A Project Report on

IoT Based Oil Skimmer Boat

Submitted by

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In partial fulfilment for the award of the degree

BACHELOR OF ENGINEERING

in

Electronics and Telecommunication Engineering

Under the Guidance of

Er. Rihana Jamadar

M. H. Saboo Siddik College of Engineering,

Mumbai University of Mumbai

2023 - 2024

CERTIFICATE

This is to certify that Students **Neha Dhabadghaw, Sayyed Ovais Latif Ali, Qureshi Moinuddin, Muskan Shaikh** are the bonafide students of M. H. Saboo Siddik College of Engineering, Mumbai.

They have successfully carried out the project titled “IoT Based Oil Skimmer Boat” in partial fulfilment of the requirement of B.E. Degree in Electronics and Telecommunication Engineering of Mumbai University during the academic year 2023-2024. The work has not been presented elsewhere for the award of any other degree or diploma prior to this.

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(Er. Rihana Jamadar) **(Er. Nayana Chaskar)**

(Project Guide) **(Project Co- ordinator)**

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(Er. Abdul Sayeed) **(Dr. Shaikh Javed)**

(EXTC HOD) **(Principal)**

Project Report Approval for B.E.

This project entitled **'IoT BASED OIL SKIMMER BOAT'** by **Neha Dhabadghaw, Sayyed Ovais Latif Ali, Moinuddin Qureshi, Muskan Firoz Shaikh** is approved for the degree of Bachelor of Engineering in Electronics and Telecommunication from University of Mumbai.

Examiners

1. - - - - - - - - - - - - - - - - - -

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Date:

Place:

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Signatures of all the students in the group

(Neha Dhabadghaw)

(Sayyed Ovais)

(Moinuddin Qureshi)

(Muskan Shaikh)

Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included; we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in this submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

Signatures of all the students in the group

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Abstract

An oil skimmer is used to extract oil from an aqua-oil combination. It creates a very acidic, alkaline, and salty environment that endangers aquatic life and pollutes coastal regions. Every year, 706 million gallons of used oil enter rivers, causing pollution. Oil spills have contaminated sea water, causing aquatic creatures to suffer. So, we suggest developing a tiny boat that functions as an oil skimmer to extract oil from water. A swarm of such tiny boats working together may clean up oil spills while also recovering the oil spilt. The boat is controlled by a dc motor powered system with two rudders, and the operator directs it with a remote. The boat has an on-board oil skimmer system that filters oil from water and collects it in a separate tank. This enables for the recovery of oil from the water as well as its cleaning.

Keywords: Skimmer, Alkaline, Rudders, Contaminated, Gallo

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List of Abbreviation

A. IoT - Internet of things
B. GPS - Global positioning system
C. DC motor - Direct current
D. LCD - Liquid crystal Display
E. GSM- Global System for Mobile Communications

Chapter 1
Introduction

An oil skimmer mitigates this issue by eliminating the oil, thereby reducing the unpleasant odors. When an oil film accumulates on the water's surface, it hinders the oxygen from reaching the water, creating an environment where anaerobic bacteria can thrive. These bacteria are the primary cause of the foul smell. Moreover, if the oil accumulates over time, it can pose a fire hazard. Therefore, the use of an oil skimmer effectively addresses these concerns by removing the oil from the water's surface.

1.1 Motivation

Developing an IoT-based oil skimmer boat presents a compelling solution for addressing oil spills and managing water pollution. Integrating IoT technology into the boat allows for more effective and targeted oil cleanup operations in water bodies.

The project's significance lies in its capacity to mitigate the environmental impact of oil spills, protecting marine life, preserving ecosystems, and safeguarding the water quality. By showcasing the effectiveness of IoT in environmental conservation, such innovation can attract attention and inspire further developments in similar technologies to combat pollution on a larger scale. The potential positive impact on both the environment and industries reliant on clean water resources adds to the importance of this endevor.

1.2 Objective

The objective of this project is to develop an autonomous oil spill cleanup system that efficiently removes oil from water bodies, protects the environment and aquatic ecosystems, and incorporates IoT technology for remote monitoring, data collection, route optimization, resource allocation, and enhanced safety measures to minimize human exposure to hazardous conditions during oil spill response operations.

1.3 Problem Statement

The skimmers operate through the use of a belt that attracts the oil which is then scraped clean and collected in a sump or tank.

1.4 Outline

This project report is organized as follows:

Chapter 2 presents the literature survey on the existing techniques.

Chapter 3 provides a brief explanation of design of the project.

Chapter 4 is dedicated to the simulation and experimental results.

Chapter 5 presents the conclusions and future scope for this project.

Chapter 2
Literature Review

The literature review presented in the international research journal of engineering and technology (irjet) 2020 publication by jabir p.p , vyshnav v.k , muhammad ashiq k , muhammed midlaj k , muhammed juraij c.t ,muhammed badhusha p , muhammed fayas investigates the significance of oil spill management and its environmental impact, particularly in aquatic ecosystems. Several historical references and notable incidents of oil spills are mentioned, such as the Lakeview Gusher Number One in 1910 and the Deepwater Horizon tragedy in 2010. These incidents serve as an initial backdrop to emphasize the need for effective oil spill management strategies. Oil spill clean-up systems efficiently remove oil from water bodies, protecting the environment and aquatic ecosystems, and can operate autonomously with remote monitoring through IoT technology, enabling real-time data collection on oil quantity and environmental parameters, optimizing resource allocation, and enhancing safety by reducing human exposure to hazardous conditions. [1]

The literature review on design and manufacturing of oil skimmer by taranjyot singh birdi, pranav salvi, swapnil nehe, rahul patil, soham kothawade in the international research journal of engineering and technology (irjet) 2021 provides the detailed technical document describing the design, manufacturing, and cost analysis of an oil skimmer. This oil skimmer is designed to extract oil from a liquid medium. It includes components such as a motor, gearbox, shaft, pulleys, belt, tank, and more. The document goes into detail about the design calculations, material selection, and fabrication processes used to create the oil skimmer. It also provides cost estimates for the materials and labor involved in the project. Experimental results from testing the oil skimmer's oil-extraction capacity are included. The document presents the successful design and construction of a belt-type oil skimmer, emphasizing its ability to extract oil from water.[2]

The literature review presented in journal of emerging technologies and innovative research (jetir) 2022 Iot based oil skimmer robot pulugujju rajesh, p. anjana reddy, p. sai charan, p. sainath reddy, p. nandana, p. sai krishna reddy explores the development of an IoT-based robot designed to skim and extract oil from water, especially in cases of oil spills .The paper addresses the importance of oil skimming in handling oil spills, highlights the impact of oil pollution on aquatic life and coastal regions, and mentions the need for developing a small boat-like robot to perform oil skimming efficiently. The robot is designed to be controlled by a DC motor-powered system with rudders, and it can be operated remotely. [3]

The literature review in the provided article highlights various studies and research projects that contribute to the understanding and development of oil skimming technology. Prof. Mamta Patel's research examines the efficiency of different belt-type oil skimmers, providing insights into their design and effectiveness. Additionally, Sadek Z. Kassab's work offers empirical correlations for belt skimmer performance under dynamic environmental conditions, aiding in understanding their operational factors. Arturo A. Keller and Kristin Clark explore novel skimmer surfaces for oil recovery, particularly in cold climates, suggesting advancements in skimming technology. Furthermore, Andrea Agrusta et al.'s research on oil skimmers for coastal and open sea cleaning expands the scope of skimming applications to larger water bodies. Anne Louise Brown, Michelle Mary Hanley, and Nathaniel M. Stanton's study on surface oil skimmer design likely provides practical engineering insights, while Tushar Pathare et al.'s work on an endless belt type oil skimmer contributes to specific design considerations and performance characteristics. Together, these studies offer a comprehensive understanding of oil skimming technology, crucial for the development and optimization of wireless oil skimmers based on IoT, as discussed in the article..[4]

The literature review in the provided article encompasses various research works focusing on oil skimming technology, marine robotics, and environmental engineering. Works by Emmad Mohammed H. Zahugi et al., Isamu Fujita and Muneo Yoshie, Prof. P.A. Patil et al., Subrajit Bhattacharya et al., and Suraj Nair et al. discuss the design, fabrication, and application of oil skimmers, highlighting their importance in mitigating marine oil spills. Additionally, references to studies on numerical modeling of oil spills, vacuum-based cleanup techniques, and advancements in unmanned marine vehicles provide further insights into related fields. These sources collectively contribute to a comprehensive understanding of oil spill cleanup technologies and their potential impact on environmental protection efforts. [5]

Chapter 3
Design Methodology

3.1 Introduction

First and foremost, the choice of a Arduino Nano serves as the central nervous system of the system. It's vital to interface the Arduino Nano with two L298N motor driver units: one dedicated to boat control and the other for the motor pump. This configuration enables precise boat movement and efficient oil skimming. To enhance the boat's functionality, essential sensors, like GPS, are connected to the Arduino Nano for real-time tracking of the boat's location.The heart of the system lies in the oil skimming mechanism, which is realized through the second L298N motor driver responsible for controlling the motor pump. This pump is designed to efficiently extract oil from the water's surface.

The system's IoT capabilities are made possible through integration with the Blynk server. This connection enables remote monitoring and control via the Blynk mobile app. A user-friendly interface is designed on the app, featuring controls for boat movement, oil skimming initiation, and real-time monitoring of critical parameters. To ensure secure and reliable data transmission, the implementation of a robust communication protocol is essential. This protocol facilitates seamless interaction between the Arduino Nano and the Blynk server, ensuring that users can control and monitor the boat with confidence. Oil collected during skimming needs a storage solution, typically an on board tank. This tank incorporates a level sensor to monitor the oil storage capacity, preventing overflows and optimizing efficiency. Additionally, a reliable power system is a prerequisite for the boat. This system should be capable of supporting the Arduino Nano, motor drivers, sensors, and the pump.

