A Low-Cost Arduino based Automatic Irrigation System using Soil Moisture Sensor: Design and Analysis

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Abstract— A low cost Arduino based Automatic Irrigation system using Soil moisture sensor is presented in this paper in which the soil moisture sensor gives it's output depending on the conditions of the soil and later with the help of Arduino it get's worked. As agriculture is given higher priority in the life of an economy so for the better agricultural growth, water is essential factor. Lack of enough water and excess of water leads to damage of plants. So we need an effective and efficient technology for better farming. Thus, the usage of a low cost arduino based automatic irrigation system using soil moisture sensor is expected to be useful to for the irrigation process in agriculture. This system requires an Arduino-UNO which contains ADC converter in it. A soil moisture sensor is the main component in this system which is used to measure the conditions of the soil like whether the soil is dry or wet. For displaying the conditions of the soil, 16x2 LCD display is the better choice to display and at last a motor is used to pump the water to the plant or crops.

Keywords—Agriculture,Arduino,Irrigation,Soil moisture sensor

I. INTRODUCTION

Now-a-days it's been a big challenge for conservation of the water as nearly 80% of the water present on the earth is used for agricultural purpose. As population is increasing day by day, the demand for food never dies and so some smart technologies have been implemented for the better agricultural growth. Considering the electronics region, many smart projects have been implemented for agricultural purpose and one of them is A Low Cost Arduino based Automatic Irrigation System using soil moisture sensor. It automatically turns ON/OFF depending on the conditions of the soil. If the soil is in dry condition, then the motor turns ON automatically and in case if it is in Wet condition, then it automatically get's turned OFF. An Automatic Irrigation system not only turns ON/OFF depending on the soil conditions but also reduces the human interference and human labour towards the work. It also saves the time and also the water as excess water leads to damage of the crops.In case if an LED is used then it also blinks depending on the soil condition.

This paper consists of six sections as mentioned below-Section II sum ups the literature review on the existing systems. Section III explains about the hardware used in this project. Section IV elucidates the methodology of the proposed work, in Section VI results of the proposed system have been discussed, Section VII gives conclusion and future scope and at last references are listed.

II. LITERATURE REVIEW

Many of the researchers have been trying to implement the agricultural field by providing sufficient water and also to save the remaining water. In order to improve the product of agriculture, some of the technologies has been implemented in different methods that are mentioned here in the paper.

Wireless sensor technology is the trending technology at present and usage of this wireless sensor techniques and wireless communication standards over traditional methods gives the better growth in agriculture [1]. Irrigation method can be controlled with the help a program from which the sprinkler's geographic location can be identified by using a GPS and later it can be communicate it wirelessly to base station [2].Remote monitoring systems are one of the use in agricultural field which improves the productivity of agricultural field in which wireless protocol plays a key role for agricultural monitoring [3].Another efficient method is to send the feedback to the system after the completion of irrigation process in which water will be monitored using wireless sensors [4].This automatic irrigation method also includes a microcontroller in which the sensing module is interfaced and also GSM module also exists [5]. The conditions of the soil can be identified using soil moisture sensor and temperature through temperature sensor. It's output is then fed to microcontroller and later with the help of relay motor can be turned ON and the water pumps to soil [6].An LCD is also used for displaying the conditions. For updated notifications a GSM module is accomodated so that the concerned person would be able to know the present status of the field [7].

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III. HARDWARE DESCRIPTION

i) Arduino-UNO

Arduino can be defined as a platform which has integration of both software and hardware.

Features

Atmega-328 is used in Arduino It is an 8bit micro controller containing 28 pins

1. Arduino consists of a crystal oscillator, voltage regulator and an ADC
2. It can be operated on an external supply of 7-12v
3. There exists 14 digital input and output pins in it.
4. There will be 6 analog pins where each pin provides 10 bits resolution.
5. Arduino can interact with both software and hardware where program can be typed,executed and can be uploaded to the board with the help of software called Arduino Integrated Development Environment (IDE).

The key features are:

1. Arduino boards produces output in form of activating a motor or glowing an LED by reading analog or digital inputs form various sensors.
2. There is no need of any extra piece of hardware for loading the new code onto it.
3. USB cable can be used for loading the code to hardware and another main feature is this software used C++ version which makes easier to understand the program.
4. Atlast,Arduino provides a standard form factor which is used to break the functions of microcontroller into a more accessible package.

