WIRELESS WATER MANAGEMENT SYSTEM USING LORA

This project report is submitted to

Yeshwantrao Chavan College of Engineering
(An Autonomous Institution Affiliated to Rashtrasant Tukdoji Maharaj Nagpur University)

In partial fulfillment of the requirement
For the award of the degree

of

Bachelor of Technology in Electronics & Telecommunication Engineering

by

Nandini Bondre

Ajit Ghawghawe

Ayushi Bhiwapurkar

Aditya Dodal

Under the guidance of

Prof. Y. S. Kale (Guide)

DEPARTMENT OF Electronics & Telecommunication Engineering

Nagar Yuwak Shikshan Sanstha's

YESHWANTRAO CHAVAN COLLEGE OF ENGINEERING,
(An autonomous institution affiliated to Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur)
NAGPUR – 441 110

2023-2024

CERTIFICATE OF APPROVAL

This is to Certify that the project report entitled "**WIRELESS WATER MANAGEMENT SYSTEM USING LORA**" has been successfully completed by **Nandini Bondre, Ajit Ghawghawe, Ayushi Bhiwapurkar and Aditya Dodal** under the guidance of **Prof. Y. S. Kale** in recognition to the partial fulfillment for the award of the degree of Bachelor of Engineering in Electronics & Telecommunication Engineering**, Yeshwantrao Chavan College of Engineering** *(An Autonomous Institution Affiliated to Rashtrasant Tukdoji Maharaj Nagpur University)*

Signature	*Signature*	*Signature*
Prof. Y. S. Kale	**Er. Bhushan Kawale**	**Dr. Milind Narlawar**
(Guide)	**(Co-guide/ Industry Person)**	**(HoD, ET Dept.)**

Signature of External: Examiner

Name:

Date of Examination:

DECLARATION

We hereby declare that:

a. The work contained in this project has been done by us under the guidance of my supervisor(s).

b. The work has not been submitted to any other Institute for any degree or diploma.

c. We have followed the guidelines provided by the Institute in preparing the project report.

d. We have conformed to the norms and guidelines given in the Ethical Code of Conduct of the Institute.

e. Whenever we have used materials (data, theoretical analysis, figures, and text) from other sources, we have given due credit to them by citing them in the text of the report and giving their details in the references. Further, we have taken permission from the copyright owners of the sources, whenever necessary.

Signature & Name of the Students

1. Nandini Bondre

2. Ajit Ghawghawe

3. Ayushi Bhiwapurkar

4. Aditya Dodal

ACKNOWLEDGEMENT

Nandini Bondre

Ajit Ghawghawe

Ayushi Bhiwapurkar

Aditya Dodal

Date:- 09/10/2023

Acceptance Letter for Project

To,

    Head of the Department
    Electronics & Telecommunication,
    YCCE, Nagpur.

Subject: Letter of acceptance of final year UG project.
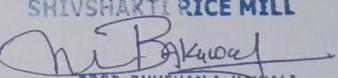
Dear Sir,

  I the Undersigned confirm my acceptance as a industry co-guide for the UG project titled " **Wireless Water Management System Using Lora** " under the guidance of **Prof.Y.S.Kale**. I will provide the necessary guidance for smooth completion of their project work.
    Thanking You.
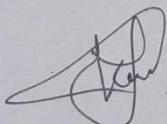
Name of the Students
1.Nandini Bondre
2.Ajit Ghawghawe
3.Ayushi Bhiwapurkar
4.Aditya Dodal

SHIVSHAKTI RICE MILL

PROP: BHUSHAN A. KAWALI

Sign. of Industry person
Designation
Seal and Stamp.

Project Completion Letter

Date: 14/05/2024

To,
Head of Department,
Electronics and Telecommunication Department,
Yeshwantrao Chavan College of Engineering, Nagpur.

Subject: Completion of UG project
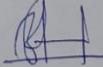
This is to certify that the following students of Electronics and Telecommunication department of Yeshwantrao Chavan College of Engineering have successfully completed final year project titled "Wireless Water Management System Using LoRa" for the academic session 2023-24.

Thanking you.

Projectees:

1. Nandini Bondre
2. Ajit Ghawghawe
3. Ayushi Bhiwapurkar
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ABSTRACT

This water tank management system utilizing LoRa technology enables real-time monitoring and management of water levels at a lower cost than conventional methods, aiding in optimizing water supply planning, mitigating shortages, and curbing wastage through timely visualization and alerts. Supported by a rural case study, its effectiveness across diverse sectors is highlighted, including agriculture, industries, urban areas, and domestic settings. Leveraging LoRa technology, the system offers a scalable and energy-efficient solution for addressing common water management challenges such as overflow and ensuring a sufficient water supply. This innovative system promotes efficient water usage, contributing significantly to sustainable water resource management efforts, and empowering stakeholders to advocate for responsible practices and participate in water conservation.

CHAPTER 1

INTRODUCTION

1.1. Overview:

Water scarcity and contamination pose significant global challenges necessitating innovative solutions for effective water management. This research introduces a Wireless Water Management System utilizing LoRa technology to address prevalent water overflow issues across diverse environments. Leveraging LoRa's long-range communication capabilities, the system enables real-time remote monitoring and automation of water pumps and motors, optimizing water usage and reducing wastage significantly.

1.2. Literature Survey:

Sr. No.	Title	Technique/Methodology used	Limitations
1.	An internet of things-based model for smart water management.	Combination IoT technologies, data analytics, and domain- specific knowledge in water management to develop an effective smart water management model.	The accuracy and reliability of data collected from IoT sensors could be affected by various factors such as environmental conditions, and sensor drift over time, potentially impacting the effectiveness of the model.
2.	Microcontroller based automated water level sensing and controlling design and	This paper aims to design, implement, and evaluate an effective microcontroller-based automated water level sensing and controlling system for efficient water	Energy Consumption and cost of implementing was high.

	implementation issue.	management.	

Table 1. Literature Survey

1.3. Problem Statement:

In regions like South Africa's Western Cape and parts of India, water shortages endanger food production. This project addresses the challenge by developing a smart water management system utilizing LoRa technology. It aims to monitor water resources in real-time, optimizing their usage for irrigation to mitigate wastage and guarantee adequate water supply for crops, particularly during dry periods. By integrating LoRa technology into water management practices, this initiative seeks to enhance agricultural sustainability and resilience in water-stressed regions, ultimately safeguarding food security in the face of water scarcity.

1.4. Thesis Objectives:

To design, develop, and evaluate a robust and efficient water controller system utilizing LoRa technology for remote monitoring and control of water distribution networks. The thesis aims to investigate the feasibility, reliability, and performance of the LoRa-based system in optimizing water usage, reducing wastage, and improving overall water management efficiency.

1.5. Thesis Organization:

Chapter 1 has the Introduction section consisting of Overview, Literature Survey, Problem Statement, Thesis objective and Thesis organization.

Chapter 2 has the Review of Literature and best of them were incited in the proposed plan to make better outcomes.

Chapter 3 consist of work done in "WIRELESS WATER MANAGEMENT SYSTEM USING LORA".

Chapter 4 comprises of Results and Discussion of the project.

Chapter 5 finishes the report Summary and Conclusions.

CHAPTER 2

REVIEW OF LITERATURE

2.1. Overview:

This chapter reviews the various literature survey done on smart Water Management System. This chapter also discussed the work done by other researcher in the field of Water Management System.

2.2. Literature Survey:

A water controller manages water distribution and usage efficiently. It comprises sensors to monitor water levels, microcontrollers to process data, and actuators to control flow. The system optimizes water usage, reduces wastage, and ensures equitable distribution. Challenges include sensor accuracy, energy efficiency, and system reliability. Solutions involve calibration, energy-saving algorithms, and redundant components. Integration with IoT enhances remote monitoring and control. Community engagement and regulatory compliance are crucial. Overall, a water controller facilitates sustainable water management, addressing challenges of scarcity and contamination while promoting conservation and equitable access to water resources.

Some of the Water Management System available are:

A. Energy-Efficient Water Management Platform (EEWMP)-

The Energy-Efficient Water Management Platform (EEWMP) integrates smart sensors, IoT connectivity, and data analytics to optimize water distribution and treatment processes while minimizing energy consumption. It employs advanced algorithms for predictive maintenance, leak detection, and demand response, alongside energy- efficient technologies. User-friendly interfaces enable remote monitoring and control, enhancing sustainability and reducing operational costs. Integration with renewable energy sources further enhances efficiency and environmental sustainability in water management [1].

B. Automatic water management system-

An automatic water management system efficiently controls water usage and distribution. It incorporates sensors to monitor water levels, quality, and usage patterns, while microcontrollers process data and actuators regulate flow. IoT connectivity

enables remote monitoring and control, optimizing water resources. The system employs algorithms for leak detection, predictive maintenance, and demand response, ensuring reliability and efficiency. User-friendly interfaces facilitate easy management, contributing to sustainable water usage and conservation efforts [2].

