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SOLAR POWER BASED SMART IRRIGATION SYSTEM WITH AID OF INTERNET

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ABSTRACT

Water management is critical in India, which has a population of more than a billion and a rising need for food, since the country's need for water grows each year. A vital part of our economy, agriculture accounts for a significant portion of our GDP and exports. Automation of irrigation may be achieved via the use of cutting-edge technology, allowing farmers to focus on more important tasks while saving time and money. To meet the needs of farmers, electricity and water resources must be increased. Because of their inability to balance the competing demands of water availability, energy availability, and timely soil profile analysis that have traditionally been the focus of irrigation design efforts, traditional irrigation approaches have shown to be less effective. This research aims to produce a solar-powered watering system that is automated. As an alternative to the current irrigation system, this will be a more affordable option. Solar energy may be used for smart irrigation and water conservation on the farms as part of this project. We've created a water system that's both portable and flexible enough to work with any current infrastructure. Incorporating NRF module technology, the system provides wireless communication capabilities. The system may be operated using an Android app that is Bluetooth-enabled. You have the option of scheduling watering by hand or by using wireless sensors and a controller.

Keywords: *Solar cell; Internet things; ESP8266*

INTRODUCTION

When it comes to the contemporary world, the Internet of Things (IoT) has become associated with innovative ideas. There are no physical mediums involved on the Internet of Things (IoT), which is a network of interconnected physical and digital devices that have their own unique IDs.[1] A wide range of fields have been affected by the notion, including energy and agriculture, which are essential for human existence. Energy conservation and Smart Home automation are not the only areas where it has had a significant impact.[2] With its linked industries, agriculture is unquestionably the major source of employment in India. 15% of global freshwater resources are supported by India. Agriculture relies heavily on irrigation. With just 35 percent of India's farmland being irrigated, 65 percent of farming relies on rain, according to World Bank figures.[3] One of the most important things to learn is how water quantity and quality affect irrigation systems and the sources from which water is used for irrigation.[4] Irrigation techniques that have been around for a long time include:

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a. Surface irrigation
b. Sub-surface irrigation.

Because of the waste of water and the spread of illness such as fungal growth, the methods outlined above are not very effective in the long run. Irrigation systems may benefit from the integration of ICTs and the Internet of Things (IoT) into conventional irrigation techniques as the world becomes a global village due to globalization. In recent years, IoT-based automation solutions have become highly popular and effective.[5] As a consequence of combining automation with the irrigation process, water loss would be dramatically reduced. Watering is controlled by a microcontroller irrigation system that uses sensors to keep tabs on the available supply. Smart irrigation systems run entirely on solar energy, the world's most plentiful and sustainable energy source. Energy conservation and environmental friendliness are also advantages of solar power production using a PV module. Wireless sensor networks with algorithms managing operation by maintaining a constant threshold have been deployed as part of ongoing research into automated irrigation systems, and numerous new innovations have been presented.[6] WSN (Wireless Sensor Network) and water pumps have been used in a number of other suggested models to monitor moisture levels.[7, 8] Using Bluetooth and the Cloud[9, 10], an irrigation system powered by Arduino Individual crop varieties and their complementing needs for moisture, sun exposure, and nutrient demand may be monitored and required management measures can be made to avert a food crisis with the introduction of cloud technology and decentralized data.[11-14] This has led to the development of Precision Agriculture[15-16], which implements irrigation strategies depending on schedule or feedback. This project aims to help farmers increase their crop yields by using efficient methods for helping them during the drought season due to deficient rainfall, preventing over flooding of the field due to excess rainfall, reducing the workload for farmers on a daily basis, periodically updating the status of soil parameters and any malfunctioning mechanical systems like pumps/motors can be pin-pointed, and finally to help the farmers figure out how to improve their yields.

A. Sensor Based Automatic Irrigation System

Water irrigation schedules are set using a variety of sensors, including those that measure soil moisture, light, temperature, and humidity levels. When the soil moisture level drops, the pump is activated, and the volume of water released is increased to compensate for the loss of water due to evaporation. The sensors are connected to an Arduino Uno board, which is used to control the pump.

B. Internet of Things (a)

The Internet of Things (IoT) is a network of interconnected physical objects that collects, controls, and exchanges information. This system collects real-time data from sensors and compares it to threshold levels in order to automate watering. Free web services platform Sparkfun provides a 50mB storage space for each registered user or subscriber. After each sensor reading cycle, the Sparkfun prototype is configured to save data on Sparkfun for 45 seconds. For example, a daily, weekly, or even yearly evaluation of water use may be made using the data recorded in this system.

