AUTOMATIC RIVER CLEANER

B.Tech Project Stage-I/ II

Submitted to the Faculty of Engineering and Technology of

MGM University Ch. Sambhajinagar 431003

In partial fulfilment of the requirement for the award of the degree of

Bachelor of Technology

In

Electronics and Computer Engineering

By

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May 2024

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CERTIFICATE

This is to certify that the Project Stage- I report entitled **" Automatic River Cleaner "** has been submitted by **Miss. Kunika Satish Auti, Miss. Rimsha Fatema Mohammed Alhajuddin, Miss. Gauri Satish Jadhav** with PRN No. **(202101104009) , (202101104017) , (202101104035)** in partial fulfilment for the award of the degree of Bachelor of Technology in **Electronics and Computer Engineering** from Jawaharlal Nehru Engineering College, MGM University, Chh. Sambhajinagar .

The matter embodied in this project report is a record of his/her own independent work carried out by him/her under my supervision and guidance. The matter embodied in this report has not been submitted to any other University or Institute for the award of any degree or diploma.

Guide	**H.O.D**	**Dean**
Prof. A.V. Khake Sir Associate Professor ETC Dept	Dr.S.N.Pawar Professor &Head ETC Dept	Dr. H.H.Shinde (Engg. & Tech.) MGMU

Project Approval Certificate

Practical oral examination for above project work is conducted on _____ and the work is approved for the award of Bachelor of Technology in Electronics and Computer Engineering.

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I certify that

The work contained in the project report is original and has been done by myself under the supervision of my guide.

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

Whenever I have used materials (data, theoretical analysis, and text) from other sources, I have given due credit to them by citing them in the text of the project report and giving their details in the references.

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ABSTRACT

This project presents an automatic river cleaning system designed to efficiently remove floating debris from water surfaces, reducing the need for labour-intensive and hazardous manual cleaning. The system incorporates an integrated camera, allowing users to monitor the river in real-time on a screen and remotely control the cleaning mechanism.

The robust mechanical arm effectively collects debris under user command, significantly enhancing water quality and protecting aquatic life. The primary objective is to provide a reliable solution for cleaning water surface debris efficiently. Detailed design considerations, including the selection of durable materials and energy-efficient components, are discussed.

Initial evaluations demonstrate notable improvements in water cleanliness. Future developments will focus on incorporating machine learning algorithms to enable the autonomous detection and removal of floating debris, further increasing system efficiency and adaptability. This project offers a sustainable approach to preserving aquatic ecosystems and promoting environmental health.

Keywords: -

- Automatic river cleaning
- Floating debris removal
- Real-time monitoring
- Remote control
- Water quality enhancement
- Machine learning algorithms
- Environmental sustainability

LIST OF ABBRIVATIONS

IDE	Integrated Development Environment
AI	Artificial intelligence
ML	Machine Learning
IOT	Internet Of Thing
IC	Integrated circuits
DC	Direct current
AC	Alternating current
IP	Internet protocol
USB	Universal Serial Bus
VIN	Input Voltage
VOUT	Output Voltage
GHz	Giga herzts
DB	Decibals
Li-ion	Lithium Ion Battery
App	Application
TKIP	Temporal Key Integrity Protocol
WEP	Wired Equivalent Privacy
AES	Advanced Encryption Standard
PCC	Pair Wise Comparison Chart

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Chapter 1

INTRODUCTION

1.1 Summary

Water pollution is a significant issue, with rivers often clogged by trash and debris, harming aquatic life and human health. The automatic river cleaner offers an innovative, efficient solution, reducing water pollution with minimal manual intervention. It features a conveyor belt and side arms that collect and deposit garbage into a storage container. Powered by pollution-free lithium-ion batteries, it operates autonomously, ensuring continuous clean-up.

Equipped with a camera, users can monitor the cleaning area in real-time and control the device remotely. Future enhancements will incorporate AI and machine learning to optimize performance. This automation improves debris removal efficiency and enhances worker safety by reducing manual collection in hazardous conditions.

This innovative solution benefits various stakeholders including government, municipalities, private institutions, and individuals, addressing water pollution challenges effectively and paving the way for future advancements in environmental preservation. Overall, the automatic river cleaner provides a sustainable, effective solution for maintaining cleaner waterways

1.2 Questions asked by client and user

Table 1.1

	Questions:
	1.What are the types of solid waste you want to clean on the surface of water?
	2.Who will be the stakeholder of this machine?
	3.Where do you want to use the machine?
	4.How user friendly should the machine's interface be for operators?
	5.What should the weight of the machine be?

6.What level of autonomy or manual control is preferred for operating the machine?
7.What should be the sequence of functions to be performed?
8.How will power be supplied to the machine?
9.What technology will you use to collect solid waste?
10.What is your budget?
11.What are the long-term goals or plans for expanding or improving the river cleaning efforts?
12.What is the main goal or purpose of the automatic river cleaner?
13.How long do you expect the cleaner to operate effectively before requiring maintenance?
14.Who will be responsible for maintaining and operating the robot after deployment?

1.3 Categorization of the response into objective constraint and function

Table 1.2

Responses from clients and Users	Objective	Constraint	Function
1. Any kind of solid waste floating on the water surface.	⟵		
2. The stakeholders will be the Government, NGOs, private sector, profit and nonprofit organizations and any individual.	⟵		
3. This machine will specifically collect solid waste floating on river water, and it can also be used to collect solid waste from ponds, lakes, canals etc.	⟵		
4. Operators shouldn't need much training to use it. The controls should be in convenient places and the design should be safe. You can also add options for customization and provide support features like a help menu.		⟵	
5. Weight of the machine will be 5 kg approx.		⟵	
6. We prefer a high level of autonomy for the machine with occasional human intervention through the app when necessary.		⟵	
7. Machine will collect the solid waste using a conveyor belt and will drop it into the container.			⟵
8. Machine will get power through Li-ion batteries.			⟵

9. This machine can be operated using Wi-Fi.			•
10. Approx 15000 to 20,000 Rs.		•	
11. The long-term goals for expanding and improving river cleaning efforts include scaling up operations, advancing technology, fostering collaboration, raising awareness, strengthening regulations, and integrating cleaning efforts with broader ecosystem restoration initiatives.	•		
12. The main goal of the automatic river cleaner is to efficiently remove debris and pollutants from river surfaces, thereby improving water quality, preserving aquatic ecosystems, and enhancing the overall environmental health of rivers and surrounding areas.	•		
13. Approximately 2 months before requiring maintenance		•	
14. The organization or entity deploying the river cleaning robot is responsible for its maintenance and post-deployment operation. This could be a government agency, non-profit organization, or private company with dedicated teams or contractors trained in robotics and environmental science ensuring its ongoing effectiveness.	•		

Chapter 2

LITERATURE SURVEY

2.1 Literature Survey.

1-Unmanned Surface Vehicle for Water Wastes Collection

Author Name: -Illani Mohd Nawi, Saeed S. Ba Hashwan, Azman Ismail

Published Year: -September 2023

Abstract: In recent days widespread floods and flash floods have been caused by heavy rains in various regions of Malaysia particularly areas near the Klang Valley. It has been revealed through investigations that river flows are obstructed by overflowing garbage and solid wastes further exacerbating the flood situation. This finding is further supported by the subpar performance of the SMART tunnel due to obstructions in irrigation and drainage channels. To address this critical issue the development of an unmanned surface vehicle (USV) garbage collector operated remotely or autonomously is proposed to effectively clean Malaysian rivers. The prototype design includes four key subsystems: obstacle avoidance (SS1) coordinate detection (SS2) live-streaming video (SS3) and movement (SS4). These subsystems are crucial for efficient navigation and debris collection by the USV garbage collector. Furthermore, the prototype's operations can be monitored and controlled by incorporating Internet of Things (IoT) technology ensuring its effectiveness. This report delves into the detailed implementation and functionality of each subsystem and explores the potential positive impact of deploying the USV garbage collector.

2-Design and Construction of a Radio-Controlled Floating Waste Collector Robot

Author Name: - Md Shahnauze Ahsan,Hossen Mobarak, Kainatun Nahar Ch

Published Year: April 2021

Abstract: This research paper proposes the design and fabrication of a cost-effective floating waste cleaning robot that will lift the waste surface garbage from the water surface. This robot is containing a propeller-driven conveyor

mechanism which collects & removes the wastage garbage & plastic wastages from the water surface. The robot consists of a conveyor belt built-in with a fixed number of claws to pick up the waste material and a steel rod bound to a DC gear motor drives it. The claws transfer the collected waste into a deposit box and from there it will be displayed in the desired location utilizing a conveyor system. 2.4 GHz radio transmitter and receiver has been used to control this cleaning machine. The motor and belt-pulley drive mechanism gives a robust performance for grabbing the floating waste materials.

3-Design of a Cost-Effective Floating Waste Cleaning Robot

Author Name: - Mahedy Hasan, Sakib Asrar, Tanvirul Azim, Syeda Prioty Sultana, Rashed Shelim, Riasat Khan

Published year: June 2023

Abstract: Plastic garbage in reservoirs causes significant harm to water quality aquatic life and the entire ecosystem. This paper presents a low-cost water waste cleaning robot to collect floating waste in ponds and lakes composed of commonly available low-cost materials requiring little human labor. This study aims to develop a robot that can collect floating trash in place of humans and evaluate the performance of the proposed system. This automatic system is constructed of floatable material and will float on the water to gather waste materials. A simple smartphone application is used to control the robot's cage-like framework resulting in an extremely user-friendly interface. The waste trapped inside will have to be manually taken out of the bot before a second launch. Successful experiments have been made to collect different types of plastic waste in a small water body. The robot's operating range and battery life are measured to ensure an efficient cleaning process in terms of time. Furthermore, the operator may adjust the robot's speed to make movement simple and precise.