CHAPTER 3

WORK DONE

3.1. CONSTRUCTION AND DESIGN:

1. Magnetic Float Sensor Operation: The magnetic float sensor comprises a float with an internal magnet and an external magnetic switch. As water levels change, the float moves, causing the magnet to approach or move away from the switch. When near, the switch closes, completing a circuit, indicating high water level; when distant, it opens, indicating low water level.

2. Connection to Microcontroller: The magnetic float sensor connects to the microcontroller, like ATMEGA328P, via input pins. The microcontroller monitors the switch state to detect high or low water levels.

3. Data Processing by Microcontroller: The microcontroller processes sensor input, determining water levels based on switch states. Additional processing may include averaging readings or comparing with predefined thresholds.

4. Transmission to LORA Transmitter: Processed water level data is sent from microcontroller to the LORA transmitter. Communication occurs through SPI or UART protocols.

5. Wireless Transmission via LORA: LORA transmitter wirelessly sends data to LORA receiver over long distances with low power usage. LORA modulation ensures reliable communication in noisy environments.

6. Reception by LORA Receiver: LORA receiver decodes transmitted data and forwards it to a microcontroller.

7. Control of Motor Pump via Microcontroller and Relay: The microcontroller on the receiver processes water level data. Based on conditions, it controls a relay connected to the motor pump.

8. Motor Pump Control: Microcontroller commands relay to switch motor pump power based on water level data. Automated control optimizes water distribution and system efficiency.

Transmitter End

Receiver End
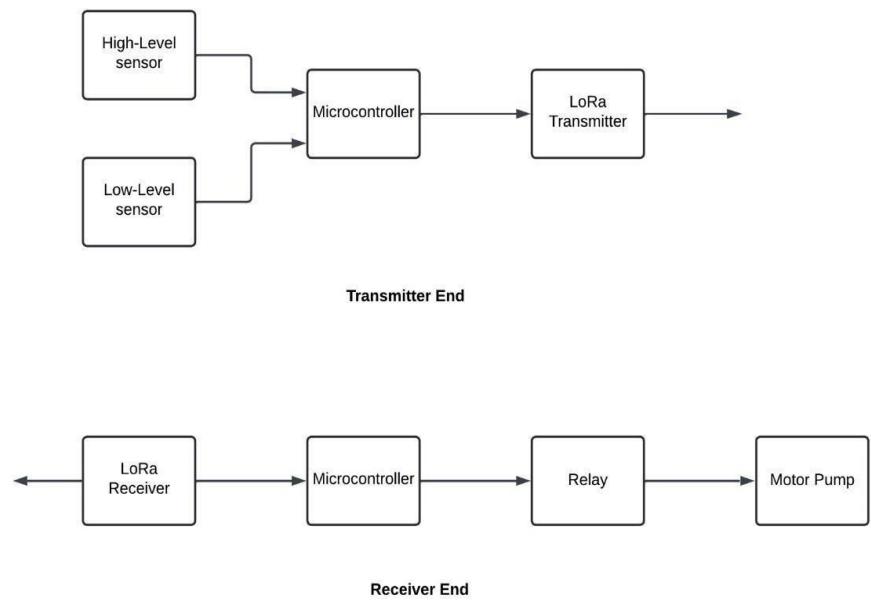
Figure. 3.1. Block Diagram

3.1.1. Construction

3.1.1.1. Transmitter Side:

1. Power Supply Connection: Connect the positive terminal of the 7.5V lithium-ion cell to the input pin of the voltage regulator circuit. Connect the negative terminal of the lithium-ion cell to the ground (GND) of the voltage regulator circuit to complete the circuit.

2. Voltage Regulation: Utilize the AMS1117 voltage regulator SMD to convert the 7.5V input voltage to stable 5V and 3.3V outputs. Connect the 5V output of the voltage regulator to the VCC pin of the ATMEGA328P and the 3.3V output to the VCC pin of the LORA-SX1278 module.

3. Controller Setup (ATMEGA328P): Connect the VCC pin of the ATMEGA328P to the regulated 5V output of the voltage regulator circuit. Write firmware for the ATMEGA328P to handle data processing and SPI communication with the LORA module.

4. LORA Module Setup (SX1278): Connect the SPI lines (MISO, MOSI, SCK) from the ATMEGA328P to the corresponding pins on the LORA-SX1278 module. Connect the Chip Select (CS) pin of the LORA-SX1278 module to a digital pin on the ATMEGA328P to select the LORA module during SPI communication.

5. High-Level and Low-Level Magnetic Float Sensors Connection: Connect one terminal of each sensor to ground (GND) for common reference. Connect the other terminal of the high-level sensor to pin PD6 (pin 12) and the low-level sensor to pin PD7 (pin 13) of the ATMEGA328P. Connect pull-up resistors between each sensor pin (PD6 and PD7) and VCC to ensure well-defined logic levels when the sensors are not actively driving the lines.
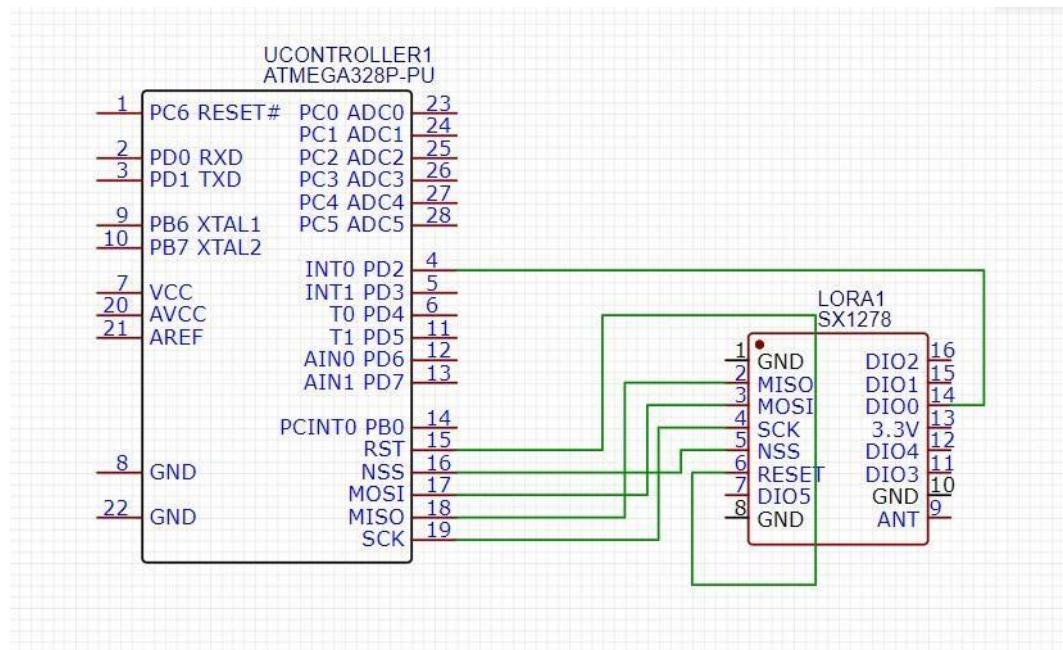
Figure. 3.1.1. Connections of LoRa Transmitter with ATmega328P

3.1.1.2. Receiver Side:

1. Power Supply Section: The positive terminal of the 12V adapter is connected to the input pin of the AMS1117 voltage regulator circuit, while the negative terminal is connected to ground. The AMS1117 voltage regulator SMD is used to regulate the input voltage and provide stable 5V and 3.3V outputs for the controller and LORA module, respectively.

2. Controller and LORA Module Connection: SPI lines (MISO, MOSI, SCK) from the ATMEGA328P controller are connected to the corresponding pins on the LORA-SX1278 module. Additionally, a digital pin on the ATMEGA328P is designated as the Chip Select (CS) pin to select the LORA module during SPI communication.

