POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

SMART RIVER CLEANER

DEPARTMENT OF CIVIL ENGINEERING

NURUL UMAIRAH BINTI MOHD RAFI

(08DKA21F2056)

SESSION II:2023/2024

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This project report is submitted to the Department of Civil Engineering in partial fulfilment of requirement for the Diploma of Civil Engineering

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SESSION II:2023/2024

AKUAN KEASLIAN DAN HAK MILIK

SMART RIVER CLEANER

1. Saya, NURUL UMAIRAH BINTI MOHD RAFI (030703-10-2044) adalah pelajar Diploma Kejuruteraan Awam, Politeknik Sultan Salahuddin Abdul Aziz Shah, yang beralamat di Persiaran Usahawan, Seksyen U1, 40150 Shah Alam, Selangor
   (Selepas ini dirujuk sebagai 'Politeknik tersebut')

2. Saya mengakui bahawa 'Projek tersebut diatas' dan harta intelek yang ada didalamnya adalah hasil karya/ rekacipta asli saya tanpa mengambil atau meniru mana-mana harta intelek daripada pihak-pihak lain.

3. Saya bersetuju melepaskan pemilikan harta intelek 'Projek tersebut' kepada 'Politeknik tersebut' bagi memenuhi keperluan untuk menganugerahkan Diploma Kejuruteraan Awam kepada saya.

Diperbuat dan dengan sebenar-benarnya diakui oleh yang tersebut;	)	
NURUL UMAIRAH BINTI MOHD RAFI (No. Kad Pengenalan:- 030703-10-2044),	)	……
	)	NURUL UMAIRAH BINTI MOHD RAFI
Di hadapan saya, PUAN SALIZAWATI BINTI KAMARUZZAMAN (760908-05-5418) sebagai penyelia projek pada tarikh: 28/08/2023	)	……
	)	PUAN SALIZWATI BINTI KAMARUZZAMAN

APPRECIATION

Bismillahirrahmanirrahim,

Alhamdulillah, I am thankful to God, who is all-loving and all-compassionate, for giving me the opportunity to complete this Final Year Project. This project was made possible through the help and support of many people, and I would like to take this opportunity to express my gratitud.

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ABSTRAK

Smart River Cleaner telah direka sebagai alat atau sistem untuk membersihkan sungai dengan cekap dan berkesan sambil memanfaatkan teknologi untuk prestasi yang optimum. *Smart River Cleaner* dapat membantu dalam mengekalkan keselamatan ekosistem akuatik dengan mengurangkan pencemaran seperti plastik, serpihan, dan bahan buangan ringan lain di sungai. Dalam projek untuk mencipta *Smart River Cleaner* yang akan menggabungkan teknologi dan fungsi canggih untuk membersihkan sungai dengan berkesan serta meningkatkan kebersihan sungai termasuk mengurangkan pencemaran air. *Smart River Cleaner* menggunakan teknologi robotik yang dapat menangkap sampah-sampah ringan seperti plastik-plastik pembungkus dan sampah-sampah yang terpaung dan tidak melebihi 6.8kg. Untuk metodologi projek ini, kami menggunakan beberapa kaedah untuk mengumpul data bagi menyediakan maklumat lebih terperinci tentang penyelidikan produk kami. Sebagai contoh, kami melakukan soal selidik dengan bertanya kepada beberapa orang pembersih sungai mengenai masalah mereka dalam membersihkan sungai dan bagaimana kami boleh menyelesaikan masalah tersebut dengan produk kami. Apa yang membuatkan produk kami lebih baik daripada yang sedia ada adalah kombinasi bahan kitar semula yang kami gunakan untuk memasang produk ini, seperti paip, bakul plastik, tayar, dan penyangkut baju yang menjadikan produk kami sebagai produk mesra alam. Selain itu, untuk penemuan projek ini, kami menguji produk ini dalam skop kecil iaitu di tasik berdasarkan saiz produk yang sesuai dengan saiznya. Dari data yang kami kumpulkan selepas menguji produk kami, data berat sampah tertinggi yang dapat ditangkap adalah 6.8kg dalam masa 30 minit. Kesimpulannya, dari data dan bukti yang ada dalam projek ini, kami berjaya mencapai objektif kami iaitu untuk mengenal pasti masalah pembersih sungai, untuk menghasilkan *Smart River Cleaner*, dan untuk memastikan kebersihan alam sekitar terjamin.

Kata kunci: Smart river cleaner, Memanfaatkan teknologi, Bahan kitar semula.

ABSTRACT

A solar smart River Cleaner has been designed as a device or system to efficiently and effectively clean rivers while leveraging technologies for optimal performance. Smart river cleaners help in maintaining the health of aquatic ecosystems by removing pollutants such as plastics, debris, and other light waste materials in the river. This project inventing A smart river cleaner that would incorporate advanced technologies and functionalities to effectively cleaning rivers and enhancing the cleanliness of the river including reducing water pollution. The Smart River Cleaner uses robotics, that could trap any of waste that are floating in the river without limitation of sizes and weight. For the methodology of this project, we did some method to collect data to provide more detail about our product research. For example, we did a questionnaire by asking some cleaners about their problems in term of cleaning the river and how did we can solve the problem with our product. What's making our product much better than the exist one is the combination of recycle material that we used to assembly this product is, pipe, plastic colander, tyre, cloth hanger that making our product as an eco-friendly product. Moreover, for the finding of the project, we did test this product in small range of scope which is in lake based on the size of the product that fit with the size. From the data that we collected after testing our product the data of highest weight of rubbish that could be trapped was 6.8kg in 30 minutes. To sum up everything we could see from the data and evidence in this project we successfully manage to achieve our objective which is to identify the river's cleaner problem, to produce smart river cleaner and to ensuring the cleanliness of environmental.

Keywords: Smart River Cleaner, Leveraging technology, Recycle Material.

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SENARAI SINGKATAN

PSA	Politeknik Sultan Salahuddin Abdul Aziz Shah
SRC	*Smart River Cleaner*
DC	Direct Current

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Our planet's lifeblood, rivers have long been a source of food, transpiration, and biological diversity. However, these vital streams are now in danger due to rising risks of pollution, industrial runoff, and debris buildup. In reaction to this environmental disaster, creative technology has emerged to safeguard the quality of our rivers. For instance, the smart river cleaner is a glimpse of hope that signals the beginning of a new phase in river conservation and restoration. The smart river cleaner is a innovative solution to the complex issues ailing our water systems. This technology is essential to protecting our rivers and ecosystems they maintain because it integrates advanced robotics, artificial intelligence, and sustainable engineering. Due to the worrying increase in pollution levels brought about by industrialization and urbanization, our waterways are suffering.

The Smart River Cleaner, which has sensors to identify a variety of contaminants such heavy metals, chemicals, and plastics, functions as a sentinel on these waterways. It not only locates the sources of pollution through real-time data analysis, but it also offers priceless insights for focused intervention and policy development. In addition to its analytical capabilities, the smart river cleaner is a very effective environmental waste removal tool. Its robotic technologies are effective at collecting floating debris.

This restores the river's scenic attractiveness while protecting aquatic life habitats downstream. Based on past data, it may optimize its cleaning paths, guaranteeing a more complete and effective cleaning procedure. This flexibility is essential in the face of constantly changing environmental obstacles. The Smart River Cleaner represents a dedication to sustainability and is more than just a technological marvel. It leaves as little of an environmental impact as possible because it does not release a single bit of carbon dioxide because the smart river cleaner did not use diesel. This strategy is in line with the pressing demand for environmentally friendly solutions that lessen the negative effects of human activity on the environment.

1.2 PROJECT BACKGROUND

The term "river pollution" refers to the contamination of river water bodies, typically due to human activity. Contaminants that are introduced into the natural environment led to river pollution. In addition to a broad spectrum of chemicals and pathogens, physical factors are also contributing factors to water pollution. Both organic and inorganic materials can be contaminants. Sungai Klang is under severe threat of pollution, which is a significant issue among many rivers in Malaysia. This river, which flows through the Klang Valley and Kuala Lumpur, has been heavily polluted by various sources including industrial waste, domestic sewage, and plastic debris. The problem has escalated to the point where it poses a serious environmental and public health risk. Unlike a former sand mining pool turned e-waste dumping site, Sungai Klang's pollution primarily results from urban runoff and inadequate waste management practices. The ongoing pollution crisis is exacerbated by periods of water scarcity due to irregular rainfall patterns and dry spells, putting additional pressure on the water resources in the region. Thus, the concept for this Smart River Cleaner was born. There is a chance that this issue will lessen river pollution to some degree. The data on river pollution from 2013 to 2021 show that the amount of pollution is rising annually. Due to people's irresponsible behavior, which involves discarding trash into rivers, river pollution is the result. River pollution is the contamination of water bodies of rivers, usually because of human activities.

1.3 PROBLEM STATEMENT

Environmental deterioration is the current problem statement that Sungai Klang is dealing with. The term environmental degradation of rivers describes how different human activities and natural processes have led to the decline in the health and quality of river ecosystems. Both human communities that rely on rivers for a variety of supplies and the ecosystem may suffer greatly because of this degradation. River environmental degradation is caused by various sources. Pollution of water, industrial discharges, Chemicals, heavy metals, and other dangerous materials are frequently released into rivers by factories and other enterprises. Water contamination can result from pesticides, fertilizers, and other agrochemicals used in agriculture washing into rivers through runoff. Other than that, interference with health and public safety. River pollution has wide-ranging effects that have an impact on public health and safety in several ways. A comprehensive strategy involving strict environmental laws, sustainable farming methods, and community awareness campaigns is needed to address these issues. Society may strive to restore and maintain the health of rivers, protecting the welfare of communities and ecosystems alike, by realizing the connections between environmental and public health issues

1.4 PROJECT OBJECTIVES

The objective of the study is to solve or provide a solution to the existing river cleaner problem. The following are the objectives of the project:

i. To identify the criteria for effective river cleaner.
ii. To produce the Smart River Cleaner.
iii. To ensuring the cleanliness of the environmental.

