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Implementation and Utilization of Automatic Watering System

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Abstract – In the electronics era, the smarter approach of leading a life should be carried out and thus human have made ‘’ Automated Plant Watering System’’ for smarter irrigation. Automated Watering System will regulate water flow in soil without much intervention, while maintaining moisture of plants. This research automatically turns ON or OFF by detecting the water content in the soil using the soil moisture sensors. An automated irrigation system will not only minimize the excess wastage of water but also imply reduction of labour and other overheads. Precise and economic water useage is very important issue for irrigated farms. The methods for irrigation scheduling are classified into several approaches based on soil water measurements, soil water balance estimates and plants stress indicators, in combination with very sophisticated methods. The control system is developed on the basis of sensor and Arduino UNO controller. The system works on the principle of measuring the soil level by means of the sensor technology which in turns controls the water pump via microcontroller in order to provide the plant enough amounts of water when necessary.

Keywords – Watering System, Irrigation, Soil Moisture Sensor, Arduino UNO, Water Pump

I. INTRODUCTION

In our day to day life, water is very essential. It is considered to be basic need of human beings, animal, plants etc. Todays, water shortage is becoming one of the biggest problems in the world and there should be a solution in this kind of problem, it is no other than water conservation. We have different methods developed for the conversation of water. Plants are also essential to human life. The food we eat, medicine, fiber which can be manufactured to fabric and clothing can also be provided by plants. It also acts as setting chambers for particulate pollutions. Like us, plants also need water in order to make their food. Water is considered one of the basic needs for plant growth. Keeping the plant property watered is important to its health. In the world of advance electronics, life of human beings should be simpler hence to make life more simple and convenient. And, 85% of worldwide available water resource is used in agriculture and this percentage will not decrease keeping in mind the rate of population growth and hence leading to high of food. It is high time to create and implement new methodologies using smart technologies for agriculture. This research is a mini model for gardening purpose at home which contains two modules-one for measuring soil moisture content in soil and the other for detecting water level in tank. This model showsthe basic switching mechanism of Water motor using sensor from any part of field by sensing the moisture present in the soil. The system of controlling irrigation facility helps millions of people.

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II. APPROACHES FOR IRRIGATION SCHEDULING

Bases upon the soil moisture level in the root zone, water balance in the root zone, and analysis of the health of the crops, there are several approaches developed an optimal irrigation schedule. In the following sections, it discussed different approaches and their applicability by the farmers. This system need to discuss the following title:

(a) Soil indication
(b) Soil water balance
(c) Computer models and remote sensing

2.1. Soil Indication

In this approach, water content of the soil are determined either by direct measurements e.g., gravimetric method or by sophisticates approaches e.g., densitometers. By knowing a minimum level of water content for each soil and crop type, irrigation water is applied to refill the root zone to field capacity before the water contents deplete below the minimum level.

2.2. Soil Water Balance

Water balance approach for scheduling irrigation (Specty and lsberie, 1996) is of paramount importance which leads to develop the mathematical models. In this approach, the main objective is to obtain a balance of inflow and outflow of soil water. Inflow includes incoming water in the form of rainfall or irrigation while outflow include water removal in any form predominantly in form of evapotranspiration (Kerry Harrison, 2009). Irrigation scheduling by the water balance approach is hence based on keeping a balance of soil water content. The main limitation of this method is its reliability as irrigation scheduling is based on estimates (e.g., evapotranspiration) which not necessarily be accurated. Therefore to implement this method, it is necessary to determine the soil water contents in the field and compare them to the calculated contents.

2.3. Computer Models and Remote Sensing

Although computer models are based on soil water balance or soil indicators approaches, these models are being used widely for irrigation scheduling (Pereira et al., 1995). These models ranges from simple to sophisticated approaches which require several inputs e.g., weather data, phonological conditions of plants. The uses of models present serious difficulties in real time application because they require validation, support advisory services, and training of irrigation managers, farmers and extensions workers.

