GSM Based Smart Irrigation System

Dr. Malatesh S H[1], Sai Deepak V[2], Manoj H A[3], Sri Hari G K[4], Chandan B R[5]
[1] *Head of Department, Dept. of Computer Science & Engineering, M S Engineering College, Bengaluru*
[2345] *UG Student, Dept. of Computer Science & Engineering, M S Engineering College, Bengaluru.*

***Abstract*—Water scarcity and inefficient irrigation methods continue to challenge agriculture worldwide. This paper presents a GSM-based smart irrigation system using soil moisture sensing, SMS communication, and relay- based pump control. The system aims to optimize water use, reduce manual labor, and improve crop yield in resource-limited rural areas. Field trials on a 5-acre farm demonstrate significant water savings and ease of use. Index Terms—Smart irrigation, GSM, soil moisture sensor, Arduino, sustainable agriculture, remote monitoring. This paper presents the design and implementation of a GSM- based Smart Irrigation System to address water usage challenges in agriculture. The system employs sensors to monitor soil moisture and environmental conditions, and communicates via GSM to alert farmers and control irrigation. The use of GSM ensures reliable operation even in remote areas without internet connectivity. By automating irrigation based on real-time data, the system minimizes water wastage and maximizes crop productivity.**

***Index Terms*—Smart Irrigation, GSM, Soil Moisture Sensor, Automation, Embedded Systems, Water Conservation.**

I. INTRODUCTION

Agriculture accounts for a large proportion of water con sumption globally. Traditional irrigation techniques often lead to water wastage and crop stress due to lack of real-time moni toring. Automated irrigation systems utilizing sensor networks and communication technologies can optimize water use by providing timely irrigation based on soil conditions. Recent advances in Internet of Things (IoT) have enabled smart agriculture systems; however, many rely on stable in ternet connectivity, which is often unavailable in rural areas. GSM-based communication, leveraging widespread mobile networks, offers an alternative that is cost-effective and robust for remote monitoring. This work proposes a GSM-based smart irrigation system using an Arduino microcontroller, soil moisture sensor, GSM module, and relay to automate irrigation. The system sends SMS alerts to farmers when soil moisture drops below a threshold and allows remote activation/deactivation of the water pump via SMS commands.

II. LITERATURE REVIEW

Smart irrigation has been studied extensively in recent years. Various wireless technologies such as Wi-Fi, ZigBee, LoRa, and GSM have been deployed. Kumar et al. proposed an IoT system using Wi-Fi for soil monitoring and irrigation control but noted that network coverage is a critical limitation in rural areas. Patel and Joshi implemented a ZigBee-based sensor network providing high accuracy but faced issues with network complexity and cost. GSM-based systems have gained traction due to their wide coverage. Singh and Chauhan developed an SMS-based irrigation system with basic control features but lacked sensor calibration and user-friendly interfaces.

Other studies demonstrated cloud-based irrigation monitoring with predictive analytics, which, while powerful, depend heavily on internet access. This paper contributes by providing a practical, low-cost GSM system with sensor calibration, robust SMS command handling, field validation, and detailed energy consumption analysis.

The integration of GSM technology into smart irrigation systems has been extensively explored in recent literature, focusing on enhancing agricultural efficiency through automation and remote control. A notable example is the development of Nano Ganesh, a GSM-based irrigation automation system that allows farmers to control irrigation pumps remotely via mobile phones. Since its introduction in 2008, Nano Ganesh has been widely adopted across India, benefiting over 60,000 farmers by enabling them to

manage irrigation schedules without the need for physical presence at the pump site.

Studies have demonstrated the effectiveness of GSM-based systems in automating irrigation processes. For instance, research presented in the International Journal of Sensors and Sensor Networks discusses a GSM-based low-cost smart irrigation system that utilizes wireless valve control to optimize water usage. The system employs GSM modules to send data from soil moisture, temperature, and humidity sensors to a central controller, which then makes irrigation decisions and communicates with the irrigation.

III. METHODOLOGY

A. System Architecture

The System Design and Architecture is built around a modular structure that incorporates real-time data collection, communication, and processing. The system comprises several key components: IoT sensors, microcontrollers, communication modules, and a cloud- based application for data visualization and management. These components work in tandem to ensure the efficient collection, monitoring, and reporting of waste bin fill levels, as well as the timely notification of waste collectors and healthcare staff.