1.5 PROJECT SCOPE

The scope and limits of the project should be used as a reference for project work to meet the objectives without exceeding the limits set. Among the scopes to produce our product is Development of autonomous Smart River Cleaner, remote monitoring and control system project, solar powered Smart River Cleaner. The river at Sungai Klang was not clean and having rubbish that fit in with our project objectives. Sungai Klang river as project target to operate the Smart River Cleaner.

Figure 1.0 : Sungai Klang at Pengkalan Batu, Klang.

1.6 IMPORTANCE OF THE PROJECT

The significance of the project or study is also mentioned in relation to noteworthy studies that provide a quick overview of the project's or study's relevance, value, and consequences. One of the project's main goals is to increase the number of brainstorming techniques available to river users for solving current issues. Moreover, it can serve as a resource for future innovation in Smart River Cleaner product development.

1.7 EXPECTED FINDINGS AND RESULTS OF THE PROJECT

The ability to clean up the river and ensure that people have access to clean water resources is the largest benefit of our product, in our opinion, as it effectively collects trash from the river. The main purpose of this device is to make the work of river cleaners easier and faster by eliminating the need for them to consider the difficulties of reaching far-off trash. The creation of autonomous smart rivers cleaner, remote monitoring and control systems, and solar-powered smart river cleaners are all made possible by following standardized designs. If everything is considered, solar river cleaners are cutting edge instruments for maintaining clean and clear rivers, which are vital for human consumption.

Furthermore, the Smart River Cleaner Tool is a cutting-edge and innovative strategy created to deal with environmental issues in river ecosystems. This innovative tool uses cutting-edge technology to clean rivers effectively and sustainably, preserving aquatic habitats and fostering ecological balance. The Smart River Cleaner operates autonomously, utilizing artificial intelligence and sensor technology to navigate the waterway intelligently. This ensures optimal coverage and targeted cleaning of polluted areas. Sensors and Detection Systems Equipped with a suite of sensors, the tool can identify and analyze pollutants, debris, and other contaminants in real-time. These sensors include water quality analyzers, and environmental sensors to assess the health of the river ecosystem.

The Adaptive Cleaning Mechanism is another feature of the Solar River Cleaner. The instrument features an adaptable cleaning system that may be adjusted according to the kind and number of contaminants that are present. Because of its adaptability, it can efficiently deal with a variety of pollutants, such as oil spills and floating debris, guaranteeing a comprehensive and customized cleaning procedure. Mitigation of Environmental Impacts In order to reduce its ecological footprint, the Smart River Cleaner was designed with environmental conservation in mind. It uses low-energy methods and environmentally acceptable materials to minimize any possible harm to the river habitat while it is in operation. Remote Monitoring and Control Through an intuitive interface, the operators may monitor and control the Smart River Cleaner remotely. This feature improves operational effectiveness by enabling real-time modifications and interventions in response to the river's fluctuating conditions.

1.8 SUMMARY

Project/study implementation involves all learning and teaching processes (PDP) which are theoretical, practical, scientific writing, monitoring, and evaluation. Students are guided by supervisors to explore new knowledge and skills and relate to existing knowledge and ensure that the project can be completed within the specified time. A project is a case study/scientific activity that is appropriately related to the field and level of study to meet the requirements of the study program. Students will be supervised by at least one lecturer and assessed by institutions and/or industries. Project courses that are implemented within one semester include activities related to identifying problems, determining objectives, submitting a literature review, determining the research methodology, data collection, analysis, and validity of the results, debating the results, and drawing conclusions as well proposals.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Literature reviews are an essential part of academic research, as they provide a comprehensive overview of the existing knowledge and theories on a specific topic. Literature reviews can be used for various purposes, such as to justify the need for a new study, to identify gaps or inconsistencies in previous research, to compare and contrast different perspectives or approaches, or to evaluate the strengths and weaknesses of existing evidence. A literature review can also help to develop a theoretical framework and a research methodology for a new investigation. In this paper, we will conduct a literature review on the topic of technology and language learning, focusing on the effects of technology on second language acquisition. We will review the main theories, methods, and findings of the relevant literature, and identify the current trends, challenges, and implications for future research.

2.2 FIELD RESEARCH

We looked into a few relevant literature reviews for our report that might serve as useful resources while we develop the Smart River Cleaner. We shall review the research on the subject of technology and language learning in this essay, with particular attention to how technology affects the acquisition of second languages. The primary theories, approaches, and conclusions of the pertinent literature will be reviewed, and the current trends, difficulties, and implications for further study will be noted. Considering the article creation and construction of a remotely operated sewage cleaning apparatus. In order to collect and dispose of the sewage wastes, the article suggests a system that makes use of a wiper motor, a power window motor, a chain and sprocket, a lifter, a bucket, and a bin. RF transmitter and receiver modules are used in conjunction with a remote control to operate the system. Using the arm and bucket, the device may travel inside the drainage pipe and remove the floating and submerged pollutants. The bin that is positioned at the bottom of the machine is filled with the collected wastes.

2.2.1 Idhris et al. In their study, "Design and Fabrication of Remote-Controlled Sewage Cleaning Machine," Idhris et al. (2023) present an innovative solution to the health hazards posed by manual sewage cleaning. The authors aim to design and fabricate an automated machine that can perform drainage cleaning tasks, thereby protecting humans from the infectious microbes commonly found in sewage. This research is driven by the prevalent issue of water logging in sewage drains, which is often caused by the accumulation of plastic, thermocol, and metal wastes. These obstructions not only hinder the drainage system but also foster the growth of pests and facilitate the transmission of diseases. By addressing these challenges, the proposed automated machine has the potential to significantly reduce health risks and improve the efficiency of sewage maintenance.

2.2.2 S. Arun Kumar. Based on their studies on aquatic waste management highlights the increasing concern over water pollution in Indian water bodies, emphasizing the need for innovative solutions to tackle the issue of floating garbage. Arun Kumar and Sasikala's study, "Effective Aquatic Waste Removal through Lake Cleaning Robot for Smart City Environment," addresses this critical problem by developing a lake cleaning robot that automates the removal of surface waste. The robot uses a Raspberry Pi integrated with proximity sensors and DC motors to detect and collect garbage efficiently, showcasing reduced computational time and high accuracy in various test conditions. Prior research in this field has explored several embedded systems and robotic solutions aimed at enhancing waste management. These include IoT-based smart dustbins, automated robots for garbage collection in water bodies using AT-MEGA microcontrollers, and multi-robot systems for lake cleaning utilizing recruitment navigation algorithms. Kumar and Sasikala's work are distinguished by its focus on a cost-effective, embedded system specifically designed for Indian lakes, aligning with national initiatives like Swachh Bharat and the Smart City Mission. Their prototype demonstrates a practical application for reducing water pollution and supports broader environmental goals by contributing to a cleaner, more balanced ecosystem. The study concludes that the developed robot holds significant potential for wide-scale implementation in various static water bodies, thereby enhancing the efficacy of aquatic waste management efforts.

2.2.3 Kaushal Patwardhan. Based on their studies "Aqua Dredger - River Cleaning Machine" explores the design, fabrication, and potential improvements of a river cleaning device aimed at addressing the pollution in water bodies. The machine is designed to automate the process of collecting and disposing of waste from rivers and lakes, thereby reducing manual labour and the associated health risks. The primary materials used include PVC sheets for the floats and various mechanical components for the propulsion and collection systems. The prototype incorporates a conveyor system to gather waste, with suggestions for future enhancements such as advanced conveyor materials and solar power integration to improve efficiency and sustainability. The device aims to support initiatives like the Clean India Mission by providing a cost-effective solution for maintaining cleaner water bodies. The document highlights the limitations of current mechanical harvesters, such as high costs and operational challenges in shallow or obstructed waters and proposes the Aqua Dredger as an adaptable and economical alternative. Future developments could expand the machine's capacity to handle larger water bodies and incorporate more sophisticated waste sorting technologies.

2.2.4 S. Al-Zubaidi. Based on their studies "Design and Development of Rivere Cleaning Robot using loT Technology" the issue of water logging caused by plastic, thermocole, and metal waste fosters the development of pests and diseases such as malaria and typhoid. Manual waste cleaning methods are often inadequate due to the extensive areas that need to be covered and the health risks posed by exposure to infectious microorganisms in the sewage. This study proposes an effective and efficient garbage collection system designed to clean waste from rivers, channels, and lakes. The system is specifically engineered to handle a wide variety of debris, including floating litter, trash, logs, and disposed tires. It incorporates IoT technology to monitor and control the cleaning process, enhancing efficiency and effectiveness. The vessel developed for this purpose is adaptable to various environments beyond offshore areas, providing versatile options for cleaning and maintaining water bodies. This innovation addresses the critical need for contamination removal in water bodies, aiming to improve environmental health and reduce disease transmission.

2.2.5 R. A. Ranga Prabodanie. Based on their studies "Cleaning the water: A smart market for nitrates" explores the issue of water pollution due to nitrates, emphasizing the complexity of controlling non-point source pollution from agriculture. Large-scale commercial entities, such as farms, significantly contribute to nitrate pollution, which affects both human health and ecosystem sustainability. Traditional technological treatments are ineffective against diffuse pollution sources, prompting the need for innovative solutions. The reviewed study proposes a tradable permit system for managing non-point source nitrate discharges, aiming to minimize transaction costs and account for externalities over time and space. This system uses a smart market approach, integrating computer algorithms to determine prices and allocations that maximize economic efficiency. The hydrological models MODFLOW and MT3D are employed to simulate groundwater flow and contaminant transport, generating response matrices used in the trading model. The proposed system includes an online auction for trading nitrate permits, providing flexibility in land use decisions and facilitating compliance with environmental standards. Initial case studies indicate that water quality constraints significantly influence trade dynamics, and the system's design can potentially be adapted for other hydrological pollutants. This approach represents a sophisticated application of science, economics, and operations research to address environmental pollution, aiming to balance economic benefits with environmental sustainability.

