Wireless Antenna-Based Motor Control System: Enabling Remote Precision and Versatility

A Project Report

Submitted to the FACULTY of ENGINEERING of

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, KAKINADA

In partial fulfillment of the requirements,

for the award of the Degree of

Bachelor of Technology

In

Electronics and Communication Engineering

By

P. Swetha	**MD. Shareef**
(20481A04H9)	**(20481A04F2)**
M. Y N V Vara Prasad	**M. Sai Krishna**
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SESHADRI RAO GUDLAVALLERU ENGINEERING COLLEGE

(An Autonomous Institute with Permanent Affiliation to JNTUK, Kakinada)

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ANDHRA PRADESH

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CERTIFICATE

This is to certify that the project report entitled **"Wireless Antenna-Based Motor Control System: Enabling Remote Precision and versatility"** is a bonafide record of work carried out by **P. Swetha (20481A04H9), MD. Shareef (20481A04F2), M. Y N V Vara Prasad (20481A04G0), M. Sai Krishna (20481A04E9.)** under my guidance and supervision in partial fulfillment of the requirements, for the award of the degree of Bachelor of Technology in **Electronics and Communication Engineering** of **Seshadri Rao Gudlavalleru Engineering** affiliated to **Jawaharlal Nehru Technological University, Kakinada**.

(Dr. B. Rajasekhar)	(Dr. B. Rajasekhar)
Project Guide	**Head of the Department**

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ABSTRACT

This paper introduces a novel water motor control system designed for remote precision and versatility, featuring an innovative combination of antenna technology, Arduino Nano microcontroller, OLED display, float sensors, and HC12 module. The system addresses the growing demand for efficient water management solutions, particularly in remote or inaccessible areas. The core functionality of the system relies on a network of float sensors strategically positioned within the water reservoir, interfaced with an Arduino Nano microcontroller. These sensors continuously monitor water levels in real-time, enabling accurate control of the water motor's operation. The Arduino Nano processes the sensor data and adjusts the motor's behavior accordingly, ensuring optimal water usage and conservation. To enhance user interaction and provide valuable feedback, an OLED display is integrated into the system, presenting critical information such as water levels, motor status, and system diagnostics. This display serves as an intuitive interface for monitoring and configuring system parameters, enhancing user experience and facilitating ease of use. Additionally, the system incorporates an HC12 module to enable wireless communication over long distances, facilitating remote operation and monitoring. This feature empowers users to control the water motor and monitor its performance from remote locations, offering unprecedented convenience and accessibility.

The proposed water motor control system represents a significant advancement in water management technology, offering superior precision, versatility, and remote accessibility compared to conventional systems. By leveraging cutting-edge technologies such as Arduino Nano, antenna technology, OLED display, float sensors, and HC12 module, the system provides an efficient and reliable solution for various water management applications, including agriculture, industrial processes, and residential usage.

CHAPTER 1

INTRODUCTION

Water is a universal solvent which plays an important role in everyday life. The total amount of water available on earth has been estimated at 1.4 billion cubic kilometers, enough to cover the planet with a layer of about 3km. About 95% of the Earths water is unfit for human consumption. About 4% is locked in the polar ice caps, and the rest 1% constitutes all fresh water found in rivers, streams and lakes which is suitable for our consumption. A study estimated that a person in India consumes an average of 135 liters per day. This consumption would rise by 40% by the year 2025. This signifies the need to preserve our fresh water resources.

Water is an indispensable resource for life and sustenance, playing a crucial role in various aspects of human civilization, including agriculture, industry, and domestic consumption. However, as global populations rise and environmental pressures increase, the management of water content, usage, and the prevention of wastage have become critical concerns.

Many houses make use of supplementary water tank to store water that is collected from rain water or water pumped from well or underground. At present, water meters are used to calculate the amount of water used at homes. This doesn't provide an efficient method of monitoring the water usage. The water is wasted at each and every outlet knowingly or unknowingly which adds up to huge amount in the end. Efficient management of the water used at homes is very much necessary as, about 50% of water supplied to the cities gets wasted through its improper usage. Water management is only possible, if the user is aware of the quantity of water he uses and the quantity available to him.

Water is essential in every hour of our lives. Hardly anyone keeps in track of the level of water in the overhead tanks. Consequently, automatic controlling involves designing a control system to function with minimal or no human interference. The idea can be implicitly used to ascertain and control the level of water in overhead tanks and prevent the wastage. In this Arduino based automatic water level indicator and controller project, the water level is being measured by using ultrasonic sensors. The objective of the project is to measure the level of water in the tank and notify the user about the water level.

"Wireless Antenna-Based Motor Control System: Enabling Remote Precision and versatility" project, the water is being measured by using float sensors. this proposes an innovative water motor control system that integrates antenna technology, Arduino Nano microcontroller, OLED display, float sensors, and HC12 module. This system aims to enable remote precision and versatility in water management, offering real-time monitoring and control capabilities even in remote or inaccessible locations.

Float sensors, strategically positioned within the water body, continuously monitor water levels and relay this data to an Arduino Nano microcontroller. Initially, the tank is considered to be empty. The motor pump is automatically turned ON when the water level becomes low and turned OFF when the tank is full. The Arduino Nano processes the sensor data and orchestrates the operation of the water motor accordingly, ensuring optimal utilization of water resources while preventing overflow or depletion. OLED display is integrated into the system, presenting essential information such as water levels, motor status, and system diagnostics. Furthermore, the incorporation of an HC12 module enables wireless communication over long distances, allowing users to remotely control the water motor and monitor its performance.

1.1 Background:

The "Wireless Antenna-Based Motor Control System" project addresses the need for efficient water management in diverse settings, particularly those where remote operation and precise control are paramount. Traditional water motor control systems often lack the flexibility and accessibility required to manage water resources effectively, especially in remote or challenging environments. The project draws inspiration from advancements in wireless communication technology, microcontroller platforms like Arduino, and sensor integration to develop a sophisticated yet user-friendly solution for water motor control. By leveraging antenna technology, the system aims to enable remote precision and versatility in water management applications. Antenna technology plays a crucial role in facilitating wireless communication over long distances, making it an ideal choice for remote control applications. By incorporating antennas into the system design, users can remotely monitor and control water motors from virtually anywhere, overcoming the limitations of physical proximity and accessibility. The project utilizes Arduino Nano microcontrollers for their versatility, ease of use, and robust community support. In addition to wireless communication and microcontroller integration, the project incorporates float sensors, to monitor water levels in real-time. These sensors provide crucial data for precise control of water motors, ensuring optimal utilization of water resources while preventing wastage or overflow and the integration of an OLED display enhances user interaction by providing real-time feedback on water levels, motor status, and system diagnostics.

1.2 Aim of the project:

The aim of the "Wireless Antenna-Based Motor Control System" project is to develop a versatile and efficient solution for water motor control, enabling remote precision in water management. By integrating antenna technology, Arduino Nano microcontrollers, sensors such as float sensors, and an OLED display, the system aims to facilitate wireless control of water motors over long distances while providing real-time monitoring of water levels and motor status. The project seeks to optimize water motor operations to ensure optimal water resource utilization, preventing wastage and overflow. Through robust design and reliability, the system aims to contribute to sustainable water management practices, addressing challenges in agricultural, industrial, and residential applications.

1.3 Methodology:

The methodology of the "Wireless Antenna-Based Motor Control System" project entails a systematic approach to designing, integrating, and testing the key components of the system. Initially, the system's architecture is meticulously planned to ensure seamless communication between components, including antenna modules, Arduino Nano microcontrollers, sensors such as float sensors, and an OLED display. Following this, wireless communication setup is established, configuring antenna modules and HC12 wireless communication modules to facilitate reliable communication between the water motor control system and remote monitoring stations. Subsequently, float sensors are integrated within the water reservoir and calibrated to provide accurate measurements corresponding to different water levels. Arduino Nano microcontrollers are then programmed to interface with sensors, process data, and control the water motor based on input parameters and user commands. Meanwhile, an OLED display is integrated to provide real-time feedback on water levels, motor status, and system diagnostics, enhancing user interaction and system monitoring. Rigorous testing is conducted to validate functionality, reliability, and performance under various conditions, with iterative optimization and refinement based on testing results and user feedback. Through this methodology, the project aims to develop a robust and efficient solution for remote precision in water management, contributing to sustainable water resource utilization and management practices.

1.4 Significance of the project:

The "Wireless Antenna-Based Motor Control System" project signifies a crucial advancement in water management technology with profound implications for sustainability and resource efficiency. By enabling remote precision and versatility in controlling water motors through wireless communication, the system offers a transformative solution for managing water resources across diverse environments. Its capability to optimize water motor operations in real-time, preventing wastage and ensuring optimal utilization, holds promise for conserving water resources and mitigating environmental impact. Efficient water management is crucial for mitigating environmental impact and promoting sustainability. By reducing water wastage and optimizing resource utilization, the system helps minimize the ecological footprint associated with water-related activities, preserving ecosystems and biodiversity. Moreover, the system's resilience to climate change-induced disruptions and its potential to enhance socio-economic development by improving access to clean water underscore its significance. Through technological innovation and knowledge transfer, the project not only advances water management practices but also informs policy and governance decisions, paving the way for more sustainable water management strategies at local, regional, and national levels. Ultimately, the "Wireless Antenna-Based Motor Control System" project embodies a holistic approach to water management, with far-reaching implications for environmental, socio-economic development, and resilience to future challenges.

1.5 Outline:

In this report, first chapter deals with introduction which gives the background and aim of the project including the methodology, outline and significance of the project. Second chapter deals with literature survey which gives the details about existing system and objective of proposed system. Third chapter deals with work title explanation which includes the explanation and project description. Fourth chapter deals with implementation tools required to complete the project. Fifth Chapter works on project implementation and explained along with features, specifications and applications. Sixth chapter deals with Results of this project which gives the photos obtained about the results in implementing the project. Seven chapter deals with Conclusion and future scope of the project.

In final the Project Outcomes are mapped with Programmer Specific Outcomes and Program Outcomes

1.6 Conclusion:

In conclusion, the "Wireless Antenna-Based Motor Control System" project represents a significant step forward in addressing the complexities of water management with remote precision and versatility. Through the integration of advanced technologies such as wireless communication, sensor integration, and microcontroller programming, the system offers a robust solution for optimizing water motor operations and conserving precious water resources. Its potential to enhance sustainability, resilience to climate change, and socio-economic development underscores its importance in addressing global challenges. By leveraging the power of technology and collective action, the "Wireless Antenna-Based Motor Control System" project embodies the transformative potential of interdisciplinary approaches to water management, paving the way for a more resilient and water-secure world.

