LoRa based Smart Irrigation System

Deepak Hadkar
Dept. of Electronics Engineering
KJSCE
Mumbai, Maharastra, India
deepak.hadkar@somaiya.edu

Prathamesh Chavhan
Dept. of Electronics Engineering
KJSCE
Mumbai, Maharastra, India
p.chavhan@somaiya.edu

Sakshi Tripathi
Dept. of Electronics Engineering
KJSCE
Mumbai, Maharashtra, India
tripathi.s@somaiya.edu

***Abstract*—The goal of this project is to create an intelligent irrigation system using Long Range (LoRa) technology. The suggested system would make use of numerous sensors to acquire information on the temperature, humidity, and soil moisture levels. Through the use of the LoRa protocol, which allows long-range communication and low power consumption, the data will be wirelessly transferred to a central controller. The central controller will next use the data analysis to assess the plants' watering needs, after which it will send instructions to actuators to change the water flow. Additionally, a user-friendly interface will be built within the system to enable remote monitoring and management of the irrigation system by users. This LoRa-based smart irrigation system is anticipated to provide a number of advantages, including enhanced agricultural productivity, better water conservation, and lower labour expenses.**

***Index Terms*—LoRa, smart irrigation, IoT, wireless communication.**

I. Introduction

The majority of irrigation systems in use today operate manually. Automated and semiautomated processes have replaced these out-of-date methods. The practical traditional irrigation techniques look like drip irrigation, sprinkler systems, ditch irrigation, and terraced irrigation. The increased need for greater agricultural productivity, inadequate execution, and decreased availability of water for agriculture are categories for the global irrigation scenario. We can solve these problems by implementing intelligent irrigation systems.

The goal of this project is to create a smart irrigation system that gives farmers a tool to produce high-quality crops while saving water and money on labour. The system uses a variety of sensors to detect variables including humidity, temperature, and soil moisture content. The cost-effectiveness, low power consumption, and data security of LoRa and MQTT technologies make them recommended for data transfer. Data is sent through WiFi and the system is connected to the internet using the ESP32 TTGO boards as communication devices. With the help of the suggested method, farmers would be able to remotely monitor their irrigation system, cutting labour costs and boosting productivity. The initiative is a step towards smart farming, a theory that is meant to increase agricultural production and output while preserving resources.

II. Overview of Existing Systems

Ravi Kodali, Mohan Kuthada - The solution that is being discussed uses LoRa technology to publish data to IBM Bluemix after being sent from a device in the field to a primary device. The data is examined using Node-Red flow, and the analysis is used to trigger the motor event. By utilising a URL to access the Node-Red flow from any device, the user may easily manually operate the motor. The system is simple to operate, requires little upkeep, and is reasonably priced while helping to enhance crop productivity, earnings, and food production. The IBM cloud provides data protection and enables remote device operation from any location in the world.[1]

Data from the Inlet, Outlet, and Weather Station sensors are transmitted to the NECTEC server via LoRa in the proposed system. In the drainage canal, field, and irrigation canal, the sensors detect a variety of characteristics, including water level, soil moisture, pH, temperature, and pressure. GSM signal strength, barometric pressure, humidity, light, rain, temperature, wind speed, and direction are all measured by the weather station. To modify the Watergate and satisfy water needs, the data is then processed and analysed. On the cloud server, the data sets are accessible from Paddy Field in Myanmar to the NECTEC server in Thailand.[2]

A Concentrator, End Nodes (Sensor Nodes and Control Nodes), a Local Database User Interface, and a Web Server Web Interface are all included in the system design. The Concentrator regulates the irrigation system, organizes the network, and gathers data from the sensor nodes. While the Control Nodes manage actuators like pumps and valves, the Sensor Nodes gauge the temperature, humidity, and wetness of the soil. All system data is kept in the Local Database User Interface, where users may also monitor and control the system. The Web Server and Web Interface store data, offer tools for remote monitoring and control and allow for data analysis in accordance with user needs.[3]