Prior to deployment in areas prone to oil spills, the system undergoes extensive testing and calibration. This ensures that all components function optimally, from boat control to oil skimming and app-based monitoring. Once deployed, a maintenance plan is essential for regular inspections and component replacements to sustain long-term functionality. The system should also be designed to allow for firmware updates to accommodate improvements and advancements in technology.

3.2 Hardware & Software Requirements

3.2.1 Hardware Specification

[1] Arduino Nano:

Fig 3.1 Arduino Nano

The Arduino Nano, a compact yet powerful microcontroller board, is a popular choice for projects such as the IoT-based oil skimmer. Powered by the Atmel ATmega328P microcontroller, it operates at 5 volts and can be powered via USB or an external supply ranging from 7 to 12 volts. With 14 digital I/O pins (6 supporting PWM) and 8 analog input pins, it offers versatility in interfacing with sensors and actuators. The Nano's 32KB flash memory, 2KB SRAM, and clock speed of 16 MHz ensure efficient program execution and data handling. Supporting communication via UART, SPI, and I2C, it facilitates seamless integration with other devices. Its small form factor (approximately 45mm x 18mm) makes it ideal for space-constrained applications like the IoT-based oil skimmer, where reliability, compactness, and low power consumption are paramount.

[2] GPS Neo6m Module:

Fig 3.2 GPS Neo6m Module

The GPS Neo6m Module plays a pivotal role in the IoT-based oil skimmer project, offering precise location tracking functionality essential for effective operation. Integrated into the system, this module utilizes signals from multiple satellites within the Global Navigation Satellite System (GNSS) to accurately determine the skimmer's location coordinates. By continuously providing real-time positioning data, it enables the oil skimmer to navigate water surfaces contaminated with oil spills with precision and efficiency. This location data is invaluable for optimizing the skimmer's path and ensuring comprehensive coverage of affected areas. Additionally, the GPS Neo6m Module facilitates remote monitoring and management of the oil skimmer's movements, enhancing operational control and efficiency in oil spill clean up operations.

[3] GSM 800L Module:

Fig 3.3 GSM 800L Module

The GSM 800L Module serves as a vital communication component within the IoT-based oil skimmer, enabling remote monitoring and control functionalities crucial for efficient operation. Integrated into the skimmer system, this module establishes GSM (Global System for Mobile Communications) connectivity, allowing the skimmer to transmit real-time data, status updates, and alerts to designated recipients or central monitoring stations. Additionally, it enables operators to remotely issue commands or adjustments to the skimmer's operation, enhancing flexibility and responsiveness in addressing varying environmental conditions or operational requirements. By leveraging GSM networks, the GSM 800L Module ensures reliable and pervasive communication coverage, even in remote or challenging locations where oil spill incidents may occur.

[4] ESP8266 D1 Mini Wi-Fi:

Fig 3.4 ESP8266 D1 Mini Wi-Fi

The ESP8266 D1 Mini Wi-Fi module serves as a crucial component in the IoT-based oil skimmer, providing essential wireless connectivity capabilities. Integrated into the skimmer system, this module enables the oil skimmer to establish connections to local Wi-Fi networks, facilitating real-time data transmission, remote monitoring, and control functionalities. By leveraging Wi-Fi connectivity, the ESP8266 D1 Mini allows the skimmer to transmit collected data, sensor readings, and operational status updates to centralized servers or cloud platforms for analysis and further processing. Additionally, it enables operators to remotely monitor the skimmer's performance, adjust operational parameters, and receive timely alerts or notifications, enhancing overall operational efficiency and responsiveness. The ESP8266 D1 Mini's compact size, low power consumption, and compatibility with popular development platforms like Arduino make it an ideal choice for integrating wireless connectivity into the IoT-based oil skimmer, enabling seamless communication and control capabilities essential for effective oil spill cleanup operations.

[5] LM2596 Voltage Buck Module:

Fig 3.5 LM2596 Voltage Bulk Module

The LM2596 Voltage Buck Module plays a critical role in the IoT-based oil skimmer project by providing reliable and efficient voltage regulation for essential components within the system. Integrated into the skimmer's electronics, this module ensures stable and precise power delivery to various components, including sensors, microcontrollers, and communication modules. By converting higher input voltages from batteries or external power sources to lower, more manageable levels, the LM2596 module ensures consistent performance and protection against voltage fluctuations. This is particularly crucial in remote or dynamic environments where power sources may vary, ensuring uninterrupted operation of the oil skimmer throughout its deployment. Additionally, the module's efficiency and compact design make it well-suited for integration into the skimmer's compact and energy-efficient design, contributing to overall system reliability and performance. Overall, the LM2596 Voltage Buck Module serves as a fundamental component in the IoT-based oil skimmer, providing essential voltage regulation capabilities to support reliable and efficient operation in oil spill cleanup operations.

[6] L298N Motor Driver Module:

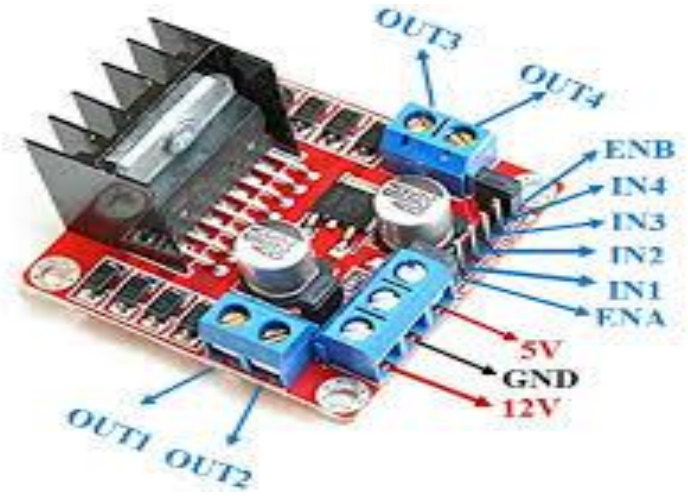


Fig 3.6 L298N Motor Driver Module

The L298N Motor Driver Module is an integral component in the IoT-based oil skimmer, responsible for controlling the movement and operation of the skimmer's propulsion system. Integrated into the skimmer's electronics, this module facilitates precise control over the motors driving the skimmer's movement across water surfaces contaminated with oil spills. With its bidirectional control capabilities and ability to handle relatively high currents, the L298N module enables the skimmer to navigate through various environmental conditions with agility and efficiency. By allowing for independent control of two DC motors, the module ensures optimal maneuverability and responsiveness of the skimmer, enabling it to navigate around obstacles and cover large areas effectively during oil spill cleanup operations. Furthermore, the module's built-in protection features, such as overcurrent protection and thermal shutdown, safeguard against potential damage to the motors and the module itself, ensuring reliable and safe operation of the oil skimmer throughout its deployment. Overall, the L298N Motor Driver Module plays a critical role in the functionality and effectiveness of the IoT-based oil skimmer, providing essential motor control capabilities for efficient oil spill cleanup operations.

[7] Oil Skimmer Belt (polyurethane):

Fig 3.7 Oil Skimmer Belt (polyurethane)

The Oil Skimmer Beit, constructed from durable polyurethane material, is an effective and environmentally friendly device designed to efficiently collect oil from the surface of water. With dimensions of 9 feet in length and 6 inches in width, this skimmer is capable of covering a substantial surface area. It operates at a consistent speed of 30 revolutions per minute (RPM), ensuring a thorough and swift oil removal process. The unique polyurethane material provides excellent resistance to water and oil, making it suitable for prolonged use in various water environments. The skimmer's design allows it to efficiently separate and collect oil, preventing contamination and harm to aquatic ecosystems. Its compact size and lightweight structure make it easy to transport and deploy in diverse settings, such as industrial facilities, marinas, or spill clean-up operations.

[8] DC MOTOR:

Fig 3.8 DC Motor

The DC Motor is a versatile and efficient component employed for propelling boats and various other applications. Operating at 12 volts, it draws a current of 1 ampere, ensuring a reliable power source for boat propulsion. This motor generates a substantial 2.14 litres of water movement per minute, which is essential for driving the boat forward with precision. Designed with durability and reliability in mind, this DC motor is engineered to withstand the demands of marine environments. It features a compact and lightweight design, making it ideal for boat propulsion while conserving space. Its efficient power consumption ensures extended battery life, making it suitable for prolonged journeys on the water. This motor plays a crucial role in ensuring smooth and controlled boat movement, contributing to a seamless boating experience.

