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Solar Based Irrigation System And Automation In Agricultural Sector

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ABSTRACT:

The irrigation system is one that distributes soil to preferred site. Basically, it is meant for agricultural purposes. The system in place determines irrigation efficiency. From antiquity, the human life is based on agriculture and the irrigation system is one of the tools enabling it. All over the world, there are many other sorts of irrigation systems, but these ones are having a lot of problems. Certainly, there are few modern systems, but most of them lack something or other. Automation has a major impact on the world economy; thus, engineers struggle to come out with combined automatic devices to construct complex systems supporting human activity so the system automatically processes itself without any human involvement. That is why we would want to build an automatic irrigation system. The project, in essence, has mechanical and electrical parts. The electrical component is photovoltaic, which is meant to generate power; the rechargeable battery stores the power. The mechanical component is pump to extract the soil from the source.

INTRODUCTION :

Major challenges for the agricultural industry in recent years have been water scarcity, shifting weather patterns, and the increasing need for food brought on by a growing world population. Often ignoring these problems, traditional irrigation methods lead to bad water use and less-than-ideal crop output. In response to these pressing concerns, the integration of technology into agriculture has proven to be a hopeful solution. The GSM (Global System for Mobile Communications) based irrigation system is a significant advancement in contemporary farming techniques. This system guarantees that crops get the proper amount of water at the suitable time by means of mobile technology allowing farmers remotely monitor and control irrigation operations. Apart from conserving water resources, this automation increases output and quality of crops.

Solar is the energy source most abundant in the world. Not only is solar power a solution to the energy crisis of today but also an environmentally friendly kind of energy. Photovoltaic generation efficiently uses the solar energy. These days, solar panels—an array of photovoltaic cells—run street lights, power soil heaters, and meet household needs. Solar panel prices have been consistently declining, which encourages its use in many other sectors. One of the applications of this technology is irrigation systems for agriculture. Solar powered irrigation system could be a good substitute for farmers in the present energy crisis in India. Once an initial investment is made, this green method of energy production provides free energy.

LITERACY SURVEY :

The integration of technology into agriculture—particularly by means of automated irrigation systems—has drawn much attention in recent years. This literature survey looks at various studies and findings on GSM based irrigation systems and their effects on the agricultural sector.

Research have shown that automated irrigation systems increase water efficiency and crop yields. , for instance, found that while increasing the growth of crops including tomatoes and cucumbers, automated drip irrigation systems significantly reduced water use. A fundamental component of GSM-based systems, irrigation techniques' accuracy is emphasized in this paper.

GSM Farming Technology Many studies have looked at GSM technology in agriculture. examined how well GSM-controlled irrigation systems operated in dry areas; their results indicated that remote control capabilities let farmers run irrigation more precisely, therefore improving water use and crop health. Mobile devices' real-time data transmission and reception enables farmers to make fast decisions.

Water Conservation Water shortage is a significant issue for farming, particularly in drought-prone areas.] contends that GSM-based irrigation systems can produce significant water savings when compared to traditional methods. Their study indicated that farmers who used automated systems cut their water use by as much as 40%, therefore indicating the possibility of sustainable practices in line with water conservation goals.

4. Monetary Benefits Many studies have examined the financial effects of GSM-based irrigation systems. did a cost-benefit study showing that long-term labor and water cost savings could offset the first investment in automation. Moreover, higher crop production can improve general farmer profitability, so enabling the move to automated systems economically feasible.

PROPOSED SYSTEM :

This device consists of a solar panel, which is the main source of energy and is provided to the charging controller to extract controlled power from the solar panel at different irradiation, as well as maintaining the correct charging voltage and current to charge the battery and increase its life. Conservation of water in farmland is managed using a soil moisture sensor microcontroller. The boost converter is used to convert DC to DC power to increase the solar panel's output power because if solar panel receives less light then boost converter gives higher voltage compared to input voltage. Boost converter is a power supply in the switch mode that contains a diode and a transistor with one energy storage part, the capacitor. Filters are used to decrease ripple output voltage. When the switch is opened, because the impedance is higher. The previously created magnetic field will be destroyed to preserve the current flow toward the charge. The polarity must be reversed for this. As a result, there will be two sources in series which will cause a higher voltage to charge the condenser via diode D. Automatic irrigation system comprises solar panel, boost converter, inverter, motor supply, soil moisture sensor, LCD monitor, 4×4 key pad, microcontroller, controller. The soil moisture sensor is inserted into the soil to measure moisture levels, and it also shows specific levels of moisture for different crops. Crops such as paddy, maize, and sugarcane can be irrigated in this scheme. In this device 4×4 key pad is used for the selection of crops. The next important part of the device is solar panel here the solar panel drives the electricity.The solar panel that converts this converted energy to sunlight is sent to power the converter and the battery. The Converter's power is governed by the regulator. Here the microcontroller requires 5v power supply so the device uses IC7805. Also connected to the single AC motor is the power supply. The 12v motor relay is connected to the motor to ON/OFF

