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A Wireless Application of Automatic Control of Drip Irrigation System

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Abstract: In past couple of decades, there is immediate growth in field of agricultural technology. Irrigation by help of freshwater resources in agricultural areas has a crucial importance. Because of highly increasing demand for freshwater, optimal usage of water resources has been provided with greater extent by automation technology. Traditional instrumentation based on discrete and wired solutions, presents many difficulties on measuring and control systems especially over the large geographical areas. Utilization of proper method of irrigation by drip is very reasonable and proficient in remotely monitored embedded system for irrigation purposes have become a new essential for farmer to accumulate his energy, time and money and will take place only when there will be requirement of water. In this approach, the soil test for chemical constituents, water content, and salinity and fertilizer requirement data collected by wireless and processed for better drip irrigation plan. This paper describes an application of a wireless sensor network for low-cost wireless controlled irrigation solution and real time monitoring of water content of soil.

Keywords: Drip irrigation, Fertilizer, Multiplexer, Pressure sensor, Remote monitoring, Soil sensors, ZigBee.

I. INTRODUCTION

During the research in the agricultural field, researchers found that the yield of agriculture goes on decreasing day by day. Use of technology in the field of agriculture plays important role in increasing the production as well as in reducing the extra man power efforts, water requirement and fertilizer requirement.

The Irrigation is the artificial application of water to the soil for assisting in growing crops. In India, the irrigated area consists of about 36 per cent of the net sown area. Presently, the agricultural sector accounts for about 83 per cent of all water uses. The remaining uses include 5, 3, 6 and 3 per cent respectively, by domestic, industrial and energy sectors and other consumers. Increasing competition with the other water users in the future would limit the water availability for expanding irrigated area. In traditional surface irrigation methods, the losses in water conveyance and application are large. These losses can be considerably reduced by adopting drip and sprinkler irrigation methods.

Indian agriculture is dependent on the monsoons, which is dependent on the nature and not a reliable source of water, so there is a need for an automatic irrigation system in country which can provide water to the farms according to their Moisture, temperature and soil types & fertilizers. For a big farm land with horticulture activity the solution will be an automated system. Water contained in the soil is called soil moisture. And it is very important for plant growth. Water soluble fertilizer can be also applied without any wastage by this drip irrigation system.

In order to produce ―"more crop per drop", growers in (semi) arid regions are currently exploring irrigation techniques in the range from using less fresh water. One of them is making agriculture in a manner of sense, which uses a different type of sensors. A site-specific wireless sensor-based irrigation control system is a potential solution to optimize yields and maximize water use efficiency for fields with variation in water availability due to different soil characteristics or crop water needs and site-specific controlling irrigation valves. Decision making process with the controls is a viable option for determining when and where to irrigate, and how much water to use. Temporal monitoring of soil moisture at different growth stages of the crop could prevent water stress and improve the crop yield.

In the last two decades, with the development of wireless technologies, several researches focused on autonomous irrigation with sensors in agricultural systems. Among these works, a drip irrigation system has a different place, and it was designed for latching the controlled solenoid valves in a citrus orchard with wireless sensors. Afterwards, soil moisture sensors and dripper valve controllers are being used for site-specific irrigation automation. The advantages of using wireless sensors are having the reduced wiring and piping costs, and easier installation and maintenance in large areas.

After the usage of wireless technology began in agricultural irrigation, a trial was made to involve different types of equipment in such instrumentation. In terms of controllers were designed microcontroller site-specific irrigation, wireless monitoring system was implemented with a field programmable gate array (FPGA). In terms of protocols, infra-red, GSM/GPRS WPANs (Wireless

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Personal Area Networks), Bluetooth, WLANs (Wireless Local Area Networks) have been put to different utilities to implement wireless sensors in precision agriculture. Many studies have successfully demonstrated the use of active and passive microwave remote sensing too. It has been seen that many irrigation scheduling methods by wireless sensors have been developed for the last several decades.

This paper gives a review of remote monitoring and control system based on existing technologies. ZigBee based remote control and monitoring system with automatic irrigation management is proposed in this project.

