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Smart Automated Solar Irrigation System

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***Abstract*: Using solar electricity to irrigate agricultural land is the topic of this paper. Weighing in at a key part in a nation's economic growth, agriculture should be improved to boost production and improve crop quality along with its expansion and also enhance the productivity. An Auto-irrigation system employing soil moisture sensors has been developed. The sensors are coupled to the Arduino UNO, which acts as both a controller and a global mobile communication system. The represented research has been executed in real life practically and it was found that all the objectives were meeting as stated.**

***Keywords*: Sensor for soil moisture, GSM, Arduino UNO, Solar power.**

1. Introduction

Farming is regarded as undeniably the biggest work supplier in India. With the growing populace, there is a requirement for expanded horticultural creation. Due to the demand for additional water, the share of new water utilised in water frameworks has risen in order to enable more creation in farms. Agribusiness accounts for 83 percent of India's overall water use, according to official figures. Spontaneous usage of water results in water waste. An urgent need for frameworks that prevent water waste without putting pressure on ranchers is emphasised.

In the course of recent years, ranchers began utilizing PCs and programming frameworks to coordinate their monetary information and monitor their exchanges with outsiders and furthermore screen their yields all the more successfully. In the Internet period, where data assumes a critical part in individuals' lives, agribusiness is quickly turning into a very information concentrated industry where ranchers need to gather and assess an enormous measure of data from a different number of gadgets (e.g., sensors, faming apparatus and so on) to turn out to be more effective underway and imparting fitting data.

In the present scenario, irrigation systems are manually operated. To utilize the water proficiently and adequately, an idea of mechanized water system is presented. Sensor-put together water system framework is based with respect to soil dampness sensor that will gauge the degree of dampness in the dirt and push the sign to the Arduino and in like manner it will inundate the harvests. The Arduino plays the role of Micro-controller This will think about the qualities got from the dampness sensor with the predefined dampness levels previously put away in the framework. In view of the qualities got from the sensors, the Arduino will turn the water system framework ON/OFF.

2. Related Work

A. Literature Segment

The growing demand for energy, the constant depletion of existing fossil fuel sources, and the growing concern about environmental pollution has made the urge for the mankind to find out new renewable energy sources and non-conventional energy source for the generation of electrical energy, such as solar, wind, and other renewables [1].

Oman is blessed with sunshine throughout the year. As a result, putting it to use in other fields is a brilliant concept. Sun powered energy is the world's most bountiful wellspring of energy. Photovoltaic generating is a viable method of harnessing solar energy. A solar pumping system is easy to build and requires little maintenance, possibly every 5 to 10 years. This reduces the cost of the system, which is based on the original investment in the solar cells and equipment [1].

They on the main side, does not need energy from any non-renewable sources for their operation because they rely on the electricity from the solar cells. They also do not require non-renewable energy sources to operate because they rely on solar electricity. Because solar pumps do not rely on fuel or oil, they are considered quite and unsoiled device that do not produces any noise and pollution [3].

As a result, the technique is beneficial to those who live distant from water and electrical networks, as well as those who reside in cities [4]. The expense of sun based boards (solar panel) has been consistently diminishing which supports its use in different areas. In this paper we propose a savvy water system framework utilizing sun based force that helps in driving water siphons to next siphon and then it fills it to a tank from bore well and the power source valve of the tank is consequently directed utilizing the GSM and the Arduino UNO; and dampness sensor which regulate the speed of flow from the tank

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to the water system, therefore maximizing the use of water resources [6].

Android sophisticated mobile phone controller is suited for Arduino-based water robot system framework [7]. This structure, they argued, would be inexpensive and easy to implement. This framework, which is based on the Arduino UNO microcontroller, receives its information voltage signal from soil moisture sensors. The Arduino analyses the sensor data with a predetermined limit. By using the HC-05 module, the Arduino is connected to an advanced Android mobile through a remote. The user interface of the Android sophisticated mobile phone displays the received information (UI). The used User Interface provides a convenient control from remote for the irrigation with simple ON and OFF switch for the user [7].

According to Rawal and Sristhi [8], IoT (Internet of Things) advancements might be used to make agriculture more efficient. The feasibility of their assignment raises three problems. Furthermore, it was necessary to protect the harvests during rainy weather. For the same reason, the rainwater is being re-used for water system effectiveness. There was a water system with a high-pressure pump. Interfacing sensors, Wi-Fi module and GSM module to execute activity. As a result of the job plan, the rancher will have access to real-time information on his field via his mobile phone, as well as a reduction in water waste and human effort.

3. Methodology

For an effective irrigation system, the size of the water pump should be sized to the area of land being watered. Along these lines, at first we thought to ascertain the land region for water system and afterward select the appropriate water pump to watering on a specific region. Additionally, as for the sun based board, it ought to have the option to produce the appropriate measure of ability to work the water siphon and the control framework [9].

To start with, the framework executed to record stickiness information utilizing sensors of the soil as demonstrated at the edge of the framework dampness in the figure 1 along with figure 2 which shows the control and how it is customized to work in framework. The set condition for soil is dry or not is above 800, automatic message which be conveyed and Cell phone to siphon and it will turn on if the soil is more above 800 and turn off if the soil is less than 400 and the pump will be turned off.

