IOT-Based Water Irrigation System with Power Generation

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ABSTRACT

This invention aims to promote sustainable development goals which match well with Goal 6 - Clean water and sanitation. This Goal Ensures the availability and sustainable management of water and sanitation for all. Water is wasted in great quantities in the agricultural industry particularly when it comes to irrigation; we frequently observe significant wastage of water. To overcome this crisis, we aimed at developing this technology to use water in an effective manner. We genuinely intend to reduce the quantity of water that is automatically squandered despite the efforts of people, by employing a lawn water sprinkler which rotates to provide water to the plants and in turn connected to the generator to generate electricity, which is an energy conversion technique.

Keywords: Sustainable, agricultural, electricity, water, energy conversion.

I. INTRODUCTION

India is a developing country in which most of the people of our country depend on agriculture. This agricultural practice requires much water for the irrigation process by which a large quantity of water is wasted. As this is the emerging era of modern science and technology, any kind of problem can be solved by using science and technology. To make the life of a farmer easier and to reduce the wastage of water, IOT based water irrigation system will be quite helpful (Arshad ali, 2020). An automated irrigation system is very helpful for farmers to grow more foods and fruits. It can reduce their work. A sufficient water supply is very important for irrigation to produce enough crops (A. Kamilaris *et al.*, 2016). An automated system can help the farmers by watering the fields by turning ON the water supply motor when water is needed in the fields. And when sufficient water is supplied in the fields, the system helps to turn OFF the water supply motor (MahirDursun *et al*., 2011). For this benefit, the farmers need not worry about water supply in the fields. Many systems exist at present. But they are very costly and not much helpful. As the farmers' economic condition is not good, so they do not apply those systems to produce more crops. The intended system is simple, low cost, and easy to use and install by which all the farmers get benefited. It helps to increase crop production by avoiding the deceitful time of irrigation (S. R. Kumbhar *et al*., 2013). By using this system, the farmers can be self-independent and able to develop their livelihood. This research is proposed to reduce the wastage of water which helps the farmers and also to generate electricity in an effective way.

II.LITERATURE ANALYSIS

There have been quite a few research works going on the agenda of automation of irrigation systems. Various other technologies (different microprocessors, different algorithms) have been used to reach a variety of conclusions. Various scientists have worked with programmed water sprinkling or water system frameworks (Yunseop (James) Kim, *et al.*, 2008). They picked distinctive measurements for deciding the soil condition and amount of water. They likewise examined various wellsprings of energy for the sensors. Making a system with sensors and the outline of the control framework was additionally and intensely discussed about by many researchers. An article on the mechanized water supply framework for urban local locations appeared that such a framework can be utilized to adequately oversee water assets (A. Kamilaris *et al.*, 2016). This system aims to modernize farming innovation by using programming segments and constructing the necessary parts for the framework. The framework is ceaselessly based and focuses on the right condition of the agricultural field (Arshad ali, 2020). There is one central center that is used to control another center. The key limit of the RF module is to pass the message to the center point and work the system.

III. DESIGN OF SYSTEM

The IOT-based automatic water irrigation system is made up of many components. It includes the following in detail

A. Soil moisture sensor:

The fork-shaped probe's resistance fluctuates according to the moisture content of the soil and functions as a variable resistor (like a potentiometer) (MahirDursun *et al*., 2011) and (S. Harishankar *et al*., 2014) as shown in Fig.1. The conductivity and resistivity of the soil improve with soil moisture content. Less water in the soil means a reduced conductivity, which raises resistance (S. Harishankar *et al*., 2014 and https://www.electrorules.com/). By measuring the output voltage that the sensor generates in accordance with the resistance, we may calculate the soil moisture content. The resistance of the probe, which is accessible at an Analogue Output (AO) pin, is used by the module to generate an output voltage. An LM393 High Precision Comparator receives the same signal and digitalizes it before making it available at a Digital Output (DO) pin. The module has a potentiometer for modifying the digital output (DO)'s sensitivity (Joaquin Gutierrez, 2013). It can be used to establish a threshold so that the module outputs LOW instead of HIGH depending on whether the soil moisture level is above or below the threshold. When a specific threshold is reached, this configuration is excellent for starting an action.

