ADVANCED WATER IRRIGATION SYSTEM

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ABSTRACT:

This paper represents a Mechatronics system used for advanced water irrigation. This system is integrated with three basic elements namely, sensing unit, controlling unit and actuating unit. Sensing unit consists of YL-69 water sensors along with YL-38 bridge circuits. Controlling unit consists of 8 bit microcontroller and SIM-900 GSM module. Actuation unit consists of DC motor operated valves assisted with driver circuits. This automated water irrigation system can be operated remotely using a mobile phone. The information about the required field to be irrigated can be sent through a registered mobile number, in the form of SMS. GSM module receives a message and there after sends set of instructions to microcontroller through MAX-232 communication device. Microcontroller is so programmed that, on receiving the instructions from GSM module, it decides which valve to be operated using corresponding DC motor. By operating valves, water to the required field or fields can be directed. The presence of water in the respective fields is again monitored by water sensors, which are mounted in the piping. Microcontroller receives signal from water sensors and sends corresponding signal to GSM module. A programmed SMS is sent back to the registered mobile number, which provides information about the presence of water in the fields as a feedback signal.

KEYWORDS: Feedback, Global System for mobile Communication (GSM), Irrigation, Microcontroller, Short Message Service (SMS), etc

INTRODUCTION:

In the countries like India, most of the economy depends on agriculture. Agriculture is the major source of food production, to the growing demand of human population. In agriculture, irrigation is an essential process which influences crop production. Irrigation is the process of artificially supplying water to the lands, where crops are cultivated. Traditionally, pumps, canal water and rainfall are the major sources of water for irrigation. These methods may lead to drawbacks, like under irrigation, over irrigation, etc. India, being a tropical country, the temperature is high and evaporation is rapid, so, artificial irrigation is necessary to meet water requirements of soil and hence, better crop production.

1.1 IMPORTANCE AND NEED OF THE TOPIC:

The distribution in rainfall is uneven and uncertain, while canal water is not available everywhere. Efficient methods of irrigation enable the application of the right amount of water, to the crop, at the right time, and uniform water distribution in the field. Hence, different water requirements of different types of crops and different types of lands can be achieved satisfactorily with the selection of proper irrigation facilities.

Generally, farmers visit their agriculture fields periodically and remain present during the irrigation to manually navigate water to the respective fields. Such irrigation method, takes lot of time and effort, particularly, when a farmer needs to irrigate multiple agriculture fields, distributed in different geographical areas. Nowadays, farmers need to manage their agriculture activity along with other occupations. Automating farm irrigation allows farmers to apply the right amount of water at the right time, regardless of the

availability of labor to operate pump motor and valves. In addition, the farmers which are using automation equipments save their efforts in the irrigation and also avoid irrigation at wrong time of the day. Automated irrigation can also reduce the chances of water scarcity and over watering of a land. Automated irrigation can improve crop performance by ensuring adequate water whenever needed. Automatic irrigation is a valuable tool for accurate soil moisture control in highly specialized greenhouse vegetable production and it is a simple, precise method for irrigation. Such irrigation systems can be programmed, so as to precisely discharge the amount of water in targeted areas.

"Advanced Water Irrigation System" is one of the automatic irrigation concept, which may overcome the problems occurring with traditional irrigation and can help farmers in effortless and remote irrigation. It can fulfill the urgent need of irrigation that makes the agricultural process easier and burden free from the farmers' point of view.

1.2 PROBLEM STATEMENT:

Water is the most critical input for enhancing agricultural productivity, and therefore, advancement of irrigation has been a key strategy in the development of agriculture in the country like India.

1.3 THEME OF THE PAPER:

The first section of this paper describes the need, importance and problem statement of the topic. Second section focuses on the literature survey trough review of different research papers, based on the advancement in the water irrigation and objective of this paper. Third section is methodology which deals with the proposed system, system components and experimentation. Last section of this paper deals with the conclusion, future scope and the references used for this research paper.

LITERATURE SURVEY:

Automation in irrigation system makes farmers' work much easier. Sensor based automated irrigation system provides promising solution to farmers where, presence of a person in the field to perform irrigation process is not mandatory. Automated irrigation systems are developed to operate the water pump remotely. It is a very tedious job for farmers to check the status of motor pump by walking through long distances [2], [3]. Research has taken place to switch the irrigation motor ON/OFF using GSM module and Mobile phone. Global system for mobile communication (GSM) is one of the most vital wireless communication systems that can be accessed and used easily. The price of GSM module and subscription fee of its services is not much expensive. Therefore, the embedded system interfaced with GSM module can widen the scope of advancement and enhance the application areas of controlling and monitoring irrigation remotely.

