ADVANCED IRRIGATION SYSTEM FOR FARMERS BASED ON SENSOR NETWORKS

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ABSTRACT

This project is about the transmission of moisture and temperature level from the field to the farmer's mobile. The project is helpful in irrigating the field based on the dry and wet conditions of the soil. This project uses ARM microcontroller and two sensors to design the entire system. The moisture and temperature levels are transmitted to the ARM microcontroller which enables the motor based on the obtained values. This project also uses GSM module to communicate with the farmer which helps the farmer to completely monitor the process. The sugar cube relay is used to enable the motor function and also to interface the motor with the ARM microcontroller.

KEYWORDS: *ARM microcontroller, soil moisture and temperature sensor, GSM module, relay, motor.*

I. INTRODUCTION

Water is an important source for the survival of the living organism. Nowadays, the pure water available for the use of humans keeps on depleting due to continuous use of water for both industrial needs and agricultural purposes. The increased population in the world would lead to increased necessity of both food and water for the survival. To overcome this, the water must have to be saved in each and every manner possible. Risk of failure of crops is mainly due to both heavy as well as lower rainfall. But, the water level required for the plants to grow is to be maintained at an optimum level. Both, the higher amount of water level in the soil and the drought condition of the soil would affect the yields of a crop. The irrigation system must have to be automated in such a way to give higher yield with minimal usage of water. GSM module is used to send messages to the farmers whenever the water content is reduced.

Hence, the entire work can be automated and reduces the work of the farmers by increasing the efficiency of the crops. This study aims to develop a system with high efficiency and high stability to irrigate the particular land area. L.L. Pfitscher and D.P. Bemardon,[1] designed a system for rice cropping and supervision by automating the irrigation system in May 2011. Yuya Suzuki and Hirofumi Ibayashi,[2] designed a Support Vector Machine(SVM) based irrigation system for home gardening in 2013. Joaquin Gutierrez and Juan Francisco Villa-Medina [3], designed an irrigation system based on GPRS Module where the data from the field are sent through a GPRS Modulein January 2014. Xiaoxue Yang[4], designed and implemented an intelligent irrigation system that could be used in the cities which helps to conserve water at a greater extent in 2014. Yudhajeet Dasgupta and Guru Darshan PM[10] has designed an application of wireless sensor networks for remotely monitoring. It represents the role of sensor networks in determining the moisture of the land. There are considerable approaches in the literature to address the problem planning of the sensor networks and irrigation system, such as I.Bennis, H.Fouchal and O.Zytoune, [5] in 2015, Hiteshkumar J.Lad and Vibhutikumar G. Joshi[6] in 2014, Nilesh R.Patel and Swarup S.Mathurkar[7], in 2013, G.Nisha and J.Megala[8],in 2014, Wilton Mill and Hans Kaell Torres[9],in 2014. The design is lightweight and portable and efficient due to usage of relative measurement of the moisture in the land at a continuous time.

II. HARDWARE REQUIREMENTS

The following are the list of components required for designing this project

2.1. Arm microcontroller

The project requires a controller to handle multiple instructions at an optimum speed hence an ARM controller was used. The ARM microcontroller is a development board with a more advanced features built within the microcontroller. The ARM microcontroller can be attached with a PC or laptop by the use of serial USB bus. ARM microcontroller enables a high speed operation of 60MHz. ARM microcontroller provides on-chip ram of 8Kb and 10-bit D/A converter for multiple input conversions. On-chip static RAM ranges from 8 to 40 Kb whereas on-chip flash memory ranges from 32 to 512 Kb. The microcontroller can be programmed through the generation of hex files and provided with additional memory slot for SD/MMC card.

Figure 1. ARM microcontroller

2.2. GSM module

GSM is a standard established to communicate between two mobile users through the use of sim card. GSM was used to transmit the current moisture and temperature level as an alert to the farmer, whenever the moisture level of the soil is lower. GSM module was interfaced with the ARM microcontroller through serial cable.

Figure.2. GSM module

2.3. Soil moisture sensor

Soil moisture sensor is a component which is used to measure the moisture content of the soil. It operates on a 5v DC supply. It uses capacitance to measure the water content of the soil. It is used to measure the permittivity of the soil, where permittivity is a function of water. The soil moisture sensor would be consisting of two pads which act as a probe. If the water content in the soil is higher, then the conductivity between the probes will be larger which will result in the lower resistance and hence it allows the current to pass through it.