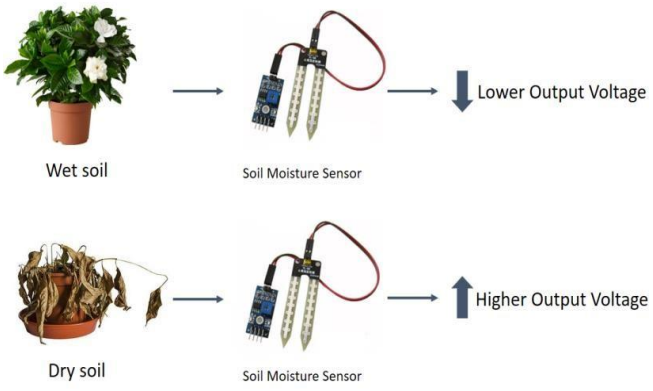

Fig.1. working of soil moisture sensor

B. Arduino:
Arduino is built on free, adaptable, and simple-to-use hardware and software for designers and developers. With the help of this platform, we can build various single-board microcomputers that the maker community can use it in many ways (MahirDursun *et al*., 2011). An ATMEL AVR microcontroller serves as the foundation for the Arduino board. Microcontrollers are integrated circuits that can be programmed using theprogramming language available in the Arduino IDE environment (A. Kamilaris *et al.*, 2016). These instructions can thenbe stored on the microcontrollers. One can write a program that communicates with the electronics on the board using these commands (Joaquin Gutierrez, 2013).

C. Relay Module:
Relays are electrical switches that can be used to manage higher voltage systems and equipment. An electromagnet is frequently used as the mechanism in module relays (Yunseop (James) Kim, *et al*., 2008). Typically, DC is used as the relay module input voltage. Although it is essentially within the limit levels that the relay is designed for, the electrical load that a relay will control can beeither AC or DC (Joaquin Gutierrez, 2013). There are various input voltage ratings for relay modules: For low power switching, it can be a 3.2V or 5V relay module; for power systems, it can be a 12V or24V relay module. For easy access, the relay module information is typically printed on the device's surface. Included in this is the input voltage.

D.Other sensors (Temperature sensor and humidity sensor):
In order to record, monitor, or communicate temperature changes, a temperature sensor which is an electronic device that monitors the temperature of its surroundings and turns the input data into electronic data is also included (Joaquin Gutierrez, 2013) as shown in Fig.2. Temperature sensors come in a wide variety of forms. Non-contact temperature sensors measure an object's temperature without making direct touch with it, whereas contact temperature sensors must make contact with the physical object being monitored (L. Garc´ıa, L. Parra *et al*., 2020).

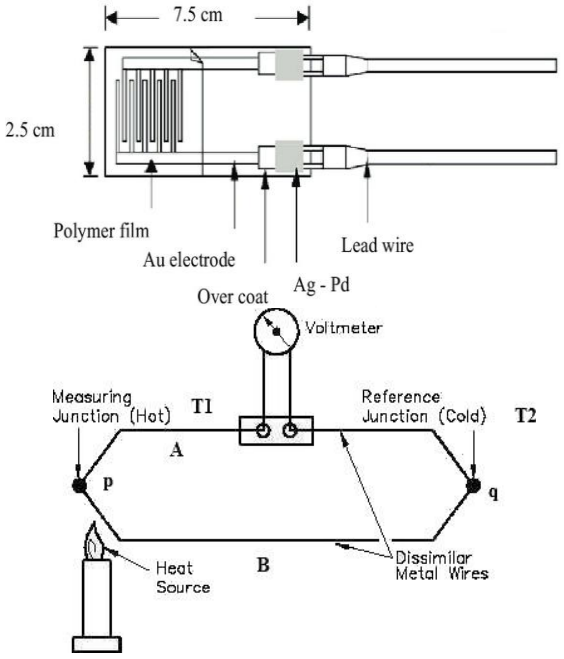

Fig.2. Temperature sensor

Absolute humidity (AH) is measured using thermal humidity sensors and is shown in Fig.3. Thermal humidity sensors, in contrast to Relative Humidity (RH) sensors, use two probes: one to detect dry nitrogen and the other to monitor the air around the sensor (Arshad ali, 2020). When moisture is accumulated on the exposed probe, the sensor detects the difference in thermal conductivity and calculates Absolute humidity (AH) [10].