Microcontrollers: The data from sensors is processed using microcontrollers such as the Arduino Uno/Mega or ESP32/ESP8266. These microcontrollers serve as the central unit for data processing, decision-making, and communication between the sensors and cloud- based infrastructure.

Communication Modules: To enable real-time communication and notifications, communication modules such as WiFi (ESP8266/ESP32), GSM (SIM800L), and LoRa are used. These modules facilitate data transmission to the central server or cloud-based application for processing and storage.

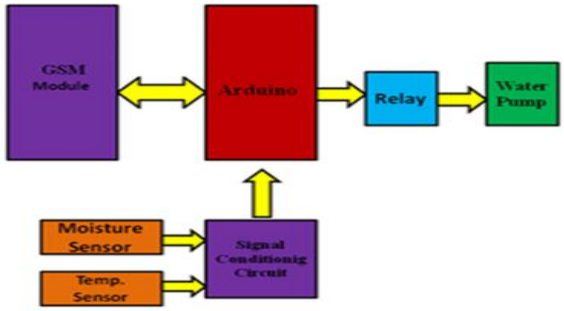


Fig. 1 Automated irrigation system architecture

Fig.1 presents the overall system architecture of scheme, here the sensors such as soil moisture sensor and temperature sensor incorporated in agriculture field, the sensed data from sensors are processed by signal conditioning circuit and compared with pre-determined threshold values of various soil and specific crops. The sensors data from agriculture field are fed to the Arduino processor which is linked to user android mobile via GSM module. In this automated irrigation system, moisture sensor checks the moisture level and if moisture level is found low then Arduino switches on water pump. Water pump gets automatically off when system finds enough moisture in the soil. Whenever system switched on or off. the pump, a message is sent to the user via GSM module, updating the status of water pump and soil moisture [3-5].

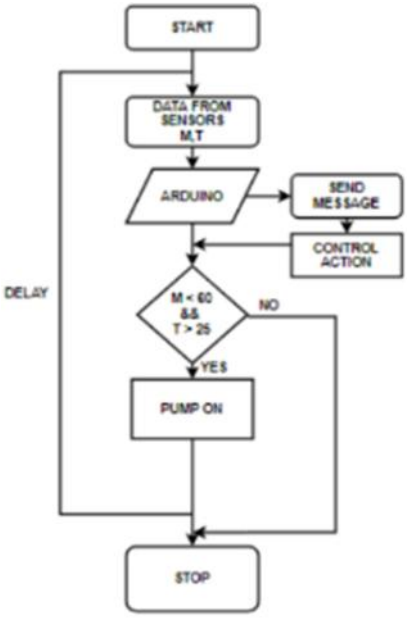


Fig-2: Working Overview

The above flowchart depicts the working of the IOT based smart Irrigation system. In the above example, the pre- set data for the Arduino is given. Moisture shall not be more than 60 and temperature shall not be more than 25. This data can be changed at any given time, according to owner's wishes, with the connected smartphone. If the moisture level or temperature is not according to the pre set data, the sensors will send data to the Arduino automatically, and the Arduino board will then take action accordingly. It will turn on and off the

water pumps. Further, if there is delay in receiving the information from the sensors, Arduino board wil lturn the pumps off if they were on.

Hardware requirements Arduino Uno

Hardware requirements Arduino Uno the ArduinoUno is an opensource microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable.[4] It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts.

GSM Module

In this work TTL SIM800 GSM module is used. The SIM800 is a complete Quad-band GSM/GPRS Module which can be embedded easily with Arduino Uno microcontroller. SIM900 GSM Module provides an industry-standard interface; the SIM800delivers GSM/GPRS850/900/1800/1900MHz performance for voice, SMS, Data with low power consumption. The design of this SIM800 GSM Module is slim and compact.