[9] Wings:

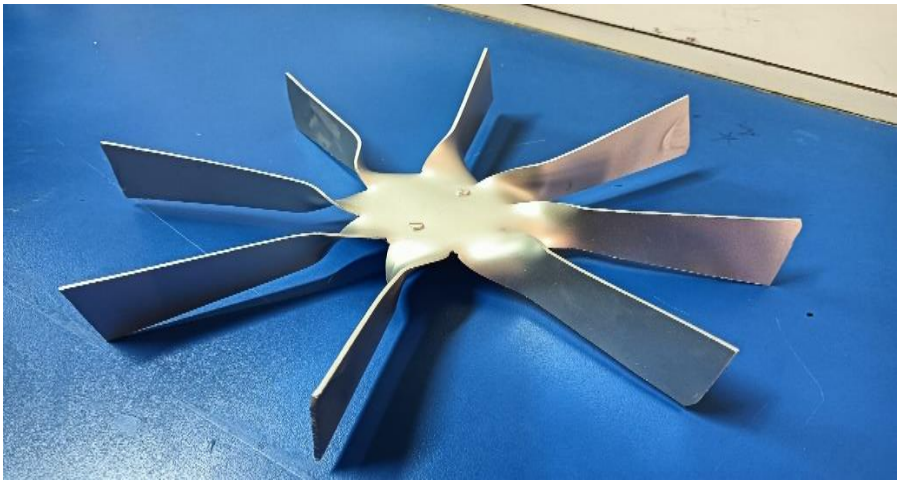


Fig 3.9 Wings

Wings designed for moving the Skimmer Belt play a crucial role in the effective operation of this oil collection device. These specialized wings are engineered for optimal performance in water surface cleaning applications. With a focus on efficiency and reliability, these propellers are carefully designed to meet the specific needs of the Skimmer Belt system. The wings are precision-crafted to provide consistent and controlled thrust, enabling the Skimmer Belt to glide smoothly across the water's surface. They are crafted from durable materials that offer resistance to corrosion and wear, ensuring long-term functionality. Their design allows for the precise adjustment of speed and direction, making it possible to tailor the Skimmer Belt's movement to the unique requirements of oil spill cleanup and water quality maintenance. These wings are essential components for achieving efficient oil collection and protecting aquatic ecosystems. Their design and construction ensure that the Skimmer Belt can effectively and safely remove oil from the water's surface, contributing to environmental sustainability and water quality management**.**

[10] DC Pump Motor:

Fig 3.10 DC Pump Motor

The DC pump motor operates within a voltage range of 3 to 6 volts, making it versatile for various applications. It draws a current between 130 to 220 milliamperes, allowing for efficient power usage. This compact yet robust motor is suitable for tasks that require precise fluid movement, such as in small-scale liquid dispensing systems or cooling mechanisms. Its low power consumption makes it an energy-efficient choice. The motor's reliable performance ensures consistent fluid flow and is ideal for projects where space is limited and power efficiency is a priority. Its broad voltage range provides flexibility in adapting to different electrical setups and applications.

[11] Float Sensor:

Fig 3.11 Float Sensor

The float sensor integrated into the boat of the IoT-based oil skimmer project is a pivotal component tasked with accurately detecting the presence of oil on the water's surface. Typically crafted from resilient materials like stainless steel or durable plastics to withstand the harsh aquatic environment, these sensors utilize buoyant float mechanisms that rise and fall with water levels. Employing either mechanical or electrical contact mechanisms, they trigger when encountering the oil-water interface. Sensitivity is finely tuned to discern minute oil quantities amidst water movements, ensuring precise detection. Mounting options vary to accommodate diverse application needs, while output signals can be digital or analog, indicating oil presence effectively. Operating over broad temperature ranges and featuring robust IP ratings, these sensors exhibit durability and reliability in outdoor settings where oil spills commonly occur. By accurately identifying oil slicks, the float sensor aids the IoT-based oil skimmer in efficiently mitigating environmental contamination, enhancing its efficacy in clean-up operations.

[12] Collection Tank:

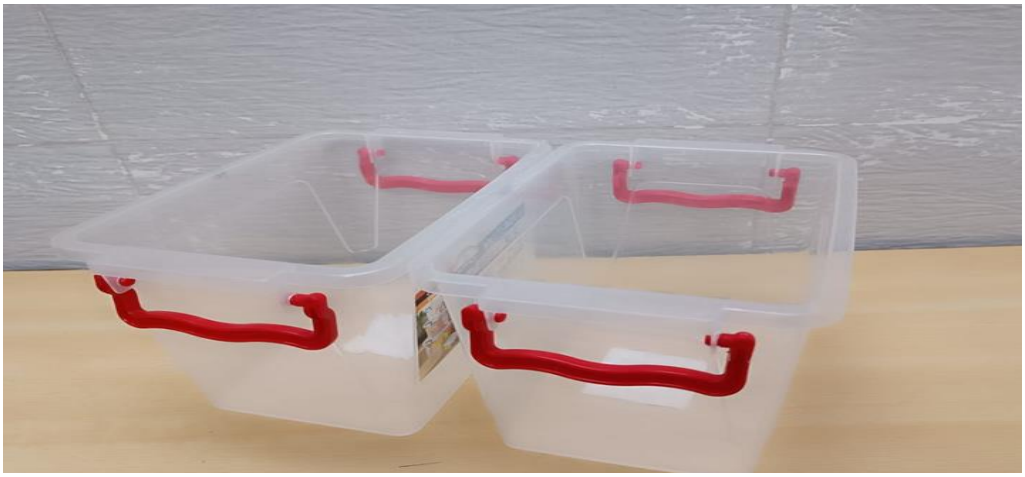


Fig 3.12 Collection Tank

The collection tank comprises two main components: The Skimmer Container and the Oil Container.

i. Oil Container:

- Dimensions: 8 inches in length and 6 inches in width.
- Capacity: It can hold up to 2 litres of oil. This container is designed for collecting and storing oil efficiently.

ii. Skimmer Container:

- Dimensions: 9 inches in length and 6 inches in width.
- Speed: The skimmer container has a skimming mechanism that operates at a speed of 30 RPM (Revolutions per Minute). This mechanism is responsible for effectively separating oil from other fluids in the collection tank.

Together, these components make up a collection system designed for the removal and containment of oil from a liquid mixture, such as in industrial or environmental applications.

[13] LCD Display :-

Fig 3.13 LCD Display

Operating Voltage: 4.7V to 5.3V.

Operating Current 1mA (without backlight)

Can display (16x2) 32 Alphanumeric Characters.

3.2.2 Software Requirement

1. Blynk App:

Fig 3.14 Blynk App

In the context of the IoT-based oil skimmer project, the Blynk app serves as a vital component for controlling and monitoring key aspects of the skimmer system. Through the Blynk platform, users can remotely access and control various functionalities of the oil skimmer boat, enhancing operational efficiency and convenience. With the Blynk app, users can interact with the skimmer system's components, such as the turbine motors, pump, and skimmer mechanism, from any location with internet connectivity. This capability enables users to initiate and adjust the skimming process according to real-time requirements and environmental conditions. For instance, users can remotely activate the turbine motors responsible for propelling the skimmer boat across the water surface, controlling its movement and positioning for optimal oil collection. Additionally, users can monitor and adjust the speed of the pump responsible for pumping water and collected oil into separate containers, ensuring efficient separation and containment. Furthermore, the Blynk app facilitates monitoring of critical parameters such as oil collection rate, battery status, and overall system performance. Users receive real-time updates and notifications regarding these parameters, allowing for timely intervention and maintenance as needed. Overall, the integration of the Blynk app into the IoT-based oil skimmer project empowers users with remote control and monitoring capabilities, enhancing operational flexibility, efficiency, and responsiveness. This ensures effective oil spill cleanup operations while minimizing environmental impact and protecting aquatic ecosystems.

3.3 System Design

3.3.1 Block Diagram

The block diagram presents a comprehensive layout of an IoT-based oil skimmer robot, integrating various components to streamline oil spill cleanup processes. At the heart of the system resides the Arduino Nano, serving as the central hub for data processing and control. Connected to it, the DC Motor for Oil Skimmer and Pump Control, intricately linked to a Wi-Fi module, allows for remote management and operation of the skimming process. This setup enables users to adjust the oil skimmer's speed and direction remotely, enhancing efficiency and adaptability during clean-up operations. The inclusion of a level sensor for oil measurement offers real-time feedback on oil quantities, facilitating precise monitoring and optimizing the skimming process. Furthermore, the GPS module provides accurate location tracking, enabling operators to monitor the robot's movements and ensure thorough coverage of affected areas. This feature is particularly valuable in large-scale clean-up efforts, where tracking the robot's progress is essential for maximizing effectiveness.

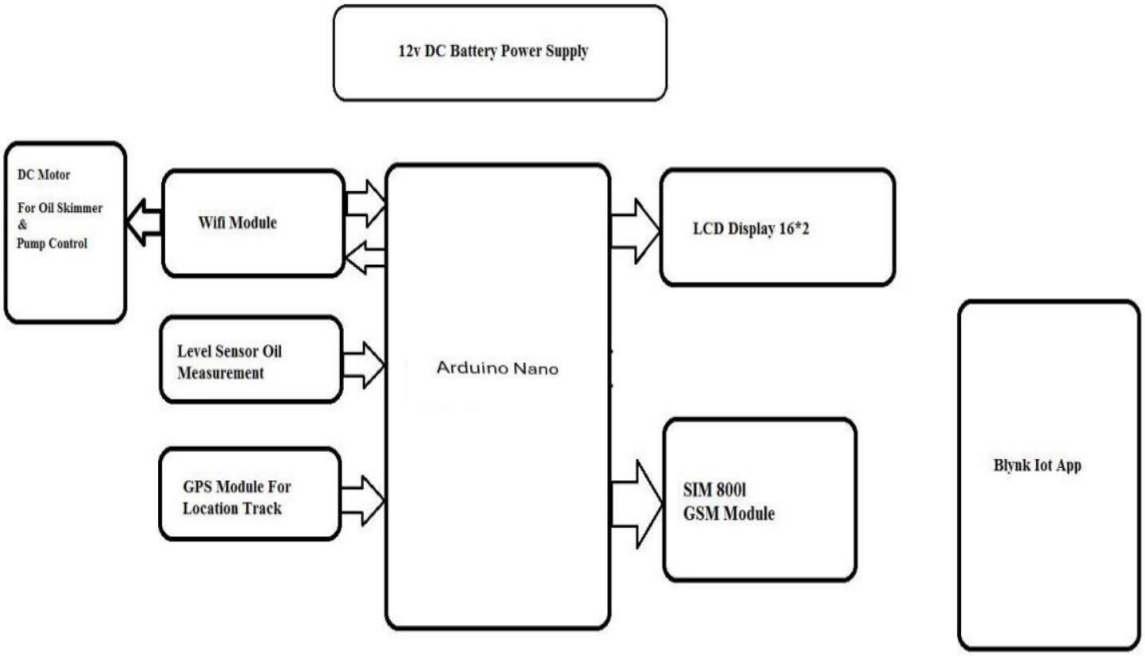


Fig 3.15 Block Diagram

To sustain continuous operation, the system relies on a 12V DC battery power supply, ensuring uninterrupted functionality even in remote or off-grid locations. The presence of an LCD display (16*2) offers a user-friendly interface, providing operators with real-time updates

on critical parameters such as oil levels and system status. This visual feedback enhances situational awareness and enables prompt decision-making during cleanup operations.