4-The Best Way to Utilize Robotic Trash Boat

with GPS Navigation

Author name: -Bhaskar Banerjee, Kaushik Mukherjee, Piyasa Mukherjee

Published year 2020

Abstract: The litters of sewage industries and other sources are being dumped in our rivers day by day. Like other countries' the government of India has also taken many initiatives like "Namami Gange" "Narmada Bachao" and so many initiatives to make the rivers clean. Keeping this in mind the project work is implemented to collect and discharge floating litters from the rivers or any other water bodies featuring the image process in the camera module and controlled through GPS module. The implemented robot is small lightweight floating energy efficient environmentally compatible (in shape size colour materials and energy supply) and can navigate autonomously and in coordination with each other in a variety of scenarios such as coastal waters artificial and natural lakes lagoons and rivers.

5-A Floating Waste Scooper Robot on Water Surface

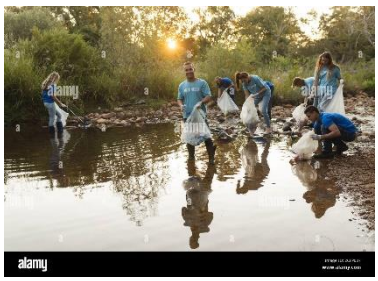
Author Name: - Niramon Ruangpayoongsak, Jakkrit Sumroengrit, Monthian Leanglum

Published year: 2017

Abstract: In developing countries cleaning water surface is a routine task. Collecting large amount of dry waste floating such as plastic bottles confront with tension on water surface and small drag force causes waste floating away. The aim of this research is to design a robot that replaces human force for floating waste scooping and investigate performance of the designed waste scoopers installed on the Floating Waste Scooper Robot. The robot mechanism design waste scoopers and control are presented. The robot has been successfully tested on calm water surface. Experiments were conducted on a pond and results show influence of varying the robot driving speed and conveyor belt speed on waste scooping. The capability of the different designed scoopers is evaluated, and weight of plastic bottles collected by human using scoop net is also compared with that of the robot.

2.1 Evolution and breakthrough in the technology associated with the project.

Table 2.1

Manual Handling	**Semi-Automatic**	**Fully Automatic**
In the past, traditional methods of river cleaning involved manual collection of garbage by individuals using large nets and containers to deposit the waste. Communities would unite and organize collective efforts aimed at cleaning a river within a specified timeframe.	Rivers became more contaminated and harmful to step in, to deal with this many communities, organizations and government together tried using semi-Automatic machines for garbage collection with a person operating it. eg:- A crane or a boat etc.	Using modern technology many automatic cleaning machines and robots are now being used to collect garbage from rivers without human intervention and that too in a short duration of time.
		
		

2.2 Solutions to the existing problems

Table 2.2

Title	Description	Features	Constraints	Images
Water Surface Cleaning Robot by WasteShark	The WasteShark is an autonomous water surface cleaning robot designed to collect floating waste and debris from water bodies including rivers, lakes, and harbors.	It utilizes AI and machine learning algorithms for navigation and obstacle avoidance. It can collect up to 200 liters of waste and has a battery life of around 16 hours per charge.	The size and weight of the WasteShark may limit its use in smaller or shallow water bodies.	 
Aquatic Weed Harvester by Aquamarine Dredging Solutions	This aquatic weed harvester is designed to remove aquatic vegetation, debris, and pollutants from the surface of rivers and lakes.	It operates using a conveyor system that scoops up vegetation and debris, depositing it into an onboard storage compartment. It can be operated manually or equipped with GPS for autonomous operation.	While effective at removing vegetation, it may not be as efficient for collecting smaller debris or pollutants.	 

Marina Trash Skimmer by Trash Trap	The Marina Trash Skimmer is a floating device designed to capture floating debris and pollutants from marinas, harbors, and waterways.	It utilizes a floating boom and conveyor system to collect debris and pollutants, which are then deposited into a storage container. It can be powered by solar energy	It may have limitations in its ability to navigate strong currents or choppy waters.	 
Water Surface Garbage Cleaning Unmanned Remote-Controlled Boat	The Relong unmanned cleaning ship was originally fueled by a gasoline generator. including a 4G remote system, navigation and obstacle avoidance during operations.	High degree of automation, allowing for wide collection range and minimal energy consumption. With intelligent wireless control, it efficiently navigates and cleans with precision.	Its effectiveness may vary depending on the type and volume of debris present in the water.	

2.3 Average cost of the existing products

Water Surface Cleaning Robot by WasteShark:

Average Cost: ₹14,60,000 - ₹21,90,000 INR

Aquatic Weed Harvester by Aquamarine Dredging Solutions:

Average Cost: ₹36,30,000 - ₹72,60,000 INR

Marina Trash Skimmer by TrashTraps:

Average Cost: ₹7,30,000 - ₹14,60,000 INR

Water Surface Garbage Cleaning Unmanned Remote-Controlled Boat:

Average Cost: ₹2,250,000 - ₹4,500,000 INR

2.4 Associated specification of the existing products

1.Water Surface Cleaning Robot by WasteShark:

Power source: Battery

Applications: River, Ponds, canals

Dimensions :190 cm x 140 cm x 45 cm

Weight: 39 kg unloaded

Cost: ₹14,60,000 - ₹21,90,000 INR

2.Aquatic Weed Harvester by Aquamarine Dredging Solutions

Power source: Diesel

Applications: Livestock, Aquaculture

Dimensions: 880 cm x 320 cm x 450 cm

Weight: 5000 kg unloaded

Cost: ₹36,30,000 - ₹72,60,000 INR

3.Marina Trash Skimmer by Trash Trap

Power source: Electric

Applications: Removes oil and floating debris from the surface of the water

Dimensions :330cm x 490cm x 150 cm

Weight: 57 kg unloaded

Cost: ₹7,30,000 - ₹14,60,000 INR

4. Water Surface Garbage Cleaning Unmanned Remote-Controlled Boat

Power source: Electric

Applications: All kinds of water weeds

Dimensions :190 cm x 140 cm x 45 cm

Weight: 1100 kg

Cost: ₹2,250,000 - ₹4,500,000 INR

2.5 Consolidate literature survey

Table 2.3

Observation from Literature survey	Requirements
1.The existing machines abroad are very expensive and importing them will increase the cost more.	1.We need a machine which is economical and budget friendly.
2.Some machines work on gasoline and fuel which may increase pollution and can be harmful for aquatic fauna due to spills and leaks.	2. The machine should prioritize environment friendliness.
3.The current machine interfaces are often complex and can be confusing for non-experts to grasp.	3.The machine should be user friendly and easy to operate.
4. The heavy weight of existing machines restricts their ability to operate effectively across various water regions.	4.The maximum weight of the machine should be optimized for ease of transportation, deployment, and manoeuvrability on the water surface.
5.The existing product does not have any Robust monitoring and evaluation mechanisms	5.Robust monitoring and evaluation mechanisms should be established to assess the effectiveness and impact of river cleaning activities, track progress, and identify areas for improvement.

