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Solar Powered Auto Irrigation System using Raspberry Pi

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ABSTRACT

The modern challenges for improving plant growth and reducing costs justifies the development of an automated irrigation system that will minimize the waste of water and reduce labor and monitoring overhead.A system is proposed to overcome this problem and that is solar powered auto irrigation system using Raspberry pi. The four parameters like temperature, light intensity, voltage and current have been measured. The temperature was measured using temperature sensor. The light intensity was measured using light dependent resistor sensor. The voltage was measured using the voltage divider. And current was measured using the current sensor module that can sense the current generated by the solar panel. These parameters as the input value for the Raspberry pi and the output was display at the Liquid Crystal Display (LCD) screen. The purpose of solar energy measurement is to ensure that system is working properly.

Along with this an automatic irrigation system is developed. By sensing the temperature and moisture content of soil automatic irrigation system works and decide whether irrigation is needed or not and how much water is needed for soil.

KEYWORDS: ***Raspberry Pi, ArduinoNano, Auto irrigation system, PV cell,***

1. INTRODUCTION

The solar energy market is one of the most rapidly expanding renewable energy market. Rising fossil fuel and burning fuel such as coal , global warming and severe other conditions have compelled many nations to look for alternative sources that is currently used worldwide for meeting rising demands of electric power. Presently we have seen a significant increase in requests for remote monitoring and control equipment for solar energy applications. The main objective of this project is to design a solar energy measurement system for measuring solar cell parameters such as voltage, current, temperature and light intensity through multiple sensors.

Irrigation is an artificial way of watering the soil for the proper growth of the plant. It is mainly used in the dry areas and the places where rainfall is less. Irrigation also helps to suppress the weeds growing in the agricultural fields. The old method used for irrigation was manual irrigation using buckets and water cans, by using sprinkler irrigation, localized irrigation , drip irrigation etc. but by using these techniques we can't predict the amount of water that is to be watered or the sufficient quantity of water that that a crop needs.Most of the time these resources are not used efficiently and substantial amount of water are wasted. Due to this water logging will occur while using these techniques to water the crops. So there is a need for the improvement to these

existing techniques in order to conserve water. So to prevent the water which is being wasted during irrigation, an automatic plant irrigation system has been developed. This works by sensing the moisture content of the soil and decides whether the pumps has operate or not. This system is not so expensive as we compare to other systems and is time saving, as the works done by the system is automatic.

Objectives

- Determine the parameters like current,voltage , temperature and intensity of solar power system.
- Design a system which sense the temperature and moisture content of the soil.
- Design a solar powered system which pumps water based on the temperature and moisture content of the soil.

This project can be implemented in agricultural fields to monitor the water content in the soil.Also this can be implemented to measure the parameters of a solar cell like current ,voltage,temperature,and intensity using multiple sensors.It offers a solution to reduce water wastage and farmer's work and also it is a timely irrigation since plants are being watered when needed. This is achieved by sensing the moisture content and temperature of the soil.

2. Literature Survey

The paper solar energy measurement system using pic by Sumedh V. Dhole et.al(2019),this system parameters can be measured using microcontroller. The key advancement introduced in this paper solar energy measurement system for measuring solar cell parameter such as voltage, current, temperature and light intensity through multiple sensors.The technology discussed in this paper is pic microcontroller.The main advantage of this method is that it is reliable and accurate.

The paper a review on different type of materials employed in solar photovoltaic by panel Rohan V Angadi et.al(2020), this review paper describes the different type of materials are used in solar photovoltaic panel. The key advancement introduced in this paper selection of materials for the manufacturing of solar cell. Technology used in this method is the measurement of different materials like Gallium Arsenide, Moncrystalline and Silicon. The main advantage of this method is determined most efficient solar materials.

The paper an analog BJT-Tuned maximum power point tracking technique for pv system by Mohammad Al-Soeidat et.al (2018),this system is track MPPT quickly with good efficiency and accuracy. The key advancement introduced in this paper is it improves the accuracy of Maximum Power Point (MPP) voltage. Technology used here is Maximum Power Point Tracking (MPPT). The main advantages of this method is that it is simple and easy to implement.