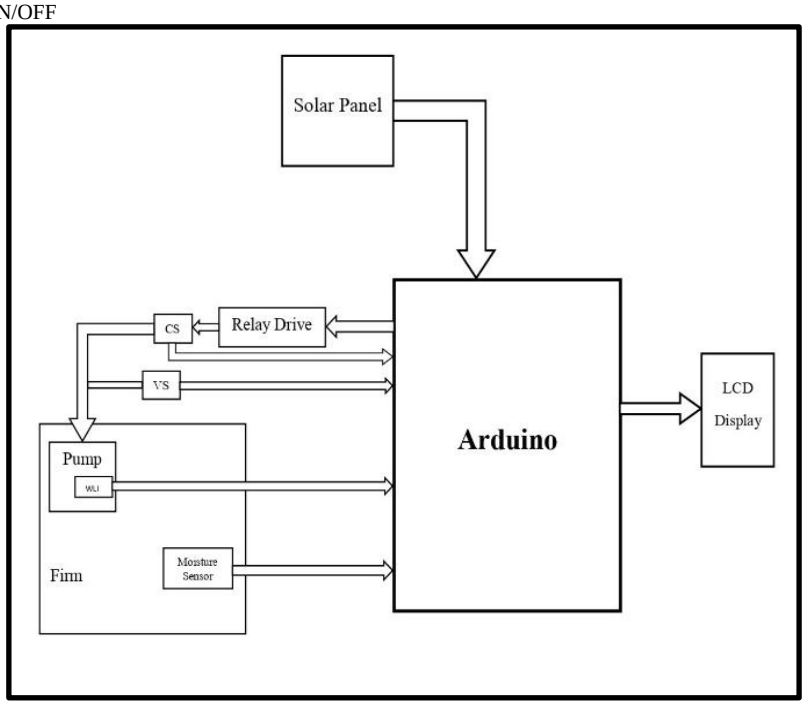


Fig 1: Block diagram of proposed system

HARDWARE USED

This project consists of many hardware components. This proposed technology helps to enable the different types of sensors through the communication with the Microcontroller in Arduino Uno.

Arduino Uno:

Arduino Uno is a microcontroller that is referred to as an actual mini-board. It has various types of pins i.e; analog and digital pins. There are 14 digital and 6 analog pins. Usually, it uses the power 7 to 12 volts for working through the USB cable.

Fig 2: Arduino Uno Moisture Sensor:

Moisture Sensor:

The soil moisture sensor consists of two probes which are used to measure the volumetric content of water. The two probes allow the current to pass through the soil and then it gets the resistance value to measure the moisture value.... Therefore, the moisture level will be higher. Soil moisture sensors measure the volumetric water content in soil.[] Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighting of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content.

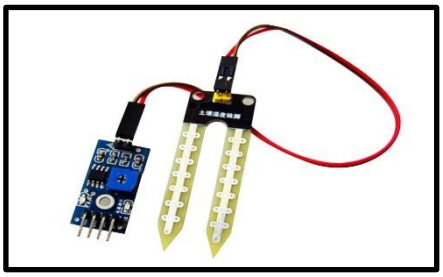


Fig 3: Moisture Sensor

Relay:

In a project that combines object detection on tracks with electricity generation, relays can play a critical role in the brake system. When an object is detected within a critical range, the system can send a signal to activate the relay.

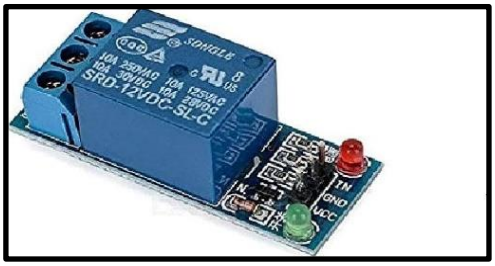


Fig 4: Relay

Water Level Indicator (float type):

A float switch is a type of level sensor, a device used to detect the level of liquid within a tank. It is a simple structure, easy to use level control device; moreover, it is neither a complicated circuit nor does it provide power. This switch has a mechanical switch than the average small sized switches. As long as the material used is in the correct shape and nature of any liquid or pressure, you can control the temperature. Applications of this Switch include shipbuilding industry, generating equipment, petrochemical and food industry, water treatment equipment, dyeing, and finishing industry, and hydraulic machinery.

