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Development of A Laboratory-Based Automated Irrigation Prototype

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ABSTRACT: Advanced technology plays significance roles in the field of agriculture. Daily activities associated to farming or garden watering is the most essential cultural and the most labour intensive task. Automation is a technology in which a device is used to execute a specific task without human involvement. The research aimed at developing a laboratory-based automated irrigation system which will serve as teaching aid for students and farmers in order to save energy, conserve water and give required amount of water to the plants when needed. This project uses soil moisture sensor, Arduino Uno, relay module, DC motor and battery. The switching ON/OFF of the motor pump is based on the moisture content or the dryness level of the soil. The sensor values of the system range are 0<SV<300 (start irrigation) and SV≥300 (stop irrigation). If this system is replicated and used on the farm, it will help farmers enjoy having plants irrigated without necessarily going to the farm. It will also solve the problem of forgetfulness or omitting an irrigation schedules.

KEYWORDS: Irrigation, Smart, System, Technology

1. INTRODUCTION

Agricultural irrigation is the artificial application of water to the soil or land for the purpose of crop production and maximization of yield. Irrigation has been a central feature of agriculture for over 5,000 (Five Thousand) years worldwide [1]. It has become a standard developmental system in mechanization. Rain fed agriculture has been the major solver of agriculture irrigation problem. But it has become a problem of allowing food availability all round year because of the problem of the impromptu drought. Time, human power and transportation has been the problem farmers encounters in handling irrigation operation, most especially the manual system of irrigation [2], [3]. Also availability of land and other irrigation components to serve as teaching aid in schools has also been challenging talk more of smart irrigation system.

In busy day to day life, many people forget to water their plants, consequentially subduing plants to suffer many disorder that perhaps, leads to loss of crops [4]. Inadequate water supply to the farm has also reduce crops yield. Different types of irrigation system are being practiced to supplement water shortage during drought period to improve crop yield and minimize consequential damages incurred from lack or insufficient moisture in the soil for plant uptake [5], [6]. Effort has been made via application of different methods of irrigation. It somehow tends to be time and money consuming since it has to be done either in the morning or evening and on daily basis depending on the crop-water-requirements of the crop under consideration [2]. Therefore, there is need for many automated systems that are capable of replacing or reducing human effort in their daily activities [7], [8]. The study aimed at developing laboratory-based smart system of irrigation using Arduino UNO module. The laboratory based Smart system of irrigation that simulates on-land obtainable practices of irrigation where farmers frequent visit to farm will not be required, and the problems of daily transportation to the farm for irrigation purpose will be curtailed. It will also go a long away in reducing irrigation-induced stress on labourers and irrigation water management will be maximized.

2. MATERIALS AND METHODS

2.1 Materials and Functions.

Aduino Uno model; an open source platform used for electronics project was used to write and upload computer code to the Arduino physical board. Soil moisture sensor; was used to measure the dampness or moisture content of the soil. The soil moisture sensor was used to measure the loss of moisture overtime due evaporation and plants used. Micro water pump: was used to pump or give out required amount of water when activated or switch on. Jump wires: Are simple wires that have connector pins at each end. The jumper cables were used to connect two points to each other without soldering. Bread board is an easy to use piece of hardware for electrical circuits which was used for making connections where appropriate. Relay module served the purpose relay is an electrical main voltage switch. This means it can be turned on or off to allow or deter the flow of current through it. So in this development a relay was used to turn on/off the motor pump. Bucket was as reservoir or source of water from where

the water pump was used to pump water from when activated during the simulation. Flower plant in a pot was flower port which contain soil and a plant was used as experimental plot; where soil moisture sensor was placed to sense the dampness of the soil. Pipe or hose: a delivery hose was used as a water channel to irrigate the plant when needed.

2.1 METHODS

For the purpose of developing the smart system of irrigation using Arduino Uno necessary connections was carried out for automation of the operation. A soil moisture sensor made up of three jumper cables was connected to the Arduino board via analog pins of the physical board as shown in Figure 11 so that whenever the moisture content of the soil depletes, it sends signal to the microcontroller which is the brain of the Arduino board. Similarly, a relay module which is an electronic switch was connected to the Arduino board to drive or activates the pump whenever the microcontroller send signal to the relay. A program was code into the system using C++ language [9] embedded in an Arduino integrated development environment (IDE) software using version Arduino 1.8.13 as shown in Figure 1. The basic command in the programming was the sensor value (SV), which was in the range 0<SV<300 (start irrigation) and SV≥300 (stop irrigation) The power supply for the Arduino board was tapped via the laptop.