CHAPTER 2

LITERATURE SURVEY

A) "Design and Implementation of Smart Irrigation System using IoT and Arduino" by M. A. K. Azad, M. R. Islam, and M. H. R. Bhuiyan.

The paper "Design and Implementation of Smart Irrigation System using IoT and Arduino" presents a novel approach to optimize water usage in agriculture through the integration of Internet of Things (IoT) technology and Arduino platform. The system utilizes Arduino Nano microcontrollers and soil moisture sensors to monitor soil moisture levels in real-time across agricultural fields. By wirelessly transmitting data via HC12 modules, the system enables remote monitoring and control of irrigation processes from a centralized location. This allows farmers to make informed decisions regarding irrigation scheduling, leading to improved water efficiency and crop yield. The implementation of the smart irrigation system involves deploying Arduino Nano units and sensors in the field, with the central control unit managing irrigation based on predefined moisture thresholds. The paper also addresses software programming and system scalability, highlighting the practical feasibility of the proposed solution. Overall, the study underscores the potential of IoT-enabled smart irrigation systems to revolutionize agricultural water management, promoting sustainability and resource conservation.

B) " A Review of an Automatic Water Level Indicator " by M.A. Baballe et al.

The authors begin by discussing the significance of water level monitoring systems in preventing water wastage, ensuring optimal water usage, and averting potential damages caused by overflow or inadequate water levels. The review delves into the technical aspects of automatic water level indicators, examining different sensing technologies, such as float switches, ultrasonic sensors, and capacitive sensors. Each technology's strengths, limitations, and applications are analyzed, providing readers with comprehensive insights into their suitability for various environments and purposes. Furthermore, the paper discusses the design considerations involved in developing effective water level indicators, including sensor placement, calibration procedures, and integration with alarm systems or control units. The authors present a critical evaluation of existing automatic water level indicators, highlighting their performance metrics, cost-effectiveness, and potential areas for improvement. They discuss recent advancements in sensor technology, signal processing algorithms, and wireless communication protocols, which have enhanced the accuracy, efficiency, and scalability of water level monitoring systems. Moreover, the review examines the practical challenges encountered in implementing automatic water level indicators, such as environmental factors, signal interference, and compatibility with existing infrastructure. Strategies for mitigating these challenges and optimizing system performance are discussed. In addition to technical considerations, the paper explores the socio-economic implications of water level monitoring, emphasizing its role in promoting sustainable water usage practices, supporting agricultural productivity, and mitigating the impacts of climate change-induced water scarcity. Overall, this review article offers a comprehensive overview of automatic water level indicators, combining technical insights with practical considerations and socio-economic perspectives.

C) " Development of an Automatic Water Pump Control System using IoT" by A. K. Paul, A. H. M. S. H. Tareq, and S. S. M. G. Rahman

Paul and colleagues' research delves into approach to automate water pump control leveraging Internet of Things (IoT) technology. The study aims to enhance water management efficiency by designing a system capable of monitoring water levels and controlling pump operations remotely. Through the integration of IoT devices and sensors, such as float sensors, the system enables real-time monitoring of water levels in tanks or reservoirs. Arduino microcontrollers facilitate data processing and decision-making, allowing for automatic activation and deactivation of water pumps based on predefined thresholds. The authors discuss the hardware setup, software implementation, and testing procedures, highlighting the system's reliability and effectiveness in automating water pump operations. By reducing manual intervention and optimizing pump usage, the automatic water pump control system contributes to improved water conservation and efficiency. Overall, the paper underscores the significance of IoT-based solutions in addressing water management challenges and promoting sustainability in various applications.

D) " Wireless Transceiver Module HC-12 based Automatic Water-level Monitoring and Control System" by K P Deshmukh, Electronics, Shri Shivaji Mahavidyalaya, Barshi.

Deshmukh and his team's study presents a sophisticated solution to the challenges of water level monitoring and control. Traditional methods of monitoring water levels often involve manual observation, which can be time-consuming, prone to errors, and inefficient. This project aims to overcome these limitations by employing HC-12 transceiver modules for wireless communication, enabling real-time monitoring and control of water levels. The system consists of water level sensors placed within tanks or reservoirs to continuously measure water levels. These sensors are connected to Arduino microcontrollers, which process the sensor data and make decisions regarding water level control. The HC-12 transceiver modules facilitate wireless communication between the water level sensors and the central control unit, providing seamless data transmission over long distances. One of the key features of this system is its ability to automatically activate or deactivate water pumps based on predefined water level thresholds. This ensures optimal water management by preventing overflow or shortage and maintaining water levels within desired ranges. Additionally, the system can provide alerts or notifications to users in case of abnormal water level conditions, allowing for timely intervention. The project involves hardware implementation, including the installation of water level sensors, Arduino microcontrollers, and HC-12 transceiver modules, as well as software programming to enable data processing and control logic. Testing and validation procedures are conducted to ensure the reliability, accuracy, and effectiveness of the system under various operating conditions.

Overall, the "Wireless Transceiver Module HC-12 based Automatic Water-level Monitoring and Control System" offers a robust and efficient solution for water level monitoring and control, with applications in diverse settings such as residential, agricultural, and industrial water management. By leveraging wireless communication technology and automation, the system contributes to improved water conservation, resource efficiency, and operational convenience.

E) " Automatic Water Level Indicator and Controller using Arduino" by Ms. Pooja K1, Ms. Kusumavathi 2, Ms. Pavithra3, Ms. Nishmitha4, Prof. Aishwarya D Shetty5.

The project titled "Automatic Water Level Indicator and Controller using Arduino" developed in 2020, introduces a smart solution for monitoring and controlling water levels using Arduino microcontrollers. The system employs sensors to detect water levels in tanks or reservoirs and Arduino-based circuitry to process the sensor data. When water levels reach predefined thresholds, the system activates or deactivates water pumps accordingly, ensuring optimal water management. This automation eliminates the need for manual monitoring, ensuring efficient water management and preventing overflow or shortage. The project encompasses hardware setup, including sensors and Arduino boards, and software programming to process sensor data and control pump operations. The project aims to address the challenges of manual monitoring and control of water levels, offering an automated and efficient solution for various applications. Through hardware setup, software programming, and testing procedures, the authors demonstrate the functionality and reliability of the automatic water level indicator and controller system. Overall, the project contributes to promoting water conservation, improving efficiency, and enhancing convenience in water management practices.

CHAPTER 3

WORK TITLE EXPLANATION

3.1 Flow Chart:

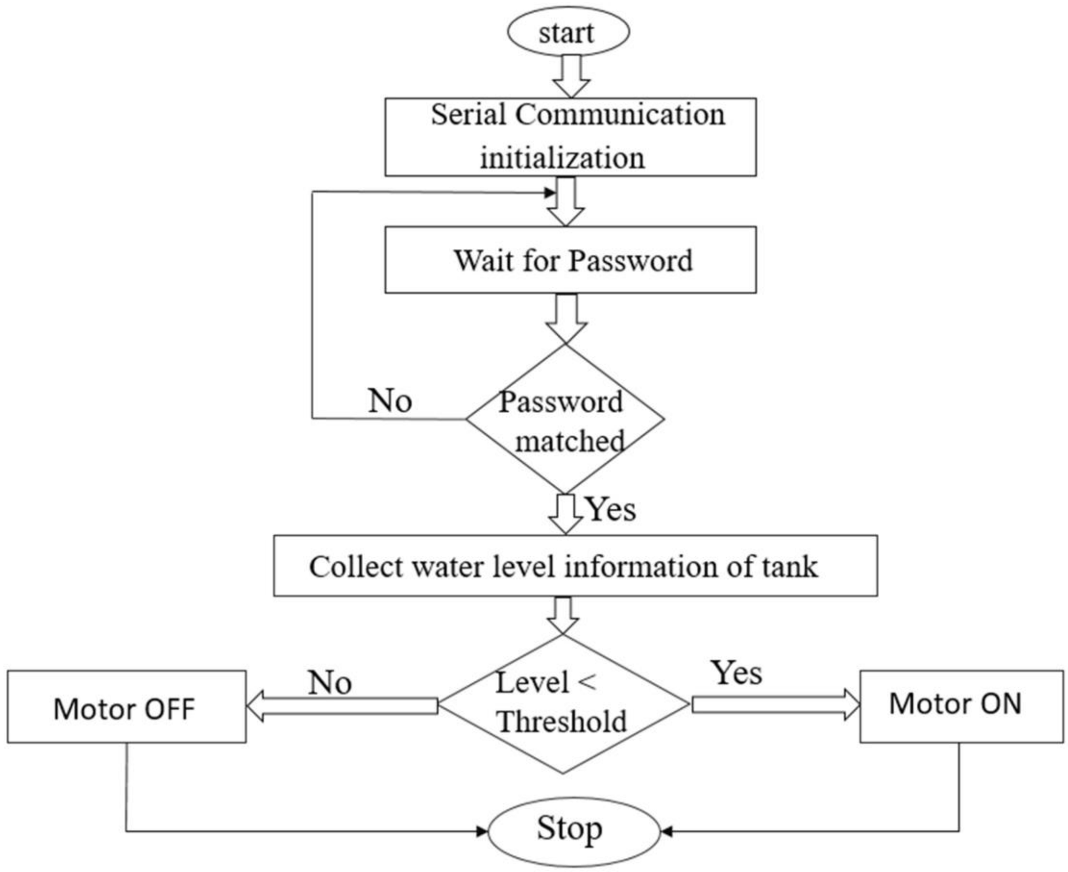

Fig 3.1: Flowchart

Initialize Arduino Nano, HC12 module, OLED display, and float sensors and set initial parameters such as motor control pins, communication settings for HC12 module, OLED display settings, and thresholds for float sensor readings. Send a signal using HC12 module to the main water source or tank for water refilling. Wait for acknowledgment signal from the main water source or tank. Read data from float sensors to determine the water level.

Activate/deactivate the water motor based on the water level and system status. If water level is below threshold and motor is off, turn on the motor and if water level is above threshold and motor is on, turn off the motor. Display relevant information on the OLED display, such as current water level, status of the motor (ON/OFF), and any error messages. Continuously check for commands received from HC12 module. Commands could include manual override for motor control or system diagnostics. If a command is received, execute the corresponding action. Actions could include turning the motor on/off, adjusting thresholds, or displaying diagnostic information.

