A

MAJOR PROJECT REPORT ON

FLOATING THRASH COLLECTOR

Submitted in partial fulfillment of the requirement for the award of degree of

BACHELOR OF TECHNOLOGY

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

SUBMITTED BY

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CMR ENGINEERING COLLEGE

UGC AUTONOMOUS

(Approved by AICTE, Affiliated to JNTU Hyderabad, Accredited by NBA & NAAC)
Kandlakoya (V),Medchal (M),Telangana –501401

(2024-2025)

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CERTIFICATE

This is to certify that the Major Project work entitled **“FLOATING THRASH COLLECTOR”** is being submitted by **D. SINDHU** bearing Roll No: **218R1A0413, D. KULLAI SHARIF** bearing Roll No**: 218R1A0414, E. SAI DINESH** bearing Roll No: **218R1A0415, G. UDAY CHANDRA** bearing Roll No: **218R1A0416** in B.Tech IV-II semester, Electronics and Communication Engineering is a record bonafide work carried out by then during the academic year 2024-25.

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We sincerely thank the management of our college **CMR Engineering College** for providing required facilities during our project work.We derive great pleasure in expressing our sincere gratitude to our Principal **Dr. A. S. Reddy** for his timely suggestions, which helped us to complete the project work successfully.It is the very auspicious moment we would like to express our gratitude to **Dr. SUMAN MISHRA,** Head of the Department, ECE for his consistent encouragement during the progress of this project.

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DECLARATION

We here by declare that the project work entitled **"FLOATING THRASH COLLECTOR"** is the work done by us in campus at **CMR ENGINEERING COLLEGE,** Kandlakoya during the academic year 2024-2025 and is submitted as Major project in partial fulfillment of the requirements for the award of degree of **BACHELOR OF TECHNOLOGY** in **ELECTRONICS AND COMMUNICATION ENGINEERING FOR CMR ENGINEERING COLLEGE , HYDERABAD.**

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ABSTRACT

Water pollution caused by floating waste has become a significant environmental concern, affecting marine ecosystems and human health. The Floating Trash Collector is an innovative solution designed to efficiently collect and remove floating debris from water bodies such as rivers, lakes, and oceans. This system operates using a combination of mechanical and automated processes to capture waste and prevent further contamination.

The device consists of a buoyant frame equipped with a conveyor belt or net system that captures floating trash as water flows through it. Solar-powered motors drive the collection mechanism, making the system energy-efficient and environmentally friendly. Sensors integrated into the collector enable real-time monitoring of waste levels and operational performance. The collected debris is stored in a compartment for later disposal or recycling.

The Floating Trash Collector offers a sustainable and cost-effective method for cleaning water surfaces, reducing marine pollution, and promoting environmental conservation. This solution can be deployed in various aquatic environments, contributing to the global effort to maintain clean and healthy water bodies.

This device is ideal for cleaning rivers, lakes, harbors, and urban water bodies, helping to prevent pollution from spreading and protecting aquatic ecosystems. Its modular structure allows for easy maintenance and scalability, making it adaptable to different water bodies and pollution levels.

CONTENTS

LISTOF FIGURES

CHAPTER 1
INTRODUCTION

1.1 Overview Of The Project

The Floating Trash Collector is an innovative and sustainable solution designed to combat water pollution by removing floating debris from various water bodies. It operates on a straightforward mechanism where water flows through the device while floating waste is captured using a conveyor belt, rotating mesh, or scoop system. This waste is collected and stored in a compartment for easy removal, disposal, or recycling. The system ensures that clean water is returned to the environment, helping to maintain the ecological balance. By targeting floating debris such as plastic, organic waste, and other pollutants, the Floating Trash Collector plays a vital role in preserving aquatic ecosystems.

One of the key features of the Floating Trash Collector is its use of renewable energy sources, such as solar power. This enables continuous, cost-effective, and eco-friendly operation without relying on external energy supplies. Advanced models are equipped with navigation systems that use GPS and sensors to detect and collect waste autonomously. These systems can be programmed to either stay in areas with high pollution or move along pre-defined routes to maximize waste collection. Real-time monitoring capabilities allow operators to track waste levels and optimize the system's performance, making it an efficient solution for long-term deployment in polluted water bodies.

The versatility of the Floating Trash Collector makes it suitable for a wide range of aquatic environments, including rivers, lakes, harbors, coastal areas, and urban water systems. In these areas, it helps to reduce the accumulation of plastic waste and other pollutants that threaten marine life and public health. The modular design of the system allows for easy maintenance and scalability, enabling it to be customized for different water body sizes and pollution levels. This adaptability ensures that the system can address both localized pollution issues and larger-scale environmental concerns.

Beyond its environmental benefits, the Floating Trash Collector also enhances the visual appeal of water bodies by keeping them clean and free from debris. This is especially important for public spaces and tourist areas where clean waterways contribute to a better environment and visitor experience.

By preventing waste from spreading to larger ecosystems like oceans, the system supports global initiatives aimed at reducing marine pollution and promoting sustainable waste management. Overall, the Floating Trash Collector is a crucial tool in the fight against water pollution, helping to protect natural resources and preserve aquatic life for future generations.

1.2 Objective Of The Project

The primary objective of the Floating Trash Collector is to reduce water pollution by efficiently collecting and removing floating debris from various water bodies, including rivers, lakes, harbors, and coastal areas. It aims to address the growing environmental threat caused by plastic waste, organic materials, and other non-biodegradable pollutants that contaminate aquatic ecosystems and pose risks to marine life and human health. By utilizing advanced collection mechanisms, such as conveyor belts, rotating meshes, or scoop systems, the Floating Trash Collector is designed to capture and store floating waste while allowing clean water to flow back into the environment. This automated process not only increases the efficiency of waste collection but also reduces the need for manual labor, making it a cost-effective and practical solution for large-scale water pollution management.

Another key objective is to promote sustainability and energy efficiency through the use of renewable energy sources. Many Floating Trash Collectors are powered by solar panels, ensuring continuous operation while minimizing the system's carbon footprint. This energy-efficient approach makes the system environmentally friendly and suitable for long-term deployment without reliance on conventional energy sources. Advanced models are also equipped with smart technologies, such as GPS and sensors, to detect and monitor trash levels, allowing for real-time tracking and optimization of collection routes. These autonomous features enable the system to operate in areas with high pollution concentration, adapt to changing environmental conditions, and improve the overall effectiveness of waste removal.

Overall, the Floating Trash Collector is designed to provide a comprehensive solution to water pollution by combining efficient waste collection, sustainable energy use, and environmental preservation, ultimately contributing to a cleaner and healthier planet.

CHAPTER 2
LITERATURE SURVEY

2.1 Existing System

The existing system of Floating Trash Collectors consists of various designs and technologies aimed at addressing water pollution by removing floating debris from different water bodies. These systems typically rely on mechanical, automated, or semi-automated processes to capture and store waste for later disposal or recycling. The most common mechanism involves a floating platform equipped with conveyor belts, rotating drums, or mesh screens that guide floating trash into a collection bin while allowing clean water to pass through. Some systems use booms or barriers to direct debris toward the collector, enhancing efficiency in areas with high waste accumulation. These devices are often anchored in place or strategically positioned in water channels where waste tends to accumulate, such as river mouths, coastal regions, and urban waterways.

Most existing floating trash collectors are powered by a variety of energy sources, including electricity, fuel, or renewable energy like solar power. Solar-powered models are becoming increasingly popular due to their sustainability and ability to operate continuously without external energy supplies. Some advanced systems incorporate smart technology, such as sensors and GPS navigation, allowing them to autonomously detect and collect debris while monitoring waste levels in real-time. This technology enables efficient route optimization, which is particularly useful in large water bodies or areas with fluctuating pollution levels. However, simpler systems still rely on manual operation, requiring regular monitoring and waste removal by human operators.

Overall, the existing floating trash collection systems play a vital role in managing water pollution but have room for improvement in terms of capacity, efficiency, and adaptability. Innovations such as increased automation, enhanced waste detection, and improved energy efficiency continue to advance these systems, contributing to the global effort to keep waterways clean and protect marine ecosystems.

2.2 Proposed Systems

The proposed system of the Floating Trash Collector aims to overcome the limitations of existing systems by incorporating advanced technologies and improving efficiency, scalability, and environmental sustainability. This system is designed to enhance the collection of floating debris, including plastics, organic waste, and other pollutants, from various water bodies while offering better automation, increased waste capacity, and minimal human intervention. The proposed design consists of a floating platform equipped with a multi-stage collection mechanism, combining conveyor belts, mesh filters, and skimming devices to capture both large and small debris. Unlike traditional systems, this advanced model can collect waste not only from the water surface but also from a few centimeters below the surface, addressing the challenge of submerged pollutants. Additionally, a smart waste segregation unit can be integrated to separate plastics, organic matter, and other materials, promoting efficient recycling and disposal.

A key innovation in the proposed system is the incorporation of autonomous navigation and smart monitoring. Utilizing GPS technology, LiDAR sensors, and advanced computer vision, the system can detect floating debris, map polluted zones, and navigate autonomously to high-density waste areas. This reduces the need for manual intervention and ensures continuous operation in large or hard-to-reach water bodies. Real-time monitoring through IoT (Internet of Things) sensors allows operators to track waste levels, system performance, and environmental parameters remotely. This data can be used to optimize collection routes and ensure timely waste removal, enhancing operational efficiency. Additionally, machine learning algorithms could be employed to predict waste accumulation patterns based on environmental factors like water currents and seasonal changes, further improving collection efficiency.

The proposed Floating Trash Collector is designed to be energy-efficient and environmentally sustainable by relying primarily on renewable energy sources. Solar panels integrated into the structure provide the necessary power for collection mechanisms, sensors, and navigation systems. Energy storage through advanced battery systems ensures uninterrupted operation even during low sunlight conditions or at night. In areas with strong water currents, kinetic energy from the water flow can be harnessed as an auxiliary power source, further improving sustainability. This dual-energy approach not only reduces operational costs but also minimizes the carbon footprint, making the system ideal for long-term deployment in both urban and remote aquatic environments.

Another enhancement in the proposed system is its modular and scalable design, allowing for customization based on specific needs. For large water bodies such as rivers and coastal areas, multiple units can be interconnected to cover extensive regions efficiently. Smaller, more compact versions can be deployed in urban water channels, drainage systems, and harbors. The system's modular nature also facilitates easier maintenance and upgrades, ensuring long-term reliability. Additionally, the collected waste is compressed within the onboard storage unit, maximizing capacity and reducing the frequency of waste removal.

In addition to physical waste collection, the proposed system may also feature water quality monitoring capabilities. Sensors can measure parameters like pH levels, temperature, and pollutant concentrations in real time. This feature not only aids in identifying pollution hotspots but also supports environmental agencies in monitoring and maintaining water quality standards. Furthermore, the collected environmental data can be used to raise public awareness and drive policy changes aimed at reducing pollution at the source.

Overall, the proposed Floating Trash Collector is a comprehensive and intelligent solution to water pollution, addressing the limitations of existing systems through advanced automation, enhanced energy efficiency, and increased adaptability. By integrating cutting-edge technology with sustainable practices, this system can play a crucial role in preserving aquatic ecosystems, supporting marine biodiversity, and promoting global efforts to combat water pollution.

2.3 Embedded Systems Introduction

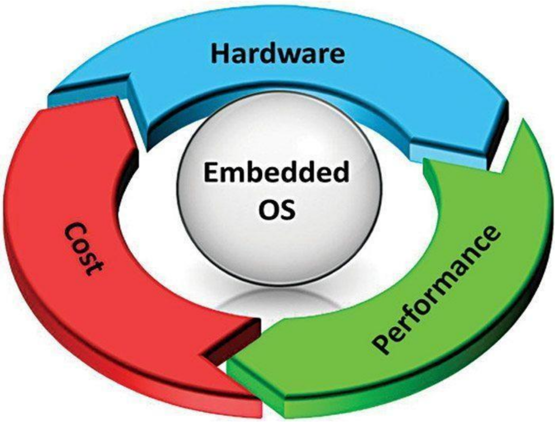

Fig:2.1 Embedded OS

An embedded system is a combination of computer hardware and software designed for a specific function or functions within a larger system. The systems can be programmable or with fixed functionality. Industrial machines, consumer electronics, agricultural and process industry devices, automobiles, medical equipment, cameras, household appliances, airplanes, vending machines and toys, as well as mobile devices, are possible locations for an embedded system. While embedded systems are computing systems, they can range from having no user interface (UI) -- for example, on devices in which the system is designed to perform a single task -- to complex graphical user interfaces (GUIs), such as in mobile devices.