Soil Moisture Sensor

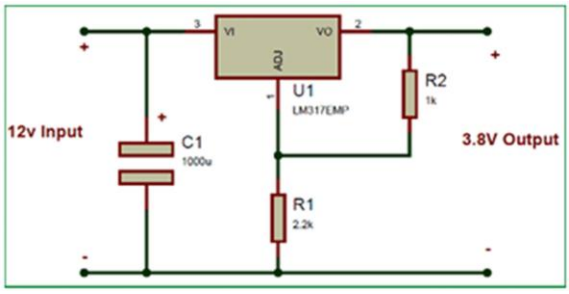
The soil moisture sensor consists of two probes which are used to measure the volumetric content of water. The two probes allow the current to pass through the soil and then it gets the resistance value to measure the moisture value. When there is more water, the soil will conduct more electricity which means that there will be less resistance. Therefore, the moisture level will be higher. Dry soil conducts electricity poorly, so when there will be less water, then the soil will conduct less electricity which means that there will be more resistance.

Temperature sensor

Temperature sensor NTC Thermistor temperature sensor module is low cost, small size module. It is very sensitive to ambient temperature. It is generally used to detect the temperature of the surrounding environment. Through potentiometer adjustment, it is possible to change the temperature detection threshold. The temperature detection range of the module is between 20 and 80 degrees Celsius. Generally, the 4-wire method of thermistor measurement is the most accurate because there is effectively no current flowing in either of the measurement cable wires and therefore no added resistance due to the cable wires.

Circuit & Working

The circuit consists of Arduino Uno which is brain of the project. A 9 V relay is utilized to turn on / off the water pump. Two DC jacks which will power the Arduino and GSM module. Working of this GSM based Automated Irrigation System is quite simple. First of all, it is a Completely Automated System and there is no need of manpower to control the system. Arduino is used for controlling the whole process and GSM module is used for sending alert messages to user on his mobile phone. If moisture is present in soil above the threshold value, then there is conduction between the two probes of Soil Moisture sensor and Arduino Pin D7 remains Low. When Arduino reads LOW signal at D7, then it sends SMS to user about “Soil Moisture is Normal. Motor turned OFF” and water pump remains in off state. Now if Moisture present in soil below the threshold level then Pin D7 becomes High. Then Arduino reads the Pin D7 and turns on the water motor and also sends message to user about “Low Soil Moisture detected. Motor turned ON”. Motor will automatically turn off when there is sufficient moisture in the soil. GSM module is used for sending SMS to the user. A LM317 Voltage regulator is used to power the SIM800 GSM module. Its operating voltage rating is 3.8V to 4.2V. Below is the Circuit Diagram of Power Supply given to the TTL SIM800 GSM Module:The circuit consists of Arduino Uno which is brain of the project. A 9 V relay is utilized to turn on / off the water pump.



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IV RESULT

Outcome of Experiment

MEASURED MOISTURE	MEASURED TEMPERATURE	PRESET MOISTURE	PRESET TEMPERATURE	CONTROL ACTION
80	32	60	25	PUMP OFF
75	29	60	25	PUMP OFF
55	28	60	25	PUMP ON
50	26	60	25	PUMP ON

The above calculations and data were taken and as seen, the system, worked according to the pre-set data and turned on or off the water pumps as required by the soil and information received.
When the moisture level was 80, it turned off the pumps since the moisture level was more than the threshold level (60). The same happened when moisture level was 75 however, when the moisture level was below the set threshold (55 and 50), the pumps switched on and started working.

V FUTURE SCOPE

A lot of future scope are available that can be used with this work to improve the efficiency and effectiveness of the system, the following recommendations can be put into consideration. The idea of using IOT for irrigation can be implemented with this system. Other activities in farming such as cattle management, fire detection and climate control can be introduced with this system. This system can be improvised by adding a Webscaper which can predict the weather and water the plants/crops accordingly. If rain is forecasted, less water is let out for the plants.

VI CONCLUSION

Irrigation plays a vital role for economic in any developing countries like India. Over the years, professionals involved in irrigation implemented manual method of irrigation. The manual method has lots of drawbacks and is quite unreliable for irrigation of big areas. Irrigation has direct impact on cost and production of final product. This system aims to eradicate the traditional manual method of irrigation which needs to be improved over the time. This prototype has many advantages which make it a good alternative to the current approaches since it facilitates the farmers to assist them in daily needs of the monitoring and controlling the field environmental parameters with minimum cost and user friendliness.

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