II. PROPOSED SYSTEM

The betterment of agriculture depends on various environmental parameters such as soil temperature, soil moisture, relative humidity, pH of soil, light intensity, fertilizing property of the soil, etc. Any small changes in any of these parameters can cause problems like diseases, improper growth of plant, etc. mainly resulting in lesser yield.

The block diagram of the proposed system of input unit is shown in Fig. 1 consists of different types of sensing unit such as Soil Moisture Sensor to measure water content of soil, Temperature Sensor detects the temperature, Humidity Sensor to measure the presence of water in air, Pressure Regulator Sensor to be selected for maintaining the recommended pressure, Molecular Sensor selected for better crop growth, Digital Camera with capability of tracking and taking photographs of the crop field to find the crop growth for measurement. The output of sensors are converted to analog using D/A converter at the transmitter input side and converted back to digital using A/D converter at the receiver output side. Multiplexer sometimes called Data selector is a combination logic circuit that selects one of 2n inputs and route it to the output. The data obtained from different types of sensors are transmitted to the Multiplexer using Wireless Sensor Network. ZigBee modules for wireless data transfer and receiving for control unit.

The block diagram of the proposed system of control unit is shown in Fig. 2 consists of data logger which allows count information to be associated with the date and time, and for the data to be downloaded onto a PC for flexible and detailed

Data analysis, Demultiplexer split a combined stream arriving from a shared medium into the original information streams and fed to different types of actuators such as drip irrigation pump, boring pump, fertilizer pump, controlling of pump speed, controlling of fertilizer input from the tank and display the field etc.

A. Drip irrigation system

Among all the irrigation methods, the drip irrigation is the most efficient and it can be practiced in a large variety of crops, especially in vegetables, orchard crops, flowers and plantation crops. Drip irrigation also known as micro irrigation & is an irrigation method which minimizes the use irrigation & is an irrigation method which minimizes

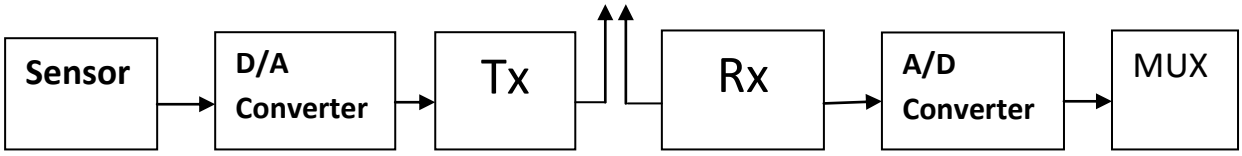

Fig. 1 Basic block diagram of proposed system (input unit)

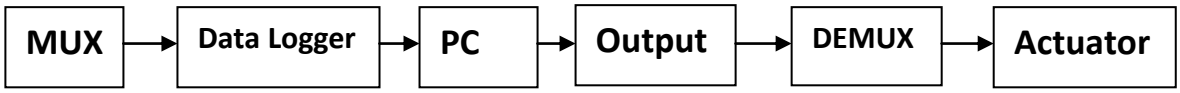

Fig. 2 Basic block diagram of proposed system (output unit)

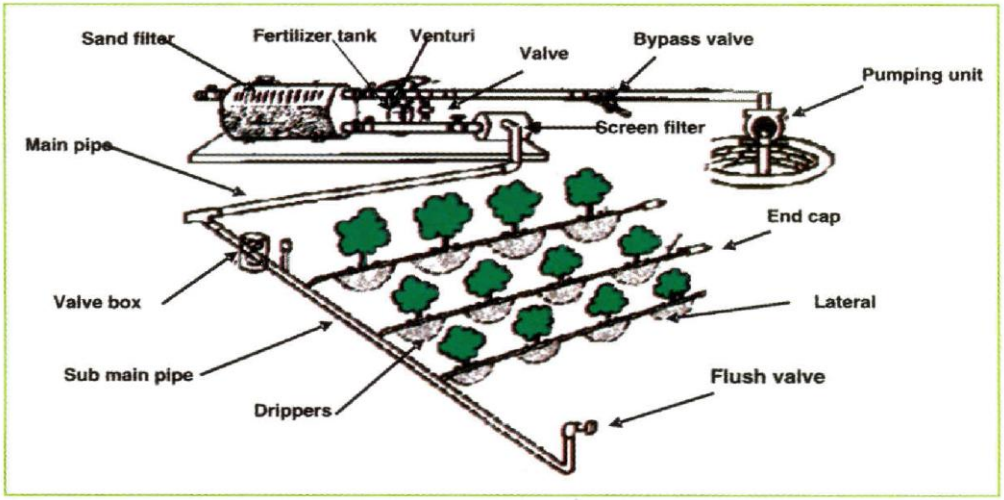

Fig3. Overview of the system installed in the area.