Chapter 3

Model requirement and design constraint

3.1 Design Objective

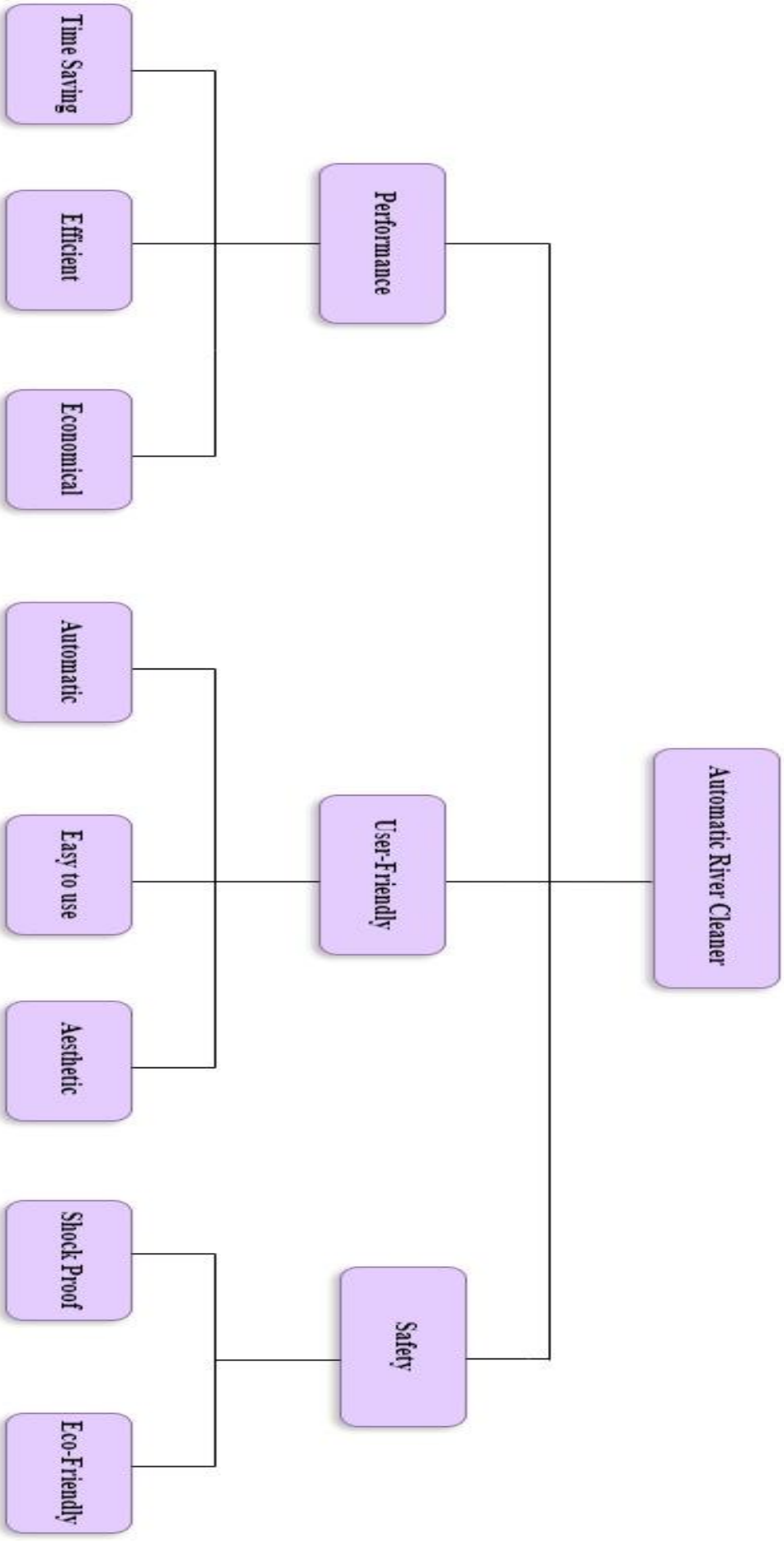
1. **Efficient Debris Removal**: The primary objective is to provide a reliable solution for cleaning water surface debris efficiently, thereby improving water quality and protecting aquatic life.
2. **Autonomous Operation**: The system should operate autonomously with minimal human intervention, incorporating features like real-time monitoring and remote control.
3. **Environmental Sustainability**: The cleaner should use pollution-free power sources, such as lithium-ion batteries, to ensure minimal environmental impact.
4. **Durability and Reliability**: The cleaner must be constructed with durable materials to withstand harsh aquatic environments and ensure long-term reliability.
5. **Cost-Effectiveness**: The design should aim to keep the cost within a range that makes it accessible to various stakeholders, including government and private organizations.

Table no 3.1 Objectives of project

Sr.No	Objectives
1	Efficient
2	Automatic
3	Shock Proof
4	Economical
5	Eco-Friendly

Table 3.2 Order the list into sets

Title: Automatic River Cleaner		
Category 1:	**Category 2:**	**Category 3:**
Time Saving	Aesthetic	Shock Proof
Efficient	Easy to use	Eco-Friendly
Automatic		
Economical		



3.1 Objective Tree

Table no 3.3 (Pairwise Comparison Chart) PCC

Objectives	Portable	Efficient	Automatic	Economical	Eco - Friendly	Score
Portable	**	0	0	0	0	0
Efficient	1	**	1	1	1	4
Automatic	1	0	**	0	1	2
Economical	1	0	1	**	1	3
Eco-Friendly	1	0	0	0	**	1

Rank the objectives in order of decreasing value of importance and the list is:

1. Efficient
2. Economical
3. Automatic
4. Eco-Friendly
5. Portable

Problem Statement Version 1

The river cleaner should be able to collect the garbage floating on water surface efficiently, it should be economical making it a cost-effective solution and the mode of operation should be automatic providing hassle free operation. Keeping in mind the environmental consciousness it should also be eco-friendly.

3.2 Constraint

1. **Weight Limit**: The machine should weigh approximately 5 kg to ensure ease of deployment and manoeuvrability.
2. **Battery Life**: The cleaner should be powered by lithium-ion batteries, which need to be efficient and long-lasting to support extended operations.

3. **Operational Environment**: The device must be able to function in various aquatic environments, including rivers, ponds, lakes, and canals, which may present different challenges such as varying water currents and debris types.
4. **Maintenance Interval**: The machine should operate effectively for around two months before requiring maintenance.
5. **Autonomy Level**: The cleaner should have a high level of autonomy with occasional human intervention through an app.

Problem statement 2

The river cleaner must efficiently collect floating garbage, offering cost-effective solutions with automatic operation for user convenience. It must prioritize eco-friendliness, operating solely on battery

3.3 Functions

1. **Debris Collection**: The machine will collect solid waste from the water surface using a conveyor belt mechanism and deposit it into an onboard container.
2. **Real-Time Monitoring**: Equipped with a camera, the cleaner allows users to monitor the cleaning area in real-time and control the device remotely.
3. **Power Management**: The cleaner will be powered by lithium-ion batteries, ensuring continuous operation without direct emissions.
4. **Remote Control**: Users can operate the machine via Wi-Fi, enabling remote control and adjustments as needed.
5. **Customizable Interface**: The user interface should be intuitive, requiring minimal training for operators, and should include options for customization and support features like a help menu.

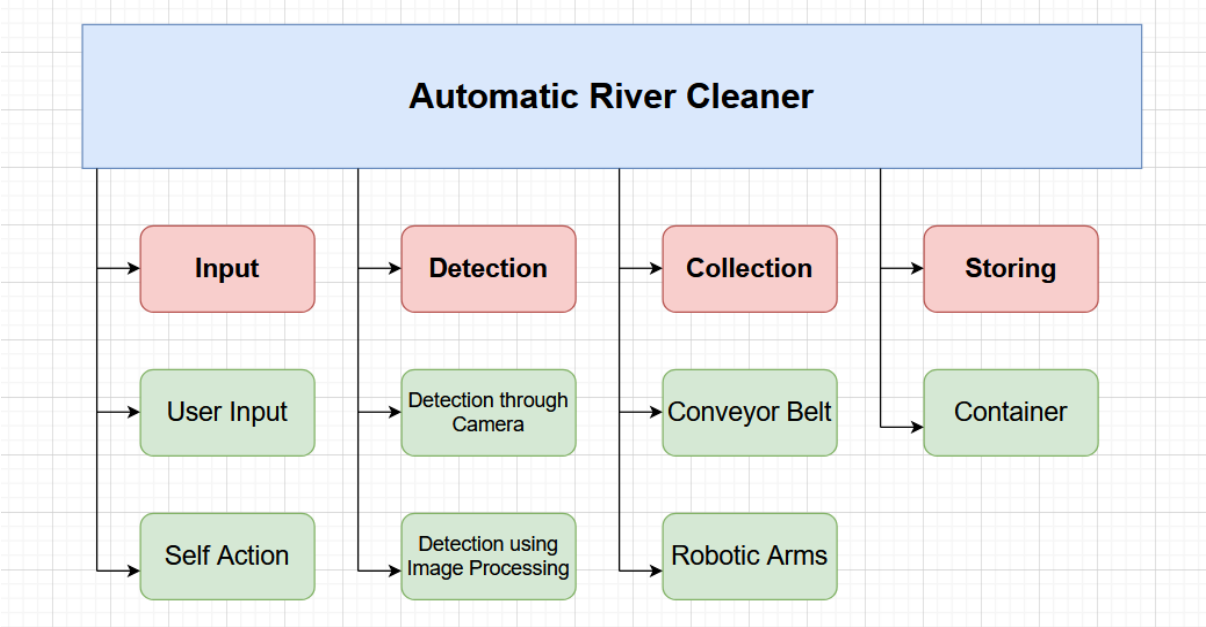


Fig 3.2 function tree

Problem statement version 3

The river cleaner, featuring a conveyor belt, efficiently gathers floating garbage, depositing it into containers without spillage. Operating automatically with minimal human intervention, it ensures hassle-free operation., it offers a user-friendly, eco conscious solution for effective river cleaning.

Chapter-4

Conceptual Design

4.0 Conceptual Design: This phase of Engineering Design has the revised problem statement, has input, and arrives at the requirements of a chosen design as output.