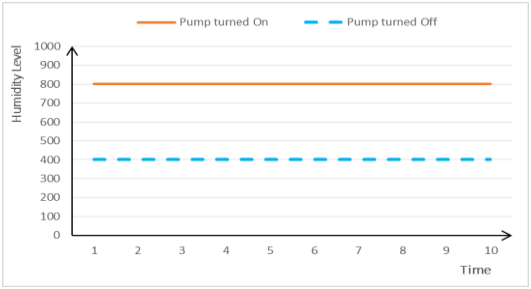

Fig. 1. Graph for the thresholds of perceived humidity represented by Humidity Level v/s Time chart

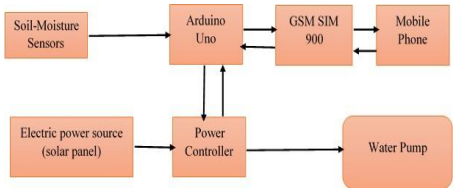

Fig. 2. Representation of the flow chart for the proposed system for smart irrigation

4. Components

A. Sensor to Check Soil Moisture

As Shown in the below provided figure 3, Sensors that assess volumetric water level are commonly referred to as soil moisture sensors. Such gadgets are used to amend the electric signs on the counter of real boundaries. The sensor also has the capability to catch signals of anything which is in the dampness of the soil.

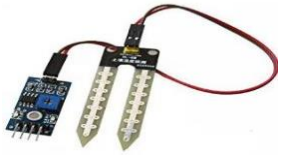

Fig. 3. Sensor for soil moisture

B. Arduino UNO

The below figure 4 shows the Arduino UNO, it is an open source electronic platform, UNO is a microcontroller board based on ATmeage328, and Arduino provides an application programming interface based on a programming language called Processing. In addition, it has a low power consumption rate, an extensive library and is quite flexible.

Fig. 4. Arduino UNO

C. GSM SIM 900 Arduino UNO's Shield

Figure 5 shows the GSM (Global System for Mobile Communication) symbol. 802.11 is the standard for GSM research. GSM Outdoors in cell phones, SIM 900 is a sophisticated transmitting and receiving device. In this project, the user (farmer) and the system communicated over vast distances to operate the farm.

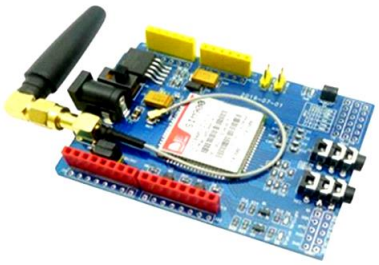

Fig. 5. GSM SIM 900 shield for Arduino UNO

D. Solar Panel

The below given Figure 6 shows a solar power panel, which converts sunshine and temperature directly into electrical energy. The solar panels utilised in this project are (185*250*5) and have a maximum power output of (5 W) [8].

Fig. 6. Solar Panel of 5Watt

E. Water Pump and Relay

Figure 7 is a DC water pump used to pump the water from one point to another. With (DC 12V) (4.2 W) (Qmax: 200L/H).

Whereas Relay is an electrically operated device, used in this project to control the operation of the water pump, shown in Figure 8.

Fig. 7. DC water pump (12V/4.2 W)

Fig. 8. Relay module

5. Implementation, Testing and Outcomes

This is the last stage of the project. Figure 10 shows the final stage of the project with all of its components, including the solar board, plants region size, electrical board with control system, hand-off switch, sophisticated mobile phone, LCD and GSM for Arduino. As stated in table-1, the system specification measuring has been taken into account when creating the system specification. Appendix: The system model had been coded into Arduino UNO and transferred to the microcontroller. The water system framework may be programmed to start or stop the water syphon when the moisture content reaches preset limitations, as illustrated in Figure 1.

As can be found in the index, the orders address the libraries which should be referenced first and foremost utilizing the order (incorporate). In all, there are total three libraries: one for the SIM900 component, another for the call function, and a third for the LCD which is connected through I2C. As a result, a number of key capacities emerged, including: (call GSM call). All of the following lists that begin with unsigned integers address the essential properties, but not the negative ones, and are arranged alphabetically. Orders like (unsigned int endeavor = 3) indicate that there are three attempts to call the enrolled client. (Boolean) indicates that there are two proclamations, True or False (1 or 0 in twofold).

Table 1
Specification table of the proposed irrigation system

Count no.	Elements	Use
1	Solar Panel	5W
2	DC Water Pump	12V DC
3	Size of plants land	0.4 square-meter
4	Arduino	5 V
5	GSM SIM900 shield	9V, Require SIM CARD,
6	Soil Moisture Sensors	4 sensors will be used
7.	Relay	NIL
* The system could irrigate land area of 1 square-meter		

Arduino is the brain of the system. In addition, it provides the framework's intelligent components. In this scenario, the water system is programmed and the client is semi-physically restricted by means of his mobile phone. A sun-oriented board provides 5 volts to the Arduino. The 4 Soil Moisture Sensors with a wetness range of 0 to 1023, showing extremely moist, very dried out soils individually. In a same geographical area, but at different positions, they provide four unique advantages of soil moisture. Then, transfer these data to the Arduino, which will compare these values with the limit values set by the client at the programming step and display the results. The edge was established in the following way: The water pump will turn on if two sensors indicate a relative humidity of more than 800; if all sensors indicate a relative humidity of less than 400, the water pump will switch off.