History of embedded systems

Embedded systems date back to the 1960s. Charles Stark Draper developed an integrated circuit (IC) in 1961 to reduce the size and weight of the Apollo Guidance Computer, the digital system installed on the Apollo Command Module and Lunar Module. The first computer to use ICs, it helped astronauts collect real-time flight data.

In 1965, Autonoetic, now a part of Boeing, developed the D-17B, the computer used in the Minuteman I missile guidance system. It is widely recognized as the first mass-produced embedded system. When the Minuteman II went into production in 1966, the D-17B was replaced with the NS-17 missile guidance system, known for its high-volume use of integrated circuits. In 1968, the first embedded system for a vehicle was released; the Volkswagen 1600 used a microprocessor to control its electronic fuel injection system.

By the late 1960s and early 1970s, the price of integrated circuits dropped, and usage surged. The first microcontroller was developed by Texas Instruments in 1971. The TMS 1000 series, which became commercially available in 1974, contained a 4-bit processor, read-only memory (ROM) and random-access memory (RAM), and cost around $2 apiece in bulk orders.

Also, in 1971, Intel released what is widely recognized as the first commercially available processor, the 4004. The 4-bit microprocessor was designed for use in calculators and small electronics, though it required eternal memory and support chips. The 8-bit Intel 8008, released in 1972, had 16 KB of memory; the Intel 8080 followed in 1974 with 64 KB of memory. The 8080's successor, x86 series, was released in 1978.

In 1987, the first embedded operating system, the real-time VxWorks, was released by Wind River, followed by Microsoft's Windows Embedded CE in 1996. By the late 1990s, the first embedded Linux products began to appear. Today, Linux is used in almost all embedded devices.

Characteristics of embedded systems

The main characteristic of embedded systems is that they are task specific. They perform a single task within a larger system. For example, a mobile phone is not an embedded system, it is a combination of embedded systems that together allow it to perform a variety ofgeneral-purpose task.

The embedded systems within it perform specialized functions. For example, the GUI performs the singular function of allowing the user to interface with the device. In short, they are programmable computers, but designed for specific purposes, not general ones.The hardware of embedded systems is based around microprocessors and microcontrollers. Microprocessors are very similar to microcontrollers, and generally refer to a CPU that is integrated with other basic computing components such as memory chips and digital signal processors (DSP). Microcontrollers have those components built into one chip.

Additionally, embedded systems can include the following characteristics:

- Comprised of hardware, software and firmware.
- Embedded in a larger system to perform a specific function as they are built for specialized tasks within the system, not various tasks.
- Either microprocessor-based or microcontroller-based -- both are integrated circuits that give the system compute power.
- Often used for sensing and real-time computing in internet of things (IoT) devices -- devices that are internet-connected and do not require a user to operate.
- Vary in complexity and in function, which affects the type of software, firmware and hardware they use; and xix
- Often required to perform their function under a time constraint to keep the larger system functioning properly.

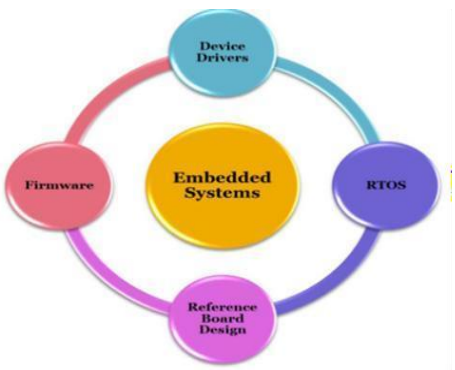

Fig:2.2 Embedded system

Embedded systems vary in complexity, but generally consist of three main elements:

- Hardware The hardware of embedded systems is based around microprocessors and microcontrollers. Microcontrollers have those components built into one chip.

- Software Software for embedded systems can vary in complexity. However, industrial-grade microcontrollers and embedded IoT systems generally run very simple software that requires little memory.
- Firmware Embedded firmware is usually used in more complex embedded systems to connect the software to the hardware. Firmware is software that interfaces directly with the hardware. A simpler system may just have software directly in the chip, but more complicated systems need firmware under more complex software applications and operating systems.

Fig:2.3 Blocks of embedded systems

2.4 Why Embedded Systems?

An embedded system is a computer system with a particular defined function within a larger mechanical or electrical system. They control many devices in common use. They consume low power, are of a small size and their cost is low per unit.

Fig:2.4 Embedded systems hardware

Modern embedded systems are often based on micro-controllers. A micro-controller is a small computer on a single integrated circuit which contains a processor core, memory, and programmable input and output peripherals.

As Embedded system is dedicated to perform specific tasks therefore, they can be optimized to reduce the size and cost of the product and increase the reliability and performance. Almost every Electronic Gadget around us is an Embedded System, digital watches, MP3 players, Washing Machine, Security System, scanner, printer, a cellular phone, Elevators, ATM, Vendor Machines, GPS, traffic lights, Remote Control, Microwave Oven and many more. The uses of embedded systems are virtually limitless because every day new products are introduced to the market which utilize embedded computers in several ways.

Let’s make it easy for you. For Example – You are sitting in a train headed to your destination and you are already fifty miles away from your home and suddenly you realise that you forgot to switch of the fan. Not to worry, you can switch it off just by clicking a button on your cell phone using this technology – The Internet of Things. Well, this is just one good thing about IoT. We can monitor Pollution Levels, we can control the intensity of streetlights as per the season and weather requirements, IoT can also provide the parents with real-time information about their baby’s breathing, skin temperature, body position, and activity level on their smartphones and many other applications which can make our life easy.

Embedded Systems has brought about a revolution in science. It is also a part of a Internet of Things (IoT) – a technology in which objects, animals or people are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

2.5 Design Approaches

A system designed with the embedding of hardware and software together for a specific function with a larger area is embedded system design. In embedded system design, a microcontroller plays a vital role. Micro-controller is based on Harvard architecture, it is an important component of an embedded system. External processor, internal memory and i/o components are interfaced with the microcontroller. It occupies less area, less power consumption. The applications of microcontrollers is MP3, washing machines.

Critical Embedded Systems (CES) are systems in which failures are potentially catastrophic and, therefore, hard constraints are imposed on them.

For example, in smart cars the amount of software has grown about 100 times compared to previous years. This change means that software design for these systems is also bounded to hard constraints (e.g., high security and performance). Along with the evolution of CES, the approaches for designing them are also changing rapidly, to fit the specialized needs of CES. Thus, a broad understanding of such approaches is missing.

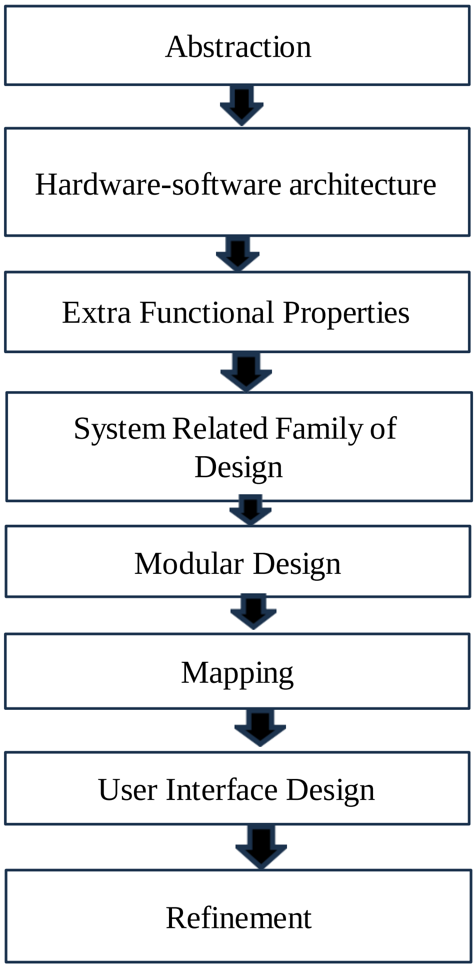

Fig:2.5 Embedded design process system

Steps in the Embedded System Design Process

The different steps in the embedded system design flow/flow diagram include the following.

Abstraction

In this stage the problem related to the system is abstracted.

Hardware – Software Architecture

Proper knowledge of hardware and software to be known before starting any design process.

Extra Functional Properties

Extra functions to be implemented are to be understood completely from the main design.

System Related Family of Design

When designing a system, one should refer to a previous system-related family of design.

Modular Design

Separate module designs must be made so that they can be used later on when required.

Mapping

Based on software mapping is done. For example, data flow and program flow are mapped into one.

User Interface Design

In user interface design it depends on user requirements, environment analysis and function of the system. For example, on a mobile phone if we want to reduce the power consumption of mobile phones, we take care of other parameters, so that power consumption can be reduced.

Refinement

Every component and module must be refined appropriately so that the software team can understand.

Architectural description language is used to describe the software design.

- Control Hierarchy
- Partition of structure
- Data structure and hierarchy
- Software Procedure.

In user interface design it depends on user requirements, environment analysis and function of the system. For example, on a mobile phone if we want to reduce the power consumption of mobile phones, we take care of other parameters, so that power consumption can be reduced. To help countries and health-care facilities to achieve system change and adopt alcohol-based hand rubs as the gold standard for hand hygiene in health care, WHO has identified formulations for their preparation. Logistics, economic, safety, and cultural.

Design Metrics / Design Parameters of an Embedded System	**Function**
Power Dissipation	Always maintained low
Performance	Should be high
Process Deadlines	The process/task should be completed within a specified time.
Manufacturing Cost	Should be maintained.
Engineering Cost	It is the cost for the edit-test-debug of hardware and software.
Size	Size is defined in terms of memory RAM/ROM/Flash Memory/Physical Memory.
Prototype	It is the total time taken for developing a system and testing it.
Safety	System safety should be taken like phone locking, user safety like engine breaks down safety measure must be taken
Maintenance	Proper maintenance of the system must be taken, in order to avoid system failure.
Time to market	It is the time taken for the product/system developed to be launched into the market.

TABLE:2.1 Embedded system design software development activities

- **Automobiles** Modern cars commonly consist of many computers (sometimes as many as 100), or embedded systems, designed to perform different tasks within the vehicle. Some of these systems perform basic utility function and others provide entertainment or user-facing functions. Some embedded systems in consumer vehicles include cruise control, backup sensors, suspension control, navigation systems and airbag systems.

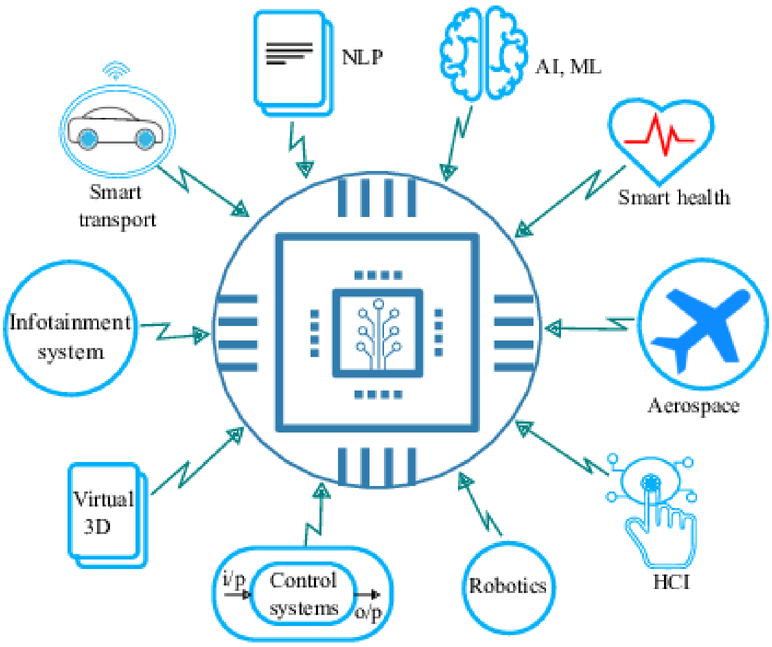

Fig:2.5 Applications of embedded systems

- **Mobile phones** consist of many embedded systems, including GUI software and hardware, operating systems, cameras, microphones and USB I/O modules.
- **Industrial machines** can contain embedded systems, like sensors, and can be embedded systems themselves. Industrial machines often have embedded automation systems that perform specific monitoring and control functions.
- **Medical equipment** These may contain embedded systems like sensors and control mechanisms. Medical equipment, such as industrial machines, also must be very user-friendly, so that human health isn't jeopardized by preventable machine mistakes. This means they'll often include a more complex OS and GUI designed for an appopriate UI.

