# Smart Irrigation System with Solar Power and GSM Technology

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***Abstract*—As of early, all aspects of life are contingent upon intelligent technology. The irrigation system is also becoming more intelligent by utilizing modern technologies, which are more advantageous than traditional methods. The irrigation process is automated through the use of solar power in the development of a clever irrigation system in this paper. This proposed system has the capacity to optimize water usage by analyzing a variety of data, including soil moisture and weather forecasts. It will also inform its proprietor of the current state of the soil and motor using GSM technology. Depending on the water demand in the field, this proposed model can autonomously activate and deactivate the motor pump by sensing the moisture content of the soil. A moisture sensor is employed to gather data regarding the soil moisture level of a specific region. After the water demand is met, the motor will automatically shut off. It will reactivate when the field dries out. The update (ON/OFF) of a motor is transmitted to the producers using GSM technology. An Arduino is responsible for the operation of the entire proposed system. DC power is produced by the solar panel in this instance. Each of these attributes will render the irrigation system considerably more economical and intelligent.**

***Keywords—Arduino, charge control circuit, GSM technology, irrigation system, moisture sensor, relay, solar panel, water pump.***

## I. INTRODUCTION

With the expansion of the global population, energy consumption is increasing rapidly on a global scale. Energy generation must be increased to meet the growing demand. Conventional energy sources, such as fossil fuels, are not environmentally favourable [1] and will be exhausted in the near future [2]. The most effective alternative method of energy generation is through renewable energy sources. Solar energy is currently one of the most prevalent and dependable energy sources. It is classified as a green technology due to its absence of greenhouse gas emissions. This form of energy is capable of powering DC loads within its range, including clever irrigation systems, battery chargers [3], and grass cutters [4]. The irrigation system is a method that artificially regulates the flow of water through pipelines, drains, and other means. The primary objectives of irrigation systems are to facilitate plant growth, maintenance of the landscape, and mitigation of the consequences of insufficient rainfall. Dhekli and Rahat are two traditional irrigation methods, while sprinklers and flood type systems are considered modern methods [5]. The availability of water is a critical factor in agricultural production. Smart water system frameworks guarantee that an adequate water supply is available in the field at the appropriate time. Water is an essential component of all living organisms. The agricultural sector is the largest water consumer, accounting for nearly 70% of the total water consumption [6]. Water wastage is evident during the act of sprinkling the field. A sophisticated irrigation system is necessary to guarantee the efficient utilisation of water in agricultural fields. Numerous investigations are currently underway to enhance irrigation systems. The irrigation system is becoming increasingly intelligent as a result of the implementation of contemporary technologies, which is more advantageous than conventional methods. A soil moisture monitoring system was recently developed in [7] that utilises a low-power consumption MSP430F149 microcontroller to implement the functions of orchard soil data for remote transmission and automatic irrigation. A project is implemented in [8] with the assistance of a framework. This project provides a smart irrigation system that autonomously activates and deactivates the engine based on the dampness content. In [9], an embedded system device (ESD) is developed to manage the irrigation procedure. The PIC18F4550 microcontroller functions as a sensor when it is connected to a GSM module. By monitoring the water level of the rice field, providing feedback to farmers, and providing them with the option to control the water, additional research has been conducted on the correct irrigation of a

field [10]. In [6], an automated irrigation system that is based on the internet of things (IoT) is proposed. This system is capable of delivering the most appropriate amount of water to the vegetation based on the moisture content.
A smart irrigation system is a hybrid of a fuzzy logic controller and the Internet of Things [11]. By sensing soil moisture and temperature, this system can regulate water flow through fuzzy principles. Another clever irrigation system that is based on the Internet of Things (IoT) has been developed,[12] which is capable of monitoring the irrigation process. The process can be managed by the owner through a Thing Speak channel that is connected to an Arduino. [13] A photovoltaic energy-based irrigation system that is both energy-efficient and readily accessible is demonstrated. This system provides the plants with the desired amount of water. A fuzzy-based automated irrigation system is intended to distribute the appropriate quantity of water and electricity to the irrigation system and the pump, respectively [14]. Watering agricultural fields has been a significant challenge for producers in recent years. Decision support systems (DSS) based on wireless sensor and actuation networks (WSAN) are being developed,[20] which can assist farmers in the administration of the irrigation process. In [21], a Raspberry Pi-based automatic irrigation IOT system is suggested for the integration of cloud computing into Precision Agriculture (PA). [22] A fee control terminal-based agricultural power management system is proposed. The fee control terminal functions consist of a combination of communication, data administration and storage, event record, parameter setting, and card processing. This system simplifies the agricultural power consumption process and establishes a stable relationship between the electricity suppliers and the consumer.
This document suggests the development of an automatic smart irrigation system that utilises GSM technology and solar power. The Arduino is provided with continuous data regarding the soil conditions via a moisture sensor. The Arduino will determine whether to activate or deactivate the water pump in accordance with the data. The apparatus is powered by solar energy. Farmers would have the ability to economically irrigate their fields, as solar energy is one of the most cost-effective energy sources. Additionally, this system guarantees optimal water utilisation and minimises water waste.

