Solar Powered Smart Irrigation System

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***Abstract*- The smart water irrigation system developed by our team is an adaptive plants and crops irrigation system. The purposes of our smart water irrigation system are to provide a water delivering schedule to the crops to ensure that all the crops have enough water for their healthy growth, to reduce the amount of water used in irrigation and to minimize the non-renewable energy usage. The prominent energy source used is solar energy and to give it an advantage we have incorporated solar tracker.**

Keywords: **Solar Tracker, Water Conservation, Soil Moisture Sensor, Arduino Uno, Blynk Application.**

I. Introduction

Over the past few years, IoT has become one of the most important technologies of the 21st century. Now that we can connect everyday objects—kitchen appliances, cars, thermostats, baby monitors—to the internet via embedded devices, seamless communication is possible between people, processes, and things.

As IoT becomes more widespread in the marketplace, companies are capitalizing on the tremendous business value it can offer. These benefits include:

- Deriving data-driven insights from IoT data to help better manage the business
- Increasing productivity and efficiency of business operations
- Creating new business models and revenue streams
- Easily and seamlessly connecting the physical business world to the digital world to drive quick time to value

The main highlight of our project is to conserve water and prevent crop damage due to excessive supply of water. Our project involves connecting the soil moisture sensor with the Arduino UNO Board. Depending upon soil moisture content, the board will cause drippers to evenly distribute water in the field. We have used Node MCU interfacing board which would give an alert message to the farmers as and when the field was invaded by external agents or in case of a farm fire. The farmer receives an alert message through Blynk application on his smart phone.

II. Problem Statement

Cost effective solar power can be the answer for all our energy needs. Solar powered smart irrigation systems are the answer to the Indian farmers who generally face the problem of frequent power cuts or non-availability of grid supply.

III. Literature Review

Usage of solar energy to power the water pumps as well as solar tracker; paper by IIT Kharagpur. To ensure no wastage of water there are soil moisture sensors placed in the soil which determine the amount of moisture present in the soil. The solar tracker which moves the solar panels according to the suns positions to ensure maximum efficiency of the solar panels. PIR and smoke sensors detect the motion of animals and humans and smoke respectively, which may cause damage to the crops.

IV. Components Used

A. *Arduino UNO Board:* It is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz ceramic resonator a USB connection, a power jack, and a reset button.

Figure.1- Arduino Uno Microcontroller [5]

B. *Node MCU Board:* Node MCU is an open source LUA based firmware developed for ESP8266 Wi-Fi chip.

Figure.2 - NodeMCU Microcontroller [5]

C. *Solar Panel:* A panel designed to absorb the sun's rays as a source of energy for generating electricity or heating.

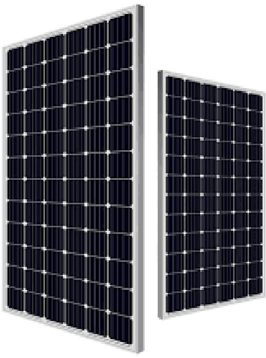

Figure.3 – Solar Panels [6]

D. *Smoke Sensor:* MQ2 is one of the commonly used gas sensors in MQ sensor series. It is a Metal Oxide Semiconductor (MOS) type Gas Sensor also known as Chemi-resistors as the detection is based upon change of resistance of the sensing material when the Gas comes in contact with the material. Using a simple voltage divider network, concentrations of gas can be detected.

Figure.4 – Smoke Sensor [6]

E. *Soil moisture Sensor:* A soil moisture sensor measure the volumetric water content in the soil. The sensor has two probes through which the current passes in the soil, then reads the resistance of the soil for reading the moisture level inside it.

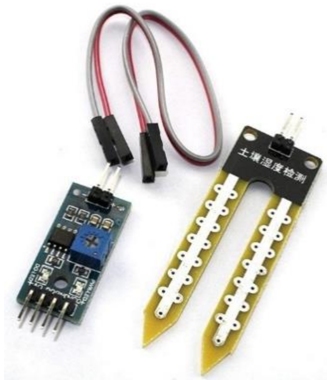

Figure.5 – Soil Moisture Sensor [5]

F. *LDR:* A photo-resistor (acronym as **LDR** for Light Decreasing Resistance, or light-dependent resistor, or photo-conductive cell) is a passive component that decreases resistance with respect to receiving luminosity (light) on the component's sensitive surface.

