Automated Wireless Watering System (AWWS)

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ABSTRACT
The Automated Wireless Watering System (AWWS) is a system designed to overcome the difficulties encountered by the traditional wired watering system. It is a PC and mobile controlled system. This system has been designed for facilitating gardening.

General Terms
Wireless Communication

Keywords
AWWS, moisture sensor, water level indicator, rain sensor, mobile control.

1. INTRODUCTION
AWWS is a watering system which is more user-friendly than the old watering systems. The main objectives of this project are:

1. To overcome the difficulties faced by the traditional watering system.

2. To facilitate the user by providing both PC control and mobile control for controlling and monitoring the watering activities.

3. To reduce the wiring mess.

2. SYSTEM DESCRIPTION
There is need to optimize the water usage due to its scarcity. Recent advances in soil water monitoring combined with the growing popularity of Wireless Sensor Networks make the commercial use of such systems applicable not only to agriculture and industry, but to homes as well[9].

The user interface for this system is developed using C# in .NET Framework 3.5. For the microcontroller and other hardware programming, we used Embedded C in AVR Studio.

3. AWWS ARCHITECTURE
Figure 1 describes the AWWS architecture. As shown, the system can be said to be divided in 2 parts: the PC side and the hardware components on the site/field. The brief functioning of components used is as follows:

1. Level Convertor: The IC used for voltage level conversion is MAX232. It is responsible for converting the signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits [4].

2. GSM Modem: The GSM modem used here is sim300 which is responsible for the wireless communication [5].

3. Micro controller: The microcontroller used here is of the AVR ATMega16. It is responsible for controlling all the functions of AWWS [3].

4. Moisture Sensor: The moisture sensor is responsible for measuring and returning the soil moisture values to the microcontroller.

5. Rain Sensor: The rain sensor is responsible for sensing the rain and returning the result to the microcontroller.

6. Motor Driver: IC L293D is the motor driver used here for pumping the water as per needed [6].

4. HARDWARE DESCRIPTION
4.1 Sensors
4.1.1 Moisture Sensor
Figure 2 shows the circuit designed for measuring the moisture content.

The moisture sensor needs an input voltage of 5 V (Vin). V out gives the obtained voltage. The probes P1 and P2 are inserted in the soil. If there is moisture, the circuit gets completed and we get the V out accordingly.

4.1.2 Rain Sensor
Figure 3 shows the circuit designed for the detection of rain. As seen in figure 3, IC NE 555 has been used in rain sensor. It is used for pulse generation. The circuit will return Boolean value to the microcontroller and the buzzer will be initiated if the rain is detected.

4.1.3 Water Level Indicator
The water level indicator circuit is same as moisture sensor circuit. Boolean values will be returned to the user.

