

SOLAR POWERED DRIP IRRIGATION SYSTEM WITH AUTOMATIC STREET LIGHTING

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ABSTRACT

Agriculture is the backbone of many developing countries, and efficient water and energy management is essential for sustainable farming. The Solar Powered Drip Irrigation System with Automatic Street Light using Arduino is designed to provide an eco-friendly and energy-efficient solution for irrigation and rural lighting. This system uses solar energy as the primary power source, reducing

dependence on conventional electricity and minimizing operational costs.

The proposed system integrates a solar panel, rechargeable battery, soil moisture sensor, water pump, relay module, light dependent resistor (LDR), and an Arduino microcontroller. During the daytime, the solar panel converts sunlight into electrical energy and stores it in the battery. The stored energy

powers the irrigation system and street lighting at night. The soil moisture sensor continuously monitors the moisture level of the soil. When the soil moisture falls below a predefined threshold, the Arduino automatically activates the water pump through a relay to supply water through the drip irrigation network. Once the soil reaches the required moisture level, the system automatically turns the pump off, ensuring efficient water usage.

Keywords: Solar powered irrigation, drip irrigation, automatic street lighting, soil moisture sensor, Light Dependent Resistor (LDR), Arduino microcontroller, photovoltaic panel, rechargeable battery, charge controller, relay module, water pump, embedded systems, renewable energy, smart agriculture, water conservation, LED street light, solar energy storage, automated irrigation control, sustainable farming.

1. INTRODUCTION

Agriculture forms the economic foundation of many developing nations, and India is no exception — a significant proportion of its population depends directly on farming for their livelihood. Among the most pressing challenges facing the agricultural sector today are the efficient management of water resources and the availability of reliable electrical power, particularly in rural and remote farming regions. Traditional irrigation methods such as flood and furrow irrigation result in excessive water usage, uneven crop watering, high labor dependency, and increased energy consumption — all of which contribute to declining agricultural productivity and unsustainable resource depletion [1]. Simultaneously, rural areas across developing countries face chronic problems of irregular electricity supply and inadequate lighting infrastructure, limiting agricultural activity after sunset and reducing safety along farm roads and pathways.

Solar energy has emerged as one of the most viable and environmentally responsible solutions to both the energy and water management challenges in

agriculture. As a clean, renewable, and abundantly available resource, solar power can be harnessed through photovoltaic (PV) panels to generate electricity independently of the conventional power grid — enabling uninterrupted operation of irrigation systems and lighting infrastructure in off-grid farming environments [2]. By storing solar-generated energy in rechargeable batteries through a charge controller, the system can supply power continuously — including during nighttime hours when irrigation monitoring and street lighting are required. The adoption of solar-powered systems also significantly reduces operational costs for farmers while minimizing greenhouse gas emissions associated with diesel or grid-powered alternatives [5].

Drip irrigation represents a transformative improvement over conventional irrigation techniques. By delivering water directly to the root zone of plants through a network of pipes, valves, and emitters, drip irrigation eliminates the losses due to surface evaporation, runoff, and deep percolation that characterize flood irrigation. Research consistently demonstrates that drip systems can reduce agricultural water consumption by 30–60% compared to surface methods while simultaneously improving crop yield and quality [8]. The effectiveness of drip irrigation is further amplified when combined with soil moisture sensing and microcontroller-based automation — ensuring that water is supplied precisely when and where the crop requires it, without any continuous human oversight. The proposed system, "Solar Powered Drip Irrigation System with Automatic Street Lighting," integrates these technologies into a unified, Arduino Uno-based embedded platform. The Arduino serves as the central controller, receiving real-time inputs from a soil moisture sensor and a Light Dependent Resistor (LDR) and generating appropriate control outputs to a relay module that switches the irrigation water pump and LED street lights. During daytime, the solar panel charges the battery through the charge controller while powering the system. At night, the stored battery energy powers the street

lighting — activated automatically by the LDR when ambient light falls below threshold — and continues to support soil moisture monitoring and pump control as required [11]. This integration of renewable energy, sensor-based automation, and smart embedded control creates a cost-effective, self-sustaining, and scalable solution for modern agricultural and rural infrastructure development.