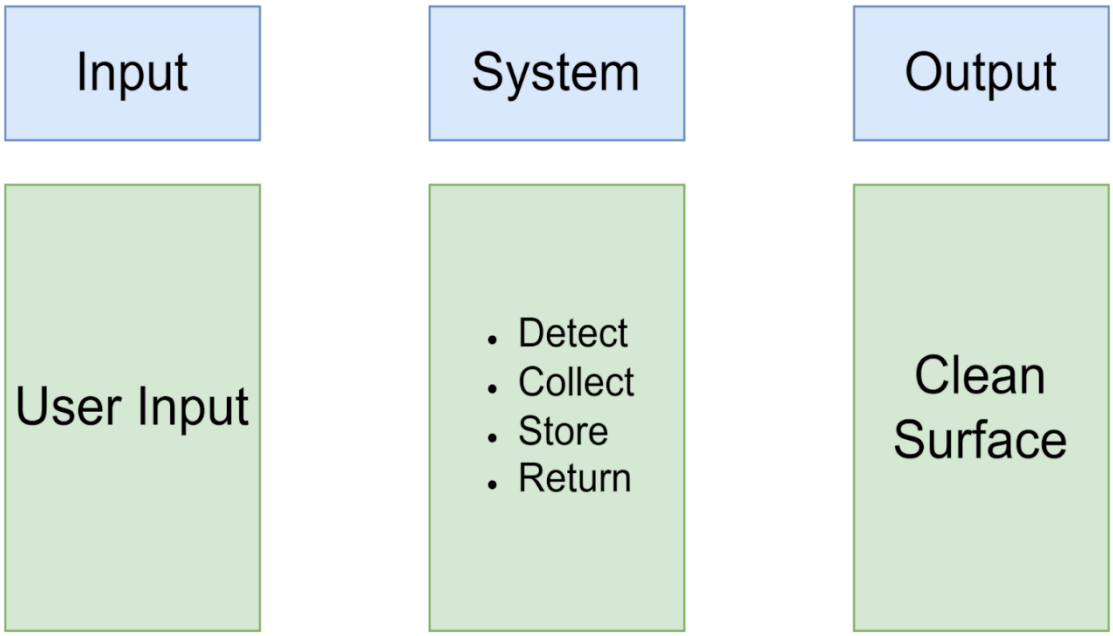
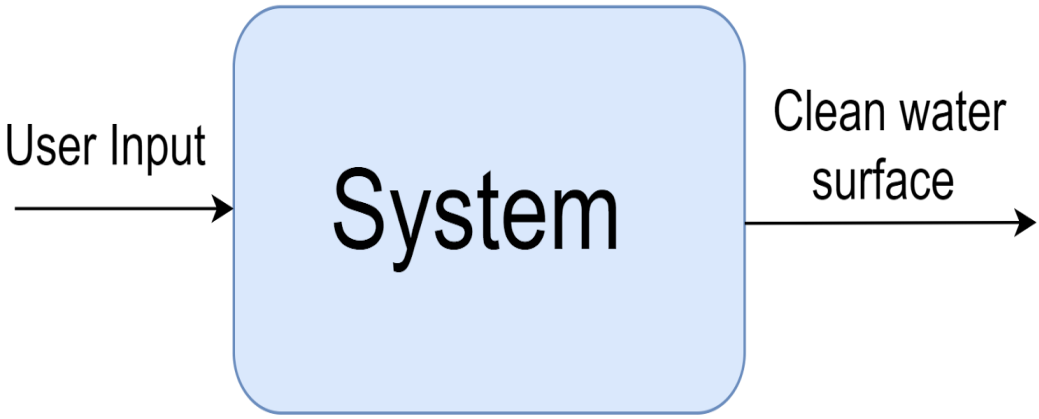
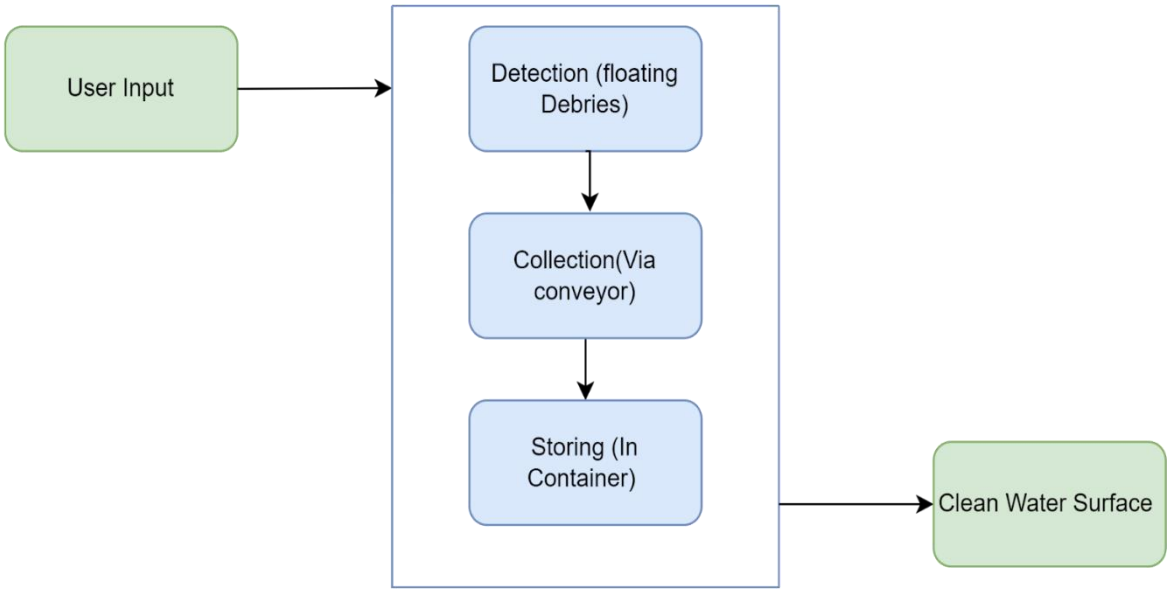


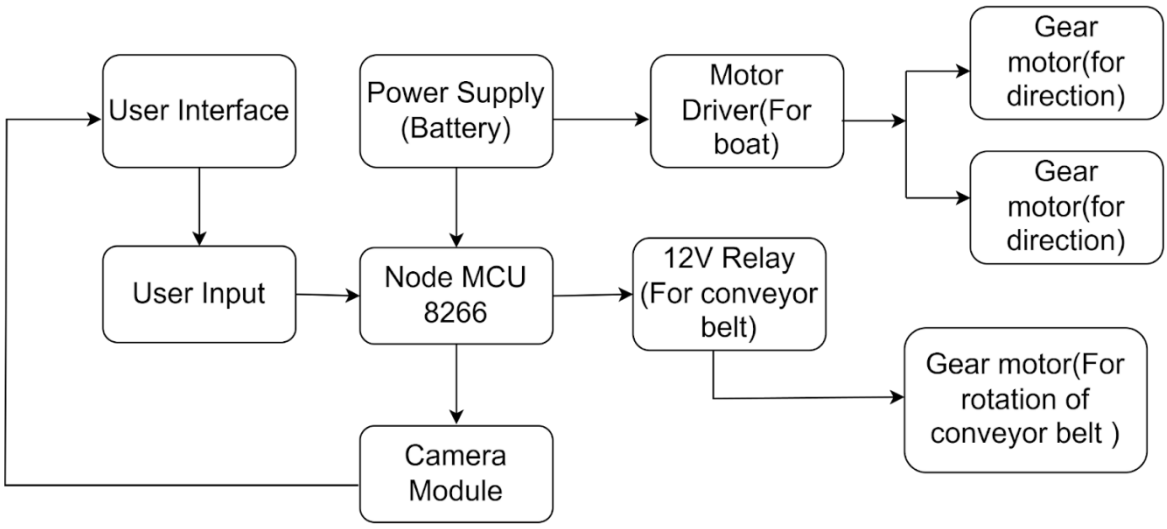
Fig 4.1 Black Box Representation: -



4.1.1 Glass Box Representation

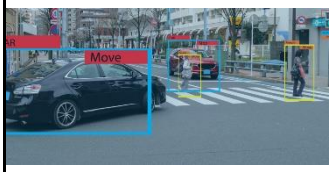
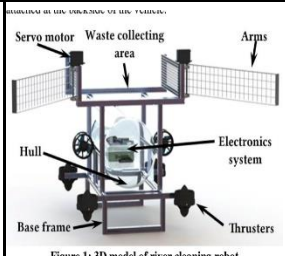