Fig.3. Humidity sensor

E. Lawn water Sprinkler:

1. The lawn water sprayer is a simple and user-friendly sprinkler that evenly distributes water around the field (R Nelson,U Sankar *et al*., 2021). The sprinkler's whirl and sprays water to the agricultural field and on the other way it produces electricity by connecting the sprayer with a generator (MahirDursun *et al*., 2011). The angle of the sprinkler is quite important for effective irrigation. In this present research we have utilized a Luker Automatic 360-degree lawn sprinkler (https://www.arduino.cc/en/Guide/Introduction).

IV.PROPOSED SYSTEM

A general block design of an Arduino-based autonomous irrigation system is shown in Fig.4. below. It shows three

sensors connected to a controller, and the values these sensors sense are sent to a mobile application, and it employs the sprinkler system' rotation to generate electricity.

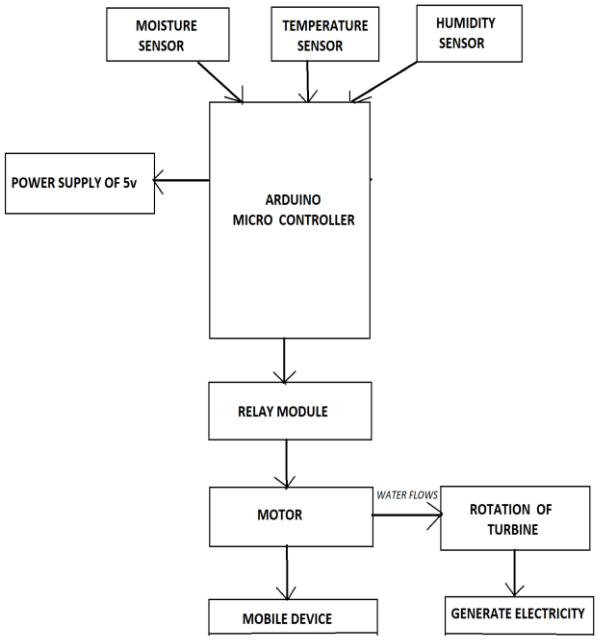

Fig 4. Block diagram of automatic irrigation system with power generation

V. METHODOLGY

The autonomous irrigation system is intended to continuously monitor the soil's temperature and moisture content. When the desired level of soil moisture is reached, the system responds accordingly by watering the soil with exactly the right amount of water and then turning off the water supply[7]. The microcontroller has already received the reference amount of soil moisture. For the three most typical soil types (sandy, loamy, and clayey soils), this reference soil moisture content was designed to be scalable[6.7]The probes for the moisture and temperature sensors were built of corrosion-resistant material and can be inserted into soil samples. By measuring the resistance between the moisture probes and matching them to the output voltage of a comparator circuit, voltage levels corresponding to the wet and dry status of the soil sample were calculated (L. Garc´ıa, L. Parra *et al*., 2020). When the sprinkler starts to spray water, the rotation of the sprinkler generates electricity by connecting it to a generator and then with a bulb.

VI. DATA GATHERING AND ANALYSIS

Recorded the values of sensor's output while the soil is as dry as possible and when it is entirelywet to get an idea of the soil moisture level.