1.2 Problem Statement

Conventional agricultural irrigation practices in India and other developing nations are characterized by widespread inefficiency in both water and energy usage. Flood irrigation — still the dominant method in many small and medium-scale farms — delivers water indiscriminately across entire field surfaces, resulting in excessive water consumption, waterlogging of soil, nutrient leaching, and significant evaporation losses. Studies indicate that traditional irrigation methods waste up to 60% of the water applied, placing enormous pressure on groundwater reserves and surface water bodies in already water-stressed agricultural regions [1][8]. The absence of soil moisture monitoring means that irrigation is performed on fixed schedules or farmer intuition rather than actual crop water requirements, leading to both over-irrigation — which damages root systems and promotes fungal disease — and under-irrigation, which stunts crop growth and reduces yield.

Energy supply presents an equally serious challenge. Many agricultural areas in rural India experience frequent and prolonged power cuts, making reliance on grid electricity for irrigation pump operation highly unreliable. Diesel-powered pump sets, often used as an alternative, impose substantial and increasing fuel costs on farmers while contributing to local air pollution and carbon emissions [7]. The lack of a self-sufficient, renewable energy source that can operate independently of the grid represents a critical gap in the sustainability of small-scale agricultural systems, particularly for farmers with limited financial resources who cannot absorb the

economic impact of both high electricity bills and irrigation crop losses.

Rural lighting infrastructure presents a third interconnected problem. Inadequate and unreliable lighting along farm roads, pathways, and agricultural areas creates safety hazards for farmers who work in the early morning or evening hours and restricts productive agricultural activity to daylight periods. Conventional street lighting systems in rural areas require grid power and manual switching, making them entirely dependent on a power supply that is frequently unavailable. The absence of automatic light control further wastes energy through lights remaining on during daytime or being switched off prematurely due to manual operation lapses [2][7]. These combined problems — water waste, energy unreliability, and inadequate rural lighting — collectively reduce agricultural productivity, increase operational costs, and limit the quality of life in rural farming communities, creating a clear need for an integrated, solar-powered, sensor-automated solution.

1.3 Scope of the Research

This research focuses on the design, hardware implementation, and functional validation of a Solar Powered Drip Irrigation System integrated with an Automatic Street Lighting mechanism, controlled by an Arduino Uno microcontroller and powered entirely by solar energy stored in a rechargeable battery. The scope encompasses two interconnected functional subsystems — an automated soil moisture-based irrigation control system and an LDR-based automatic street lighting system — unified within a single embedded platform and powered by a common solar energy harvesting and storage infrastructure [11].

The irrigation subsystem continuously monitors soil moisture through an analog soil moisture sensor connected to the Arduino's analog input. When the measured moisture level falls below a programmable threshold — indicating that the soil has dried sufficiently to require watering — the Arduino activates the water pump through a relay

module, supplying water through the drip irrigation pipe network directly to the plant root zone. The pump is automatically deactivated once the soil moisture sensor detects that adequate moisture has been restored, preventing over-irrigation and conserving water [8][10]. The street lighting subsystem uses an LDR connected to the Arduino to detect ambient light intensity. During daytime, the high LDR resistance signal keeps the street light relay de-energized, maintaining the LED lights in the off state. As ambient light falls below the threshold at dusk, the Arduino activates the relay to switch on the LED street lights, and reverses this action automatically at sunrise — eliminating the need for any manual switching intervention [2][9]. The solar energy subsystem consists of a photovoltaic panel, a solar charge controller, and a rechargeable battery. The charge controller regulates the charging current from the PV panel to prevent battery overcharging and over-discharging, ensuring safe and efficient energy storage throughout the day-night operating cycle [5][6]. The scope of this research includes component selection, circuit design, firmware development in the Arduino IDE, system assembly, and testing of both subsystems under actual solar irradiation and soil moisture variation conditions. It does not extend to large-scale multi-zone farm automation, GSM/IoT-based remote monitoring, or grid-tied solar energy systems — these are identified as future enhancement directions. The proposed system is designed to be simple, affordable, and reproducible for small-scale farmers, rural communities, and educational project implementations.