2.2.6 Ferdinand Apietu Katsriku. Based on their studies "Smart River Monitoring Using Wireless Sensor Networks" explores the issue of monitoring and communicating water quality data in real-time is crucial for sustainable development, particularly in developing countries where water-borne diseases are prevalent. Rivers, essential for human and animal life, require efficient monitoring networks to alert stakeholders about changes in water quality. Traditional methods in Ghana, which involve field officers collecting water samples for lab analysis, are challenging, time-consuming, and expensive, and often lack the needed temporal granularity. New in situ measurement devices, such as the HANNA pH meter, HACH turbidity meter, and spectrophotometer, have been proposed but still do not ensure timely data collection as they are not permanently deployed. A modern approach involves using wireless sensor networks (WSNs), which consist of autonomous, self-configuring, battery-powered sensor nodes capable of measuring and transmitting data to a central office. These nodes, equipped with wireless transceivers, offer advantages such as autonomy, reliability, robustness, speed, accuracy, and cost-effectiveness, making WSNs a preferred technology for monitoring river pollutants. The data gathered is typically sent through a gateway to the cloud, enabling real-time access via a web portal. In Ghana, Libelium wireless sensors were deployed at the Weija dam intake to provide continuous real-time data, accessible to the public. These sensors were chosen for their robustness, accuracy, ease of setup, low energy consumption, and compatibility with other systems. The study compares the performance of these sensors with traditional lab measurements and plans to benchmark them against future fiber optic sensors. This research highlights the effectiveness of WSNs in water quality monitoring and their potential for broader environmental management applications.

2.2.7 R. A. Ranga Prabodanie. Based on their studies "Cleaning the water: A smart market for nitrates" explores the issue of water pollution due to nitrates, emphasizing the complexity of controlling non-point source pollution from agriculture. Large-scale commercial entities, such as farms, significantly contribute to nitrate pollution, which affects both human health and ecosystem sustainability. Traditional technological treatments are ineffective against diffuse pollution sources, prompting the need for innovative solutions. The reviewed study proposes a tradable permit system for managing non-point source nitrate discharges, aiming to minimize transaction costs and account for externalities over time and space. This system uses a smart market approach, integrating computer algorithms to determine prices and allocations that maximize economic efficiency. The hydrological models MODFLOW and MT3D are employed to simulate groundwater flow and contaminant transport, generating response matrices used in the trading model. The proposed system includes an online auction for trading nitrate permits, providing flexibility in land use decisions and facilitating compliance with environmental standards. Initial case studies indicate that water quality constraints significantly influence trade dynamics, and the system's design can potentially be adapted for other hydrological pollutants. This approach represents a sophisticated application of science, economics, and operations research to address environmental pollution, aiming to balance economic benefits with environmental sustainability.

2.2.8 Matt Meersmane. Based on their studies "Smart Assessments: reduced maintenance, Cleaner Water and Fewer complaints" they explores the issues about Bill Mihelich's dedication to soil conservation exemplifies the significance of sustainable land management practices in agriculture. Despite implementing no-till farming for 27 years, he faced frustration over the lack of financial incentives compared to his neighbors enrolled in conservation programs. However, in 2014, a pilot program in Van Buren County introduced a groundbreaking approach by integrating a land management factor into drain assessment calculations. This innovative initiative, championed by Van Buren County Drain Commissioner Joe Parman, the Van Buren Conservation District, and The Michigan Chapter of the Nature Conservancy, acknowledges and rewards individuals like Mihelich for reducing sediment and runoff, benefiting both landowners and the entire drainage district. The collaboration between stakeholders and support from organizations like the Great Lakes Protection Fund and Michigan State University underscores the collective effort towards promoting sustainable land practices and improving water quality.

2.2.9 P. K. Dutta. Based on their studies "An automated surface water cleaning robot for ponds and water reservoirs" they explores the issues about the development of Surface Water Cleaning robots marks a significant advancement in addressing the pressing issue of water pollution in surface water bodies such as rivers, lakes, and ponds. These robots are specifically engineered to tackle the accumulation of various pollutants, including plastics, which not only endanger human health but also threaten the delicate ecosystems inhabited by diverse aquatic organisms. Utilizing a Conveyor Belt mechanism, these robots efficiently collect and remove surface wastes, while also addressing the challenge of capturing elusive pollutants like Algae and Duckweed by guiding them towards the water body's edges. Integration of a camera module enables real-time monitoring of waste accumulation and aids in navigation, enhancing the effectiveness of waste collection operations. The propulsion system, powered by water propellers, facilitates manoeuvrability and waste collection, while an Android application, coupled with Bluetooth technology, enables remote control and monitoring of the robot's movements and waste collection activities. Employing sustainable materials such as recyclable plastics and waste materials for the robot's construction underscores a commitment to environmental stewardship. By reducing reliance on human intervention for waste removal, these robots not only mitigate health risks associated with manual cleanup efforts but also safeguard the well-being of aquatic life. In summary, the implementation of Surface Water Cleaning robots presents a promising solution to combat water pollution, benefiting both human communities reliant on clean water sources and the preservation of aquatic ecosystems.

2.2.10 Puneeth E Raikar, based on their studies about "Lake Health Monitoring and Waste Collecting Aquabot" this paper emphasis on design and fabrication of the river waste cleaning machine. The idea has done looking at the current situation of our national rivers which are dumped with crore liters of sewage and loaded with pollutants, toxic materials, debris etc. The government of India has taken charge to clean rivers and invest huge capital in many river cleaning projects like Namami Gange, Narmada Bachao and many major and medium projects in various cities like Ahmadabad, Varanasi. By taking this into consideration, this machine has designed to clean river water surface. Nowadays almost all the manufacturing process is being atomized to deliver the products at a faster rate. Automation plays an important role in mass production. In this project we have fabricated a remote operated river cleaning machine. The main aim of the project is to reduce the manpower, time consumption for cleaning the river. In this project we have automated the operation of river cleaning with the help of a motor and partially submerged cage arrangement. Some needs of automation are described below. Here using RF transmitter and receiver are to control the cleaning machine. Automation can be achieved through computers, hydraulics, pneumatics, robotics, and robotics forms an attractive medium for low-cost automation.

2.3 MATERIAL

After spending time on the literature review research I found that a few of perfect material for us to use in the making of Smart River Cleaner like the most reseach have use are Radio Fraquency Transmitter and receiver board.

2.3.1 Radio Frequency Transmitter

A radio frequency (RF) transmitter is a device that generates electromagnetic waves at radio frequencies to transmit information wirelessly through the air. It serves as the essential component in various communication systems, including radio broadcasting, television transmission, wireless networking, and remote control applications. The transmitter modulates the information onto a carrier wave by varying its amplitude, frequency, or phase, depending on the modulation scheme employed. This modulation process enables the transmitter to encode audio, video, data, or other types of information onto the RF signal for transmission.

The key components of an RF transmitter typically include an oscillator, a modulator, and a power amplifier. The oscillator generates the carrier wave at the desired frequency, which is then modulated with the input signal from the modulator. The modulator alters the characteristics of the carrier wave according to the information to be transmitted, ensuring that the resulting RF signal carries the intended data. Finally, the power amplifier boosts the strength of the modulated RF signal to achieve the desired transmission range and signal quality. RF transmitters play a crucial role in enabling wireless communication across various domains, facilitating the exchange of information over long distances without the need for physical connections.

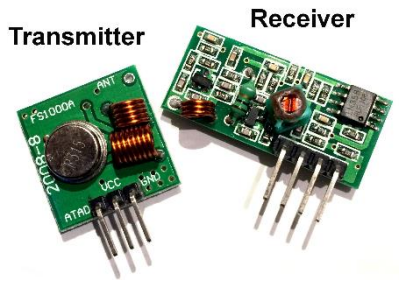


Figure 2.0: Radio frequency transmitter

2.3.2 Receiver Board

A receiver board, often used in remote-controlled boats, serves as the intermediary link between the boat and its controller, enabling wireless communication and control. This essential component receives signals transmitted by the controller and translates them into commands that govern the boat's movement and operation. Typically, the receiver board consists of a radio frequency (RF) receiver module, microcontroller, and motor drivers.The RF receiver module receives radio signals transmitted by the controller, operating on a specific frequency band compatible with the transmitter. These signals carry control information, such as throttle, steering, and auxiliary functions, encoded by the controller. The receiver demodulates the RF signals and extracts the encoded data, which is then processed by the microcontroller.

The microcontroller serves as the brain of the receiver board, executing firmware that interprets the received control commands and translates them into actions for the boat. Based on the decoded signals, the microcontroller activates the appropriate motor drivers to adjust the boat's speed, direction, and other functions accordingly. Additionally, the microcontroller may incorporate features such as fail-safes and signal processing algorithms to enhance the reliability and responsiveness of the control system. Overall, the receiver board plays a vital role in enabling seamless communication between the controller and the boat, facilitating precise and intuitive remote operation for users.

Figure 2.1: Receiver board and remote controller.

2.4 SUMMARY

The literature reviewed gives the significance of addressing water pollution through innovative solutions and collaborative efforts. Surface Water Cleaning robots offer a promising approach to mitigate pollution in rivers, lakes, and ponds, effectively removing various pollutants, including plastics, while protecting aquatic ecosystems. These robots utilize advanced technologies such as Conveyor Belt mechanisms, camera modules for monitoring, and propulsion systems for maneuverability, enhancing their efficiency in waste collection. Moreover, their use of sustainable materials reflects a commitment to environmental responsibility.

Similarly, the integration of a land management factor into drain assessment calculations exemplifies a proactive strategy to incentivize sustainable land practices. This pilot program, spearheaded by stakeholders like the Van Buren County Drain Commissioner and environmental organizations, acknowledges and rewards landowners for minimizing sediment and runoff, ultimately benefiting the entire drainage district. The collaboration between stakeholders and support from external organizations highlight the importance of collective action in promoting environmental conservation and improving water quality.

The significance of technological innovation, cooperation, and policy interventions in mitigating water pollution and advancing sustainable land management practices is emphasized by both programs. Stakeholders can collaborate to protect water supplies and ecosystems for current and future generations by utilizing robotics breakthroughs and incorporating environmental considerations into legislative frameworks.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

This chapter will explain about the progression of this Final Year Project for Semester 4 and Semester 5. I included a flow chart in this chapter to show the sequence of operations that required to complete the work. My flow chart is typically drawn at the beginning of our project as a guidance to complete our project. Flow charts help project teams to plan, organize, and communicate complex procedures more effectively, aiding in identifying potential bottlenecks, dependencies, and areas for optimization. Additionally, flow charts facilitate collaboration among team members by providing a common reference point for understanding project workflows and enabling more efficient problem-solving and decision-making. Overall, flow charts play a crucial role in streamlining project management and enhancing project clarity, coherence, and efficiency.