The choice of components for the WHO-recommended hand rub formulations takes into account cost constraints and microbicidal activity. The following two formulations are recommended for local production with a maximum of 50 litres per lot to ensure safety in

2.6 Combination Of Logic Devices

Logic gates are physical devices that use combinational logic to switch an electrical one ("1") or zero ("0") to downstream blocks in digital design. Combinational logic uses those bits to send or receive data within embedded systems. Data bits build into digital words used to communicate with other design blocks within the system. Digital bits and words do this with logic gates in an organized fashion using dedicated address, data, or control signal nodes. Logic gates are the physical devices that enable processing of many 1's and 0's.

Logic families are collections of integrated circuits containing logic gates that perform functions needed by embedded systems to communicate with one another to drive the design. Logic gates are organized into families relative to the type of material and its operational characteristics.

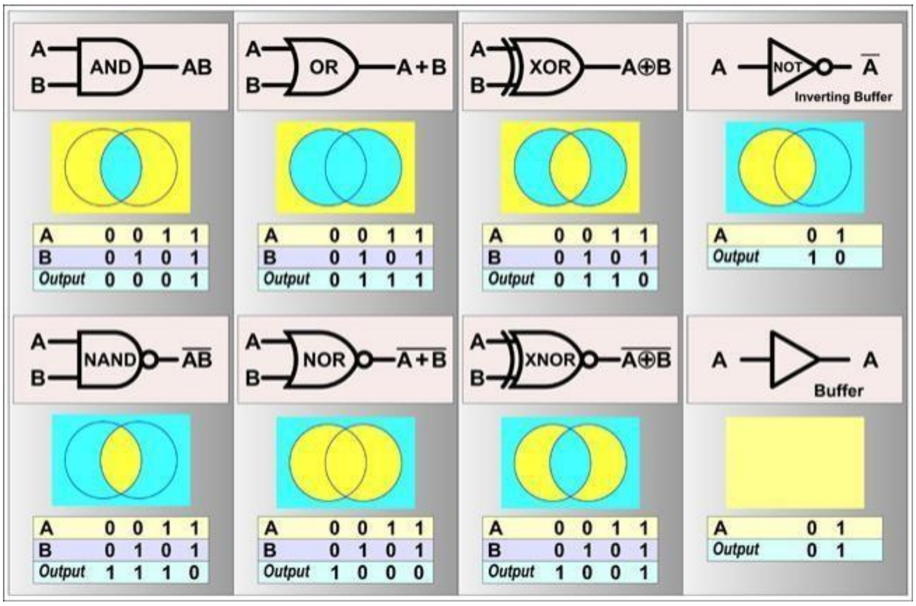

Fig:2.6 Logic gates

Most logic gates are made from silicon, although some utilize gallium arsenide or other semiconductor materials. The semiconductor material is doped for organization into layers. The doped layers drive power capabilities and typical impedances at input or outputs of each gate. Logic gates used together must employ the same, or complementary, material properties. Knowledge of material properties for logic gates will drive selection of parts within design blocks.

Embedded systems evolution was built from combinational logic families made possible from the discovery of the transistor.

The transistor is made from semiconductor material and is compact. It is able to handle large amounts of power quickly. The transistor employs three terminals to activate electron flow for use in downstream devices as electricity.

Electricity represented as 1's and 0's combines to communicate information throughout an embedded system. Because of its compact size, many millions of transistors combine within very small spaces. This allows millions of gates to operate in compact areas while transmitting and receiving mind-boggling amounts of intelligence through combinational logic. This is all accomplished within a minimal power budget.

The versatility of logic gates allows for simplification through Boolean algebra and Karnaugh maps, reducing the number of gates required, which enhances circuit efficiency and minimizes cost. Logic gates are the backbone of digital devices, from microprocessors and embedded systems to control units and communication systems, exemplifying the power of binary logic in modern technology.

Fig:2.7 Embedded system group

CHAPTER 3
HARDWARE REQUIREMENTS

3.1 Mechanical Design

The mechanical design of a floating trash collector primarily consists of a buoyant structure, a waste collection mechanism, and a propulsion or anchoring system. The buoyant structure, often made from high-density polyethylene (HDPE), aluminum, or fiberglass, ensures stability and floatation on water surfaces. The waste collection mechanism includes a conveyor belt, mesh nets, or skimmer arms that direct floating debris towards a central storage area. Some designs incorporate rotating drums or suction systems to improve efficiency in gathering waste. The propulsion system varies based on application, with options such as solar-powered motors, water currents, or anchoring systems to keep the device in position.

The collected waste is stored in compartments that can be emptied periodically, ensuring the device remains functional over extended periods. Proper hydrodynamic design is essential to minimize resistance and maximize efficiency, allowing the collector to operate effectively in lakes, rivers, and coastal waters.

3.1.1 Catamaran Inspired Layout

All computer operating systems are designed for a particular computer architecture. Most software applications are limited to particular operating systems running on particular architectures. Although architecture-independent operating systems and applications exist, most need to be recompiled to run on a new architecture. See also a list of common operating systems and their supporting architectures.

3.1.2 Pvc Bridge Deck And Platform

The bridge deck of the USV is constructed using lightweight PVC material, balancing structural integrity with weight considerations. This PVC platform serves as the central structure where all the electrical components are housed, including the microcontroller, motors, and power supply. Additionally, the platform accommodates a specially designed module for debris collection, enhancing the USV's functionality in removing floating debris from the water surface.

3.1.3 Collection Module Design

The collection module, resembling a deep-sea cage, is a critical component of the USV mechanical design. Constructed from durable plastic material, the module features multiple openings on all sides, strategically positioned to allow water to pass through while trapping floating debris inside. The front side of the module is designed facilitate easy entry of debris, while the remaining sides incorporate mesh walls to prevent debris from escaping.

3.1.4 Propulsion System

The propulsion system of the USV comprises DC motors positioned at the rear of the vehicle. These motors are inclined towards the water surface, optimizing propulsion efficiency and maneuverability. The motor assembly is designed to withstand the challenges of operating in water environments, with appropriate sealing mechanisms to protect against water ingress and corrosion.

3.2 Electronics

Electronics components are used to regulate and supply the voltage to various components of the USV in order to control and obtain the desired mechanical outputs. All the electronics components need a voltage power supply source in order to operate in given conditions. Various electrical and electronics components are used to correctly operate this USV.

3.2.1 L298n Drive Controller

The L298N serves as a dual H-Bridge motor driver, facilitating simultaneous speed and directional control for two DC motors. Capable of handling motors with voltages ranging from 5 to 35V and peak currents up to 2A, this module is designed for high power motor control tasks. It comprises an L298 motor driver IC and a 78M05 5V regulator. With its robust design, the L298N can control up to 4 DC motors or 2 DC motors with both directional and speed control functionalities. This versatile motor driver IC is suitable for a wide range of applications involving DC and stepper motors.

Key features of L298N:

- Voltage Range - 5V to 35V wide range of input voltage.
- Current capability - 2A per channel continuously and 3A peak per channel with proper heat sinking.
- Dual H- Bridge - allows both direction and speed control of either two DC motors or one stepper motor.

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- PWM control - supports pulse-width modulation for speed variation.
- Thermal protection - Built in thermal shutdown protection to prevent IC from overheating while induced under heavy loads.

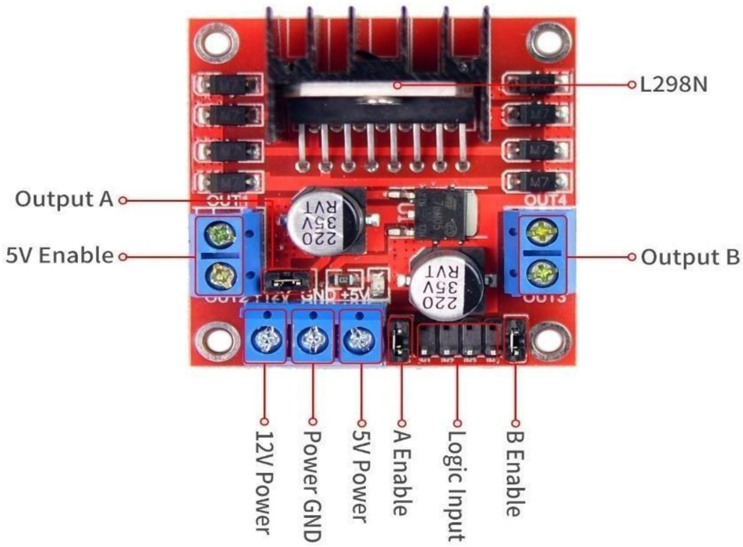

Fig 3.1: L298N drive controller

- Dual H- Bridge - allows both direction and speed control of either two DC motors or one stepper motor.
- PWM control - supports pulse-width modulation for speed variation.
- Thermal protection - Built in thermal shutdown protection to prevent IC from overheating while induced under heavy loads.

3.2.2 Esp 32

The ESP32 is a versatile single combo chip featuring both 2.4GHz Wi- Fi and Bluetooth functionalities, crafted using TSMC low-power 40nm technology. It boasts robustness, capable of operating in temperatures ranging from -40°C to +125°C. With high integration, it includes built-in antenna switches, RF components, power and low-noise amplifiers, filters, and other power management modules, while requiring minimal printed circuit board space. It can function as a standalone system or as a slave device to a host like any Node MCU, reducing communication stack overhead on the primary application processor.

Key features of ESP 32:

● Wifi connections - It has built in Wifi capabilities. It supports Wifi 802.11b/g/n for wireless communications.

● Bluetooth connectivity - It supports bluetooth V4.2 for connectivity with other devices and networks.

● Dual-Core processor - ESP32 features two Xtensa LX6 microprocessor cores, both of which can be independently controlled and programmed. The main use of this is for multitasking and efficient handling of various different tasks.

● Secure connections - It supports secure connectivity with features such as SSl/TLS,WPA and WPA2 encryption protocols. Thus, it can be used for applications which require secure communications over the network.

● Sensors Integration - different variants of ESP 32 are available with different built in sensors such as temperature, humidity and hall effect sensors present for sensing various applications without adding other external sensor components.

Fig 3.2: ESP 32

3.2.3 Dc Motors

Two DC motors are utilized to govern the movement of the two wheels arranged differentially. The operating voltage of these DC motors are about 12V, with a no-load current of 60 – 180 mA. These DC motors are also combined with a small speed reduction gear box. The gear reduction ratio is 1:48. The two propellers are attached at each shaft of the two DC motors. Each time when the drive controller sends the power to these motors, it rotates the shafts which in turn rotate the propellers attached to the shaft. The RPM of the motor is 1000 RPM. The torque produced by the motor is sufficient enough to propel the weight of the USV on the water’s surface, including any floating debris present in the collector container. The shafts are attached to the rotor shaft to extend the length of the overall shaft in order to reach the water surface. At the end of the shaft rotating blades with three fins are attached to both the shafts. These rotating blades are partially submerged in the water. The rotational force and moment generated by the DC motor is sent through the shafts, which is received by the rotating blades. These blades send the rotational moments into the water to push the USV. Two DC motors are employed to maneuver the USV in any direction. The power supply direction is changed to achieve the required direction of propulsion of the USV.

For the USV to move in:

● Forward - DC motor 1 rotates in an anticlockwise direction, and DC motor 2 rotates in a clockwise direction.

● Reverse - DC motor 1 rotates in a clockwise direction and DC motor 2 rotates in an anticlockwise direction.

● Left - DC motor 1 and DC motor 2 both rotates in anticlockwise direction 12

● Right - DC motor 1 and DC motor 2 both rotate in clockwise direction. To change the direction of rotation of the DC motor, the voltage terminals are reversed by the signals sent to the drive controller.