2.LITERATURE SURVEY

1. Solar Powered Drip Irrigation for Sustainable Agriculture Author: Food and Agriculture Organization (FAO) Description: This publication examines the application of solar energy in powering irrigation systems for sustainable agricultural water management. The authors highlight that solar-powered irrigation eliminates dependence on grid electricity and diesel fuel, reducing operational costs significantly for rural farmers. The study demonstrates that photovoltaic-driven pumping systems can achieve reliable irrigation performance in remote and off-grid locations, supporting the core energy architecture of the proposed system [1].
2. Solar Energy for Agricultural Applications Author: International Renewable Energy Agency (IRENA) Description: This report evaluates the technical and economic feasibility of solar energy deployment in various agricultural applications including water pumping, irrigation, and rural electrification. The authors present data showing that solar-powered agricultural systems can provide reliable, low-cost alternatives to diesel and grid-powered systems, particularly in developing countries. The findings validate the solar panel and rechargeable battery architecture adopted in the proposed drip irrigation and street lighting system [2].
3. Microcontroller-Based Embedded Systems for Agricultural Automation Author: Muhammad Ali Mazidi, Janice Gillispie Mazidi, and Rolin D. McKinlay Description: This foundational text covers the design principles of embedded systems and microcontroller-based control for automated applications. The authors detail sensor interfacing, relay control, and programmed decision-making techniques directly applicable to Arduino-based agricultural automation. The embedded system design methodology described forms the theoretical and practical basis for the Arduino Uno-based control architecture implemented in the proposed system [3].
4. Arduino Programming for Sensor-Based Automation Systems Author: Simon Monk

Description: This work provides a comprehensive guide to programming Arduino microcontrollers for sensor-interfaced automation applications. The author covers analog sensor reading, digital output control, relay switching, and threshold-based decision logic — all of which are directly implemented in the firmware of the proposed solar irrigation and street lighting system. The study confirms that Arduino Uno is a suitable, cost-effective platform for agricultural automation projects requiring multi-sensor input processing and relay-based actuation [4].

5. Solar Powered Agricultural Systems — Technical Evaluation Author: National Renewable Energy Laboratory (NREL) Description: This technical report assesses the performance of solar energy systems deployed in agricultural environments, evaluating photovoltaic panel efficiency, battery storage capacity, and charge controller operation under varying solar irradiation conditions. The findings provide the technical basis for sizing the solar panel and battery bank used in the proposed system, ensuring that sufficient energy is stored during daytime operation to power both the irrigation pump and LED street lights throughout the night [5].

6. Solar Energy Applications in Rural Areas Author: Ministry of New and Renewable Energy, Government of India Description: This government report documents the deployment of solar energy systems for rural electrification, agricultural water pumping, and street lighting across India. The authors present case studies demonstrating successful solar-powered irrigation and lighting installations in off-grid rural communities, directly supporting the design objectives and application context of the proposed system for Indian agricultural settings [7].

7. Efficient Irrigation Practices and Water Conservation in Agriculture Author: Central Ground Water Board (CGWB) Description: This publication evaluates water conservation strategies for Indian agriculture, with particular emphasis on drip and micro-irrigation techniques. The authors demonstrate that drip irrigation systems reduce water consumption by 30–60% compared to flood irrigation while improving crop yield and soil health. The water efficiency benefits established in this study provide the agricultural motivation for adopting drip irrigation in the proposed solar-powered system [8].

