Solar Based Smart Irrigation System

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Abstract:-

This article presents a novel mobile application utilizing modern information and communication technology for agriculture, centered on the Internet of Things (IoT), embedded systems, and unmanned aerial vehicles (UAVs). The proposed agricultural monitoring system, employing Arduino microcontroller boards, Wi-Fi modules, and environmental sensors, facilitates data collection on temperature, humidity, and soil moisture. UAVs gather environmental data across the farm, enabling cloud-based computation of irrigation requirements for each region. Additionally, the system remotely monitors farm conditions, including water needs, through an Android mobile application, aiding farmers. Results indicate the effectiveness of our IoT-based system in reducing unnecessary water irrigation, aligning with smart agriculture goals.

As the global population burgeons, the demand for increased food production escalates. Traditional farming methods necessitate extensive labor and water usage. This paper introduces a compact automated agricultural system prototype. Employing directional guides, the hardware enables precise processes such as seeding, humidity sensing, and watering, ensuring optimal crop growth and economic viability. From seed sowing to watering, the entire system operates autonomously. Testing involved integrating the hardware with a scaled-down plantation model to validate functionality.

Keywords: Solar Panels, Arduino Uno, Soil Moisture Sensor, Relay, Lithium Battery, PIR Sensor, TP4058 Module, Gear Motor, LDR Sensor, Submersible Pump, Buzzer.

1. Introduction :-

The development of Agricultural Automation Systems aims to alleviate labor burdens and address socio-economic challenges prevalent in the agricultural sector. Leveraging artificial intelligence (AI), such systems optimize various processes including seed sowing and harvesting, enhancing efficiency and productivity. The dwindling professional workforce in agriculture, particularly in countries like India where 70% of the population relies on agriculture, underscores the urgency for automation. Food security remains paramount, necessitating streamlined farming methods. Historically, a significant portion of the population engaged in farming, but urban migration reflects the sector's challenges, including inadequate earnings for farmers and declining growth rates.

Automated agriculture integrates precision techniques and advanced technologies to enhance product quality and production efficiency while reducing labor. Technological advancements enable automation across all farming stages, from seeding to harvesting. Key technologies driving smart farming include autonomous robots, drones (UAVs), sensors, and the Internet of Things (IoT). Developing nations, heavily reliant on agriculture for GDP, face challenges ranging from quality of land and lack of utilities to economic disparities and climate change.

2. Block Diagram :-

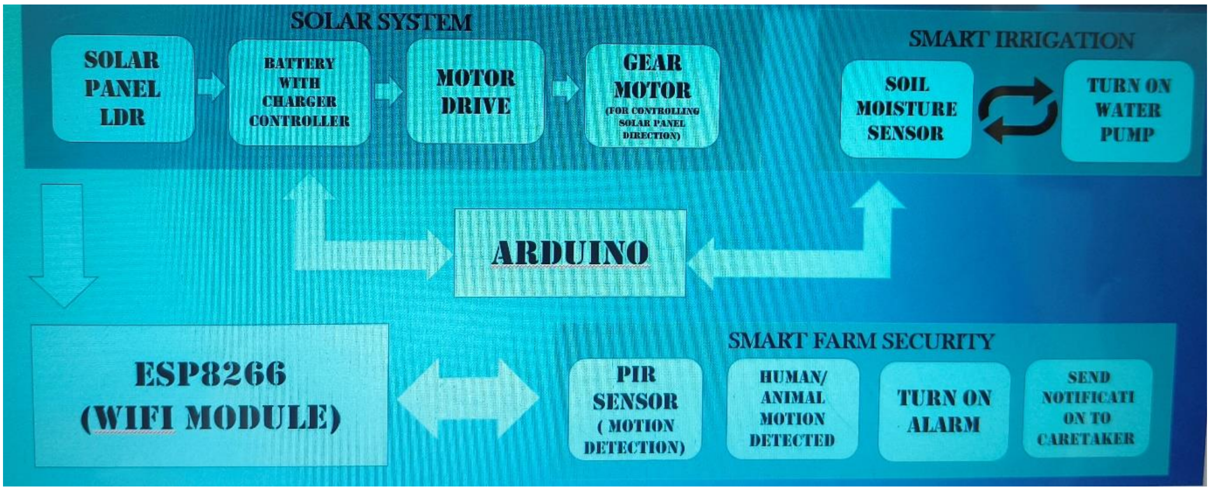

Fig. No. 1 – Block diagram of the project.

3. Working Priciple

A solar-powered automatic plant watering system detects soil moisture levels and waters plants as needed. When moisture decreases below a set threshold, the water pump activates automatically until the desired moisture level is reached. Soil moisture is measured through conductivity between sensor probes. High soil moisture and mineral levels increase conductivity. This system, commonly employed in open fields, maximizes solar energy utilization, powering both itself and the water pump, effectively harnessing renewable resources for agricultural irrigation.
The working principle of a solar-based smart irrigation system revolves around harnessing solar energy to power the system and employing smart technology to optimize water usage in agriculture. This system typically consists of solar panels, sensors, controllers, water pumps, and irrigation equipment.