3.2 Existing System:

In The Existing System the RF module used as both Receiver Module and Transmitter Module.

RF module:

RF (Radio Frequency) modules are electronic devices used to transmit and receive radio signals wirelessly over a certain range of frequencies. They are commonly used in various applications such as remote controls, wireless communication systems, telemetry, and IoT devices. RF modules operate within specific frequency bands, such as 315 MHz, 433 MHz, 868 MHz, or 2.4 GHz. The choice of frequency depends on factors like range requirements, interference, and regulations. This frequency range varies between 30 kHz & 300 GHz. In this RF system, the digital data is represented as variations in the amplitude of carrier wave.

RF modules can support various communication protocols such as ASK (Amplitude Shift Keying), FSK (Frequency Shift Keying), and OOK (On-Off Keying). The effective communication range of RF modules depends on factors like the output power of the module, the frequency used, obstacles in the transmission path, and interference. Range can vary from a few meters to several kilometers. They have different data transmission rates, typically ranging from a few hundred bits per second (bps) to several megabits per second (Mbps). RF modules usually operate at low power levels, making them suitable for battery-powered applications. The power consumption depends on factors like transmission power, modulation scheme, and duty cycle. RF modules can operate in simplex, half-duplex, or full-duplex modes, allowing one-way or two-way communication between devices.

RF Module Working as Transmitter:

An RF module functioning as a transmitter plays a pivotal role in wireless communication systems. It starts by receiving an electrical signal from a source like a sensor or microcontroller. This signal undergoes modulation, where it's impressed onto a carrier wave, often using techniques like Amplitude Modulation (AM), Frequency Modulation (FM), or Phase Modulation (PM). The modulated signal then enters an RF oscillator circuit, transforming it into a high-frequency radio wave suitable for wireless transmission. To ensure effective communication, the signal is typically amplified to boost its strength before being routed to an antenna. The antenna then emits the RF signal into the air, its design crucial for determining transmission range and directionality. Compliance with regulatory standards regarding frequency bands and transmit power levels is essential. Additionally, RF modules often include control circuitry and interface options for seamless integration into larger systems, facilitating functions like frequency tuning and power control. Overall, RF modules serving as transmitters are integral components in enabling wireless communication across various applications, including remote control systems, telemetry, wireless sensor networks, and IoT devices.

RF Module Working as Receiver:

A receiver RF module captures and decodes the radio waves transmitted by the transmitter module. It typically consists of an antenna, a radio-frequency (RF) amplifier, a mixer, a demodulator, and a decoder. The antenna receives the radio waves and converts them into electrical signals where as the RF amplifier amplifies the weak electrical signals received by the antenna to a level suitable for further processing. The mixer combines the received signal with a local oscillator signal to convert the radio frequency signal to a lower intermediate frequency (IF) signal. The demodulator extracts the original information from the modulated carrier wave. Depending on the modulation technique used by the transmitter, the demodulator performs the corresponding demodulation process (e.g., detecting changes in amplitude for ASK modulation). The decoder processes the demodulated signal to recover the original data transmitted by the transmitter.

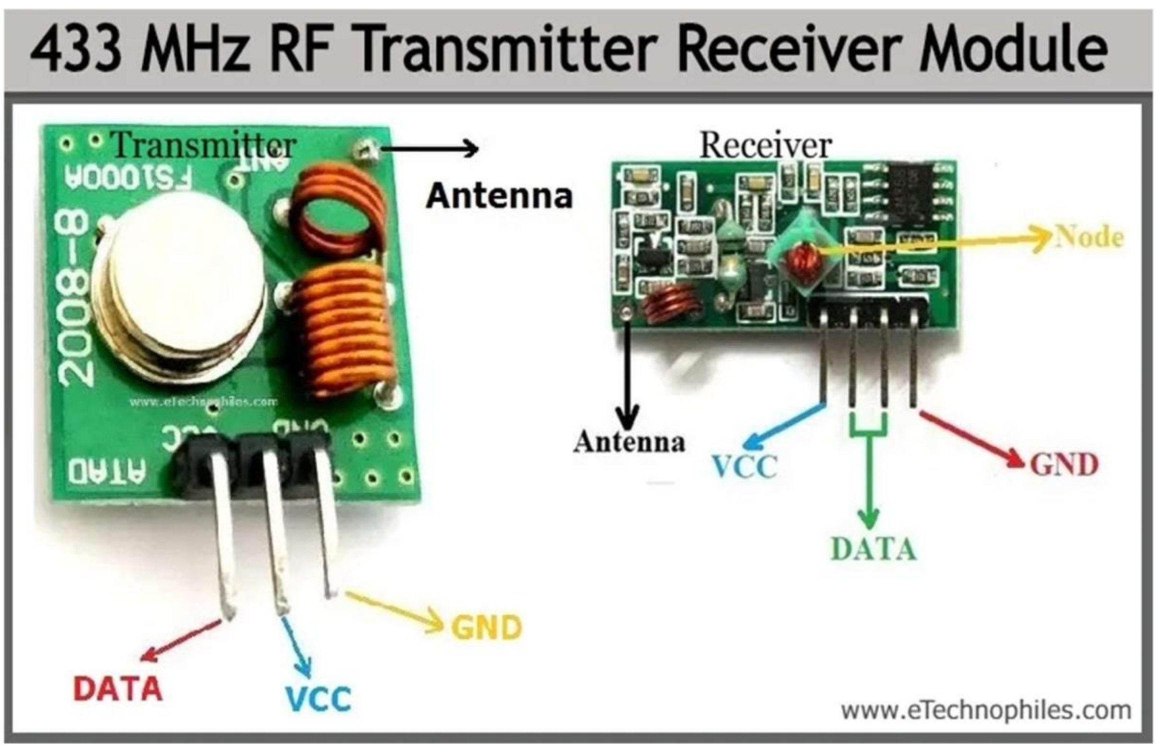

Fig. 3.2: RF Module

Problems Faced:

Range Limitations: The effective range of RF communication is influenced by factors such as output power, antenna design, and environmental conditions. If the distance between the transmitter and receiver exceeds the range capabilities of the RF modules, communication may fail.

Signal Degradation: RF signals can experience attenuation and signal degradation as they propagate through obstacles such as walls, buildings, or foliage. This attenuation can weaken the signal received by the RF module, affecting the reliability of communication.

Environmental Factors: Environmental conditions such as electromagnetic interference, temperature variations, and humidity levels can affect the performance of RF modules. Shielding, proper grounding, and environmental sealing may be necessary to mitigate these effects.

Interference: RF communication can be susceptible to interference from other electronic devices operating in the same frequency band. This interference can disrupt communication between the transmitter (HC-12) and receiver (RF module), leading to unreliable data transmission.

Protocol Compatibility: The transmitter (HC-12) and receiver (RF module) must use compatible communication protocols and settings to establish a successful connection. Incompatible settings or configurations may result in communication errors or inability to establish a link.

Line of sight: Although walls and other obstructions may attenuate (lessen) or block signals entirely, the receiving device must be in the radiation pattern emitted by the transmitter, which is also considered line of sight.

problems faced by RF modules when line of sight is not clear, various strategies can be employed:

Antenna Diversity: Using multiple antennas or antenna diversity techniques can mitigate the effects of fading and signal fluctuations caused by multipath propagation.

Frequency Diversity: Employing frequency hopping or spread spectrum techniques can improve communication robustness by spreading the transmitted signal across multiple frequencies, reducing the impact of interference and fading.

Repeater Stations: Installing repeater stations or relay nodes can extend the communication range and bypass obstacles by relaying signals between distant RF modules.

Channel Planning: Selecting optimal communication channels and avoiding congested or noisy frequency bands can help minimize interference and improve communication reliability in challenging environments.

Signal Processing Techniques: Implementing advanced signal processing algorithms such as equalization, error correction coding, and adaptive modulation can enhance the resilience of RF communication systems to signal degradation and interference

3.3 Proposed System:

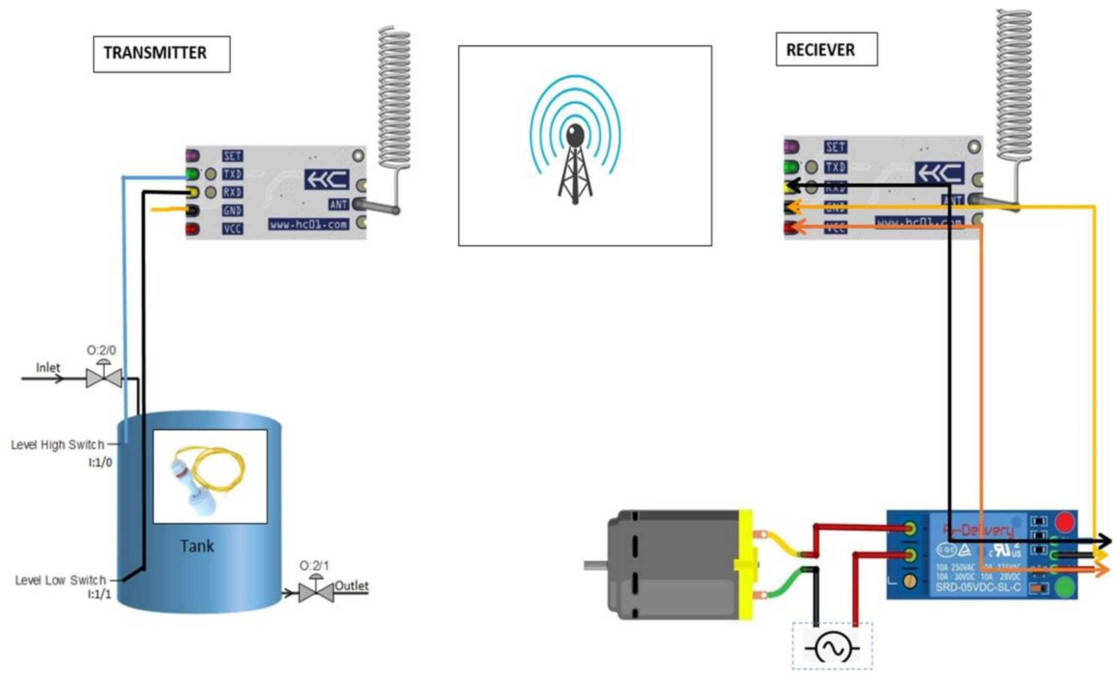

Fig 3.3: Circuit Diagram

The Wireless Antenna-Based Water Motor Control System operates by utilizing a network of interconnected components to enable remote precision control and versatility. At the heart of the system lies the Arduino Nano, functioning as the central control unit. It receives data from the float sensors strategically placed within the water tank to monitor the water level accurately. These float sensors, typically consisting of floats attached to switches, change state based on the water level fluctuations. The Arduino Nano processes this data and makes decisions regarding the operation of the water motor.