8. Smart Farming Technologies and Automated Irrigation Systems Author: Springer Nature Publications Description: This compilation examines the integration of sensors, microcontrollers, and automation technologies in modern smart farming systems. The authors review soil moisture sensor-based automatic irrigation control systems and evaluate their effectiveness in reducing water wastage and labor requirements. The study confirms that LDR-based automatic lighting and soil moisture-triggered irrigation — the two core automation functions of the proposed system — are well-established and validated smart farming technologies [10].

3. EXISTING SYSTEM

Conventional irrigation systems used in small and medium-scale Indian agriculture rely predominantly on manual water management practices. In flood irrigation — the most widely used method — farmers open field channels or water inlets and allow water to flow freely across the entire cultivated area until the ground appears saturated. This approach requires continuous human presence during irrigation, consumes far more water than the crops actually need, and causes significant losses due to surface runoff, deep percolation

below the root zone, and direct evaporation from the wet soil surface [1]. The irrigation timing and duration are determined by farmer experience rather than actual soil moisture measurements, leading to chronic over-irrigation in some fields and under-irrigation in others — both of which negatively impact crop yield and soil health over time.

In terms of energy supply, most existing small-scale irrigation systems rely either on grid electricity to power AC induction pump motors or on diesel engine-driven pump sets. Grid-powered irrigation systems are unreliable in rural areas where power outages are frequent and prolonged, particularly during peak agricultural seasons when demand is highest. Diesel pump sets impose substantial and continuously rising fuel costs on farmers and require regular maintenance of mechanical components including fuel filters, pistons, and injection systems. Neither source is sustainable or environmentally friendly — grid electricity in India is predominantly generated from coal, while diesel combustion releases particulate matter and CO₂ directly into the agricultural environment [2][7]. There is no provision for energy storage in either approach, meaning that irrigation is entirely dependent on the real-time availability of external power.

Street lighting in rural agricultural areas is similarly dependent on grid power with manual switching by a local operator or timer. These systems require continuous grid connection, are susceptible to power outages, and waste energy when lights are left on during daylight hours due to timer misconfiguration or operator absence. Light-sensitive automatic control is absent in most existing rural lighting installations, and the infrastructure required to extend grid power to remote farm roads and pathways is expensive to install and maintain [2][9]. The result is that large areas of agricultural land and access roads remain unlit during nighttime hours, creating safety hazards for farmers, livestock, and vehicles. The

combination of water-inefficient irrigation, unreliable energy supply, and inadequate automated lighting highlights the comprehensive limitations of existing conventional approaches and establishes a clear case for the integrated solar-powered automated system proposed in this work.

Disadvantages of Existing System

Conventional flood and furrow irrigation methods waste 40–60% of applied water through surface evaporation, runoff, and deep percolation below the root zone. As documented in [1] and [8], this excessive water consumption places severe strain on groundwater reserves and surface water bodies, contributing to water scarcity in already stressed agricultural regions. The absence of soil moisture monitoring means irrigation is performed on arbitrary schedules rather than actual crop need, causing both over-watering — which promotes root disease and soil salinization — and under-watering, which stunts plant growth and reduces crop yield.

Reliance on grid electricity for irrigation pump operation exposes farmers to the full impact of frequent rural power outages, making irrigation unreliable precisely during the critical dry periods when it is most needed. Diesel pump alternatives impose high and rising fuel costs, require regular mechanical maintenance, and generate air and noise pollution in agricultural environments — all disadvantages documented in [2] and [7] that make conventional energy sources fundamentally unsuitable for sustainable small-scale farming.

The complete absence of automation in existing irrigation systems requires continuous human presence and manual labor for pump operation, valve adjustment, and irrigation timing. This dependency increases labor costs, reduces operational flexibility, and makes it impossible to respond promptly to rapid changes in soil moisture caused by unexpected rainfall or high evapotranspiration — all conditions that

automated sensor-based systems handle immediately without human intervention [10].