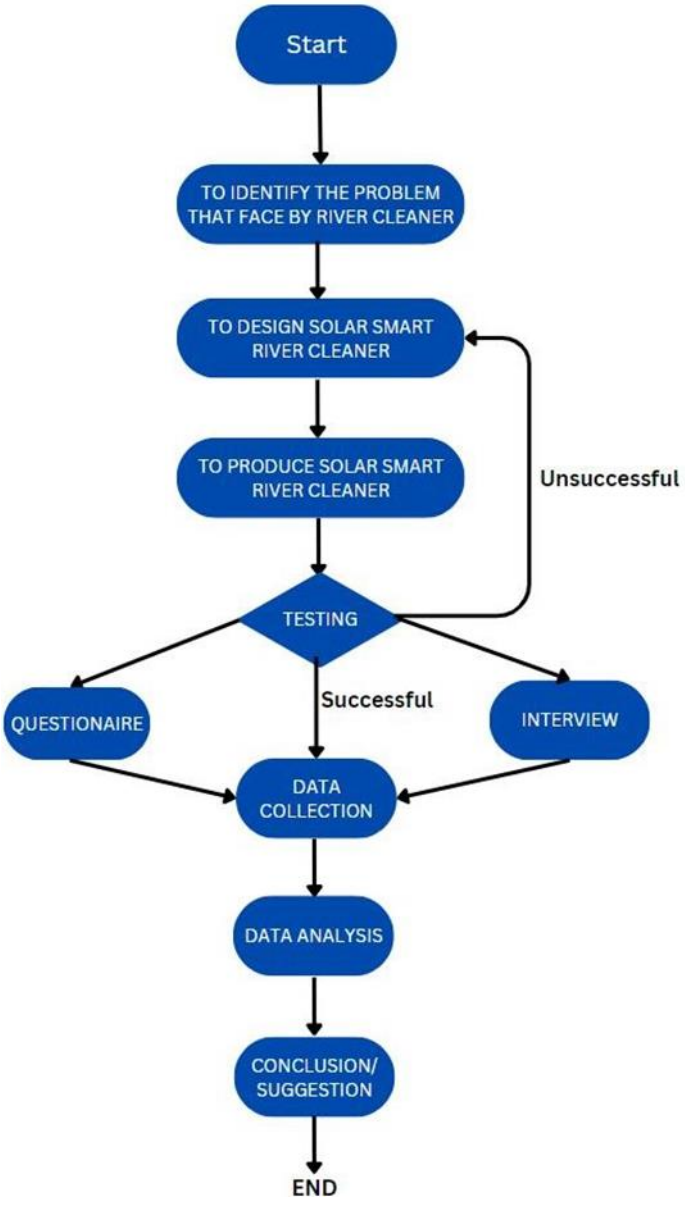


Figure 3.0: Flow chart represent a process to build Smart River Cleaner

3.1.1 Project Design

We design the innovation towards the Smart River Cleaner. We sketch the product for a clear vision of our project. Then we drew the product using AutoCAD for a better vision of our innovation.

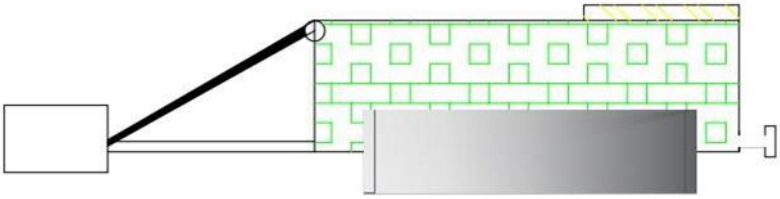


Figure 3.1: Right View

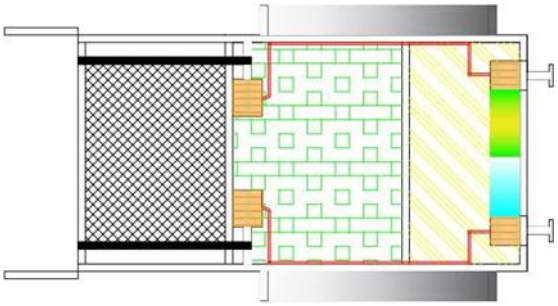


Figure 3.2: Top View

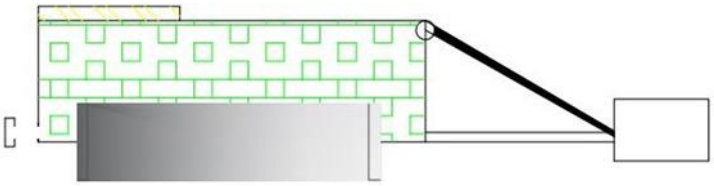


Figure 3.3: Left View

3.1.2 Project Assembling Method

To identify the project methods, we use materials and components that were bought from the internet to build the Smart River Cleaner. How do we build? The first step is to build a frame to support the plastic colander by using ½ inch pipe. We measure the perimeter of the plastic colander and cut the ½ pipe by following the plastic colander frame and joining it up.

Next , for the second step binding the DC motor by using steel band at the frame. DC motor as a power to pull up plastic window net by connecting with rubber band. For the support of the plastic window net we used a paint roller as a support to support the plastic window net. Solar panel and LED light hanging on the top of the frame.

Furthermore, the battery and the motherboard of the controller are put into the small plastic box and tied up by using a steel band at the back of the frame to avoid being stained with water. Battery is the main source of the power for the entire electrical system to run, the solar panel will be the support to the LED light.

As soon as the setup is on, the rubber band and motor Pulley starts to rotate and will have the power to rotate the plastic window net to collect the waste materials from the sewage. The direction of the Smart River Cleaner is controllable, by using a small DC motor and the leaf fan that has been installed to change the direction of the (SRC) control by the controller remote. The RF Transmitter acts as a control of the speed of the DC motor.

3.2 MATERIALS

3.2.1 Direct Current (DC) Motor

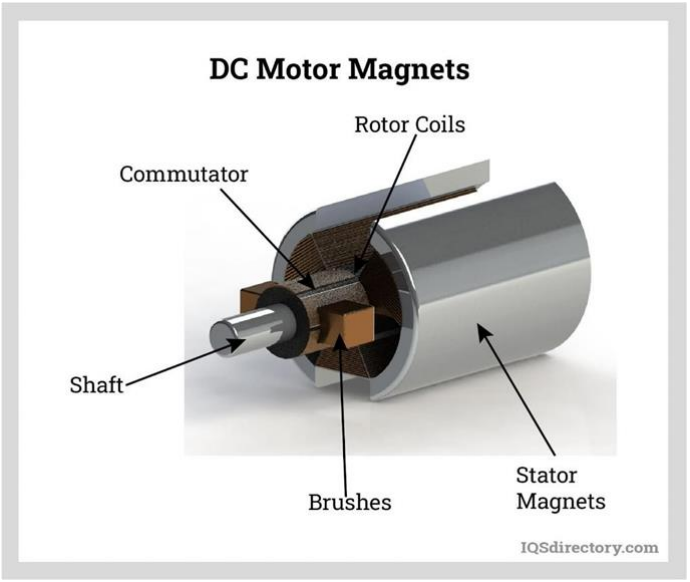


Figure 3.4: DC Motor

A direct current (DC) motor as shiwn **Figure 3.4: DC Motor** is an electro-mechanical device that converts electrical energy into mechanical energy through the interaction of magnetic fields. It operates on the principle of Lorents force, where a current-carrying conductor in a magnetic field experiences a force.

In this project we are going to use DC motor because DC motors find widespread use due to their simplicity, controllability, and versatility in applications for our project. Other than that, DC motors are widely used in various applications, including robotics, electric vehicles, conveyor systems, fans, and many other industrial and consumer devices. They offer advantages such as simplicity, controllability, and ease of speed regulation.

3.2.2 Solar Panel

Figure 3.5: Solar Panel

Solar panels as shown **Figure 3.5: Solar Panel** are devices that convert light from the sun, which is composed of particles of energy called "photons", into electricity that can be used to power electrical loads. The smart river cleaner will get the electricity from the solar panel. Solar panels can be used for a wide variety of applications including remote power systems for cabins, telecommunications equipment, remote sensing, and of course for the production of electricity by residential and commercial solar electric systems.

Solar panels collect clean renewable energy in the form of sunlight and convert that light into electricity which can then be used to provide power for electrical loads. We used solar panel as an electrical sources to support our 10W spotlight.

3.2.3 Polyvinyl Chloride (PVC) Pipe

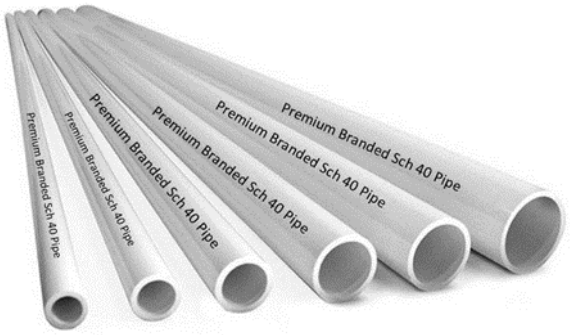


Figure 3.6: Polyvinyl Chloride (PVC) Pipe

Polyvinyl chloride (PVC) pipe as shown **Figure 3.6: PVC pipe** is a versatile and widely used thermoplastic piping material known for its durability, affordability, and corrosion resistance. PVC pipes come in various sizes and types, including rigid and flexible options. The rigid PVC pipes are commonly used for water distribution systems, irrigation, and plumbing due to their high tensile strength and resistance to pressure.

In addition, PVC pipes can float in water due to their low density. PVC, is a relatively lightweight material, and when formed into a hollow structure like a pipe, it displaces a volume of water greater than its own weight. The buoyancy effect allows PVC pipes to float on the surface of water, making them useful in various applications.

In this situations, the buoyancy of PVC pipes is intentionally utilized for our smart river cleaner. The PVC pipes will be used to create floating structures as a base for Smart River cleaner.

