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A Real – Time Irrigation Control System for Precision Agriculture using WSN in Indian Agricultural Sectors

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ABSTRACT
India is the agriculture based country. Agricultural sector is playing vital role in Indian economy. Our ancient people completely depended on the agricultural harvesting. This paper is a basic implementation to bring Indian agricultural system to the world class standards. Paper is used to find the exact field condition. 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 and its apparatus such as drip irrigation, sensors and remote control. Our paper aim is to control the wastage of water in the field by using the drip irrigation and also to provide exact controlling of field by atomizing the agricultural environment by using the components and building the necessary hardware. The humidity and temperature of plants are precisely monitored and controlled. By using drip irrigation the water will be maintained at the constant level i.e. the water will reach the roots by going drop by drop. Irrigation system controls valves by using automated controller to turn ON & OFF. This allows the farmer to apply the right amount of water at the right time, regardless of the availability of the labor to turn valves or motor ON & OFF. This reduces runoff over watering saturated soils avoid irrigating at the wrong time of the day. It improves crop performances and help in time saving in all the aspects. In this paper an ARM LPC2148 Microcontroller based drip irrigation mechanism is proposed, which is a real time feedback control system for monitoring and controlling all the activities of drip irrigation system more efficiently. GSM is used to inform the user about the exact field condition. The information is given on user request in form of SMS. Eg. GSM modem can be controlled by standard set of AT (Attention) commands. These commands can be used to control majority of the functions of GSM modem. GSM serves as an important part as it is responsible for controlling the irrigation on field and sends them to the receiver through coded signals. GSM operates through SMS's and is the link between ARM processor and centralized unit. The drip method of irrigation has been found to have a significant impact on resources saving, cost of cultivation, yield of crops and farm profitability.

Introduction

Agricultural irrigation is highly important in crop production everywhere in the world. In Turkey, 75% of the current fresh water is consumed in the agricultural irrigation. Therefore, efficient water management plays an important role in the irrigated agricultural cropping systems.

Drip irrigation systems can be classified as Traditional Drip Irrigation system, Subsurface Drip Irrigation (SDI) and low cost alternative systems. In this paper the design of a Microcontroller based drip irrigation mechanism is proposed, which is a real time feedback control system for monitoring and controlling all the activities of drip irrigation system more efficiently. Irrigation system controls valves by using automated controller to turn ON & OFF. This allows the farmer to apply the right amount of water at the right time, regardless of the availability of the labor to turn valves or motor ON & OFF. This reduces runoff over watering saturated soils avoid irrigating at the wrong time of the day. It improves crop performances and help in time saving in all the aspects [1].

Water is very precious to all the humans and as well as to the plants, trees. The major amount of fresh water is utilized by the agricultural industry for irrigation. By using drip irrigation the water will be maintained at the constant level i.e. the water will reach the roots by going drop by drop. This is very important because this can only ensure the survival of the plants. If the field is irrigated heavily with water, there are chances that the plant may die because of excessive irrigation. The water could also wash them away during irrigation if very strong force of water is released at the same time. On the other hand, if there is insufficient water, then also there are chances that the plants may die due to lack of water. So, it is very important for the farmer to maintain the content on the field [1].

GSM operates through SMS's and is the link between ARM processor and centralized unit. ARM7TDMI is an advanced version of microprocessors and forms the heart of the system. Our paper aims to implement the basic application of atomizing the irrigation field by different components and building the necessary hardware. All these sensors are bringing the analogue information to the controller; here it processes the information and gives report to user. With that status of the crop, user can take the required action on the crop with necessary action.

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Investigation

Here ARM LPC2148 Microcontroller and GSM are used for the automation of drip irrigation and also to monitor the field and gives the accurate results to the farmer. As shown in the below block diagram (i.e. Fig 1) different types of sensors were used. Those sensors will send the input data to the ARM LPC2148 Microcontroller. Here the microcontroller controls the operation through some AT-command those commands were written in the program by the user. Through those commands the Microcontroller gives the desired output. Here the farmer can check the output through his mobile (i.e. farmer gets the information of the field through the sms) in the similar way all the information can be seen on the LCD panel in the field.