Solar panels capture sunlight and convert it into electrical energy, which is then stored in batteries or used directly to power the system. Sensors, such as soil moisture sensors, measure environmental parameters critical for plant growth, including soil moisture levels, temperature, and humidity.

A controller unit processes data from sensors and determines irrigation requirements based on preset parameters and crop needs. When soil moisture levels drop below a certain threshold, indicating the need for watering, the controller activates the water pump.

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The water pump, powered by solar energy, draws water from a water source, such as a well or reservoir, and distributes it to the irrigation system. Depending on the system design, water may be delivered through drip irrigation, sprinklers, or other methods tailored to the specific crop and field conditions.

4. Hardware Description

Arduino uno

An open-source microcontroller board that is ideal for learning embedded systems programming is the Arduino Uno. It offers a practical method for grasping the complexities of hardware-software interaction, making it perfect for novices. To encourage openness and facilitate learning, the whole schematic and printed circuit board (PCB) layout for this platform are available online. There are also plenty of thorough instructions available for Arduino Uno Internet of Things (IoT) applications and home automation. All Arduino boards are programmed using a free software package called the Arduino Integrated Development Environment (IDE). It works with a variety of operating systems, including as Linux, macOS, and Windows. There are also rumors that independent smartphone apps may be available that enable programming of Arduino boards, thus increasing accessibility and practicality.

Features:

The operating voltage is 5V
The recommended input voltage will range from 7v to 12V
The input voltage ranges from 6v to 20V
Digital input/output pins are 14
Analog i/p pins are 6
DC Current for each input/output pin is 40 mA
DC Current for 3.3V Pin is 50 mA

Solar Panel

A solar panel is a device that uses photovoltaic cells to turn sunlight into electricity. When exposed to sunlight, these cells, which are usually composed of silicon, produce direct current (DC) electricity. Renewable energy is captured by solar panels and used for a variety of purposes, such as isolated regions, enterprises, and residential buildings.

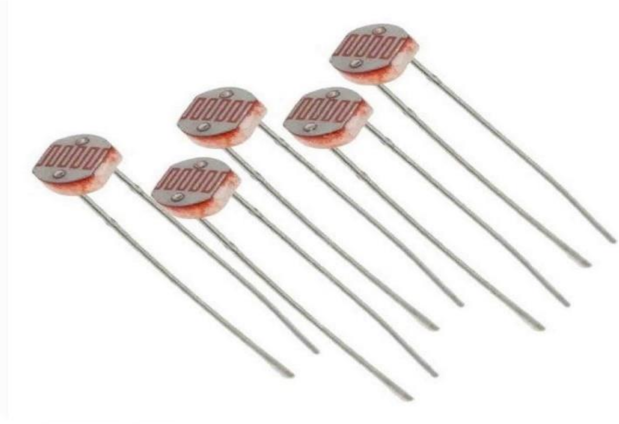
Lithium ion Battery

A lithium-ion battery is a rechargeable energy storage device that utilizes lithium ions to generate electrical power. It is commonly found in portable electronic devices such as smartphones, laptops, and electric vehicles due to its high energy density, long lifespan, and lightweight design.

Gear Motor

A servo motor is a type of rotary actuator that allows for precise control of angular position. It consists of a motor coupled with a feedback sensor that continuously monitors and adjusts the motor's position to match a desired target. Servo motors are commonly used in robotics, automation, and motion control systems for their high precision and accuracy.

LDR Sensor



A resistor type whose resistance varies according to the amount of light it receives is called an LDR (Light Dependent Resistor) sensor. The resistance of an LDR increases in the dark and reduces in the presence of light. Light-sensitive applications including automatic lighting controls, security systems, and streetlights frequently use LDR sensors.

5. Advantages and Disadvantages

Advantages

Using a smart irrigation system is more productive and efficient than using a regular one. Any area that requires water and humidity will be automatically identified by this system, which will then irrigate and fertilize it. In contrast, the old approach just follows the prescribed routine, which may cause certain areas to overwater while leaving other areas dry.
A drip system is how a smart watering system functions. It is a good substitute for conventional watering techniques and contains a soil moisture sensor. It is the most effective way to cut down on water waste.

Disadvantages

The watering system for marts is a little pricey. The number of systems you require depends depend on how big your property is. Naturally, cutting costs on water bills will result in lower costs.
It is best to repair this system underground before planting if you wish to use it to water your grass. because holing will cause damage to certain areas of the lawn.

