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Automated Irrigation System in Farming by Solar Energy

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ABSTRACT

This paper proposes a automated irrigation system in farming by solar energy. Smart irrigation system powered by solar energy offer several advantages for farmers. That sounds like a fantastic setup! Combining a solar-powered water pump equipped with a moisture sensor for automatic water flow controls offers a smart solution for optimizing irrigation efficiency. The moisture sensor can detect when the soil needs watering, allowing the system to deliver just the right amount of water precisely where and when it's needed. This not only saves water but also optimizes crop growth by avoiding over or under watering. By harnessing solar energy, the system reduces reliance on grid power, saving electricity costs and reducing carbon footprint. Moreover the automatic water flow control helps minimize water wastage by delivering water directly to the plants root as needed, reducing losses due to evaporation or runoff. Additionally, storing excess solar energy in batteries ensures continuous operation even during periods of low sunlight or at night, enhancing the system's reliability and efficiency. Overall, it's a win-win for both farmers and the environment.

Keywords: Smart irrigation, Solar Energy, Solar Panel, Pump, Battery, Moisture Sensor and Temperature Sensor.

Introduction: - India has a significant agricultural sector, playing a crucial role in its economy and society. The nation boasts a diverse array of crops, encompassing rice, wheat, cotton, and tea, positioning it as a prominent agricultural powerhouse. The sector also faces challenges, including the need for modernization, water scarcity, and climate change impacts. Farming is highly dependent on weather conditions, making irrigation systems crucial for the agricultural sector. They help mitigate the risk of droughts and ensure that crops receive the necessary water to grow, regardless of unpredictable weather patterns. Effective irrigation system can significantly improve crop yields and sustainability, making agriculture more resilient to climatic

changes.Farming is depends upon weather, so many trouble come in agricultural business. Irrigation system is very important for this sector. So water resource management plays an vital role in farming. The efficiency of water use is depended on performance of the irrigation technologies and management practices.[1]

Solar energy stands as a crucial renewable resource, and leveraging automation allows for maximizing solar panel output by continuously aligning them with the sun's rays.[1][2]. Creating an IoT-based solar energy system tailored for smart irrigation has the potential to revolutionize agricultural methods globally, especially in regions with water scarcity and high solar insulation. [3]. Smart agriculture, in general, refers to the incorporation of new technologies in crop management to make remote monitoring, resource optimization, and the automation of the systems involved easier [4]. IoT-Powered smart irrigation systems play a pivotal role in agriculture, counteracting the negative impacts of traditional methods on plant health and water usage. Through sensor integration, data analysis, and automation, these system optimize water management, increase crop yields, and promote sustainability in farming practices by providing real-time data insight for informed decision-making and precise control.[5][6]. This paper introduces a smart irrigation system powered by solar energy, employing a water pump to draw from a bore well into a tank, with automated regulation of the tank's outlet valve facilitated by Arduino UNO,GSM, and a moisture sensor. This integrated setup efficiently controls water flow from the tank to the irrigation field, enhancing water usage optimization [7]. The Android app-enabled smart irrigation system, powered by solar energy and controlled by a Raspberry Pi microcontroller, integrate soil moisture and temperature sensors to empower farmers in monitoring and managing their farms efficiently. This innovative solution enables remote irrigation control via a simple Smartphone interface, enhancing agriculture practices [8].Our venture aims to boost the availability of usable energy through the implementation of an automation system. That will maintain for storing solar energy, proper utilization of water in farm and making smart and easy system for water pumping. Energy serves as a cornerstone for the nation's development.