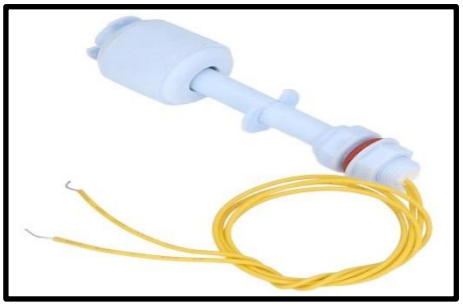
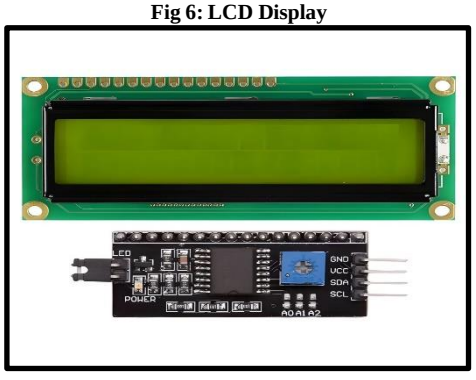


Fig 5: Water Level Indicator (float type)

LCD Display:

LCD modules are very commonly used in most embedded projects, the reason being its cheap price, availability and programmer friendly. Most of us would have come across these displays in our day to day life, either at PCO's or calculators. The appearance and the pin outs have already been visualized above now let us get a bit technical. 16×2 LCD is named so because; it has 16 Columns and 2 Rows. There are a lot of combinations available like, 8×1, 8×2, 10×2, 16×1, etc. but the most used one is the 16×2 LCD. So, it will have (16×2=32) 32 characters in total and each character will be made of 5×8 Pixel.

Fig 6: LCD Display



VI. SYSTEM METHODOLOG

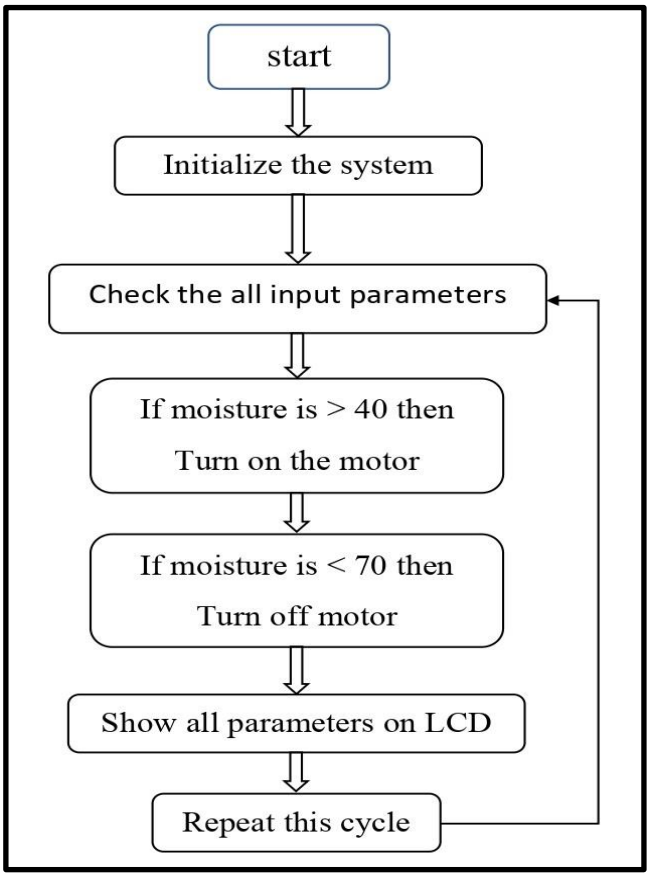


Fig 7: Flow of system operation

VII. EXPERIMENT AND ITS RESULT :

- The solar-based irrigation system successfully automated the watering process.
- Efficiency: Reduced water wastage by 30-40% compared to manual irrigation.
- Cost-effectiveness: Decreased electricity bills due to solar power usage.
- Sustainability: Promoted eco-friendly farming practices by reducing dependency on conventional electricity.
- Automation Benefit: Improved crop health through consistent and timely irrigation.

VIII. ADVANTAGES

1. Boost to Rural Economy.
2. Remote Monitoring and Control.
3. Scalability and Flexibility.
4. Labor Savings.
5. Increased Crop Productivity.

IX . LIMITATION :

1. High Initial Investment.
2. Space Requirements for Solar Panels.

APPLICATIONS :

1. Water-Saving Irrigation.
2. Precision Agriculture.
3. Off-Grid Farming Operations.

4. Greenhouses and Controlled Environment Agriculture.
5. Rural Electrification and Energy Access.

CONCLUSION :

In conclusion, the Solar-Based Irrigation and Automation In Agricultural Sector project presents a transformative solution for the agricultural sector, addressing critical challenges such as water scarcity, high operational costs, energy dependence, and climate change. By harnessing renewable solar energy and integrating automation technologies, the project offers an efficient, sustainable, and cost-effective alternative to traditional irrigation methods. It enhances water use efficiency, reduces carbon emissions, and supports increased crop productivity, benefiting farmers of all scales—from smallholders to large commercial farms. Moreover, the system promotes energy independence, climate resilience, and rural development, fostering long-term sustainability in agriculture. As technology continues to advance, solar-powered irrigation and automation systems will play an increasingly vital role in ensuring food security, improving livelihoods, and contributing to global environmental goals.

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