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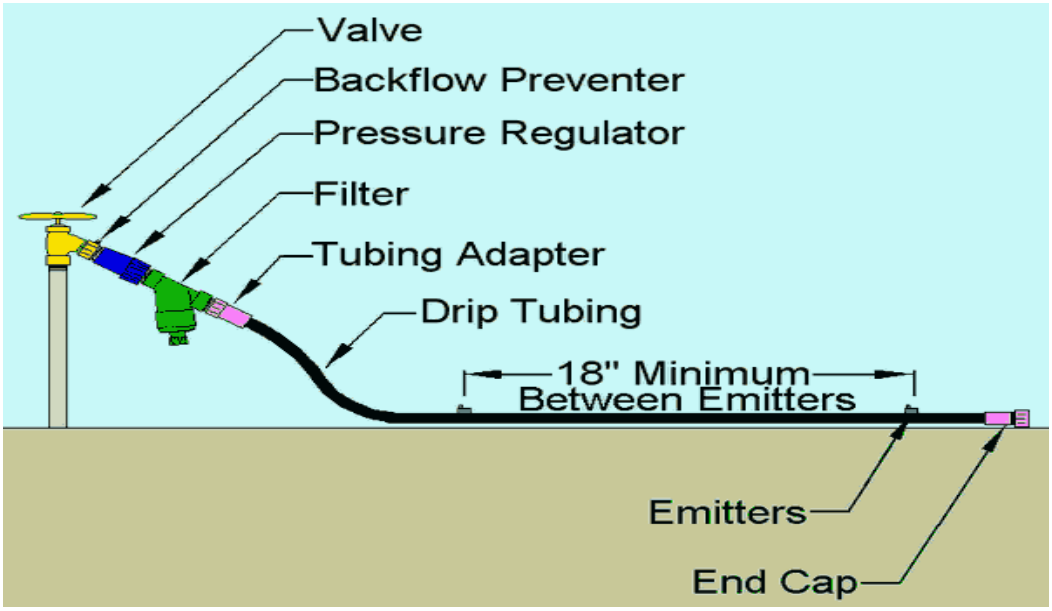


Fig4. Internal part of drip system

the use of water & fertilizer by allowing water to drip slowly to the roots of plants, either onto the soil surface or directly onto the root zone due to which a large quantity of water is saved & also the fertilizer which comes to the plant with the water. In drip irrigation, water is applied near the plant root through emitters or drippers, on or below the soil surface, at a low rate varying from 2 - 20 lit res per hour. The soil moisture is kept at an optimum level with frequent irrigation. Fig3. Shows the overview of drip system installed in area.

Drip irrigation results in a very high water application efficiency of about 90-95 per cent. The high efficiency of drip irrigation results from two primary factors. The first is that the water soaks into the soil before it can evaporate or run off. The second is that the water is only applied where it is needed, (at the plant's roots) rather than sprayed everywhere. Fig. 4 shows an internal part of drip system.

B. Wireless unit

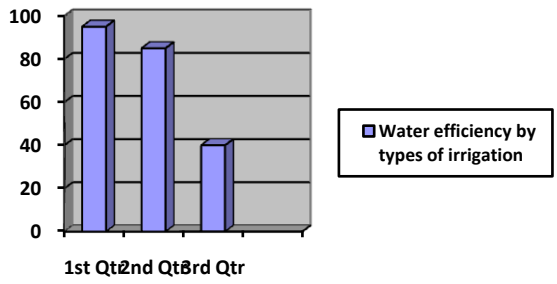
ZigBee is an IEEE 802.15.4 -based specification for a suite of high-level communication protocols used to create personal area network with small, low-power digital radio. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other wireless personal area network (WPANs), such as Bluetooth or Wi-Fi.