2.4. Applied Components

The main components of Automatic Watering System are;

- Arduino UNO(AT mega 328P microcontroller)
- 12 V DC Water Pumps
- Soil Moisture Sensors
- Ultrasonic Sensor (HCSR-04)
- Relays
- 16*2 LCD Display

2.4.1) Arduino UNO

The Arduino UNO is a widely used open-source microcontroller board based on the ATmega 328P microcontroller and developed by Arduino. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. Table 1 show the Arduino UNO Specification.

Table 1. Specification of Arduino UNO

Operation Voltage	5V
Digital I/O Pins	14(6 provide PWM output)
PWM Digital I/O Pins	6 Pins
Analog Input Pins	6 Pins
DC Current per I/O Pin	20mA
DC Current for 3.3V Pin	50mA
LED BUILTIN	13

2.4.2.DC Motor

The main advantage of DC (direct current) pumps over AC (alternat.0ing current) pumps is that they can operate directly from a battery, making them more convenient and portable. Specification of DC Motor is shown in table 2.

Table 2. Specification of DC Motor

Operation Voltage	DC12V
Power Consumption	3.6W
Working Current	450mA
Size	38×30×24mm

2.4.3. Ultrasonic Sensor

HC-SR04 distance sensor is commonly used with both microcontroller and microprocessor platforms like Arduino, ARM, PIC, Raspberry Pie etc. The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor, this reflected wave is observed by the Ultrasonic receiver module as shown in figure-1. Table 3.show the Pin Description of Ultrasonic Sensor.

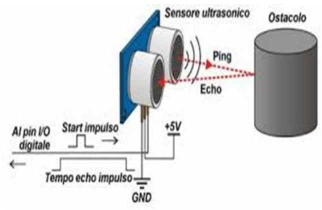

Figure-1 Working Principle of Ultrasonic Sensor

Distance = Speed Time/2 (1)

Table 3.Pin Description of Ultrasonic Sensor

Pin No	Pin Name	Description
1	Vcc	The Vcc pin powers the sensor, typically with +5V
2	Trigger	Trigger pin is an Input pin. This pin has to be kept high for 10us to initialize measurement by sending US wave.
3	Echo	Echo pin is an Output pin. This pin goes high for a period of time which will be equal to the time taken for the US wave to return back to the sensor.
4	Ground	This pin is connected to the Ground of the system.

2.4.4. Soil Moisture Sensor

Soil moisture sensor measure the volumetric water content in soil. A soil moisture sensor probe is made up of multiple soil moisture sensors. Technologies commonly used in soil moisture sensors include:

(a) Frequency domain sensor such as a capacitance sensor.
(b) Neutron moisture gauges, utilize the moderator properties of water for neutrons.
(c) Electrical resistance of the soil.

Table 4.shows the Specification of Soil Moisture Sensor.

Table 4. Specification of Soil Moisture Sensor

Power Supply	+5 V DC
Working Current	20 mA
Interface Type	Analog
Working Temperature	100 C ~ 300 C

III. System Cosideration

This part includes the system block diagram, circuit diagram and operation, flow chart of the ultrasonic sensor and flow chart for soil moisture sensor.

3.1. Block Diagram of Watering System

This system consists of many components and sensor such as relay, dc motor, water pump, soil moisture sensor, ultrasonic sensor and Arduino Uno. Arduino Uno is used as a programmable controller board to run the hold cleaning process. Water pump is used for watering. Soil moisture is used for sensing the water moisture. The overall block diagram of the automatic watering system is shown in figure 2.