Calibrating the sensor:

```
void setup()
{
 Serial.begin(9600);
}
void loop()
{
int sensorValue = analogRead(A0);
Serial.println(sensorValue);
delay(1);
```

The aforementioned code is used to assign and read the dry value and wet value.

```
if(percentage < 10)
{
Serial.println("pump on");
digitalWrite(3,LOW);
}
```

The Arduino will turn pin 3 to LOW, the pump will turn on (our relay module utilizes the active low signal to trigger), and it will print a message saying "pump on" on the serial monitor if the moisture percentage falls below 10.

```
if (percentage > 80)
{
 Serial.println("pump off");
 digitalWrite(3,HIGH);
}
}
```

The Arduino will turn off the pump and print "pump off" on the serial monitor when the moisture percentage rises to above 80%, which denotes that the soil is completely submerged in water and it automatically stops the water supply.

Output of the proposed Prototype:

Fig 6.1 Prototype output 1

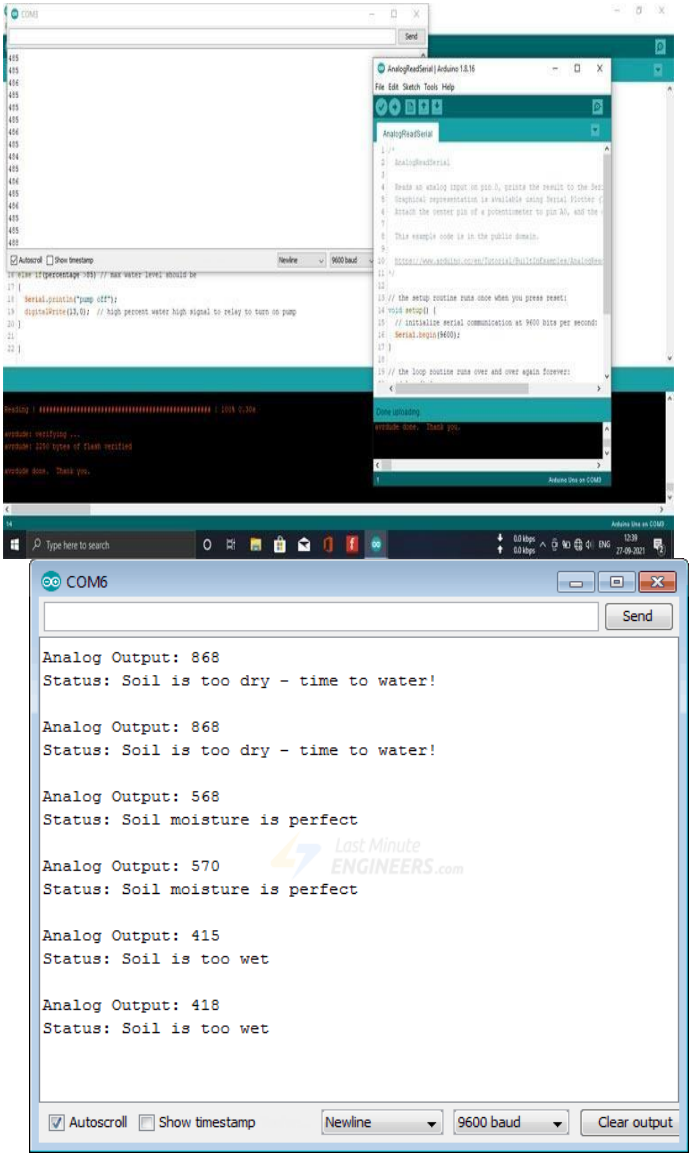

Fig 6.2 Prototype output 2

VII.CONCLUSION

India is a nation where most of the land is used for agriculture. A requirement for agricultural outputs is irrigation. The farming industry benefits from farms being irrigated better and more effectively. As a result, this effort has created a smart irrigation system based on IoT with a moisture sensor, humidity and temperature sensor. A system that is designed can irrigate a fieldwith less water. Crops can be kept at their ideal threshold moisture levels to provide better yields. To encourage proactive water management for agricultural land, this evaluation is being proposed. The system's microcontroller promises to lengthen system life by reducing power consumption, which results in lower power usage. It saves time, eliminates human error in altering soil moisture levels that are already available, and helps businesses maximize their net earnings in accordance with aspects like sales, product quality, and growth. Water flow drives a turbine into motion. The lawn water sprinkler is connected to the generator, which generates power, and is an emerging and cost-effective method.

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