2.4. Temperature sensor

Temperature sensor is a component which is used to measure the temperature content of the soil. The temperature sensor operates at a voltage of 5v. The temperature sensor has a negative temperature coefficient of resistance. The resistance value goes down with increase in the temperature and vice versa. It is connected in series with a suitable biasing resistor to form a potential divider network; thereby the changes in the soil temperature could be determined.

2.5. Relay

A relay is an electromagnetic switch, which operates on the principle of electromagnetic field. Relay consists of an electromagnet to perform switching operation. Relay is used to control a circuit by using a low-power signal. It is also used for controlling several circuits by providing a single signal. In this design, 5v relay is used for the switching purpose.

2.6. Motor

Motor converts electrical energy in to mechanical energy. The motor receives the input and the required power supply from relay which enables the motor based on the obtained input from sensors. The motor operates when the land is in dry condition to pump water in to the field for automatic irrigation purposes.

III. DESIGN

The project is implemented through the usage of sensors, relay, ARM microcontroller, GSM module and a motor. The microcontroller receives the input from sensors. The following block diagram shows the working mechanism of this project.

3.1. Working mechanism

The sensors measure moisture and temperature level and transmit them to the microcontroller. The microcontroller analyses the input from the sensors whether the particular moisture level can be optimal for the growth of plants in that field. The microcontroller then enables the relay which controls the motor operation. The motor pumps the water in to the soil based on the input from microcontroller.
The sensors will be measure the soil moisture level based on the changes in resistance of the instrument. Hence the motor will be turned on when the sensor indicates very low moisture level. The power required for the sensor to operate in such conditions will be supplied from the microcontroller board.

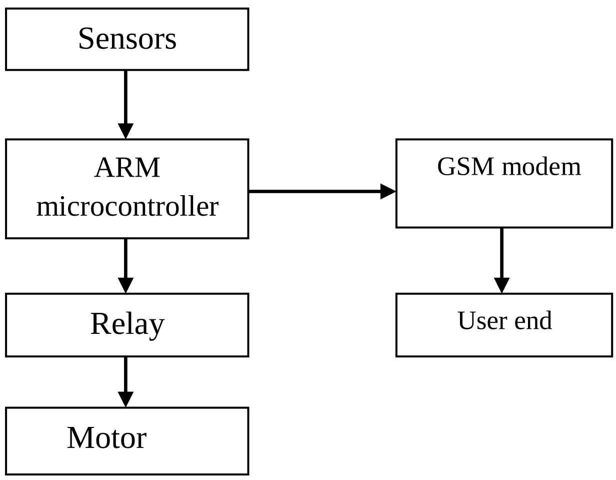

Figure.3. Block diagram of the system

GSM module was interfaced with the microcontroller hence the moisture level and motor condition will be automatically transferred to the farmer's mobile after every sensor measurement.
Relay is used to interface the motor with the microcontroller. Hence the relay will be used to provide the power required for the motor to operate. The motor will be turned off once the sensor indicates it to the motor.

IV. EXPERIMENTAL RESULTS

The system measures moisture from the soil up to 10cm which is suitable to provide accurate result for most of the crops. The challenging part in this system is that the finding the optimum value of the crops. Each and every crop have different moisture value, hence it is difficult to design the sensors for each crops. We can improve this using higher number of sensors in detecting the moisture level at various parts of the land. This system has sensor which can measure a maximum moisture level from soil up to 10cm at voltage requirement of 5V. Hence for measuring moisture for a fewer area of soil, this system can serve as a highly useful tool but when the area level increases the size and number of sensor also increases. To increase the efficiency of this system in a large area it is necessary to form a network with high number of sensors.

V. CONCLUSION

This paper proposes a simple mechanism that helps to reduce the work of farmers at a greater extent. It save nearly 60-70% of water wastage and reduce human effort in agriculture. The system is light weight and is portable which could be placed anywhere on the land. The components required are simple enough and could be made at a low cost. Finally, this system should be developed in a way that it reduces lot of human works and performs complex instructions to measure moisture at various conditions for various crops.

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