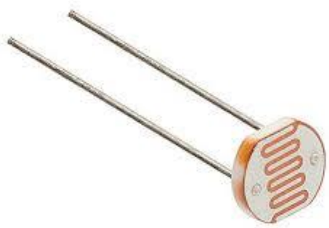

Figure.6 – Light Dependent Resistor [6]

G. *PIR (Passive Infrared Sensors):* A device used to detect motion by receiving infrared radiation. When a person walks past the sensor, it detects a rapid change of infrared energy and sends a signal.

Figure.7 – Passive Infrared Sensors [6]

V. PROPOSED SYSTEM

Irrigation can be automated by using sensors, microcontroller,android application and pumps. The low cost soil moisture sensor is used. It continuously monitors the field. The sensor is connected to arduino board. The sensor data obtained is then used to measure the mositure level in the soil.

If the moisture level is less than the threshold value then the query is triggered. This enables the activations of the water pumps placed inside the tank reservoir containing water. The water flows from the tank through the pumps and into the field.

This goes on till the water level in the field reaches above the threshold value. There is even distribution of water throughout the field. The whole system is powered by the sun's energy using a solar tracker. The solar tracker is pivoted on a stand that allows its rotation up to 270 degrees. This enables it to change its angle based on the position of the sun so as to ensure maximum capture of the sun's energy without any wastage.

The Blynk mobile application is designed in such a way to analyze the data received and notify the farmer of any security breach. The presence of PIR sensor and the smoke sensor ensures the safety of the field from farm fires and attack from external agents.

The PIR sensor detects the motion inside the fields and the smoke sensor detects smoke. Motion of any external agents such as rodents, animals, humans is detected. There is also a buzzer connected in this system that would go off in case of the presence of motion in the fields.

If there are external agents, then the buzzer would generate a loud sound as well as a notification would be sent to farmer through Blynk App using the WIFI module of the Node MCU board. In case of fire, the same thing would happen, thus ensuring complete security. This is a small diagrammatic representation of our proposed system depicting the components in fig.8:

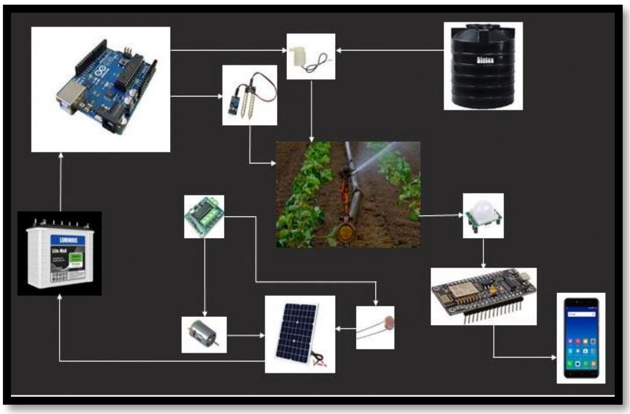

Figure.8 – Block Diagram of the SPSIS

VI. CIRCUIT DIAGRAM

Figure.9 shows the circuit diagram for Smart Irrigation System.

