A SURVEY TO DESIGN AND DEVELOP AUTOMATIC IRRIGATION SYSTEM

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ABSTRACT

Objective: This survey is to design an irrigation system with low cost and less power consuming microcontroller with better performance.

Methods: To design a low cost and power efficient irrigation system, most commonly available and used microcontrollers are chosen. To improve the performance of irrigation system, modern wireless communicating technologies such as GSM, ZigBee, and Bluetooth were interfaced with the microcontroller and special application software's were developed and introduced to automate the irrigation system for better water usage. In this work, a survey related to the automating irrigation system is discussed, and different microcontrollers are compared. This survey deals with real time issues in irrigation and future research scope for irrigation automation.

Result: Different microcontrollers features are tabulated after the discussion and a methodology for effective irrigation system is discussed.

Conclusion: This analysis method is to be improved by placing more number of sensor nodes with less power and economic microcontrollers.

Keywords: Agriculture, Irrigation, Microcontroller, Wireless sensor node.

INTRODUCTION

For agriculture, water is the important resource. For different crops and at different stages of that crop water required for irrigation varies. Due to industrialization, the ground water level is decreased and the annual rainfall becomes unpredictable because of global warming. Because of these reasons, farmers are forced to utilize the minimum water for agriculture. Nowadays, most of the agriculture lands are using irrigation-based cultivation. Irrigation is the technique in which water is supplied at regular intervals to the crops for effective agriculture. Different types of irrigation techniques are followed around the world; the most common irrigation techniques are surface irrigation, sprinkler irrigation, and drip irrigation. In surface irrigation, the water is flooded in the field to moisture the soil. In drip irrigation, less amount of water is inserted directly to the roots of the agriculture. In sprinkler irrigation, water is sprayed over the crops in a circular motion through overhead pipes. Above said irrigation techniques are automated using different microcontrollers. In this automation process, different types of sensors such as temperature sensor, humidity sensor, and moisture sensors are used to monitor the condition of soil. To enhance this application, wireless technology such as ZigBee and GSM were interfaced. Figs. 1 and 2 indicate the typical water irrigation device without wireless devices and with wireless devices. In this paper, different microcontroller-based automatic irrigation system is discussed, and their drawbacks were analyzed.

In the work [1], moisture sensor is used to sense the moisture level in soil. The output of sensor is connected to the analog to digital converter (ADC) module, and then, to the Atmega based microcontroller. Based on the sensor value, the microcontroller controls, the water supply for irrigation through driver circuit and relay board. If moisture content in soil is high water to the crops will be stopped. If the moisture content in the soil is low water to the crops will be opened. The flow of water is controlled by a motor based on the control signal from controller. Status of the motor is sent to the farmer through short message service (SMS). The status of the motor and moisture level of soil is displayed in the liquid crystal display (LCD) in the agriculture field itself. Keypad is interfaced to the microcontroller to feed the quantity of water to be supplied. This system is designed and implemented for surface type irrigation.
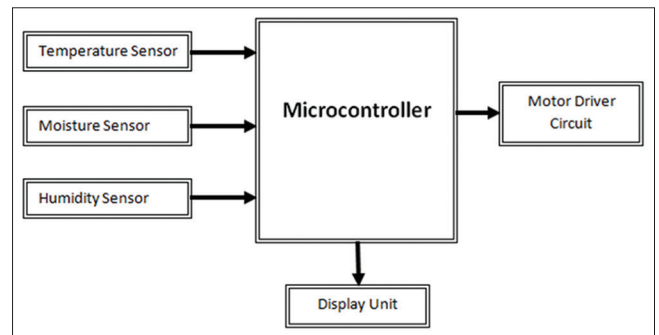

Fig. 1: Typical arrangement of automatic irrigation system

In the work [2], PIC microcontroller is used to control the water flow. To acquire the status of the moisture in soil, moisture sensor is used. PIC microcontroller has internal 10-bit ADC module, so the sensor is directly interfaced. To control the water flow solenoid valve is used. The entire system is operated on the battery backup which is powered by solar panel. LCD is used to display the status of motor and moisture level in soil. This system is designed and implemented for surface type irrigation.

In [3] the author used moisture sensor, temperature sensor, and humidity sensor to predict the environmental condition accurately. pH sensor is used to measure the nature of soil before and after adding fertilizer. Leaf sensor is used to monitor the moisture level in the plant leaf, and level sensor is used to check the status of water in the well before water is supplied to the field. Based on these values, LPC 2148 controller controls the water flow to the field using motor. The GSM is interfaced with the controller to start and stop the process of irrigation and LCD to display the status of the field. This system is designed and implemented for surface type irrigation.

In the work [4], Atmega 328 based smart irrigation system for surface irrigation is developed. In this author control, the water flow based on the values acquired from temperature and moisture sensor. To turn ON and OFF, the water supply pump motor is interfaced with

the microcontroller using pump driver board. Servo motor in the system is used to control the angular position of the pipe to ensure the water distribution evenly throughout the field. This system can be implemented for surface type irrigation.

Sprinkler type irrigation is discussed in the work [5]. In which the four selector switches are interfaced with the microcontroller. Based on the selection of selector switches, the period of irrigation is determined. In this solenoid valves are used to control, the water flow to the field and water flow sensor is used to determine the presence of water in the pipeline. Three sprinkler water pipes are controlled through microcontroller.