Existing rural street lighting systems depend entirely on grid power availability and manual or timer-based switching, making them both unreliable and energy-wasteful. The lack of light-sensitive automatic control means lights frequently operate during daylight hours — wasting stored energy — or remain off during nighttime due to power outages or switching failures [9]. The capital cost and technical complexity of extending grid infrastructure to remote farm roads and pathways makes conventional street lighting economically unviable for most rural agricultural communities, leaving large areas inadequately lit and creating ongoing safety hazards for farmers and livestock during early morning and evening working hours.

4. PROPOSED SYSTEM

The proposed Solar Powered Drip Irrigation System with Automatic Street Lighting presents a fully integrated, renewable energy-powered, and sensor-automated embedded solution that simultaneously addresses water management, energy independence, and rural lighting challenges in agricultural environments. The system is built around an Arduino Uno microcontroller that serves as the central control unit, receiving real-time sensor inputs and generating appropriate relay control outputs to manage both the irrigation water pump and the LED street lighting system — all powered by solar energy stored in a rechargeable battery through a solar charge controller [4][11].

The solar energy subsystem forms the power backbone of the entire system. A photovoltaic panel converts incident sunlight into DC electrical energy during daytime hours. This energy is channeled through a solar charge controller — which regulates the charging voltage and current to prevent battery

overcharging and over-discharging — into a rechargeable battery for storage. The stored battery energy powers the Arduino microcontroller, sensors, relay modules, and actuators throughout both day and night operating cycles. This energy independence from the conventional grid ensures uninterrupted system operation even during extended power outages, making it particularly valuable for remote and off-grid agricultural areas [5][6].

The automated irrigation subsystem uses a soil moisture sensor connected to the Arduino's analog input pin to continuously monitor the volumetric moisture content of the soil in real time. The Arduino reads the sensor's analog output voltage, which varies inversely with soil moisture level, and compares it against a pre-programmed lower threshold. When the measured moisture falls below this threshold — indicating that the soil has dried and the crop requires watering — the Arduino drives the relay module to its energized state, closing the relay's normally open contact and activating the water pump motor. Water is then delivered through the drip irrigation pipe network directly to the plant root zones through emitters, ensuring precise and localized water application that minimizes evaporation and surface runoff losses [1][8]. When the soil moisture sensor detects that the moisture level has been restored to the required level, the Arduino de-energizes the relay and stops the pump automatically — completing a self-contained, fully automated irrigation cycle that requires no human intervention.

The automatic street lighting subsystem uses an LDR connected to the Arduino's analog input as a light intensity detector. During daytime, high ambient light intensity causes the LDR resistance to drop significantly, producing a high-voltage signal at the Arduino input that keeps the street light relay in its de-energized state and the LED lights switched off. As evening approaches and ambient light intensity

falls, the LDR resistance rises and the input voltage drops below the programmed threshold. The Arduino detects this transition and energizes the street light relay, switching the LED street lights on automatically without any manual operation [2][9]. The reverse transition at sunrise — when rising light intensity causes the LDR signal to cross back above threshold — automatically de-energizes the relay and switches the lights off, conserving battery charge for the following night's lighting operation. The entire system operates continuously and autonomously, with the Arduino executing its monitoring and control logic in a continuous loop — making real-time decisions based on live sensor data from both the soil moisture and light intensity inputs simultaneously [3][10].

Advantages of Proposed System

The proposed system eliminates dependence on grid electricity and diesel fuel entirely by using solar energy as its sole power source. As validated in [2] and [5], solar-powered agricultural systems provide reliable, low-cost energy in off-grid and rural environments — enabling continuous irrigation and lighting operation regardless of grid availability. The use of a rechargeable battery with a charge controller ensures that stored solar energy is available throughout the night and during periods of reduced sunlight, providing energy autonomy that conventional systems cannot match [6].

The soil moisture sensor-based automatic irrigation control ensures that water is delivered to crops precisely when required and in the exact quantity needed, preventing both over-irrigation and under-irrigation. As established in [1] and [8], drip irrigation combined with automated soil moisture monitoring reduces water consumption by up to 60% compared to flood irrigation while simultaneously improving crop yield — representing a direct and measurable benefit for water-stressed agricultural regions. The elimination of manual

pump operation reduces labor requirements and allows farmers to focus on other productive agricultural activities [10].

