvested land crop in the year 2012(U.S). Also, irrigation in India have played very important role it has networks of major and minor canals from Indian rivers, groundwater well and also rainwater harvesting (which collects rain water and stores rather than not allowing to go down). In 2013-14 only about 36.7% of agriculture land is irrigated. In monsoon seasons nearly 2/3 of cultivated land in India is dependent. 65% of irrigation is from groundwater [3].

II. HOW DRIP AND SPRINKLER IRRIGATION IS BENEFITED IN AGRICULTURAL FIELDS

Drip irrigation

Israel invented drip irrigation in 1960's, then modern drip irrigation began its improvement in Germany in 1860. Few current developments are Micro-spray heads it uses micro-spray heads which are generally used on trees/vine crops. Usage of plastic to hold and distribute water in dripping irrigation was introduced in Australia by Hannis Thill. Drip irrigation is water-saving technique which allows dripping of water and sufficient nutrients slowly to the soil or root of plant. Drip irrigation reduces pest problems and diseases in the field. It has low power pump. Having good adaption, it is suitable for different surface of the soil, during this process there can be pipe blockage in which it needs to be maintained regularly [4]. Drip irrigation should be implemented at right time in right amount so that plants will grow optimally. 2-20 liters/hour is dripped in the soil from the system of small plastic pipes called as emitters or drippers. It is more sustainable because it precise the amount of water without much wasting, by preventing overwatering. Fields with irregular shapes are accommodated easily. And the moisture which is present in root zone is maintained in field capacity [5].

Sprinkle Irrigation

In 1871, named Joseph Lesser of New York invented first sprinkle. The main aim was to save time by eliminating need to water. Again in 1872 an inventor named Philip W. Pratt first automatic sprinkler shows Fig.1 And Fig.2 Sprinkle irrigation is the process which allows water to sprinkle around the crops in the field. And also permit good control of

water, which protects trees from freezing in the field. It is highly efficient system which gives uniform distribution of the water in the land, it does not need any specially trained person or farmer to operate it. Disadvantage is that there can be pest problem sometimes during process of irrigation, in which efficiency of water will decrease with high climatic conditions like strong wind or high temperature zone. However, sprinkle irrigation is suited for sandy type of soil with infiltration rate, but not suitable for soil which is having like crust form [6] **Table 1**.

III. STATES WHICH COME UNDER DRIP IRRIGATION AND SPRINKLER IRRIGATION

Table 1. Drip Irrigation and Sprinkler Irrigation

Sl No	State	Drip irrigation	Sprinkler	Total
1.	Rajasthan	55715	1098133	1153848
2.	Maharashtra	778660	347623	1126283
3.	Andhra Pradesh	665661	323457	989118
4.	Karnataka	293593	385675	679268
5.	Haryana	17772	542431	560204
6.	Gujarat	309520	246222	555742
7.	Orissa	12320	46090	58410
8.	Tamil Nadu	206756	28217	234973
9.	West Bengal	589	150576	151165
10.	Kerala	17301	4280	21581

Fig 1. Drip Irrigation Showing Involvement of Dripping of Water onto Soil.

Fig 2. Sprinkler Irrigation in Agricultural Field Land for Crops Irrigation

IV. INSTINCTIVE/AUTOMATIC PLANS OF IRRIGATION SYSTEM USING MICROCONTROLLER

As we know every irrigation system has drip, sprinkle and surface irrigation in which it gets automated with help of few electronic appliances and electronic gadgets, such as computer, sensors and other devices. Automatic irrigation will work

very effectively with positive impacts, once it is installed in agricultural field the water supply to agricultural field becomes easier and does not require any person to perform the operations. Few automatic irrigations can be performed by using mechanical appliances [7 -10]. In this article, we are describing about few irrigation systems that work automatically.