Its low power consumption limits transmission distances to 10–100 meters line of sight, depending on power output and environmental characteristics. ZigBee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. ZigBee is typically used in low data rate applications that require long battery life and secure networking. ZigBee has a defined rate of 250 kbit/s, best suited for intermittent data transmissions from a sensor or input device. In this paper we use Zigbee sensor for transmitting and receiving purpose.

ZigBee Sensors are compact, battery powered environmental sensors for ZigBee networks. They provide real-time temperature, light and humidity information for a variety of applications Installation is easy. Simply insert batteries, add the zigbee sensor to the ZigBee network, and configure the update interval. Mount the device in an out-of-the way location and start communicating.

III. EXPERIMENTAL RESULT

The following are the result obtained from the different types of irrigation. There are 3 types of irrigation such as surface irrigation, sprinkler irrigation and drip irrigation. The Graph1. Shows the efficiency of water usage by these methods. In which drip irrigation uses less water compare to others. TheGraph2. Shows the installation cost for different irrigation method Surface irrigation requires accurate land leveling, regular maintenance and high level of famer's organization to operate the system. Sprinkler and drip irrigation require little land leveling; system operation and maintenance are labour intensive.



Graph1. Efficiency of water usage by different irrigation method.

In this Graph 1. Y-axis represent efficiency of water usage and X-axis represent different irrigation method. First is drip irrigation (95%) then sprinkler (85%), last surface

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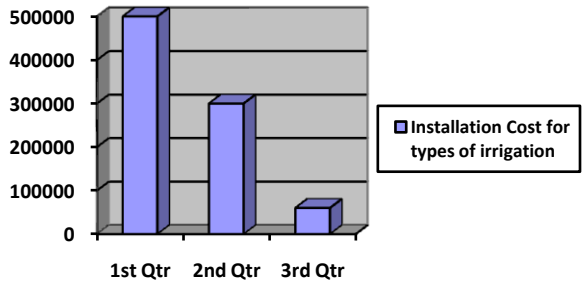
irrigation (nearly 40%). In this table 1. Shows the water usage of different type of system.

S.No.	Types of irrigation method	Efficiency of water use (%)
1.	Drip irrigation	90% - 95%
2.	Sprinkler irrigation	80% - 90%
3.	Surface irrigation	30% - 40%

Table1. Efficiency of water use by 3 types of system.

In graph 2. In X-axis shows types of irrigation. First one is Drip irrigation, second is Sprinkler irrigation, third one is surface irrigation method. In Y-axis shows installation cost for different irrigation method. In Table 2. Shows relative cost of various types of irrigation system. Installation cost for drip irrigation method is costlier than other types. But once installed then maintenance cost and labour cost for operation is cheapest compare to others. In sprinkler irrigation installation cost is low than drip system but maintenance cost is higher. In surface irrigation, installation cost is very low but maintenance and labour cost per year is very much costlier when compare with others. Hence drip irrigation is better in water usage and maintenance.



Graph 2. Installation cost for different methods of irrigation.

S.No.	Types of irrigation system	Costs (rupee/ha)
1.	Drip irrigation	190000 - 520000
2.	Sprinkler irrigation	130000 - 320000
3.	Surface irrigation	6500 - 65000

Table 2. Relative costs of various types of irrigation system.

IV. CONCLUSION

In this paper, a wireless data acquisition network was implemented and applied to irrigate trees. The developed irrigation automation system can be proposed to be used in Several commercial agricultural productions since it were obtained in low cost and in reliable operation. This application of sensor-based site-Specific irrigation has some advantages such as preventing moisture stress of trees, diminishing of excessive water usage and ensuring of rapid growing weeds .It can be concluded that the modern use of electronic, electrical, chemical and mechanical systems will be very advantages for better agricultural output. Preservation of water sources and minimizing the use of inorganic fertilizer are possible with these drip methods. Use of bio-fertilizer in appropriate manner will find better guiding parameters through the various sensing methods.

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