4.1.4 Battery Level Indicator
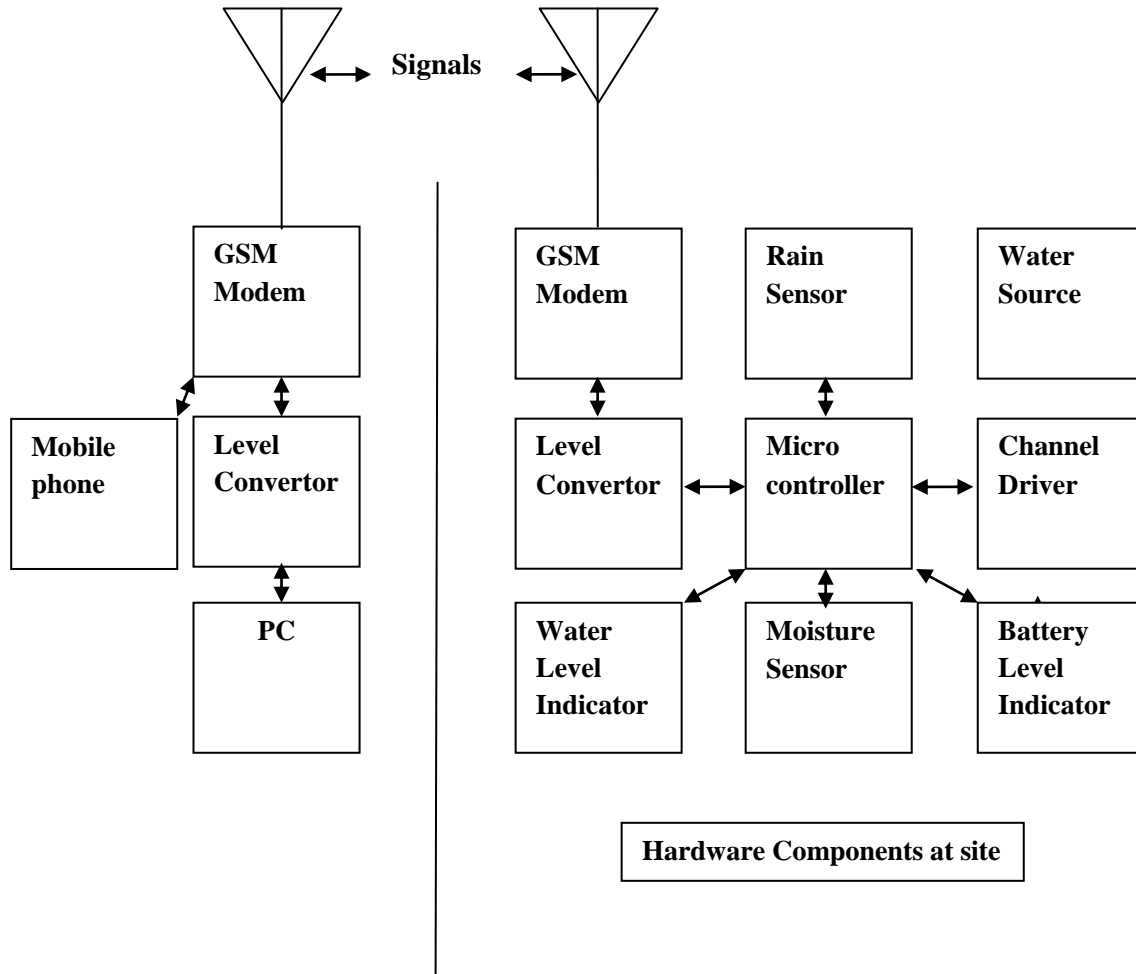Figure 4 shows the battery level indicator circuit.
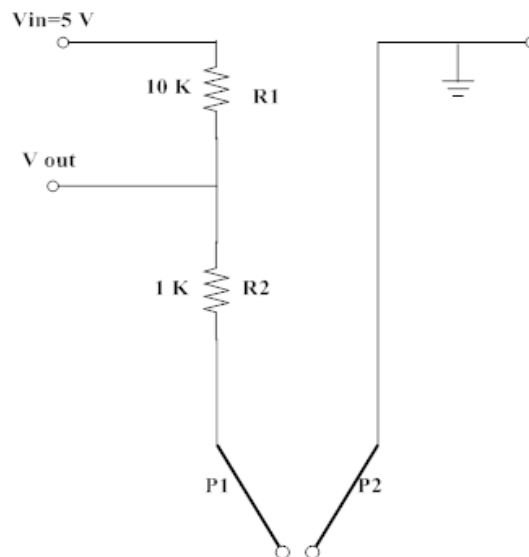
Fig 1: AWWS Architecture
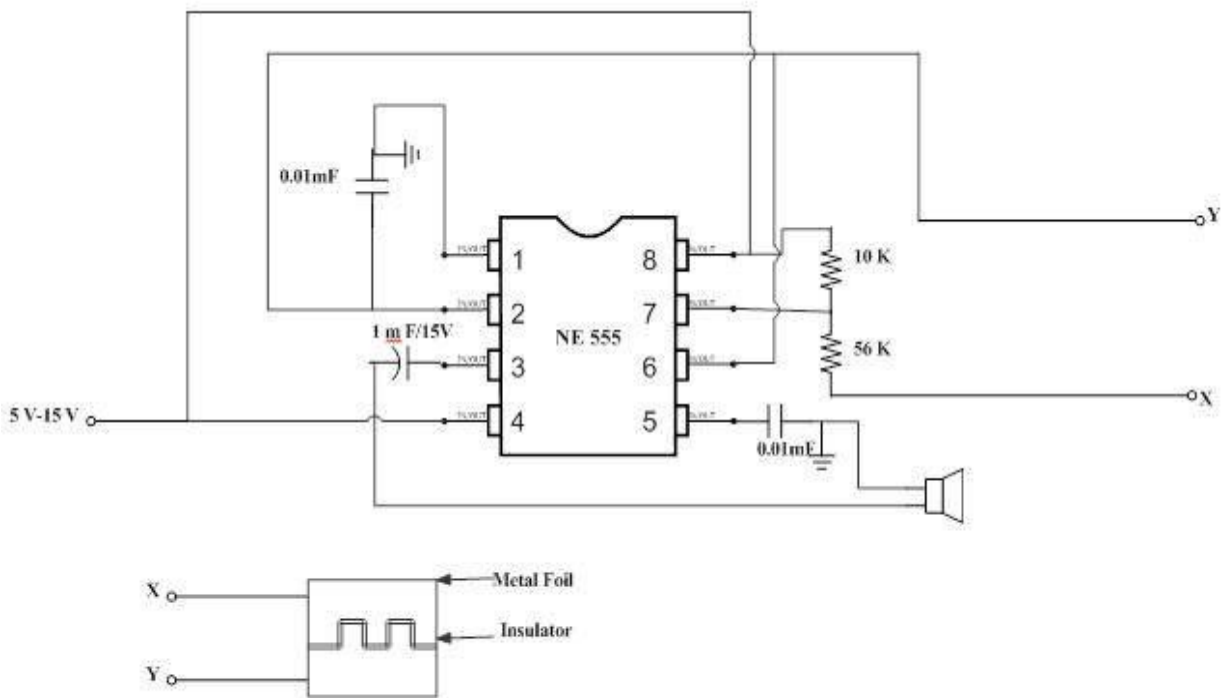