V. IRRIGATION SYSTEM ON SENSING THE CONTENT OF THE SOIL

This paper is intended for improvements of irrigation field which has switches submersible pumping of on/off. It also gives estimation of water in the soil. The main intention is to provide reduction of human interference and ensuring proper power irrigation. Microcontroller is main principle of this, it is nothing but a chip which is integrated on single VLSI. Power supply used is of 5V, a bridge rectifier in which it uses four or more diodes in bridge which converts AC to DC and voltage regulator. Microcontroller is programmed in it; it receives the input signal from sensor material [11]. It is done to know varying conditions of moisture content in the soil like dryness, wetness, moisture content etc. Comparator as OP-AMP which **Fig 3** shows interface between sensing material and chip which transferring moisture contents of soil conditions. When the microcontroller receives the data from material, it compares data and produces the output signals and also activates the relays for submersible pump. By using two metallic stiff rods it is inserted in agricultural field land in distance shows **Fig 3.**

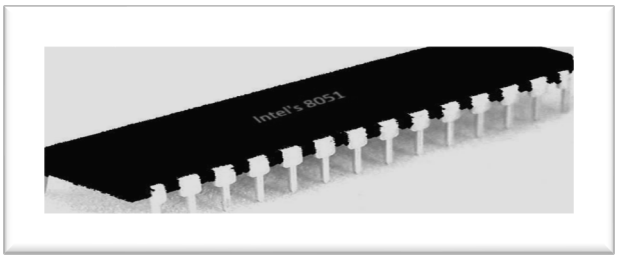

Fig 3. Intel 8051 Microcontroller

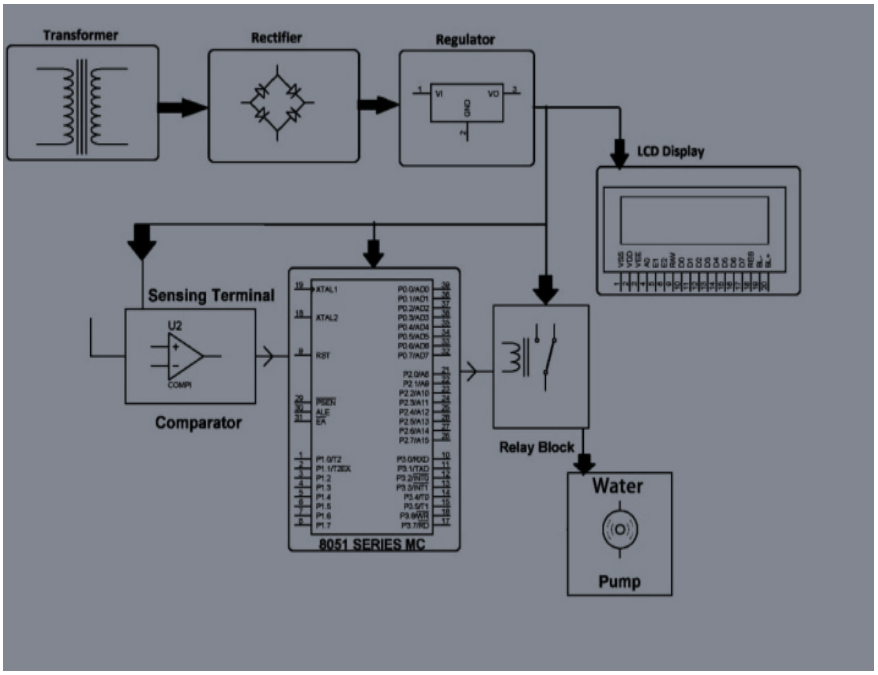

Fig 4. Control Unit

Fig 4 shows Connections of metallic rods are interfaced to control unit. The project is outlined to operate automatic irrigation which comprises between moisture sensing content interfaced with an op-amp customized as comparator so when moisture in the soil reduces pump will get start to on operation. When moisture content gets appropriate out-turn it switches to off the motor shows **Fig 5**.

Fig 5. Moisture in the Soil Reduces Pump

VI. MEASURING OF SOIL MOISTURE CONTENT BY UTILIZING GRAVIMETRIC METHOD

Why measuring the content of the soil is important?

Fig 6 shows Measuring soil moisture is crucial in agriculture. It allows need for agriculture to be chartered in advance of crop showing signs of distress. Knowing about the moisture content will get to know about further circumferences to be taken. Soil should contain sufficient amount of water which will be present in depth of one meter of soil level. The availability amount of the water will enhance for vegetarian to grow. As we know earthworms are farmers friend, it improves quality of soil it recycles organic waste to humus. By this it makes soil fertile and helps crop to growth. So physical, biological and chemical properties of soil will change as moisture conditions changes [12].