3.2.4 Plastic Window Net

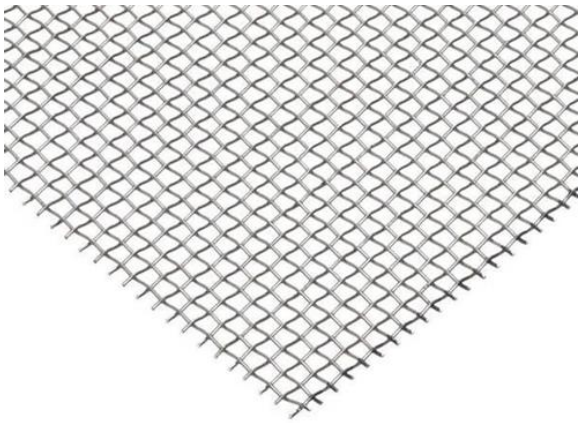


Figure 3.7: Plastic Window Net

Plastic window nets as shown **Figure 3.7: Plastic window net** are designed to serve various purposes, including insect protection, privacy, and sometimes to filter sunlight. The netting typically has a fine mesh size to prevent insects, bugs, and other small pests from entering the enclosed space while still allowing air circulation.

In this project Plastic window nets are as a trap for collect the rubbish connect with DC motor and rubber band. The plastic window net will follow the power of the DC motor that connect with the rubber to rotate together and pull up the floating rubbish at the surface of the river into the plastic colander.

3.2.5 Stranded Wire

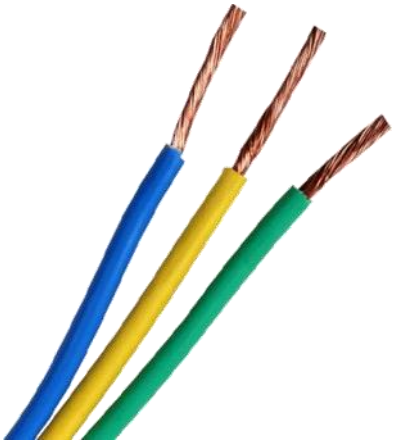


Figure 3.8: Stranded Wire

The wire's conductive core facilitates as shown **Figure 3.8: Stranded wire** the flow of electrical current, while the outer insulation provides protection against environmental factors and prevents unintended contact with conductive materials. The insulation material can vary and may include thermoplastics, somersetting plastics, or rubber, depending on factors like temperature resistance, flexibility, and the specific application requirements.

We use stranded wire as wire for our wiring. This is because the wiring system for smart river cleaner does not need to use a large wire size. In conclusion, stranded wire has met the specifications of our project.

3.2.6 Heavy Duty Plastic Colander

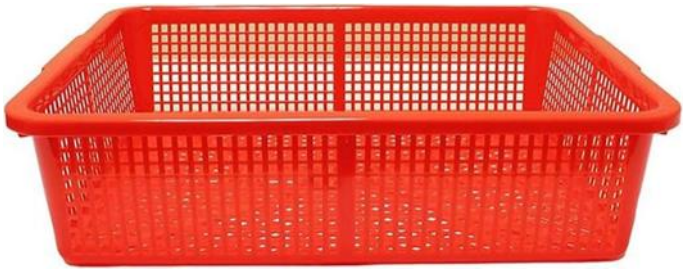


Figure 3.9: Heavy Duty Plastic Colander

A heavy-duty square plastic colander as shown **Figure 3.9: Plastic colander** is a robust and durable kitchen tool designed for more demanding culinary tasks. Constructed from sturdy, high-quality plastic materials, this colander is built to withstand the rigors of heavy use. The plastic colander, repurposed as a trash storage component for smart river cleaner. Its perforated structure enables water to pass through while efficiently trapping solid waste, preventing it from re-entering the water system. This adaptability makes the plastic colander an effective tool to storagw the rubbish.

In addition, the collected waste stored in the plastic colander can be easily emptied and properly disposed of and ensuring that the smart river cleaner operates continuously to maintain water quality. This integration of technology and a repurposed plastic colander shows a forward-thinking approach to environmental issues, demonstrating how simple yet innovative solutions can contribute to the conservation and preservation of water ecosystems.

3.2.7 Small Plastic Fan

Figure 3.10: Plastic Fan

We used small plastic fan as shown **Figure 3.10: Small plastic fan** that attach to DC motor as a mechanism to make the smart river cleaner moves. The small plastic fan, ingeniously attached to a DC motor, serves as a key mechanism for propelling the smart river cleaner through water with efficiency and precision. The fan, harnesses the power generated by the DC motor to create a forward thrust.

As the motor spins the fan blades, it generates a flow of water in the opposite direction, propelling the cleaner forward. The compact size of the fan ensures that it can navigate through various water environments, including narrow or shallow areas where larger propulsion systems might be impractical.

3.2.8 Remote Controller

Figure 3.11: Remote Controller

The controller as shown **Figure 3.11: Remote controller** for smart river cleaner plays an important role in orchestrating its operations and ensuring effective navigation and waste removal. This device serves as the brain of the cleaner, allowing operators to remotely guide and supervise its movements. Equipped with a range of sensors, the controller receives real-time data from the smart river cleaner, including information about water conditions, debris concentration, and the cleaner's current location.

3.2.9 Radio Frequency Transmitter

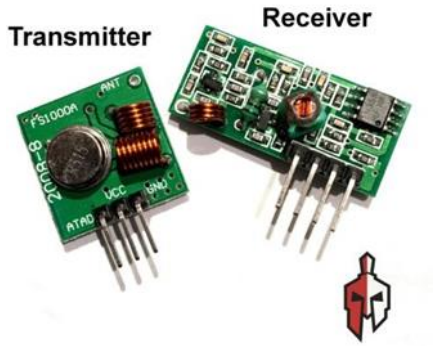


Figure 3.12: Radio Frequency (RF) Transmitter

The RF (Radio Frequency) transmitter as shown **Figure 3.12: RF transmitter** employed in a smart river cleaner is a vital component that facilitates wireless communication between the cleaner and its control system. This technology enables operators to remotely command and monitor the cleaner's functions without the need for a physical connection.

The RF transmitter, typically integrated into the cleaner's communication system, emits radio waves carrying data packets containing instructions or feedback from the cleaner. These radio waves travel through the air and are received by a corresponding RF receiver on the controller, establishing a seamless and efficient means of communication over a certain range.

3.2.10 5000 mAh Battery

Figure 3.13: 5000 mAh Battery

We used 12V battery as shown in the **Figure 3.13: 12V Battery** as a power source for supporting the DC motor in a smart river cleaner. This portable and rechargeable battery provides the necessary electrical energy to drive the DC motor, which, in turn, powers various components of the cleaner, such as the propulsion system or other electrical mechanisms. Its 12-volt output is well-suited for the energy requirements of the DC motor, offering a reliable and efficient power supply that enables the cleaner to operate autonomously in aquatic environments.

3.2.11 Spotlight

Figure 3.14: Spotlight

The spotlight as shown **Figure 3.14: Spotlight** was positioned strategically on the cleaner, the spotlight illuminates the surrounding area, allowing operators to monitor the cleaner's progress and identify potential obstacles or debris. This feature is particularly valuable for nighttime or dimly lit environments, ensuring that the smart river cleaner can effectively navigate and target areas with higher concentrations of pollutants. The spotlight's design takes into consideration the unique challenges of water environments, providing a focused and adjustable beam that aids in precision cleaning and maneuvering.

3.3 DATA ANALYSIS METHOD

The analysis of data gathered through interviewing and questionnaire methods involves distinct processes tailored to each approach. We need to prepare a set of key questions, the interviewer engages in dialogue, records responses through note-taking or recording, and subsequently transcribes and analyzes the data thematically or qualitatively. This method allows for delicate exploration and clarification, but it is time-intensive and susceptible to interviewer bias. Besides that, the questionnaire method utilizes written or typed sets of questions, distributed to a larger sample through various means. Following the collection of responses, quantitative analysis ensues, summarizing and interpreting numerical data. Questionnaires are cost- effective and efficient for our project but may yield limited depth of information and face challenges related to respondent bias. We adopt a mixed-methods approach, combining the strengths of both techniques to attain a more comprehensive understanding of the research topic. This integration allows for triangulation of findings, enhancing the overall validity and reliability of the analysis.

3.3.1 Interviews

i. **Develop interview questions**:

   Create a set of well-crafted questions that cover the relevant aspects of the smart river cleaner. These questions should be open- ended, allowing interviewees to provide detailed responses. Consider asking about how long they have experience as river cleaner, their personal information and also asking them if they have a tool, what is the best tools that can ease them to clean the river.

ii. **Record and transcribe data**:

   Record the interviews with the consent of the participants, either through audio or video recording. Transcribe the interviewsaccurately for easier analysis. If permitted, consider taking notes during the interview to capture additional details and non-verbal cues.

iii. **Analyze the data**:

Start analyzing the transcribed data by systematically reviewing each interview. Look for recurring themes, common feedback, or notableinsights. Identify patterns, trends, and noteworthy quotes that provide valuable information about the signboard's performance, usability, or user preferences.

3.3.2 Questionnaire

i. This method involves the use of technology to build questionnaires in the form of Google Forms that can be filled out by cleaners in the area where the survey is conducted and can be filled out online. The questionnaire is designed to collectdata on the number of people who are aware of the cleanliness of the river.

ii. Questions in the questionnaire may include how long they have experience as a river cleaner? And what are the problems that they are facing when cleaning the river. In addition, in the questionnaire there are also questions related to if they have a tool that can assist in river cleaning, what type of tool would be most helpful for them.