Fig 3.3: DC Motors

A DC motor is an electromechanical device that converts direct current (DC) electrical energy into mechanical energy through the interaction of magnetic fields and electric currents. The motor consists of two main components: the stator, which provides a stationary magnetic field, and the rotor (or armature), which rotates within this field. When a DC voltage is applied to the armature windings, it generates a magnetic field around the conductors. This magnetic field interacts with the stator's magnetic field, creating a force on the armature conductors. According to Fleming's Left-Hand Rule, the direction of this force is perpendicular to both the current and the magnetic field, resulting in rotational motion.

The commutator and brushes are essential components that ensure continuous rotation. The commutator is a cylindrical structure made of copper segments, which reverses the direction of current in the armature windings as the rotor turns. This reversal maintains the torque in a consistent direction, enabling smooth rotation. The brushes, typically made of carbon or graphite, conduct electricity from the external circuit to the rotating commutator. The torque produced by the motor depends on factors such as the strength of the magnetic field, the current in the armature, and the number of turns in the winding.

DC motors are highly versatile and are used in a wide range of applications, from small devices like toys and household appliances to large industrial machinery and electric vehicles. They are valued for their ability to provide precise control over speed and direction, making them ideal for applications requiring accuracy and reliability

3.2.4 Switch

A switch is used to make or break a circuit. In this USV a switch is present to complete the total circuit. A single close/break switch is used to control the total power supply to run the circuit. Wires are soldered to the terminals of the switch. The power buttons are labeled by I and O. These represent I for power on and O for power off.

Fig 3.4 : Switch

3.2.5 Battery

The USV uses a battery for providing the current supply to all the electrical and electronics components used in this mobile robot. Since different components of different operating voltages are used in the circuit the batteries are combined in parallel connection and controllers are used to supply the required voltage for respective components. Six rechargeable batteries of 3.7V each with 1200mAh are used to power the two DC motors used through the L298N drive controller. Also the ESP 32 controller receives current supply from these batteries. These rechargeable batteries are connected in parallel connection in order to achieve the 12V operating voltage of the DC motor.

The battery in a floating trash collector serves as a critical component, providing the necessary power to operate the system's various functionalities. Typically, rechargeable batteries, such as lithium-ion or lead-acid batteries, are used due to their high energy density, durability, and efficiency. These batteries store energy generated from renewable sources like solar panels, ensuring that the system remains eco-friendly and sustainable. The stored energy powers the propulsion system, trash collection mechanism, sensors, and control units, enabling the collector to function autonomously or semi-autonomously.

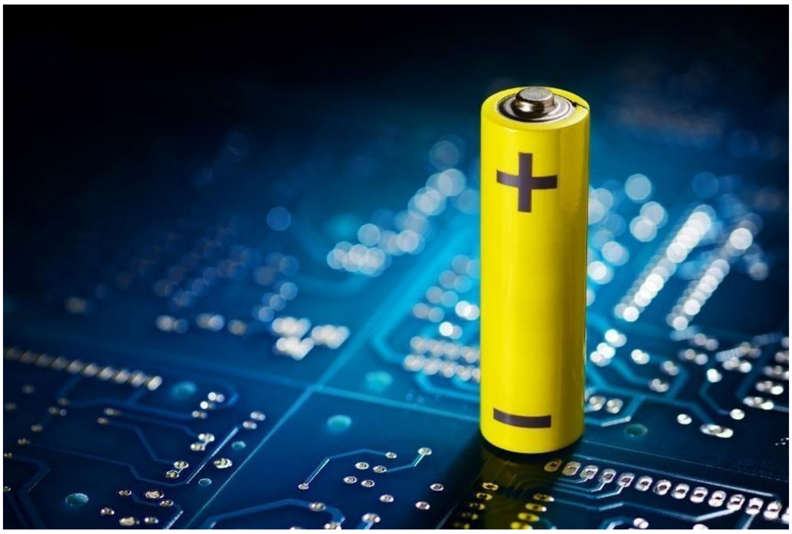

Fig 3.5: Battery

The battery system is designed to optimize energy usage, with intelligent power management software regulating the distribution of power to different components. This ensures that essential operations, such as navigation and trash collection, are prioritized, even during periods of low energy availability. Additionally, the battery is equipped with safety features, including overcharge and discharge protection, to enhance its lifespan and reliability.

In some advanced designs, the battery system is modular, allowing for easy replacement or scaling based on the collector's energy requirements. The integration of energy-efficient components further reduces the load on the battery, extending its operational time. Regular maintenance and monitoring of the battery's health are essential to ensure consistent performance and prevent unexpected failures.

Overall, the battery plays a pivotal role in enabling the floating trash collector to operate efficiently and sustainably, making it a cornerstone of the system's design.

3.2.6 Breadboard

A breadboard is a rectangular plastic board featuring numerous small holes, allowing for easy insertion of electronic components. These holes are a matrix of electrical sockets. Under the holes are series connections of electrical copper cab;es, which are used to transmit the supply to the various components attached to the board. In this application a breadboard is used, in order to provide easy connections for the ESP 32 module with the help of jumper cable wires.

Breadboards are particularly useful for beginners and professionals alike, as they allow for quick assembly and modification of circuits. Mistakes can be easily corrected by rearranging components, making it an ideal platform for learning and experimentation. Modern breadboards are solderless, which means components can be plugged in and removed without causing damage, ensuring reusability. However, due to their temporary nature, breadboards are not suitable for high-frequency circuits or permanent installations. They are widely used in educational settings, hobbyist projects, and initial stages of electronic design.

Fig 3.6: Breadboard

3.2.7 Connecting Wires

Jumper cables and copper wires with plastic casings around it are used all over the hardware setup to transfer the voltage supply to all the electronics components. Breadboard and drive controllers use male-to-male, female-to- female and male-to female jumper cables to transmit electrical energy. Whereas the DC motors receive power on long electrical wires which are covered by plastic casings to prevent unwanted discharge of electrical source energy.

Whereas the DC motors receive power on long electrical wires which are covered by plastic casings to prevent unwanted discharge of electrical source energy.

Fig 3.7: Connecting wires

3.2 Camera Sensor

To track the trash the cameras play a vital role. To select the right camera this project is prototyped with 2 different cameras, ESP 32 CAM module and Samsung Note 10 Back camera.

3.2.1 Esp 32 Cam Module

The ESP32 Cam module is a compact camera module characterized by low power consumption and built upon the ESP32 platform. It incorporates an OV2640 camera and an ESP32 CAM-MB micro USB to serial port adapter. It's mainly used in Internet of Things(IoT) applications such as wireless video monitors and image upload using Wifi.

Fig 3.8: ESP 32 Cam Module

Key features of ESP 32 cam:

● ESP 32 cam Module has WiFi and bluetooth support using ESP32- s Module

● 0V2640 Camera with flash

● TF card - support up to 4G TF card for data storage.

● Wifi video monitoring and image upload

● Deep sleep current - 6mA

● Pinheader used for easy integration and embedded into user products.

● Bluetooth V4.2 BR/EDR

● Output image format - JPEG(OV2640 support only), greyscale

The board contains IPEX block output, ESP32-S, Tantalum capacitor, a slot for inserting TF card, Voltage regulator chip, FPC connector.The board is a cost efficient and more feature rich solution for adding camera functionality. The board is also versatile in development with the inbuilt integration of Wifi and bluetooth modules.On the other hand, the Samsung Note 10 Also highlights a pro-grade camera framework that incorporates .

● Primary camera with 12MP resolution featuring a variable-aperture f/1.5- 2.4 lens.

● Dual-pixel autofocus, and optical picture stabilization

● Coupled with a 16MP ultra-wide-angle camera with a fixed-aperture f/2.2 focal point

● And a 12MP fax camera with a f/2.1-aperture focal point, both of which too highlight optical picture stabilization

● Additionally, there is a devoted time of flight (ToF) sensor for profundity estimation in representation mode.

The ESP32-CAM is a compact and cost-effective camera module based on the ESP32 microcontroller, designed for IoT and machine vision applications. It integrates an OV2640 camera sensor capable of capturing high-quality images and video streams. The module features built-in Wi-Fi and Bluetooth connectivity, enabling wireless communication for remote monitoring and control. It also includes a microSD card slot for local data storage, supporting up to 4GB cards. The ESP32-CAM is powered by a dual-core Tensilica LX6 processor, which operates at a frequency range of 80 MHz to 240 MHz, ensuring efficient multitasking and image processing.

The module's 4MB PSRAM provides ample memory for buffering images and video streams, allowing for higher resolution and smoother performance. It supports various image formats, including JPEG, BMP, and grayscale, making it versatile for different applications.

The ESP32-CAM is equipped with GPIO pins for interfacing with external peripherals, as well as UART, SPI, and I2C communication protocols for seamless integration with other devices. Its low power consumption and multiple sleep modes make it suitable for battery-powered projects.

The ESP32-CAM is widely used in applications such as home automation, wireless surveillance, and IoT devices requiring image recognition and tracking. Despite its compact size, it offers robust functionality, making it a popular choice for developers and hobbyists alike.

3.3 Floating Platform

The floating platform forms the structural foundation of a floating trash collector, ensuring stability, buoyancy, and durability in aquatic environments. It is typically constructed from lightweight and corrosion-resistant materials such as high-density polyethylene (HDPE), aluminum, or fiberglass, which can withstand prolonged exposure to water and harsh conditions. The design of the platform incorporates a hydrodynamic shape to minimize water resistance and maintain efficient movement.

To ensure balance and stability, the platform may feature multiple pontoons or a catamaran-style design, which distributes weight evenly and prevents capsizing. It also provides mounting points and support for all components, including the propulsion system, sensors, collection mechanisms, and storage compartments. Protective housings for sensitive electronics and mechanical parts are integrated to prevent water ingress and damage.

Additionally, the platform is equipped with buoyancy aids to handle varying loads, such as the added weight of collected trash or equipment. For maintenance and accessibility, the platform may include walkways, hatches, or detachable sections. Safety features, such as reinforced edges or barriers, further enhance operational reliability, ensuring that the floating trash collector performs effectively in diverse water conditions.

3.4 Safety Features

Safety features in a floating trash collector are integral to ensuring operational reliability, durability, and protection against hazards. These systems are equipped with emergency stop mechanisms that immediately halt operations in case of critical situations or malfunctions. Buoyancy aids, such as additional pontoons or inflatable components, maintain stability and prevent sinking even when handling heavy trash loads. Protective enclosures safeguard sensitive electronics like microcontrollers and sensors from water damage, impacts, or harsh environmental conditions. Electrical systems include overcurrent and overload protection to prevent damage to motors or batteries due to excessive power demands. Collision avoidance systems, using sensors such as ultrasonic devices, cameras, or LIDAR, detect obstacles and enable the collector to reroute safely. The structure itself is weather-resistant, designed to endure heavy rains, strong winds, and prolonged UV exposure.

3.5 Pedal Powered System

Pedals in a floating trash collector are often used in manually operated systems to provide an eco-friendly and cost-effective propulsion method. These systems typically involve a pedal-powered mechanism where the operator's pedaling motion drives the movement of the trash collector through water. The pedals are connected to a chain-and-sprocket system or a crankshaft, which transfers the mechanical energy to the propulsion system, such as paddles or small propellers.

In addition to propulsion, pedal-powered systems can also be integrated with trash collection mechanisms. For example, the pedaling motion can drive a conveyor belt or scooping arm that collects floating debris and directs it into storage compartments. This dual functionality makes pedal-operated trash collectors efficient and sustainable, as they rely solely on human energy without the need for external power sources.

Pedal-powered trash collectors are particularly suitable for small-scale operations in lakes, ponds, or calm rivers, where manual effort is sufficient for navigation and trash collection. They are lightweight, portable, and easy to maintain, making them an ideal solution for community-driven cleanup initiatives.