To enable wireless communication, the system employs HC-12 modules, serving as both transmitters and receivers. One HC-12 module is connected to the Arduino Nano as the transmitter, while another is connected as the receiver. These modules establish a wireless link, allowing the Arduino Nano to transmit control commands to the water motor system remotely. Additionally, the HC-12 modules facilitate bidirectional communication, enabling feedback from the water motor system to be transmitted back to the Arduino Nano for monitoring and control purposes.

The OLED display serves as the interface for providing real-time feedback to the user. Connected to the Arduino Nano, it displays essential information such as water level readings, motor control status, and any error messages. This visual feedback enhances the user experience by providing insights into the system's operation and ensuring prompt response to any anomalies or maintenance requirements.

In operation, the system continuously monitors the water level using the float sensors and adjusts the operation of the water motor(s) via the relay module to maintain the desired water level in the tank or reservoir. The Arduino Nano processes the sensor data, executes control logic based on predefined parameters or user input, and communicates with the operator through the OLED display. The wireless communication facilitated by the HC-12 module enables remote monitoring and control of the system, offering flexibility and convenience in various applications.

Ultimately, the system's functionality revolves around maintaining the desired water level in the tank while ensuring efficient and reliable operation of the water motor. By leveraging wireless communication, precise sensor data, and intelligent control algorithms, the system achieves remote precision and versatility, enabling seamless water motor control in various applications and environments.

CHAPTER 4

SOFTWARE & HARDWARE DETAILS

4.1 Hardware Components:

A) Arduino Nano:

The Arduino Nano is a compact yet powerful microcontroller board favored by hobbyists, educators, and professionals alike for its versatility and ease of use. At its core lies the ATmega328P microcontroller, the same chip found in the Arduino Uno, providing ample processing power for a wide range of projects. What sets the Nano apart is its diminutive size, making it ideal for applications where space is at a premium. Measuring just 18x45mm, it fits snugly onto a breadboard, allowing for easy prototyping and experimentation. Despite its small form factor, the Nano boasts an impressive array of features. With 14 digital input/output pins, 6 analog inputs, and support for PWM (Pulse Width Modulation) output, it offers plenty of flexibility for interfacing with sensors, actuators, and other peripherals. Additionally, its onboard USB connectivity simplifies both programming and power supply, eliminating the need for a separate programmer or power source. This USB interface also enables seamless integration with the Arduino IDE, a user-friendly development environment with a vast library of code examples and tutorials. Its affordability, accessibility, and robust community support make it an indispensable tool for anyone looking to explore the exciting world of embedded systems and physical computing.

Fig 4.1: Arduino Nano

B) HC 12 Module:

The HC-12 module is a highly popular and cost-effective wireless communication module based on the SI4463 transceiver chip. It operates in the 433MHz ISM (Industrial, Scientific, and Medical) band and is widely used for establishing long-range wireless communication links in various projects, such as remote control systems, telemetry, sensor networks, and IoT applications. The HC-12 module offers a maximum communication range of up to 1,000 meters in open space when configured in optimal conditions, making it suitable for outdoor and long-distance applications. It supports multiple communication modes, including transparent UART serial communication and half-duplex serial communication with configurable baud rates ranging from 1.2 kbps to 115.2 kbps. The module features a simple command set for configuring parameters such as communication frequency, transmission power, and operating modes, making it easy to integrate into Arduino, Raspberry Pi, and other microcontroller-based projects. Additionally, the HC-12 module operates on low power, consuming only around 1.8mA during active transmission, which makes it suitable for battery-powered applications requiring energy efficiency. Its compact size, ease of use, and affordable price make the HC-12 module a popular choice among hobbyists, makers, and engineers for building wireless communication systems with extended range and reliability. HC-12 in a legal frequency band of 433.4 MHz to 473.0 MHz supported with hundred communication channels. The monitoring and control range is up to 500 meters in open-air and about 100 meters indoor.

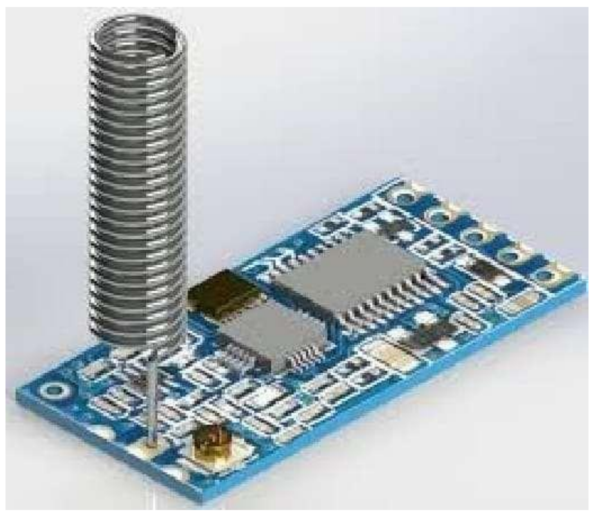

Fig 4.2: HC 12 Module

C) Float Sensor:

Float sensors, also known as float switches or level sensors, are devices used to detect the level of liquid within a container or reservoir. They typically consist of a buoyant float attached to a lever or arm that pivots around a fixed point. As the liquid level rises or falls, the float moves accordingly, causing the lever to actuate a switch or sensor mechanism. Float sensors are commonly employed in various applications, including water tanks, sump pumps, industrial machinery, and household appliances like washing machines and dishwashers. They provide a simple and reliable method for monitoring fluid levels and triggering automated actions, such as activating pumps or alarms, based on predefined thresholds. These sensors come in different configurations to suit different environments and liquids. For instance, vertical float switches are suitable for vertically mounted tanks, while horizontal float switches are ideal for horizontally positioned tanks or confined spaces. Some float sensors utilize mechanical switches, where the movement of the float physically actuates a switch mechanism, while others employ non-contact methods such as magnetic reed switches or capacitive sensors for improved reliability and longevity. Advantages of float sensors include their simplicity, robustness, and low cost. However, they may be susceptible to issues like sticking due to debris or buildup on the float, and they may not be suitable for very viscous liquids or turbulent environments. Regular maintenance and proper installation are essential to ensure accurate and reliable operation. Overall, float sensors play a crucial role in various industries by providing an effective means of liquid level detection and control.

Fig 4.3: Float Sensor

D) 4 Channel Relay Module:

A 4-channel relay module is an electronic device used to control multiple electrical circuits or devices using a single microcontroller or digital signal. Each relay on the module typically consists of a coil and a set of switch contacts. When an electrical current is applied to the coil, it generates a magnetic field, which causes the switch contacts to open or close, depending on the relay type. These modules are commonly used in automation, robotics, home appliances, and industrial control systems to switch high-power or high-voltage loads such as lights, motors, heaters, and solenoids. The 4-channel configuration allows for independent control of up to four separate circuits, providing flexibility and versatility in various applications. One of the main advantages of using relay modules is their ability to isolate the low-voltage control signals (typically from a microcontroller or digital output) from the higher voltage or current circuits being controlled. This helps protect sensitive electronic components from damage and ensures safe operation. Most 4-channel relay modules feature opto-isolation, which further enhances electrical isolation between the control and load circuits, reducing the risk of noise, interference, or voltage spikes affecting the control signals. These modules typically have screw terminals or headers for easy connection to external devices and power sources. They are also compatible with a wide range of microcontrollers, such as Arduino, Raspberry Pi, and other development boards, making them easy to integrate into various projects. Some relay modules come with additional features like status LEDs for visual indication of relay activation, and diodes for protection against back EMF (electromotive force) generated by inductive loads. Overall, 4-channel relay modules are valuable components in electronics and automation projects, offering reliable switching capabilities for controlling multiple electrical circuits with ease and efficiency.

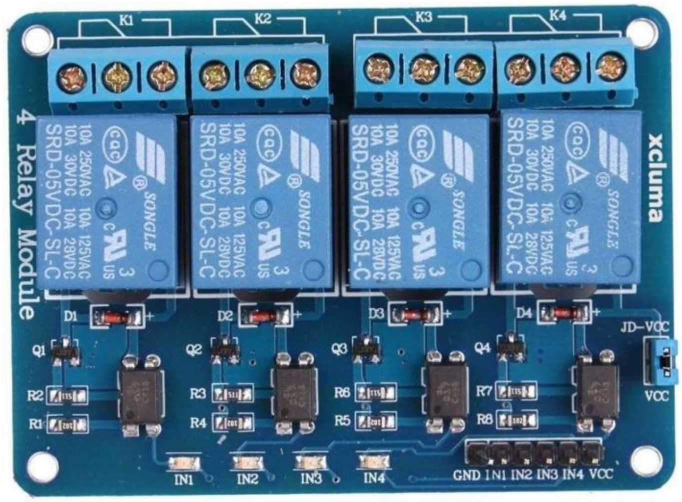

Fig 4.4: Four Channel Relay Module

E) OLED Display:

OLED (Organic Light Emitting Diode) displays are a type of display technology that offers numerous advantages over traditional LCD displays. OLEDs consist of thin layers of organic materials sandwiched between two electrodes, which emit light when an electric current is applied. This allows OLED displays to produce vibrant colors, high contrast ratios, and wide viewing angles without the need for a separate backlight, resulting in thinner and more energy-efficient displays. One of the key benefits of OLED displays is their ability to achieve true blacks by turning off individual pixels completely, leading to superior contrast and deeper blacks compared to LCDs. This results in richer and more lifelike images, especially in low-light environments. OLED displays are also known for their fast response times, making them well-suited for applications requiring smooth motion, such as gaming and virtual reality. Furthermore, OLED displays are flexible and can be manufactured on flexible substrates, enabling the production of curved or even rollable displays. This flexibility opens up new possibilities for innovative form factors in smartphones, wearables, and other portable devices. OLED technology offers excellent power efficiency because it only consumes power when emitting light. This allows for improved battery life in mobile devices and lower energy consumption in general. OLED displays are commonly used in smartphones, tablets, smartwatches, televisions, and automotive displays due to their superior image quality, energy efficiency, and design flexibility. However, they are also used in smaller form factors, such as OLED modules for Arduino and Raspberry Pi projects, providing crisp and colorful graphical output for various applications such as data visualization, gaming, and user interfaces.