4.2 Expanded glass box model with functional Structure

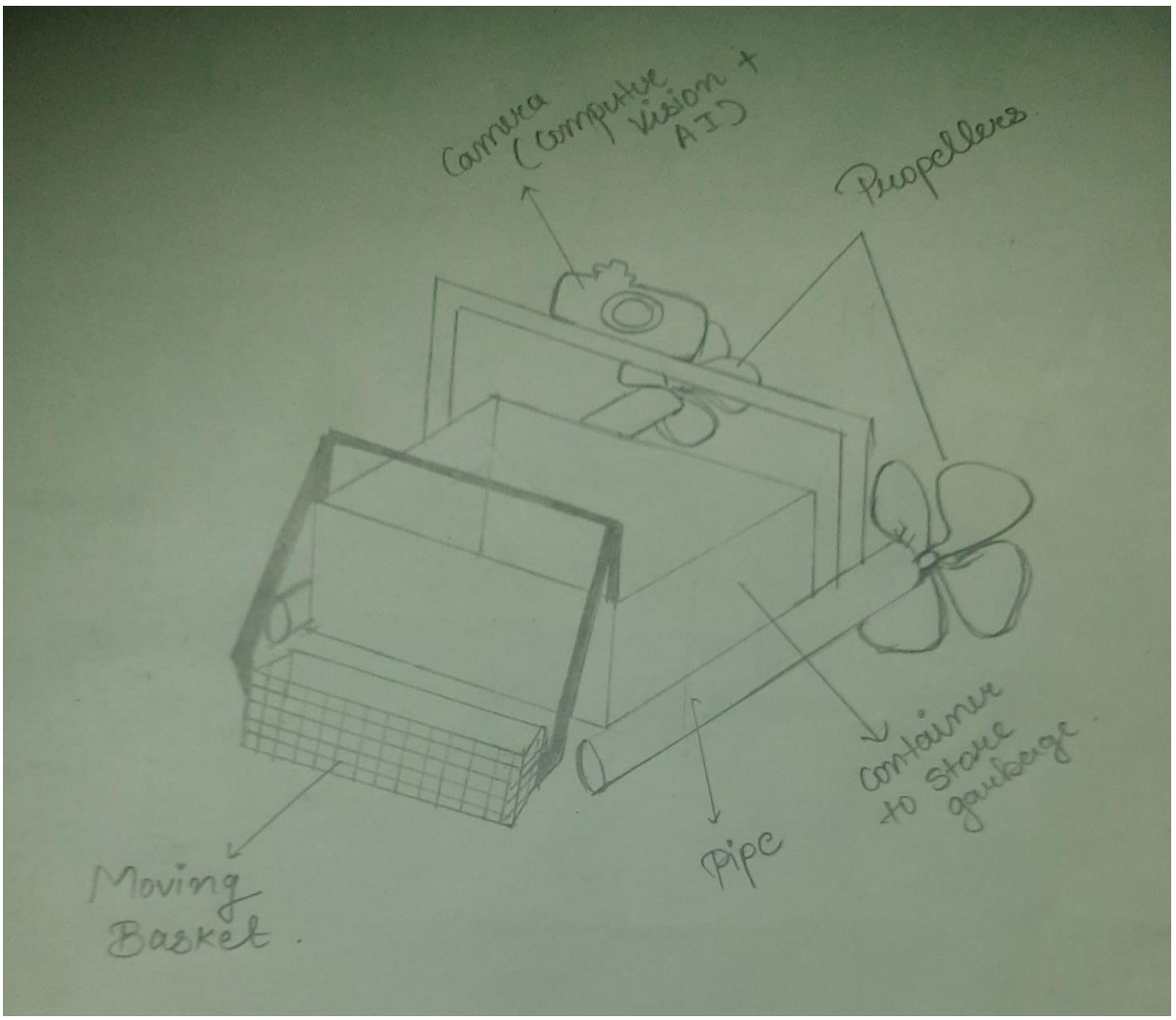


4.3 Selection Path Showing the Concepts

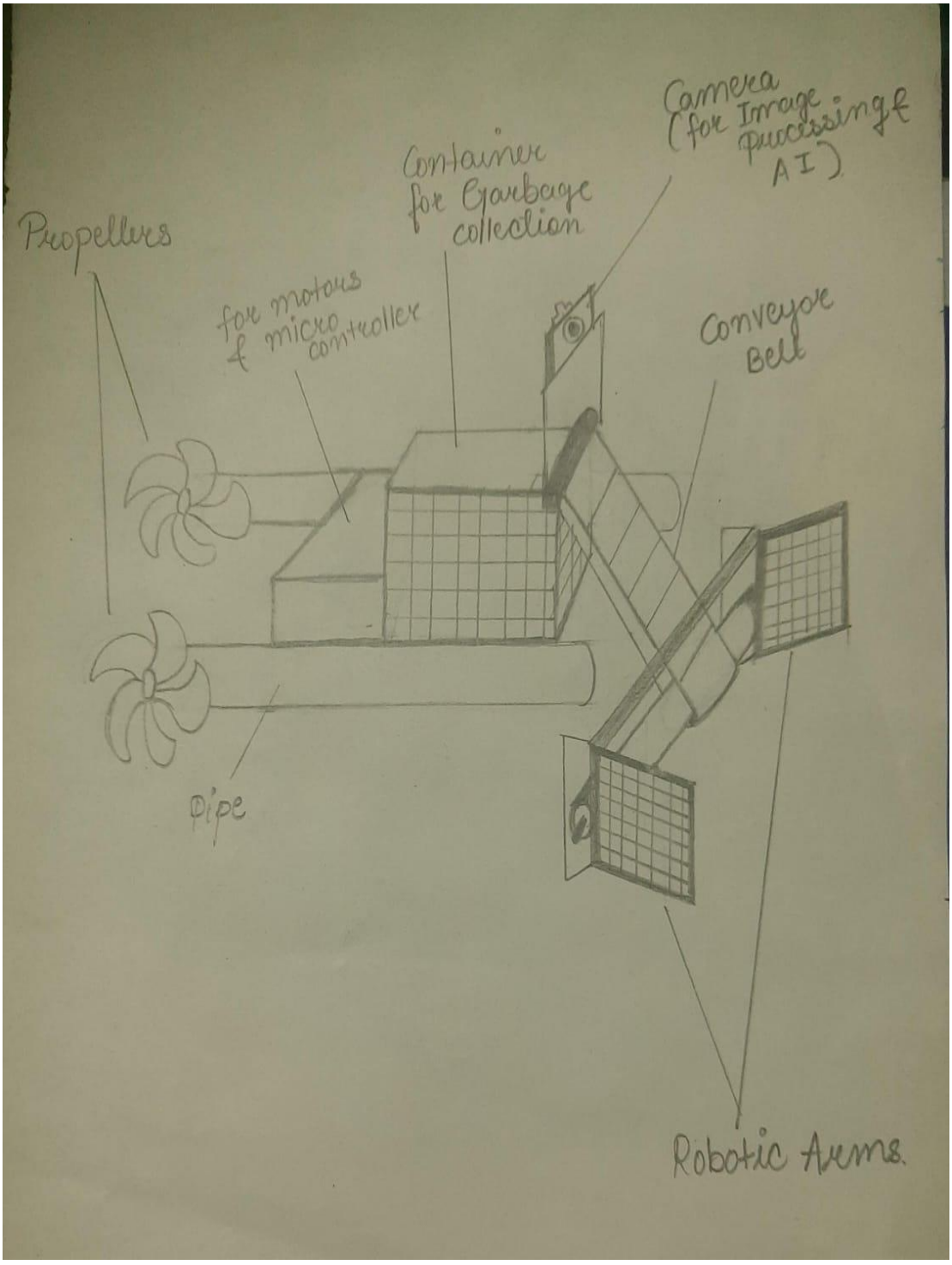
Table 4.1

	Mean 1	Mean 2	Mean 3	Mean 4
Function 1 Input				 
Function 2 Detection				
Function 3 Collection		 Figure 1: 3D model of river cleaning robot		
Function 4 Storing				

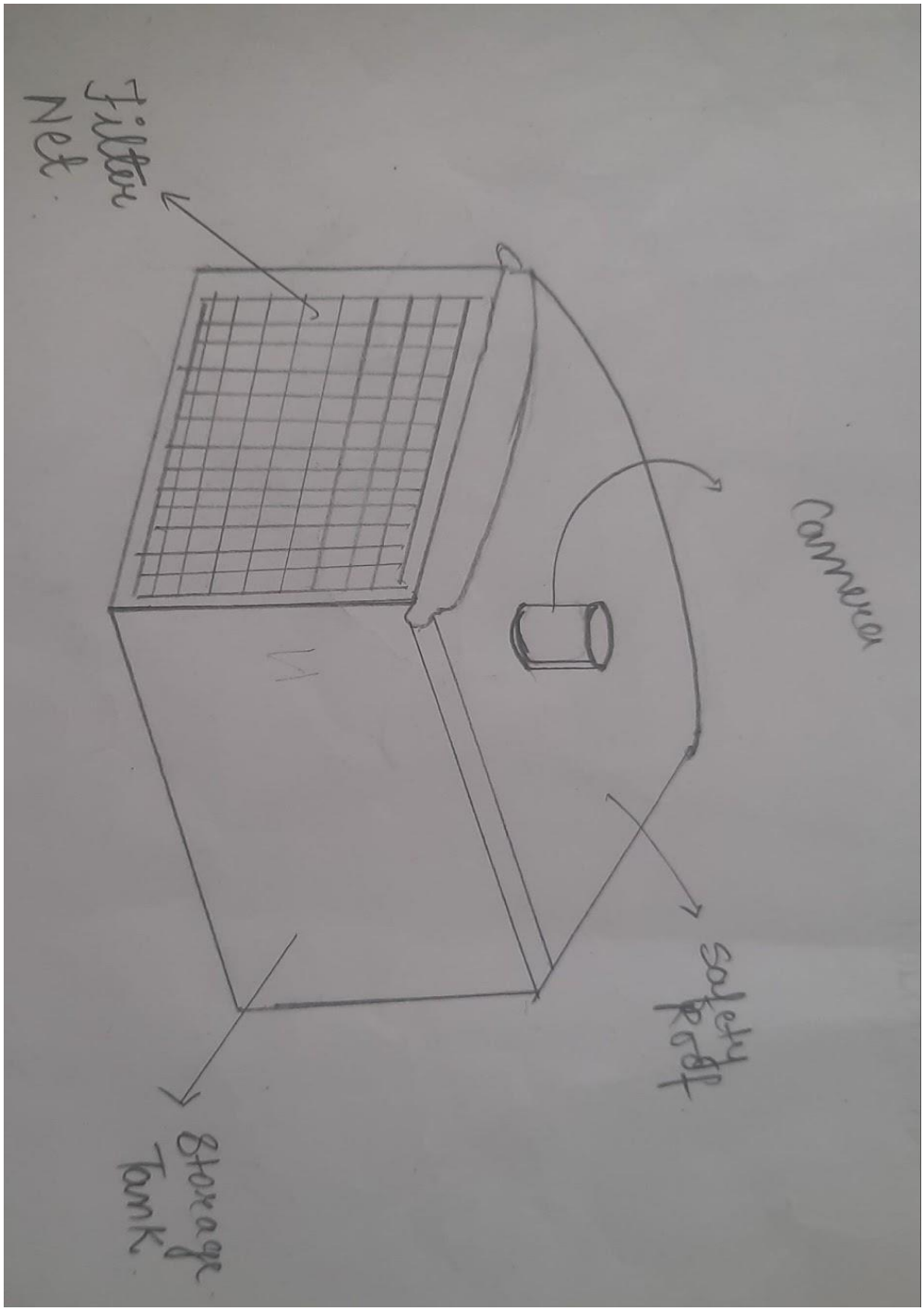
4.3.1 Conceptual Model:1



4.3.2 Concept 2:



4.3.3 Concept 3:



4.4: Comparison of concepts: The PUGH chart.

