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Review Paper on Solar Power Smart Irrigation System

Megha Dharmik (M.Tech. Student)
Divya Meshram (Assistant Professor)
Priyadarshini College of Engineering, Hingna, India

Abstract: The integration of solar energy with irrigation systems has resulted in smart irrigation systems that are energy efficient, cost-effective, and environmentally sustainable. This review paper provides an overview of solar power smart irrigation systems, highlighting their components, working principles, and performance. The various types of smart irrigation systems based on different control strategies and sensors are discussed, along with their advantages and limitations. The potential of solar power smart irrigation systems in increasing water-use efficiency, reducing water waste, and improving crop yields is also discussed. Additionally, the current state-of-the-art and future trends in solar power smart irrigation systems are presented. Overall, this review provides a comprehensive understanding of solar power smart irrigation systems and highlights their potential in addressing the global water crisis and promote sustainable agriculture.

Keywords : Raspberry Pi, Solenoid Valves Moisture Sensor, Relay Module, Battery, Solar Panel, DC-DC Converter, DC Water Pump

Introduction :

Solar power smart irrigation systems combine the benefits of solar energy and smart irrigation technology to provide an energy-efficient and sustainable solution for agriculture. These systems use solar panels to generate electricity, which is then used to power the irrigation system, reducing dependence on grid electricity. The smart irrigation component of the system uses sensors and control algorithms to optimize water use, reducing water waste and improving crop yields. Solar power smart irrigation systems promote sustainable agriculture and address the global water crisis by using renewable energy and reducing water consumption. This technology has been gaining popularity in recent years due to its many advantages and the increasing demand for sustainable agriculture solutions.

Components :

Raspberry pi :

The Raspberry Pi 3 is a small, low-cost, single-board computer designed to promote the teaching of basic computer science in schools and developing countries. It was introduced in 2016

and is the third generation of the Raspberry Pi family. The Raspberry Pi 3 has a quad-core ARM Cortex-A53 CPU, 1 GB of RAM, and integrated 802.11n wireless and Bluetooth 4.1. It also has various connectivity options, including HDMI, Ethernet, and USB ports, and can run various operating systems, such as Raspberry Pi OS, Ubuntu, and Android. It can be used for a variety of projects, from home media centers and game consoles to DIY cell phones and weather stations.

Solenoid valve :

A solenoid valve is an electrically-operated valve that controls the flow of liquid or gas in a system. It uses a solenoid (electromagnet) to actuate a plunger that opens or closes the valve. Solenoid valves are commonly used in industrial and commercial applications to control fluid flow in pipelines and machinery.

Moisture sensor:

A moisture sensor is a device used to measure the amount of water or humidity present in a material or environment. Moisture sensors come in various types and use different technologies such as capacitive, resistive, or optical methods to determine the moisture content. They are widely used in agriculture, building automation, and other industries where monitoring moisture levels is important for optimizing processes, preventing damage, or ensuring safety.

Relay Module:

A relay module is a compact device that contains one or more relays and is used to control and switch high-power electrical devices. A relay is an electrically-operated switch that uses a low-power input signal to control a high-power output circuit. The relay module provides an interface for connecting to a low-power control circuit, such as a microcontroller, and a separate high-power circuit that operates the load. Relay modules are widely used in automation and control systems for switching lights, motors, and other electrical devices.

Solar panel :

A solar panel consists of a series of photovoltaic (PV) cells, made of materials that produce an electric current when exposed to sunlight. The cells are connected in a series and packaged in a weather-resistant casing, forming a solar panel. Solar panels are commonly used in residential and commercial settings to generate electricity, reducing dependence on fossil fuels and decreasing carbon emissions. They can also be used in remote locations where the grid connection is not possible. Solar panels have improved in efficiency and decreased in cost over the past few decades, making them increasingly accessible and popular.

DC Water pump:

A DC water pump is a type of pump that runs on direct current (DC) electricity, usually from a battery or solar panel. DC water pumps are used for various applications, such as pumping water for irrigation, livestock, and domestic use and draining or transferring liquids in industrial settings. They are commonly chosen for their energy efficiency and ability to run on renewable energy sources, making them a popular choice in remote and off-grid locations. Some of the advantages of DC water pumps include their low voltage requirements, high efficiency, low noise, and long lifespan.

Dc to dc converter:

A DC-DC converter is an electronic circuit that converts a direct current (DC) source from one voltage level to another. It is used to provide regulated DC power from a source of varying or unreliable DC voltage and can improve efficiency, reduce noise and electromagnetic interference (EMI), and increase the usable power output. DC-DC converters can be found in a variety of applications, including portable electronic devices, automotive systems, renewable energy systems, and industrial controls. There are several types of DC-DC converters, including step-up, step-down, and isolated converters, each with specific voltage conversion characteristics and design considerations.

Objective :

The objective of solar power smart irrigation systems is to provide a sustainable and energy-efficient solution for agriculture by combining solar energy and smart irrigation technology. These systems aim to:

- Reduce dependence on grid electricity and promote the use of renewable energy.
- Optimize water use through the use of sensors and control algorithms, reducing water waste and improving crop yields.
- Increase water-use efficiency, leading to a more sustainable and efficient irrigation system.
- Promote sustainable agriculture by reducing the environmental impact of traditional irrigation methods.
- Improve the livelihoods of farmers by increasing food security and reducing operating costs.

By achieving these objectives, solar power smart irrigation systems play a crucial role in addressing the global water crisis and promoting sustainable agriculture.

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