Methodology

All the sensors will give analog output but our processor will accept only the digital data. So we have to connect all the sensors to the ADC channel pins which are in-built to the processor. The total circuit arrangement is shown in the below figure (i.e. Fig 1). LCD will be on field display purpose. In the circuit the GSM module will contains a Subscriber Identity Module (SIM) user can communicate with this SIM-Number. When the particular command activated or given by the user, immediately the corresponding sensor will activates and reads the present reading and immediately sends results to the same user mobile and displays in the LCD panel in the field. Immediately user will take the necessary action if required. Here we are using total seven sensors to monitor the field condition. Those are Temperature, Humidity, Soil moisture, Leaf sensor, PH sensor, Level sensor, Phase sensor. All these devices are connected to the ARM processor. GSM is used for communication purpose, with the help of AT (attention)-Commands we can communicate with the components.

Here other important devices are AC motors. For soil module and level sensing applications we are using motors. One motor is used to store water and another is for releasing the stored water into the soil.

The circuit arrangement is given below and the detailed pin connections are shown below in the Figure 3. These will monitor the field and gives the accurate results to the user. Here the new and important things like, Leaf sensor, PH, Soil, Level sensors.

- To monitor weather leafs are healthy or not.
- The PH sensor is used to monitor the soil condition, weather the soil having harmful acidic nature or normal base nature. If acidic nature is present means we have to dilute the content and neutralize it or we will provide the necessary fertilizer.
- In case of soil moisture, we will check weather soil is dry or wet. If it is dry means, this condition is very harmful to plants. So immediately an SMS will be sended to the farmer to release the water into the soil and make it wet. For this we will use the level sensor and phase sensor will be very useful.
- Temperature and humidity are useful in the case of monitoring the weather conditions.

And we are using the two ac motors, one is for the bringing the water into the storage from ground. Whereas another one is helpful in case of sending water into field from the storage.

Concept of Real – Time Irrigation System

By using the concept of modern irrigation system a farmer can save water up to 50%. This concept depends on two irrigation methods those are: conventional irrigation methods like overhead sprinklers, flood type feeding systems i.e. wet the lower leaves and stem of the plants. The entire soil surface is saturated and often stays wet long after irrigation is completed. Such condition promotes infections by leaf mold fungi. The flood type methods consume large amount of water and the area between crop rows remains dry and receives moisture only from incidental rainfall.

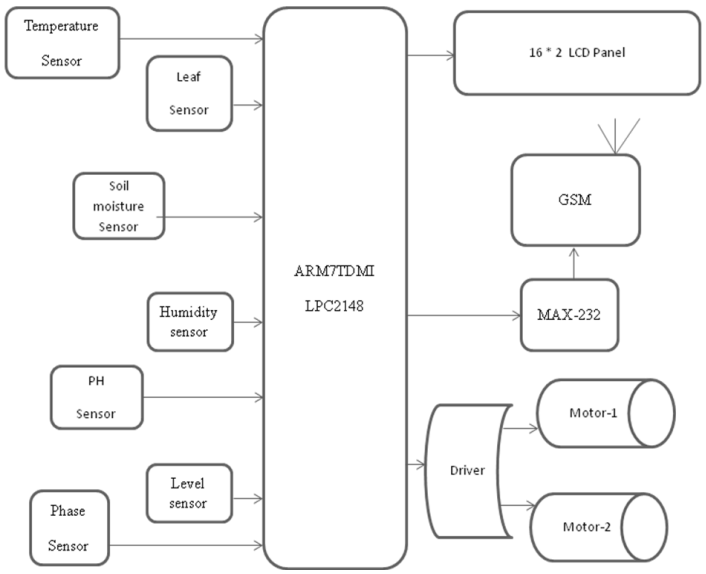

Fig 1: Block Diagram of Real – Time Irrigation System

The trickle or drip irrigation is a type of modern irrigation technique that slowly applies small amounts of water to part of plant root zone. Water is supplied frequently, often daily to maintain favourable soil moisture condition and prevent moisture stress in the plant with proper use of water resources. The diagram below shows the entire concept of the modern irrigation system.

