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SOLAR POWERED IRRIGATION SYSTEM BY IOT

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Abstract

All of our energy needs may be met by affordable solar electricity. For Indian farmers, solar-powered intelligent irrigation systems hold the key to success. This system comprises of an autonomous water flow control system that uses a moisture sensor in conjunction with a solar-powered water pump. It is the suggested remedy for the current energy dilemma facing Indian farmers. By using less grid power, this system saves electricity, and by cutting down on water loss, it saves water. This paper's primary goal is to develop an automatic irrigation system that can detect the moisture content of the soil. And a soil moisture sensor, which measures the moisture content and gives different crops a controlled amount of moisture, reaches this degree of sensing. If the moisture content of the soil drops below a particular amount, the sensor notifies the microcontroller of the detected value. In order to maintain the soil's moisture content, the crops receive automatic watering at the appropriate amount based on the value detected by the sensor. The sensor transmits the observed value to the microcontroller if the moisture content of the soil decreases. Afterwards, the water pump turns on automatically based on the humidity level. The goal of this research is to use solar energy for irrigation while reducing human interference for farmers. . This paper's main goal is to reduce human interference—farmers in particular—and utilize solar energy for irrigation, one of the non-renewable resources.

KEYWORDS:* *Smart irrigation; solar power; solar pump; moisture sensor; energy crisis.

1. Introduction

The lack of rain and water in the soil necessitates the application of the right irrigation strategy. The water content of the soil determines the needs of agricultural fields at all times. However, ongoing soil water extraction lowers soil moisture levels, therefore preventing this issue should be followed by the anticipated irrigation system [1]. The world's most plentiful energy source is solar energy. In addition to providing a solution for the current energy issue, solar electricity is a sustainable energy source. Using solar energy efficiently is possible with photovoltaic production. These days, a lot of street lights, water heaters, and household loads are powered by solar panels, which are an array of photovoltaic cells. Solar panels are becoming more and more affordable, which is encouraging their use in a variety of industries. An example of how this technique is applied is in agricultural irrigation systems [2]. A solar-powered irrigation system could be a good substitute for farmers in India given the country's current energy shortage. This is an environmentally friendly method of producing energy that, after an initial expenditure, yields free energy.

This paper presents a solar-powered automatic irrigation system that uses water pumps to pump water from a bore well to a tank. A controller and moisture sensor are used to automatically regulate the tank's outlet valve, controlling the water flow rate from the tank to the irrigation field to maximize water consumption.

2. Literature Review

Based on a 2011 assessment by the Indian Bureau of Electrical Energy, there are approximately 18 million agricultural pump sets and 0.5 million new connections with an average capacity of 5 HP added annually. Total amount consumed each year is 131.96 billion KWh (19% of the total electricity consumed) in the agriculture sector. As cited in paper [1] solar powered smart irrigation technique is the future for the farmers and a solution for energy crisis. So for the proposed solar powered system we are using techniques analyzed in paper [2] and [4] and modified. Sine

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PWM technique has been used for inverter operation for minimum harmonics as given in paper [3] which further increases the efficiency of the system. The rating of the system was calculated corresponding to the pump specifications referring to paper [5].

2.1 Objective

The main objective is to design a low cost and time-based irrigation system with the help of microcontroller. Irrigation Scheduler measures various parameters such as humidity, temperature, and soil moisture.

- To develop a smart irrigation system in order to get a significant saving in the consumption of water to irrigate the crops.
- To control the water application convenient for giving light and frequent irrigation and higher water application efficiency.
- To provide sufficient follow capacity to meet the irrigation demand.
- To reduce the erosion of soil that is common in surface irrigation system.