Literature Review

By AGRIVI, Irrigation system are acritical component of modern-day farm management optimizing crop quality and yields. Irrigation systems play a crucial role in agriculture by ensuring that crops receive the water they need to grow, especially in areas where rainfall is insufficient or unreliable. They come in various forms, from simple techniques like furrow irrigation to more advanced method like drip irrigation, each suited to different crops, soil types and environmental conditions [1]. Irrigation plays a crucial role in agriculture, ensuring crops receive adequate water supply for optimal growth. Here's a breakdown of some common irrigation system and their suitability for different types of crops: Surface irrigation, Sprinkler Irrigation, Drip Irrigation, Subsurface Irrigation [2].IoT-driven smart irrigation system are revolutionizing agriculture by optimizing water usage, increasing productivity, and promoting environmental sustainability. By leveraging sensors and data analysis, farmers can make precise decision about when and how much to irrigate, ultimately leading to healthier crops and more efficient resource utilization [3]. Smart Irrigation System in Agriculture, by David Vallejo-gomez conducted a comprehensive review of existing literature on smart irrigation systems, focusing on those employing artificial intelligence techniques in both urban and rural agriculture for soil crops. The aim to identify systems currently in use or adaptable to urban agriculture[4]. Smart agriculture leverages technology to enhance efficiency and productivity in farming practices, from monitoring soil conditions to automating irrigation systems. It's all about using data and automation to optimize crop management processes [4][5].The solar-powered smart irrigation system you described sounds quite efficient. By integrating solar power, a battery, a water pump, and a control circuit, it optimizes water usage for crop based on soil moisture sensing circuit allows for precise irrigation control, ensuring that water is only applied when needed. This not only conserves water

but also helps improve crop yield by providing the right amount of moisture for optimal growth. Overall, it's a smart and sustainable solution for agriculture [6]. Saleh Babaa's Smart Irrigation system, powered by Arduino and solar energy, explores innovative approaches to agricultural irrigation leveraging solar power. Their project involves the development of a smart Auto irrigation system integrating soil moisture sensors connected to an Arduino UNO acting as a controller. Additionally, a global system for mobile communication facilitates data transmission between the controller and the user [7]. Solar-powered water pumping systems offer versatile applications, including town water supply, livestock watering, and irrigation. The irrigation system, in particular, is beneficial for paddy fields, gardens, and other agricultural needs, making it a sustainable solution for watering plants and vegetables [8]. By MeilindaAyundyahrini, The integration of solar water pump systems (SWPS) into agricultural and plantation irrigation, as part of smart farming in Thailand, showcases its effectiveness in supporting food security. SWPS offers usr friendly, cost-effective, and efficient solutions, contributing to increased productivity, income, and overall efficiency in agricultural processes [9]. The primary objective of this project is to create an efficient agricultural irrigation system powered by Solar Energy, utilizing components such as the 8051 series microcontroller, 12V DC mini submersible pump,Op-Amp, LCD, Solar Panel, MOSFET, Relay, Motor, Voltage Regulators, LED, Crystal and Transistors. This system aims to optimize water usage in agriculture, offering numerous advantages to farmers [10][11][12]. The water requirement of crops varies depending on factors such as the type of crop, climate, soil type, and stage of growth. It's typically measured in terms of crop evapotranspiration (ETc) and can be estimated using various methods like the FAO Penman-Monteith equation or crop coefficient approach. Farmers often use this information to optimize irrigation schedules and conserve water resources [14][15]. Implementing an automatic irrigation system with control measures based on soil moisture level is indeed crucial for optimizing crop yield and water management. Integrating renewable solar energy for continuous operation adds another layer of sustainability. A fully automated irrigation system is crafted and engineered through the integration of various hardware components. [16][17][18]. In the end, the research findings from all related literature reviewed that indication technique and process in agriculture and other related field need to automated and improve specially in developing countries around the world. Incorporating solar power not only enhances sustainability but also contributes to creating a cleaner environment, which is vital for agriculture. Implementing these findings could significantly benefit agricultural practices worldwide. Our effort is to make this model very and simple so that every farmer can use it.

Water Requirement of Crops

Crop water requirements are influenced by crop traits, farming methods, and environmental factors. Typically, Corn necessitates approximately 600-650 mm of water, whereas Sorghum ranges from 450-650 mm, varying based on hybrid type and environmental conditions.