## II. METHODOLOGY AND DESIGNING OF SMARTIRRIGATION SYSTEM

This model is proposed to automate the irrigation system by sensing the moisture content of the soiland switching the motor pump ON/OFF. Irrigation is of paramount importance in the agricultural sector. Therefore, the implementation of this prototype model can guarantee the timely delivery of an adequate quantity of water to the field. A Arduino UNO series is employed in this undertaking. This Arduino UNO is programmed to receive the input signal of the soil's varying moisture condition through the sensing arrangement.

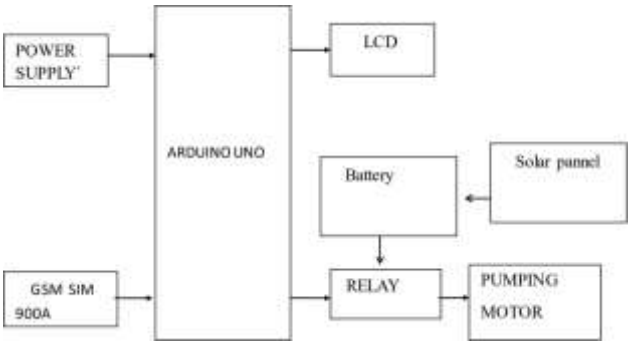


Fig. 1: Block diagram of a Smart Irrigation System with Solar and GSM Technology.

DC power is generated when the sun's beams strike the solar panel, as illustrated in Fig. 1. It is stored in the batteries after passing through the charge controller. Subsequently, it is directed to the inverter, which converts the DC supply to AC. To increase the voltage from 12 volts to 220 volts, a transformer is utilised, which is connected to the relay. The microcontroller and the water pump are connected by a relay. The entire circuit is under the control of Arduino, which serves as the decision-making device. The output command is displayed on an LCD display that is connected to the Arduino. Additionally, a GSM is available for the purpose of transmitting SMS messages to the owner's mobile device. SMS messages are transmitted to the mobile device to notify it that the motor is operational. It performs the same action when the motor is turned off by transmitting the status that the motor is turned off. The moisture sensors, which detect the water level in the soil, are connected by two instruments. A garden plant was utilised to evaluate the intelligent irrigation system. For that purpose, the necessary temperature and daily water consumption were estimated. Assume that The plant requires 600-800 mm of water per day, and the soil's temperature must be between 21°C and 24°C. The Arduino code is configured in accordance with the data. This framework is cost-effective and has the

potential to reduce water waste. Furthermore, in arid regions, an irrigation system necessitates a computerised framework that will effectively monitor and regulate water requirements.

This proposed smart water system framework ensures the correct utilisation of water and saves time. The sensing device's operational principle is illustrated in Fig. 2 as a flow chart.

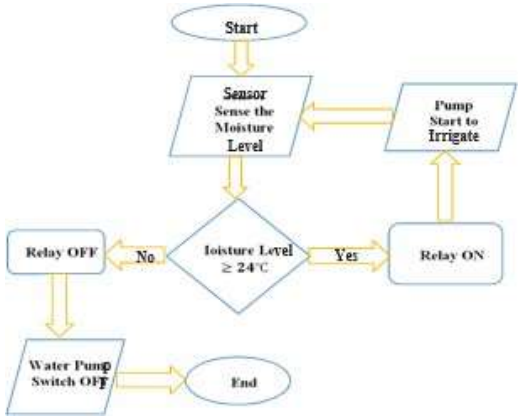


Fig. 2: Flowchart of the working method of the sensing device. device.

## III. SOFTWARE IMPLEMENTATION

In this section, software implementation is discussed. For software setup, all simulations are done by Arduino IDE software. Fig. 3 shows the full circuit diagram of the proposed solar power smart irrigation system. It is shown that, Atmega328 is the GSM module. In the top left corner, an LCD is shown.

Fig. 3: Designed circuit diagram by Arduino.
In the middle of the circuit, a Arduino UNO is shown. This Arduino UNO is the main controlling part which monitors the whole irrigation process.