Fig 2: Moisture Sensor
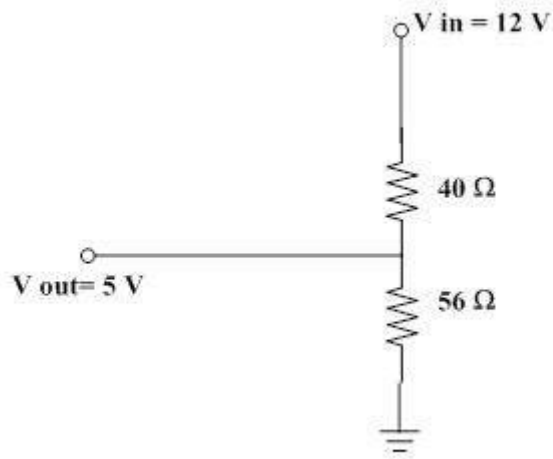
Fig 3: Rain Sensor

Fig 4: Battery Level Indicator

Here, the essential value that should be returned is 12 V. This value may vary a bit.

4.2 Final Circuit

The final circuit design consists of the micro controller, level convertor and channel/motor driver. Figure 5 shows the final circuit design.

5. FLOW CHART FOR FUNCTIONING OF AWWS

Figure 6 shows the step by step functioning of AWWS.

The general process in brief: The user initiates the system from PC side. If the user selects manual mode of operation, the watering will be initiated and the user have to switch off the watering by him. If the user selects automatic mode of operation, the micro controller will initiate the all the sensors.