Drip irrigation requires about half of the water needed by sprinkler or surface irrigation. Plants can be supplied with more precise amounts of water. Disease and insect damage is reduced because plant foliage stays dry. Operating cost is usually reduced. Federations may continue during the irrigation process because rows between plants remain dry. Fertilizers can be applied through this type of system. This can result in a reduction of fertilizer and fertilizer costs. When compared with overhead sprinkler systems, drip irrigation leads to less soil and wind erosion. Drip irrigation can be applied under a wide range of field conditions. A typical Drip irrigation assembly is shown in figure (2) below [1].

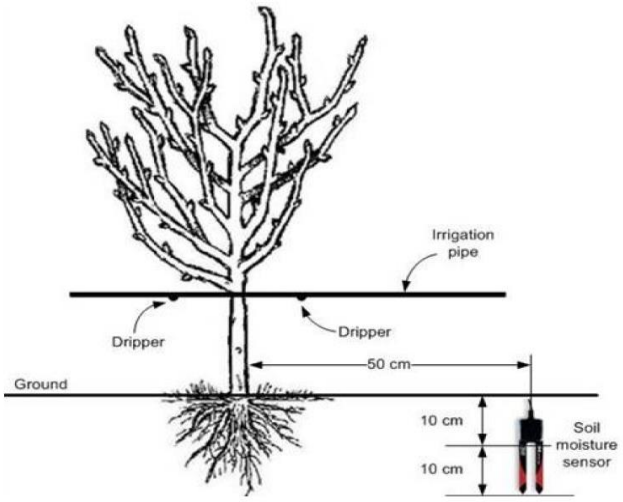

Figure 2: Drip Irrigation

A wetted profile developed in the plant's root zone is as shown in Figure above. Its shape depends on soil characteristics.

Drip irrigation saves water because only the plant's root zone receives moisture. Little water is lost to deep percolation if the proper amount is applied. Drip irrigation is popular because it can increase yields and decrease both water requirements and labor.

Circuit Diagram Of Real – Time Irrigation System

Our circuit diagram for the real – time irrigation system in agriculture is given below with different types of sensors. The arrangement consists of all the devices and it includes pin connections. Each pin connection is shown clearly in the below figure. This will give you the clear picture about the pin configuration. All the sensors are connected to the ADC pins. Because they will give analog output. So to convert and use the data, we need to give these outputs to ADC-pins.