Fig 4.5: OLED Display

F) Power Adaptor(5V):

A 5V power adapter is an electronic device used to convert AC (alternating current) mains electricity into DC (direct current) power at a stable voltage of 5 volts. Typically, a 5V power adapter consists of a transformer, rectifier, voltage regulator, and output connector. The transformer converts the high-voltage AC input from the mains power supply into a lower-voltage AC signal, which is then rectified to produce a pulsating DC voltage. The voltage regulator then filters and stabilizes this DC voltage to ensure a steady 5V output, regardless of variations in input voltage or load conditions. 5V power adapters come in various form factors, including wall adapters, desktop adapters, and USB adapters. Wall adapters plug directly into a wall outlet and have a fixed output cable with a connector suitable for the device being powered. When selecting a 5V power adapter, it's essential to consider factors such as output current (measured in amps or milliamps), connector compatibility, and safety certifications. The output current rating should be sufficient to meet the power requirements of the device being powered, while safety certifications such as UL (Underwriters Laboratories) or CE (Conformité Européenne) ensure that the adapter meets rigorous safety and quality standards. Overall, 5V power adapters are essential accessories for powering a wide range of electronic devices, providing reliable and efficient DC power from standard AC mains electricity sources.

Fig 4.6: Power Adaptor (5V)

4.2 Software Details:

4.2.1 ARDUINO IDE

Introduction to ARDUINO IDE:

Arduino IDE (Integrated Development Environment) is an open-source software platform used for programming Arduino boards. It provides a simple and user-friendly interface for writing, compiling, and uploading code to Arduino microcontrollers. With Arduino IDE, even beginners can easily develop projects and prototypes using Arduino boards.

Working of ARDUINO IDE:

Arduino IDE works by providing a text editor where users can write their code in the Arduino programming language (based on C/C++), which is then compiled and uploaded to the Arduino board via a USB connection. The IDE handles the compilation process and converts the code into machine-readable instructions that can be executed by the microcontroller on the Arduino board.

Various Methods of ARDUINO IDE:

1. Writing Sketches: Users can write their code, known as sketches, using the Arduino programming language.

2. Library Integration: Arduino IDE supports the integration of libraries, which are collections of pre-written code that extend the functionality of Arduino boards.

3. Serial Monitor: Arduino IDE includes a serial monitor tool that allows users to send and receive data between the Arduino board and the computer for debugging and monitoring purposes.

4. Board Manager: It provides a board manager feature that enables users to install additional board definitions for different Arduino-compatible boards.

Types of Fields in ARDUINO IDE:

1. Programming: Writing code to control the behavior of Arduino boards.

2. Electronics: Integrating electronic components and sensors with Arduino boards.

3. Embedded Systems: Developing projects that involve real-time control and interaction with the physical world.

4. IoT (Internet of Things): Building connected devices that can communicate over the internet using Arduino boards.

5. Robotics: Creating robotic systems and automation projects using Arduino as the brain.

Applications of ARDUINO IDE:

1. Home Automation: Control lights, appliances, and security systems remotely.

2. Wearable Technology: Develop wearable devices such as fitness trackers and smart watches.

3. Environmental Monitoring: Build systems for monitoring temperature, humidity, air quality, etc.

4. Education: Arduino IDE is widely used in educational settings to teach programming, electronics, and robotics.

5. Art Installations: Create interactive art installations with sensors and actuators controlled by Arduino boards.

Arduino IDE is a powerful and versatile tool for programming Arduino boards, making it accessible to both beginners and experienced developers. Its simplicity, coupled with a wide range of applications and community support, makes it an ideal platform for prototyping projects, learning electronics, and exploring the world of embedded systems. Whether you're a hobbyist, student, educator, or professional, Arduino IDE provides a platform for creativity and innovation in the realm of physical computing.

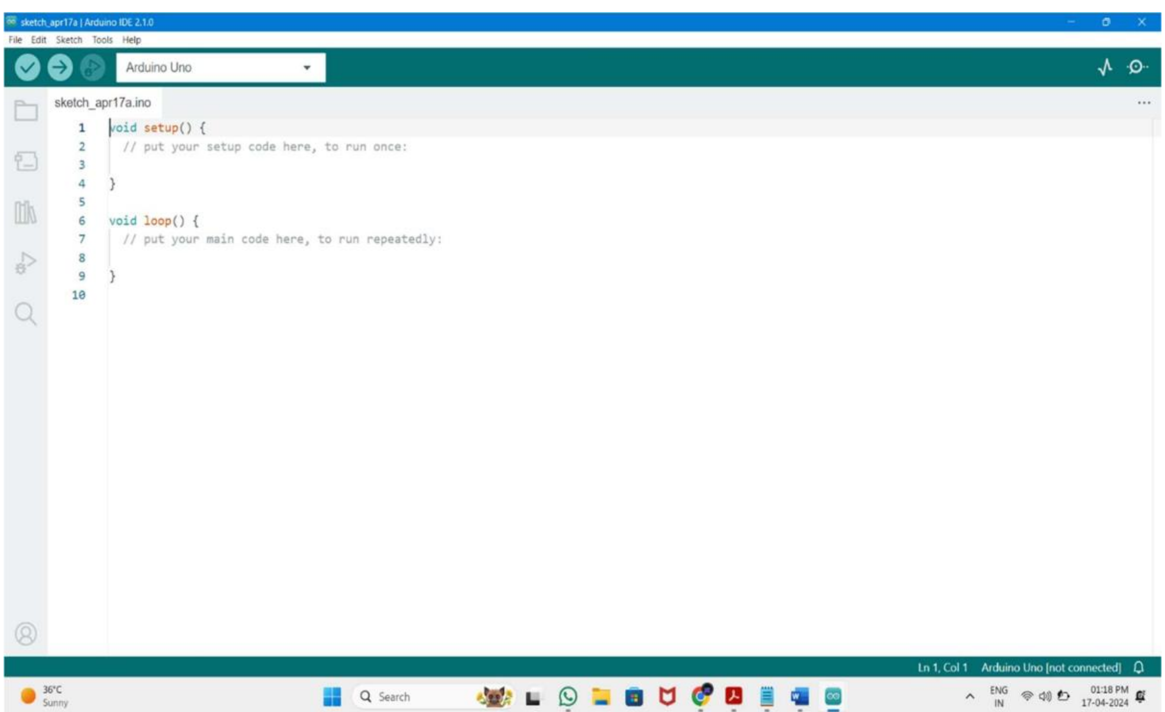

Fig 4.7: ARDUINO IDE Interface

4.3 Code:

```
#include <Wire.h>

#include <Adafruit_GFX.h>

#include <Adafruit_SH1106.h>

#define OLED_RESET -1

Adafruit_SH1106 display(OLED_RESET);

int floornum=0;

int currentfloor=0;

String myString,top,bot;

int g,d,h,t,k='1';

int gr=A0,rr=A1;

const unsigned char up [] PROGMEM = {

0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,

0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x38, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x7c, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00,

0x00, 0x00, 0x00, 0x00, 0x01, 0xff, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x03, 0xff, 0x80, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x0f, 0xff, 0xe0, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x1f, 0xff, 0xf0, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,

0x00, 0x00, 0x00, 0x00, 0x7f, 0xff, 0xfc, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0xff, 0xff, 0xfe, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x03,
0xff, 0xc7, 0xff, 0x80, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x07, 0xff, 0x81,
0xff, 0xc0,

0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x1f, 0xfe, 0x00, 0xff, 0xf0, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x3f, 0xfc, 0x00, 0x3f, 0xf8, 0x00, 0x00, 0x00, 0x00,
```

0x00, 0x00, 0x00, 0x00, 0xff, 0xf0, 0x00, 0x1f, 0xfe, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x01, 0xff, 0xe0, 0x00, 0x07, 0xff, 0x00, 0x00,

0x00, 0x00, 0x00, 0x00, 0x00, 0x07, 0xff, 0x80, 0x00, 0x03, 0xff, 0xc0, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x0f, 0xff, 0x00, 0x00, 0x00, 0xff, 0xe0, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x3f, 0xfc,

0x00, 0x00, 0x00, 0x7f, 0xf8, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x7f, 0xf8, 0x00, 0x00, 0x00, 0x1f, 0xfc, 0x00, 0x00, 0x00, 0x00, 0x00, 0x01, 0xff, 0xe0, 0x00, 0x00, 0x00, 0x0f, 0xff, 0x00, 0x00, 0x00, 0x00, 0x00, 0x03, 0xff, 0xc0,

0x00, 0x38, 0x00, 0x03, 0xff, 0x80, 0x00, 0x00, 0x00, 0x00, 0x0f, 0xff, 0x00, 0x00, 0x7c, 0x00, 0x01, 0xff, 0xe0, 0x00, 0x00, 0x00, 0x00, 0x1f, 0xfe, 0x00, 0x01, 0xff, 0x00, 0x00, 0x7f, 0xf0, 0x00, 0x00, 0x00, 0x00, 0x7f, 0xf8, 0x00, 0x03, 0xff, 0x80, 0x00, 0x3f, 0xfc, 0x00, 0x00,

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0x00, 0x1f, 0xf0, 0x0f, 0xe0, 0x00, 0x0f, 0xff, 0x00, 0x00, 0x00, 0xff, 0xe0, 0x00, 0x0f, 0xe0, 0x03, 0xc0, 0x00, 0x3f, 0xfc, 0x00, 0x00, 0x00, 0x7f, 0xf8, 0x00, 0x03, 0x80, 0x01, 0x00, 0x00,

0x7f, 0xf8, 0x00, 0x00, 0x00, 0x1f, 0xfc, 0x00, 0x01, 0x00, 0x00, 0x00, 0x01, 0xff, 0xe0, 0x00, 0x00, 0x00, 0x0f, 0xff, 0x00, 0x00, 0x00, 0x00, 0x00, 0x03, 0xff, 0xc0, 0x00, 0x00, 0x00, 0x03, 0xff, 0x80, 0x00, 0x00, 0x00, 0x00, 0x0f, 0xff,

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0x00, 0x00, 0x00, 0x03, 0xff, 0xc0, 0x00, 0x00, 0x00, 0x00, 0x00, 0x07, 0xff, 0x80, 0x00, 0x00, 0x07, 0xff, 0x80, 0x00, 0x00, 0x00, 0x00, 0x00, 0x01, 0xff, 0xc0, 0x00, 0x00, 0x1f, 0xfe, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0xff, 0xf0,