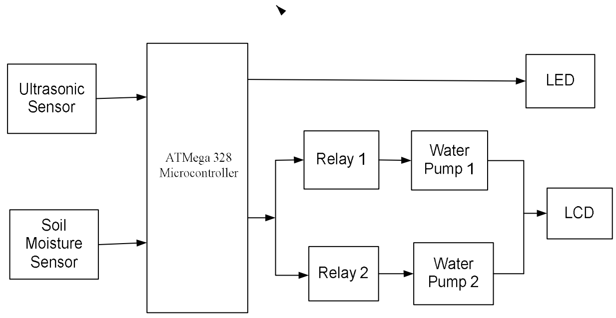

Figure -2 Block Diagram of Watering System

3.2. Circuit Diagram and Operation

Firstly the ultrasonic sensor is connected to digital pin of D11 and D12 for water level sensing, two moisture sensor is connected to analog pin of A3 and A4 pin of Arduino for soil moisture sensing, relay 1 and relay 2 are connected to D13 and D6 for pump to watering LED red, yellow and green are connected to D2, D3, D4, D5, D6 and D7 for displayed the moisture level condition.The circuit diagram of the system is shown in figure 3.

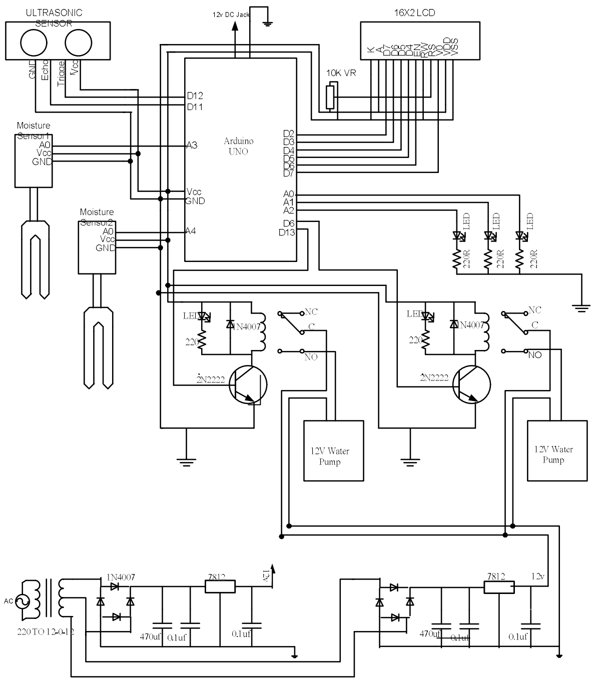

Figure-3 Circuit Diagram of Automatic Watering System

When the power is turned On ultrasonic sensor is sensed the water level, if level is low red LED is ON, if level is middle yellow LED is ON and red LED is OFF and if level is full green LED is ON, red LED and yellow LED are OFF. Then the two moisture sensors are sensed the signal from regarded soil, if moisture sensor 1 value is lower than the regarded moisture level, relay 1 is ON and pump 1 is start to watering and moisture level is reached the regarded level 1 is OFF and watering process is completed for soil moisture 1 sensor. As well as moisture sensor 2 value is lower than the regarded moisture level, relay 2 is ON and pump 2 is start to watering and moisture level is reached the regarded level relay 2 is OFF and watering process is completed for moisture 2 sensor.

3.3. Flow Chart for Ultrasonic Sensor

Ultrasonic sensor is used for sensing the distance as shown in Figure 4.

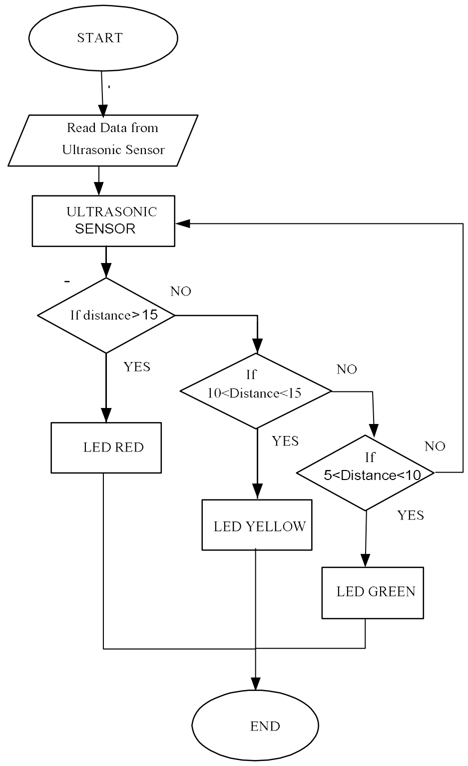

Figure-4 Flow Chart for Ultrasonic Sensor

3.4. Overall Circuit Design

Figure 5 shows the overall system of the watering system.