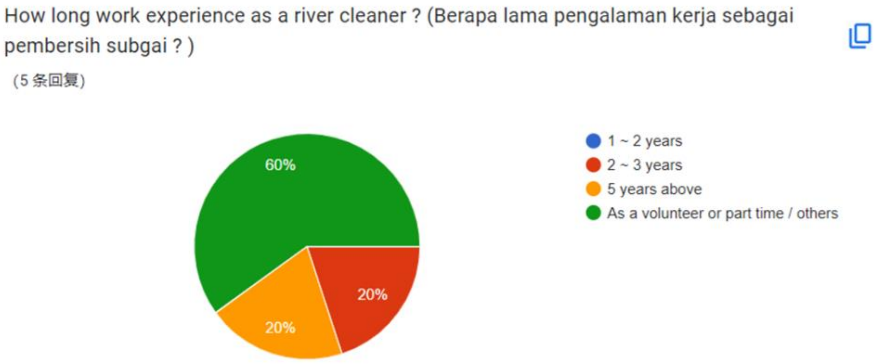


Figure 3.15: Some the answer from the questionnaire

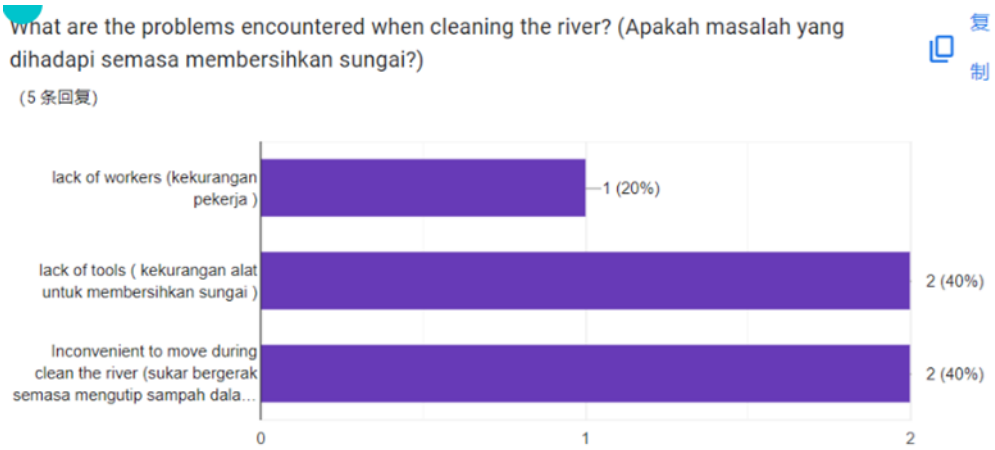


Figure 3.16: Some the answer from the questionnaire

3.4 PROJECT COST

Num.	Material	Unit	Price	Total price
1	DRILL MOTOR	2	RM17.02	RM34.04
2	DC MOTOR 3V	2	RM2.00	RM4.00
3	12V LITHIUM BATTERY	1	RM60.90	RM60.90
4	PVC END CAP	2	RM12.73	RM25.45
5	MICRO DC FAN	2	RM3.30	RM6.60
6	27MHZ REMOTE &12V RECEIVER BOARD	1	RM50.13	RM50.13
7	CABLE TIE	1	RM6.90	RM6.90
8	RABBER BAND	1	RM3.90	RM3.90
9	PVC MESH 1 METER	1	RM6.00	RM6.00
10	PAINT ROLLER REFILL	2	RM2.10	RM4.20
11	CABLE INLINK 4.0MM	1	RM2.20	RM2.20
12	CABLE LINK 2.5 MM	1	RM1.80	RM1.80
13	CABLE LINK 1.5 MM	1	RM1.40	RM1.40
14	PVC BRACKET	1	RM1.50	RM1.50
15	ARROW PVC SOLVENT GLUE	1	RM4.50	RM4.50
16	PVC PIPE 15 MM	1	RM13.20	RM13.20
17	PVC END CAP 15 MM	6	RM0.30	RM1.60
18	PVC TEE 15 MM	12	RM0.60	RM7.20

19	PVC ELBOW 15 MM	12	RM0.50	RM6.00
20	50P DRYWALL SCREW	1	RM1.33	RM1.33
21	10M 12MM STEEL BAND	1	RM8.74	RM8.74
22	1.15M CLASS 80 MM PIP	2	RM7.70	RM15.39
23	BASKET	1	RM2.40	RM2.40
TOTAL				RM269.38

Table 1.0: Cost breakdown

3.5 GANTT CHART

Gantt chart for Semester 5 from Week 1 to Week 14

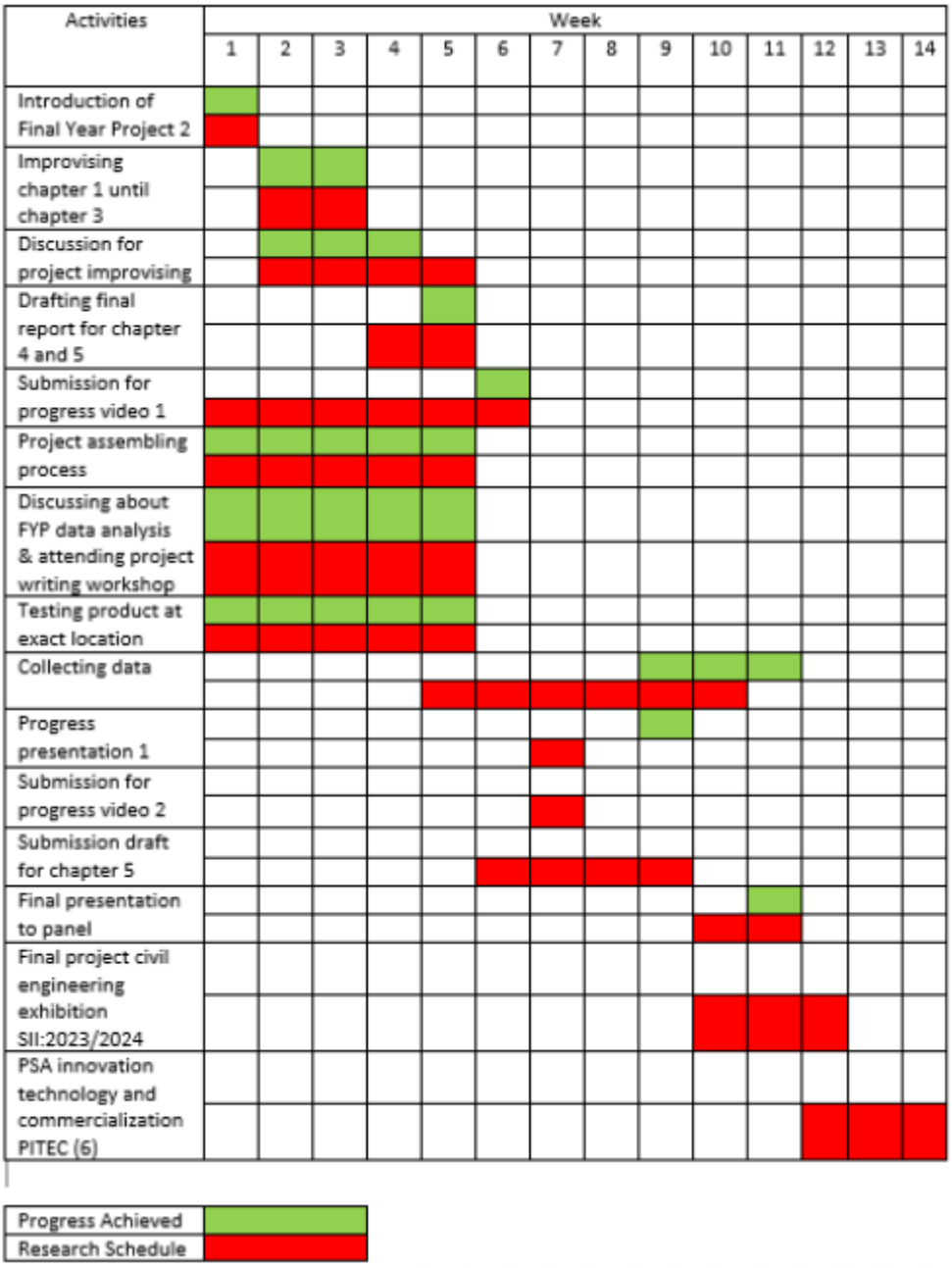


Table 2.0: Gantt chart for Semester 5

3.6 SUMMARY

In conclusion, the methodology adopted for this real-type project has proven to be effective in guiding the execution of tasks and achieving project objectives. By meticulously planning and detailing each step of the project workflow, we have ensured clarity, efficiency, and consistency in our approach. The systematic arrangement of tasks in the methodology has facilitated smooth coordination among team members, enabling seamless collaboration and communication. Moreover, the methodology has provided a structured framework for problem-solving and decision-making, allowing us to address challenges promptly and adapt to changing circumstances. Overall, the methodology has served as a valuable tool for project management, guiding us through the implementation process and contributing to the successful execution of the project.

CHAPTER 4

DATA ANALYSIS

4.1 INTRODUCTION

This chapter analyzes the results of the study based on several project tests that have beendone. If this final project is not fully completed, it cannot be implemented. This chapter alsodiscusses preliminary research for future projects. Each project has to achieve the goals set atthe beginning, and the performance of the group members on each project must be evaluated to see if it will be successful or not. The goal for Smart River Cleaner project is to meet the needs of us to determine the weight of rubbish that can be collected using Smart River Cleaner and ensure that our products can be used smoothly. To make this project success, several key studies have been conducted. The questionnaire that has been made for the users of this project shows that the information we received has an impact on us and also the "Smart River Cleaner" project in terms of advantages and disadvantages. The main part of the project has also been modified and improved to get a useful project.

Preliminary study of motor types:

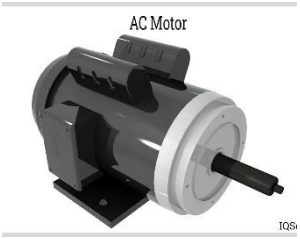
AC Motor	**DC Motor**
	

Table 3.0: Picture of AC Motor and DC Motor

In the selection of motor, we use DC Motor. This is because in the terms of price, DC Motor is much cheaper than AC Motor and DC Motor can be installed easily. However, DC Motor is our choice because of its low cost, simplicity of installation, fit for the needs of the application, compatibility with power sources, and maintenance benefits. To sum up, these elements support the Smart River Cleaner system's overall efficacy, cost, and sustainability in reducing river pollution and fostering environmental preservation.

Preliminary study of mechanism that lifts garbage from the river into the smart river cleaner:

Wire mesh	**Tyre tube**
	

Table 4.0: Picture of Wire mesh and Tyre tube

In the selection of the mechanism that lifts garbage from the river into the Smart River Cleaner, after multiple time we try to run the project we found that the wire mesh cannot lift the garbage up because of its uneven surface while the tyre tube that have claw can lift the garbage up. This outcome highlights the importance of selecting a mechanism that can efficiently handle the varying surface conditions encountered in river cleaning operations.