RUKE_jun05a | Arduino 1.8.13

File Edit Sketch Tools Help

RUKE_jun05a

```
int sms = A0;
int motor = 11;
int sv = 0;
int limit = 500;

void setup() {
  // put your setup code here, to run once:
pinMode(sms, INPUT);
pinMode(motor, OUTPUT);
Serial.begin(9600);

}

void loop() {
  // put your main code here, to run repeatedly:
sv = analogRead(A0);
Serial.print("moisture =");
Serial.println(sv);
//if (sv > 0 && sv < 300){
 if (sv < limit){
  digitalWrite(motor, HIGH);
  }
  else {
    digitalWrite(motor, LOW);
    }
}
```

Figure 1: Code for the Smart Irrigation system

2.3 Evaluation of the system

The two functional component of this project were the soil moisture sensor and the motor pump. The Arduino board was programmed using IDE software. The function of the soil moisture sensor was to sense the dampness of the soil. The

relay module drives the pump to irrigate the plants. The microcontroller of the Arduino Uno board controls the pump and monitor the moisture of the soil. The circuit diagram in Figure 2 shows how the Arduino was connected to the soil moisture sensor and a motor pump where jumper cables were used through the digital and analog pins of the physical board.

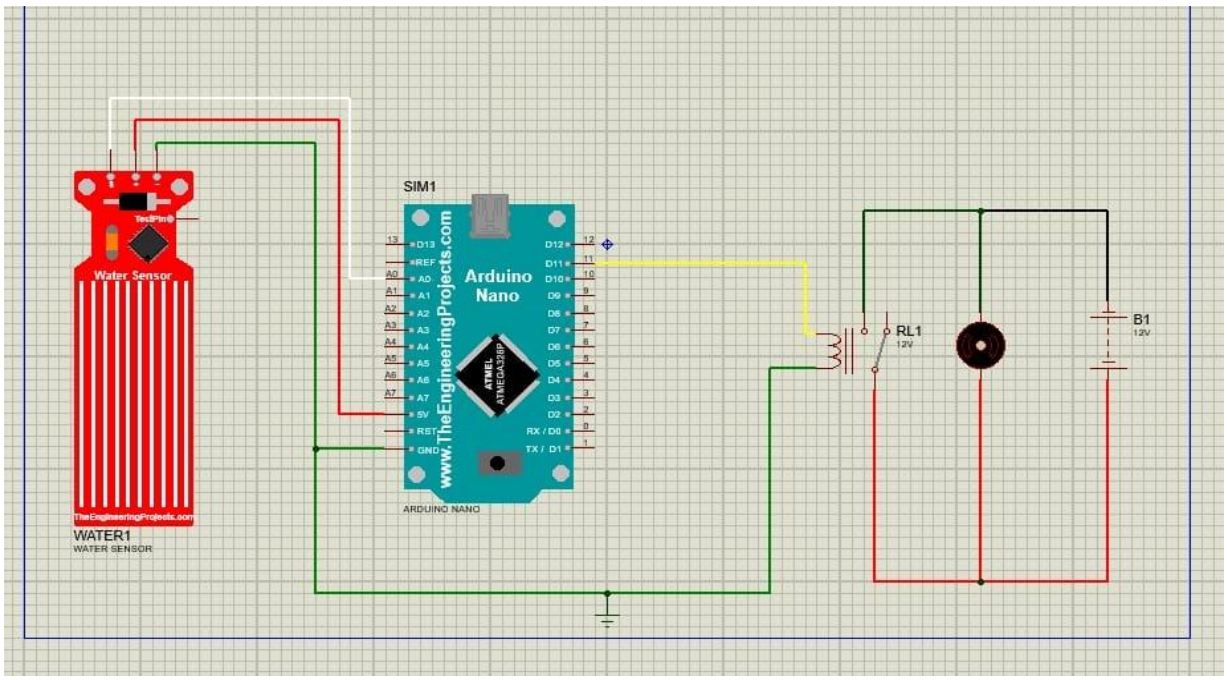

Figure 2: System Circuit diagram

3. RESULT AND DISCUSSION

Figure 3 shows the representation of the smart system of irrigation tested on the basis of microcontroller and Arduino sensor technology. The system among other aforementioned components consist of 9volt battery to power the pump. The program was uploaded into the Arduino physical board, the value of the moisture content of the soil began to show as sensed by the soil moisture sensor. When the value of the moisture content of the soil was less than 300 (i.e. sensor value greater than 0 and less than 300) as shown on Figure 4, The relay turned on the pump to start irrigating or dispensing water to the plant; when the value of the moisture content of the soil (sensor value, SV≥300 as presented by Figure 5, the pump will automatically switch off. The assigned or defined value can be changed in the program. The dryness value assigned was from 0 to 300 in which the relay will automatically switched on the pump.