## IV. HARDWARE IMPLEMENTATION AND RESULT ANALYSIS

In this section, hardware implementation and results are presented. Hardware implementation comes after seeing the successful software simulation. Fig. 6 shows the set-up environment for the practical implementation of the proposed device. Solar panel is seen for the generation of electrical energy which drives the proposed system. Water pump,

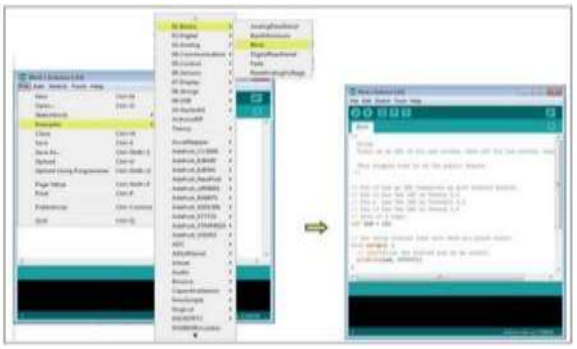

Fig. 4: Code in Arduino IDE software.

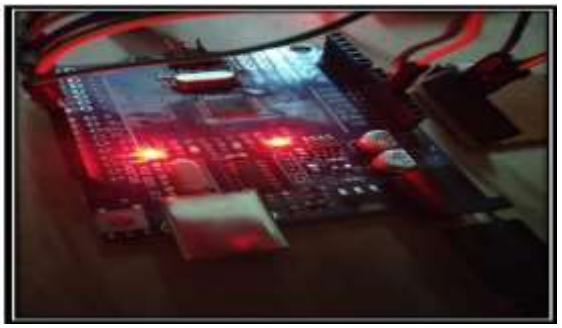

Fig. 5: Smart Irrigation System with Solar and GSM Technology

antenna, capacitor, GSM module, relay and LCD display canalso be seen in Fig. 6. The desired outputs of the proposed systems are shown inFigs. 7 The motor turns on when the moisture sensor finds the soil dry and thus the irrigation process starts. Fig. 7 illustrates that the system is running successfully after sensing the soil moisture level.

Fig. 7. Display is showing output when the soil is dry (Motor is ON)

Whenever the motor turns ON or OFF, the owner is notified by getting SMS through GSM technology. Fig. 8 shows that depending on both motor and soil condition, GSM sends a message to the mobile of the owner.

### 1 ADVANTAGES OVER OTHER TRADITIONAL METHODS

- The water pump can be operated by this system for a few hours in the absence of sunlight
- .The stored energy may be utilised for alternative purposes.
- The water pump is regulated by the soil

moisture sensor, which minimises water wastage.

- The sensors employed are user-friendly and possess a high degree of sensitivity.
- Low power consumption and minimal maintenance.
- By making minor adjustments to the ambient environmental parameters, it can be applied to a variety of plant species.
- The setup can be readily improved and new features can be added.
- A cost-effective system that offers the highest level of automation.

TABLE I. COST ESTIMATION

| Components | Quantity | Price (US dollar) |
|---|---|---|
| Arduino UNO | piece | 6.00$ |
| GSM Module (TTL SIM800) | piece | 4.70$ |
| Transistor BC547 | pieces | 0.05$ |
| Connecting wires | 1 set | 0.90$ |
| 16x2 LCD Display | piece | 1.30$ |
| Power supply 12v 1A | piece | 2.00$ |

## 2 LIMITATIONS AND FUTURE SCOPE OF SMART IRRIGATION SYSTEM

Though the system runs successfully, a few issues are confronted because of low daylight and blustery climate. Another limitation of this system is that the moisture sensor cannot detect the dampness level for all day long in a handy water system field. This framework is exceptionally successful, as nowadays innovation is running with time and it is totally helpful with the way of life of the lifestyle of the human being.

The objective of this project is fulfilled but there is some update that can be done to make this irrigation system more effective.

- GSM can be added for sending SMS to the mobile ifoccurs any problem.
- Ambient temperature, light intensity, and humiditycan be measured.
- Weather update can be sent through SMS
- A solar panel can be used as an automatic sun raytracking system.
- As the proposed system is automatic, an ultrasonic sensor can be used to avoid any type of obstacles for perfect operation.

## V. CONCLUSION

In this proposed smart irrigation system, an automatic mode of operation is designed for watering purposes. With this type of device, no extra assistance is needed. It works perfectly in the absence of the owner by detecting the soil condition through a moisture sensor and according to the condition of the soil, the Arduino runs the irrigation system. It also notifies its user about the current status of both soil and motor. Here, solar power is used as the main source of electricity. Therefore, the availability of electricity is not mandatory. This method of watering the soil is very helpful for farmers especially in the rural areas because of its reasonable cost. To test the performance of the irrigation system in a garden, both dry and wet soils are arranged. Thisproposed system works as per expectation level by providing maximum automation without wasting any water. It is also tested that; the system is able to run the water pump without the sunlight for a few hours with the stored energy in the batteries. Before starting the operation, the moisture sensor needs to be checked.

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