In work [6], the drip irrigation automation is discussed. In this work, the agriculture field is divided into different sectors; each sector is monitored by temperature and moisture sensors. The received value from each sector is combined and processed in 8051-based microcontroller. This controller controls the water flow in the field. Communication between sensor and microcontroller is only through wired medium.

Shikha and Vibha designed an irrigation system using ZigBee and GSM module [7]. In this work, sensor node designed with AVR microcontroller and sensors to monitor the field data. The moisture sensor, humidity sensor, and temperature sensors in sensor nodes are used to predict the field atmosphere perfectly. For better prediction number of such sensor nodes are deployed in the field. This sensor
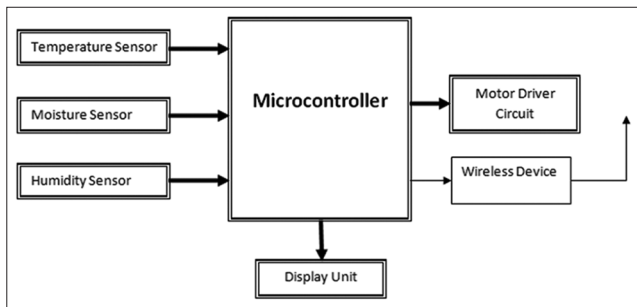

Fig. 2: Typical arrangement of automatic irrigation system with wireless device

node transmits the measuring value to the base station through ZigBee module. The base station consists of PC, ZigBee, and GSM module. The results from different sensor nodes were stored in a database for future reference, and abnormal status was indicated to the end user through SMS. This system is used to report the status of an agricultural field.

In modern days, wireless sensor technologies are implemented in all applications. In the work [8], ARM controller based wireless sensor node (WSN) is developed and deployed in the field to measure the temperature and moisture level in soil. Based on the value WSN controls the water flow in the field. At the same time, the measured value is transmitted to wireless information unit through ZigBee based device to upload the data to the server. The uploaded data can be viewed from anywhere through specified IP for the system. This system can be implemented for monitoring the status for any type of field.

RESEARCH AREA AND DISCUSSION

In agricultural field, the farmers could not able to deploy the costly and complicated irrigation systems in their field. Hence, it is necessary to develop the low and less complicated irrigation system for the betterment of farmer's life.

In above-mentioned works, all the authors analyze the parameters such as temperature, humidity, and moisture of soil only in specific location to control the flow of water. This information is not sufficient to predict the accurate condition of a field. Hence, its recommend to install number of such sensors to monitor the soil condition continuously.

To monitor the soil condition, WSN can be used. The high-cost wireless devices such as GSM and GPS usages can be avoided and low cost ZigBee based devices can be used to reduce the overall cost of the system.

In the remote areas such as agriculture field, the developing system may operate in battery backup. To protract the lifetime of battery, less power consuming microcontrollers, sensors, and wireless operating devices are to be installed. It is also important for battery operating system to retain in the power down mode at unoperated conditions.

To minimize the water usage for agriculture climatic conditions can also be considered for better water management.
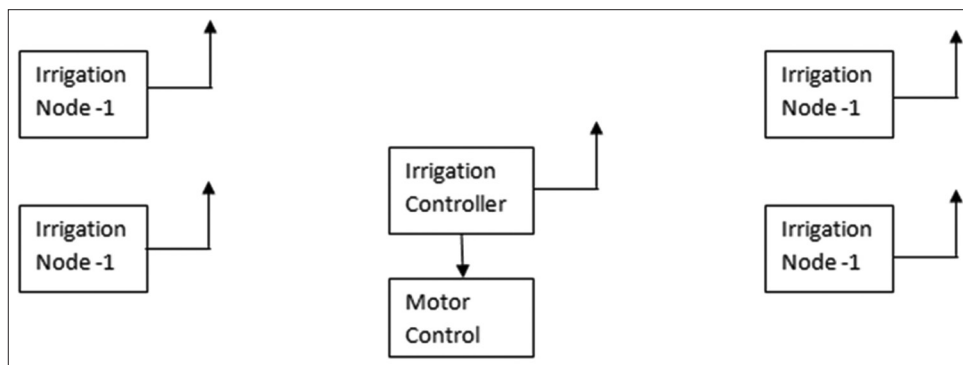

Fig. 3: Proposed methodology for developing better automatic irrigation system

Table 1: Comparison of microcontrollers used in irrigation system

Microcontroller	Bit operation	Operating frequency (MHz)	Flash memory (K Bytes)	RAM size	Operating voltage (v)	Cost (INR)
ARM (LPC2148)	32	25	512	SRAM 40 K Bytes	3.6	500
32 bit AVR	32	25	-	2 K Bytes	5	700
Atmega 328	8	20	32	SRAM 2 K Bytes	5.5	180
PIC16F877A	8	20	8	RAM 368 Bytes	5	200
8051	8	12	4	RAM 128 Bytes	5	100

Comparison of the controllers used in the irrigation system is given in Table 1. From this table, it is easy to choose a low power operating and highly efficient device depending on the application.

Fig. 3 indicates the methodology for developing better automatic irrigation system by collecting the data of field from various sensor nodes (irrigation node) and sent to the irrigation controller to take the necessary action.

CONCLUSION

Agriculture is one of the important fields in which new technologies to be implemented to reduce the burden of farmers. In this work, commonly available and low cost based irrigation automation for sprinkler, drip, and surface irrigation is analyzed and discussed. The possibility for future research activity in irrigation process is indicated to develop a better automatic irrigation system with low cost and less circuit complexity for the betterment of farmers.

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