Solar Powered Soil Condition Activated Irrigation System with Automated Bird Repellant

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Abstract. Irrigation plays a very important role in agriculture. Not all geographical regions utilize irrigation which is an important activity that is expensive. For the regions where irrigation is used, it commonly amounts to significant energy consumption. Traditional methods of farming are time-consuming and can only be efficient on a small scale. This project was implemented to make irrigation progressively inventive, easy to use, more efficient and cheaper than the current irrigation system and to solve traditional farming problems like an attack on crops by bird thereby increasing agricultural productivity. This system incorporates a soil moisture sensor to guarantee the application of water to soil adequately. It uses a PIR sensor and a buzzer to solve the problem of attack on crops by birds. This project is powered by a solar panel which is one of the cheapest form of renewable energy and environmentally friendly. The main objective of this project is to upturn the agricultural productivity of the nation by automating the irrigation process. Bird attacks on farmlands are also responsible for destroying a vast amount of crops. One of the traditional problems of agriculture is that farmers frequently neglect to water their plants; it can be as a result of inattentiveness or because of the fact that the farmers are far from home. The utilization of the soil moisture sensor limits the human presence. The microcontroller utilizes the real-time readings of the sensors and automates the irrigation and bird repellent process.

From the results, it was observed that the irrigation time was higher in totally dry clay compared to partially wet clay and wet clay respectively. For clay, the irrigation time is in order of magnitude dry clay > partial wet clay > wet clay of the irrigation other soil samples. For the loamy soil, the dry soil was higher. It follows the same trend as the clay in magnitude. It can be found in sandy soil that the wet sample was higher than the totally dry and partially wet sandy soil in terms irrigation time.

Keywords: Microcontroller, Sensors, Irrigation, Buzzer, Solar

1. Introduction

Agriculture is a sure way to the prosperity of a nation. Every region of the world which has developed a contemporary economy has done so by setting up a compelling establishment in agriculture. Almost 70% of Africa’s inhabitants are associated with agriculture. Therefore, agriculture remains Africa’s surest wager for developing comprehensive economies and creating decent employment opportunities(AASR). The bulk of Africa’s populace depends on subsistence farming (about 65%). In Africa, the average farmer is a woman with no fertilizer, no high yield seeds, no irrigation and no medication for the animals [6]. Agriculture is the major stream of income for the main part of the Nigerian family and it is an important division of the nation’s economy.

The agricultural sector is very significant to Nigeria’s economy, the importance of this sector cannot be exaggerated as it is a spur for the provision of food, a critical expansion to the gross domestic product, creating jobs, providing crude resources for agro-allied ventures, and creation of foreign wages. A sectoral examination of the genuine GDP (gross domestic product) conducted in 2006 showed that the agricultural segment of Nigeria has contributed about 41 percent of the GDP compared with the 41.2 percent it contributed in 2005. (CBN,2011) [1].

By the year 2042, the total populace is anticipated to increase to 9 billion individuals [2]. There will be an enormous challenge in providing abundant high quality and nutritious foods for such populace, particularly in the light of the pattern to utilize arable land for biofuel production. Also, with the traditional methods of agribusiness a few downsides like wastage of seed, ill-advised splashing of pesticide on yield so soil standard get corrupts likewise food end up unsafe to human body, if the major issue of water which is looking by every country, particularly India, Brazil, China, and South
Asian nations is just due to the inappropriate utilization of water and water management insufficiency [2].

Nigeria should be where food supply ought to be in abundance because of its vast Agricultural land. The atmosphere and soil in Nigeria support the development of numerous foods and cash crops. Regardless of all these, farming practices in Nigeria aren't comparable to what it used to be in time past, and the commitment of the Agricultural segment to the Nigerian economy is very low. This is because of a decent number of reasons. Some of which are:

1. poverty {insufficient funds and capital},
2. Bad road network{transportation},
3. poor power supply,
4. lack of modern farm machines{inadequate},
5. poor irrigation, fertilization, and drainage system
6. poor agricultural policies,
7. global warming. e. t. c

Despite Nigeria’s rich agricultural resources, the agricultural sector has been advancing at an incredibly low rate. Less than 70 percent of the country’s cultivable land is underdeveloped with rural and conventional agriculturists using simple cultivating techniques, with resultant low yields to build up or develop most of this land [3].

The primary objective of this project is to address the drawbacks of the current irrigation system, the difficulties of power utilization and water management for increased productivity in the agricultural sector of the nation by designing a solar powered soil condition activated irrigation system with automated bird repellent, clean inexpensive power supply for huge scale cultivating, helping agriculturists and the country overall. Solar energy is easily accessible, non-polluting and an encouraging means of diminishing the use of non-renewable energy sources and sustainable advancement [7-10].