Methodology:

In our system, solar energy harvested by the solar panel automatically pumps water from a bore well into a ground level storage tank, adjusting the water flow based on sunlight intensity. By employing a single-stage energy consumption process, water is efficiently directed to the field through a simple valve mechanism, conserving significant energy and promoting the use of renewable resources. Furthermore, a soil moisture sensor detect soil moisture levels, allowing for precise regulation of water flow to meet the crop's specific needs, thus preventing overwatering and conserving water resources effectively across different system level (low, medium and high).

Description

This Automated Irrigation system comprises two main components:1.The Solar Pumping System and 2. The Automatic Irrigation System.

In the Solar Pumping System, a solar panel of specified requirements is installed near the pump set. A control circuit is utilized to charge the battery using solar energy. The battery, in turn, power the water pump via a converter circuit submerged in the well. The pumped water is then stored temporarily in an overhead tank before being released into the field.

Within the Automatic Irrigation System, the water outlet valve of the tank is electronically controlled by a soil moisture sensing circuit. This sensor, positioned in the cultivated field, convert soil moisture content into voltage. The voltage is then compared to a reference voltage set by the farmer, determining different moisture levels for various crops or conditions (low, medium and high). The difference between these voltages indicates the required amount of water for the soil. A control signal activates a stepper motor,which adjust the valve's cross-sectional area to regulate water flow accordingly, ensuring that water usage aligns with soil moisture levels.

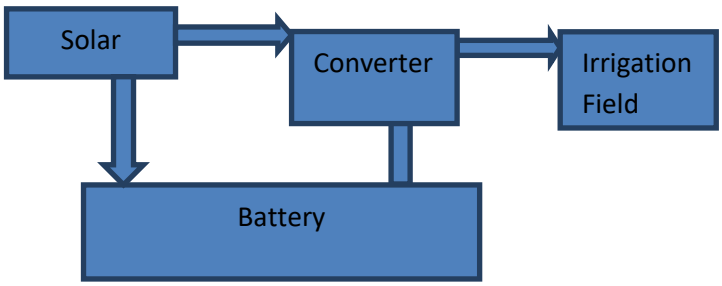

Fig.1 : Block diagram of solar pumping system.

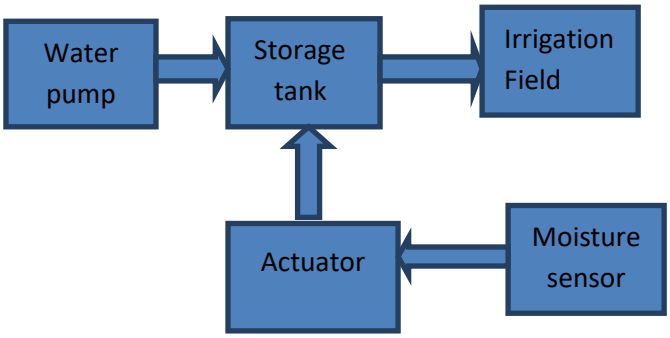

Fig.2: Block diagram of Automatic irrigation system

Operational Reading for the System

Operation	Water Level	Motor Rating (kW)	Torque
Level 1	No	23	Max
Level 2	Low	19	Medium
Level 3	Medium	17	Low
Level 4	High	00	Nil

Conclusion

Our vision for implementing the proposed automated irrigation system entails numerous benefits for both the government and farmers alike. For the government, it present a solution to energy crises, optimizing water usage and reducing wastage while minimizing human intervention for farmers. Moreover, surplus energy generated by solar panels can be fed back into the grid with minor adjustment to the system circuit, potentially becoming a revenue source for farmers. This approach not only promotes farming in India but also addresses energy challenges. Additionally, the proposed system offers an easy-to-implement and environmentally friendly solution for irrigation fields.

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Crop	Duration	TotalWater Requirement (mm)
Rice	110	1000-2500
Wheat	100	450-650
Cotton	165	700-1300
Maize	100	500-800
Soybean	85	450-700
Chillies	205	500
Ragi	95	400-450
Sorghum	105	450-650
Sunflower	110	350-500
Sugarcane	360	1500-2000
Tomato	70	600-800
Cabbage	120	380-500
Bean	90	300-500
Onion	130	350-550

Table 1 - Water Requirement of Crops

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