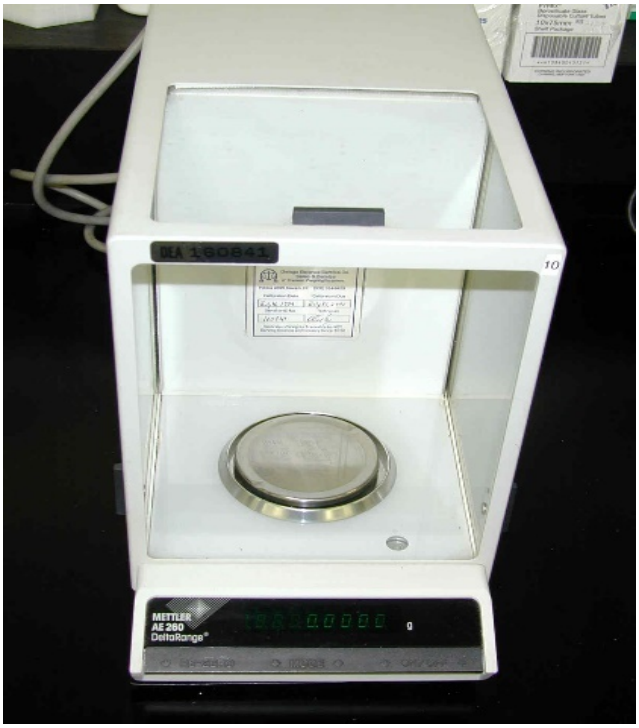

Fig 6. Measuring soil moisture

Gravimetric Method to Measure Soil Moisture

It is common technique in which soil moisture content is measured. (Also known as drying method) which can also be done in laboratory following few standard protocols. Fresh soil (forest area or grassland area) samples are taken for demonstration purpose. The soil is being weighed to differentiate of wet and dry sample soil. Samples are put in oven for 24 hours at 105 ºC. Once the samples in the oven are dried, they are weighed again and weights are noted down. So, those are the weights after soil which is dried in the oven. After oven is dried the empty weights of soil moisture are measured.

The moisture content in dry weight can be calculated by using following formulas: -

$$\text{md} = \frac{(wt.of\ wet\ soil\ tare)-(wt.of\ dry\ soil\ tare)}{(wt.of\ dry\ soil\ tare)-(tare)}$$

Water content in volumetric basis is expressed as:

$$\text{mvd} = \frac{Volume\ of\ soil}{\text{Volume of water}}$$

$$\text{Volume of water} = \frac{wt.of\ water}{\text{water density}}$$

And also,

$$\text{Volume of soil} = \frac{Bulk\ density}{\text{wt.of dry soil}}$$

Thus,

$$\text{mvd} = \frac{wt.of\ water}{\text{wt.of dry soil}} * \frac{bulk\ density}{\text{water density}}$$

Furrow Irrigation

It is one of oldest methods of irrigating agriculture land. It is also known as flood irrigation. Farmer allows flowing of water down small trenches which runs through crops. Water is applied to the top end of each furrow and water flows down influenced by gravity. Water is supplied using gated pipes or bank less systems. Speed of water movement is determined by surface conditions like smooth/roughness. Common spacing ranges will be from 0.7-2m. There will be many furrows which may contain single row of plants/many rows in case of bed type system in which crop is planted between them. Furrow range will be lesser than100m-2,000m, it also depends on soil type, crop type for growing and furrow irrigation is mainly suited for cotton, maize and sugarcane shows **Fig 7** and **Fig 8.**

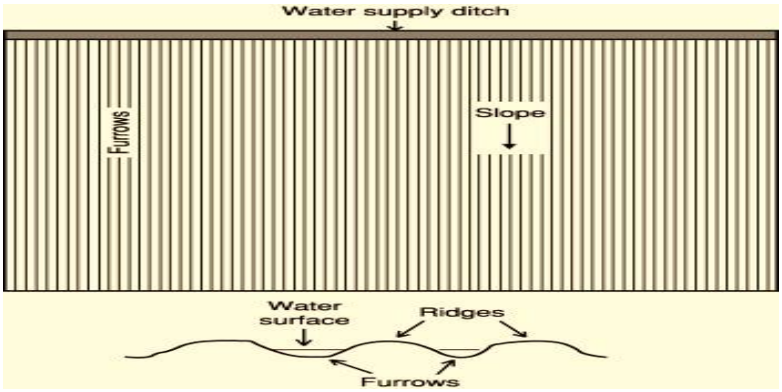

Fig 7. Pictorial Representation of Furrow Irrigation

Fig 8. Furrow Irrigation in The Field

Few Technical Challenges How Irrigation is Impacted to Environment

As we know irrigation involves solving numerous engineering problems and economic too.