Integration with a SIM8001 GSM Module enables the robot to communicate via cellular networks, facilitating communication with stakeholders and providing timely updates on clean-up progress. Additionally, the inclusion of the Blynk IoT App enhances accessibility and control, allowing users to remotely monitor the robot's performance, receive notifications, and adjust settings as needed. Overall, the block diagram showcases a sophisticated yet user-friendly system designed to streamline oil spill clean-up efforts. By leveraging IoT technologies and remote connectivity, the oil skimmer robot offers enhanced efficiency, real-time monitoring, and adaptability, ultimately contributing to more effective and environmentally responsible clean-up operations.

3.3.2 Circuit Diagram

In the circuit diagram of your IoT-based oil skimmer robot, several key components work together to facilitate its operation and monitoring. At the heart of the system is the Arduino Nano, which serves as the central processing unit. It's responsible for orchestrating the robot's functions by receiving input from various sensors and modules, processing this data, and sending commands to actuators based on programmed logic. The GPS Neo6m Module plays a crucial role by providing accurate location data to the robot. This information allows the robot to determine its position in real-time, facilitating navigation and tracking tasks essential for effective operation. Integrated with the GSM 800L Module, the robot gains the ability to communicate over cellular networks. This feature enables it to send alerts, updates, and notifications to designated recipients via SMS or establish data connections for remote monitoring and control.

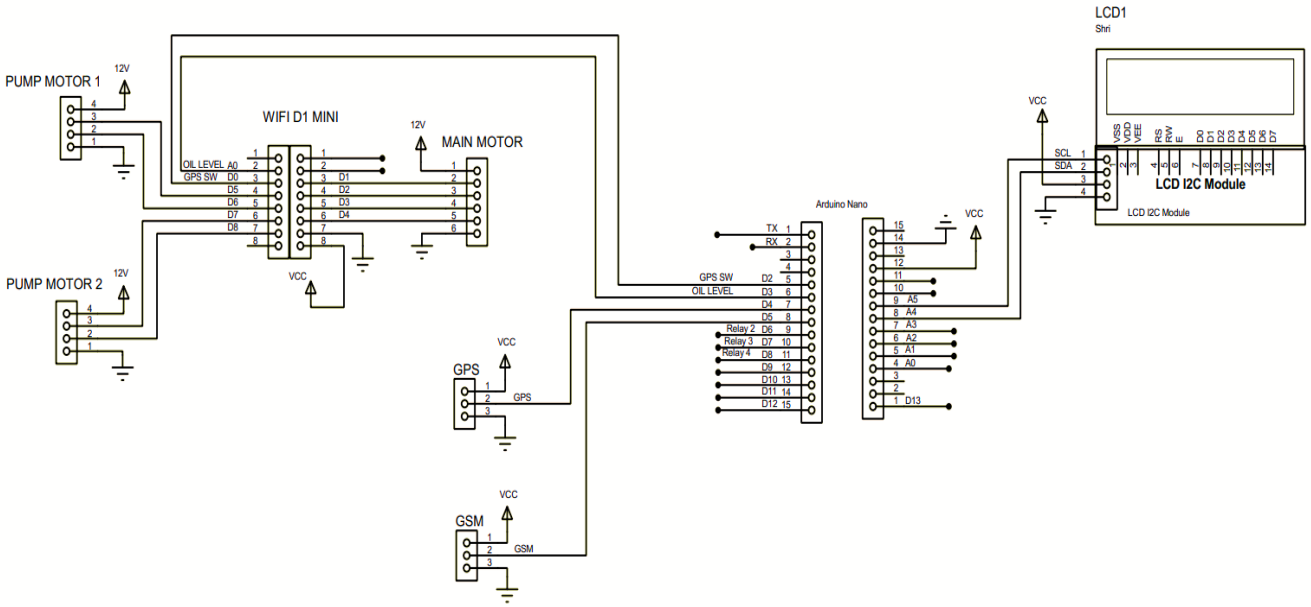


Fig 3.16 Circuit Diagram

The ESP8266 D1 Mini Wi-Fi module adds another layer of connectivity by enabling the robot to connect to local wireless networks. This capability allows operators to access real-time data streams, receive notifications, and interact with the robot's functions remotely using smartphones or computers connected to the same network. To ensure stable and consistent power delivery, the LM2596 Voltage Buck Module

regulates the voltage supplied to various components of the system. This module prevents damage to sensitive electronic components and ensures reliable performance of the robot under varying operating conditions.

Controlling the operation of DC motors used in the robot, the L298N Motor Driver Module regulates the speed and direction of these motors based on commands received from the Arduino Nano. This precise control enables the robot to move effectively and operate its various mechanisms efficiently .The Float Sensor is a critical component that detects the level of oil in the collection tank. When the oil reaches a certain level, the sensor sends a signal to the Arduino Nano, indicating that the tank is full and requires emptying. This prevents overflow and ensures the efficient operation of the oil skimming process. Finally, the LCD Display provides a user-friendly interface for monitoring the robot's operation. It displays essential information such as oil level, GPS coordinates, system status, and diagnostic messages, allowing operators to monitor the robot's performance and make informed decisions.

3.3.3 PCB Layouting:

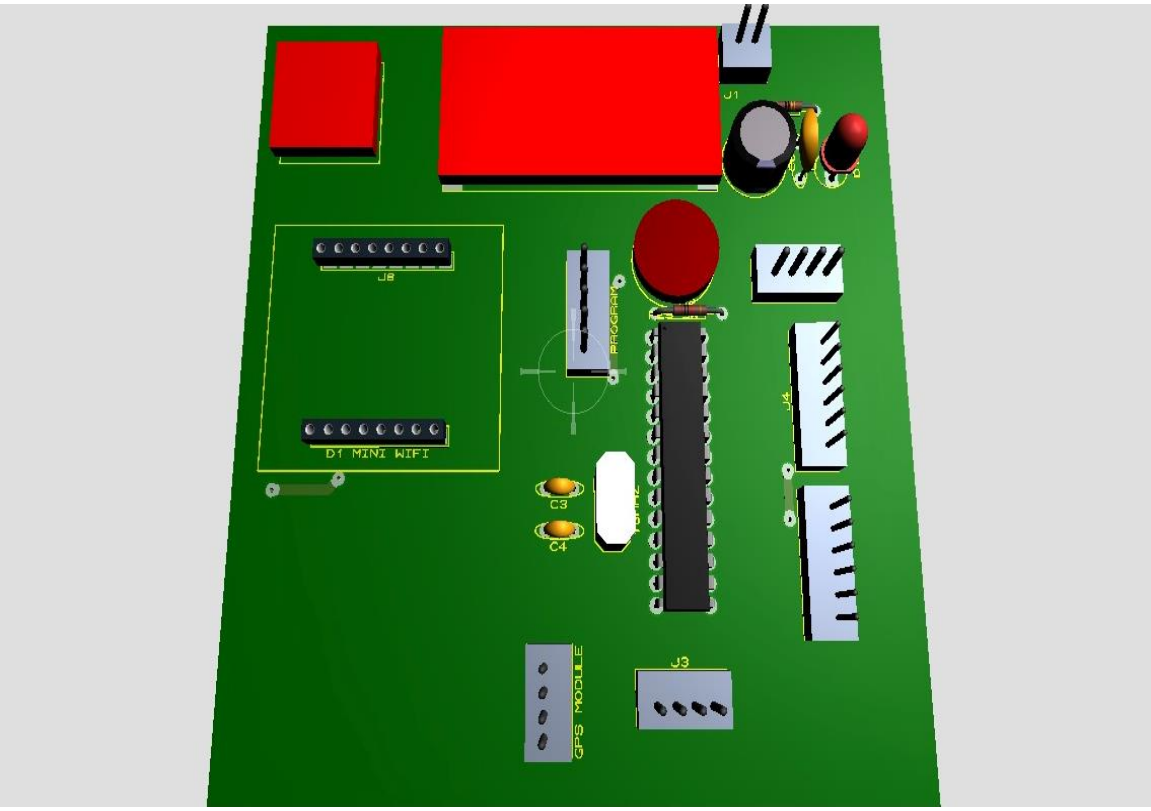


Fig 3.17 PCB Layouting

The IoT-based oil skimmer PCB Layouting created using Proteus software consists of several essential components for its operation. At the heart of the system is the Arduino Nano, which acts as the central control unit responsible for overseeing and managing various functions of the oil skimmer. To ensure stable power supply, a Voltage Regulator is included in the circuit. The Mini Wi-Fi Module facilitates wireless communication, allowing the skimmer to connect to the internet or a local network for data transmission and remote control. The Float Sensor is used for monitoring the water surface or oil levels by emitting and receiving ultrasonic pulses. Two Motor Drivers control the boat's DC motors, responsible for propelling the skimmer. Lastly, the GPS Module receives signals from satellites, providing accurate geographical coordinates, enabling precise tracking of the skimmer's location. This integrated system offers the ability for remote control, monitoring, and autonomous navigation, making it an efficient tool for oil-skimming operations, and it can transmit critical data over the internet for further analysis and remote control capabilities.