The LDR-based automatic street lighting provides reliable nighttime illumination along farm roads and pathways without any manual switching, timer configuration, or grid power dependency. Energy is consumed only when ambient light is insufficient — maximizing battery utilization efficiency and extending the operational life of the lighting system between charging cycles [9]. The complete system is implemented using widely available, low-cost components — Arduino Uno, standard relay modules, a soil moisture sensor, LDR, and commercially available solar panels and batteries — making it affordable, reproducible, and maintainable by farmers and local technicians without specialized technical expertise [4][7].

Circuit Diagram Explanation

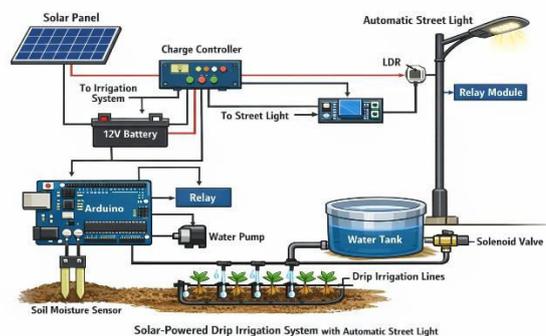


Fig1: Circuit Diagram

The overall circuit of the solar powered drip irrigation system with automatic street light is built around the Arduino Uno, which acts as the central controller of the entire system. The circuit begins with a solar panel that converts sunlight into electrical energy. This energy is regulated using a charge controller and stored in a rechargeable battery to provide a stable power supply for the system. The battery powers the Arduino Uno, sensors, relay modules, and other electronic components. A soil moisture sensor is connected to the analog input pins of the Arduino to monitor the

moisture level in the soil. When the sensor detects dry soil, it sends a signal to the Arduino, which processes the data and activates a relay module connected to a water pump motor. The relay works as an electronic switch that allows the Arduino to control the high-power motor safely. Once activated, the pump supplies water through drip irrigation pipes directly to the plants until the required moisture level is reached.

The automatic street lighting section of the circuit uses a Light Dependent Resistor (LDR) sensor connected to another input pin of the Arduino Uno. The LDR detects the intensity of sunlight and changes its resistance according to the light level. During daytime, the high light intensity causes the Arduino to keep the LED street lights turned off. When night falls and the light intensity decreases, the Arduino senses the change in the LDR signal and activates another relay that switches on the LED street lights. The entire circuit works in coordination through the programmed logic stored in the Arduino Uno, allowing the irrigation system and street lighting system to operate automatically without human intervention. This integrated circuit design ensures efficient water management, energy conservation, and reliable operation using renewable solar power.

5. RESULTS

The results and discussion of the solar powered drip irrigation system with automatic street light show that the system operates efficiently and reliably. During testing, the solar panel successfully converted sunlight into electrical energy and stored it in the battery, which supplied power to all components of the system. The microcontroller, such as the Arduino Uno, effectively controlled the entire process by receiving signals from the soil moisture sensor and light sensor. When the soil moisture level was low, the controller automatically activated the water pump to start the drip irrigation process, ensuring that crops

received adequate water while preventing wastage. Similarly, the automatic street lighting system worked properly by turning on during low light or nighttime conditions and switching off during daylight, which helped in conserving energy. The drip irrigation pipes distributed water directly to the plant roots, improving water efficiency and supporting healthy plant growth. Overall, the integrated system performed successfully, demonstrating that the combination of solar energy, sensor technology, and automated control can provide an efficient, cost-effective, and environmentally friendly solution for agricultural irrigation and lighting, especially in rural areas where electricity supply may be limited.

5.1 Successful Solar Power Generation

The solar panel system successfully generated electrical energy from sunlight and stored it in the battery. The stored energy was sufficient to operate the irrigation system and the automatic street lights. This confirms that the solar energy source can effectively power the entire system without depending on conventional electricity.