- There is chance of poor soil salinity control if there is enough giving water for the plant. It leads to increased soil salinity which builds up toxic salts in surface of the soil.

- To remove those salts Leaching/method of drainage is used to carry salts away.
- Clogging filters in which algae can clog filters by using UV and ultrasonic methods, it can be used for algae control in irrigation.

Groundwater Irrigation Development in The Country

According to central water commission (CWC) of India, the state having highest percentage of annual sustainable ground water resource are found in Uttar Pradesh state. It has 77.19 billion cubic meters of ground water resources [13]. Using global hydrological model, annual groundwater estimated is 12,600km$^{3.}$ Tihama and Batinah coastal plains in Yemen and Oman are few examples. Total groundwater is estimated from range 600-1100km^3. 137 countries of 63 data are of irrigation. 56% of global area are located in countries for which data are extent of groundwater irrigation. In statistics most of consideration estimation referred to the 1990's. Few hydrogeology and Chicot aquifer system in which India is that country which is varied hydrogeological situation which results from diversified geological, climatological and topographic setups. Few hydrogeological influences the geomorphology, pedology of land surface. Few Chicot aquifer system refers to an extent of Southwest Louisiana. It is the most heavily pumped aquifer in Louisiana, which accounts 41% of the state's groundwater usage. Including aquaculture agriculture sectors withdrawals 72% of groundwater shows Fig.9.

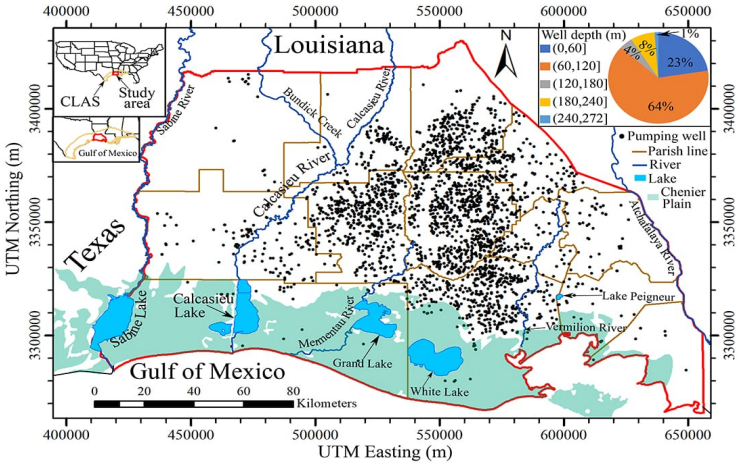

Fig 9. Irrigation Development in The Country

Fig 9. showing that Chicot aquifer (which is marked in red line). Black dots which represent pumping wells. Blue lines show major rivers in Chicot. Pie chart gives fraction of pumping wells.

VII. SMART IRRIGATION FOR AGRICULTURE LAND USING IOT

Smart irrigation was founded in the 2017 by three entrepreneurs – Seryozha Barkhudaryan, Artyom Tonoyan, Grigori Kartashyan. The smart irrigation which is also known as precision agriculture. Many sensing technologies are used in precision agriculture, by providing data it helps farmer to optimize crops. And also get used to changing of the environmental factors that includes electro chemical sensor, mechanical sensors, Air flow sensors, agricultural weather stations, humidity sensor and pH Sensor etc., And also few factors which influence the irrigation system are climate factor, Temperature, wind speed, and also crop types. One of main sensor used is soil moisture sensor. It is used to check soil moisture content in the soil by measuring volumetric water content in the soil. Value of threshold will be fixed which checks with above and below levels shows **Fig 10**.

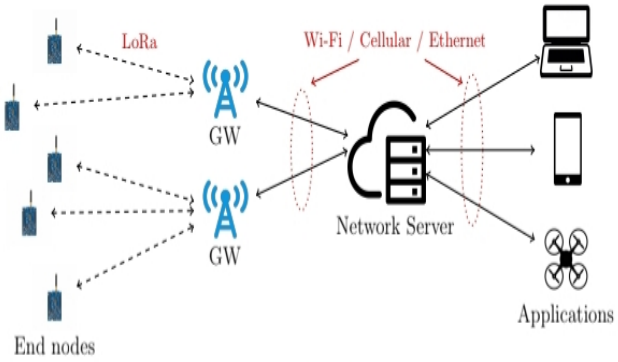

Fig 10. Smart Irrigation

The systems with IoT are implemented by providing optimization in water usage which also monitors irrigation systems. Dependency on manual labour has been decreased significantly because of few processes like pest control, fertilization is becoming automated nowadays. They have been implemented by using of robots, drones, sensors, analytical tools for monitoring farms. It monitors the crop field with help of sensors and few automatic irrigation systems. IoT solutions are helping farmers to close the supply demanding gap, it ensures high yields, and also protection of the environment. IoT in agriculture comprises equipment, wireless connectivity and IT services. IoT have been potential to agriculture in many aspects and few are mentioned below shows **Fig 11**.