C. Wi-Fi Networking

In order to maintain track of the field's state, we employ Wi-Fi technology to transmit soil metrics to a cloud-based database.[2] Using a luminosity sensor that measures the light intensity in the surrounding environment and can generate artificial light in case of low intensity provides us an

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advantage in locations where sunshine is scarce. All of the sensor data is stored on Sparkfun, which is then analyzed to determine how much more effective our system is at managing water. When the temperature is greater, the plants are watered more often to make up for the increased evaporation. This is where the temperature sensor comes into play. This year's ground-nut harvest data is being compared to that of prior years to determine how much water we have conserved, as well as how much money we saved.

LITERATURE SURVEY

Studies in the domain of smart irrigation systems have been done in order to give a simple and effective way to automate the irrigation process. Research on irrigation has focused on its wasteful use of water, lack of remote farm monitoring, and inability to draw relevant conclusions. An automated irrigation system is the goal of this study, which outlines an effective approach for integrating sensors with Arduino. Some of the research we've cited is summarized in the table below.

Using sensors to monitor crops, Rajalakshmi P and Mrs.'s. Devi Mahalakshmi created a new method. A proof-of-concept for automating the irrigation system included wireless transmission of sensor data from the field, storage in a database, and control through mobile application. Our Wi-Fi module ESP8266 is used to transport data wirelessly to the cloud in their system, while the NRF24L01 is used in their system to transfer data wirelessly.[17]

Using solar electricity, Joaqun Gutierrezet et al.[18] created an automated watering system for remote organic farms. As a result of this effort, their internet-controlled duplex communication technology may be used in many different situations. The internet connection is made available where mobile devices may connect to the internet. Our method uses cloud storage and GSM technologies to irrigate crops more effectively.[18]

Two tiers of decision-making are involved in Jia Uddin et al.[19] suggests method for an automated irrigation system. These threshold values, known as secure and unsecure, are 0cm and 10cm respectively, stored in the microcontroller's software. It is up to the farmer or user to act if sensor values fall into a middle range. A decoder reads the message given by the owner to switch the motor ON or OFF and makes this choice. In order to avoid utilizing electricity as an alternative, the complete system is powered by solar power.[18]

In our suggested system, the threshold values may be set to function at various water content levels in order to alleviate the problem of too many decision makers. Trial and error coding is used to build up moisture levels in the code.

It was suggested by R. Suresh et. al.[20] that the sensor nodes convey detected values to the microprocessor, which then controls the solenoid valve. In order to activate the buzzer, this microcontroller communicates with a mobile phone that is in auto-answer mode and sends this activation signal to the microcontroller. A microcontroller application is used in this system, which reduces the overall use of electricity.

For example, with our system, the microcontroller is simply responsible for turning the motor on or off depending on the moisture content and a choice included in its code, rather than two separate devices that communicate with each other.

PROPOSED SYSTEM

ESP8266 is the master controller for the automated solar powered smart irrigation system (SSIS), which includes a DC water pump and humidity and temperature sensors from the DHT11 family. There are four layers to this model: the Physical/Perception layer, Interface layer, Network layer and application layer shown in Fig 1 of the model.

Sensors attached to the system for data gathering make up the physical or perceptual layer. Information gathered by sensors is sent to a master controller, which serves as an intermediary between the physical and application layers. The processing unit is in charge of the whole thing.
As data is amassed at the network layer, a channel for two-way communication and connection through cloud infrastructure is made possible. This is where the monitoring and control functions are performed on data that has made it to the application layer. ESP8266 serves as the master controller in this design.
The following features are included in the SSIS prototype:
For example,
a. It focuses on checking the condition of the DC water pump at the location.
b. For screening purposes, GUI interfaces are useful since they allow users to see the current condition.

c. Taking control of the water pump's operation based on data that is periodically collected
Prototyping M-2-M as a major element is at the heart of the control and monitoring system's fundamental topic.

COMPONENTS DESCRIPTION

A. ESP8266:-

With the 32-bit microcontroller and complete TCP/IP stack of the ESP8266, microcontrollers can connect to Wi-Fi networks and establish basic TCP/IP connections by utilizing Hayes-style instructions. A. With a power source of between +/- 3.3 volts and programming in LuaScript, it was capable of operating. Integrating a soil humidity sensor is a popular use for chip clock rate acceleration and an ADC (Analog to Digital Converter).
It's a digital humidity and temperature sensor with a modest price tag, the DHT11. In order to detect humidity in the air and provide an output on the data pin, the device uses a capacitive humidity sensor and a thermistor. Compact and cost-effective, it's an excellent choice.