4.4.1The weights are listed in the following table

Table 4.2

Objective	Weight	Reason
Efficient	9	To efficiently collect floating debris from the surface of rivers, preventing it from polluting waterways and harming aquatic ecosystems.
Automatic	8	To automate the process of river cleaning, reducing the need for manual labour
Economical	6	By making river cleaning more affordable and accessible, we can work towards healthier waterways and a cleaner environment for all.
Eco Friendly	6	To protect the environment by removing harmful pollutants from rivers
Portable	5	Portable river cleaners can access a wider range of river locations, including shallow or narrow areas where larger vessels cannot operate.

Table 4.3

Objectives	Weight	Concept 1	Concept 2	Concept 3
Efficient	9	Datum	+	+
Automatic	8	Datum	+	++
Economical	6	Datum	++	–
Eco Friendly	6	Datum	+	– –
Portable	5	Datum	++	+
Total +ve score			+45	+30

Total -ve score			0	- 18
Overall score			45	12

4.4.2 The Best Concept is Concept 2

4.5 Component Requirements

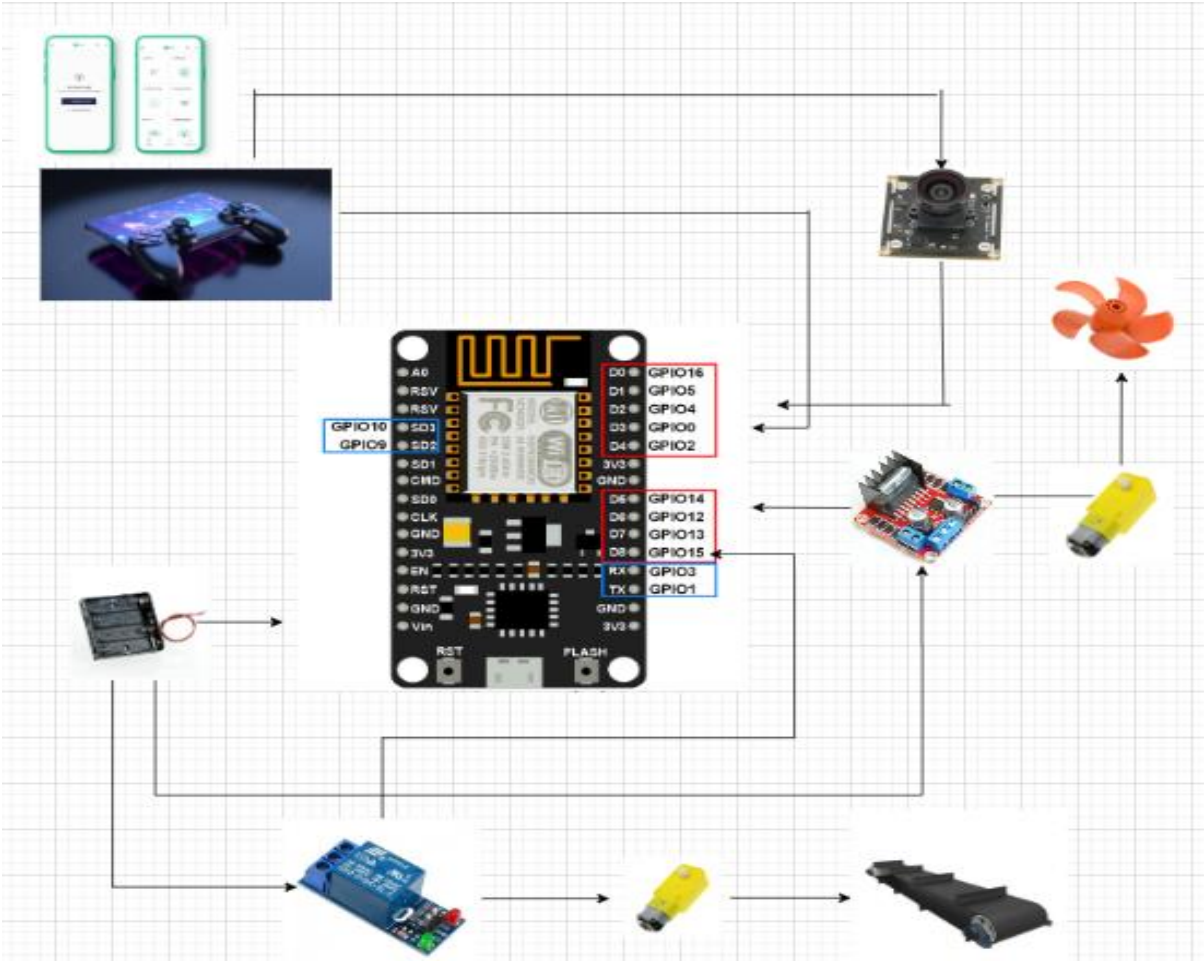
Table 4.4

No.	Resource	Quantity	Specification
1	**Node MCU ESP8 266**		• Model: ESP8266-12E • Wireless Standard: 802.11 b/g/n • Frequency range: 2.4 GHz - 2.5 GHz (2400M-2483.5M) • Wi-Fi mode: Station / SoftAP / SoftAP+station • Stack: Integrated TCP/IP • Output power: 19.5dBm in 802.11b mode • Data interface: UART / HSPI / I2C / I2S / Ir • Remote Control GPIO / PWM • Supports protection mode: WPA / WPA2 • Encryption: WEP / TKIP / AES • Power supply: from 4.5 VDC to 9 VDC (VIN) or via micro-USB connector • Consumption: with continuous Wi-Fi transmission about 70 mA (200 mA MAX) - in standby < 200μA • Operating temperature: from -40°C to +125°C • Dimensions (mm): 58×31.20×13 • Weight: 10 grams
2	**L298N Motor driver**		• Dual H Bridge Motor Driver • L298N motor driver IC • Drives up to 2 bidirectional DC motors • Integrated 5V power regulator • 5V – 35V drive voltage

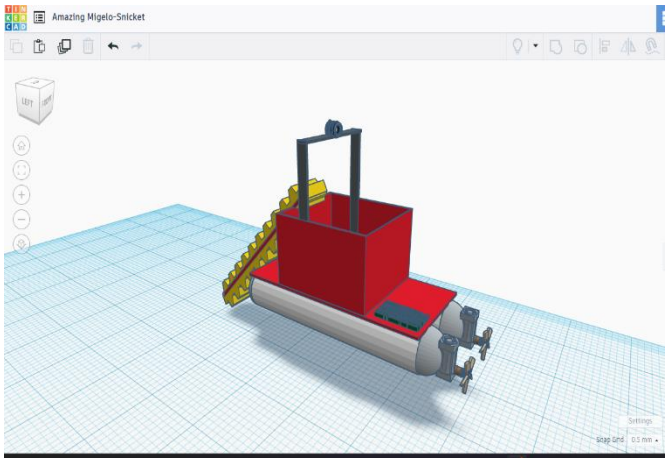
			• 2A max drive current
3	**Lithium-Ion Battery**		• Voltage: 3.7 volts nominal voltage. • Capacity: Variable, typically ranging from 500mAh to several thousand mAh (milliampere-hours). • Chemistry: Lithium-ion. • Rechargeable: Yes, can be recharged multiple times. • Size: Various form factors, commonly cylindrical or pouch shaped. • Weight: Typically, lightweight. • Operating Temperature: Usually between -20°C to 60°C (-4°F to 140°F). • Charging: Requires a specific Li-ion charger. • Safety: Contains built-in protection circuitry to prevent overcharging, over-discharging, and short-circuiting. • Applications: Used in various electronic devices such as smartphones, laptops, power banks, and electric vehicles
4	**12V Relay Module**	1	• **Function:** A relay module is an electromechanical switch used to control high-power devices with low-power signals, typically from a microcontroller or digital circuit. • **Voltage:** The relay module operates at a voltage of 12 volts (12V), meaning it requires a 12V power supply to function properly. • **Switching Capability:** It can switch high-current and high-voltage loads, making it suitable for various applications like controlling lights, motors, heaters, and more. • **Components:** Typically consists of a relay, which is essentially an electromagnetic switch, along