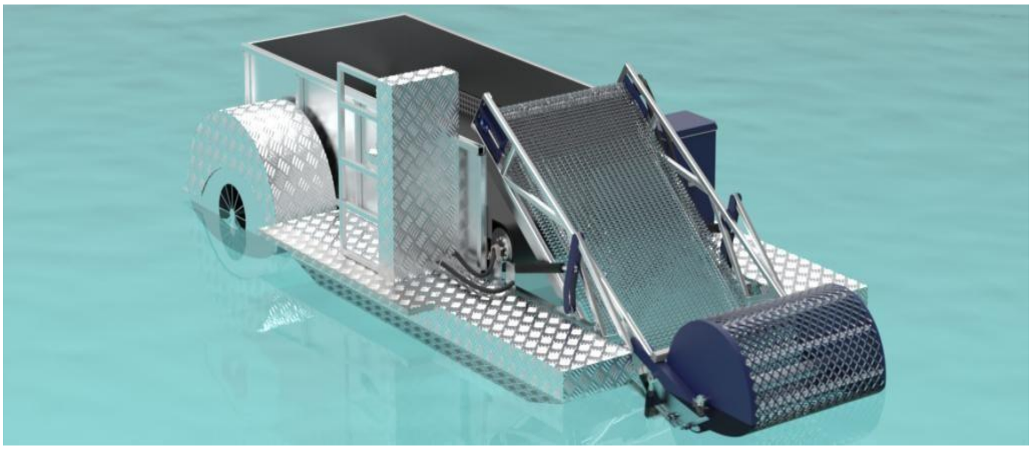

Fig 3.9: Pedal powered system

This sustainable approach not only reduces operational costs but also raises awareness about water pollution and the importance of environmental conservation.

CHAPTER 4

SOFTWARE COMPONENTS

4.1 Arduino Software

The Arduino is a family of microcontroller boards to simplify electronic design, prototyping .and experimenting for artists, hackers, hobbyists, but also many professionals. People use it as brains for their robots, to build new digital music instruments, or to build a system that lets your house plants tweet you when they're dry. Arduinos (we use the standard Arduino Uno) are built around an ATmega microcontroller — essentially a complete computer with CPU, RAM, Flash memory, and input/output.

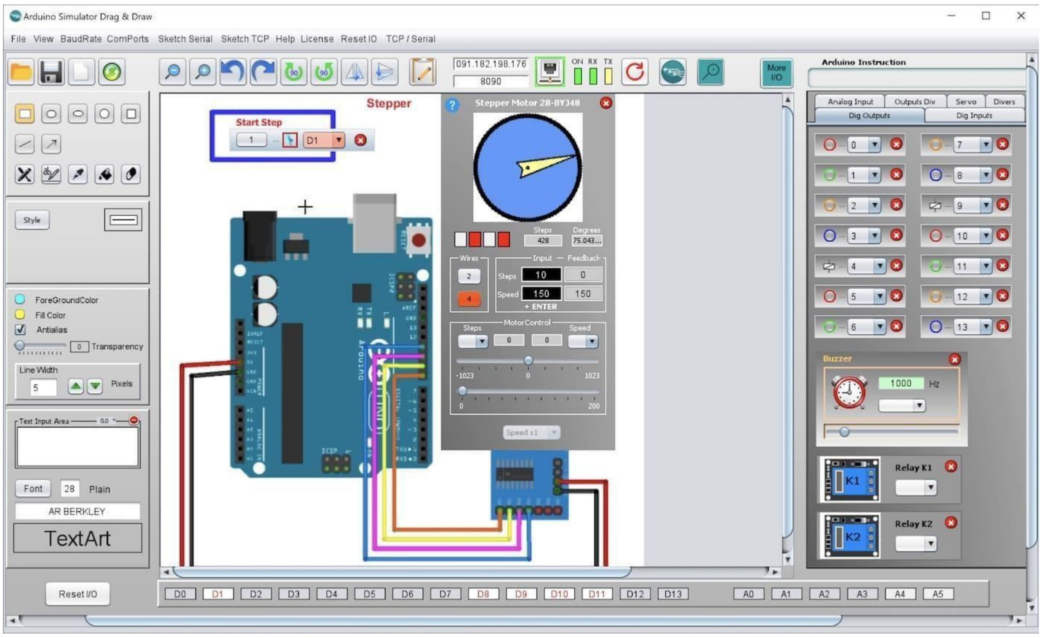

Fig 4.1: Arduino software

Sensor Integration and Data processing :

The system relies on various sensors to detect obstacles, navigate, and collect environmental data.

- Ultrasonic Sensors (HC-SR04): Used for obstacle detection and avoidance by measuring the distance between the collector and floating objects. The NewPing.h library helps in processing sensor readings efficiently.
- GPS Module (NEO-6M): Enables location tracking to guide the trash collector along predefined routes or return it to a docking station. The TinyGPS++ library is used to decode latitude and longitude data.

- Water Quality Sensors (TDS/PH/Temperature Sensors): These monitor environmental conditions, such as water pollution levels, and use DFRobot_GravityTDS.h for processing.

Motor Control for Navigation and waste Collection

The collector moves using DC motors or servo motors, controlled via an L298N motor driver. The AFMotor.h or Servo.h library is used to:

- Drive propellers or paddle wheels to move the collector.
- Steer using differential motor control for turns and directional adjustments.
- Operate a mechanical arm or conveyor belt (if present) to lift waste into the collection bin.

Autonomous Navigation and Obstacle Avoidance :

To move efficiently across water bodies, the software includes:

- GPS-guided path planning, allowing predefined waypoints.
- Ultrasonic-based collision avoidance, stopping or rerouting when obstacles are detected.
- PID control algorithms to maintain a stable course and prevent drifting due to water currents.

Communication and Remote Monitoring :

For real-time monitoring and data logging, the collector communicates via:

- Wi-Fi (ESP8266/ESP32): Enables remote control and data transmission using the WiFi.h or ESP8266WiFi.h libraries.
- GSM Module (SIM800L): Sends SMS alerts about waste levels or battery status using SoftwareSerial.h.
- LoRa Modules (SX1278): Allows long-range, low-power communication if the collector operates in large lakes or
- reservoirs.

Data Logging and Cloud Integration :

Collected data can be stored locally or uploaded to a cloud server:

- SD Card Storage (SD.h library) logs sensor readings and GPS coordinates.
- IoT Cloud Platforms (ThingsBoard, Firebase, AWS IoT) store real-time data and provide remote dashboards for monitoring.
- Web Dashboard or Mobile App (using React, Flask, or Blynk) enables real-time visualization of the collector's operation.

Power Management and Efficiency :

The Arduino software also handles:

- Battery Monitoring: Alerts when battery levels are low.
- Power-saving modes: Reduces motor speed when inactive to conserve energy.

Overall, the Arduino-based Floating Trash Collector combines sensor data processing, motor control, navigation algorithms, and wireless communication to operate autonomously, ensuring efficient waste removal from water bodies.

4.2 Control System Software

Control System Software for a floating trash collector is vital to manage its operations efficiently. It typically includes the following components:

1. Navigation System:
    - Uses GPS and compass integration for precise movement.
    - Enables autonomous or remote-controlled navigation in water bodies.
2. Motor and Actuator Control:
    - Manages the propulsion system for movement.
    - Controls the mechanical components like trash scooping or conveyor mechanisms.
3. Obstacle Avoidance:
    - Processes data from ultrasonic sensors, LIDAR, or cameras to detect obstacles.
    - Implements algorithms for real-time path correction.
4. Perational Modes:

- Includes different modes like automatic trash collection, standby, or manual control.

5. System Diagnostics:
    - Monitors the performance of onboard components.
    - Provides alerts for maintenance or troubleshooting.
6. User Interface:
    - Offers visual dashboards for operators to monitor and control operations.
    - Displays collected data like the volume of trash or battery status.

4.3 Sensor Integration

Sensors Integration in a floating trash collector is essential for efficient and autonomous operation. Here's an overview of the key components involved:

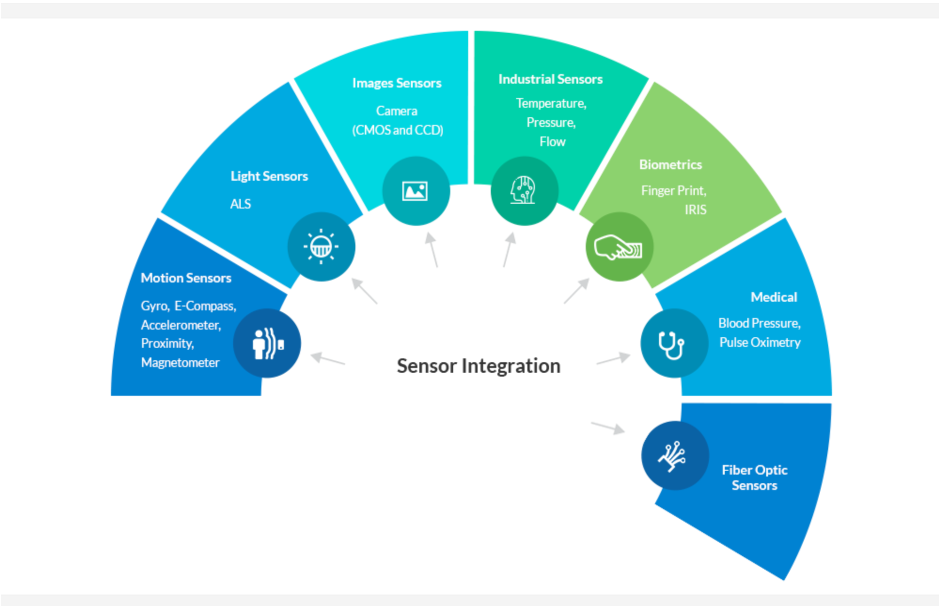

Fig 4.2:Sensor Integration

1. Object Detection Sensors:

- Detect obstacles underwater and on the surface for collision avoidance.
- Capture real-time images for visual identification of trash or hazards.
- Measures distances and maps the environment for navigation.

2. Water Quality Sensors:

- Monitors parameters like pH, turbidity, or dissolved oxygen to assess environmental health.

3. GPS Module:

- Provides location tracking and enables precise navigation.

4. Trash Detection Sensors:

- Uses image processing (via cameras) or infrared sensors to identify floating debris.

5. Energy Sensors:

- Tracks battery levels or solar panel efficiency for power management.

4.4 Wireless Communication

Wireless communication in a floating trash collector involves robust protocols such as Wi-Fi for transmitting large data like video feeds, Bluetooth for short-range tasks, and RF modules for long-range connectivity in remote areas. Cellular networks like 4G or 5G may complement these for enhanced coverage. Real-time data transmission supports navigation, sensor readings, and video streams while enabling remote adjustments to operations. Alerts for critical issues like system malfunctions or low battery ensure prompt intervention. Cloud integration facilitates data storage, analysis, and collaboration between units, while encryption and authentication protocols secure communication against unauthorized access. Fail-safes, such as fallback RF systems and predefined safe zones, enhance reliability in case of network disruptions. These features collectively ensure efficient, secure, and autonomous operation of the trash collector.

4.4 Power Management

Power management in a floating trash collector ensures optimal energy use for uninterrupted performance. The system starts with efficient energy source management, where solar power systems regulate panel efficiency and battery-powered systems track levels to prevent over-discharge. Hybrid systems intelligently switch between power sources based on availability. Load balancing distributes power effectively among components like motors, sensors, and communication systems, prioritizing critical tasks during low power. Smart charging algorithms extend battery life by optimizing storage and charging cycles. Real-time monitoring tracks energy consumption and alerts operators to issues like abnormal power usage or low battery. Energy-saving modes activate during idle periods to conserve power, while safety mechanisms, including overcurrent protection and return-to-dock functions, ensure reliability and prevent hazards. These integrated features allow for seamless, energy-efficient operation tailored to environmental and functional needs.

Hybrid setups smartly switch between solar and battery energy, maintaining seamless operation. Load balancing distributes power effectively among navigation, sensors, and communication, prioritizing critical tasks during energy shortages. Smart algorithms predict energy requirements and enable energy-saving modes during idle periods, reducing wastage. Real-time monitoring tracks power consumption and notifies operators of low battery or unusual usage patterns. Additionally, safety mechanisms, such as overcurrent protection, thermal management, and an automatic return-to-dock function, ensure secure and continuous operation. These features collectively ensure a balance between performance and energy conservation.

4.5 Data Analysis

Fig 4.3: Data analysis

Data analysis in a floating trash collector optimizes operations and environmental impact assessment. It starts with analyzing trash collection metrics to understand pollution hotspots and seasonal patterns. Environmental monitoring uses water quality data, like pH and turbidity, to assess ecosystem health and guide conservation. Navigation and operational insights optimize routes based on GPS data and obstructions, ensuring efficient movement. System performance data highlights wear and tear for predictive maintenance, reducing downtime. Energy efficiency analysis evaluates power usage, optimizing energy distribution and conservation. Historical data drives predictive models for trash patterns and mechanical reliability, supporting proactive decisions. Collaboration occurs via shared reports and visualizations with stakeholders to raise awareness and foster partnerships for effective cleanup and sustainability.