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0x00, 0x01, 0xff, 0xc0, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x07, 0xff, 0x00, 0x07, 0xff, 0x80, 0x00, 0x00, 0x00,

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0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,

0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00

};

const unsigned char down [] PROGMEM = {

0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,

0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x40, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x40, 0x00, 0xe0, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,

0x00, 0x00, 0x01, 0xe0, 0x03, 0xf8, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x03, 0xf0, 0x0f, 0xfc, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x07, 0xf0, 0x0f, 0xff, 0x00, 0x00, 0x00,

0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x1f, 0xf0, 0x03, 0xff, 0x80, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x7f, 0xf0, 0x01, 0xff, 0xe0, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0xff, 0xf0, 0x00, 0x7f, 0xf0, 0x00, 0x00, 0x00,

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```

0x3f, 0xfc, 0x00, 0x00, 0x01, 0xff, 0xc0, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0xff, 0xf0, 0x00, 0x00, 0x00, 0xff, 0xf0, 0x00, 0x00, 0x00, 0x00, 0x00, 0x01, 0xff, 0xe0, 0x00, 0x00, 0x00, 0x3f, 0xf8, 0x00, 0x00, 0x00, 0x00, 0x00, 0x07, 0xff, 0x80, 0x00, 0x00, 0x00, 0x1f, 0xfe,

0x00, 0x00, 0x00, 0x00, 0x00, 0x0f, 0xff, 0x00, 0x00, 0x00, 0x00, 0x07, 0xff, 0x00, 0x00, 0x00, 0x00, 0x00, 0x3f, 0xfc, 0x00, 0x00, 0x00, 0x00, 0x03, 0xff, 0xc0, 0x00, 0x00, 0x00, 0x00, 0x7f, 0xf8, 0x00, 0x00, 0x00,

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0xf0, 0x03, 0xff, 0x80, 0x00, 0x3f, 0xfc, 0x00, 0x07, 0xff, 0x80, 0x00, 0x3f, 0xf0, 0x01, 0xff, 0xe0, 0x00, 0x0f, 0xfe, 0x00, 0x1f, 0xfe, 0x00, 0x00, 0xff, 0xf0, 0x00, 0x7f, 0xf0, 0x00, 0x07, 0xff, 0x80, 0x3f, 0xfc, 0x00, 0x03, 0xff,

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0x00, 0x00, 0x00, 0x00, 0x07, 0xff, 0x00, 0x00, 0x7f, 0xc0, 0x00, 0x3f, 0xfc, 0x00, 0x00, 0x00, 0x00, 0x03, 0xff, 0xc0, 0x00, 0x1f, 0x00, 0x00,

0x7f, 0xf8, 0x00, 0x00, 0x00, 0x00, 0x00, 0xff, 0xe0, 0x00, 0x0e, 0x00, 0x01,

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0x00, 0x0e, 0x00,

0x00, 0x00

};

const unsigned char uparrow [] PROGMEM = {

0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x0e, 0x00, 0x00, 0x00, 0x00, 0x1f, 0x00, 0x00, 0x00, 0x00, 0x3f, 0x80, 0x00, 0x00, 0x00, 0xff, 0xc0, 0x00, 0x00, 0x01,

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```
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0x00, 0x00, 0x00

};

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};

const unsigned char closedoor [] PROGMEM = {

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0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00

};
```

```
void setup(){
  Serial.begin(9600);
  Serial.println("Detecting gestures ...");
  display.begin(SH1106_SWITCHCAPVCC, 0x3C);
  display.setTextSize(2);
  display.setTextColor(WHITE);
  display.clearDisplay();
  display.display();



  pinMode(gr,OUTPUT);
  pinMode(rr,OUTPUT);
  display.setCursor(5,3);
  display.print("AUTOMATIC WATER TANK CONTROL");
      display.display();
      display.clearDisplay();
      delay(2000);
}

void loop() {
  if (Serial.available())
    {
      myString = Serial.readStringUntil('*');
```

```
if(myString.substring(0, 1) == "T")
{
  top=myString.substring(1, 4);
  Serial.println("TOP:"+top);
}

else if(myString.substring(0, 1) == "B")
{
  bot=myString.substring(1, 4);
  Serial.println("BOT:"+bot);
}

if(top=="0" && bot=="0" && k=='1')
{
  Serial.println("Motor on");
  display.setCursor(0,5);
  display.print("TNK LVL:LO");
  display.setCursor(0,25);
  display.print("MOTOR:ON");
  display.display();
  display.clearDisplay();
  k='0';
  digitalWrite(gr,LOW);
```

```
  delay(2500);
  digitalWrite(gr,HIGH);
  delay(1000);
}

else if(top=="1" && bot=="1" && k=='0')

{

  Serial.println("Motor off");
  display.setCursor(0,5);
  display.print("TNK LVL:HI");
  display.setCursor(0,25);
  display.print("MOTOR:OFF");
  display.display();
  display.clearDisplay();
  k='1';



  digitalWrite(rr,LOW);