3. Motor Control Section: The motor is connected to the SLA-12VDC-SLC 10A relay module. The relay module includes contacts that control the flow of current to the motor based on signals received from the controller. To ensure safety and electrical isolation, the relay module is driven by signals passed through an optocoupler (PC817 IC). The optocoupler PC817 provides isolation between the low-voltage control circuit (controller) and the high-voltage load circuit (motor), preventing electrical interference and protecting the controller from high-voltage spikes.
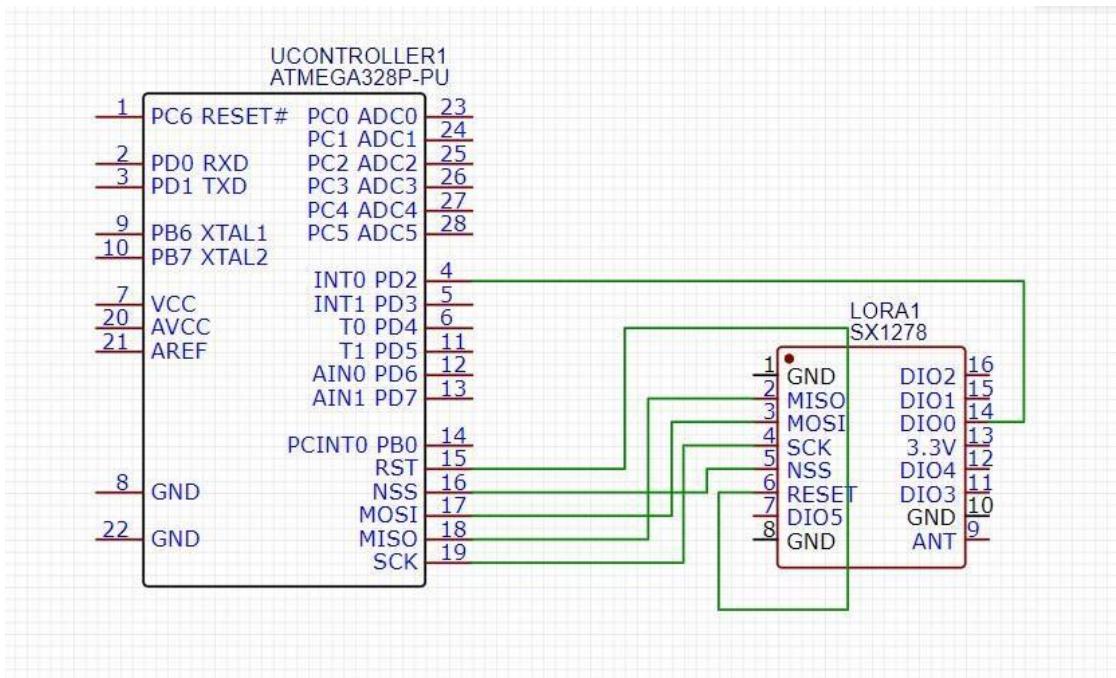
Figure. 3.1.2. Connections of LoRa Receiver with ATmega328P

3.2. Working

3.2.1. Transmitter Side:

1. Voltage Regulation: The AMS1117 voltage regulator converts the 7.5V input voltage from the lithium-ion cell to stable 5V and 3.3V outputs required by the ATMEGA328P and LORA-SX1278 module, respectively.

2. Controller Setup (ATMEGA328P): The ATMEGA328P microcontroller is powered by the regulated 5V output from the voltage regulator. Firmware is developed for the ATMEGA328P to handle data processing and SPI communication with the LORA module.

3. LORA Module Setup (SX1278): The LORA-SX1278 module is powered by the regulated 3.3V output from the voltage regulator. SPI communication is established between the ATMEGA328P and the LORA module for data exchange.

4. High-Level and Low-Level Magnetic Float Sensors Connection: The high-level and low-level magnetic float sensors are connected to digital pins PD6 and PD7 of the ATMEGA328P, respectively. Pull-up resistors ensure stable logic levels for sensor readings when not actively driven. The firmware monitors the sensor inputs and takes appropriate actions based on the liquid level readings, such as triggering alarms or controlling pumps.
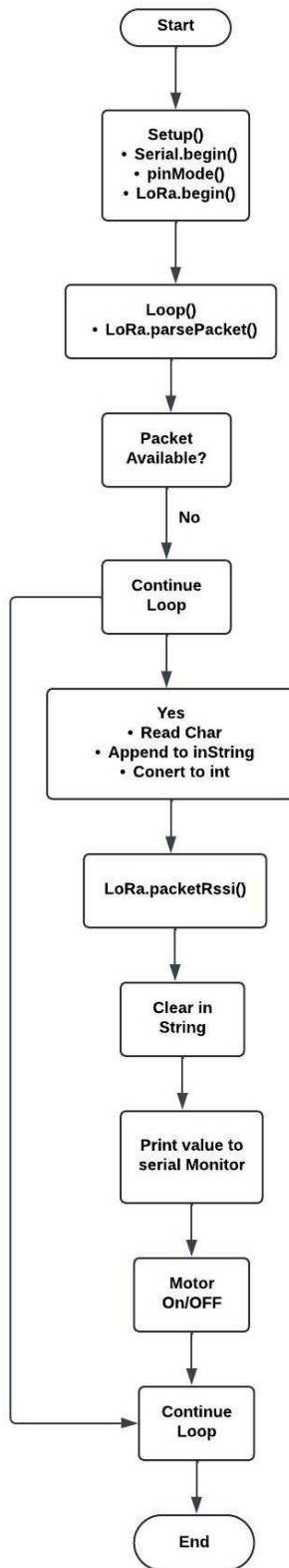
Figure. 3.2.1. Transmitter Flowchart

3.2.2. RECEIVER SIDE:

1. Power Supply Section: The receiver is powered by a 12V adapter with a current rating of 1 amp. The input voltage from the adapter is regulated using the AMS1117 voltage regulator SMD to obtain stable 5V and 3.3V outputs. The 5V output powers the ATMEGA328P controller, while the 3.3V output powers the LORA-SX1278 module.

2. Controller and LORA Module Setup: The ATMEGA328P controller and LORA-SX1278 module are connected via the SPI (Serial Peripheral Interface) communication protocol. SPI lines (MISO, MOSI, SCK) from the ATMEGA328P are connected to the corresponding pins on the LORA-SX1278 module. A digital pin on the ATMEGA328P is assigned as the Chip Select (CS) pin to select the LORA module during SPI communication.

3. Motor Control Section: The motor is controlled by a relay module, specifically the SLA-12VDC-SLC 10A relay. The relaymodule is driven by signals from the controller, which are isolated using an optocoupler (PC817 IC). The optocoupler provides electrical isolation between the low-voltage control circuit (controller) and the high-voltage load circuit (motor). It switches the relay based on the data received from the transmitter, allowing control of the motor.

```
                    ┌─────────┐
                    │  Start  │
                    └─────────┘
                         │
                         ▼
              ┌────────────────────┐
              │      Setup()       │
              │  • Serial.begin()  │
              │    • pinMode()     │
              │   • LoRa.begin()   │
              └────────────────────┘
                         │
                         ▼
              ┌────────────────────┐
              │      Loop()        │
              │ • LoRa.parsePacket()│
              └────────────────────┘
                         │
                         ▼
                ┌──────────────┐
                │    Packet    │
                │  Available?  │
                └──────────────┘
                         │  No
                         ▼
                ┌──────────────┐
                │   Continue   │
                │     Loop     │
                └──────────────┘
                         │
                         ▼
              ┌────────────────────┐
              │        Yes         │
              │    • Read Char     │
              │ • Append to inString│
              │   • Conert to int  │
              └────────────────────┘
                         │
                         ▼
              ┌────────────────────┐
              │  LoRa.packetRssi() │
              └────────────────────┘
                         │
                         ▼
                ┌──────────────┐
                │   Clear in   │
                │    String    │
                └──────────────┘
                         │
                         ▼
                ┌──────────────┐
                │Print value to│
                │serial Monitor│
                └──────────────┘
                         │
                         ▼
                ┌──────────────┐
                │    Motor     │
                │    On/OFF    │
                └──────────────┘
                         │
                         ▼
                ┌──────────────┐
                │   Continue   │
                │     Loop     │
                └──────────────┘
                         │
                         ▼
                    ┌─────────┐
                    │   End   │
                    └─────────┘
```
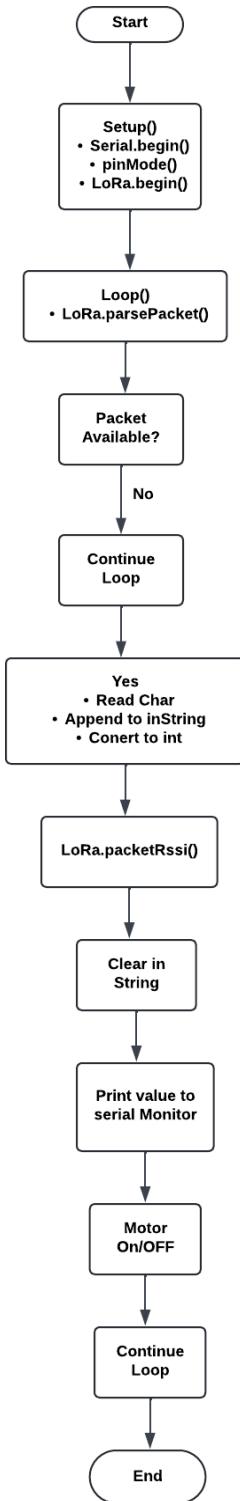
Figure. 3.2.2. Receiver Flowchart

3.3. Components Description

3.3.1. LoRa
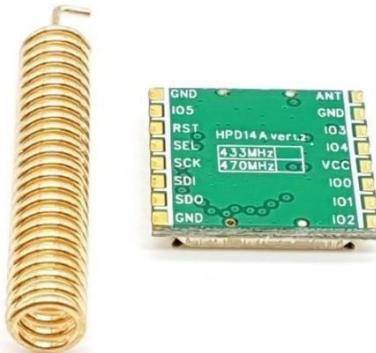
Figure. 3.3.1.1. LoRa SX1278

LoRa, short for Long Range, is a wireless communication technology developed for low-power, wide-area networks (LPWANs). It is designed to enable long-range communication with low power consumption, making it suitable for Internet of Things (IoT) and machine-to-machine (M2M) applications. Here are some specifications and features of LoRa:

1. Long Range: LoRa technology can provide communication ranges of up to several kilometers in urban environments and even more in rural areas, depending on factors such as antenna placement and environmental conditions.