3.3.4 Flow Chart

- **Hardware Part**

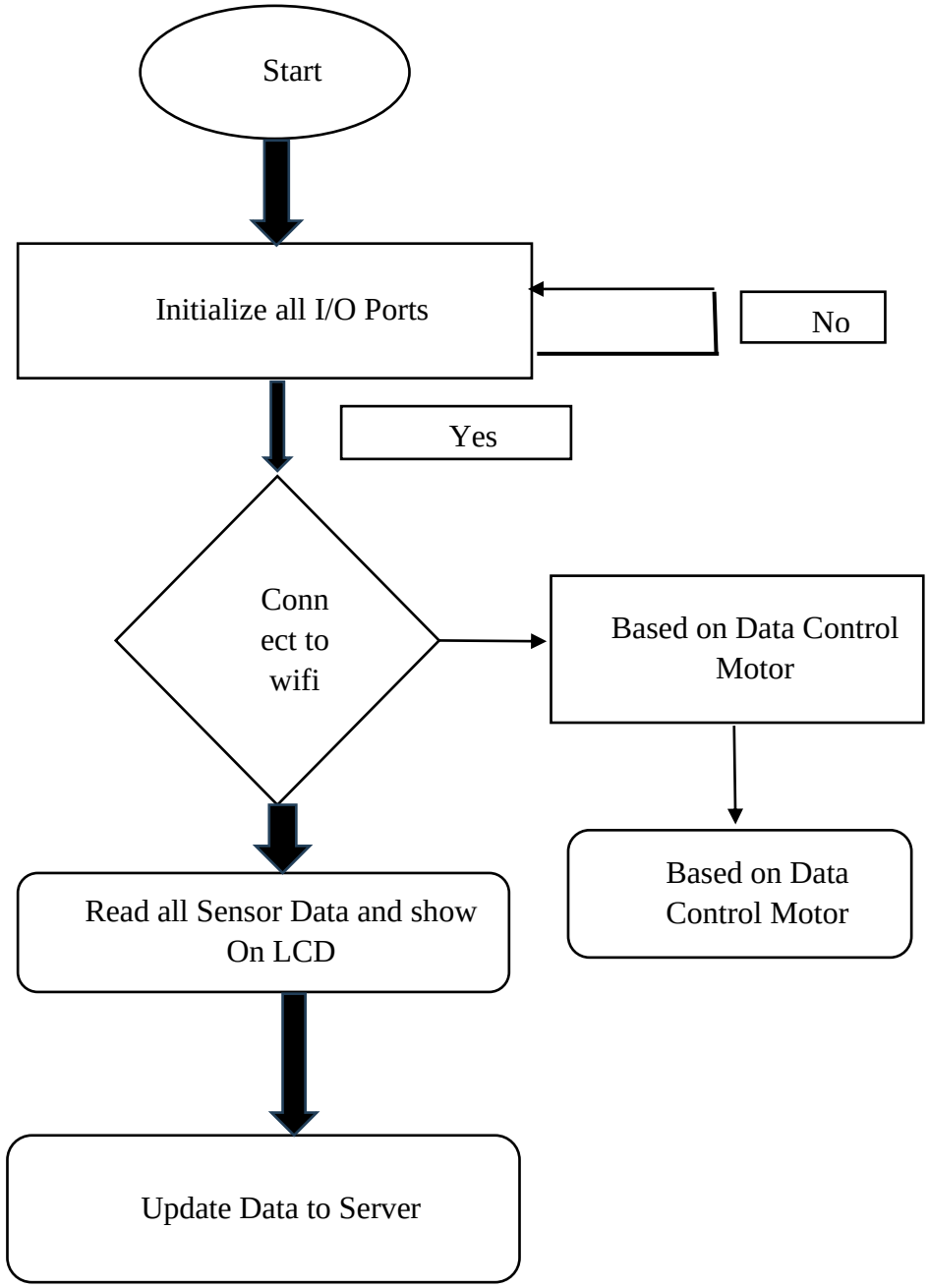


Fig 3.18 Hardware Flowchart

Here's a short explanation of the hardware flowchart for an IoT-based oil skimmer boat:

1. Initialize I/O Ports: Start by setting up and initializing all the input/output ports of the system, ensuring that everything is ready for operation.

2. Check Initialization Success: Verify if the initialization was successful. If it's successful (YES), proceed to the next step. If not (NO), you may need to reinitialize the I/O ports.

3. Connect to W-iFi Module: Establish a connection with the W-iFi module. This is crucial for data communication with the server.

4. Send Data to Server: After successfully connecting to the W-iFi module, send the collected data to a remote server. This data likely includes information from various sensors on the oil skimmer boat.

5. Read Data Sensor on LCD Display: Display the received or processed data from the sensors on an LCD screen. This allows for real-time monitoring and feedback.

6. Control DC Motor: Based on the data from the sensors (e.g., oil level, location, or other relevant parameters), control the DC motor(s) to operate the oil skimmer as needed. For example, adjust the speed or direction of the motor to collect oil effectively.

7. Update Data to Server: After processing and utilizing the data, make sure to update the server with any relevant information or changes in the system's status. This could include updates on the amount of oil collected, the skimmer's location, or other pertinent data.

The hardware flowchart outlines the sequential steps involved in the IoT-based oil skimmer boat's operation, from initialization to data collection, control, and communication with a server for real-time monitoring and management.

- **Software Part**

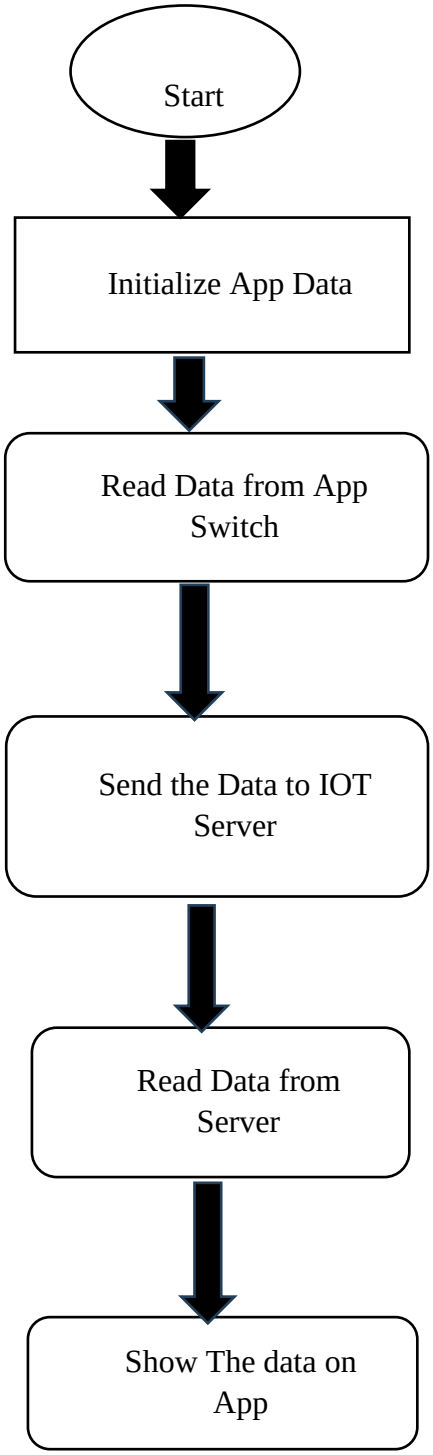


Fig 3.19 Software Flowchart

Here's a short explanation of the software flowchart for an IoT-based oil skimmer boat:
1. Initialize App (Blynk): Start by initializing the Blynk app, which serves as the user interface for monitoring and controlling the oil skimmer boat.

2. Read Data from the App: Collect data inputs or commands from the Blynk app, which could include instructions for controlling the boat or receiving information from on-board sensors.
3. Send Data to IoT Server: Transmit the data collected from the app to an IoT server. This server likely stores and processes the data for further analysis or remote monitoring.
4. Read Data from the Server: Access data from the IoT server, which may include information about the boat's status, sensor readings, or other relevant data.
5. Show Data on App through Blynk Server: Display the data retrieved from the IoT server on the Blynk app. This provides the user with real-time information and feedback, allowing them to monitor and control the oil skimmer boat remotely.
The software flowchart outlines the key steps involved in the operation of the IoT-based oil skimmer boat, from initializing the app to exchanging data with an IoT server and presenting the information on the Blynk app for user interaction and monitoring.