Technical specifications-

Parameter	Value
1. Operating Voltage	5V
2. Recommended Input Voltage	7-12V
3. DC Current on I/O Pins	40 mA
4. DC Current on 3.3V Pin	50 mA
5. Flash memory	32KB
6. SRAM	2 KB
7. EEPROM	1 KB
8. Frequency (Clock Speed)	16 MHz

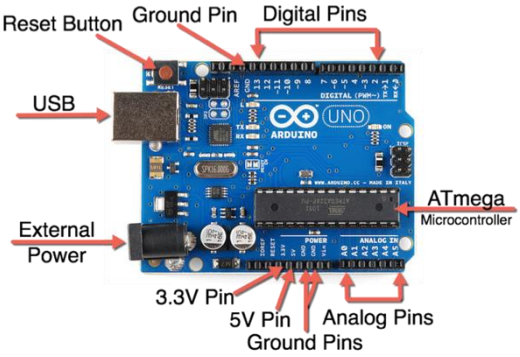

Fig.1 Arduino-UNO

ii) Soil Moisture Sensor

A soil moisture sensor is an electronic device which is used to determine the volumetric quantity of water content in the soil. Based on the property called electrical resistance or dielectric constant, this soil moisture sensor determines the moisture content in the soil. This soil moisture sensor is made up of Nickel because nickel has best conductivity and it will not get corroded in the soil even if it used for a long purpose. So it can be used for long purpose.

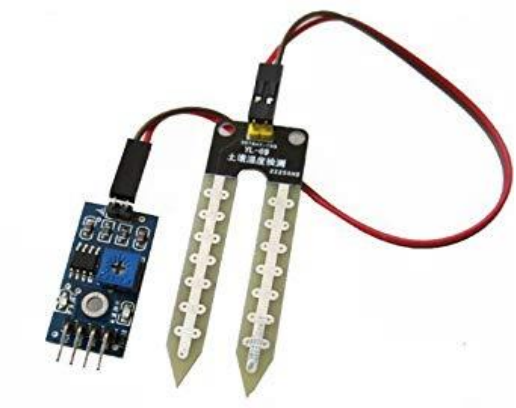

Fig.2 Soil Moisture Sensor

iii) Relay Module

This relay can be defined as an electromagnetic switch which is used to turn ON/OFF a much larger current. Relay consists of an electromagnet which is a coil of wire and it behaves like a temporary magnet whenever an electricity pass through it.

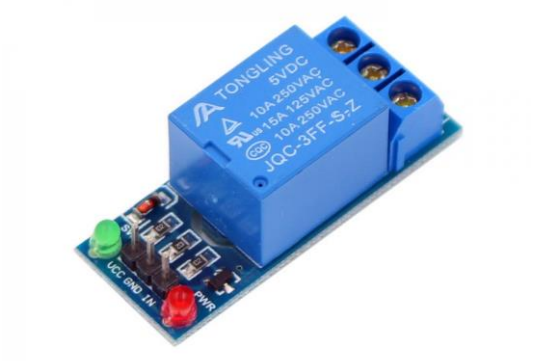

Fig.3 Relay Module

iv)D.C 12V Brushless Motor

Here it is used to pump the water to the soil. Generally an electrical energy can be converted into the mechanical energy with the help of motor as it is an electrical machine and later pump is used to convert mechanical energy into form of work done.

Fig.4 D.C 12V Brushless Motor

v)LCD Display

Liquid crystal display(LCD) is a combination of both liquid and solid which is used to produce an image that is visible and also to display the content in digital watches,portable computers etc…It is made up of two polarizing sheets and a liquid crystal solution in between them. This LCD can be used with arduino by interfacing it with the arduino.

Fig.5 Liquid crystal display showing the status of the field.

IV. METHODOLOGY OF THE PROPOSED WORK

The below block diagram explains the working of the system. Generally when an Arduino receives the power supply, then soil moisture sensor get's activated. When the soil moisture sensor is dipped in the soil, it determines the conductivity of the soil using the two prongs and the wet soil is more conductive than dry soil. This soil moisture sensor consists of a comparator in it and it compares the measured voltage with the pre-defined voltage and this analog output is given as input to analog pin of Arduino. When the moisture level in the soil is less than the threshold value then the pump turns ON automatically and water flows to the soil and incase if it's more than the threshold then it automatically turns OFF. An LCD is also connected to the Arduino in which the status of the field will be indicated over there.
An Arduino IDE software can be used here for programming.