Monitoring soil moisture and air temperature in agricultural areas is possible with LoRa technology. In this research, LoRa technology was used to transmit data on air temperature and soil moisture across equipment, enabling low-cost soil temperature and humidity monitoring. The system enables communication between an access point and the ESP32 microcontroller for data transmission utilising the Ceyene programme at a frequency of 433 MHz. According to the study, LoRa technology provides an effective and reasonably priced method for monitoring agricultural areas.[7]

LoRa Nodes and LoRa Gateway make up the LoRa system. The LoRa Gateway, which serves as a relay between LoRa Nodes and the LoRa network server, is the subject of this study. A LoRa Gateway with excellent signal reception sensitivity is intended to facilitate two-way multi-channel communication across an area as big as several square kilometres. For outdoor deployment, it should also be capable of high processing performance, have rich interfaces, and be water-resistant. Five functional modules, comprising the controller, localization, power management, LoRa, and communication modules, make up the LoRa Gateway. Enclosures offer levels of protection that are compliant with the IP65 standard.[11]

III. PROBLEM STATEMENT

Agricultural fields are far from the farmer's home, making it difficult to keep an eye on them. Several factors, including air and soil temperatures, have a significant impact on agricultural output. Using a frequency of 433 MHz, the first low-cost implementation of Lora, a spread spectrum modulation method developed from spread spectrum chirp technology, can transport data up to 7.5 km away. In this study, Lora technology, which does not require cellular frequencies, was used to transmit data on soil moisture and air temperature between equipment. Data may be sent online for internet-based monitoring by connecting Lora to the ESP32 microcontroller and utilising the Ceyene programme. The study demonstrates that soil temperature and humidity monitoring using Lora technology is affordable. Air temperature and sensor depth variations were used to establish the test setting.

IV. BLOCK DIAGRAM

The block diagrams for LoRa based smart irrigation system is specified in Fig. 1.