The paper Iot based solar energy monitoring system by Suprita M. Patil et.al (2019),this system is monitoring of solar energy using Iot. The key advancements introduced in this paper is that using renewable energy technologies will reduce environmental impact.The technology discussed in this paper is Internet of Things (IOT). The advantages of this method are that it results in improvement in efficiency and accuracy.

The paper MPPT control photovoltaic system using hybrid method under variant weather condition by Cheikhna Cheikh Ahmedet.al (2019),this system is designed to control the photovoltaic system and also takes into consideration of random change in the atmosphere. The system studied include 240 W panel a DC-DC boost converter, and a resistive load. The key advancement used in this method is that it allows panel voltage to be higher voltage. The technology used in this method is MPPT. The advantage of this method is that increase in charge efficiency.

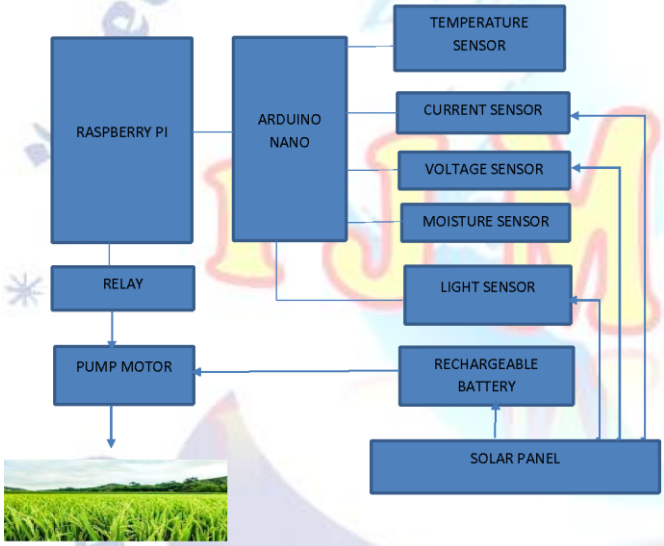
The paper solar and Biomass based hybrid power system for rural areas by S Harivardhagini et.al (2020) this system is designed to provide 24 hours of electricity to rural areas. With the new technologies and good infrastructure one can construct efficiency hybrid power plant for small rural areas. The key advancement used in this method is that it provides 24 hours of electricity by combining solar and bio mass. The technology used in this method is solar and bio mass. Advantage of this method is that it provides efficient used renewable energy and also provide benefit to rural areas where severe crisis of supply of electricity.

Introduction of different maximum power point tracking method using photovoltaic systems by More Akshay Samadhanet.al (2019) In this system analyses a PV model which extracts the energy from sun rays for a DC application. This project is using maximum power

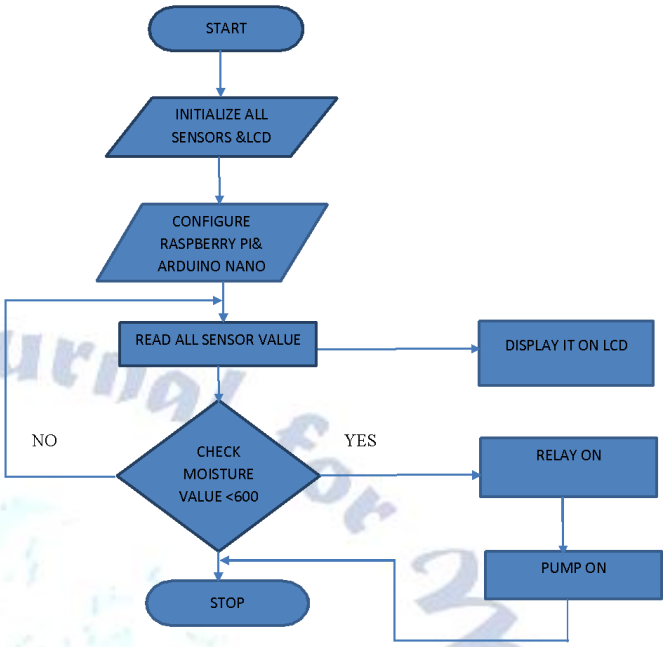
point tracking which provides higher efficiency from photo voltaic cell unit. The analysis tries to highlight the superiority of fuzzy logic over other contemporary methods.