4.2 RESEARCH FINDINGS

4.2.1 Real Type Project

In order to assess the effectiveness and significance of smart river cleaner technologies, research initiatives usually combine quantitative and qualitative research approaches. With the use of sensors and monitoring devices mounted on the cleaner, quantitative approaches gather data that may be used to assess things like debris accumulation rates, water quality indicators, and operating efficiency metrics. Empirical evidence of the cleaner's effectiveness and its contribution to enhancing river health is provided by this data-driven method.

On the other hand, qualitative research methods involve gathering insights from cleaners through questionnaires. These techniques seek to comprehend opinions, firsthand knowledge, and comments about the implementation and efficiency of the smart river cleaner. By gathering qualitative information such as user experiences, difficulties encountered, and suggestions for improvement, qualitative research can deepen the study. These initiatives produce thorough results that add to a comprehensive understanding of the smart river cleaner's influence on reducing pollution and improving river ecosystems by fusing quantitative and qualitative research methodologies. Qualitative insights are added to the empirical facts gathered through quantitative data collecting to provide a comprehensive evaluation of the cleaner's efficiency and to guide future approaches to sustainable river management.

4.2.2 Empirical Results and Data Analysis

In the context of research, empirical results and data analysis are conclusions drawn from the gathering and analysis of real-world data, frequently using methodical research techniques. For understanding the study's consequences and for drawing conclusions and inferences, these results are crucial. The steps in the process are collecting data, analyzing it using statistical or qualitative methods, and interpreting the results. The research methodology used determines the degree of intricacy and detail in the reporting of empirical data.

In the context of a study on Smart River Cleaner, empirical result may include data related to the performance, effectiveness, and impact of these smart river cleaner in each setting. For example, statistics on the weight of trash that a smart river cleaner could remove in a certain amount of time, whether or not smart river cleaners can make the work of river cleaners easier, and whether or not the cleanliness of the river changed after employing smart The process of data analysis entails arranging, purifying, and conducting statistical analysis on the gathered data in order to spot trends, patterns, and connections.

Questionnaires data before modification

A small number of responders who are employed as river cleaners or who have previously volunteered to clean the river. We conducted a group interview with them and asked them to fill out a Google Form with a few questions on their work-related experience. Our goal is for at least ten persons to fill out this form and be interviewed. In addition, respondents must fill out a form with personal information about themselves, including name, age, occupation, and previous employment history. Twenty percent of the responders were female, with an average age of twenty. 40% (4) of the respondents were male and ranged in age from the average of 20 to 40. Many of them have worked in rivers for more than a year.

The results of the analysis of respondents' answering question that we give which is what are the problem that encounter when cleaning the river . People problems evaluate through the analysis above. A total of statements has been outlined related to the respondents' problems. Based on the data obtained from the table above, respondents gave answers 20% of them are having problem with the lack of worker , other 40% is lack of tools and lastly 40% of them is inconvenient to move during clean the river.

The response to the final question displays a wide range of responses from the respondents. For example, the long-handled net to scope waste eliminates the need for us to enter the river to gather trash in the middle of the waterway. Next, a remotely controlled waste net that can gather trash from the centre of the river. Other than that, it is simple to capture rubbish and gadgets using remote controls without the need for human strength. gadgets that can collect rubbish passively, like robots that clean the ocean.

It shown that most respondents indicated they would want to have a tool or other item that can assist them in cleaning the river. This demonstrates that the majority of those employed by the river have already recognized their issues in terms of cleaning. To make their job easier, they need to consider how to solve their difficulty by suggesting.

Questionnaire data after modification

After interviewing most of the respondents choose to agree and strongly agree with the above statement for use to create the smart river cleaner because the project we do can be clearly seen and improve their work environment were making their job easier to finish and keeping the cleanliness of river all the time. A total of 7 people agreed with the statement.

Most of the respondents gave positive feedback about the project we run and were rooting for us to finish this product successfully. The proof is that we could see that we achieved the third objective which is to determine the weight of rubbish. The data below shows the weight of rubbish that we can collect with the set timing which is 30 minutes.

4.3 DATA ANALYSIS

We went through five rounds of data collecting in order to arrive at an average dataset that was obtained from the smart river cleaner's operations. This combined data provides strong support for evaluating the smart river cleaner's performance and efficacy, providing insightful information on how well it clears debris and keeps the waterway clean.

Number of collection data	Time	Weight
Data 1	30 mins	5.6 kg
Data 2	30 mins	6.0 kg
Data 3	30 mins	4.7 kg
Data 4	30 mins	6.3 kg
Data 5	30 mins	5.8 kg

Table 5.0: Set of data for first testing at Sungai Klang

Average data collection: $\frac{5.6 + 6.0 + 4.7 + 6.3 + 5.8}{5} = 5.68kg$

Effective data: 5.68 kg per 30 minutes

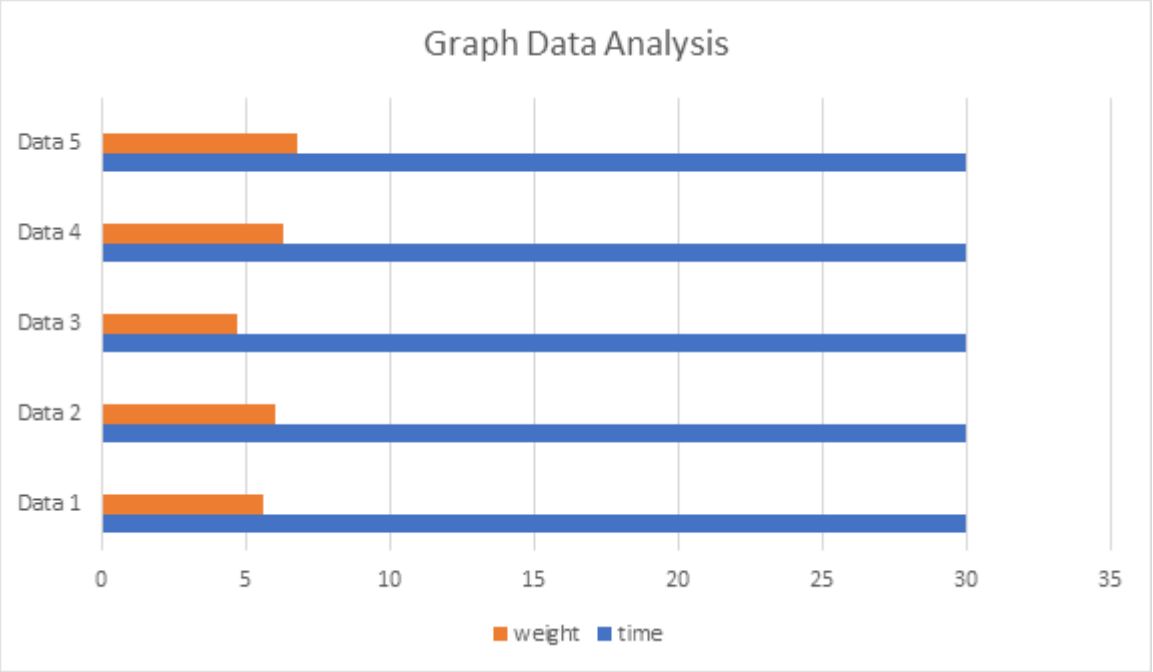


Figure 4.0: Graph for first testing at Sungai Klang

Data analysis for second testing at Tasik Widuri

To evaluate the effectiveness of the SRC in preventing the accumulation of garbage, we conducted a test by placing a 5 kg weight of non-polluting debris such as plastic bottles and tree debris on the surface of the lake. This evaluated the system's ability to manage and intercept such debris by simulating real-world settings. We also timed how long it took the SRC to collect and confine the five kilograms of debris, which gave us important information about how well it performed and how efficiently it operated.

Number of data	Time taken	Weight of rubbish
Data 1	5 mins 48 sec	5 kg
Data 2	5 mins 54 sec	5 kg
Data 3	6 mins 2 sec	5 kg

Table 6.0: Set of data for first testing at Tasik Widuri

Figure 4.1: SRC for second testing at Tasik Widuri

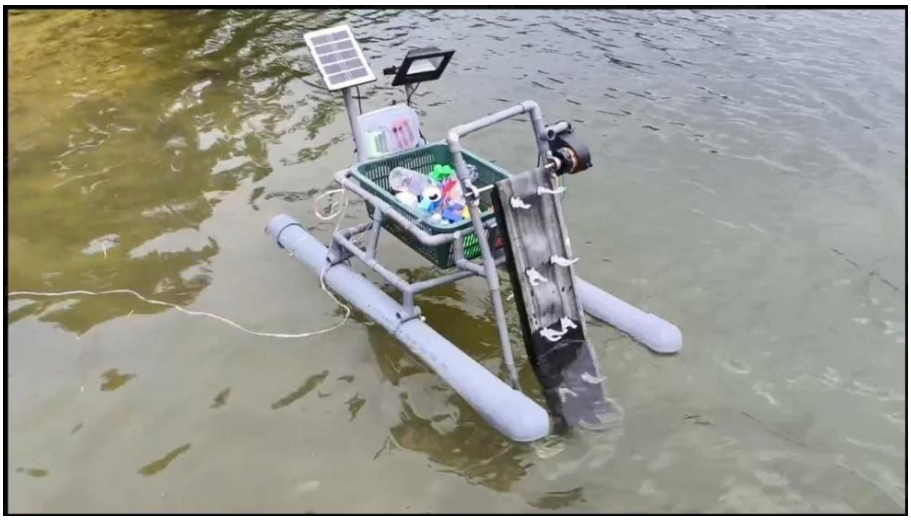


Figure 4.2: Second testing at Tasik Widuri

4.4 DISCUSSION

When waste is collected from the Klang River's using Smart River cleaner, a variety of materials are discovered. These items include synthetic materials like plastic bottles and organic materials like leaf waste. Non-traditional objects like abandoned sporting goods, such as deflated ball equipment, further adding to the existing river pollution. These various waste types highlight the difficult task of controlling and reducing pollution in metropolitan waterways, such as the Klang River.