The advancement has even taken place to switch on or off the water pumping motor automatically, depending upon the soil moisture level in the respective agricultural fields. Moisture sensor senses the moisture content of the soil and turns motor ON/OFF accordingly. System also informs about temperature rise, concentration of CO_2 in soil, moisture content of soil, etc to the farmers' mobile via SMS using GSM-Bluetooth module and hence, farmers can remotely take the necessary actions. Fertility meter and ph. Meter are also used to determine the percentage of potassium, phosphorus and nitrogen which are the most important ingredients of soil. This system waters a larger area with small amounts of water over a long period of time. [1], [6]. The need of electromechanically programmed system, for remote controlling of mechanical devices, like water pumping motor, water pipe valves, etc based on sensors in the irrigation fields, has arrived. Many existing systems use computers along with data base technologies for monitoring and controlling irrigation activity. Basically, it includes the remote operating of solenoid valves using GSM technology. It only allows making ON/OFF the valves, but it comes with the limitation of unable to control the flow of water as per requirement [4], [5], [8]. In real time, farmers need cheap and simple feedback assisted user interface for controlling automated irrigation system. Nowadays, mobile phone is the most common device used by famers. Therefore, mobile phone is used in sensor based automated irrigation system [5], [7], [8].

2.1 OBJECTIVE OF THE PAPER:

To remotely control the irrigation of several lands at different places and report the water navigation through wireless controls.

METHODOLOGY:

In this paper, a prototype for automatic controlling of irrigation water along with the water navigation is described. Prototype includes sensor node, controller node and mobile phone. In sensor node, water sensor is integrated with SST89E516RD microcontroller using SIM300 GSM module. In controller node, GSM module and three DC motor driven valves are integrated with SST89E516RD microcontroller.

For experimentation, three pots as three different irrigation fields are used. Each field is provided with a separate piping for the water supply from a

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common water source. A command signal in the form of SMS is sent to the GSM module, to irrigate particular field or fields. Instruction set in the form of SMS is sent to GSM module from registered mobile number. GSM module is integrated with microcontroller through RS-232 communication device. Microcontroller is also integrated with DC motor operated valves and water sensors. After receiving SMS in desired format, controller decides which valve to open and/or close and in how much percentage. Depending on the decision taken by controller, an action signal will be sent to the DC motors to operate the respective valve allowing water in the field. The presence of water is sensed by water sensors mounted in the piping and corresponding signal will be sent to controller. On receiving signal from water sensors, microcontroller sends signal to GSM module. GSM module sends SMS to registered mobile number insuring presence of water in the corresponding fields. So, it is a feedback assisted closed loop control system. These water sensors are used to sense the water presence which in turns confirms the proper working of the valves. For example, if a farmer wants to open a valve 'B' and suppose farmer does not receive a feedback message triggered by water sensor, it is crystal clear that, the valve 'B' is not working anymore. In such a case, farmer can operate manual valves provided in parallel with motor operated valve.

3.1 PROPOSED SYSTEM:

Depending upon the field/fields to be irrigated, a particular set of instructions is sent from registered mobile number to the GSM module in the form of SMS. GSM module decodes the set of instructions and sends related signal to microcontroller through RS232 communicating device. Microcontroller is programmed with Embedded C to operate DC motor operated valves as per the instruction set. DC motor operates clockwise or anticlockwise resulting in the opening and closing of the valves. Using this prototype, three fields can be irrigated in fifteen different ways. A DC motor controlled valve has five different positions viz. completely closed or 0%open, 25% open, half open or 50% open, 75%open and fully open or 100% open.

3.2 SYSTEM COMPONENTS :

Sensing unit, actuating unit and controlling unit are described below, in more details to understand their design and working principle.

A. SENSING UNIT:

A variety of water sensors are available in the market, out of which YL-69 water sensor along with bridge device YL-38 is used to detect the presence of water in the irrigation pipes, Figure 3.1 shows YL-69 water sensor and YL-38 bridge circuit which helps GSM module, to sends SMS to registered mobile number, insuring presence of water in corresponding fields.

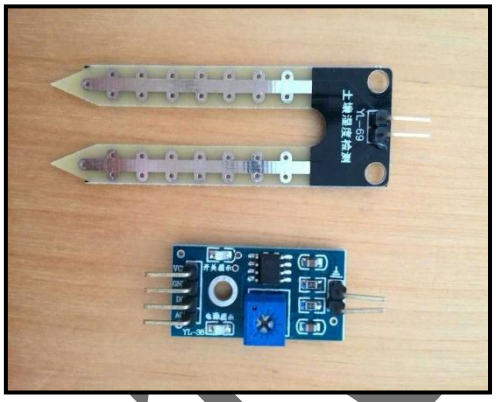

Figure 3.1: YL-69 water sensor and YL-38 circuit

The bridge device YL-38 can also be called as middle man circuit. YL-69 itself has two pins which need to be wired to the pins on the YL-38 Bridge. On the other end of YL-38, there are four pins namely VCC, GND, DO (Digital Output) and AO (Analog Output). This sensor has two plastic probes which has metal strips attached on it. This sensor is fitted in the pipes, such that, when water flows through pipe, sensor probes will come in water contact. When both the probes, come in contact with water, current passes through them, which triggers the output to middle bridge YL 38 and gives signal to microcontroller.