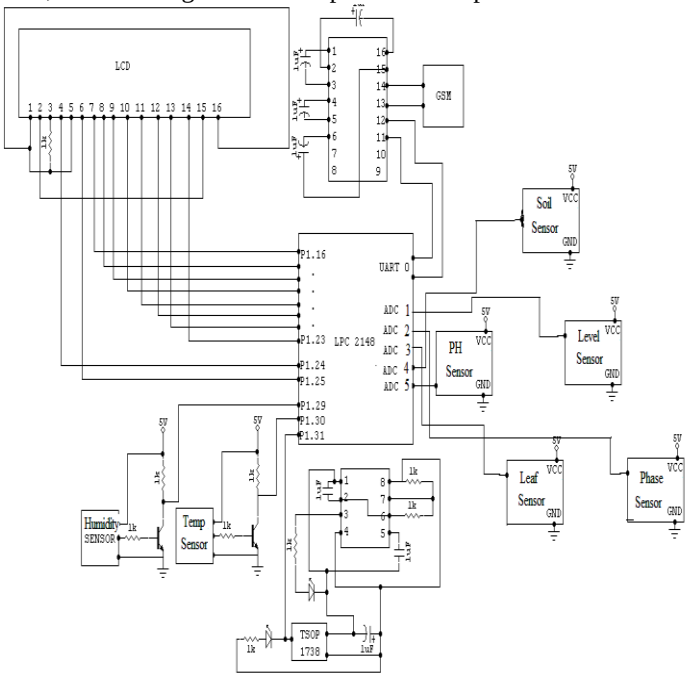

Figure 3: Circuit of real-time automation system of Indian agricultural system

Operation of Real-Time Atomation Of Indian Agricultural System

Before going to the operation of the circuit, first we have to give the necessary power supply to all the components. The designed components need 5v supply to work whereas the arm processors need 3.3v supply. So we are giving 3.3v from the LM317. This is the device can provide 3.3v to the processor. For remaining devices will get supply from our power supply circuit will give 5v output.

The system structure is composed of the MCU-based home wireless control centre, one WSN centre node module, and several data collecting nodes, GSM module, GSM network and mobile phone. The WSN data collecting node modules are connected with different types of sensors.

When the components are activated, all the components will read and gives the output signal to the controller, when the user want to get the information then user should have to send a message from his mobile and immediately corresponding readings will send short message to the users through the GSM module and GSM network immediately. Here we use only GSM for prototype development.

The sensor readings are analog in nature so the ADC pin in the controller will convert the analog signals into digital format. Then the controller will access information. The operation of the circuit is given as, when we want access our field information then we have send a message to GSM modem, that modem consists of SIM (Subscriber Identity Module) and another will be user mobile. When user want to access the field information, then user should send message to the GSM.

Then the particular sensor will activate and reads the present condition of the field and gives the same information to the user number. User can analyze the results, if the results are seems to be very bad, then user should provide necessary fertilizers or any other precautions they have to follow.

Conclusion

The paper "A Real – Time Irrigation Control System for Precision Agriculture using WSN in Indian Agricultural Sectors" has been successfully designed. The Microcontroller based drip irrigation system proves to be a real time feedback control system which monitors and controls all the activities of drip irrigation system efficiently. They can provide irrigation to larger areas of plants with less water consumption and lower pressure. Integrating features of all the hardware components used have developed it. The results will be displayed on the both LCD panel and user mobile, for testing the output instantly . Using this system, one can save manpower, water to improve production and ultimately profit.

Future Enhancements

By developing a Smart Wireless Sensor and by using upcoming techniques a farmer can increase his profit by solving different problems that are faced by the farmer in his routine life. And also to involve ARM – Controller with a video capturing by using an MMS facility about the crop position and at the same time sending video to the farmer.

References

1. "Design of Embedded System for the Automation of Drip Irrigation". Ijaiem(2319-4847), vol 1, issue 2, October 2012.
2. Microcontroller based drip irrigation, technical paper on Drip Irrigation www.engineers .com April 30, 2010
3. Real-time automation of agricultural environment for modernization of Indian agricultural system. 2010 International Journal of Computer Applications (0975 - 8887) Volume 1 – No. 22.
4. Wireless sensor networks agriculture: for potato farming, kshitij shinghal et. al. / international journal of engineering science and technology vol. 2(8), 2010, 3955-3963
5. "a wireless application of drip irrigation automation supported by soil moisture sensors" Vol 6; 2011 Academic Journals ,ISSN 1992-2248, DOI: 10.5897/SRE10.949 .
6. [pdf]UM_lpc21xx_lpc22xx_2, lpc2129 user manual, 03 may 2004.
7. LPC-ARM-Book-srn, The Insider"s Guide to the PHILIPS ARM&-Based Microcontroller.
8. AT Commands from wave-com.
9. "wireless sensor networks agriculture: for potato farming", kshitij shinghal et. Al. / international journal of engineering science and technology Vol. 2(8),2010, 3955-3963
10. Intelligent Humidity Sensor for - Wireless Sensor Network Agricultural Application. International Journal of Wireless & Mobile Networks (Ijwmn) (Vol. 3, No. 1, February 2011) Doi:10.5121/Ijwmn.2011.3111 118