A Review Paper on Raspberry Pi and its Applications by Dr. L Solanki et.al (2020) It is the detailed study about raspberry pi. The Raspberry Pi is a smaller version of a modern-day computer capable of performing task effectively. Raspberry Pi support various programming languages such as Python, C, C++, BASIC, Perl and Ruby. Advantages are Inexpensive device and is available easily across worldwide, Extensive peripheral support.

3. METHODOLOGY

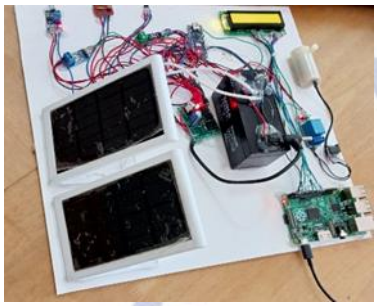


Raspberry pi is a multipurpose device. In this system raspberry pi is used as a control unit. Arduino Nano is used to convert the analog values from the sensors to digital values. To check the temperature, intensity of light, voltage and current of the solar panel. For this sensor like LM35 as temperature sensor, ACS712 as current sensor, voltage divider as voltage sensor,LDRas light intensity sensor. Also, the moisture content of the soil is checked. Based on the moisture content the raspberry pi will gave a relay and pumps water to the soil.



Initialize all the sensors like temperature sensor LM 35, current sensor ACS712, voltage sensor as voltage divider, light sensor as light dependent resistor and moisture sensor. All the sensors are initializing and set up to get the output value to the LCD display. After this Raspberry Pi will be programmed to get the correct output. And Arduino nano is place to convert the analog value from the sensor to its corresponding digital values. To covert the analog values from the sensor. Each sensor should have around eight pins. For all sensors, Raspberry Pi doesn't have enough pin, so that in this system uses Arduino nano as a converter. After connecting the sensors and Raspberry Pi and also the voltage and current sensor will connect the battery. Temperature sensor is connected to the solar panel to get the temperature of sun light. After these initializations the values from the sensor will displayed on the LCD display. Check the moisture of the soil. Place a threshold value for the moisture content. If the moisture of the soil is greater than the threshold value relay will be on and corresponding to this pump will on. After the water level of the soil is comes to threshold value pump will be stop its function.

4. RESULTS



Firstly, this project proposes a solar energy measurement using raspberry pi, in which four parameters like voltage, current, temperature and light intensity is measured. These parameters where given as the input value to Arduino and then to raspberry pi and the output is displayed on 16*2 LCD display.

Along with this an auto irrigation system that works from the power of solar is developed. Sensors where used to sense the temperature and moisture content of soil. If the moisture level is found to be below the desired level, the moisture sensor sends the signal to raspberry pi to turn on water pump and supply water to the agriculture field. when the desired moisture level is reached water, pump stops pumping the water and this whole process is controlled by the relay.

5. CONCLUSIONS

In the conclusion, first the project achieved in measuring all parameters such as temperature, current, voltage and light intensity by using different sensors and displayed on 16*2 LCD display. By measuring these parameters, the best position and time the electricity produced by solar panel is found out.

An automated irrigation was successfully designed and assembled. Itserves to reduce the consumption of water used, the human monitoring time and the labour associated with standard methods. Such a system can manufactured at a relatively low cost using simple electronic parts. This design is still in a prototype stage. More tests need to be conducted before the efficiency, durability, and reliability can be demonstrated. Additionally, many improvements can be made to make the system more versatile, customisable, and user-friendly.

The timing can be defined by the user (eg . with switch and 7 segment display) instead of being hardwired in the Logic Circuit electronics. The threshold humidity levels may be adjustable using several multi-turn potentiometers. All electronic components may be incorporated on a printed circuit board. They may also integrated onto a single chip (so called System On Chip). Also, a flame detection sensor which is used for detecting fire in the farm. It takes data from the field and send it to Raspberry pi.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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