2. Low Power Consumption: One of the key advantages of LoRa is its low power consumption. It allows devices to operate on battery power for extended periods, making it ideal for applications where power efficiency is critical.

3. Low Data Rate: LoRa operates at relatively low data rates compared to other wireless technologies like Wi-Fi or cellular networks. Typical data rates range from a few hundred bits per second to tens of kilobits per second. This lower data rate contributes to its long-range capability and low power consumption.

4. Wide Coverage: LoRa networks can cover large geographic areas with relatively few base stations. This makes it cost-effective to deploy and manage networks for applications like smart cities, agricultural monitoring, and asset tracking.

5. Scalability: LoRa networks can scale to support large numbers of devices, making it suitable for applications with thousands or even millions of connected devices spread over a wide area.

6. Low Cost: LoRa technology offers low-cost hardware solutions, making it accessible for a wide range of applications, including those with budget constraints.
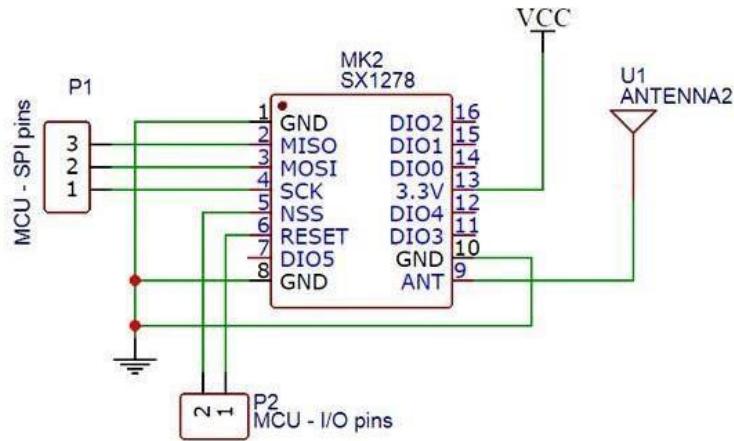
Figure. 3.3.1.2. Pin Diagram of LoRa Module

Pin diagram description:

- In transmitter mode, the SX1278 LoRa module serves to send data wirelessly. It requires connections for SPI communication (MOSI, MISO, SCK, NSS/SEL), enabling communication with a microcontroller or host device. The RESET pin allows for device reset if necessary. Digital input/output pins (DIO0-DIO5) are utilized for various purposes like indicating transmission status or receiving interrupts.

- In receiver mode, additional functionalities are enabled. DIO0 serves as Data Out, indicating received data. DIO1 and DIO2 signal transitions from RX state, providing status information. DIO3 monitors the RSSI threshold, while DIO4 serves as an interrupt triggered by RSSI. Finally, DIO5 outputs the module's clock signal.

LoRa is favored over other modules for its exceptional long-range capabilities, enabling communication over vast distances even in challenging environments. Its low power consumption ensures extended battery life, crucial for continuous monitoring applications. LoRa's resilience to interference and ability to penetrate obstacles enhance its reliability for IoT deployments. Its open standard nature and availability of off-the-shelf components simplify implementation and scalability, making it a versatile choice for wireless communication needs. In summary, LoRa's combination of long-range performance, low power consumption, robustness, and scalability positions it as a top-tier solution for various wireless connectivity applications.

Feature	RF(Rx-Tx) Modules	Bluetooth	Wi-Fi	LoRa
Range	Short	Short to Medium	Medium	Long
Data Rate	Low	Moderate to High	High	Low
Power Consumption	Variable	Low (Bluetooth Low Energy)	High	Low
Frequency Band	Varies	2.4 GHz (Bluetooth)	2.4 GHz, 5 GHz	Sub-GHz
Topology	Variable	Point-to-Point, Mesh	Star, Infrastructure	Star-of-Stars
Use Cases	Various	Short-Range Applications	High-Data-Rate Applications	Long-Range, Low-Power Apps

Table 2. Comparison of LoRa over other wireless modules
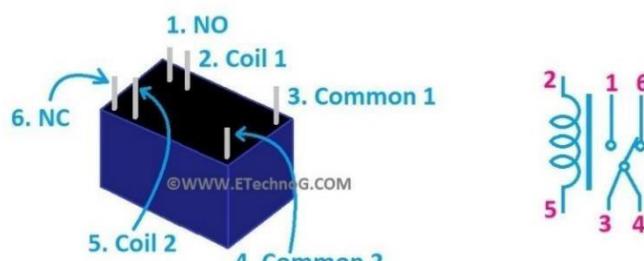
3.3.2. Relay

Figure. 3.3.2.1. Relay Module

A relay is an electromechanical switch that uses an electromagnet to mechanically open or close electrical contacts. It serves as a crucial component in electrical circuits, enabling the control of high-power loads with low-power signals. When an electrical current passes through the relay's coil, it generates a magnetic field that attracts an armature, causing the contacts to switch positions. Relays offer electrical isolation between the control circuit and the load, protecting sensitive electronics from high-voltage or high-current components. They come in various types, including electromechanical relays (EMRs), solid-state relays (SSRs), and reed relays, each suited for specific applications based on factors like switching speed, power rating, and environmental conditions. Widely used in industrial automation, home automation, automotive systems, telecommunications, and more, relays provide versatile and reliable switching solutions essential for diverse electrical and electronic applications.


Figure. 3.3.2.2. Relay Pin Diagram

Pin diagram description:

1. Coil Pins (Control Input): These pins are where the control signal is applied to energize the relay's coil, creating a magnetic field. There are usually two coil pins, often labeled "coil" or "control input." Applying a voltage across these pins activates the relay, causing the contacts to change state.

2. Normally Open (NO) Contact: This pin is connected to one end of the relay's normally open contact. In its resting state (when the relay is not energized), this pin is not electrically connected to any other pin. When the relay is energized, the normally open contact closes, establishing an electrical connection between this pin and the Common (COM) pin.

3. Common (COM) Contact: This pin is connected to the common terminal of the relay's contacts. It serves as a common connection point for the normally open (NO) and normally closed (NC) contacts. When the relay is not energized, this pin is electrically connected to the normally closed (NC) contact.

4. Normally Closed (NC) Contact: This pin is connected to one end of the relay's normally closed contact. In its resting state (when the relay is not energized), this pin is electrically connected to the Common (COM) pin. When the relay is energized, the normally closed contact opens, interrupting the electrical connection between this pin and the Common (COM) pin.

3.3.3. Octocoupler
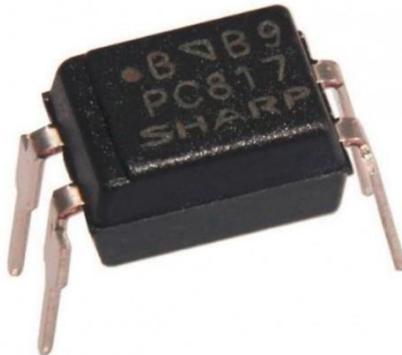
Figure. 3.3.3.1. Octocoupler PC817 Module

The PC817 is a widely used optocoupler, comprising an infrared emitting diode (IRED) coupled with a phototransistor. It facilitates electrical isolation and signal transmission between two isolated circuits by emitting infrared light from the LED, which activates the phototransistor, allowing current conduction between its collector and emitter terminals. This component finds extensive application in power supply circuits, motor control systems, microcontroller interfaces, and industrial control setups for tasks like voltage level shifting, noise reduction, and signal isolation. Different package types cater to diverse needs, and specifications such as isolation voltage and current transfer ratio (CTR) ensure compatibility with various circuit requirements. Manufacturers such as Sharp, Everlight Electronics, and Lite-On produce PC817 variants, each tailored to specific applications. Its straightforward operation, reliability, and effectiveness in providing electrical isolation make it an essential component in numerous electronic designs.
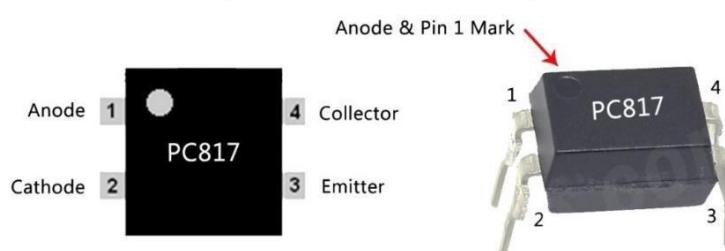
Figure. 3.3.3.2. Octocoupler Pin Diagram

Pin diagram description:

The PC817 optocoupler typically comes in a standard 4-pin package.