3.3.4 3D-Model:

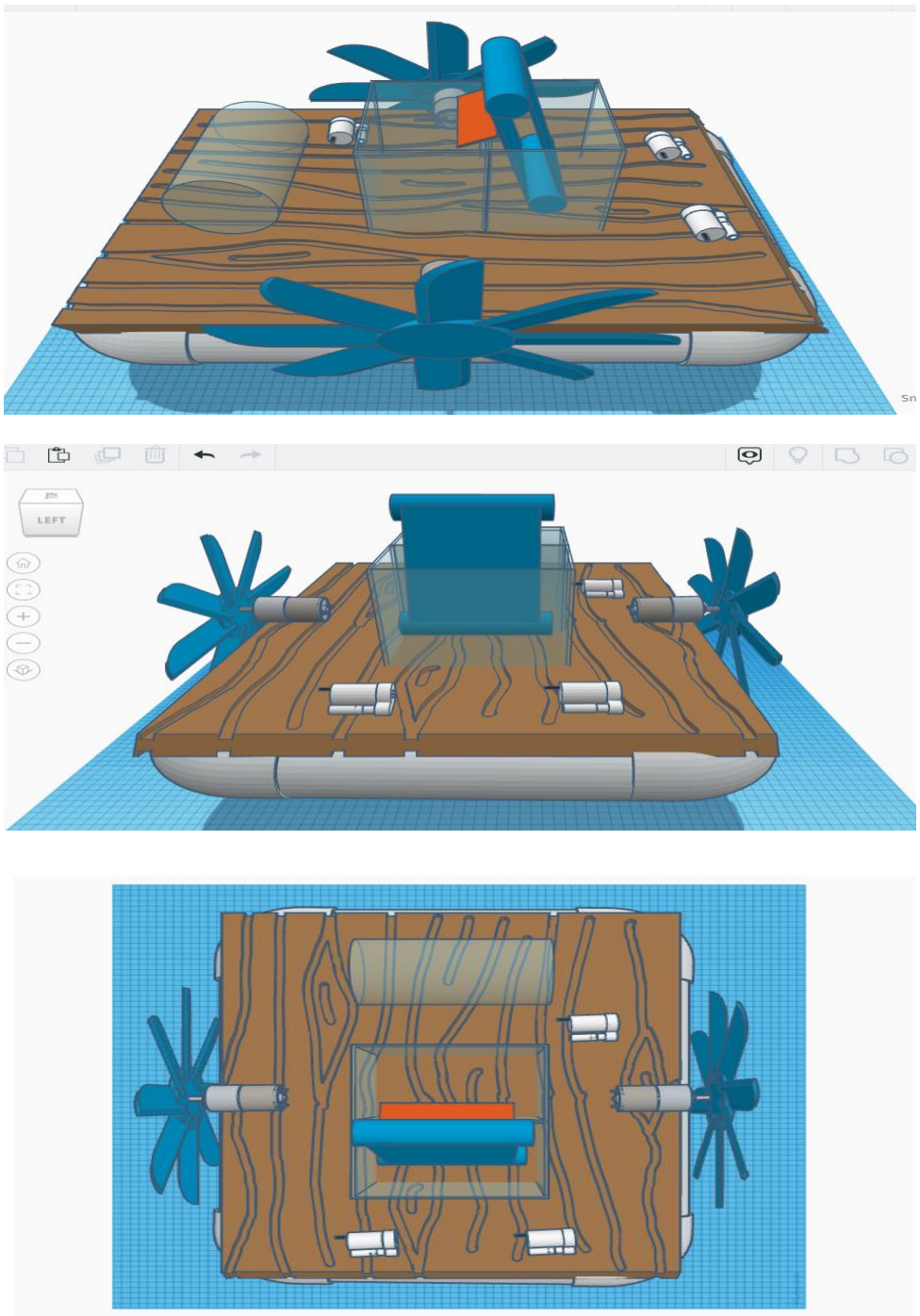


Fig 3.20 3D-Model of Oil Skimmer

Chapter 4

Result Discussion

Updating the GSM module with information from the SIM card and displaying messages on the LCD screen.

This means that the GSM module, which allows devices to communicate over cellular networks, is being updated with data from the SIM card, like phone number or network credentials. Meanwhile, messages received by the device are shown on the LCD display for the user to read.

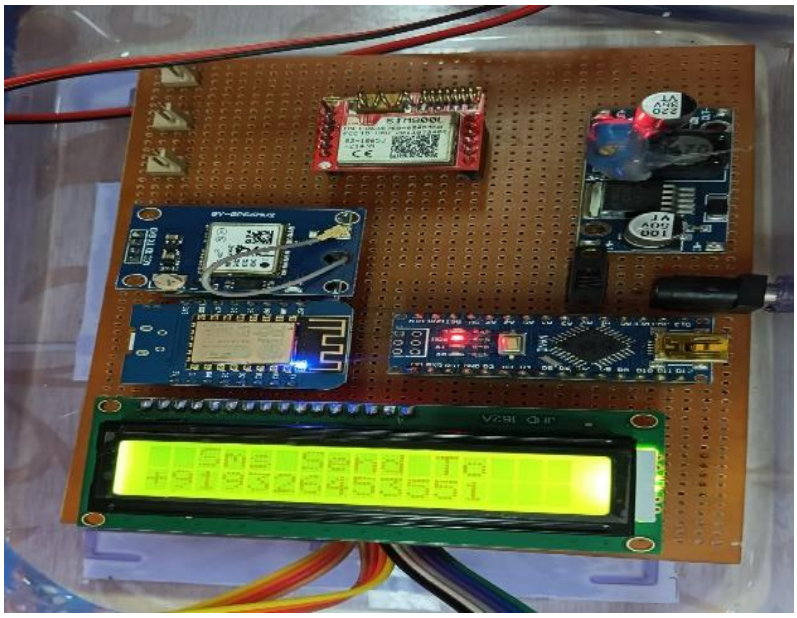


Fig 4.1 LCD display

Notification of location update sent to the designated phone number.

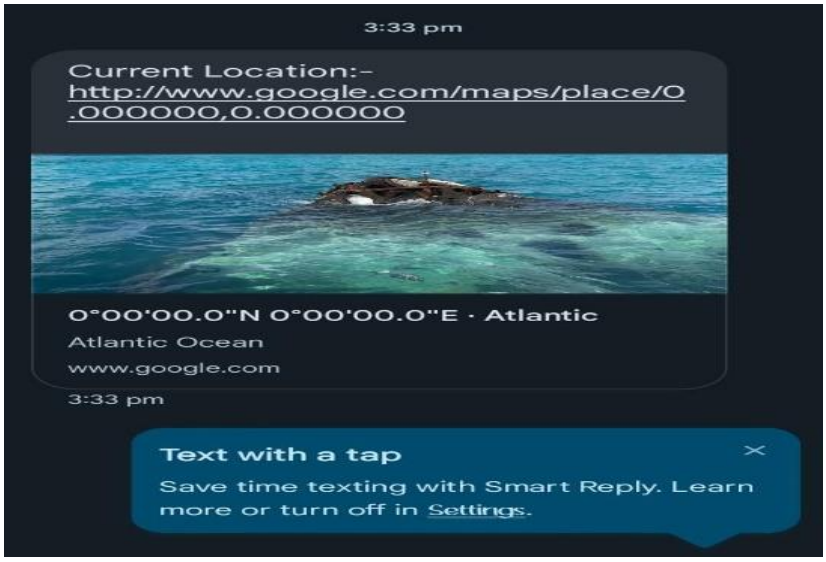


Fig 4.2 Message received on the device

Detection of contaminated water and oil by using Float Sensor.

- Level 1:- Oil detected.
- Level 0:- Oil not detected

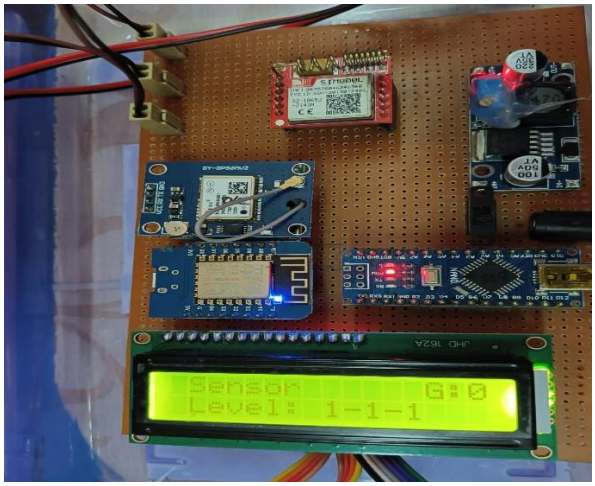


Fig 4.3 Oil level detection

Pump & Rolar Controller:
It consists of 4 buttons.

- Button 1: - Collection Of Contaminated Water
- Button 2: - Rotation of skimmer belt to separate contaminated water and oil.
- Button 3: - Disposing of purified water.
- Button 4: - Transfer of collected oil in another tank.

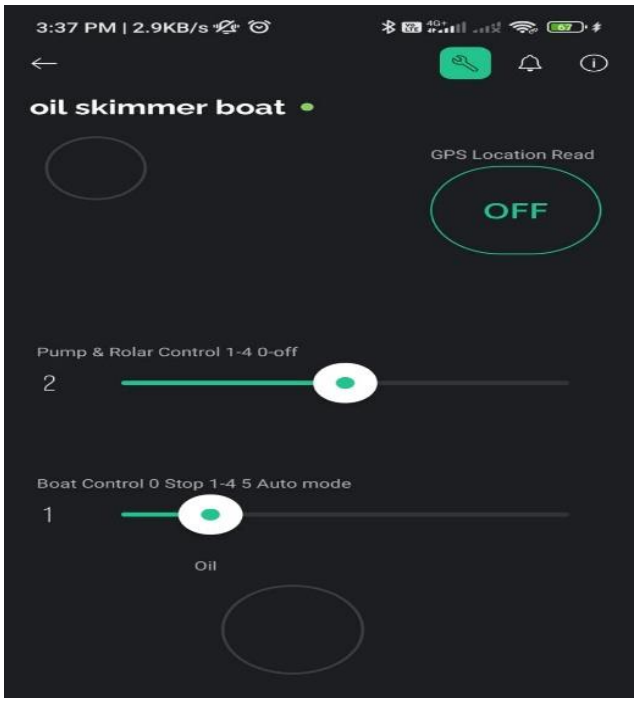


Fig 4.4 Indication through buttons

Boat Controller:
It consists of 5 buttons.