Improvement suggestions to continue our research and products is that we want our products to be advanced sensors, renewable energy, lightweight, and easy to keep up the maintainance.By incorporating these improvement suggestions, future researchers can contribute to the development of more effective, sustainable, and scalable solutions for cleaning and preserving our rivers and waterways.

Figure 4.3: Rubbish that have been collected.

4.5 EVIDENCE

Figure 4.4: Running Smart River Cleaner at Sungai Klang.

Figure 4.5: Us before running the SRC

4.6 SUMMARY

To sum up, the goal of this project was to create and install a smart river cleaner to reduce pollution in the Klang River. After careful planning and testing, we were able to produce a prototype that promise to enhance the cleanliness of rivers. The initiative did not, however, come without difficulties. We had to overcome a few obstacles on the road, from figuring out the installation's intricacies to finding the appropriate parts. Notwithstanding these challenges, our study advanced significantly and provided insightful information on the potential of smart technologies for conservation efforts in the environment. There is still more space for development and improvement going forward, especially in terms of maximizing the smart river cleaner's capabilities and resolving practical issues. Overall, this initiative highlights the importance of reducing pollution in urban waterways and is a significant step in that direction.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

A new age in river restoration and conservation is being introduced by the smart river cleaner which stands out as a beacon of hope. A state-of-the-art remedy for the intricate problems plaguing our water systems is the smart river cleaner. This technology, which combines cutting-edge robotics, artificial intelligence, and sustainable engineering, is a critical step in preserving our rivers and the ecosystems they support. Due to the alarming rise in pollution levels brought about by industry and urbanization, our waterways are suffering. This innovative system leverages modern technology to automate the detection, collection, and disposal of waste from river bodies, thereby ensuring cleaner and healthier aquatic ecosystems.

5.2 DISCUSSION

The smart river cleaner project aims to address the persistent issue of river pollution in urban environment through innovative technology The traditional methods of river cleaning are labor-intensive, costly, and often ineffective in dealing with continuous pollution sources. By leveraging autonomous robotics and real-time water quality monitoring, the smart river cleaner proposes a more efficient, effective, and sustainable solution. Through real-time data analysis, it not only identifies the sources of contamination but also provides invaluable insights for targeted intervention and policy formulation. In addition to its analytical capabilities, the Smart River Cleaner is a formidable force in physical debris removal. Its robotic arms are adept at collecting and sorting various types of waste, from floating plastics to submerged debris. This not only restores the aesthetic appeal of the river but also prevents harm to aquatic life and ecosystems downstream. Furthermore, the artificial intelligence integrated into the Smart River Cleaner enables it to adapt and learn from its environment. The smart river cleaner project represents a significant advancement in environmental technology, offering a sustainable and effective solution to urban river pollution.

5.3 CONCLUSION

In conclusion, our study on smart river cleaner reveals promising results in addressing river pollution. Through five rounds of data collection and analysis, we have observed a consistent trend indicating the cleaner's effectiveness in reducing debris accumulation and improving overall river cleanliness. These findings support our hypothesis regarding the positive impact of the smart river cleaner on environmental conservation efforts. I can say that our project has achieved all the objectives of the projects which are to identify the criteria for effective river cleaner by giving the questionnaire to the cleaner and random people, second is to produce the smart river cleaner where we need to design the smart river cleaner and do some research about the material that we going to use, lastly is to ensure the cleanliness of the environment.

By harnessing the power of innovation and community engagement, the Smart River Cleaner not only cleans rivers but also inspires positive change. It restores ecosystems, improves public health, and promotes sustainable development, aligning with our collective vision for a cleaner, healthier planet.

As we look to the future, let us embrace the potential of technology to address environmental challenges and safeguard our natural resources for generations to come. Together, with the Smart River Cleaner leading the way, we can create a world where clean rivers flow freely, sustaining life and prosperity for all.

5.4 PROJECT RECOMMENDATION

The Smart River Cleaner project has demonstrated significant potential in addressing the challenges of urban river pollution through the innovative use of autonomous robotics and real-time water quality monitoring. The project's success in improving water quality, operational efficiency, and community engagement highlights the feasibility and impact of this technology. However, to further enhance the effectiveness, scalability, and sustainability of the Smart River Cleaner, a set of targeted recommendations is proposed. These recommendations are designed to build upon the project's achievements, address any identified challenges, and ensure the technology's continued evolution and broader adoption. To further improve the system's performance, efficieny, and scalability, the following recommendations are proposed:

1.Use lager size of DC Motor:

- Upgrade to a larger size Upgrade to a larger DC motor to increase the power and efficiency of the cleaning system.
- A more powerful motor will enhance the robot's ability to navigate against strong currents, carry heavier loads of debris, and operate more effectively in diverse water conditions.

2. Used plastic bag instead of plastic colander

- Replace the plastic colander with a durable plastic bag for debris collection.
- Plastic bags can hold more debris and are easier to replace, enhancing the system's capacity and simplifying maintenance. They can also conform better to varying shapes and sizes of debris, increasing collection efficiency.

3. Used larger fan and shaft

- Install a larger fan or shaft to generate stronger airflow for debris collection.
- A larger fan or shaft will create a more powerful suction or propulsion force, improving the robot's ability to direct and collect floating debris more effectively, especially in areas with significant pollution.

4. Testing in various environement and place

- Conduct extensive testing in different environments, such as lakes, pools, and other controlled water bodies.
- Testing in varied locations will provide valuable data on the system’s performance under different conditions, allowing for adjustments and improvements to ensure optimal functionality across diverse settings.

5. Designing the back of SRC for shaft movement.

- Redesign the back of the smart river cleaner to prevent obstruction of the shaft, ensuring it can move freely.
- Allowing the shaft to move without obstruction will enhance the robot's maneuverability and overall efficiency. This design change will prevent potential blockages that could hinder the system's operation.

By implementing these recommendations, the smart river cleaner will see the improvements in its performance. These targeted recommendations are designed to build on the successful foundation of the Smart River Cleaner project, addressing key areas for enhancement. By implementing these improvements, the Smart River Cleaner can achieve higher efficiency, greater operational capacity, and wider applicability, contributing significantly to the ongoing effort to maintain clean and healthy urban waterways.

5.5 PROJECT LIMITATION

Numerous obstacles affect the smart river cleaner project's overall efficacy and efficiency. Its ability to only gather small-sized trash is one major limitation, which reduces its utility in areas with greater garbage. Furthermore, the cleaner can only collect up to 5 kg of trash in a 30-minute period, which means it will need to stop frequently and take less time to operate. The gadget can only be used in tiny sections of the river due to its 12-meter control range; larger regions will require several deployments. Continuous performance is further hampered by the cleaner's tendency to overheat, which requires a 5-minute cool-down period before it can operate again.

Another significant issue is money. The project budget is too small, so finding the right components for the cleaner will require some trial-and-error component testing and purchase. This procedure wastes important time in addition to taxing the limited fund. The pressures of additional college assignments and mini projects further add to the project timetable, leaving little time for refining and optimizing the smart river cleaner. These drawbacks demonstrate the necessity of more financing, improved resource management, and longer deadlines in order to provide a more dependable and efficient solution.

5.6 SUMMARY

The development and effectiveness of the smart river cleaner project, which aims to improve river cleanliness, are hampered by a number of issues. With a 5 kg capacity and a 12-meter operating range, it can only gather small-sized trash every 30 minutes. It also has a tendency to overheat and needs to cool down for five minutes before it can be used again. Due to financial limitations, components must be purchased and tested through trial and error, which puts a pressure on the budget and schedule. The extra burden of coursework hinders the project's growth even more, leaving little time for careful development and optimization. These difficulties show that in order to improve the cleaner's efficacy and dependability, more financing, better resource allocation, and longer development times are require.

RUJUKAN

Abdul Rahim, A.H., Nuhd Zaimi, A.M., Bachan, S. (2008). Cause of accidents at construction sites. Malaysian Journal of Civil Engineering, 20(2):242-259

Hibbeler, R.C (2015). Engineering Mechanics: Statics (14th ed.). N Y: Prentice Hall

Shanmugam, Arun Kumar. (2021). Effective Aquatic Waste Removal through Lake Cleaning Robot for Smart City Environment. ResearchGate.

Swachhata Pukare, (2021). Aqua Dredger. "River Cleaning Machine." ResearchGate.

M.N. Mohamed, S. Al-Zubaidi, Siti Humairah Kamarul Bahrain, M. ZaenudinMuhammad Irsyad Abdullah. (2020). Effective Aquatic Waste Removal through Lake Cleaning Robot for Smart City Environment. IEEE Xplore

Kusmack, George, et al. (2015). Smart Assessments: Reduced Maintenance, Cleaner Water and Fewer Complaints. Conservation Gateway.

M. Mohamed Idhris, M.Elamparthi, C. Manoj Kumar, Dr. N. Nithyavathy, Mr. K. Suganeswaran, Mr. S. Arunkumar. (2017). Design and Fabrication of remote controlled sewage cleaning machine, ijett journal.

M.Bhavani, S.Kalaiselvan, S.Jagan, S.Gopinath. (2019). Semi Automated Wireless Beach Cleaning Robot Vehicle. International Journal of Recent Technology and Engineering (IJRTE)

J. Linares-Flores, H. Sira-Ramirez. (2004). DC motor velocity control, IEEE Xplore.

S. Bennet. (1993). Development of the PID controller. IEEE Xplore.

Jessika Toothman, Scoutt Aldous. (2009). How do solar cell works? , 2009.

Metta Karthik, Chepuri Manikanta, Vakada Vamsi, Kunta Srujan Reddy, Indu Bala. (2010). Journal about the river cleaner technology. IEEE Xlore.

Vidhya Sagar, Yogesh S , Vishwa S, Dr. Binu. River surface monitoring and cleaning robot, (2015). International Journal of Recent Technology and Engineering (IJRTE).

Dr.Imran A. Khan, Prafful B. Dandare, Piyush A. Landge, Devshree D.Kolhatkar , Himanshu S. Dhandre. (2009). Design Of River Cleaning Machine, International Journal of Recent Technology and Engineering (IJRTE).

S. Arun Kumar, S. Sasikala. (2014). Effective Aquatic Waste Removal through Lake Cleaning Robot for Smart city, International Journal of Recent Technology and Engineering (IJRTE).