B. Moisture Sensor:

Low-cost digital humidity and temperature sensor DHT11 is an example of this. The data pin is connected to a capacitive humidity sensor and a thermistor for reading the temperature of the air. In terms of both size and price, it's a good fit.

C. DC Pump: -

DC pumps may move fluid in a number of ways thanks to the motor, battery, or solar power that powers them. With sunlight shining on solar cells, 12 V of DC electricity is taken from the panels and used in this prototype. Because it may be powered directly from a rechargeable battery, it is more portable, energy-efficient, and user-friendly than a traditional power supply.

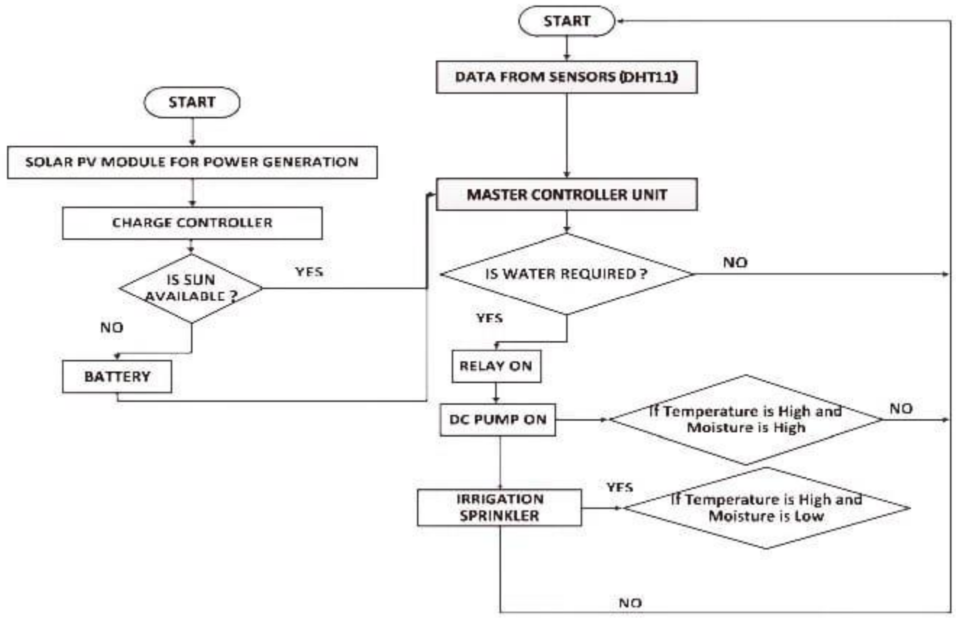

Figure 1: Flow chart Diagram of Working System

D. Charge Controller

An electric charge controller, also known as a charge regulator, slows the rate at which electric current is added to or removed from an electric battery. By avoiding overcharging and deep draining via regulated discharges and offering protection against overvoltage, it helps prolong battery life and allows its safe use. The circuitry built into a battery pack rated at has been controlled by a series charge controller in this prototype.

E. PV module:

A PV module is a grouping of PV cells connected in series and in parallel to boost current and voltage. Using the concept of photovoltaic effect, individual PV cells may capture solar electricity by producing DC (Direct Current) power. Using a motor, battery, or solar power, a DC pump may transfer fluid in a number of ways. When exposed to sunlight, PV panels with solar cells provide DC electricity that may be used in this prototype. Because it may be powered only by a battery, it is more practical, portable, energy-efficient, and simpler to use. Charge controllers (also known as charge regulators) slow down the pace at which electric current is added or withdrawn from electric batteries. By avoiding overcharging and deep draining via regulated discharges and offering protection against overvoltage, it helps prolong battery life and allows its safe use. Using a series charge controller, a battery pack rated at was utilised to control circuitry in this prototype

F. Battery:

A battery's capacity and power ratings, depth of discharge, round-trip efficiency, and longevity are all elements that go into its assessment. Lead acid batteries are used in this design because to their low cost and high efficiency in small-scale activities.