5.2 Efficient Operation of the Microcontroller

The microcontroller, such as the Arduino Uno, worked effectively in controlling the entire system. It successfully processed signals from sensors and activated the irrigation pump and street lights according to the programmed conditions. This ensured proper automation of the system.

5.3 Accurate Soil Moisture Detection

The soil moisture sensor accurately detected the moisture level in the soil. When the soil became dry, the sensor sent a signal to the controller, which automatically started the irrigation process. When the moisture level reached the required level, the system stopped watering, helping to prevent water wastage.

5.4 Proper Functioning of the Drip Irrigation System

The drip irrigation system distributed water directly to the plant roots through pipelines and emitters. This method ensured efficient water usage and reduced evaporation losses. The system provided uniform water supply to crops, which is beneficial for plant growth and agricultural productivity.

5.5 Automatic Street Light Control

The automatic street light system worked properly based on light intensity. During nighttime or low-light conditions, the lights turned on automatically, and during daytime they turned off. This feature helps in saving energy and improves safety in agricultural areas during the night.

5.6 Overall System Reliability and efficiency

The integrated system performed reliably during testing. All components such as the solar panel, battery, sensors, controller, irrigation unit, and lighting system worked together efficiently. The results indicate that the system is suitable for agricultural applications, especially in rural areas where electricity supply is limited.

6. CONCLUSION

The solar powered drip irrigation system with automatic street light is an innovative and efficient solution designed to improve agricultural irrigation and rural lighting using renewable energy. The system integrates solar power generation, sensor technology, microcontroller-based control, and drip irrigation techniques to create a smart and automated agricultural system. By using solar energy as the primary power source, the system reduces dependence on conventional electricity and provides a sustainable alternative for farmers, especially in rural and remote areas. The successful implementation of this system demonstrates how renewable energy and

embedded technology can be combined to improve agricultural productivity and resource management.

One of the most important advantages of this system is efficient water management. Traditional irrigation methods often lead to excessive water usage and wastage. In contrast, the drip irrigation method delivers water directly to the plant roots through pipelines and emitters, ensuring that plants receive the exact amount of water required for growth. The soil moisture sensor continuously monitors the moisture level of the soil and sends data to the controller. The controller, such as the Arduino Uno, processes this information and automatically activates or deactivates the irrigation pump. This automation prevents both over-irrigation and under-irrigation, leading to better crop health and efficient water usage.

Another significant feature of the system is the use of solar energy. Solar panels capture sunlight and convert it into electrical energy, which is stored in a rechargeable battery. This stored energy powers the irrigation system, sensors, and automatic street lights. Since solar energy is clean, renewable, and freely available, the system becomes environmentally friendly and cost-effective in the long term. It also helps reduce electricity consumption and minimizes the carbon footprint associated with conventional power sources

The automatic street lighting system integrated with the irrigation setup provides additional benefits for agricultural fields. By using a light sensor, the system detects the level of surrounding light and automatically switches the street lights on during nighttime and off during daytime. This feature ensures proper illumination in agricultural areas, which improves safety and visibility for farmers working at night. It also helps save energy by operating the lights only when required.

The project also highlights the importance of embedded systems in modern technological

applications. The microcontroller acts as the central control unit that connects and manages all the components of the system. Sensors provide input data, while actuators such as pumps and lights perform the required actions based on the programmed instructions. This combination of hardware and software enables the system to operate automatically with minimal human intervention. The use of a microcontroller-based system also makes the project flexible and scalable, allowing additional features or sensors to be added in the future.

In conclusion, the solar powered drip irrigation system with automatic street light is a practical and eco-friendly solution that addresses important challenges in agriculture and rural infrastructure. The integration of renewable energy, sensor technology, and automated control creates a smart system that improves efficiency and sustainability. With further development and large-scale implementation, such systems can play a significant role in promoting modern agriculture, conserving natural resources, and supporting the development of rural communities.

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