

EFFICIENT IRRIGATION BY USING WIRELESS SENSOR NETWORKS

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Abstract

Irrigation is the artificial application of water to the land. Irrigation is used for growing of agricultural crops, maintenance of landscapes, and re-vegetation of soils in dry areas during periods of inadequate rainfall. There is an urgent need to develop improved irrigation strategies for sustainable use of water resources. Drip irrigation is also known as trickle irrigation or micro irrigation or localized irrigation. It allows water slowly to the roots of plants, through a valves, pipes or emitter. Drip Irrigation prevents soil erosion, saves water and fertilizer. Farmers can produce higher yields while saving on water as well as fertilizers. Water and nutrients are delivered across the field in pipes called 'drippers'. Each dripper emits drops containing water and fertilizers, resulting in the uniform application of water and nutrients direct to each plant's root zone, across an entire field. Wireless sensor network system consists of large numbers of wireless sensor nodes which are distributed across agricultural environment in order to make sure high precision and reliability of data acquisition. A sensor network is an emerging field with increasing applications day by day. Wireless monitoring of field not only allows user to reduce the human power, but it also allows user to see accurate changes in it. It is cheaper in cost and consumes less power.

Keywords: Irrigation, Drip irrigation, Soil moisture, Soil types, Wireless sensor network.

Introduction

India is called country of agriculture. Agriculture which is the backbone of Indian economy, in India 70-80% economy depends on agriculture. The continuous increasing demand of the food requires the rapid improvement in food production technology. In a country like India, where the economy is mainly based on agriculture and the climatic conditions are isotropic, still we are not able to make full use of agricultural resources. The main reason is the lack of rains & scarcity of land reservoir water [1]. The continuous extraction of water from earth is reducing the water level due to which lot of land is coming slowly in the zones of un-irrigated land. Another very important reason of this is due to unplanned use of water due to which a significant amount of water goes waste. At the present era, the farmers have been using irrigation technique in India through the manual control in which the farmers irrigate the land at the regular intervals. This process sometimes consumes more water or sometimes the water reaches late due to which the crops get dried. There are several methods of irrigation. They vary in how the water is supplied to the plants. The goal is to apply the water to the plants as uniformly as possible, so that each plant has the amount of water it needs neither too much nor too little [2].

Irrigation is the artificial application of water to the land. Irrigation is used for growing of agricultural crops, maintenance of landscapes, and re-vegetation of soils in dry areas during periods of inadequate rainfall. There is an urgent need to develop improved irrigation strategies for sustainable use of water resources. There are many different types of irrigation systems. These are classified depending on how the water is distributed throughout the agricultural field viz., Manual irrigation, Surface irrigation, Sprinkler irrigation, Sub-irrigation, Center pivot irrigation, Lateral move irrigation and Drip irrigation [2].

Drip irrigation is also known as trickle irrigation or micro irrigation or localized irrigation. It allows water slowly to the roots of plants, through a valves, pipes or emitter. Drip Irrigation prevents soil erosion, saves water and fertilizer. Fertilizer can also be supplied through drip itself so it avoids leaching of fertilizer. In drip irrigation drops of water are delivered at the root of plants. In this type of irrigation, evaporation and runoff of water are minimized. Drip irrigation is efficient water and nutrient delivery system for crops. It delivers water and nutrients directly to the plant's roots, in the right amounts, at the right time, so each plant gets exactly its needs at time to grow optimally. Farmers can produce higher yields while saving on water as well as fertilizers. Water and nutrients are delivered across the field in pipes called 'drippers'. Each dripper emits drops containing water and fertilizers, resulting in the uniform application of water and nutrients direct to each plant's root zone, across an entire field.

Automatic irrigation

In India, agriculture is dependent on the monsoons, which is dependent on the nature and it is 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 temperature, soil moisture and soil types & fertilizers. These are very important for plant growth. The available traditional methods of irrigation are drip irrigation, ditch irrigation, sprinkler system. This problem can be easily rectified by making use of the automated system rather than the traditional systems. The main idea is using new technologies to yield higher growth of the crops [5& 9].

Wireless sensor based irrigation

A wireless sensor based irrigation control system gives solution to optimize yields and maximize the use of water effectively for fields with requirement and even variation in water availability such as different soil characteristics or crop water needs and site-specific controlling irrigation valves. Decision making process with the controls is suitable option for determining when and where to irrigate, and how much water to use. Monitoring of soil moisture at different growth stages of the crop could prevent water stress and improve the crop yield [2, 5 and 8].

Wireless management

Wired network connect devices to internet through cables. It is difficult to use cable in ceilings, walls, and floor. Cable may damage easily. It needs more space when compared to wireless. In wireless

network, device connected each other in wireless connection. In wireless, multiple device from remote place use same internet connection to share files [4, 5 and 6]. It allows mobile devices such as laptop, tablet, and iPods to move around freely within the range of network and maintain internet connection. It is not much expensive, it is easier to add or remove extra devices in network range. But in wired network it needs extra cable during each connection. In common place, wireless network is convenient to access compare to wire. Wireless network use large amount of users because there is no limitation in specific number of connection ports. Instant transfer of data or uploading of data in common place use wireless connection as easy and convenient.

Result and Discussion

Irrigation

Irrigation is the process of applying controlled amounts of water to plants at needed regular intervals. It helps to grow agricultural crops, maintain landscapes and re-vegetate disturbed soils in dry areas during less rainfall. Irrigation also used in crop production, suppressing weed growth in grain fields and preventing soil consolidation. Effective irrigation will help in entire growth process from seedbed preparation, germination, root growth, nutrient utilization and plant growth and re growth, yield and quality. Irrigation is usually depends in areas where rainfall is irregular or dry times or drought is expected. There are many types in irrigation systems, where water is supplied to the entire field uniformly. Irrigation water can takes from groundwater, through springs or wells, surface water, through rivers, lakes, or reservoirs, or even other sources, such as treated waste water or desalinated water. As a result, it is critical for farmers to protect that agricultural water source from contamination.