6. Result

Android-based mobile user interfaces for our smart irrigation system with Arduino RemoteXY. In this study, the two areas of the farm are defined as Area 1 and Area 2. Fartner can simply select any agricultural area and display the relevant environmental information. In the LoT cloud system, the measured values of temperature (°C), humidity (%) and soil moisture (%) are measured by region. The processing latency of the watering rate is 0.5 seconds from the wireless reference transmission of the measured data received from the sensors. describes a practical prototype of the smart irrigation system we developed. Additionally, the hardware components of our proposed LAV for farm-environment data collection are presented as screenshots. In addition, environmental sensors have been successfully tested and evaluated and compared with real weather reports in Riyadh, Saudi Arabia, for example. A successful irrigation control system using artificial neural networks has previously been evaluated, as described in our study.

7. Future Scope

Solar-based smart irrigation systems have significant future scope due to their potential to address key challenges in agriculture, such as water scarcity and energy efficiency. Here are some areas where future advancements could be made:

1. **Energy Efficiency**: Future systems can focus on optimizing energy usage by integrating advanced sensors and algorithms. This could include using AI to predict irrigation requirements based on weather forecasts, soil moisture levels, and crop data, ensuring that energy is used only when necessary.

2. **Water Conservation**: Enhancements in sensor technology and data analytics can lead to more precise water management, reducing water wastage. For example, by incorporating real-time data on soil moisture, temperature, and humidity, systems can adjust irrigation schedules accordingly.

3. **Remote Monitoring and Control**: Future systems could offer more sophisticated remote monitoring and control capabilities, allowing farmers to manage irrigation systems from anywhere using mobile devices. This could include features such as automated alerts, reporting, and scheduling.

4. **Integration with IoT and AI**: The integration of Internet of Things (IoT) devices and artificial intelligence (AI) can further improve the efficiency of solar-based smart irrigation systems. AI algorithms can analyze data from various sources to provide actionable insights, such as predicting crop water requirements and optimizing irrigation schedules.

5. **Scalability and Affordability**: Future systems should focus on scalability and affordability to make them accessible to a wider range of farmers, including small-scale farmers in developing countries. This could involve developing modular systems that can be easily customized and expanded based on the size of the farm.

6. **Environmental Sustainability**: Future systems can prioritize environmental sustainability by using eco-friendly materials and technologies. This could include incorporating solar panels with higher efficiency and durability, as well as using recyclable components.

Overall, the future of solar-based smart irrigation systems lies in integrating advanced technologies to improve efficiency, reduce water usage, and make irrigation more sustainable and accessible to farmers around the world.

8. Conclusion:

This paper delves into the implementation of an IoT-based system in agriculture, emphasizing its design and significance in facilitating efficient farming practices through data analysis. It discusses the design and connectivity of Wireless Sensor Network (WSN) nodes with the internet, highlighting their role in control systems. Cloud-based services are recommended for storing data collected from various sensors and actuator nodes. The study successfully implements a new IoT-based irrigation system for monitoring environmental data in agricultural fields. Additionally, a drone is developed to support smart water irrigation. The research aims to deploy the developed irrigation system in farms within the Shagra province of Saudi Arabia in real-time. Future enhancements include SMS notifications regarding crop-specific irrigation needs and analysis of crop growth stages using a UAV-based camera. Furthermore, the paper proposes incorporating automatic flight control based on hand movements in the future design of agricultural UAVs.

9. Refrences :

1. Boursianis, A. D., Papadopoulou, M. S., Diamantoulakis, P., Liopa-Tsakalidi, A., Barouchas, P., Salahas, G., ... Goudos, S. K. (2022). Internet of things (IoT) and agricultural unmanned aerial vehicles (UAVs) in smart farming: a comprehensive review.18, 100187.

2. Karar, M. E., Alotaibi, F., Al Rasheed, A., & Reyad, O. (2021). A pilot study of smart agricultural irrigation using unmanned aerial vehicles and IoT-based cloud system.Systems and Control. 2101, 01851.

3. Choudhary, R., Rajarathnam, M., Alekya, M., Prithiv Hari, K., & Selva Kumar, S. (2020). Agriculture automation system.Journal of Physics: Conference Series, 1706, 012089.

4. Barkunan, S. R., Bhanumathi, V., & Sethuram, J. (2019). Smart sensor for automatic drip irrigation system for paddy cultivation.Computers & Electrical Engineering,73, 180-193.

5. A. Walter, R. Finger, R. Huber, N. Buchmann Opinion: Smart farming is key to developing sustainable agriculture Proceedings of the National Academy of Sciences, 114 (24) (2017), pp. 6148-6150

6. R. Nukala, K. Panduru, A. Shields, D. Riordan, P. Doody, J. Walsh Internet of things: A review from farm to fork 2016 27th Irish Signals and Systems Conference (ISSC) (2016), pp. 1-6, 10.1109