1. Pin 1 (Anode, A or +): This pin is connected to the anode of the infrared emitting diode (IRED) inside the optocoupler. It is usually marked with a notch or a dot on the package to indicate the orientation.

2. Pin 2 (Cathode, K or -): Pin 2 is connected to the cathode of the IRED. It is internally connected to the ground or the negative terminal of the input side of the optocoupler.

3. Pin 3 (Collector, C): Pin 3 is the collector of the phototransistor inside the optocoupler. It is connected to the collector terminal of the output side of the optocoupler.

4. Pin 4 (Emitter, E): Pin 4 is the emitter of the phototransistor. It is connected to the emitter terminal of the output side of the optocoupler.

3.3.4. ATmega 328P

Figure. 3.3.4.1. ATmega 328P

The ATmega328P is an 8-bit AVR microcontroller renowned for its versatility and low power consumption. With a maximum clock speed of 20 MHz, it boasts 32 KB of flash memory for program storage, 2 KB of SRAM for temporary data storage, and 1 KB of EEPROM for non-volatile data storage. Featuring a range of peripherals including digital and analog I/O pins, a 10-bit ADC, timers/counters, UART, SPI, and I2C interfaces, it facilitates diverse applications such as robotics, IoT, and consumer electronics. Its power-saving modes and various package options make it suitable for battery-powered and space-constrained designs. Widely supported by development environments like Arduino IDE and Atmel Studio, it's easily programmable using high-level languages like C, making it accessible to hobbyists and professionals alike. Its compatibility with the Arduino ecosystem further enhances its appeal, making it a popular choice for embedded systems and DIY projects.
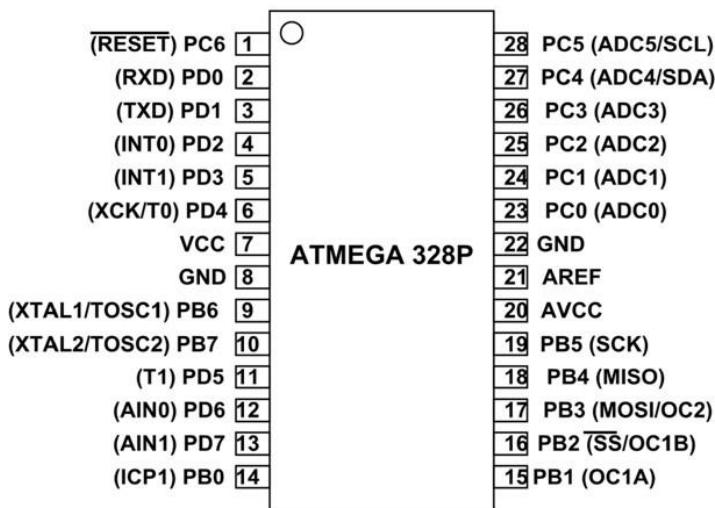
Figure. 3.3.4.2. Pin diagram of ATmega 328P

Pin diagram description:

The ATmega328P microcontroller features a versatile pinout, crucial for interfacing with external components and peripherals. Here's a brief description of its pin diagram:

1. Power Pins: VCC (Pin 7) is connected to the power supply (typically 5V). GND pins (Pins 8 and 22) are for power return.

2. Crystal Oscillator Pins: XTAL1 (Pin 9) and XTAL2 (Pin 10) are connected to an external crystal oscillator for clock signal generation.

3. Digital Input/Output Pins (GPIO): Pins 2 to 13 are serve as digital input/output pins. They can be configured as either input or output and can drive high or low signals.

4. Analog Input Pins: A0 to A5 (Pins 23 to 28) are analog input pins for connecting sensors or other analog devices. These pins can also function as digital I/O pins.

5. Serial Communication Pins: RX (Pin 2) and TX (Pin 3) are used for serial communication (UART). SDA (Pin 27) and SCL (Pin 28) are used for I2C communication. MOSI, MISO, and SCK are used for SPI communication.

6. Reset Pin: Pin 1 Used to reset the microcontroller.

7. Power Supply Pins: AVCC (Pin 20) is connected to the analog power supply for ADC. AREF (Pin 21) is reference voltage for analog inputs.

8. Miscellaneous Pins: PWM Pins are some of the digital pins can also serve as PWM output pins. Interrupt Pins are some digital pins support external interrupts.

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3.3.5. Magnetic Float Sensor

A magnetic float sensor is a device designed to measure the level of a liquid in a container. It comprises a float containing a permanent magnet and a stationary sensor housing equipped with reed switches or Hall effect sensors. As the liquid level changes, the float rises or falls, altering the position of the magnet. When the magnet reaches a predetermined proximity to the sensor, it triggers the sensor to produce an output signal. This signal can be binary, indicating whether the liquid level has crossed a certain threshold, or analog, providing continuous measurement. Magnetic float sensors find extensive use in various industries for monitoring liquid levels in tanks, reservoirs, and industrial equipment. They are favoured for their reliability, resilience to harsh environmental conditions, and compatibility with a wide range of liquids, including corrosive or abrasive substances.

Figure. 3.3.5.1. Magnetic Float Sensor

Magnetic float sensors are preferred over other sensor types due to their simplicity, versatility, and reliability. Their straightforward design, which includes a buoyant float containing a magnet, ensures easy operation and maintenance while providing accurate liquid level measurements. These sensors can be used with various liquids, including corrosive or hazardous substances, without direct contact, making them suitable for challenging environments. Their non-contact operation reduces wear and tear, leading to extended lifespan and decreased maintenance costs. Additionally, magnetic float sensors offer high precision, robust construction, and seamless integration into existing systems, making them an efficient and cost-effective choice for liquid level monitoring and control across a wide range of industries.

Sensor Type	Float Sensor	Switch Sensor	Carbon Sensor	Magnetic Sensor
Operation	Float mechanism	Water bridging electrodes	Carbon conductivity	Magnetic field detection
Reliability	Moderate	Moderate	Low	High
Maintenance	Periodic cleaning	Electrode cleaning	Frequent, carbon rod	Minimal
Cost	Moderate	Moderate	Low	Moderate
Applications	Domestic, sump pumps	Residential, commercial	Limited due to quality	Various agriculture
Response Time	Moderate	Fast	Fast	Fast
Environment Suitability	Limited to clean water	Suitable for various liquids, affected by various impurities	Limited to clean water	Versatile suitable for various environments

Table 3. Comparison of Magnetic sensor over other sensors

3.4. Costing and Expenses

Sr. No.	Item	Price(in Rs)
1.	Screw Header	30
2.	Diode-1N40007	15
3.	AMS 1117 5.0V	50
4.	AMS 1117 3.3V	60
5.	Cap-100uf	10
6.	Cap-22uf	20
7.	Cap-22pf	8
8.	Crystal-16MHz	30
9.	IC-ATmega 328P	720
10.	2pin-Push Button	20
11.	Resistor-330 ohm	8
12.	Resistor-1Kohm	4
13.	Relay-SLA-12VDC-SL-C	60
14.	Transistor – 2N2222A	20
15.	IC-PC817	20
16.	LoRa-SX1278 Module	1900
17.	Spiral Antenna	80
18.	Magnetic Float Sensor	180
19.	IC-Base-28pins	30
20.	Motor	250
21.	PCB	60
22.	3D Enclosure	1000

23.	Multicore Flexible Wire	30
Total		4665

Table 4. Costing and Expenses

CHAPTER 4

RESULTS AND DISCUSSION

RESULT AND DISCUSSION

The implementation of the water controller system with LORA technology has significantly improved water distribution efficiency and monitoring capabilities. With real-time data transmission and remote control functionalities, the system effectively manages water flow, leading to optimized resource utilization and enhanced operational control in water management processes.