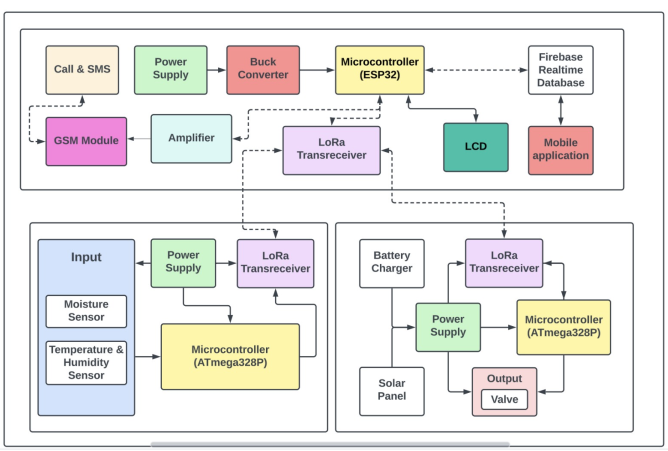

Fig. 1. Block Diagram of LoRa-based Smart Irrigation System

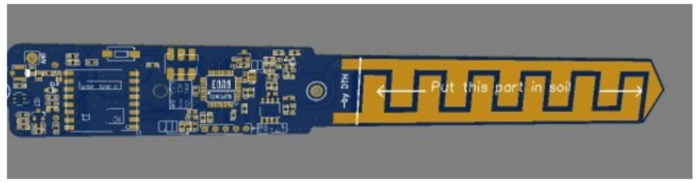

Fig. 2. PCB Design of Soil Moisture sensor

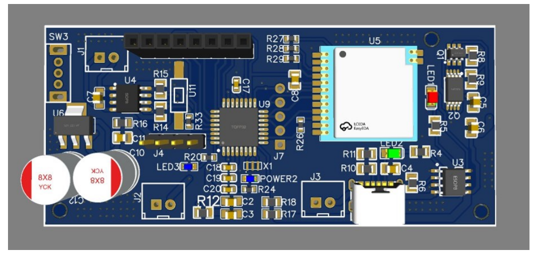

Fig. 3. PCB Design of Smart Valve

V. IMPLEMENTATION

- First, we conducted a literature review before starting this work. We gathered a lot of studies that are pertinent to this topic. These publications taught us that managing space and electricity should also be taken into account.
- The components that were necessary for our project were then decided upon.
- A smart valve (Electric tap) and soil moisture sensor that can measure moisture, temperature, and humidity were built with consideration for the power and space requirements. Both variants rely on an RFM98W-sx1278 chip for communication and an ESP32 controller. Below is a display of two PCB designs.
- To manage and keep track of the health of the plants, a web, and mobile application should be created. Below is a screenshot of the user interface for the web app.
- Finally, the parts can be synthesized before being put together.
- Lastly taking the experimental observations, calculations may be done, after which the result can be concluded.

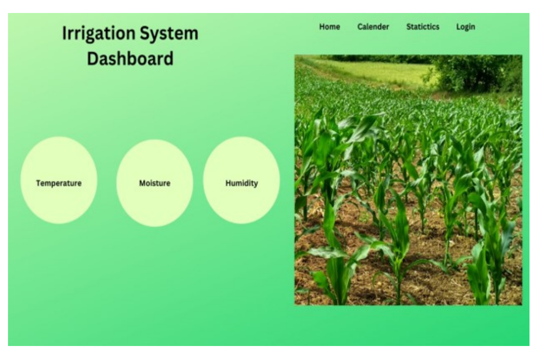

Fig. 4. Web Application Dashboard

Testing

Fig. 5. Web Application LogIn page

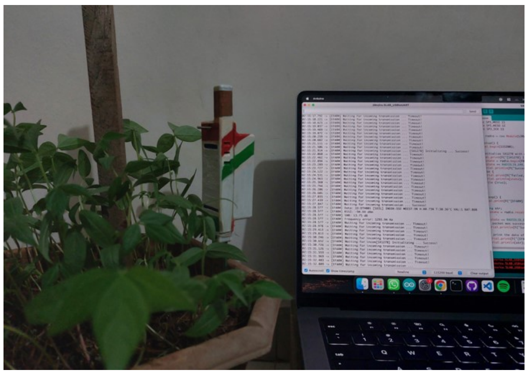

Fig. 6. Testing at nearby location

VI. CONCLUSION

The LoRa-based smart irrigation system provides a viable answer for raising agricultural yield while lowering water use, to sum up. The suggested system architecture consists of an application for monitoring and managing the irrigation system, a LoRa Node and LoRa Gateway for data transmission, and a cloud for data processing and storage. The LoRa Gateway is built to handle two-way, multi-channel communication, excellent water resistance for outdoor deployment, extensive user interfaces, and high processing performance. The system's ability to monitor soil moisture and air temperature was evaluated, and the findings demonstrated that LoRa technology makes it possible to do so inexpensively and effectively. Overall, the system offers a cost-effective and scalable solution for remote irrigation management.

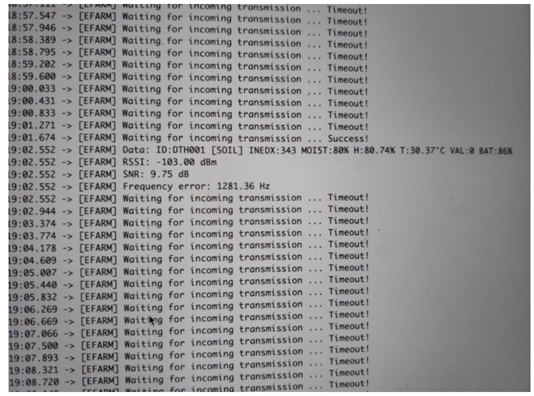

Fig. 7. Testing in football field

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