When two out of four sensors record stickiness information more than 800 (soil is dry), the Arduino should switch on the framework subsequently to flood the land till the four sensors record stickiness esteems beneath 400 (soil is moist) (soil is wet). As soon as a sensor detects that the soil is moist, it also displays it on the LCD screen and shuts down the siphon. When a client constrains a framework. It is conceivable that in the event that two out of four sensors record a moistness information of 800 or more (soil is extremely dry), the Arduino should send a text message to the rancher GSM SIM900 then, at that point the rancher should get instructing him/her to turn on a water syphon, as shown in Figure 9. There will be an automatic shut-off of the system when the sensors record a moisture value of less than 400 (soil is extremely wet).

A. Permeability of Clay Soil

As shown in the diagram below, the soil dampness sensors report the soil's moisture content every five seconds. Ion the above table, the last column shows the value for average humidity for all the 4 sensors which have been taken in use is shown in the figure 9.

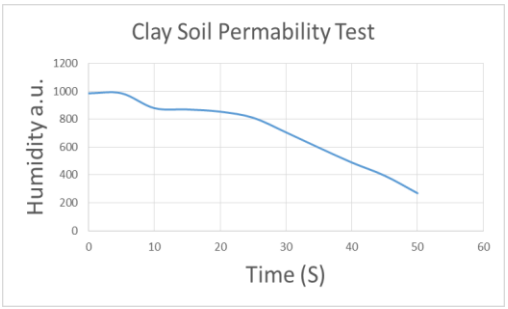

Fig. 9. The average value of humidity perceived by the four sensors in clay soil

B. Sandy Soil Permeability

Each of the four soil moisture sensors measures the soil moisture every five seconds. The chart below shows the collected data in the given figure 10: Average Humidity Value for Four Sensors.

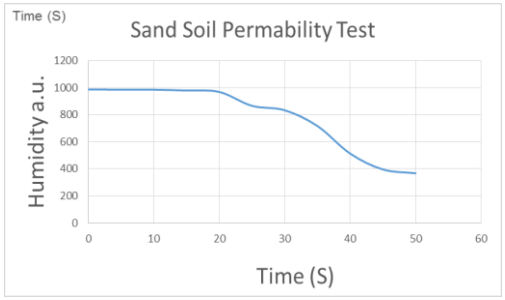

Fig. 10. The average value of humidity perceived by the four sensors in sand soil

C. Coarse Soil Permeability

This is the recorded soil moisture information recorded by the four soil moisture sensors every five seconds. Figure 11 shows the plotted curve of humidity level v/s time(s), whereas the data-table shows the average humidity value sensed by the four sensors.

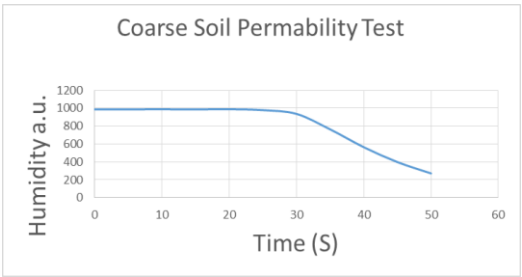

Fig. 11. The average value of humidity perceived by the four sensors in coarse soil

6. Conclusion

The proposed system is designed to monitor soil moisture, and the project provides an opportunity to study the existing system and its characteristics and shortcomings. The proposed structure can be used to turn on/off the sprinklers based on soil moisture. Then mechanize the water cycle, which may be the most difficult task in the waxing process. Agriculture may use most of the water through sports. This structure uses data from the soil moisture sensor to submerge the soil and prevent it from coming out of water or underwater soil systems. Keep away from crop damage. Owners of farms can monitor interactions online using a web page. As a result of this project, it can be concluded that the use of IoT and robotization can lead to significant improvements in agriculture. A potential alternative to present laborious and cumbersome interactions with water systems, the technology enables the productive use of existing water resources.

The irrigation control which is proposed have to be achieve the research aims as:

- Soil humidity sensors allow you to monitor soil moisture levels.
- Irrigation system is automatically controlled by an Arduino programmed and connected to a cell phone.
- If the soil is dry or moist, the water pump will automatically turn ON and OFF to irrigate the plants.

In the future, if there are several farms that need to be watered independently at various times, they can be controlled by a single system (centralised). Also, electronic entrance valves should have a regulator as a result.

As an example, the rancher might be given the option of turning on/off the siphon to begin/stop the cycle of the water system without having to be present at home.

As a result of unfavorable weather circumstances, farmers may opt to halt the development of crops or yields may be negatively affected. So, the rancher may have to halt the structure from a distance.

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