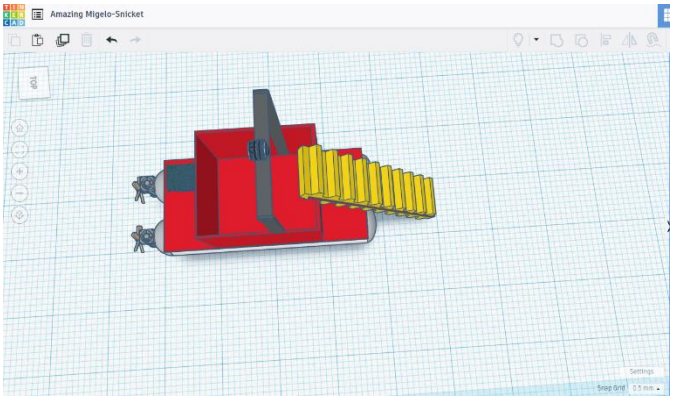
			with supporting circuitry like transistors, diodes, and resistors. • **Control Input:** Accepts a low-voltage input signal (usually from a microcontroller or digital circuit) to toggle the relay's state (ON/OFF). • **Output Contacts:** Offers one or more sets of output contacts that physically switch in response to the control signal. These contacts are used to connect or disconnect the load. • **Isolation:** Provides electrical isolation between the control circuit and the load circuit, ensuring safety and preventing interference between the two circuits. **lication:** Widely used in automation, robotics, IoT ernet of Things), home automation, automotive, and ustrial control systems.
5	**Camera Module**		• Resolution: Specifies the number of pixels in the image (e.g., 12MP). • Sensor Size: The physical dimensions of the sensor, affecting image quality and low-light performance. • Aperture: The size of the opening that lets light into the sensor, impacting low-light performance (e.g., f/1.8). • Focal Length: Determines the field of view and zoom capability (e.g., 28mm). • Image Stabilization: Helps reduce blur caused by camera shake, especially in low light or when using zoom. • Autofocus: Determines how quickly and accurately the camera can focus on subjects. • Video Resolution and Frame Rate: Specifies the quality and smoothness of recorded videos (e.g., 4K at 30fps). • HDR (High Dynamic Range): Enhances details in both bright and dark areas of an image or video.

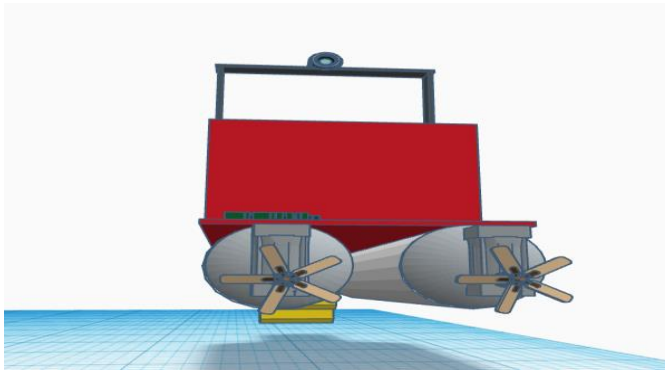
4.5.1 Circuit Diagram:

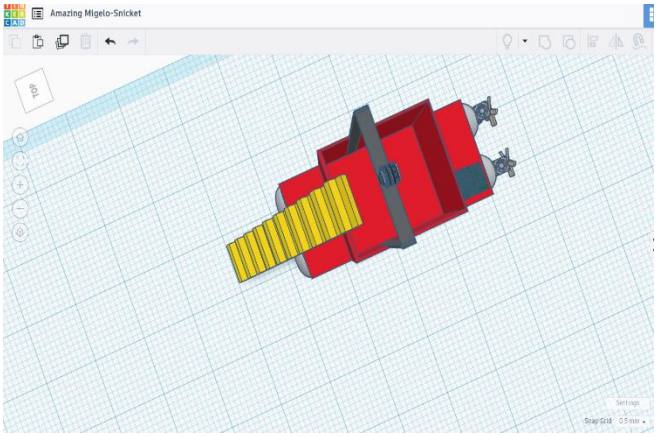


4.5.2 3D model


Amazing Migelo-Snicket


Amazing Migelo-Snicket




Amazing Migelo-Snicket

Chapter-5

Software and libraries

5.1 Introduction To Arduino Ide

The Arduino Integrated Development Environment (IDE) is a versatile and user-friendly platform for developing and programming microcontroller projects. It is the official software used to program Arduino boards and compatible microcontrollers, making it a cornerstone of many educational, hobbyist, and professional electronics projects. Here's an in-depth look at the Arduino IDE, its features, and how it facilitates development with microcontroller platforms like NodeMCU, among others.

5.2 **Key Features Of Arduino IDE**

1. **Cross-Platform Compatibility**

   The Arduino IDE is available for Windows, macOS, and Linux, ensuring that users across different operating systems can use it without compatibility issues.

2. **Simple and Intuitive Interface**

   The IDE's clean and straightforward interface makes it easy for beginners to start coding immediately. It includes a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions, and a series of menus.

3. **Integrated Development Environment**

   Combines a code editor, compiler, and uploader in one place. The editor supports features like syntax highlighting, auto-completion, and brace matching to enhance the coding experience.

4. **Extensive Library Support**

The Arduino IDE supports a vast array of libraries that extend its functionality, allowing users to easily include code for various sensors, displays, motors, and other hardware components.

5. **Board and Port Management**

   Users can select the specific Arduino or compatible board they are using, as well as the communication port, simplifying the process of uploading code to the microcontroller.

6. **Serial Monitor**

   The IDE includes a built-in serial monitor that allows users to communicate with their Arduino board, debug their programs, and view real-time data sent from the board.

5.3 Tools

1. Help

Here you find easy access to a number of documents that come with the Arduino Software (IDE). You have access to Getting Started, Reference, this guide to the IDE and other documents locally, without an internet connection. The documents are a local copy of the online ones and may link back to our online website.

2. Sketchbook

The Arduino Software (IDE) uses the concept of a sketchbook: a standard place to store your programs (or sketches). The sketches in your sketchbook can be opened from the **File > Sketchbook** menu or from the **Open** button on the toolbar. The first time you run the Arduino software, it will automatically create a directory for your sketchbook. You can view or change the location of the sketchbook location from with the **Preferences** dialog.

3. Tabs, Multiple Files, And Compilation

Allows you to manage sketches with more than one file (each of which appears in its own tab). These can be normal Arduino code files (no visible extension), C files (.c extension), C++ files (.cpp), or header files (.h).

Before compiling the sketch, all the normal Arduino code files of the sketch (.ino, .pde) are concatenated into a single file following the order the tabs are shown in. The other file types are left as is.

4. Uploading

Before uploading your sketch, you need to select the correct items from the **Tools > Board** and **Tools > Port** menus. The **boards** are described below. On the Mac, the serial port is probably something like **/dev/tty.usbmodem241** (for an UNO or Mega2560 or Leonardo) or **/dev/tty.usbserial-1B1** (for a Duemilanove or earlier USB board), or **/dev/tty.USA19QW1b1P1.1** (for a serial board connected with a Keyspan USB-to-Serial adapter). On Windows, it's probably **COM1** or **COM2** (for a serial board) or **COM4**, **COM5**, **COM7**, or higher (for a USB board) - to find out, you look for USB serial device in the ports section of the Windows Device Manager. On Linux, it should be **/dev/ttyACMx** , **/dev/ttyUSBx** or similar. Once you've selected the correct serial port and board, press the upload button in the toolbar or select the **Upload** item from the **Sketch** menu. Current Arduino boards will reset automatically and begin the upload. With older boards (pre-Diecimila) that lack auto-reset, you'll need to press the reset button on the board just before starting the upload. On most boards, you'll see the RX and TX LEDs blink as the sketch is uploaded. The Arduino Software (IDE) will display a message when the upload is complete, or show an error.

When you upload a sketch, you're using the Arduino **bootloader**, a small program that has been loaded on to the microcontroller on your board. It allows you to upload code without using any additional hardware. The bootloader is active for a few seconds when the board resets; then it starts whichever sketch

was most recently uploaded to the microcontroller. The bootloader will blink the on-board (pin 13) LED when it starts (i.e. when the board resets).

5. Third-Party Hardware

Support for third-party hardware can be added to the **hardware** directory of your sketchbook directory. Platforms installed there may include board definitions (which appear in the board menu), core libraries, bootloaders, and programmer definitions. To install, create the **hardware** directory, then unzip the third-party platform into its own sub-directory. (Don't use "arduino" as the sub-directory name or you'll override the built-in Arduino platform.) To uninstall, simply delete its directory.

6. Preference

Some preferences can be set in the preferences dialog (found under the **Arduino** menu on the Mac, or **File** on Windows and Linux). The rest can be found in the preferences file, whose location is shown in the preference dialog.

7. Language Support

Since version 1.0.1 , the Arduino Software (IDE) has been translated into 30+ different languages. By default, the IDE loads in the language selected by your operating system. (Note: on Windows and possibly Linux, this is determined by the locale setting which controls currency and date formats, not by the language the operating system is displayed in.)

If you would like to change the language manually, start the Arduino Software (IDE) and open the **Preferences** window. Next to the **Editor Language** there is a dropdown menu of currently supported languages. Select your preferred language from the menu, and restart the software to use the selected language. If your operating system language is not supported, the Arduino Software (IDE) will default to English.

You can return the software to its default setting of selecting its language based on your operating system by selecting **System Default** from the **Editor Language** drop-down. This setting will take effect when you restart the Arduino Software (IDE). Similarly, after changing your operating system's settings, you must restart the Arduino Software (IDE) to update it to the new default language.

8. Boards

The board selection has two effects: it sets the parameters (e.g. CPU speed and baud rate) used when compiling and uploading sketches; and sets and the file and fuse settings used by the burn bootloader command. Some of the board definitions differ only in the latter, so even if you've been uploading successfully with a particular selection you'll want to check it before burning the bootloader. You can find different boards **here**.