- Button 1: - Forward movement of the boat.
- Button 2: - Backward movement of the boat.
- Button 3: - Rotation of the boat in clockwise direction.
- Button 4: - Rotation of the boat in anticlockwise direction.
- Button 5:- Set the boat in automation mode.

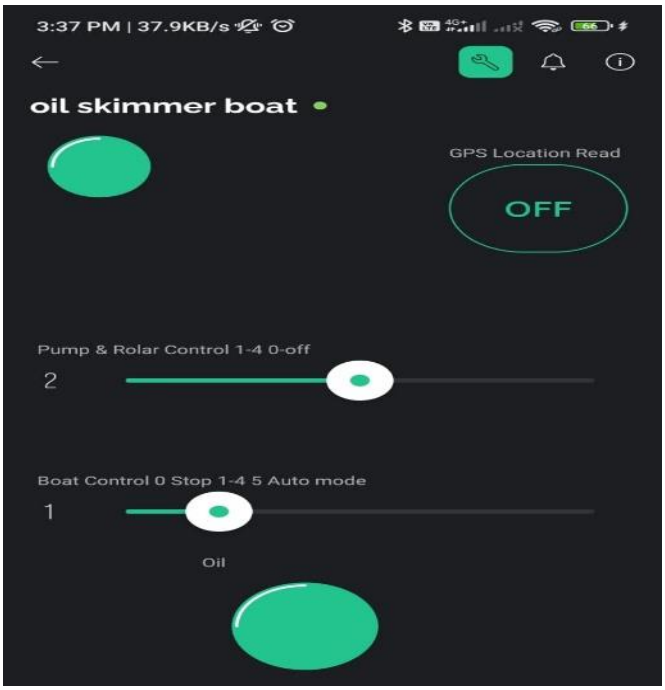


Fig 4.5 Movement of boat through buttons

In the first step of the process, we'll use a DC pump motor to collect both oil and water present on the water surface. This involves using the pump to draw in the mixture of oil and water and transfer it to a container for further processing. Essentially, the DC pump motor acts as a tool to gather and contain the oil and water mixture from the water surface, preparing it for subsequent separation and treatment.

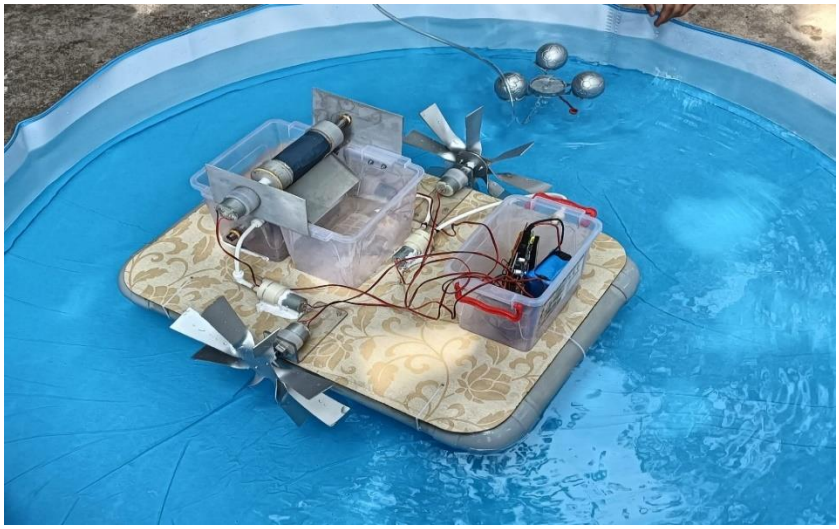


Fig 4.6 Front view of Boat

Following the initial collection of the oil and water mixture using the DC pump motor, the subsequent step involves separating these two substances. This separation is achieved using an oil skimmer belt composed of polyurethane material. The belt is designed to efficiently segregate the oil from the water, allowing the oil to be collected in one container while the water is directed into another container. Once separated, each substance can be subjected to additional processing as needed. In essence, the oil skimmer belt serves as a tool to divide the oil and water components, facilitating their individual collection for further treatment or disposal.

Once the oil and water have been successfully separated in the previous step, the subsequent task is to release any excess water back into the water surface. This process is accomplished by employing another DC pump motor, which is controlled by an L298 Motor driver module. Essentially, the DC pump motor is utilized to draw in and discharge the excess water from the separation process, allowing it to be returned to the water surface. The L298 Motor driver module serves as the control mechanism for this pump motor, regulating its operation and ensuring precise control over the release of water. In summary, this step involves the controlled discharge of excess water using a DC pump motor controlled by the L298 Motor driver module, effectively completing the separation process and returning the water back to its original environment.

Fig 4.7 Top view of boat

In the last stage of the process, when the container holding the extracted oil reaches its capacity, it becomes necessary to transfer the oil to another location for further handling. To accomplish this, a DC pump motor is employed to facilitate the transfer of the oil from one container to another. However, to ensure uninterrupted oil collection from the water surface, an additional container is required to store the extracted oil. This extra container serves as a backup, allowing for continuous oil collection without the need to pause the skimming process. By having a spare container ready, the system can maximize its oil collection efficiency, ensuring that no oil is lost during the transfer process due to capacity constraints. In essence, the use of an additional container enhances the overall effectiveness of the oil skimming operation, enabling seamless oil transfer and contributing to the successful cleanup of oil-contaminated water surfaces.

In the final step, all four stages of the oil skimming process are seamlessly integrated and automated through the Blynk app. This means that users can control and monitor the entire process remotely using their smartphones or tablets. The app allows for the activation of the

DC pump motors for collecting oil and water from the water surface, the operation of the oil skimmer belt to separate the oil from the water, the release of excess water back into the water surface using another DC pump motor controlled by the L298 Motor driver module, and the transfer of oil to another location when the container becomes full.

Fig 4.8 Left-side view of boat

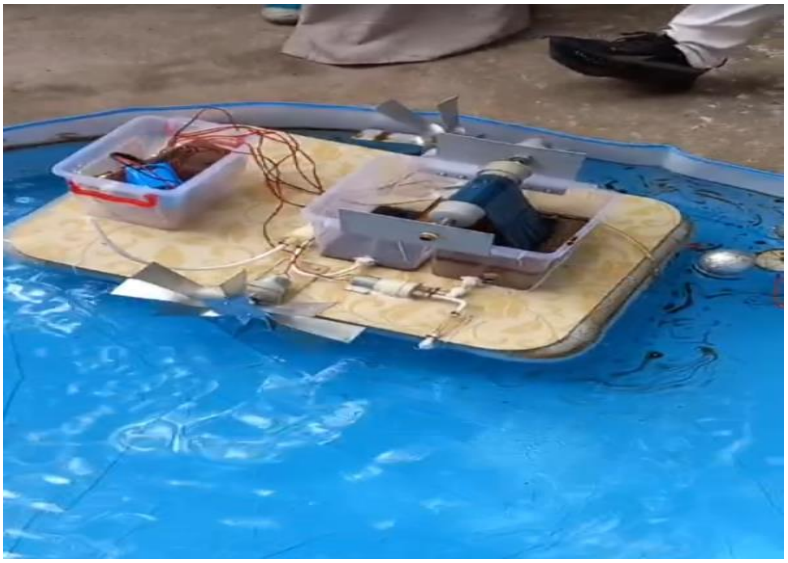


Fig 4.9 Right -side view of boat

By utilizing the Blynk app, users can easily oversee the entire oil skimming operation, receive real-time updates on the progress, and make adjustments as necessary without the need for manual intervention. This automation streamlines the process, enhances efficiency, and ensures that the oil skimming system operates smoothly and effectively. Ultimately, the integration of the Blynk app into the oil skimming process offers convenience, flexibility, and control, making oil spill cleanup operations more efficient and manageable.

Chapter 5
Conclusion

5.1 Conclusion

The IoT-based oil skimmer project presents a promising solution for effectively addressing oil spill clean up operations. By utilizing a combination of carefully selected components, including a boat with optimized dimensions, turbine motors, skimmer belt, pump, and skimmer motor, the system demonstrates efficient oil separation from water surfaces. Integration of IoT capabilities through the Blynk application enhances the system's functionality by enabling remote monitoring and control, thus improving operational efficiency and facilitating timely interventions.

Through rigorous testing and analysis, it is evident that the skimmer mechanism, powered by a 12V, 4Amp battery configuration, efficiently collects oil while minimizing power consumption. The use of a polyurethane belt for oil-water separation further enhances the system's efficiency. Additionally, the compact design of the skimmer mechanism ensures manoeuvrability and ease of operation in various environmental conditions.

Overall, the project highlights the importance of technological innovation in addressing environmental challenges such as oil spills. By providing a sustainable and efficient solution for oil spill clean-up, the IoT-based oil skimmer project contributes significantly to environmental protection and ecosystem preservation. Further advancements and refinements in the system's design and operation hold promise for enhancing its effectiveness and expanding its application in real-world scenarios.