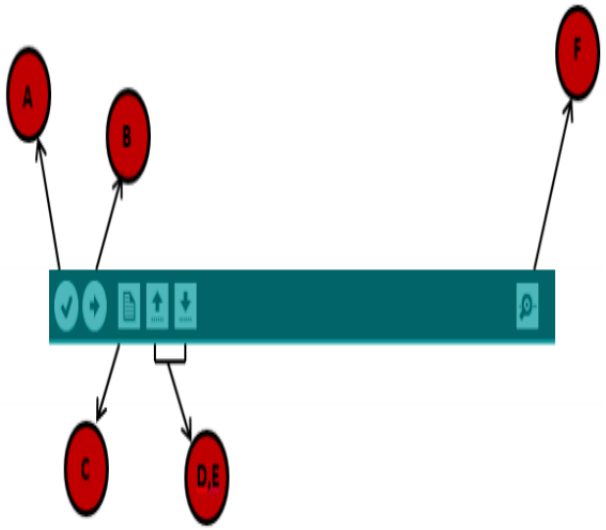

Fig.6 Arduino software

A→ Used to predict the compilation error.
B-> Program can be uploaded with this.
C→Used to create a new sketch and this is the shortcut form.
D->One of the example sketch can be opened directly.
E->Sketch can be saved by using this.
F→This is for serial monitor which is used to receive serial data from the board and send the serial data to the board.
Next click the "Upload" button in the environment and then Wait for few seconds.If the upload is done successfully, then message "Done uploading" will appear in the status bar.