Figure. 4.1.1. Transmitter Module


Figure. 4.1.2. Receiver Module
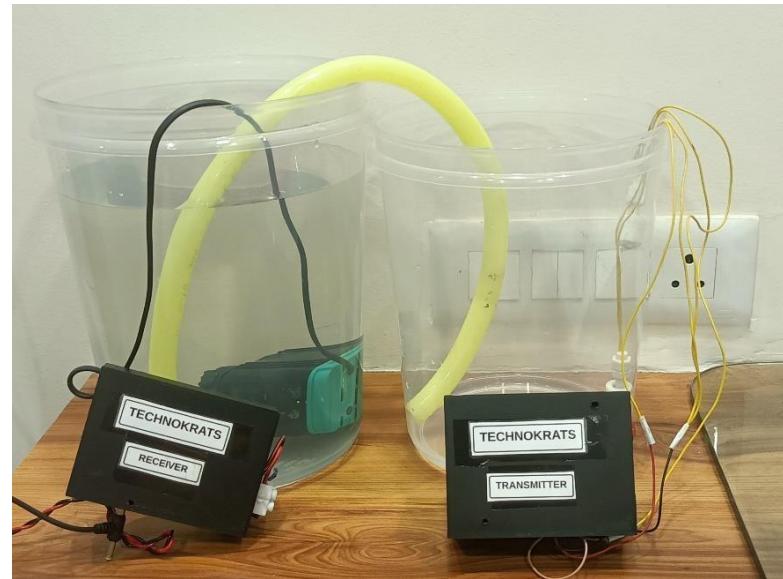
Figure. 4.1.3. When water level is low
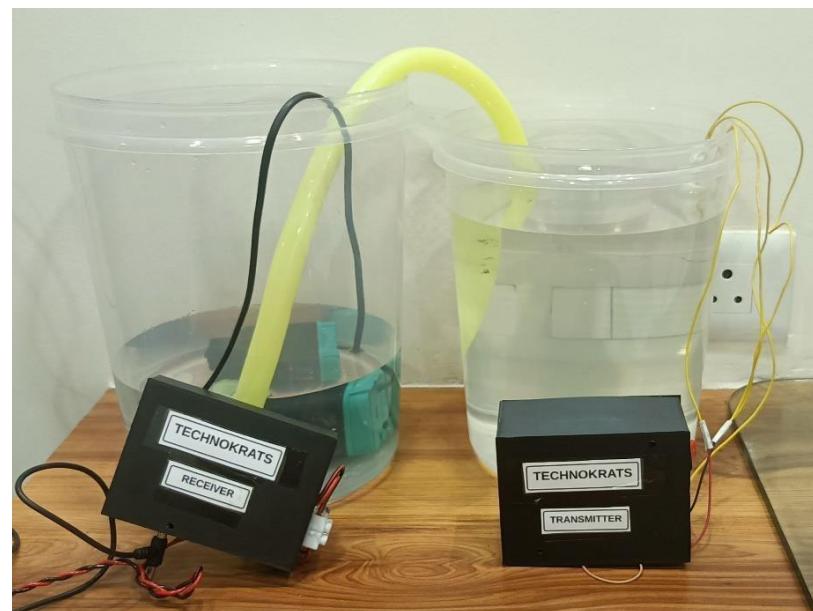
Figure. 4.1.4. When water level is high

CHAPTER 5

SUMMARY AND CONCLUSION

5.1. SUMMARY

A water controller system leveraging LoRa technology enables remote monitoring and control of water infrastructure. LoRa sensors deployed at various points in the system collect real-time data on parameters such as flow and pressure. LoRa's long-range capabilities ensure connectivity even in remote areas, while its low-power consumption extends battery life for sensor nodes. The system's scalability and flexibility enable it to adapt to changing demands and infrastructure configurations. Overall, a water controller system utilizing LoRa technology offers a cost-effective and efficient solution for managing water resources while reducing operational costs and environmental impact.

5.2. CONCLUSION

The water controller system presents a significant advancement in water management practices, offering precise control and monitoring capabilities. By harnessing LORA technology, the system enhances resource allocation, conserves water, and promotes sustainable irrigation practices. Further refinements and integration with smart sensors promise even greater efficiency and environmental conservation in water distribution systems.

5.3. FUTURE SCOPE

In the future, water management with LoRa technology promises to revolutionize how we monitor and manage water resources. LoRa enables networks of small sensors to communicate over long distances, providing real-time data on water levels, quality, and flow. As technology advances, these sensors will become smaller and more affordable, facilitating deployment even in remote areas. This has the potential to greatly benefit communities lacking access to clean water, as it allows for remote monitoring of water quality, aiding in environmental protection. Overall, the future of water management with LoRa technology holds great promise for improving access to clean water and ensuring environmental sustainability through innovation and collaboration.

CHAPTER 6

APPENDIX

APPENDIX

Sr. No.	Authors	Title of Paper	Name of International Journals / International Conference	Place and date of Publication with Citation Index
1.	R. Ullah, A. W. Abbas, M. Ullah, R. U. Khan, I. U. Khan, N. Aslam, S. S. Aljameel	Eewmp: An IoT-based energy-efficient water management platform for smart irrigation	Scientific Programming	Ullah, Rafi, et al. "EEWMP:an IoT-based energy-efficient water management platform for smart irrigation." Scientific Programming 2021 (2021):19.
2.	Santosh Anand	Automatic water management system	First International Conference on Advanced Scientific Innovation in Science, Engineering and Technology (ICASISET 2020)	Anand, Santosh, et al. "Automatic water management system." Proceedings of the First International Conference on Advanced Scientific Innovation in Science, Engineering and Technology, ICASISET 2020, 16-17 May 2020,

				Chennai, India. 2021.
3.	M. Caruso, V. Castiglia, A. Del Pizzo, R. Miceli, M. Salles, G. Schettino, V. Traversa, F. Viola	Low-costsmart energy management based on ATmega 328p-pu microcontroller	2017 IEEE 6th International Conference on Renewable Energy Research and Applications (ICRERA)	M. Caruso, V. Castiglia, A. Del Pizzo, R. Miceli, M. Salles, G. Schettino, V. Traversa, F. Viola, Low-cost smart energy management based on ATmega 328p-pu microcontroller, in: 2017 IEEE 6th International Conference on Renewable Energy Research and Applications (ICRERA), IEEE, 2017, pp. 1204-1209.
4.	S. Devalal, A. Karthikeyan	LoRa technology - an overview	2018 Second International Conference on Electronics, Communication and Aerospace Technology (ICECA)	S. Devalal, A. Karthikeyan, Lora technology-an overview, in: 2018 second international conference on electronics, communication and aerospace technology

				(ICECA), IEEE, 2018, pp. 284-290.

Table 5. Appendix

CHAPTER 7

LITERATURE CITED

LITERATURE CITED

1. Paper: S. Devalal, A. Karthikeyan, Lora technology-an overview, in: 2018 second international conference on electronics, communication and aerospace technology (ICECA), IEEE, 2018, pp. 284-290.

Title: LoRa technology-an overview.

Devalal, Shilpa and Karthikeyan talked about LoRa technology is introduced as a solution addressing the limitations of existing IoT connectivity options, particularly in terms of power consumption and range. Like microwave sensors, LoRa technology offers advantages such as long-range coverage and low power consumption, making it suitable for battery-operated embedded devices in industries ranging from manufacturing to smart cities. However, the development of LoRa sensors requires considerations such as network coverage and interference, similar to the challenges faced in implementing microwave sensors. Despite these challenges, the paper emphasizes the potential of LoRa technology to revolutionize IoT connectivity, driven by the increasing demand for reliable and energy-efficient solutions in industrial automation. As with microwave sensors, the adoption of LoRa technology may require customization for specific applications but holds promise for significant growth, supported by advancements in technology and standardization efforts.

2. Paper: R. Ullah, A. W. Abbas, M. Ullah, R. U. Khan, I. U. Khan, N. Aslam, S. S. Aljameel, Eewmp: an iot-based energy-efficient water management platform for smart irrigation, Scientific Programming 2021 (2021) 1-9.

Title: EEWMP: An IoT-based energy-efficient water management platform for smart irrigation.

Ullah, Rafi and Abbas has talked about efficient water management in agriculture is pivotal, particularly in the face of burgeoning population growth and finite freshwater resources. SWAMP harnesses Internet of Things (IoT) technology to autonomously regulate water reserves, distribution, and consumption levels, thereby optimizing agricultural water usage while mitigating issues such as over-irrigation and under-irrigation. This integration of IoT with agricultural practices underscores its potential in

enhancing crop yield and ensuring food security amid escalating population demands. Moreover, the evolution of IoT in precision agriculture has revolutionized traditional farming methods by enabling real-time data collection and decision-making with minimal human intervention. SWAMP, as a paradigmatic example, utilizes field-deployed sensors and cloud-based platforms to monitor soil conditions, weather patterns, and crop health, facilitating precise irrigation scheduling and resource management. Despite these advancements, challenges persist in optimizing the efficiency and energy consumption of sensor networks. In response, the proposed Energy-Efficient Water Management Platform (EEWMP) introduces strategies to reduce energy consumption and enhance network stability. Through simulation-based experiments, the performance of SWAMP and EEWMP is compared, highlighting EEWMP's superiority in terms of energy efficiency, network stability, and longevity. Such comparative analyses contribute to ongoing efforts to refine and enhance smart irrigation technologies, paving the way for more sustainable and resilient agricultural practices.

3. Paper: Augustin, Aloÿs, et al. "A study of LoRa: Long range & low power networks for the internet of things." Sensors 16.9 (2016): 1466.

Title: A study of LoRa: Long range & low power networks for the internet of things.