  delay(2500);
```

```
      digitalWrite(rr,HIGH);
      delay(1000);
    }
  }
}
```

CHAPTER 5

RESULTS

5.1 Software Results:

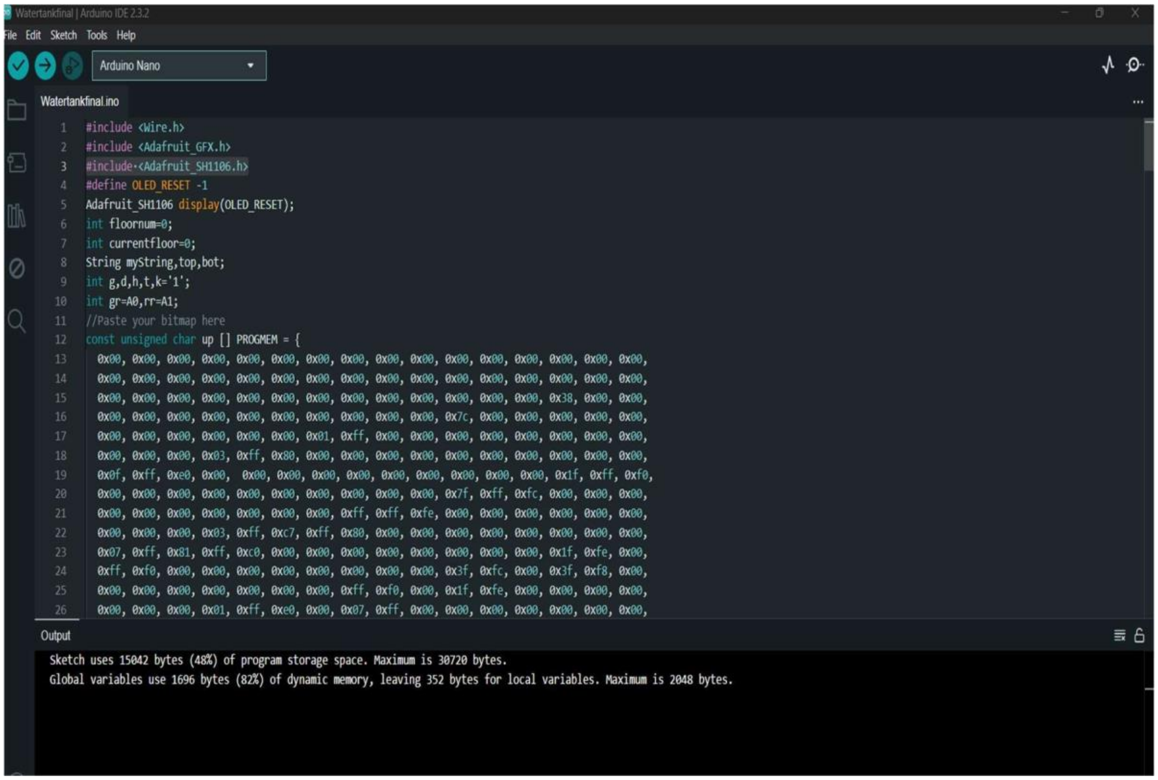


FIG. 5.1: Code Execution

In the Arduino IDE (Integrated Development Environment), code is executed. Code holds some specific libraries and functions like Adafruit_GFX and Adafruit_SH1106 library provided by the Arduino framework. The `Adafruit_GFX.h` and `Adafruit_SH1106` libraries are commonly used in Arduino projects, especially when working with OLED (Organic Light-Emitting Diode) displays, specifically the SH1106 controller.

1. Adafruit_GFX:

This library is a graphics library developed by Adafruit for Arduino and other microcontroller platforms. It provides a common set of graphics functions for drawing shapes (such as lines, circles, rectangles), text, and images on displays. The main purpose of this library is to abstract away the details of drawing graphics, making it easier to create graphical user interfaces (GUIs) or display information on screens. `Adafruit_GFX.h` is often used as a dependency for other display libraries developed by Adafruit, such as the `Adafruit_SSD1306` library.

2. Adafruit_SH1106:

This library is specifically designed for OLED displays that use the SH1106 controller chip. The SH1106 controller is commonly found in monochrome OLED displays with resolutions like 128x64 or 128x32 pixels. The library provides functions to initialize the display, set pixel colors, draw shapes and text, and control the display's settings. With `Adafruit_SH1106`, you can easily create projects that display text, graphics, and simple animations on SH1106-based OLED screens.

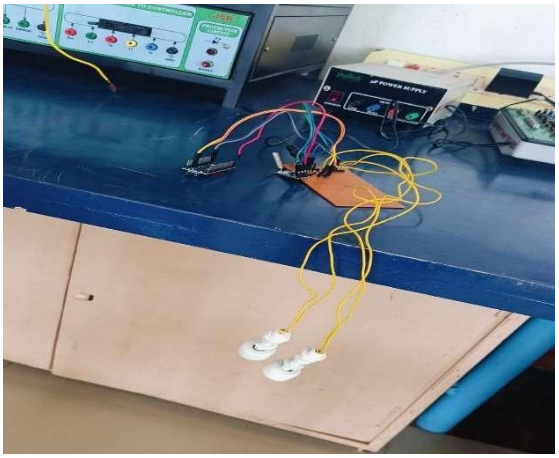
5.2 Hardware Results:

Case.1: In Lab (3.5 meters)

FIG. 5.2.1: In Lab

The outputs are taken in lab of our EEE dept. Both the Transmitter kit and Receiver kit covers a distance of 3.5 meters. The outputs are taken when the water level is HIGH as well as when the water level is LOW. The OLED display the output as “MOTOR ON” when the water level is low and “MOTOR OFF” when the water level is High.

A) Transmitting Kit **B) Receiving Kit**



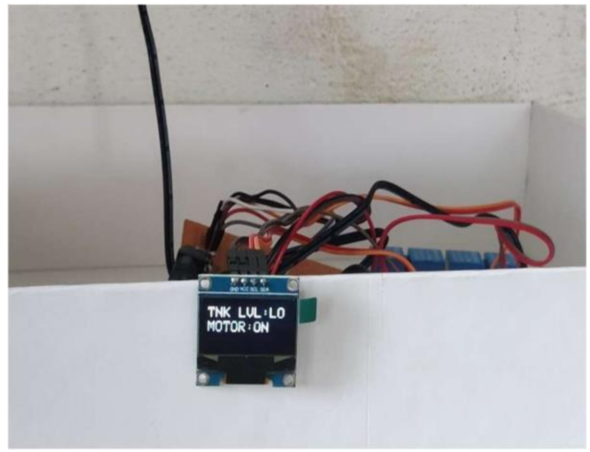
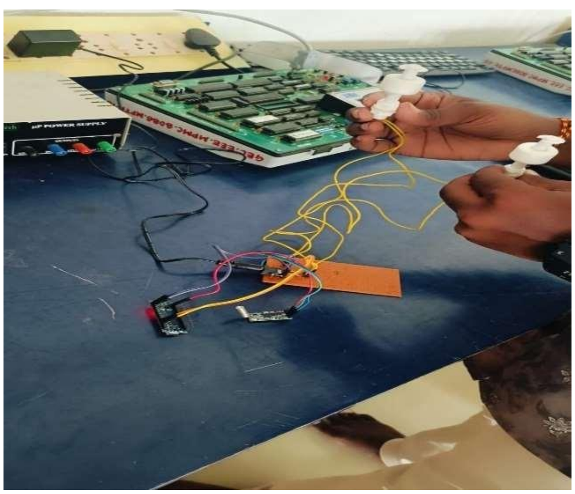


FIG. 5.2.2: Water level LOW—Motor ON

When the Float sensor reads the water level as LOW, it transmits the signal to receiver via HC- 12 Module. So, when the water level in tank is low, the OLED displays as “Tank Level LOW” and “MOTOR ON”.

A) Transmitting Kit **B) Receiving Kit**



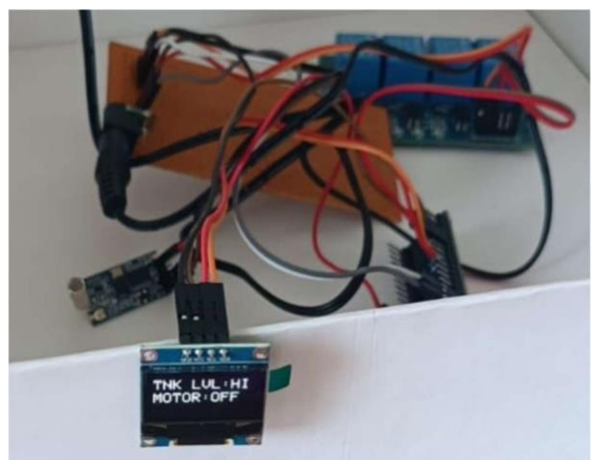


FIG. 5.2.3: Water level HIGH—Motor OFF

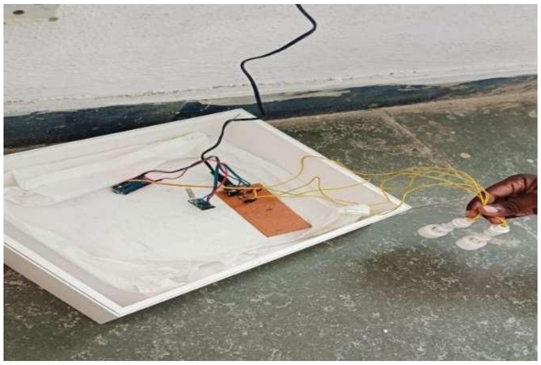
When the Float sensor reads the water level as HIGH, it transmits the signal to receiver via HC- 12 Module. So, when the water level in tank is high, the OLED displays as “Tank Level HIGH” and “MOTOR OFF”.

Case.2: Between 2 adjacent Classes (17 meters)

FIG. 5.2.4: Between Two Classes

The outputs are taken in between lab and the next class of our EEE dept. Both the Transmitter kit and Receiver kit covers a distance of 17 meters. The outputs are taken when the water level is HIGH as well as when the water level is LOW. The OLED display the output as "MOTOR ON" when the water level is low and "MOTOR OFF" when the water level is LOW.

A) Transmitting Kit **B) Receiving Kit**



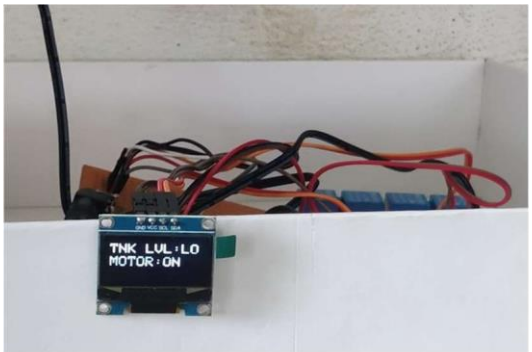


FIG. 5.2.5: Water level LOW—Motor ON

When the Float sensor reads the water level as LOW, it transmits the signal to receiver via HC- 12 Module. So, when the water level in tank is low, the OLED displays as "Tank Level LOW" and "MOTOR ON".

A) Transmitting Kit **B) Receiving Kit**

FIG. 5.2.6: Water level HIGH—Motor OFF

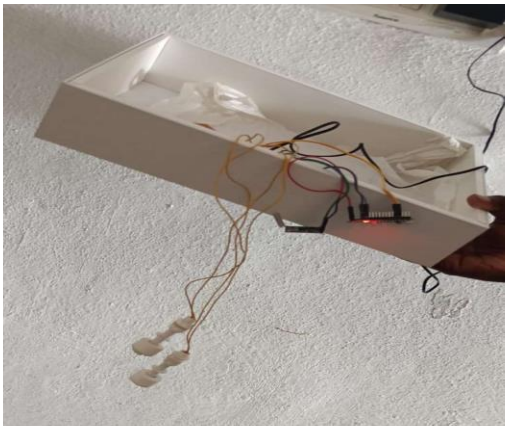
When the Float sensor reads the water level as HIGH, it transmits the signal to receiver via HC- 12 Module. So, when the water level in tank is high, the OLED displays as "Tank Level HIGH" and "MOTOR OFF".

Case.3: Between 2 Classes (20 meters)

FIG. 5.2.7: Between Two Classes

The outputs are taken in between lab and the class far from lab of our EEE dept. Both the Transmitter kit and Receiver kit covers a distance of 20 meters. The outputs are taken when the water level is HIGH as well as when the water level is LOW. The OLED display the output as “MOTOR ON” when the water level is low and “MOTOR OFF” when the water level is LOW.

A) Transmitting Kit **B) Receiving Kit**



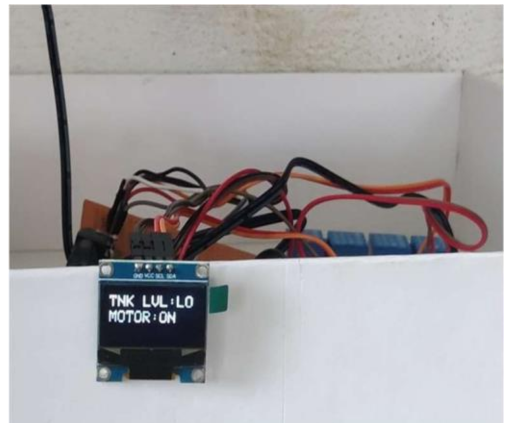
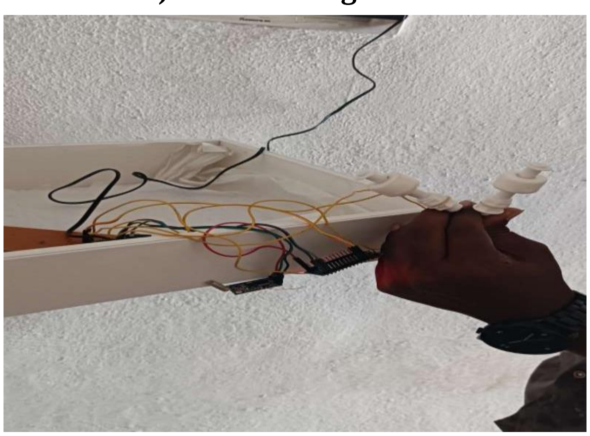


FIG. 5.2.8: Water level LOW—Motor ON

When the Float sensor reads the water level as LOW, it transmits the signal to receiver via HC- 12 Module. So, when the water level in tank is low, the OLED displays as “Tank Level LOW” and “MOTOR ON”.

A) Transmitting Kit **B) Receiving Kit**



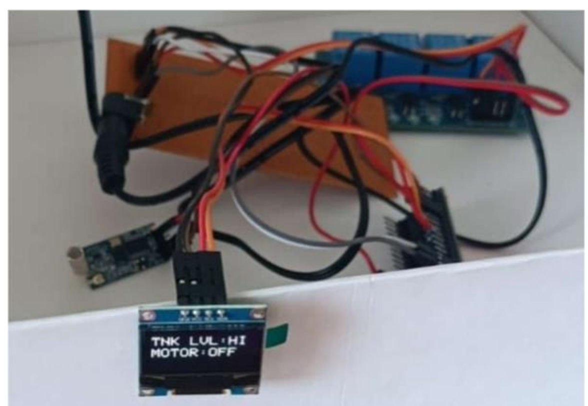


FIG. 5.2.9: Water level HIGH—Motor OFF

When the Float sensor reads the water level as HIGH, it transmits the signal to receiver via HC- 12 Module. So, when the water level in tank is high, the OLED displays as “Tank Level HIGH” and “MOTOR OFF”.

Case.4: Between 2 floors (35 meters)

A) Transmitting Kit **B) Receiving Kit**

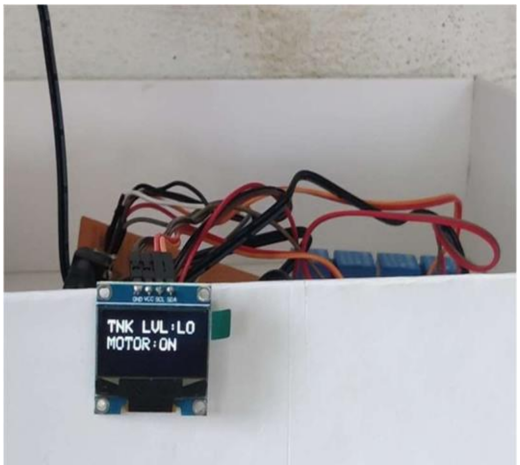


FIG. 5.2.10: Water level LOW—Motor ON

When the Float sensor reads the water level as LOW, it transmits the signal to receiver via HC- 12 Module. So, when the water level in tank is low, the OLED displays as “Tank Level LOW” and “MOTOR ON”.

A) Transmitting Kit **B) Receiving Kit**

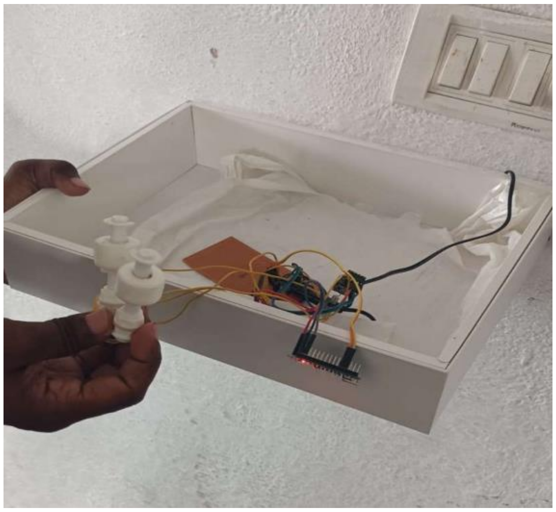


FIG. 5.2.11: Water level HIGH—Motor OFF

When the Float sensor reads the water level as HIGH, it transmits the signal to receiver via HC- 12 Module. So, when the water level in tank is high, the OLED displays as “Tank Level HIGH” and “MOTOR OFF”.

The outputs are taken in between 2 floors in our EEE dept. Both the Transmitter kit and Receiver kit covers a distance of 35 meters. The outputs are taken when the water level is HIGH as well as when the water level is LOW. The OLED display the output as “MOTOR ON” when the water level is low and “MOTOR OFF” when the water level is LOW.

CHAPTER 6

CONCLUSION

In conclusion, the "Wireless Antenna-Based Motor Control System" presents an innovative solution for efficiently managing water levels in tanks remotely. By integrating hardware components such as Arduino Nano, float sensors, OLED display, HC12 Bluetooth modules, and a 4-channel relay module, alongside the Arduino IDE software platform, this system enables precise monitoring and control of motor operations from a distance.

The project's practical implementation has demonstrated its effectiveness over varying transmission distances, showcasing reliable functionality up to 35 meters. Furthermore, the theoretical capability to operate over distances of up to 500 meters highlights its potential for applications requiring extended range communication. This system offers versatility in its application, finding utility in diverse scenarios such as agriculture, industrial settings, or domestic water management. It empowers users with the ability to remotely monitor water levels and efficiently control motor operations, contributing to resource conservation and operational efficiency.

Overall, the Wireless Antenna-Based Motor Control System represents a significant advancement in remote control technology, combining precision, versatility, and practicality to address real-world challenges in water management. With further refinement and adaptation, it holds promise for broader implementation in various sectors, facilitating smarter and more efficient utilization of resources.

6.1 Future Scope:

The "Wireless Antenna-Based Motor Control System" has promising future prospects, with several avenues for enhancement and expansion:

1. Enhanced Range and Reliability: Research and development efforts can focus on improving the system's transmission range and reliability, potentially utilizing advanced communication protocols or alternative wireless technologies to overcome obstacles and interference.