A.Block diagram of the automatic irrigation system

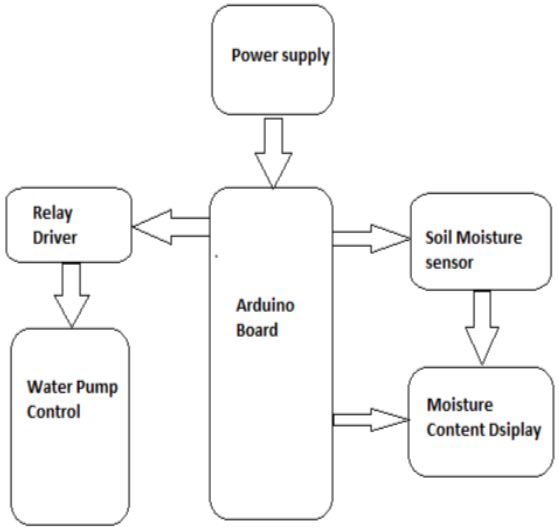

Fig.7 Block diagram describing the automatic irrigation system

B.Flowchart of an automatic irrigation system

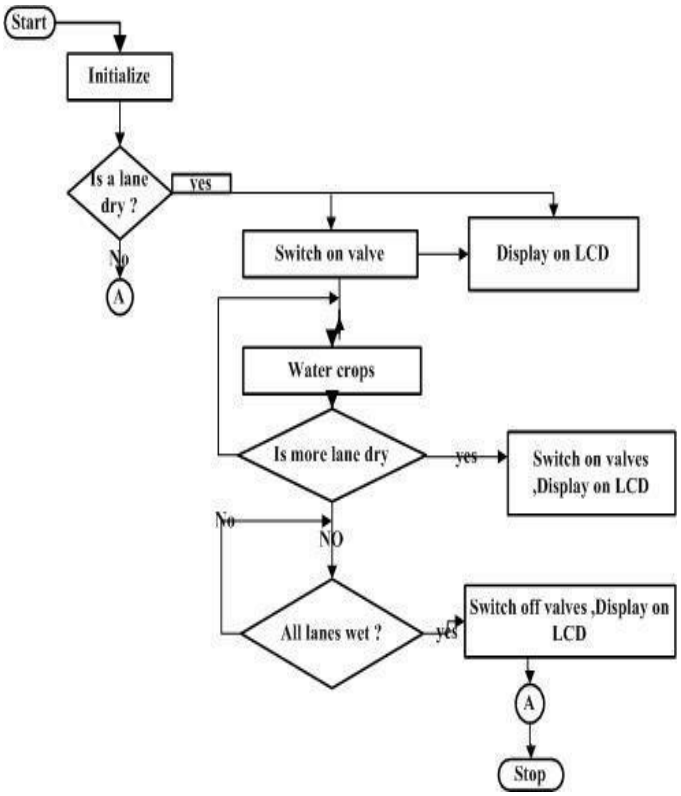

Fig.8 Flowchart of an automatic irrigation system

C.Arduino Code for an Automatic Irrigation system

```
#include<LiquidCrystal.h>
int val;
 int relay = 7;

LiquidCrystal Lcd(12,11,5,4,3,2);
void setup()
{

 Lcd.begin(16,2);
 pinMode(A0,INPUT);
 pinMode(relay,OUTPUT);
}
void loop()
{
val=analogRead(A0);
 Lcd.setCursor(0,1);
 Lcd.print("moisture is:");
 Lcd.setCursor(13,1);
 Lcd.print(val);
          Lcd.setCursor(0,0);


 if(val<700)
 {
  Lcd.print("pump is off");
  digitalWrite(relay,HIGH);
 }
 else
 {
  Lcd.print("pump is  on");
  digitalWrite(relay,LOW);
 }
 delay(1000);
}
```

V. RESULTS AND DISCUSSION

After implementing the proposed system, an experiment has been performed to check the conditions of the soil on different days which is mentioned in the bar graph below. It shows that when a plant is watered manually it consumes more amount of water and when it is done using sensor, it consumes less amount of water. Fig.9 shows the representation of the experiment performed on different days. This watering is done considering different parameters like weather conditions, type of plant and type of soil. If the weather is cool then it requires less amount of water and incase if it is hot it then requires more amount of water per a day. As represented in the graph, if watering is done manually then there occurs more consumption of water and water loss will be very high. In that case, when watering is done manually then an excess amount of water may lead to death of plant too. If an Arduino and a soil moisture is used then according to moisture conditions watering will be done automatically. It also consumes enough amount of water only. No excess water occurs and there will

be no wastage of water and it can be saved for future use. Also depending on the type of soil watering will be done, for suppose black soil needs 3 litres of water per day. Likewise depending on type of plant and type of soil watering can be done.

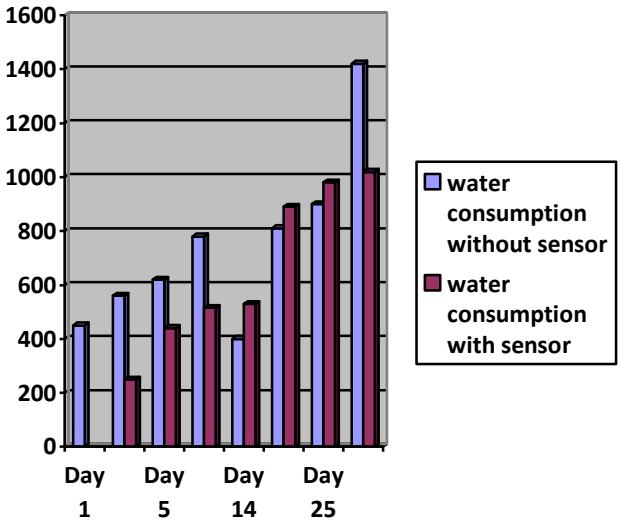

Fig.9 Bar-graph showing the result of the experiment

VI. CONCLUSION

An Automatic irrigation system is implemented which is an effective and efficient system for irrigating the plants and also to save the water for future use. This system is very volatile and can be developed in an easy manner and also according to various types of plants and various types of soil it can be adjusted without any human efforts. This system mainly reduces the human interference and also saves the energy. Apart from those, it requires low maintenance and also less cost. So much amount of water can be saved by using this automatic irrigation system. This automatic irrigation system can be put out to a bigger level as this is restricted to farming at home. After this irrigation is done then a person needs to know whether this irrigation has done or not. In order to meet this requirement, this can be extended using GSM module which sends messages to the certain person after the completion of process. So that the certain person could be able to know the conditions of the field time to time. If incase this system is used in larger area for suppose consider an acre then it costs nearly 50,000/- for that large area.

VII. REFERENCES

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