Data analysis in a floating trash collector optimizes operations and environmental impact assessment. It starts with analyzing trash collection metrics to understand pollution hotspots and seasonal patterns. Environmental monitoring uses water quality data, like pH and turbidity, to assess ecosystem health and guide conservation. Navigation and operational insights optimize routes based on GPS data and obstructions, ensuring efficient movement. System performance data highlights wear and tear for predictive maintenance, reducing downtime. Energy efficiency analysis evaluates power usage, optimizing energy distribution and conservation. Historical data drives predictive models for trash patterns and mechanical reliability, supporting proactive decisions. Collaboration occurs via shared reports and visualizations with stakeholders to raise awareness and foster partnerships for effective cleanup and sustainability.

4.6 Autonomous Navigation

Autonomous navigation in a floating trash collector is a sophisticated system that integrates advanced technologies to enable efficient and independent operation in challenging aquatic environments. It begins with path planning algorithms, such as A* or Dijkstra, which calculate the most efficient routes, dynamically adjusting to real-time changes in the surroundings to ensure maximum area coverage. Obstacle avoidance plays a critical role, utilizing data from cameras, LIDAR, and ultrasonic sensors to detect and navigate around obstacles. Machine learning enhances this by distinguishing trash from non-trash objects, ensuring smarter navigation. SLAM (Simultaneous Localization and Mapping) is employed to construct and update real-time maps of the environment, making the system adaptable to new obstacles and features.

Additionally, environmental sensors provide data on water currents, enabling the navigation system to predict and adjust to changes, maintaining stability and precise movement even in turbulent waters. GPS integration and historical data analytics optimize routes, focusing on trash-heavy zones to minimize redundant paths, ensuring both energy efficiency and task effectiveness. The navigation system also incorporates fail-safes, such as returning to designated safe zones or docking in emergencies like adverse weather or critical system malfunctions. These features, combined with predictive algorithms and robust sensor integration, enable the trash collector to operate autonomously, safely, and effectively, making it a powerful tool for sustainable waste management in aquatic ecosystems.

4.7 Trash Sorting And Classification

Trash sorting and classification in a floating trash collector is a complex, highly efficient system designed to enhance waste management and recycling. The process begins with image recognition, where high-resolution cameras capture images of the collected trash. Machine learning algorithms analyze these images to identify and classify waste, such as plastics, metals, organic matter, and glass. Material detection sensors, like infrared or near-infrared sensors, further enhance classification by distinguishing materials based on their physical and chemical properties, while metal detectors identify metallic items quickly. Sorting mechanisms, including automated systems such as conveyor belts with robotic arms or air jets, segregate trash into specific compartments based on classification, ensuring streamlined operations.

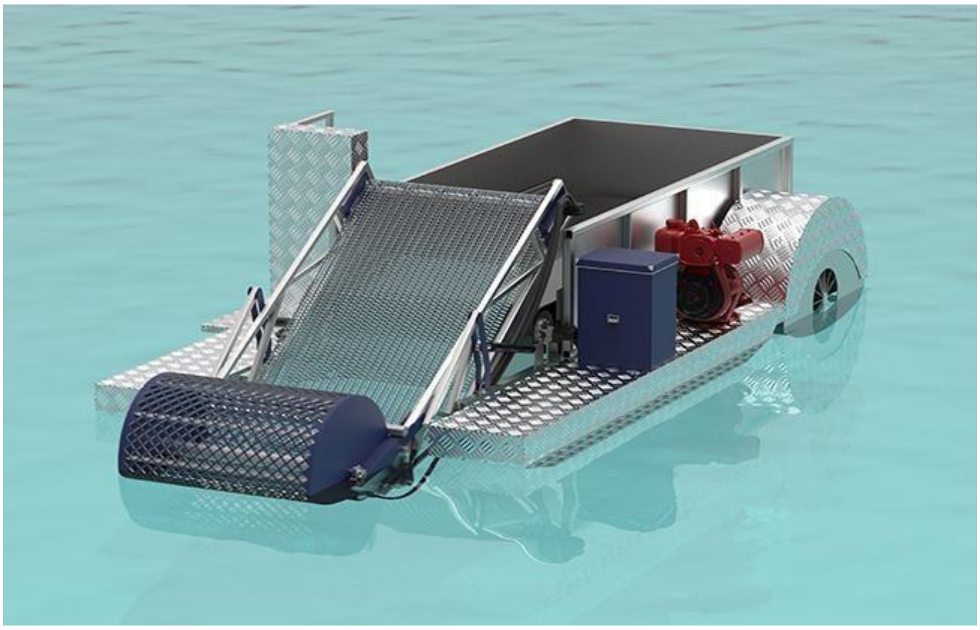

Fig 4.4: Trash sorting and classification

Real-time analysis allows the system to adapt to varying types of waste, improving sorting efficiency through continuous learning algorithms. The system also records and reports data on the quantity and type of trash collected, providing valuable insights for environmental studies and waste management strategies. These reports help track pollution trends and recycling contributions. Additionally, sorted trash is compacted and stored in designated compartments, maximizing storage capacity and facilitating easier disposal or recycling. By incorporating advanced technologies like machine learning, material detection, and automated sorting, trash sorting and classification systems in floating trash collectors ensure a high level of operational efficiency while contributing to environmental sustainability.

CHAPTER 5

WORKING MODEL AND ITS COMPONENETS

5.1 Working of The Device

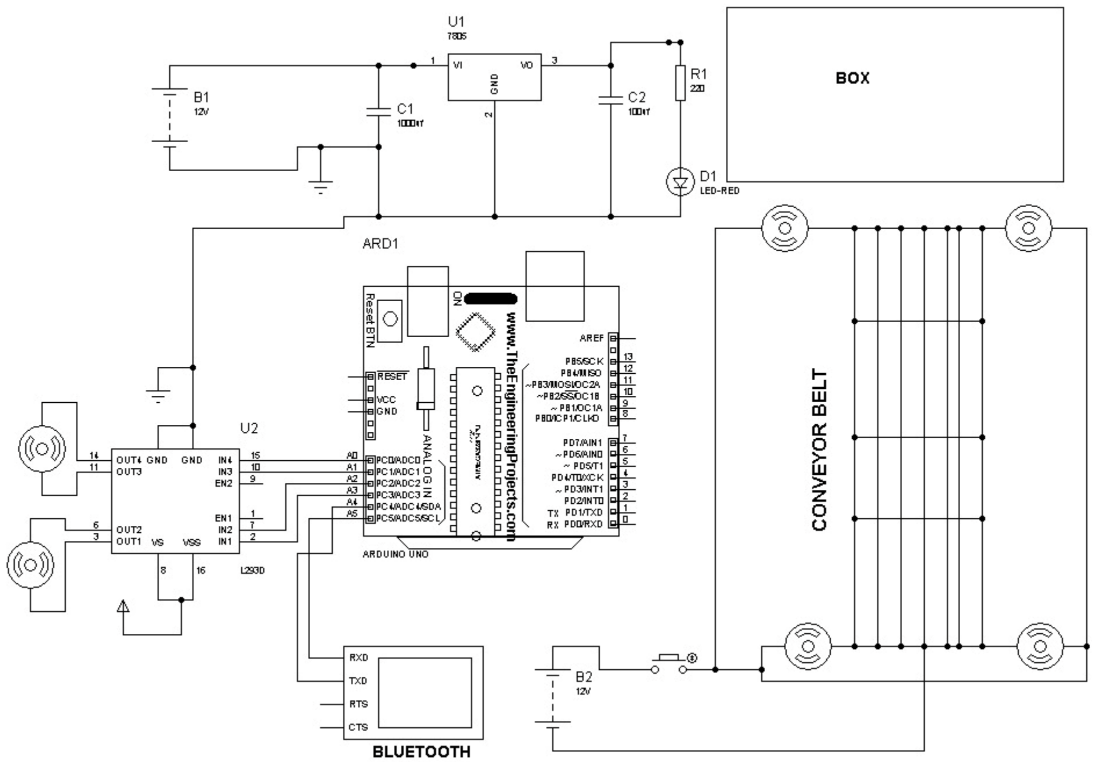

Fig 5.1 : Block diagram of floating thrash collector

The floating trash collector operates as an autonomous or semi-autonomous system designed to remove debris from water bodies efficiently. Its working begins with the floating platform, which provides buoyancy and stability, ensuring the system remains afloat even under varying loads. The platform supports all components, including the propulsion system, trash collection mechanism, sensors, and storage compartments. The propulsion system, powered by motors or paddles, enables movement across the water surface. It is often driven by renewable energy sources like solar panels, making the system eco-friendly. Navigation is guided by GPS modules and gyroscopes, which ensure precise route planning and obstacle avoidance.

The trash collection mechanism is the core of the system, featuring conveyor belts, nets, or scooping arms that gather floating debris. Advanced systems integrate machine learning algorithms to differentiate between trash and natural elements, ensuring efficient collection. The collected waste is stored in onboard compartments, which are designed for compact storage to maximize capacity. Sensors, including cameras, ultrasonic devices, and water quality monitors, play a crucial role in detecting trash, obstacles, and environmental conditions. These sensors provide real-time data to the control system, enabling adaptive decision-making.

The control system, typically powered by microcontrollers like Arduino or Raspberry Pi, manages all operations, including navigation, trash collection, and communication. It processes data from sensors and executes commands to optimize performance. The system also incorporates safety features such as emergency stop mechanisms, buoyancy aids, and protective enclosures to ensure reliable operation in diverse conditions. In emergencies, such as adverse weather or critical power levels, the system can automatically return to a docking station.

Overall, the floating trash collector combines advanced technologies, sustainable energy sources, and robust design to clean water bodies effectively while minimizing environmental impact. It serves as a vital tool for maintaining aquatic ecosystems and promoting environmental conservation.

The floating trash collector offers numerous advantages that contribute to environmental conservation, operational efficiency, and technological innovation.

Environmental Impact:

- Reduction in Water Pollution: Efficiently removes floating debris from water bodies, improving water quality and preserving aquatic ecosystems.
- Waste Management: Helps collect and segregate trash for proper disposal or recycling, reducing environmental contamination.
- Support for Biodiversity: Prevents harm to aquatic life caused by ingesting or entangling in debris.

Operational Efficiency:

- Automation: Advanced sensors and navigation systems enable autonomous operation, minimizing human intervention and maximizing efficiency.
- Precision: Machine learning and imaging technologies ensure accurate detection and collection of debris, reducing unnecessary efforts.

- Adaptability: Dynamic navigation and obstacle avoidance make it effective in varied environments, from calm ponds to flowing rivers.

Technological Advancements:

- Integration of Renewable Energy: Solar panels and energy-efficient components promote sustainability by reducing dependency on non-renewable power sources.
- Smart Systems: Use of IoT, GPS, and real-time monitoring provides valuable data for environmental studies and operational improvements.
- Modular Design: Allows customization and scalability for different use cases, whether community cleanups or industrial applications.

Cost-Effectiveness:

- Reduced Labor Costs: Automation eliminates the need for constant manual operation, saving manpower and associated expenses.
- Reusable Materials: Durable components and renewable energy sources ensure long-term, economical use.

Community and Awareness:

- Public Engagement: Promotes awareness about water pollution and environmental conservation, encouraging active participation in cleanup efforts.
- Educational Opportunities: Provides a practical platform for research and education in robotics, IoT, and sustainability.

Overall, the floating trash collector combines innovative technology with environmental stewardship, offering a practical solution to water pollution while fostering community engagement and technological growth.

While floating trash collectors offer numerous advantages, they are not without challenges or limitations. Here's an in-depth look at their disadvantages:
High Initial Cost:

- Designing, manufacturing, and implementing advanced systems with features like GPS navigation, machine learning algorithms, and durable materials can be expensive.

Maintenance Requirements:

- Regular maintenance is necessary to ensure components like sensors, motors, and trash collection mechanisms function properly. Wear and tear in aquatic environments can increase operational costs.

Limited Coverage:

- Depending on the size and mobility of the collector, it may only clean a small area. Multiple units may be required for larger water bodies, increasing costs.

Power Dependency:

- Although solar panels and energy-efficient components are often used, the system still relies on stable power sources. Insufficient energy storage can disrupt operations during low sunlight or high-demand periods.