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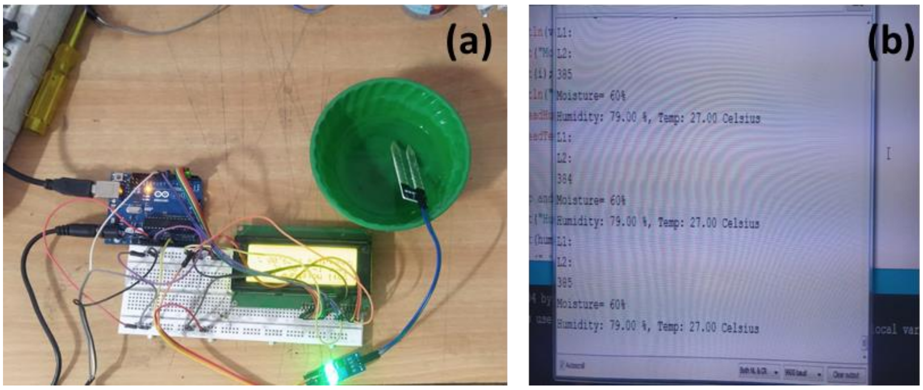

Figure 2: (a) Final product (b) With result Display

IMPLEMENTATION

A. Algorithm for Irrigation

The algorithm's logic makes it easier to determine whether crops or plants need to be watered. In order to maintain soil moisture levels, the cascade phases of logic and decision-making criteria are used to monitor the DC pump's status in the cloud infrastructure. Moisture sensors in the soil are used to begin the process. The master controller unit, which includes ESP8266, receives the data from the sensors. The master controller is used to make decisions and monitor soil moisture levels. These are the criteria that the module is looking for. As soon as the controller detects a dry soil, a relay is triggered to activate the water pump, resulting in water flow. Water flow is halted if the controller shuts off the relay when the soil becomes moist. Powered by a solar panel and a charge controller, the complete system is powered by solar energy. When the solar panel's irradiance is low or nonexistent, the prototype may operate in one of two ways: directly from the master controller or via a battery storage unit.

B. The Actualization of Software

The first step in getting things done is to design the application's graphical user interface. The Blynk platform was used to build the app, and the resulting user interface is seen in Figure 3. There are two primary functions that the user may access via the interface:

a. Keeping tabs on the current state of things monitoring and managing status depending on the monitored data, as well as the M-2-M function of the DHT11.

"Registered User" and "Create a Dashboard" are the two most prominent choices on the UI. As soon as we click on "Registered user," we are sent to a dashboard with a list of all of our installed appliances. Using this functionality, the user may create a dashboard that is tailored to their needs for a volatile control and monitoring application. To create a dashboard, just click the "Add Devices" button, and you will be sent to an interface where you may add features related to the management and monitoring of a particular device. The ESP8266 module, which implements the MQTT protocol, may be used from anywhere in the globe to manage the device. Schema for the ESP8266 module's authentication and authorization layer assigns a distinct user and account to each of the devices that have been installed using those credentials for control and monitoring. SSID and user-defined password are the only credentials needed. In the following step, the communication layer of the schema is mainly concerned with transmitting alerts from the ESP8266 through text message and e-mail. Users of Internet of Things (IoT) devices are continually alerted when anything occurs or simply at regular intervals. intervals, as an example, to provide information about data. We have sent email and SMS messages using the ESP8266. When a trigger is triggered, the IFTTT web service connects two web services through "recipes," which in turn set off a subsequent action. In Fig. 2 you can see the hardware prototype in action. Fig. 3 shows

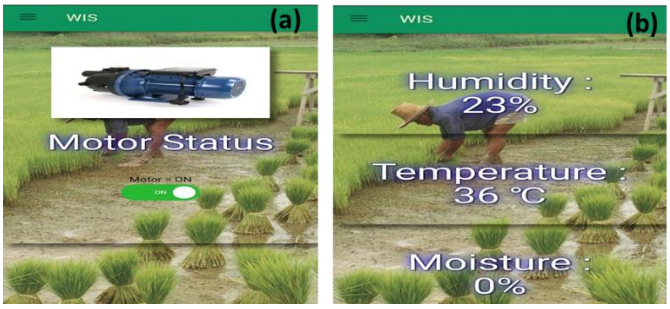

Figure 3: Application Result Display

CONCLUSION

In summation, we may say that the irrigation system on automation makes best use of available resources to increase irrigation efficiency. If you are in a dry area, this technique may help you increase the sustainability of your farming operations. Data storage and a sensor node are both included in the prototype for this project. Soil factors such as temperature, wetness, luminosity, and humidity may be measured using the sensor element node, which is set up in the field. The motor is activated and deactivated based on the soil characteristics, which are determined by the threshold values included in the code. GSM messages are used to notify consumers of the situation. Sparkfun may be used to access cloud data in the similar way. Our test groundnut plant's water requirements have decreased over time; thus, we can conclude that we have effectively saved water by looking at 2015-2016 groundnut crop data and comparing it to 2017 groundnut plant data. On a variety of tests, the system's functioning has been deemed successful, allowing it to be utilised to analyse diverse crops. We are now working on incorporating solar panels to power the motor as a potential future development of this project.

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