B. ACTUATING UNIT:

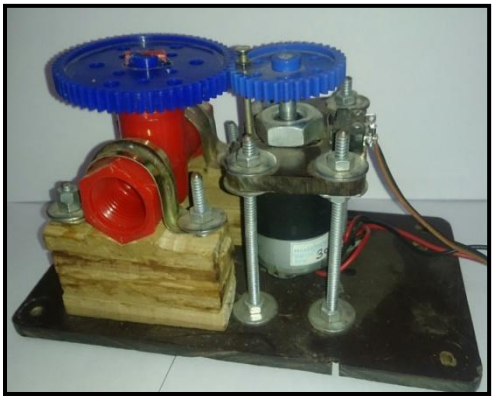

Figure 3.2: DC motor operated valve

Figure 3.2 shows DC motor operated valve, which can serve as Actuator Node. It is the main component in the prototype which leads to the actual navigation of the irrigation water.

DC motor operated valves are integrated with the controller. Microcontroller sends decision signal to DC motor and accordingly motor rotates clockwise or

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anti-clockwise. The rotation of motor results in the opening or closing of the valve.

C. CONTROLLING UNIT:

Control unit consists of microcontroller SST89E516RD which is integrated with sensing unit, actuating unit and GSM module, as shown in figure 3.3.

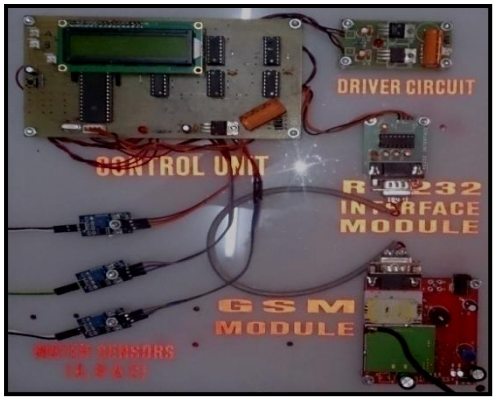

Figure 3.3: Integrated control unit

Depending upon the field/fields to be irrigated, a particular set of instructions is sent from a registered mobile number to the GSM module in the form of SMS. GSM module is integrated with controller through RS-232 interface module. DC motors are integrated with controller through driver circuits and water sensors are also integrated with controller through bridge circuits.

3.3 EXPERIMENTATION:

The prototype of Advanced Irrigation System includes three irrigation fields provided with separate piping from a common water sours. DC motor operated valves are mounted in piping to control the water flow to the particular field. Every piping has water sensor at the end (near to the field), to detect presence of water in that particular field. Three DC motors, three water sensors and GSM module are integrated with microcontroller as explained earlier. In order to control the flow of water to the particular field or fields, user need to send a set of instructions from a registered mobile number to the GSM module.

This prototype has three valves and each valve has five states viz. 0% open, 25% open, 50% open, 75% open and 100% open. Every state of the valve is designated by unique set of instruction as shown the table 3.1. Every valve used in this experimentation can be operated automatically using a defined set of instruction. Depending upon the state of valve, water is directed to the desired field. Water sensors mounted in the piping detect the presence of water and a feedback signal is sent to the registered mobile number in the form of message, which insures the water navigation.

Set of Instruction	State of Valve		
	Valve A	Valve B	Valve C
A100	100% open	Closed	Closed
A75B25	75% open	25% open	Closed
A75C25	75% open	Closed	25% open
A50B50	50% open	50% open	Closed
A50B25C25	50% open	25% open	25% open
A50C50	50% open	Closed	50% open
A25B75	25% open	75% open	Closed
A25B50C25	25% open	50% open	25% open
A25B25C50	25% open	25% open	50% open
A25C75	25% open	Closed	75% open
B100	Closed	100% open	Closed
B75C25	Closed	75% open	25% open
B50C50	Closed	50% open	50% open
B25C75	Closed	25% open	75% open
C100	Closed	Closed	100% open

Table 3.1: Set of instructions and states of valves

CONCLUSION AND FUTURE SCOPE:

4.1 CONCLUSION:

This paper presents a prototype for automatic controlling of irrigation water along with water navigation feedback. The experimental results show that, the prototype is capable for automatic controlling and remote accessing of irrigation motor and motor operated valves. This prototype can also facilitate the farmers in remotely monitoring water navigation to desired fields.

4.2 FUTURE SCOPE

The described automated irrigation system can be assisted with soil moisture detecting sensors. With the help of which, farmers' involvement in the irrigation will be minimum. If any field has water contents below the required moisture level then, the irrigation motor will be switched on automatically and corresponding alert will be given on the registered mobile number. The control system can also be modified in such a way that, motor will remain on only if the control system receives a confirmation message from registered mobile number within the specified time.

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