2. Integration of IoT Capabilities: Integration with Internet of Things (IoT) platforms can enable remote monitoring and control via the internet, providing users with access to real-time data and control from anywhere in the world. This could involve incorporating Wi-Fi or cellular connectivity modules into the system design.

3. Data Analytics and Predictive Maintenance: Implementing data analytics algorithms can enable predictive maintenance by analyzing historical data on water usage patterns and

motor performance. This proactive approach can help prevent equipment failures and optimize system efficiency.

4. Smart Automation and AI Integration: Incorporating artificial intelligence (AI) algorithms can enable the system to learn and adapt based on user behavior and environmental conditions. Smart automation features could optimize motor control strategies and enhance energy efficiency.

5. Scalability and Modular Design: Designing the system with scalability and modularity in mind allows for easy expansion and customization to accommodate larger tanks or multiple monitoring points. This flexibility ensures adaptability to diverse applications and evolving user requirements.

6. Integration with Renewable Energy Sources: Exploring integration with renewable energy sources such as solar power can enhance sustainability and reduce reliance on conventional power sources. This could involve designing the system to prioritize renewable energy usage whenever available.

7. User Interface Improvements: Enhancements to the user interface, such as mobile applications or web-based dashboards, can provide users with intuitive controls and comprehensive monitoring capabilities, enhancing user experience and accessibility.

8. Market Adoption and Commercialization: Pursuing avenues for market adoption and commercialization, such as partnerships with manufacturers or distributors, can accelerate the deployment of the system in various industries and sectors, driving widespread adoption and impact.

By exploring these future directions, the Wireless Antenna-Based Motor Control System can evolve into a robust, intelligent, and widely deployed solution for remote water management, contributing to resource conservation, efficiency, and sustainability.

6.2 Applications:

The "Wireless Antenna-Based Motor Control System" has diverse applications across various sectors where remote monitoring and control of water levels are critical. Some notable applications include:

1. Agriculture: In agricultural settings, the system can be used to automate irrigation systems, ensuring optimal water levels in fields, orchards, and greenhouses. Farmers can remotely monitor soil moisture levels and adjust irrigation schedules accordingly, leading to improved crop yields and water efficiency.

2. Water Management: Municipalities and water utilities can utilize the system to monitor water levels in reservoirs, water towers, and distribution networks. This enables proactive

management of water resources, early detection of leaks or overflows, and efficient operation of pumps and valves.

3. Industrial Processes: Industries that rely on water for manufacturing processes, such as food and beverage, pharmaceuticals, and chemical production, can benefit from the system's ability to control water levels in storage tanks and processing equipment. It ensures consistent water supply, minimizes wastage, and enhances operational efficiency.

4. Environmental Monitoring: The system can be deployed for environmental monitoring applications, such as monitoring water levels in rivers, lakes, and wetlands. This facilitates real-time data collection for ecological research, flood forecasting, and habitat management.

5. Aquaculture: In aquaculture operations, the system can manage water levels in fish tanks and ponds, maintaining optimal conditions for fish health and growth. It enables aqua culturists to remotely monitor water quality parameters and automate water exchange processes.

6. Smart Homes: Homeowners can integrate the system into smart home automation setups to manage water usage and prevent water damage. It can be used to monitor water levels in household tanks, such as rainwater harvesting systems or sump pumps, and automatically control water pumps or valves based on predefined thresholds.

7. Remote Monitoring in Rural Areas: In remote or off-grid areas with limited access to infrastructure, the system can provide essential water management capabilities for community water supply systems, livestock watering, and irrigation projects. It offers a cost-effective and scalable solution for decentralized water management.

8. Research and Education: Educational institutions and research organizations can use the system for hands-on learning experiences and scientific experiments related to water management, sensor technology, and wireless communication. It serves as a valuable tool for teaching STEM (Science, Technology, Engineering, and Mathematics) concepts and fostering innovation.

These applications demonstrate the versatility and practicality of the Wireless Antenna-Based Motor Control System in addressing diverse water management challenges across different sectors, ultimately contributing to sustainability, efficiency, and resilience in water resources management.

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8. *Erua J. Band, Anyasi, F. I," Design of an Automatic Water Level Controller Using Mercury Float Switch", Edo State, Nigeria*

9. *PAXAJ SHUKLA, SHAISHAV SHAH, VIDITA TILVA," WATER LEVEL CONTROL WITH SPOKEN MESSAGE", Ahmedabad, Gujarat, India*

10. M. A. K. Azad, M. R. Islam, M. H. R. Bhuiyan "Design and Implementation of Smart Irrigation System using IoT and Arduino", 2019

11. M. H. R. Bhuiyan, M. A. K. Azad, M. R. Islam, "Development of a Smart Irrigation System for Agriculture using IoT and Arduino", 2019
12. S. R. P. Nikhila, A. Rajesh, "IoT-Based Smart Water Management System using Arduino", 2020
13. S. S. S. Anusha, K. S. Niharika, M. K. Chakravarthy, "Smart Water Monitoring and Controlling System using IoT" ,2021
14. A. K. Paul, A. H. M. S. H. Tareq, S. S. M. G. Rahman, " Development of an Automatic Water Pump Control System using IoT", 2022

PROGRAMME OUTCOMES(POs)

Engineering Graduates will be able to

1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool Usage: Create, Select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES(PSOs)

The ECE Graduates will be able to

1. Designing electronics, and communication systems in the domains of VLSI, embedded systems, signal processing, and RF communications and applying modern tools.

2. Applying the contextual knowledge of Electronics and Communication Engineering to design, develop, analyze and test systems containing hardware and software components taking into societal, environmental, health, safety, legal and economic considerations.

PROJECT OUTCOMES

Students will be able to

1. Work in a team.

2. Design Wireless Antenna-Based Motor Control System: Enabling Remote Precision and Versatility for Water Management and High-Performance remote monitoring.

3. Develop the electronic circuits.

4. Use modern tools like ARDUINO IDE.

5. Perform execution.

6. Analyze the results and conclude.

7. Prepare project report.

Project Outcomes	**Programme Outcomes (POs)**												**PSOs**	
	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
Outcome 1	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Outcome 2	2	3	2	2	2	3	2	2	2	2	2	2	3	3
Outcome 3	3	2	2	2	2	2	2	2	2	2	2	2	3	3
Outcome 4	2	2	2	1	2	2	2	2	2	2	2	2	3	3
Outcome 5	1	2	2	1	1	2	2	2	2	1	2	2	2	3
Outcome 6	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Outcome 7	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Mapping Table

Note: Map each project outcomes with POs and PSOs with either 1 or 2 or 3 based on level of mapping as follows:

1- Slightly (Low) mapped

2- Moderately (Medium) mapped

3-Substantially (High) mapped