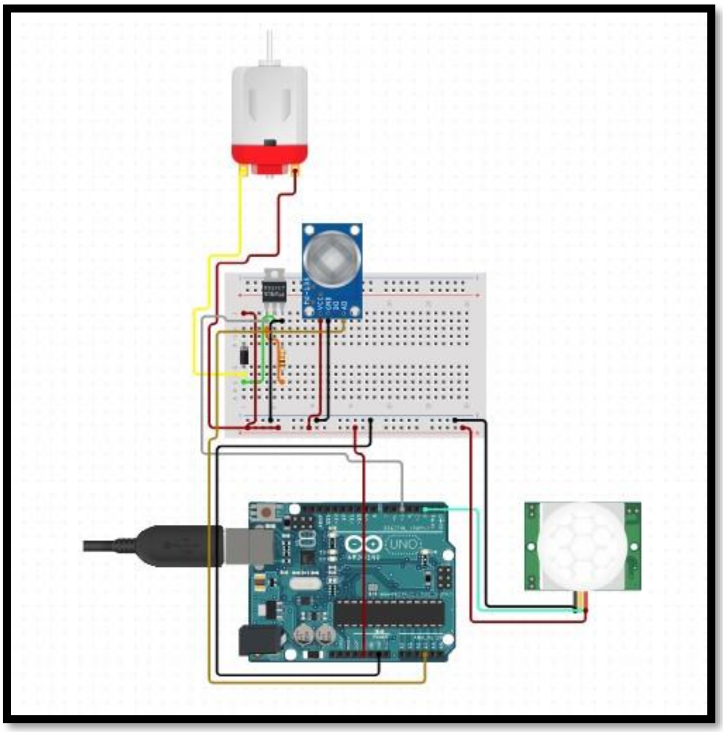

Figure.9 – Circuit Diagram of the SPSIS

VII. WORKING OF THE SYSTEM

As we know that the sun rises in east and sets in west, so the direction of incoming sunlight changes. So, we have set the Solar panel on a rotating axis which has LDR sensors fit on both ends.

The purpose of this is to attain maximum efficiency i.e. maximum solar power being generated by rotating in the direction of the sunlight. This solar tracker captures the required solar energy from the sun to run the water pumps. The soil moisture sensor present in the soil detects the moisture level in the soil and sends the readings to the Arduino board. If the moisture level drops below a certain threshold value the pumps go on and water gets distributed in the field evenly. Once the water requirements have been reached the pumps go off, hence the water supply gets cut. This ensures water not getting wasted.

For security purposes we have the used 2 PIR sensors at 2 corners of the field. The PIR sensor itself has two slots in it, each slot is made of a special material that is sensitive to IR. When a warm body like a human or animal passes by, it first intercepts one half of the PIR sensor, which causes a positive differential change between the two halves. When the warm body leaves the sensing area, the reverse happens, whereby the sensor generates a negative differential change. These change pulses are what is detected. After installing PIR sensors at a location on the field we will be able to detect any human or animal entering the field.

In case if there is fire in the field, we have used Smoke Sensors. It can detect LPG, Smoke, Alcohol, Propane, Hydrogen, Methane & Carbon monoxide concentrations anywhere from 200 to 10000ppm. From a farmer's point of view, his/her farm is one of the most important things in their life. So, security plays an important rule.

In both the situations, intruder breaking in or fires, a buzzer alarm is triggered, and a notification is sent to the farmer, too. This is done through the Blynk Application on the farmer's smart phone.

But farmers don't want to hear buzzer every time they enter the field, so to control the security system we have a feature in our app which would allow farmers to close the security system whenever they enter the field so that the system doesn't get alerted.

VIII. FUTURE SCOPE

As per future perspective, this system can be more intelligent system which predicts user actions, nutrient level of plants, time to harvest, etc. With using machine learning algorithms more advancement can be done in the future which will help the farmer a lot. Also, by the addition of temperature sensor as well as humidity sensors, the moisture level in the field will be determined more efficiently and with more accuracy. The temperature sensor would detect the temperature of the surroundings and using machine learning algorithms the necessary moisture level reading could be depicted.

IX. CONCLUSION

The automated Smart Irrigation System using IoT is found to be cost effective for enhancing the techniques to preserve water resources and to optimize them for agriculture production.

The system requires less maintenance so it is easily affordable by all farmers; the cost of the installation of the solar panel being a one-time investment. The security features being the highlight of the system make it even more effective and protected from almost any kid of hazards or attacks.

ACKNOWLEDGEMENT

The authors would like to show gratitude to the management of Shah and Anchor Kutchhi Engineering College, Chembur, Mumbai for their support. We would like to thank our honorable professors - Ms. Archana Chaugule, Mr. Manish Bhelande and Mr. Santosh Rathod for their guidance and enlightening us with their knowledge in the creation of our system.

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