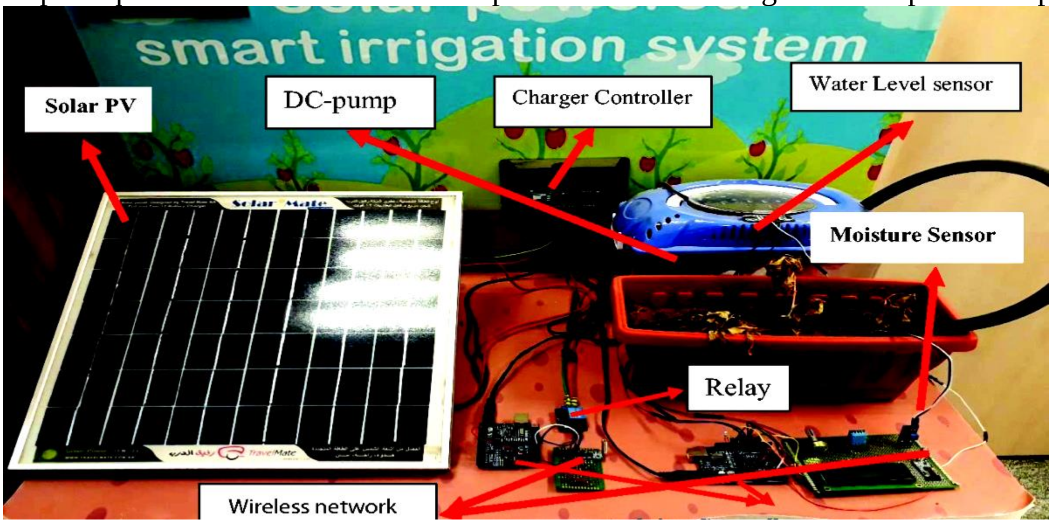
2.2 Scope

- Incomes can rise significantly with IOT based solar irrigation, especially for rural growers who have erratic access to fuel or energy.
- Irrigation through lowers the labor required to distribute water.
- Drip irrigation can lower the pressure of weeds and diseases and improve the effectiveness of chemical application by directing water toward the roots of a crop.
- Water consumption efficiency is greatly increased by smart irrigation.

3. Methodology

3.1 General

With this suggested system, depending on the amount of sunlight, water from a bore well is automatically pumped into a ground level storage tank using solar energy from solar panels. Unlike conventional systems, which include pumping water from a bore well into another well and then onto a field using a different pump, our approach only requires one energy stage, during which the water is pumped into a ground level. Tank, from which the water flow into the field is managed by a basic valve system. This results in significant energy savings and effective use of renewable energy sources. An intelligent algorithm is used to manage a valve, adjusting the water flow into the field based on the land's moisture requirements. Our technique makes advantage of dirt. A moisture sensor measures the amount of moisture in the soil and regulates the flow of water based on the crop's required moisture content. This prevents overwatering of the crops and helps save water.



3.2 System Process Description

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The solar pumping module and the autonomous irrigation module make up the two primary modules of the proposed irrigation system. A solar panel with the necessary specifications is installed next to the pump set in the solar pumping module.

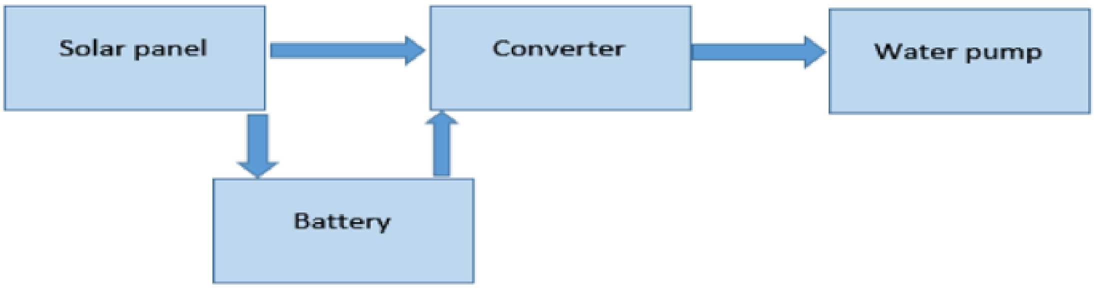

Fig. 1: Block diagram of solar pumping module.

The battery is then charged via a control circuit. The water pump, which is immersed inside the well, receives electricity from the batteries via a converter circuit. After that, the water is pumped into an overhead tank where it is momentarily stored before being released into the field. A soil moisture detecting circuit in the autonomous irrigation module electronically controls the tank's water discharge valve. The crop cultivation field is where the sensor is positioned. The sensor transforms the soil's moisture content into comparable voltage. This is applied to a sensing circuit with a reference voltage that the farmer can modify to set various moisture levels for various crops. The voltage is determined by how much water, soil needs.
A stepper motor that rotates at an angle proportional to the voltage differential was given a control signal. The cross-sectional area of the valve that controls the water flow is in turn controlled by the stepper motor. Water flow is therefore proportionate to the moisture differential.

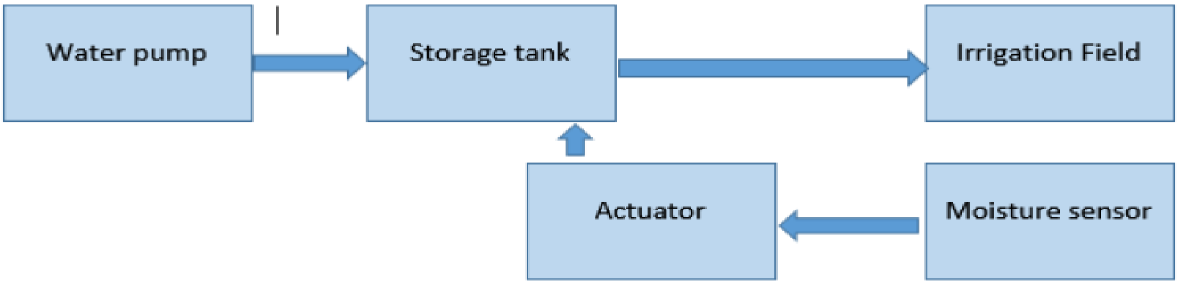

Fig. 2: Block diagram of automatic irrigation module.