If it is raining, it is notified to the user accordingly and the system stops. If not, the moisture level obtained from moisture sensors is compared with the reference values; if it less than the reference value, the water level in the storage tank is measured. If there is ample amount of water, then watering is initiated else the user is notified to refill the tank. After every specific period of time, the moisture level values are checked. If it gets greater than the reference value, then the user is notified and the watering is stopped automatically.
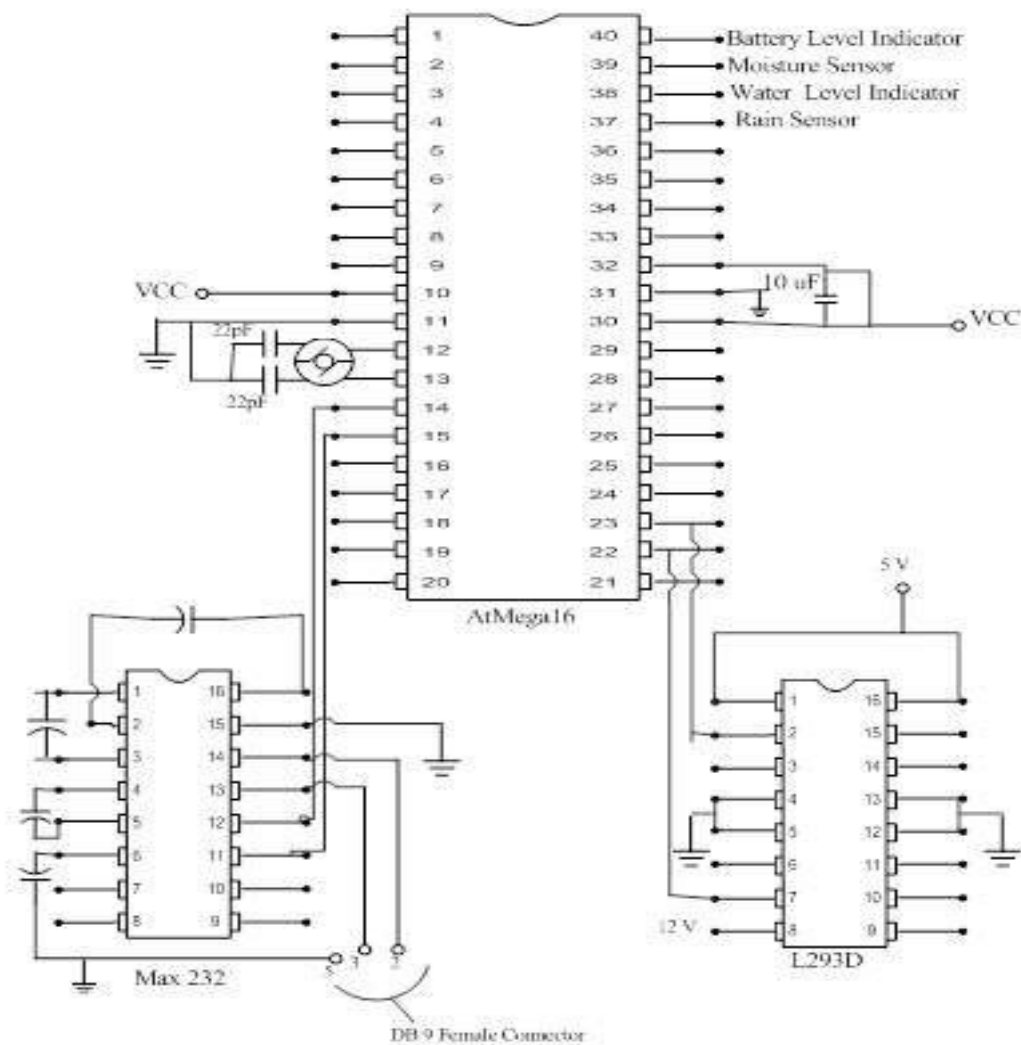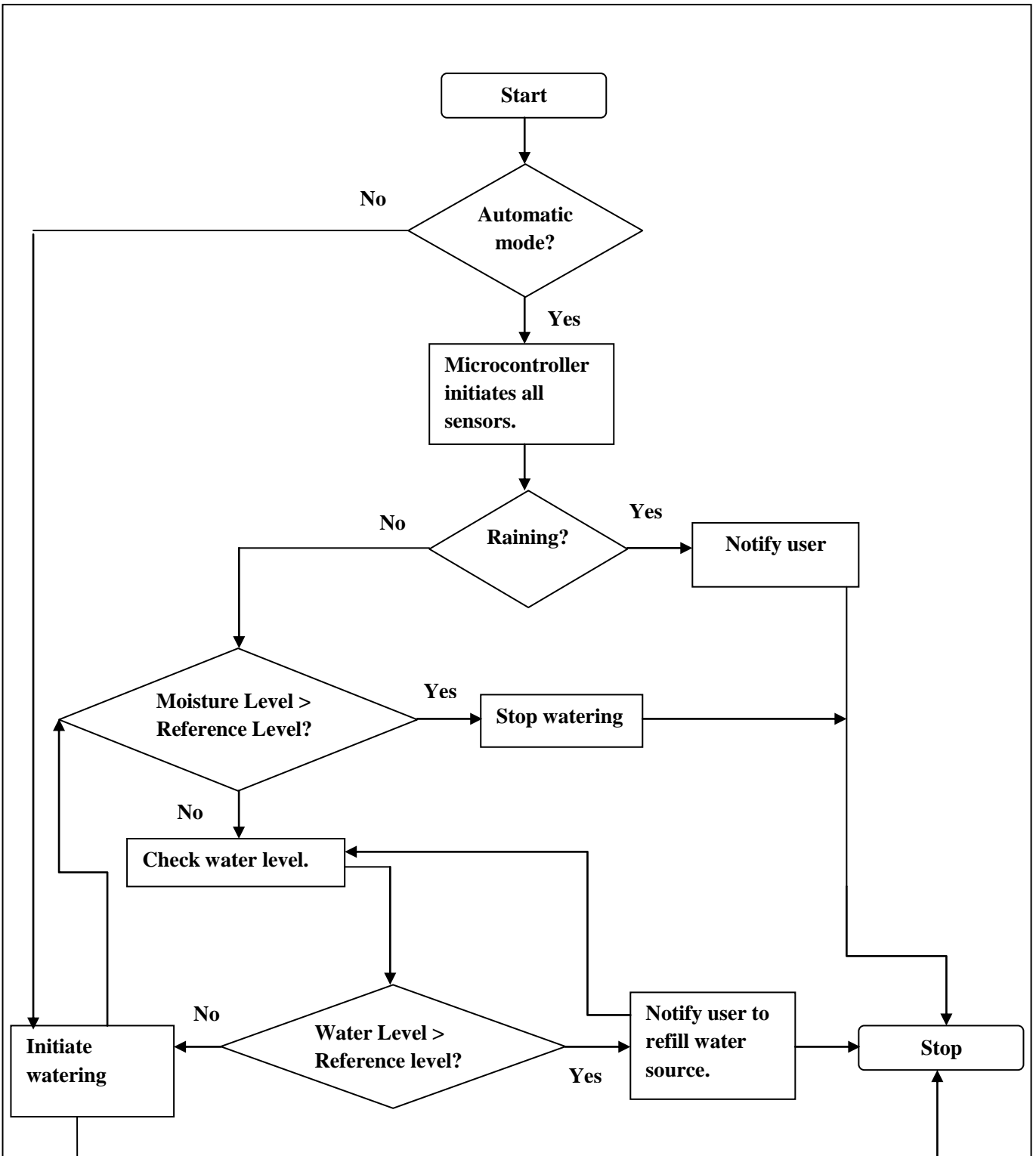