Environmental Challenges:

- Floating trash collectors may struggle in rough or turbulent waters due to instability or difficulty in navigating waves and currents.
- Certain debris, such as submerged or very lightweight materials, may evade collection mechanisms.

Technological Limitations:

- Machine learning models might sometimes misclassify objects, leading to inefficiencies in sorting trash.
- The integration of cameras and sensors in murky or low-visibility water conditions may reduce accuracy.

Infrastructure Needs:

- Docking stations and proper disposal facilities are required for handling collected waste, adding to logistics and operational complexity.

Limited Focus:

- Floating trash collectors only address surface-level pollution, leaving submerged debris or chemical pollutants untreated.

Potential Ecological Disruption:

- While designed to help aquatic ecosystems, incorrect or aggressive trash collection mechanisms might inadvertently disturb or harm natural habitats or aquatic species.

Scalability Issues:

- Scaling the system for widespread use across various types of water bodies requires considerable resources, planning, and customization.

While these limitations can pose challenges, they can often be mitigated through thoughtful design, regular maintenance, and technological improvements.

Yesterday

Floating trash collectors are innovative devices designed to remove waste from water bodies, helping to maintain cleanliness and protect aquatic ecosystems. These systems often use vortex mechanisms, pumps, or automated bins to gather floating debris efficiently.

One approach involves a floating garbage collection system that utilizes a free vortex concept. Researchers have studied various parameters such as pump characteristics, vessel height, and immersion depth to optimize the system's efficiency. By adjusting these factors, they aim to achieve the best possible flow for collecting waste. Another method employs IoT-based automated floating waste collectors, like the Seabin mechanism, which uses a submersible water pump to draw in water and filter out floating debris. This system can notify operators when the bin is nearly full, ensuring timely waste disposal.

Additionally, some designs focus on fabrication and cost-effectiveness, aiming to reduce government expenses on water body cleanup. These collectors often integrate conveyor mechanisms or pedal-powered boats to remove waste while minimizing manual labor

Floating trash collectors are designed to tackle water pollution by removing debris from lakes, rivers, and oceans. These systems vary in complexity, from simple manually operated devices to advanced automated solutions.

One innovative approach is the free vortex floating garbage collection system, which optimizes waste removal by studying parameters like pump characteristics, vessel height, and immersion depth. Researchers analyze vortex profiles to determine the most efficient flow for collecting debris. The system's effectiveness is enhanced by adjusting the immersion depth and flow rate, ensuring maximum waste capture.

Another method involves portable trash collector boats, which are designed for small streams and drainage systems. These boats automate the collection process, reducing manual labor and health risks associated with water pollution. The boats are engineered to handle specific trash loads, ensuring efficient waste removal.

For larger-scale applications, river water trash collectors are developed to address widespread pollution. These systems use suction mechanisms powered by eco-friendly flow generators to remove floating debris. The collected waste is stored in a catch bag, while clean water is released back into the river. Each unit can capture significant amounts of marine litter daily, contributing to cleaner water bodies.

One widely used design is the submersible pump-based collector, which functions by drawing water along with floating debris into a filtration chamber. The system separates pollutants like plastic waste, organic matter, and oils before releasing clean water back into the surroundings. Some advanced versions integrate sensors to detect waste concentration and adjust the suction power dynamically, optimizing efficiency.

Another innovative approach involves conveyor-driven floating trash collectors, where rotating belts or paddles scoop up debris from the water's surface. As the waste moves along the conveyor system, it is funneled into storage containers for easy removal or recycling. This method is particularly effective for polluted rivers and lakes, where large amounts of floating trash accumulate. Some models employ AI-driven tracking systems to monitor waste movement and adjust collection pathways accordingly.

For broader applications, floating barrier-assisted collection systems are implemented to guide debris toward central collection points. These barriers prevent waste dispersion, making collection more systematic. Solar-powered conveyor belts lift the captured trash into designated bins, reducing reliance on external power sources. These barriers are often deployed in coastal areas and river mouths where trash accumulation is substantial.

Emerging technologies like autonomous robotic trash collectors take waste removal further with AI-powered sensors and navigation capabilities. These robotic units scan the water surface for debris and use mechanical arms to collect and store trash. Once full, they return to a designated disposal hub, minimizing human intervention. Some prototypes even incorporate real-time monitoring through IoT systems, enabling remote operation and efficiency tracking.

One of the most commonly used systems is the vortex-driven trash collector, which uses controlled water flow to guide debris into a collection chamber. This approach leverages hydrodynamic principles to funnel floating waste into designated storage bins, preventing dispersion. Such systems are widely deployed in urban canals and lakes, where debris accumulation is frequent.

Another advanced technology includes sensor-equipped floating waste collectors. These devices utilize real-time monitoring through IoT sensors that detect the density and movement of trash within a water body. When waste levels reach a predefined threshold, the sensors trigger automatic suction or conveyor mechanisms to begin collection. This ensures efficient waste removal without constant human supervision.

For large-scale applications, river-cleaning floating barriers function by directing waste toward centralized collection zones. These barriers are strategically placed to intercept plastic waste before it drifts into the ocean. Some solar-powered models employ automated conveyor belts to lift trash from the water and deposit it into storage units, reducing reliance on external power sources.

Additionally, autonomous robotic trash collectors are gaining popularity. These AI-driven systems navigate independently using GPS tracking and image recognition to locate and collect floating waste. The robots analyze the type of debris detected, categorizing it for appropriate disposal or recycling. When their storage capacity is reached, they return to collection hubs for unloading.

CHAPTER 6

RESULT

A floating trash collector symbolizes a vital step toward achieving sustainable water management and environmental protection in a rapidly industrializing and urbanizing world. By harnessing cutting-edge technologies like autonomous navigation, real-time sensors, and machine learning, these systems offer a highly efficient solution for removing floating debris and minimizing water pollution. Their ability to segregate trash and collect data for analysis ensures not only immediate waste removal but also long-term insights into pollution trends and waste management practices.

The incorporation of renewable energy sources, such as solar panels, enhances the eco-friendliness of these collectors, aligning them with global efforts to reduce carbon footprints. Additionally, features like compact storage mechanisms, adaptive navigation systems, and safety protocols make them operationally reliable across diverse water environments, from calm lakes to bustling harbors.

However, the importance of floating trash collectors transcends their functional attributes. They serve as a symbol of humanity's commitment to preserving aquatic ecosystems and fostering biodiversity. While challenges like maintenance costs, technological limitations, and scalability need to be addressed, ongoing advancements in engineering and design pave the way for making these systems more accessible and effective.

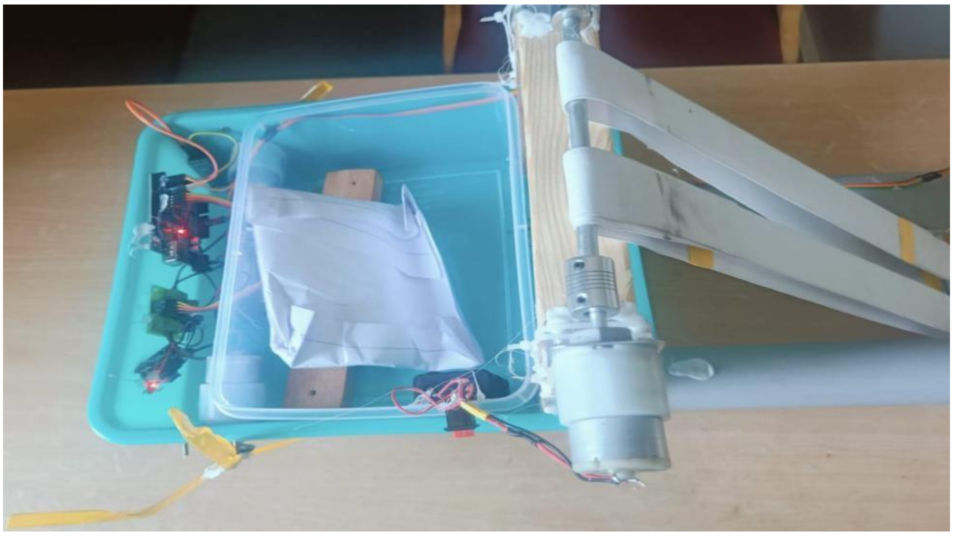

Fig 6.1 : Floating thrash collector

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Their deployment not only contributes to cleaner waterways but also raises societal awareness about environmental stewardship, inspiring collective action toward combating water pollution. As the world increasingly prioritizes sustainability, floating trash collectors emerge as powerful tools in the global effort to maintain cleaner, healthier, and more vibrant aquatic ecosystems for generations to come.

One of the key outcomes is the reduction of plastic pollution in rivers, lakes, and oceans. Floating trash collectors effectively capture plastic waste before it disperses further into marine ecosystems, preventing harm to aquatic life. Research studies indicate that systems such as Seabin and autonomous robotic collectors can remove thousands of kilograms of waste annually, contributing to waterway conservation.

Another major result is the enhanced efficiency of waste management in urban and industrial water systems. By automating the collection process, these devices minimize human labor while improving the accuracy of waste removal. IoT-integrated models continuously monitor pollution levels, ensuring timely waste disposal without requiring constant manual oversight.

From an economic perspective, floating trash collectors have reduced cleanup costs for municipalities and environmental agencies. Traditional manual cleanup methods require extensive manpower and resources, but automated floating systems significantly lower operational expenses. Additionally, some advanced models facilitate waste sorting and recycling, creating economic opportunities by repurposing collected debris.

Overall, the integration of floating trash collectors has led to cleaner water bodies, increased efficiency, and cost-effective waste management strategies. These advancements support sustainability efforts while addressing the global issue of water pollution.

6.2 Advantages

The floating trash collector offers significant advantages that address water pollution while contributing to environmental sustainability and technological progress. Here's a detailed exploration of its benefits:

1. Environmental Conservation:

- The system effectively removes floating debris from water bodies, improving water quality and preserving aquatic ecosystems. By reducing plastic and other pollutants, it prevents harm to marine and freshwater biodiversity, safeguarding species and their habitats.

- It supports waste segregation and proper disposal practices, minimizing contamination and enabling recycling, which helps to reduce the overall environmental footprint.

2. Operational Efficiency:

- Equipped with advanced sensors and automation technologies, the trash collector can efficiently detect and collect debris with minimal human intervention. This precision ensures focused cleaning without disturbing natural elements like aquatic plants.

- Its ability to operate autonomously in remote or hard-to-reach areas makes it ideal for cleaning water bodies that are otherwise inaccessible.

3. Sustainable Energy Use:

- The integration of renewable energy sources, such as solar panels, allows the system to operate sustainably and minimizes dependence on non-renewable resources. This makes it environmentally friendly and cost-effective in the long run.
- Energy-efficient components and intelligent power management systems further reduce operational costs.

4. Adaptability and Versatility:

- Floating trash collectors can be customized for diverse water environments, including lakes, rivers, harbors, and oceans. They can be scaled to meet the needs of different locations, whether for community cleanups or large-scale industrial use.
- They are designed to function effectively in various conditions, including calm waters, flowing rivers, and even moderately turbulent seas.

5. Data Collection and Monitoring:

- By integrating IoT and water quality sensors, these collectors can gather valuable environmental data, providing insights into pollution levels and trends. This data aids in research and policymaking, driving better conservation efforts and strategies.
- The real-time monitoring capabilities enhance their functionality, enabling quick decision-making and adaptive operations.

6. Cost-Effectiveness:

- Automation reduces labor costs associated with manual trash collection. Additionally, the durability of materials and components ensures the system's longevity, making it an economically viable solution over time.
- Renewable energy integration also contributes to reducing power-related expenses.

7. Raising Public Awareness:

- The deployment of such systems raises awareness about water pollution and the importance of environmental stewardship. It inspires communities, governments, and organizations to take proactive measures toward conservation.

- It serves as a visible commitment to sustainability, promoting education and engagement in addressing environmental challenges.

8. Contribution to Global Goals:

- Floating trash collectors align with global efforts like the United Nations Sustainable Development Goals, particularly those targeting clean water and sustainable ecosystems. Their adoption underscores a commitment to maintaining healthy aquatic environments and reducing pollution.

Overall, the floating trash collector exemplifies the fusion of innovation, environmental care, and practicality. Its advantages extend beyond cleaning water bodies; it fosters awareness, supports sustainability, and contributes to a cleaner planet for future generations.