3.3 Execution

We are using a 2 HP water pump and a number of modules, each of which is designed and manufactured independently before being put together to execute the suggested system. To capture solar energy, one uses 53W is produced by the PVL-68 solar panel at the nominal operating cell temperature. It's a 24V solar cell of the amorphous silicon variety.

Specification of the solar panel selected:

Short circuit current – 3.98 A
Irradiance – 580 W/m2
Open circuit voltage – 18.1 V
Array capacity --240Wp

A solar panel's maximum and lowest load test readings are tabulated when the test is completed.

Table 1: Load test characteristics of solar panel.

S. No	Voltage (in Volts)	Current (in Ampere)	Irradiance (W/m2)
1	5.2	1.45	300
2	17.5	2.95	710

3.3.1 Design of converter and battery specification

A boost converter is used to create 12V D.C., which is then used to generate 230V D.C., the DC input for an inverter. The technology of sine PWM is utilized to produce 230V AC power. The manufactured inverter circuit is depicted in Figure 4. Concerning the battery, we are utilizing a 12V, 100Ah battery for a 2 HP pump.

3.3.2 Moisture sensor module

A moisture sensor is used to sense the level of moisture content present in the irrigation field. It has a level detection module in which we can set a reference value. This circuit can be used with analog probes that produce a voltage proportional to soil moisture such as VG400 probe shown in Fig. 3. The moisture content of the soil is found by using the soil moisture sensor such as VG400 which produces an equivalent output voltage proportional to the conductivity between the two probes.

Fig. 3: Soil Moisture Sensor probe.

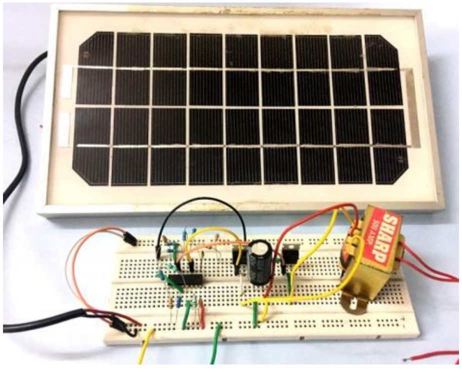

Fig. 4: Inverter circuit.

3.3.3 Automatic valve regulation circuit

We are employing a stepper motor as an actuator control of the valve that is connected to the tank's outflow valve in order to achieve automatic valve control. The driver circuit that activates the stepper motor receives a control pulse from the controller and the moisture sensor signal. In this manner, the exit valve is gradually opened or closed based on the soil's moisture content in the field. When the soil moisture content reaches the required value, the valve is fully closed and power to driver circuit is killed and controller is put into sleep mode for low power consumption. When the moisture in soil is dried and reach a minimum cut-off value, the controller comes out of sleep mode and flow of water is regulated. This way the whole system works automatically.

4. Cost Estimation

Although the initial outlay is substantial, it can be recovered in 2.5 years. The annual cost of pumping water alone comes to Rs. 18 million if we estimate that the cost of power is Rs. 1.5 million per kilowatt hour. We may save up to 4.8 million KWh of electricity a year by employing the solar water pump, which is a significant energy savings. With minor adjustments and circuit upgrades, the extra energy can also be fed into the grid; also can increase the farmer's income.

Table2: Cost analysis.

Component	Unit Cost	Quantity	Total Cost
Solar Panel (1.4m^2)	24000	4	Rs.96000
Converter Circuit	400	1	Rs.400
Battery 24V,100Ah	8250	1	Rs.8250
		Overall cost	Rs.104650

5. Conclusion

The system was found to be successful when implemented for bore holes as they pump over the whole day. Solar pumps also offer clean solutions with no danger of borehole contamination. The

system requires minimal maintenance and attention as they are self starting. To further enhance the daily pumping rates tracking arrays can be implemented. This
system demonstrates the feasibility and application of using solar PV to provide energy for the pumping requirements for sprinkler irrigation. Even though there is a high capital investment required for this system to be implemented, the overall benefits are high and in long run this system is economical.

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