Augustin talked about an extensive analysis of LoRa (Long Range) technology within the context of Low Power Wide Area Networks (LPWANs) for the Internet of Things (IoT). It begins with an abstract outlining LoRa's characteristics and its significance in IoT infrastructure. The introduction highlights the growing need for efficient communication protocols due to IoT devices' limited resources and massive deployment expectations. It distinguishes between low-power local area networks and low-power wide area networks, with LoRa falling into the latter category. Related works such as IEEE802.15.4, Bluetooth/LE, IEEE 802.11 ah, Sigfox, and DASH7 are briefly discussed to contextualize LoRa's position among IoT communication technologies. The purpose statement outlines the objectives of the paper, including providing an overview of LoRa, evaluating its performance, and suggesting enhancements. The paper's organization is then detailed, with sections dedicated to LoRa's functional

overview, physical layer analysis, LoRa WAN MAC protocol description, performance evaluation, and conclusion. The LoRa physical layer is analyzed next, covering its proprietary chirp spread spectrum modulation technique and key parameters such as bandwidth, spreading factor, and code rate. Experimental evaluations of LoRa's performance are discussed, including its immunity to interference and selectivity.

The paper concludes by summarizing the findings and proposing potential enhancements to LoRa technology. It underscores the significance of LoRa in facilitating IoT communication, particularly in applications requiring long-range and low-power connectivity. Overall, the paper contributes to the understanding and advancement of LPWAN technologies, specifically focusing on the capabilities and performance of LoRa in IoT environments.

4. Paper: Leens, Frédéric. "An introduction to I 2 C and SPI protocols." IEEE Instrumentation & Measurement Magazine 12.1 (2009): 8-13.

Title: An introduction to I2C and SPI protocols.

In this paper Leens talked about introduction to I2C and SPI protocols encompasses foundational documents essential for understanding these communication standards in digital electronics systems. NXP Semiconductors' I2C-bus specification and user manual provide a detailed framework for implementing the I2C protocol, offering insights into its structure, operation, and practical applications. Similarly, Texas Instruments' documentation on the I2C Interface offers valuable technical guidance and reference material for engineers and developers working with I2C-based systems. Furthermore, a technical document from Burr-Brown Corporation delves into the intricacies of interfacing the MSP430 microcontroller with the TMP100 temperature sensor using the I2C protocol, offering practical examples and solutions for real-world applications. On the SPI side, resources such as Motorola's Serial Peripheral Interface (SPI) Tutorial serve as comprehensive guides to understanding the SPI bus architecture, communication principles, and best practices for implementation. Maxim Integrated's guide on SPI further enhances this understanding, providing in-depth insights into SPI protocol features, device compatibility, and system integration considerations. Together, these literature sources contribute significantly to the body of knowledge surrounding I2C and SPI protocols, elucidating their roles,

functionalities, and ongoing relevance in modern communication technologies and embedded systems design.

5. Paper: Dhaker, Piyu. "Introduction to SPI interface." Analog Dialogue 52.3 (2018): 49-53.

Title: Introduction to SPI interface

The text presents a detailed exploration of Serial Peripheral Interface (SPI) communication protocols, focusing on its application in digital electronics systems. SPI facilitates communication between a master device and multiple slave devices, offering full-duplex communication with synchronized data transmission. The protocol operates via four signals: Clock (SCLK), Chip Select (CS), Master Out Slave In (MOSI), and Master In Slave Out (MISO). The master generates the clock signal, synchronizing data transmission, while the chip select signal enables communication with specific slaves. Different SPI modes, distinguished by clock polarity and phase, offer flexibility in data sampling and shifting. The article illustrates four SPI modes through timing diagrams, detailing clock polarity, phase, and data transmission. It further discusses regular SPI mode, where each slave requires an individual chip select signal, and the daisy-chain method, enabling multiple slaves with a single chip select signal. Moreover, it introduces Analog Devices' SPI-enabled switches and multiplexers, highlighting their role in reducing GPIO usage and simplifying system-level designs. The cited references include the primary document, additional articles discussing SPI configurations and applications, and datasheets providing technical specifications for relevant devices.

6. Paper: Wang, Ning, and Chong Zhao. "Onboard Secondary Power Supply Automatic Test Hardware Design and Implementation." 7th International Conference on Education, Management, Information and Mechanical Engineering (EMIM 2017). Atlantis Press, 2017.

Title: Onboard Secondary Power Supply Automatic Test Hardware Design and Implementation.

The paper discusses the hardware design and implementation of an onboard secondary power supply automatic test system. The design includes components such as the MSP430 microprocessor, power circuit, reset circuit, clock circuit, communication

interface circuit, and load circuit. The MSP430 microcontroller is chosen for its ultra-low power consumption and high integration capabilities. The power circuit utilizes the AMS1117 voltage adjustment chip to regulate the voltage from 5V to 3.3V for the MSP430. A reset circuit ensures proper initialization of the system, while a clock circuit provides the necessary timing for the microcontroller's operation. The communication interface circuit employs RS232 for communication between the system and external devices, with the MAX3222 chip facilitating level conversion. Additionally, the load circuit is designed to provide different load conditions for testing various power supplies. The design principles and components are supported by references to relevant literature, including works on LabVIEW programming, advances in DoD's ATS framework, commercial ATS program management, and the modernization of army depot automated test systems. These references contribute to the understanding and implementation of the described hardware design for the secondary power supply test system.

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[1] R. Ullah, A. W. Abbas, M. Ullah, R. U. Khan, I. U. Khan, N. Aslam, S. S. Aljameel, Eewmp: An IoT-based energy-efficient water management platform for smart irrigation, Scientific Programming 2021 (2021) 1-9.

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SOCIAL UTILITY

The introduction of a Wireless Water Management System utilizing LoRa technology responds to pressing global concerns regarding water scarcity and contamination. This system aims to address prevalent issues such as water overflow in various environments by enabling real-time remote monitoring and automation of water pumps and motors. By harnessing LoRa's long-range communication capabilities, it optimizes water usage, significantly reducing wastage and promoting efficient water management practices across diverse sectors.

Embedded systems play a pivotal role in modern technology, facilitating automation, control, and monitoring across industries. In this context, the Wireless Water Management System integrates hardware and software components to enable efficient water management and conservation efforts. By leveraging embedded systems, the system ensures the seamless operation of monitoring and control functionalities, contributing to its effectiveness in addressing water-related challenges.

Water wastage from overhead tanks and in agriculture represents critical obstacles to water conservation efforts globally. The system addresses issues such as leakage, faulty valves, and inefficient irrigation practices through real-time monitoring and management. By detecting and addressing these issues promptly, it helps mitigate water wastage and promotes sustainable water usage practices across sectors, ultimately contributing to water conservation efforts.

Overall, the societal relevance of the Wireless Water Management System lies in its ability to address pressing water management challenges, promote sustainable practices, and safeguard vital resources in water-stressed regions. By empowering stakeholders with real-time data and control capabilities, the system contributes to more efficient water usage, benefiting communities and ecosystems worldwide.

CO-PO MAPPING TABLE

				PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
VIII	ET2 451 : Maj or Proj ect	1	Design and analyze application based electronic systems.	3	3	3	3	3	3	3	3	3	3	3	3	3	3
		2	Implement core / multidiscipl inary / industry based electronics projects in cost effective manner.	3	3	3	3	3	3	3	3	3	3	3	3	3	3
		3	Communica te technical details effectively	3				3		3	3	3	3	3	3	3	3

Table 6. Co-Po Mapping Table

Yeshwantrao Chavan College of Engineering

Project Preliminary Investigation Report

Name of Department:

Electronics and Telecommunication

Name of Project Guide:

Prof. Y. S. Kale

Students Details:

Sr. No.	Name of Student	Email ID	Mobile No.
01	Nandini Bondre	nandinibondre8910@gmail.com	7218868192
02	Ajit Ghawghawe	ajitghawghawe@gmail.com	9764311262
03	Ayushi Bhiwapurkar	a.bhiwapurkar2202@gmail.com	7843082202
04	Aditya Dodal	adityadodal@gmail.com	9404284592

Title of the Project:

Wireless water management system using LoRa

Area of Project Work:

IoT and Embedded Systems

Problem Statement:

South Africa's Western Cape is enduring a drought so severe that it may cause Cape Town to become the first major city in the developed world to run out of water. Currently, the city is doing everything it can to limit water consumption by its residents and visitors.

In India every year, Trillions liters of water is being wasted by Overflow which is more than 30% of total water wasted in India. In our day-to-day life, in apartments and building for water supply motor is directly ON without knowing the time required to completely fill the tank. In such cases large amount of water is wasted until and unless motor is switched OFF manually by human. Due to negligence of human being, tank overflow is common problem faced.

This problem can be solved by wired as well as by using wireless technology like Wi-Fi, IR, Bluetooth modules. But it is difficult to make such wired connection in buildings occupying large areas. Similarly, in agriculture overflow of water tank is common issue. Agriculture irrigation consumes 70% of water worldwide so water over flow is most common issue faced in agriculture.

All these problems can be solved with the "Wireless water management system using LoRa" without human interference.