Irrigation scheduling

Irrigation scheduling is the process in which farmer can determines the timing and quantity of water to be applied to the crop. The main challenge is to estimate how much water is needed at different growth stages and climatic conditions. To avoid over or under watering, it is important to know how efficiently the plant can use it. Depends on the following method it's easy to predict how much water is needed at that particular time

This includes

- Plant observation,
- Feel and appearance of the soil,
- Using soil moisture monitoring,
- Estimating from weather based data.

Plant observation

Observing the plant characteristics, such as leaf colour, curling of the leaves can be useful to indicate plant moisture stress, and it needs irrigation. Productivity may be lowered, particularly if moisture stress occurs. The moisture status of plants can also be measured using sensor also [7].

Feel and appearance of the soil

Sometimes feel of the soil is used to monitor moisture levels. A soil sample can be obtained by using a soil probe. Soil moisture can be estimated by squeezing soil into a ball, observing the appearance of the ball and also creating a ribbon of soil between the thumb and forefinger. (i) Sands and sandy loams - are slightly coherent, will form a weak ball under pressure but it easily breaks or sometimes dry, loose, flows through fingers. (ii) Loams, clay loams and clays- are coherent, soil can ribbons easily, and we can't roll into long thin rods 2.5 diameter, sometimes crumbly and powdery, small lumps break into powder, and will not ball under pressure and (iii) Comment - need adequate water and air for good plant growth but sometimes desperately need watering and will die soon.

Soil moisture monitoring

Soil moisture can be measured as a volume of water. It is force that exert on soil to extract the amount of water it needs for growth. Soil moisture suction can be measure by plant stress and it is tool for farmer to use in scheduling their irrigation.

Wireless sensor network system consists of large numbers of wireless sensor nodes which are distributed across agricultural environment in order to make sure high precision and reliability of data acquisition. Sensor nodes are responsible for collecting of temperature, humidity and moisture data, the collected data is transmitted to sink nodes by multi-hop. Sink nodes have functions such as collecting of data and storing of data, computing and data integration in a certain than common nodes. Sink node is used to connect wireless sensor network with transmission network and client terminal. The collected data is sent to farmer through GPS, GPRS, WIFI and other radio transmission. Farmer analyzes data to make a decision i.e., collected reading are beyond range means no need to switch ON the emitter to water the plant. If collected reading is below range, send control to switch ON the emitter and after sometimes it again check the range, take action to continue or switch OFF the emitter.

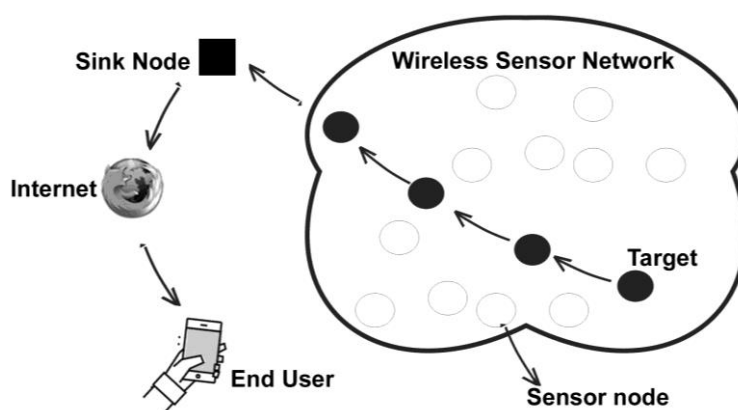


Fig. 1: Transmission of data from WSN to farmer.

Wireless Sensors have been used in agriculture to monitor and collect data of soil water availability, soil fertility, leaf temperature, soil moisture, plant water status, local climate data, pest-disease infestation etc. In this research temperature sensor, humidity sensor and soil moisture sensors are used [3].

The temperature, relative humidity, soil moisture value of cultivation land for few consecutive days is tabulated in Table 1.

Table 1: Environmental factors readings

Year	Month	Day	Hour	Minute	Temperature (°c)	Relative humidity (%)	Soil moisture (%)
2019	Feb	10	05	00	18.53	70	40
2019	Feb	11	05	00	19.43	68	39
2019	Feb	12	05	00	24.15	66	38
2019	Feb	13	05	00	21.36	67	39
2019	Feb	14	05	00	23.29	64	38
2019	Feb	15	05	00	20.53	68	39

Temperature – degree of heat present in atmosphere,

Relative humidity – the amount of water vapor present in air. It is expressed in percentage of amount need for saturate the same temperature.

Soil moisture is mass of water present in region to the mass of solid present in that region.

In automatic irrigation method it is necessary to check temperature sensor, soil moisture sensor and humidity sensor reading at frequent interval of time. All the wireless sensor reading is stored in system to check whether the condition such as temperature, moisture, humidity is suitable for plant growth at routine. If any change occurs e.g., soil need moisture, controller alert motor pump to turn ON the emitter to water the plant. Again after some interval of time, controller checks and turns OFF the emitter if needed. Because of over watering also affect the production level. In drip irrigation release drops by drop of water at root zone. So no wastage of water and it prevent weeds growth.

CONCLUSION

A sensor network is an emerging field with increasing applications day by day. This paper has described the design and implementation of a wireless sensor network for monitoring agricultural environment. IOT has important significance in promoting agricultural information. Wireless monitoring of field not only allows user to reduce the human power, but it also allows user to see accurate changes in it. It is cheaper in cost and consumes less power.

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