Figure-5 Circuit Operation and Pin Layout

3.5. Flow Chart for Soil Moisture Sensor

The soil moisture sensor senses the moisture of soil and the block diagram of is in figure 6.

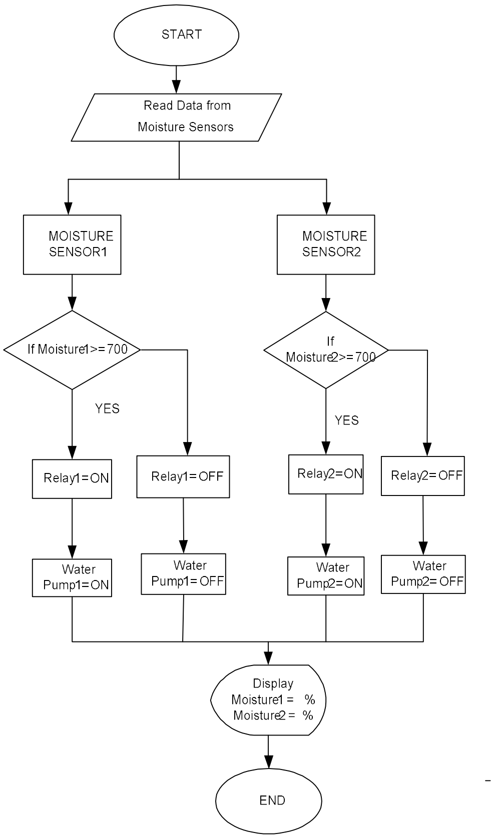

Figure-6 Flow Chart for Soil Moisture Sensor

IV. Test And Result

This section includes testing the water level and sensing the moisture of soil.

4.1. Water Level Testing

When the power is ON, ultrasonic sensor is started to sensing the level of water. The sensor signal is continuously sending the data to arduino. If the water level is above 15 cm from the sensor, the Green LED is ON as shown in figure 7.

Figure-7 Water Level Testing condition (Stage 1 – Green LED)

And then, the water level is up to 10 cm from the sensor, the Yellow LED is On. Lately, the level of water reaches to 5cm from it, the Red LED is ON. The water level testing condition stage 2 and 3 are shown in figure 8 and 9 respectively.

Figure-8 Water Level Testing condition (Stage 2 - Yellow LED)

Figure-9 Water Level Testing condition (Stage 3 – Red LED)

4.2. Sensing the Soil Moisture

When the soil Moisture sensor is sensing the soil, the datas are reached the arduino and then it sent back to ralays. In this thesis, relays are used as a limit switch to control the 12V water pump DC motor. If soil moisture is reached above 700 percentages, relay is ON, then motor run for irrigation process. The soil moisture is reached below 700 percentages , the relays is OFF, then water filling motor will stop.

Figure-10 Sensing the Soil Moisture -Sensor 1

Figure-11 Sensing the Soil Moisture- Sensor 2

V. Conclusion

This cannot doubt about the advantages of all the approaches by different researchers, however the main issue elaborated from the above discussion, is the identification of the end user for a particular approach. Same are real for the simulation irrigation schedule models. But if the irrigation schedule model has to be implemented by the water managers in the region, the solution will be easy. This research uses the simulation models based upon soil indicators or water balance approaches and this can also use the remote sensing techniques depending upon the complexity of the simulation.

The results of the system are to get knowledge how to use modern technology in agricultural fields, to design an embedded system which can completely help the gardeners, to know about the irrigation application, to reduce the physical causes and inconvenience, to maintain the loss/ frequent damage of irrigation equipment, to control the wastage of water and electricity.

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