Prior Art (Patent Search):

Patent Application No.	Title of Patent	Existing Solutions (Abstract of Patent)
US 2018/ 0262571 A1	Integrated IoT (internet of things) System solution for smart Agriculture management	The utility model relates to the technical field of wireless sensing, specifically an agricultural IoT (Internet of Things) monitoring device based on optical fiber sensing. The device is characterized in that the device is provided with a microcontroller, a parameter

		recorder and the parameter recorder is connected with the sensors .
202111054179	IoT Based Water Distribution System	A communication network interface can connect one or more embodiment of present invention such as, but not restricted to a ground water management device, one or more computing devices and other known elements therefore Machine learning models can also be employed to perform data analysis and other functional operations of the system. The IoT based water management system can be deployed to control water distribution from a remote location.
US 8,948,921 B2	System and method for smart irrigation	The smart irrigation system comprises a central control system having a user interface and a Smart scheduler. The central control system is configured to derive and send an irrigation schedule for the irrigation. The Smart scheduler comprises a data receiver, a processor, and a signal interface. The data receiver is configured to receive the irrigation schedule. The processor is configured to convert the irrigation schedule to

		a series of control signals that the irrigation controller recognizes. The signal interface is configured to connect to the irrigation controller and to send the series of control signals to the irrigation controller. The system uses weather data and irrigation site-specific information to automatically apply the optimal irrigation schedule. User are able to remotely control the irrigation via networks such as Internet.

Literature Review:

Title of Paper	Details of Publication with Date and Year	Literature Identified for Project
"A study of LoRa low power and wide area network technology"	May 1, 2017.	2017 International Conference on Advanced Technologies for Signal and Image Processing (ATSIP)
"Smart Water Quality Monitoring and Metering Using Lora for Smart Villages"	August 8, 2018	2018 2nd International Conference on Smart Grid and Smart Cities (ICSGSC)
"LoRa for the Internet of Things"	February 15, 2016	European Conference/ Workshop on Wireless Sensor Networks
"LoRa Technology-An Overview"	March 2018	2018 Second International Conference on Electronics, Communication and

		Aerospace Technology (ICECA)

Current Limitations:

1. Water Wastage in Urban Areas: In urban settings, water tanks are often manually controlled, leading to potential overflow issues. This occurs when the tanks reach their maximum capacity but continue to receive water due to oversight or delays in shutting off the supply. This problem is exacerbated during periods of heavy rainfall or when water supply systems are not properly regulated. The overflow of water tanks not only leads to the wastage of a precious resource but also contributes to waterlogging and urban flooding in some cases.

2. Agricultural Overflows: Agriculture is a major consumer of water worldwide, and inefficient irrigation practices can result in significant water wastage. Overflows commonly occur when irrigation systems are not properly managed or maintained. For example, in flood irrigation methods, excess water may not be absorbed by the soil and instead runs off into surrounding areas or irrigation ditches, leading to wastage. Additionally, outdated irrigation infrastructure or lack of modern water management techniques can contribute to this problem.

3. Limited Connectivity in Monitoring Systems: Real-time monitoring and control of water systems, such as water tanks and irrigation systems, often rely on connectivity technologies like Wi-Fi and 4G. However, in certain areas, particularly rural or remote locations, there may be limited or no access to these connectivity options. This lack of connectivity restricts the ability to remotely monitor water usage, detect leaks or overflows, and adjust water flow as needed. Without real-time monitoring and control capabilities, addressing water wastage becomes more challenging and inefficient, leading to potential environmental and economic consequences.

Proposed Solution:

We propose the development of a "Wireless Water Management System Using LoRa" that addresses the current limitations while avoiding internet or IoT

dependencies. Our system will leverage LoRa technology for wireless communication and control, ensuring efficient water management. It will provide a versatile and reliable solution for various applications such as agriculture, industrial liquid control, municipal water supply, and water tank and motor control in homes and buildings.

Objectives and Scope of Work:

Objectives:

The objective of automating water pump control based on real-time water levels is to minimize manual intervention and optimize efficiency. By utilizing sensors and actuators, the system continuously monitors water levels and adjusts pump operation accordingly, reducing the burden on personnel and ensuring timely responses to fluctuating demands. Remote monitoring capabilities enable seamless operation even in areas with limited internet connectivity, allowing stakeholders to intervene and troubleshoot remotely. Moreover, the system's efficiency-focused approach aims to prevent water wastage by activating pumps only when necessary, conserving resources and reducing energy consumption. Through the integration of intelligent algorithms, the system analyzes real-time data to accurately predict demand patterns and optimize pump schedules. Overall, this comprehensive approach enhances operational reliability, promotes resource conservation, and contributes to sustainable water management practices.

Scope of Work:

In the future, water management with LoRa technology promises to revolutionize how we monitor and manage water resources. LoRa enables networks of small sensors to communicate over long distances, providing real-time data on water levels, quality, and flow. As technology advances, these sensors will become smaller and more affordable, facilitating deployment even in remote areas. This has the potential to greatly benefit communities lacking access to clean water, as it allows for remote monitoring of water quality, aiding in environmental protection. Overall, the future of water management with LoRa technology holds great promise for improving access to clean water and ensuring environmental sustainability through innovation and collaboration.

Feasibility Assessment:

I. Expected Outcomes of the Project

1. Enhanced Agricultural Efficiency: In agricultural applications, our system is expected to significantly improve water usage efficiency. By automating irrigation and preventing overflow, farmers can optimize water resources, leading to increased crop yield and reduced water wastage. This outcome is particularly vital in addressing global agricultural challenges and ensuring food security.

2. Cost Reduction: The adoption of our LoRa-based water management system in agriculture is anticipated to reduce operational costs. By eliminating manual monitoring and control, farmers can save on labor expenses and reduce energy consumption, making agriculture more economically viable.

3. Sustainable Farming Practices: Our system promotes sustainable farming practices by delivering the right amount of water to crops at the right time. This precision irrigation can minimize soil erosion, fertilizer runoff, and waterlogging, contributing to environmentally responsible agriculture.

4. Adaptability: Our solution's adaptability extends to various agricultural practices, including automated drip lines and sprinkler systems. It can cater to the specific needs of different crops and farming techniques, offering flexibility to farmers.

5. Conservation of Water Resources: By preventing water overflow and optimizing irrigation, our system contributes to the conservation of precious water resources. This outcome aligns with sustainable water management practices, especially in regions facing water scarcity.

II. Innovation Potential

Our "Wireless Water Management System Using LoRa" project brings innovation, primarily benefiting agriculture. It introduces:

1. Precision Agriculture: Automated irrigation enhances crop yields and reduces water wastage, revolutionizing traditional farming practices.

2. Resource Conservation: By preventing overflow and ensuring precise water application, our system conserves water and minimizes environmental impact.

3. Economic Viability: Cost reduction through automation makes farming economically sustainable, optimizing resource use for better returns.

4. Scalability: The adaptable system caters to small family farms and large-scale operations, promoting widespread adoption.

5. Data-Driven Farming: Real-time data empowers farmers to make informed decisions, enhancing crop management and resource allocation.

6. Global Relevance: Addressing water scarcity and sustainability challenges, our innovation holds global significance for food security and responsible agriculture.

III. Task Involved

• Create Hardware Prototype: We start by building a sturdy hardware model for our water management system. This involves putting together key parts like sensors, controllers, and wireless modules. Our aim is to make sure the system accurately measures water levels and effectively controls the water pump.

• Develop Software and Testing: Next, we work on the software part. We create programs that handle data, make quick decisions based on water levels, and manage the water pump. Rigorous testing ensures that the software works seamlessly with the hardware. We also set up real-time data monitoring so we can keep an eye on water levels and how well the system is running.

• Deployment and Improvement: After successful testing, we take the system into the field, where it's needed, like in agriculture or homes. We keep making it better by fine-tuning the way it works. This involves adjusting how it makes decisions and responds. We also create easy-to-follow instructions so others can use and fix it if needed. Our goal is to make sure the wireless water management system works smoothly in real-life situations.

IV. Expertise Required

1. Hardware and Software Development: We need expertise in both hardware and software development for our water management system, with a focus on LoRa technology.

2. Real-world Testing and Deployment: Proficiency in field deployment and testing is crucial to ensure the system's functionality in practical scenarios.

3. Documentation and User Guidance: Creating clear and user-friendly documentation is essential for easy implementation and troubleshooting.

V. Facilities Required

Facilities for hardware prototyping, including sensors, microcontrollers, and testing equipment.

Milestones and Time Plan

	Task	JULY 2023	AUG 2023	SEP 2023	OCT 2023	NOV 2023	DEC 2023	JAN 2024	FEB 2024	MAR 2024	APR 2024
Design	Conceptual Design	✓									
	Detailed design		✓								
	Design Modifications			✓							
	Final Design				✓						
Develop	Procurement (If any)				✓						
	Prototyping					✓					
	Modification s						✓				
Deliver	Testing and Validation							✓			
	Final Modifications								✓		
	IPR/ patent draft									✓	
	Thesis and Poster										✓

Name and Signature of Project Guide   Signature of HOD

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