Fig 5: Final Circuit of AWWS

Fig 6: Flowchart for AWWS

6. FUNCTIONS OF AWWS

The system provides 2 modes of operation: manual and automatic. When the manual mode of operation is selected, the system will work just as the traditional watering system. The user decides when to start watering and when to stop it. When the automatic mode of operation is selected, the user need not pay attention to the stopping of the system once it is started. The watering will be decided according to the moisture level values.

If the user is not around, he/she can initiate the system using the mobile control. A code for initiation is sent to the microcontroller from the mobile phone as text message. We consider '$S' as the code for initiation. Once microcontroller receives this message, the system will start working in the automatic mode.

7. TEXT MESSAGE FORMAT

When the user starts the system, a message containing '$S' is sent to the microcontroller via GSM Modem through the program. Once the microcontroller receives this message, it will initiate the moisture sensors, rain sensors and water level indicator. The values returned by all these sensors are sent back to the user interface in a predefined format. The values are extracted from this message and displayed. The values are returned in a specific format to both PC and mobile by the micro controller. Consider the values returned by moisture sensor, battery level indicator, rain sensor and water level indicator as 3.05, 12.02, 0 and 1 respectively. So the message sent to the user will be as: $3.05/12.02/0/1$. The '/' acts as a splitter, which helps to split the values before displaying them to user.

8. .NET PROGRAMMING

The graphical user interface is developed on .NET framework 3.5. The two most important modules in the programming are sending message to GSM modem on site through PC and vice versa. Other one is to send message from mobile to GSM modem on site. For GSM communication, a library called Mobile Messaging Toolkit is needed to be downloaded. It contains all the necessary commands needed for the GSM communication.

9. EXPERIMENTAL SETUP

As seen before, AWWS architecture has been divided into 2 parts: PC side and the hardware components on the site.

The PC to be used should contain Windows XP. The CPU used should have RS232 male connector. The hardware components at the site contain a rechargeable battery of 12 V. The external circuitry is placed in a tray full of soil. This tray is divided into two sections- one section of soil is dry and one section of soil is wet.

The following table shows the experimental readings provided by the moisture sensor, according to the conditions specified:

Conditions	Moist Soil	Dry Soil
Reference Value	3.00 V	5 V
Reading 1	2.50 V	5.02 V
Reading 2	2.35 V	4.99 V
Reading 3	2.56 V	4.98 V

Table 1: Experimental Readings provided by moisture sensor

The values obtained at the ADC channels of the microcontroller are converted into digital values. According to the circuit design, if the probes detect moisture, the reading obtained should be less than the reference value (3V). If the probes do not detect any moisture or in case the moisture level is not up to the level required, the value obtained should be greater or equal to the reference value but less than or equal to Vin (that is in the range of 3V to 5V).

The working of water level indicator is same as moisture sensor. But the micro controller will send only the Boolean values to the user interface, that is, it will send '0' if water level is less, else it will send '1' if water level is equal to or above the reference value.

The rain sensor directly sends the Boolean values to the micro controller to notify the rain status.

The battery level indicator simply returns the battery level (for AWWS it will be 12V).

10. CONCLUSION

The Automated Wireless Watering System is a user friendly system, which notifies the user about its status. The 2 modes of operations provide the user with the option of automatic and manual process. The system also provides the log file of the events carried out.

11. FUTURE SCOPE

In a developing country like India, the energy and water crisis have increased. This system can be designed at a larger scale, so that it could be used in the agricultural field, with an objective of reducing energy consumption and wastage of water to a certain extent.

12. ACKNOWLEDGMENTS

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