Fig 11. Smart Irrigation System using IoT

Data collection by using smart agriculture sensors, this approach is of farm management, few equipment's used are autonomous vehicles, variable rate technology, motion detectors and wearable devices. This data helps to track state of the business as wells as staff performances and equipment's efficiency.

Smart Greenhouses it is system which consists of ZigBee modules, soil moisture sensor, controlled circuit, display circuit etc., plant growth of microclimate is done by using of sensors, actuators and control systems that enhances for growth conditions and automatic growth process. One of best irrigation systems used for greenhouse is Raindrop R560DP automatic watering kit, Geevon automatic watering system shows **Fig 12** and **Fig 13.**

Fig 12. Smart Greenhouses

Fig 13. Geevon Automatic Watering System

Principle of technology in which Revalcon smart farming works.
Diverse of combining backgrounds of hardware enhancement, water managing and software engineering by this Revalcon team got working to develop an integrated smart irrigation system. In 2019, Revalcon idea came into reality with design of functionality of irrigation management system. It is combination of hardware and software. Solar powered nodes which use monitor wind, humidity and operation of irrigation system valves. This data is imputed to wireless mode which is known as LoRa technology to centrally located server Shows Fig 14.

Fig 14. Lora Technology Architecture

Basically, In LoRa architecture two recent communications which was introduced in the field of LPWAN's (Low Power Wide Area Network) are LoRa and LoRaWAN. LoRa is wireless spectrum modulation technique, whereas LoRaWAN are protocol that enables IoT devices. These two communications are desired to help smart forming applications.

VIII. INDIA'S FIRST IRRIGATION PROJECT-BHAVANI SAGAR DAM

Fig 15. shows Bhavani sagar dam was the first irrigation which is located in Tamil Nadu in Erode district. It is second largest dam in Tamil Nadu as well. (First one in Russia). It is constructed in Bhavani River. It is a reservoir which has official name as Keel Bhavani Anal. Construction cost of this dam is around ₹210 million (US$2.6 million).
After Independence it was one of major project in India which was initiated in the year 1948. Project was completed in the year 1955 and for usage purpose it was opened in the year 1956. This dam is located some 16 km west to Sathyamangalam.

Fig 15. Bhavanisagar Dam

Hydrography of BHAVANISAGAR DAM

Dam receives water from two main areas in western Ghats. Eastern catchment area which includes Upper Bhavani, Avalanche and Emerald lakes, Gedhai, Pillur and Nellithurai. Western catchment includes Portimund, Parson's valley, Pykara, Glenmorgan, Chinkara etc., There are 12 major rivulets that includes west and east Varagar slopes. Bhavani takes an abrupt of 120º turns around north-east which flows for another 25 km. It has two hydroelectric power stations and another one is Bhavani River. Each of units has 16 MW installed capacity. While, 32 MW of power is generated throughout the year.

IX. CONCLUSION AND FUTURE SCOPE

Technology have been improved a lot nowadays. Farmers were struggling to grow the crops in the agricultural field due to insufficient supply of water and also nutrients. When atmospheric condition changes growth of crops may differ in irrigation. As few mechanizations have enhanced it is serving a major help to farmers, many machinery applications are automated type. Irrigation helps to grow crops; it revegetates disturbed oil in the area which is in dried condition and maintain landscapes. Using automation soil moisture content, it helps to check moisture content in the soil. Water resources can be utilized effectively based on few parameters so that agriculture becomes more upgraded. Few of irrigations like drip irrigation, sprinkle irrigation at different seasons is another future scope. Sensors also plays an important role it determines accuracy of soil moisture and it is detected to control temperatures and humidity. Thus, irrigation system can be adjusted and modified according to changing environment. In making technological advances, data analysis best in decision making. Collecting the data or receiving the data from sensors using IoT makes to know about real state of crops which is grown and also makes better harvesting decisions. Giving production of crops in minimum duration have been enhanced with many advanced technologies.

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