2. Materials and method

The solar-powered soil condition activated irrigation system with automated bird repellent is designed to specific requirements. These requirements are categorized as follows:

i. Hardware requirements
ii. Software requirements

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2.1. Hardware requirements

The hardware framework is separated into two sections namely; the central control unit and the sensory units. The central control unit houses the majority of the components and is the brain of the whole framework. The sensory units comprise of the soil moisture sensor utilized for getting information about the soil moisture content and the passive infrared(PIR) sensor for getting information on motion that is movement of birds in the field. These sensors feedback the information to the central control unit remotely. The central control unit and the sensory unit are designed to be powered by a solar panel. The block diagram of the system is shown in the Figure 1 below
Figure 1: Block diagram of the system

Figure 2 below shows the circuit diagram of the system. It consists of all the components required to build the system and it shows how the systems circuit will be constructed.
2.2 Software requirement

This consists of the microcontroller programming of the ATmega238 using Arduino IDE software and a personal computer. The Arduino Uno is the microcontroller utilized for the construction of this project. It comprises of an Arduino integrated development environment (IDE), and it is programmed using C programming language. The microcontroller chip programmed is the Atmega238 chip. Outlined below are the functions of the programs;

i. Obtain information from the analog moisture sensors
ii. Signal conversion from analog to digital
iii. Read the digital signal
iv. Send control signals based on the read signal.

The Arduino programming workflow using the Arduino IDE is described below in Figure 3 and Figure 4.
3. Results of the construction of the project using soil samples

3.1 Construction

The construction of the power supply unit was carried out using a solar panel and a battery. The power supply unit consists of a 10watts solar panel and a 12volts battery. This unit supplies power to the soil condition activated solar powered irrigation system with automated bird repellent. Figure 5 shows the diagram of the power supply unit of the system.
Figure 5 Soldered components of the control and sensory circuit. This is the connection of the components of the system to a vero board. After testing the various components with a multimeter to ensure that they supply the required voltage and current for the system to function properly, and testing them together on a bread board, the components are connected to the Arduino and soldered to the vero board permanently.
Figure 6: displays the soldered components of the system to a vero board.

Figure 6 displays the system in the testing stage. When the components are connected to the Arduino and the Arduino is connected to the power source, the LCD screen comes on and displays a blank screen. When the soil moisture sensor is put inserted into a soil with low soil moisture the microcontroller sends an output to the DC pump which supplies water to the soil. When the soil moisture of the soil is normal the soil moisture sensor sends an output to the microcontroller which sends an output to the DC pump to cut off water supply. Also when motion is detected by the PIR (passive infrared) sensor the microcontroller triggers the buzzer which goes off. When motion is no longer detected by the PIR (passive infrared sensor) the buzzer goes off.
Figure 7: When motion is detected

Figure 7 displays the output of the system when motion is detected. When motion is detected by the PIR (passive infrared) sensor, the microcontroller sends an output to the buzzer which goes off and the LCD which displays “Bird alert”.

Figure 8: When irrigation is required

Figure 8 displays the output of the system when water content is low. When the soil moisture is low the microcontroller send output to the DC pump which supplies water to the plants and the LCD screen which displays “Smart Irrigation”.

Table 4.1 The reading of Soil Samples, Soil Type, Initial Soil State and Irrigation Time(Sec.)
| CATEGORY | SOIL SAMPLE | SOIL TYPE | INITIAL SOIL STATE | IRRIGATION TIME (SECS) |
|----------|-------------|-----------|--------------------|------------------------|
| A        | 1           | SANDY     | Totally dry        | 12                     |
|          | 2           | SANDY     | Partially Wet      | 10                     |
|          | 3           | SANDY     | Wet                | 6                      |
| B        | 1           | LOAMY     | Totally dry        | 20                     |
|          | 2           | LOAMY     | Partially Wet      | 13                     |
|          | 3           | LOAMY     | Wet                | 7                      |
| C        | 1           | CLAY      | Totally dry        | 30                     |
|          | 2           | CLAY      | Partially Wet      | 20                     |
|          | 3           | CLAY      | Wet                | 12                     |

**Figure 9: Chart of irrigation time against soil samples**
In Figure 9, it was observed that the irrigation time was higher in totally dry clay compared to partially wet clay and wet clay respectively. For clay, the irrigation time is in order of magnitude dry clay > partial wet clay > wet clay of the irrigation other soil samples. For the loamy soil, the dry soil was higher. It follows the same trend as the clay in magnitude. It can be found in sandy soil that the wet sample was higher than the totally dry and partially wet sandy soil in terms irrigation time.

4. Conclusion
The soil condition activated solar irrigation system with automated bird repellent was developed with the aim of addressing the drawbacks of the current irrigation system, the difficulties of power utilization and water management for increased productivity in the agricultural sector of the nation. To accomplish the objectives of this project, a solar panel was used to power the system, this empowers the system to work efficiently without requiring an AC source. Management of water is accomplished by the use of the soil moisture sensor which decides when the soil needs to be irrigated. The effectiveness of this system us that power is preserved in two ways:

i. The project is direct current (DC) controlled, and the system is triggered only when the microcontroller receives data sent from the sensory unit data.

ii. The system is totally powered by a solar panel.

The completion of this project work has brought about the following achievement:

i. Construction of an irrigation framework.

ii. Successful design and implementation of a Solar Powered Soil Condition Activated Irrigation System with Automated bird repellent.

iii. Designed to defeat current drawbacks of the irrigation system.

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