Arduino Software (IDE) includes the built in support for the boards in the following list, all based on the AVR Core. The **Boards Manager** included in the standard installation allows to add support for the growing number of new boards based on different cores like Arduino Due, Arduino Zero, Edison, Galileo and so on.

- *Arduino Yún* An ATmega32u4 running at 16 MHz with auto-reset, 12 Analog In, 20 Digital I/O and 7 PWM.
- *Arduino Uno* An ATmega328P running at 16 MHz with auto-reset, 6 Analog In, 14 Digital I/O and 6 PWM.
- *Arduino Diecimila or Duemilanove w/ ATmega168* An ATmega168 running at 16 MHz with auto-reset.
- *Arduino Nano w/ ATmega328P* An ATmega328P running at 16 MHz with auto-reset. Has eight analog inputs.
- *Arduino Mega 2560* An ATmega2560 running at 16 MHz with auto-reset, 16 Analog In, 54 Digital I/O and 15 PWM.
- *Arduino Mega* An ATmega1280 running at 16 MHz with auto-reset, 16 Analog In, 54 Digital I/O and 15 PWM.
- *Arduino Mega ADK* An ATmega2560 running at 16 MHz with auto-reset, 16 Analog In, 54 Digital I/O and 15 PWM.
- *Arduino Leonardo* An ATmega32u4 running at 16 MHz with auto-reset, 12 Analog In, 20 Digital I/O and 7 PWM.
- *Arduino Micro* An ATmega32u4 running at 16 MHz with auto-reset, 12 Analog In, 20 Digital I/O and 7 PWM.
- *Arduino Esplora* An ATmega32u4 running at 16 MHz with auto-reset.
- *Arduino Mini w/ ATmega328P* An ATmega328P running at 16 MHz with auto-reset, 8 Analog In, 14 Digital I/O and 6 PWM.
- *Arduino Ethernet* Equivalent to Arduino UNO with an Ethernet shield: An ATmega328P running at 16 MHz with auto-reset, 6 Analog In, 14 Digital I/O and 6 PWM.
- *Arduino Fio* An ATmega328P running at 8 MHz with auto-reset. Equivalent to Arduino Pro or Pro Mini (3.3V, 8 MHz) w/ ATmega328P, 6 Analog In, 14 Digital I/O and 6 PWM.

- *Arduino BT w/ ATmega328P* ATmega328P running at 16 MHz. The bootloader burn ed (4 KB) includes codes to initialize the on-board Bluetooth® module, 6 Analog In , 14 Digital I/O and 6 PWM..
- *LilyPad Arduino USB* An ATmega32u4 running at 8 MHz with auto-reset, 4 Analog In, 9 Digital I/O and 4 PWM.
- *LilyPad Arduino* An ATmega168 or ATmega132 running at 8 MHz with auto-reset, 6 Analog In, 14 Digital I/O and 6 PWM.
- *Arduino Pro or Pro Mini (5V, 16 MHz) w/ ATmega328P* An ATmega328P running at 16 MHz with auto-reset. Equivalent to Arduino Duemilanove or Nano w/ ATmeg a328P; 6 Analog In, 14 Digital I/O and 6 PWM.
- *Arduino NG or older w/ ATmega168* An ATmega168 running at 16 MHz*without* aut o-reset. Compilation and upload is equivalent to Arduino Diecimila or Duemilanove w/ ATmega168, but the bootloader burned has a slower timeout (and blinks the pin 13 LED three times on reset); 6 Analog In, 14 Digital I/O and 6 PWM.
- *Arduino Robot Control* An ATmega328P running at 16 MHz with auto-reset.
- *Arduino Robot Motor* An ATmega328P running at 16 MHz with auto-reset.
- *Arduino Gemma* An ATtiny85 running at 8 MHz with auto-reset, 1 Analog In, 3 Dig ital I/O and 2 PWM.

5.4 Libraries Used

Libraries provide extra functionality for use in sketches, e.g. working with hardware or manipulating data. To use a library in a sketch, select it from the **Sketch > Import Library** menu. This will insert one or more **#include** statements at the top of the sketch and compile the library with your sketch. Because libraries are uploaded to the board with your sketch, they increase the amount of space it takes up. If a sketch no longer needs a library, simply delete its **#include** statements from the top of your code.

There is a **list of libraries** in the reference. Some libraries are included with the Arduino software. Others can be downloaded from a variety of sources or through the Library Manager. Starting with version 1.0.5 of the IDE, you do can import a library from a zip file and use it in an open sketch. See these **instructions for installing a third-party library**.

1. ESP8266WiFi Library

- **Purpose**: Provides the necessary functions to connect the NodeMCU (ESP8266) to Wi-Fi networks.
- **Installation**: Comes pre-installed with the ESP8266 board package in Arduino Ide

```
#include <ESP8266WiFi.h>

const char* ssid = "your_SSID";
const char* password = "your_PASSWORD";

void setup() {
  Serial.begin(115200);
  WiFi.begin(ssid, password);
  while (WiFi.status() != WL_CONNECTED) {
    delay(1000);
    Serial.println("Connecting...");
  }
  Serial.println("Connected!");
}

void loop() {
  // Your main code here
}
```

2. Servo library

- **Purpose**: Controls servo motors, often used in conjunction with motor drivers like L298N for precise movements.
- **Installation**: Can be installed via the Arduino Library Manager.

```
#include <Servo.h>

Servo myServo;
const int servoPin = D4;

void setup() {
  myServo.attach(servoPin);
  myServo.write(90); // Set servo to middle position
}

void loop() {
  // Control the servo motor
  myServo.write(0);   // Move to position 0
  delay(1000);
  myServo.write(180); // Move to position 180
  delay(1000);
}
```

3. L298N Motor Driver Library

- **Purpose**: Provides an easy interface to control motors via the L298N driver.
- **Installation**: Installable via Arduino Library Manager or by downloading from GitHub.

```
const int motorPin1 = D1; // IN1 on the L298N
const int motorPin2 = D2; // IN2 on the L298N

void setup() {
  pinMode(motorPin1, OUTPUT);
  pinMode(motorPin2, OUTPUT);
}

void loop() {
  digitalWrite(motorPin1, HIGH);
  digitalWrite(motorPin2, LOW);
  delay(1000); // Run motor forward for 1 second

  digitalWrite(motorPin1, LOW);
  digitalWrite(motorPin2, HIGH);
  delay(1000); // Run motor backward for 1 second
}
```

4. ESP32 Camera Library

- **Purpose**: Required for using camera modules with ESP32. This library allows capturing images and streaming video.
- **Installation**: For ESP32-based camera modules, use the ESP32 board manager URL in Arduino IDE.

```
#include "esp_camera.h"
#include <WiFi.h>

// Camera configuration
void setup() {
  // Initialize camera settings here
}

void loop() {
  // Capture and process images
}
```

5.Wire Library

- **Purpose**: Facilitates I2C communication. Useful if your project involves additional sensors or modules that use I2C.
- **Installation**: Pre-installed in Arduino IDE.

```
#include <Wire.h>

void setup() {
  Wire.begin();
  // Initialize I2C communication
}

void loop() {
  // I2C communication handling
}
```

6- Conclusion:

In conclusion, the automatic river cleaner represents a significant advancement in addressing the pervasive issue of water pollution in rivers. By integrating a conveyor belt and side arms for efficient debris collection and utilizing pollution-free lithium-ion batteries, these devices offer an environmentally friendly and autonomous solution. The incorporation of real-time monitoring and remote-control capabilities further enhances their operational efficiency and safety. Future developments in AI and machine learning promise to optimize performance and adaptability, making these cleaners even more effective. Overall, the automatic river cleaner stands out as a sustainable, efficient, and safer alternative to traditional manual methods, promising a cleaner and healthier aquatic environment.

7-Future Scope:

Future Scope of the Automatic River Cleaner Project

1. **AI and Machine Learning Integration:**

Implement AI and ML algorithms to enhance the system's ability to identify and adapt to different types of debris and varying water conditions.

2. **Expanded Monitoring Capabilities:**

Develop advanced camera systems with higher resolution and better night vision to improve real-time monitoring and control.

3. **Enhanced Automation:**

Increase the level of automation to further minimize human intervention, making the system more autonomous and efficient.

4. **Improved Energy Efficiency:**

Explore alternative renewable energy sources such as solar power to complement or replace lithium-ion batteries for a more sustainable energy solution.

5. **Scalability and Customization:**

Design scalable models that can be adjusted in size and capacity to clean larger or smaller water bodies as needed.

6. **Modular Design:**

Create modular components that can be easily replaced or upgraded, allowing for quick maintenance and adaptability to different environments.

7. **Advanced Data Analytics:**

Use data collected from the river cleaners to analyse pollution patterns and inform environmental policies and clean-up strategies.

8. **User Interface Improvements:**

Develop a more intuitive user interface for easier remote control and monitoring, including mobile app integration.

9. **Safety Features:**

Enhance safety features to further protect workers, such as automatic shutdown in hazardous conditions and better warning systems.

10. **Community and Environmental Impact:**

Partner with local communities and environmental organizations to raise awareness and promote the benefits of river cleaners.

11. **Regulatory Compliance:**

Ensure compliance with local and international environmental regulations and contribute to the development of new standards for automated water cleaning technologies.

12. Pilot Projects and Case Studies:

Conduct pilot projects in various locations to test and refine the technology, documenting successes and areas for improvement to guide future deployments.

8 -Reference

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