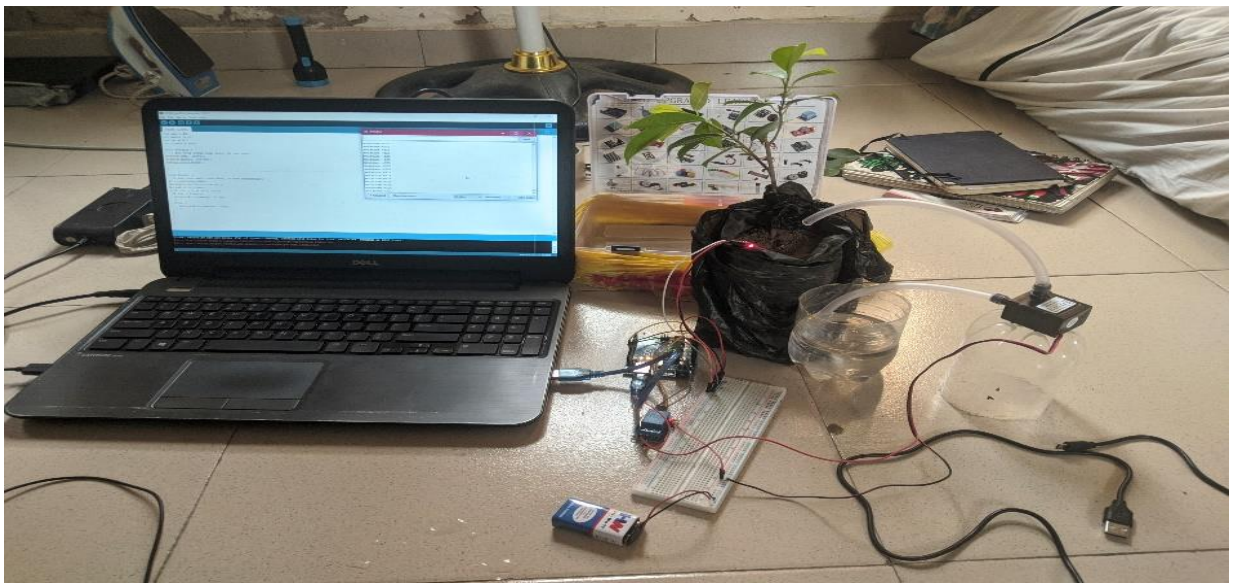

Figure 3: Completed Smart Irrigation prototype during Evaluation

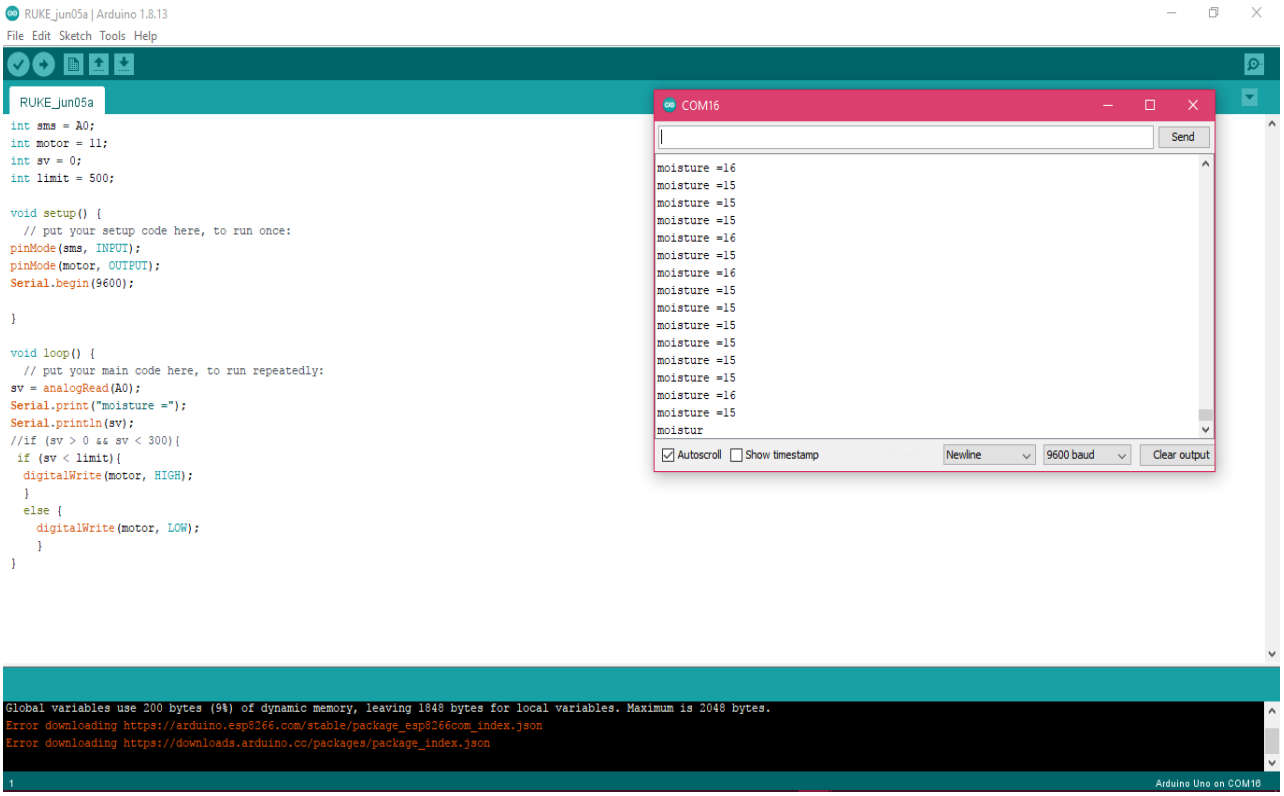

Figure 4: Soil moisture value below the assigned value

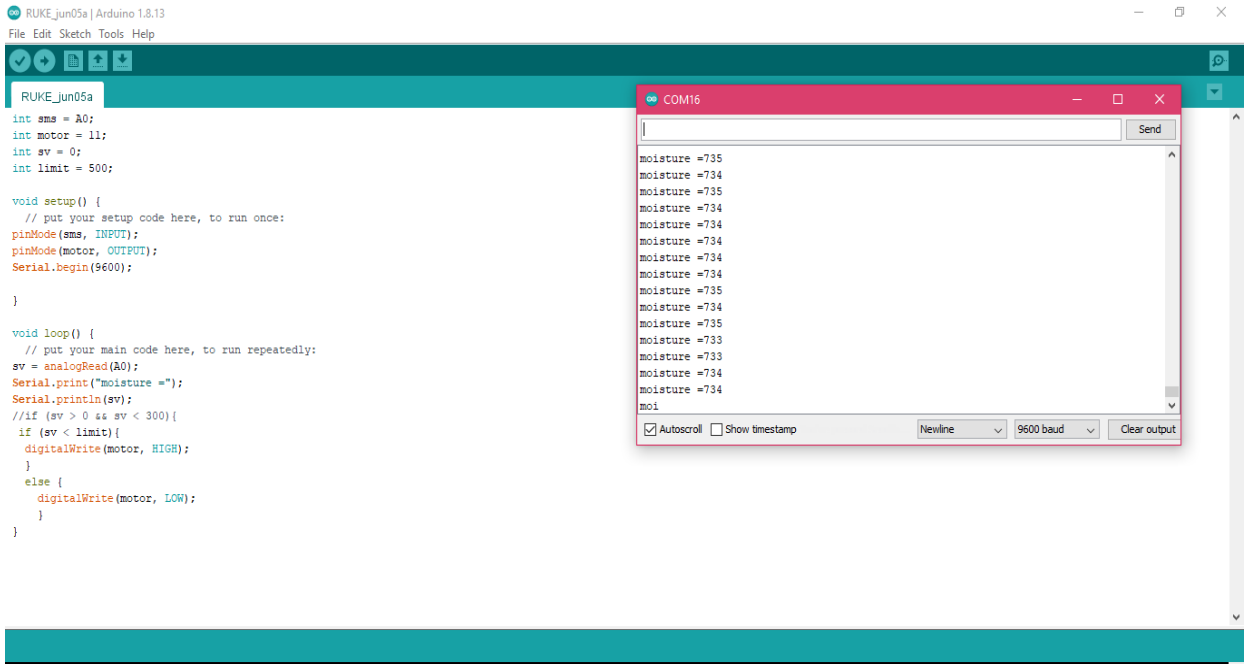

Figure 5: Soil moisture value above the assigned value

CONCLUSION

Laboratory based automatic system of irrigation using Arduino Uno was developed. The circuit consisted of Arduino Uno, relay module, soil moisture sensor, DC pump, and a battery (9v). This system uses signal from the soil moisture sensor to irrigate the soil to avoid excess or less water supply to the plant. The working principle of this prototype can be replicated on the farm to remedy and limit The frequent visit to the farm by farmers to irrigate their farm land. This research also shows that automated irrigation using soil moisture sensor requires less water, less energy or human power and time than the manual system of irrigation. The system is more convenient, efficient and user friendly as well. The main limitation of this research is that the prototype was developed and tested in small scale but when trying to put it in a real sense, it seems to have initial high cost of installation. However subsequent benefits cannot be over emphasized. The research therefore recommends that this technology be

utilized in large scale farming for the judicious use of water and optimal productivity.

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