A floating trash collector offers numerous advantages in addressing water pollution, environmental conservation, and efficient waste management. One of its primary benefits is its ability to continuously remove floating debris from lakes, rivers, and coastal waters, thereby improving water quality and reducing the harmful effects of waste accumulation on aquatic life. By preventing plastic and other pollutants from degrading in water bodies, these systems contribute to the protection of ecosystems and biodiversity. Additionally, floating trash collectors are designed for autonomous or semi-autonomous operation, utilizing advanced technologies such as sensors, AI-based detection, and GPS navigation to enhance efficiency. Their ability to function with minimal human intervention makes them a cost-effective solution for large-scale waste collection efforts.

Another key advantage is their integration with renewable energy sources like solar panels, which enables sustainable operation with reduced carbon footprint. This makes floating trash collectors an eco-friendly alternative to traditional waste removal methods, lowering dependency on fossil fuels. Furthermore, these systems can be equipped with IoT connectivity, allowing for remote monitoring, data collection, and optimization based on pollution patterns. This collected data plays a crucial role in environmental policymaking and scientific research, aiding authorities in developing better waste management strategies.

Beyond technological benefits, floating trash collectors contribute to public awareness and community engagement. Their deployment encourages local participation in conservation efforts and fosters a sense of responsibility toward maintaining clean waterways. By serving as a visible solution to water pollution, these systems inspire further innovations and regulatory support in environmental protection initiatives. The modular design of floating trash collectors ensures adaptability across different environments, whether in urban canals, rural water bodies, or industrial wastewater zones. Their customizable features allow them to address specific pollution challenges effectively, making them versatile tools in environmental cleanup efforts.

Ultimately, floating trash collectors not only address immediate waste collection needs but also establish a long-term framework for sustainability, research, and technological advancement in water conservation. Their ability to operate autonomously, minimize human involvement, and integrate with renewable energy sources underscores their importance as modern solutions for tackling the global issue of water pollution.
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6.3 Applications

Floating trash collectors play a crucial role in improving water quality and reducing pollution across various environments. Their applications span multiple sectors, each aiming to mitigate waste accumulation and promote sustainability.

1. Urban Waterways Cleanup – Many cities deploy floating trash collectors in canals, lakes, and reservoirs to remove plastic waste, organic debris, and pollutants. These systems help prevent waterborne diseases, enhance the aesthetics of public spaces, and improve the functionality of drainage systems.
2. Marine Conservation – Ocean-based floating trash collectors contribute to the removal of plastic pollution and oil spills that threaten marine ecosystems. In coastal areas, these devices are placed strategically to capture waste before it drifts further into the ocean, protecting aquatic life.
3. Industrial Waste Management – Industries located near water bodies often use automated trash collection systems to manage waste generated from factories. These systems ensure compliance with environmental regulations by filtering pollutants and preventing industrial runoff from contaminating natural water sources.
4. River Protection Initiatives – Many environmental organizations and governments use floating trash collectors as part of river-cleaning projects. These devices prevent excessive accumulation of plastic waste and help restore the natural health of rivers,

reducing the impact on surrounding communities.

5. Tourism and Recreational Areas – Floating trash collectors are deployed in lakes, beaches, and resorts where water pollution affects tourism and local economies. Keeping these areas clean enhances visitor experience and helps preserve biodiversity.
6. Sustainable Waste Processing – Some advanced floating trash collectors integrate recycling mechanisms, sorting waste into biodegradable and non-biodegradable categories. This approach supports circular economy initiatives by repurposing collected materials for new uses.

These applications showcase how floating trash collectors are vital for environmental protection, efficient waste management, and sustainable development.

CHAPTER 7
CONCLUSION AND FUTURESCOPE

7.1 Conclusion

Floating trash collectors play a crucial role in maintaining the cleanliness of water bodies by effectively capturing and removing floating debris. Their implementation has significantly reduced water pollution, particularly plastic waste, contributing to healthier aquatic ecosystems. By integrating advanced technologies such as AI-driven detection, IoT monitoring, and solar-powered operations, these systems have improved efficiency, minimized manual labor, and lowered operational costs.

Additionally, floating trash collectors support broader environmental conservation efforts by preventing pollutants from entering oceans and disrupting marine life. They are widely applied in urban waterways, industrial sites, rivers, and coastal areas, addressing pollution challenges across multiple sectors. With ongoing advancements in automation and sustainability, these devices continue to evolve, offering even more effective solutions for water management and waste reduction.

Overall, floating trash collectors represent an innovative and practical approach to combating water pollution while promoting ecological restoration. Their role in improving global environmental health makes them a valuable asset in achieving cleaner and more sustainable water bodies.

7.1 Future scope

The future of floating trash collectors is poised for significant advancements, driven by technological innovations and increasing environmental concerns. These systems are expected to evolve with enhanced automation, sustainability, and efficiency to tackle water pollution more effectively.

One promising development is the integration of solar-powered floating waste collectors, which utilize renewable energy to operate autonomously. These systems are designed to function continuously without human intervention, reducing operational costs and environmental impact. Some models incorporate photovoltaic-powered conveyor belts that

and oceans.

Another emerging trend is the use of autonomous surface vehicles (ASVs) equipped with AI-driven navigation and real-time monitoring capabilities. These robotic systems can track waste accumulation, optimize collection routes, and adapt to changing environmental conditions. Researchers are developing GPS path-tracking algorithms to enhance the precision of ASVs, ensuring robust performance even in challenging weather conditions.

Additionally, smart floating trash collectors are being designed with IoT-enabled sensors that detect pollution levels and adjust collection mechanisms accordingly. These systems can communicate with monitoring stations, providing real-time data on water quality and waste accumulation. This approach allows for proactive waste management and efficient resource allocation.

The future also holds potential for biodegradable filtration platforms, which combine waste collection with ecological restoration. These floating structures incorporate microbial filters that break down organic pollutants while capturing plastic debris. Some experimental designs include bacteria-infused filters that help cleanse water naturally, contributing to long-term environmental sustainability.

Overall, floating trash collectors are expected to become more autonomous, energy-efficient, and environmentally friendly. With continued research and technological advancements, these systems will play a crucial role in combating water pollution and preserving aquatic ecosystems.

One promising advancement is the development of solar-powered floating waste collectors, which harness renewable energy to operate autonomously. These systems use photovoltaic-powered conveyor belts to propel waste into collection bins, ensuring continuous operation without human intervention. This approach significantly reduces reliance on external energy sources while maintaining efficiency.

Another emerging trend is the integration of autonomous surface vehicles (ASVs) equipped with AI-driven navigation and real-time monitoring capabilities. These robotic systems optimize collection routes and adapt to changing environmental conditions using GPS path-tracking algorithms. This ensures robust performance even in challenging weather conditions, making them ideal for large-scale water cleanup operations.

Additionally, smart floating trash collectors are being designed with IoT-enabled sensors that detect pollution levels and adjust collection mechanisms accordingly. These systems provide real-time data on water quality and waste accumulation, allowing for proactive waste management. Some models even incorporate automated sorting mechanisms to separate biodegradable and non-biodegradable waste, improving recycling efficiency.

The future also holds potential for biodegradable filtration platforms, which combine waste collection with ecological restoration. These floating structures incorporate microbial filters that break down organic pollutants while capturing plastic debris. Some experimental designs include bacteria-infused filters that help cleanse water naturally, contributing to long-term environmental sustainability.

With continued research and technological advancements, floating trash collectors are expected to become more autonomous, energy-efficient, and environmentally friendly. These innovations will play a crucial role in combating water pollution and preserving aquatic ecosystems.

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APPENDIX

```
#include <SoftwareSerial.h>

String inputString = "";    // a String to hold incoming data bool

stringComplete = false;  // whether the string is complete const

int m11 = 9;

const int m12 = 8;

const int m21 = 10;

const int m22 = 11;

const int bz = A0;

#define trigPin1 2

#define echoPin1 3

long duration, distance, ULSensor;

SoftwareSerial bluetooth(6,7);

String Readcmd;

void setup()

{

  Serial.begin(9600);

  bluetooth.begin(9600);

  inputString.reserve(200);

  Serial.println("WELCOME TO BLUETOOTH CONTROL ROBO");

  bluetooth.println("WELCOME TO BLUETOOTH CONTROL ROBO");

  pinMode(trigPin1, OUTPUT);

  pinMode(echoPin1, INPUT);

  pinMode(bz,OUTPUT);

  pinMode(m11, OUTPUT);

  pinMode(m12, OUTPUT);
```

```
  pinMode(m21, OUTPUT);
  pinMode(m22, OUTPUT);
  digitalWrite(bz,LOW);
  digitalWrite(m11, HIGH);
  digitalWrite(m12, LOW);
  digitalWrite(m21, HIGH);
  digitalWrite(m22, LOW);
  delay(2000);
  }
void loop()
{
  UltrasonicSensor(trigPin1, echoPin1);
  ULSensor = distance;
  if(ULSensor < 20)
  {
    Serial.println("DISTANCE IS LESSTHAN THRESHOLD VLUE ROBO
STOP");
    bluetooth.println("DISTANCE IS LESSTHAN THRESHOLD VLUE ROBO
STOP");
    digitalWrite(m11,LOW);
    digitalWrite(m12,LOW);
    digitalWrite(m21,LOW);
    digitalWrite(m22,LOW);
    digitalWrite(bz,HIGH);
    delay(500);
  }
  else
```

```
  {
   digitalWrite(bz,LOW);
  }
  delay(800);
 Serial.print("DISTANCE = ");
 Serial.println(ULSensor);
 bluetooth.print("DISTANCE = ");
 bluetooth.println(ULSensor);
 serial_check();
}
void serial_check()
{
  while (bluetooth.available()>0) {
   char x = bluetooth.read();
   if(x == 'w' || x == '1')
    walk();
    if(x == 'b' || x == '2')
    back();
    if(x == 'l' || x == '3')
    left();
    if(x == 'r' || x == '4')
    right();
    if(x == 's' || x == '5')
    stop();
  }
  }
```

```
void back()
{
  digitalWrite(m11,LOW);
  digitalWrite(m12,HIGH);
  digitalWrite(m21,LOW);
  digitalWrite(m22,HIGH);
  Serial.println("MOVING BACK");
  bluetooth.println("MOVING BACK");
}
void walk()
{
  Serial.println("MOVING FORWARD");
  bluetooth.println("MOVING FORWARD");
  digitalWrite(m11,HIGH);
  digitalWrite(m12,LOW);
  digitalWrite(m21,HIGH);
  digitalWrite(m22,LOW);
}
void left()
{
    Serial.println("MOVING LEFT");
    bluetooth.println("MOVING LEFT");
    digitalWrite(m11,LOW);
    digitalWrite(m12,HIGH);
    digitalWrite(m21,HIGH);
    digitalWrite(m22,LOW);
```

```
}
void right()
{
   Serial.println("MOVING RIGHT");
   bluetooth.println("MOVING RIGHT");
   digitalWrite(m11,HIGH);
   digitalWrite(m12,LOW);
   digitalWrite(m21,LOW);
   digitalWrite(m22,HIGH);
}
void stop()
{
   Serial.println("STOP");
   bluetooth.println("STOP");
   digitalWrite(m11,LOW);
   digitalWrite(m12,LOW);
   digitalWrite(m21,LOW);
   digitalWrite(m22,LOW);
}
void UltrasonicSensor(int trigPin, int echoPin)
{
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
```

```
duration = pulseIn(echoPin, HIGH);

distance = (duration / 2) / 29.1;

}
```

Appendix-1 : Gather components

Before beginning the project, ensure you have all necessary components:

- Floating Platform
- Infrared (IR) Sensors
- ESP32 CAM and Computer vision
- Power supply
- Conveyer belt
- L298N drive controller
- Arduino UNO
- Motor drive modules

Appendix-2 : Circuit design and wiring:

- Battery – Provides energy to the system
- Voltage regulators – Ensures stable voltage for microcontrollers and sensors
- Arduino UNO – Acts as the brain, controls motors, sensors and communication
- Motor driver – Controls propulsion and conveyor belt motors
- GPS Module – Enables autonomous navigation
- WIFI module – Enables remote monitoring

Appendix-3 : Sensors and cameras identify floating debris and guide the collector.

Appendix-4 : The system directs waste into a storage unit using pumps or conveyor belts.

Appendix-5 : Testing the system

Appendix-6 : Final testing and Optimization in mobile app

Appendix-7 : Monitor and Maintain