References

[1] International Research Journal of Engineering and Technology (IRJET) 2020 FLOATING OIL SKIMMER WITH RC Jabir P.P 1, Vyshnav V.K 2, Muhammad Ashiq K 3, Muhammed Midlaj K 4, Muhammed Juraij C.T 5,Muhammed Badhusha P 6, Muhammed Fayas2I

[2] International Research Journal of Engineering and Technology (IRJET)2021 Design and Manufacturing of Oil Skimmer Taranjyot Singh Birdi1, Pranav Salvi2, Swapnil Nehe3, Rahul Patil4, Soham Kothawade

[3] Journal Of Emerging Technologies And Innovative Research (JETIR) 2022 IOT BASED OIL SKIMMER ROBOT Pulugujju Rajesh, P. Anjana Reddy, P. Sai Charan, P. Sainath Reddy, P. Nandana, P. Sai Krishna Reddy

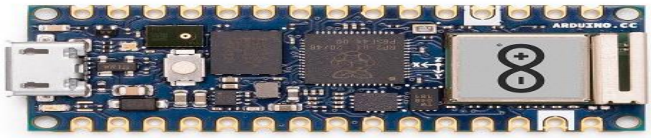
[4] International Journal for Multidisciplinary Research (IJFMR) 2024 Wireless Oil Skimmer System Based on IOT Prof. Akshay. M. Shelake Miss. Jui. P. Awale, Miss. Ankita. V. Mohite,Miss. Shreya. M. Lokare, Miss. Rutuja. M. Balai

[5] International Journal of Electronics and Telecommunication Engineering (IJECE) 2019 IOT BASED SMART OIL SKIMMER ROBOT FOR THE MARINE OIL SPILL K..Manoj Kumar, R.Gowtham, J.G.Kishore Kumar, R.Pandi Prabakaran

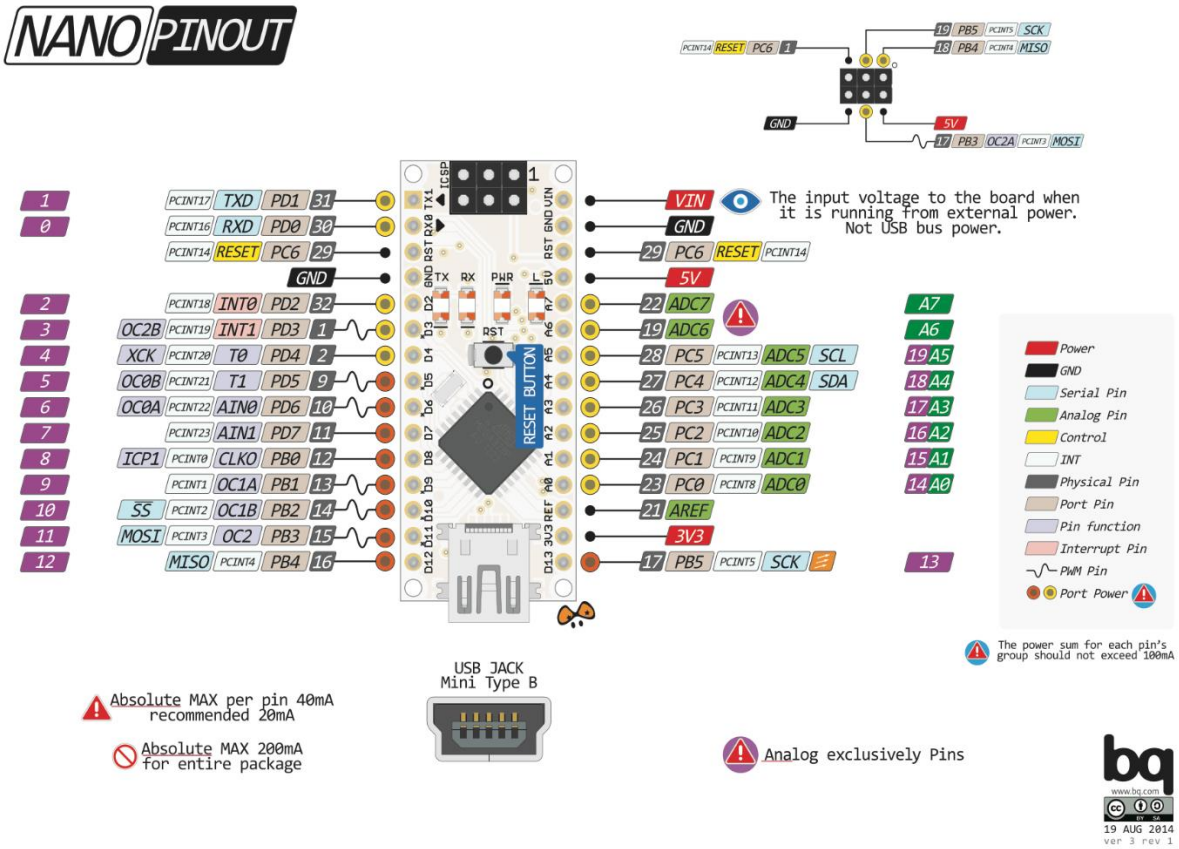
Appendix-I

1. Arduino Nano:

The Arduino Nano is Arduino's classic breadboard friendly designed board with the smallest dimensions. The Arduino Nano comes with pin headers that allow for an easy attachment onto a breadboard and features a Mini-B USB connector.



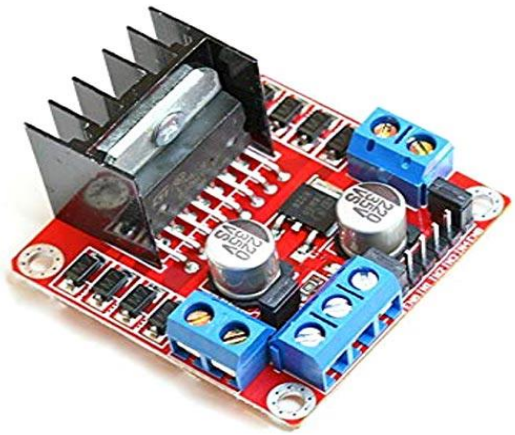
Arduino Nano Pin Mapping :



Features:

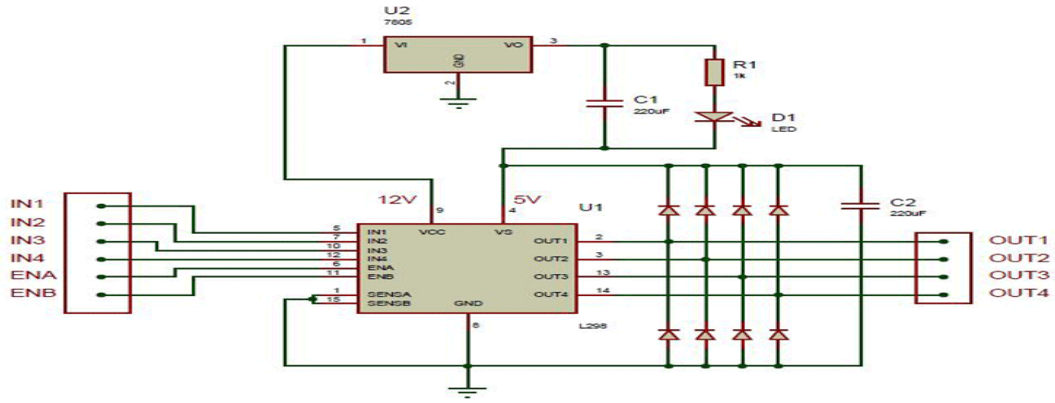
Parameters	Value
Microcotroller	Atmel ATmega328P
Operating Voltage	5 volts (V)
Input Volatge	7-12 volts (V)
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	8 (A0 through A7)
DC Current per I/O pin	40 mA
DC Current for 3.3V pin	50 mA
Flash Memory	32 KB (2 KB used by bootloader)
SRAM	2 KB
EEPROM	1 KB
Clock Speed	16 MHz
Dimensions	Approximately 18.5 mm x 43.2 mm
Weight	Approximately 7 grams
Operating temperature	-40°C to 85°C
Input Voltage (Limits)	-0.5V to VCC + 0.5V
Analog Reference Volatge	External voltage or internal reference (5V)
USB Interface	Yes

2. L298N Motor Driver Module:



This L298N Motor Driver Module is a high power motor driver module for driving DC and Stepper Motors. This module consists of an L298 motor driver IC and a 78M05 5V regulator. L298N Module can control up to 4 DC motors, or 2 DC motors with directional and speed control.

L298N Motor Driver Module Pin Mapping :



Pin Name	**Description**
IN1 & IN2	Motor A input pins. Used to control the spinning direction of Motor A
IN3 & IN4	Motor B input pins. Used to control the spinning direction of Motor B
ENA	Enables PWM signal for Motor A
ENB	Enables PWM signal for Motor B
OUT1 & OUT2	Output pins of Motor A
OUT3 & OUT4	Output pins of Motor B
12V	12V input from DC power Source
5V	Supplies power for the switching logic circuitry inside L298N IC
GND	Ground pin

Features:

1. Driver Model: L298N 2A
2. Driver Chip: Double H Bridge L298N
3. Motor Supply Voltage (Maximum): 46V
4. Motor Supply Current (Maximum): 2A
5. Logic Voltage: 5V
6. Driver Voltage: 5-35V
7. Driver Current:2A
8. Logical Current:0-36mA
9. Maximum Power (W): 25W
10. Current Sense for each motor
11. Heatsink for better performance
12. Power-On LED indicator

Appendix-II: Copies of the Reference Papers

[1] https://www.irjet.net/archives/V7/i4/IRJET-V7I4151.pdf

[2] https://www.irjet.net/archives/V8/i9/IRJET-V8I9228.pdf

[3] https://www.jetir.org/papers/JETIR2205780.pdf

[4] http://www.internationaljournalssrg.org/uploads/specialissuepdf/ICTER

[5] https://www.ijfmr.com/papers/2024/1/13063.pdf

Appendix-III: Copy of the Published Paper

[1] https://ijsrem.com/volume08issue04april2024/