WATER DUST CLEANING ROBOT

A Project report is submitted in partial fulfillment of the requirements for the award of Degree of Bachelor of Science in Electrical and Electronic Engineering.

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DECLARATION

I hereby declare that this project "**Water Dust Cleaning Robot**" represents my own work which has been done in the laboratories of the Department of Electrical and Electronic Engineering under the Faculty of Engineering of Daffodil International University in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering, and has not been previously included in a thesis or dissertation submitted to this or any other institution for a degree, diploma or other qualifications. I have attempted to identify all the risks related to this research that may arise in conducting this research, obtained the relevant ethical and/or safety approval (where applicable), and acknowledged my obligations and the rights of the participants.

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APPROVAL

The project entitled **"Water Dust Cleaning Robot"** submitted by **Pratul Kanti Sikder (192-33-5217) & Obaidullah Hasan raj (192-33-5231)** has been done under my supervision and accepted as satisfactory in partial fulfillment of the requirements for the degree of **Bachelor of Science in Electrical and Electronic Engineering** in **January, 2024.**

Signed

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Dedicated

To

My parents and My Teacher

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

BAETE	Board of Accreditation for Engineering and Technical Education
DIU	Daffodil International University
MCU	Microcontroller Unit
RX	Receive
TX	Transmit
Li-on	Lithium Ion
SPP	Serial Port Protocol

LIST OF SYMBOLS

Symbol	*Name of the symbol*
ω	Angular velocity, rad/sec
ξ	Damping ratio

ACKNOWLEDGEMENT

First of all, we want to give thanks to **Almighty Allah**. With his blessing we are able to complete our work with best effort.

We want to pay our utmost respect to our Supervisor **Name, Designation** of the **Department of EEE, Daffodil International University** for who has given us the chance to work on an impactful idea and taken care of every issue of development of this concept. Then we would like to take this opportunity to express gratitude to our supervisor for being dedicated in supporting, motivating and guiding us throughout this project. This project can't be done without his useful advice and help. Also thank him very much for giving us the opportunity to work with this project.

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ABSTRACT

This project presents the design, development, and implementation of a water dirt-cleaning robot with Bluetooth control capabilities. The robot is designed to navigate indoor spaces, effectively removing dirt, dust, and debris from various surfaces using a combination of water-based cleaning mechanisms. The integration of Bluetooth technology allows users to remotely control the robot's movements and cleaning functionalities via a dedicated mobile application. The robot's hardware consists of a robust chassis housing a water tank, cleaning brushes, and maneuverable wheels for seamless navigation. The Bluetooth-enabled control system gives users real-time access to the robot's functions through a user-friendly mobile interface. Users can initiate, pause, or modify cleaning tasks and adjust cleaning modes. This innovation offers a convenient and adaptable solution for maintaining cleanliness in homes, offices, or commercial spaces. The integration of Bluetooth control enhances user experience by providing flexible and intuitive operation, marking a significant advancement in automated cleaning technology.

Keywords: dirt cleaning, robot, dust cleaning, remotely control, Bluetooth control.

CHAPTER 1
INTRODUCTION

1.1 Introduction

In recent years, the evolution of robotics and smart technologies has revolutionized various aspects of daily life, with cleaning automation being a significant area of innovation. This ongoing progress has led to the development of sophisticated cleaning robots designed to streamline and enhance household and commercial cleaning tasks. Among these advancements stands the Bluetooth-controlled water dirt-cleaning robot, representing a fusion of robotics, connectivity, and efficient cleaning mechanisms.

The primary objective of this project is to introduce a cutting-edge cleaning solution that combines the convenience of autonomous operation with the flexibility of Bluetooth-enabled remote control. By leveraging the capabilities of Bluetooth technology, users can now interact with and direct the cleaning process of the robot using their smartphones or tablets, transcending the traditional constraints of manual intervention.

This innovation addresses the growing demand for smarter, more efficient cleaning solutions in both residential and commercial settings. Its significance lies not only in the integration of autonomous navigation and cleaning functionalities but also in the incorporation of Bluetooth connectivity, enabling users to supervise and customize cleaning tasks from a distance.

The following sections delve into the intricacies of the robot's design, its operational functionalities, and the seamless integration of Bluetooth technology. Through this exploration, the transformative potential of this Bluetooth-controlled water dirt-cleaning robot in redefining contemporary cleaning practices becomes evident.

1.2 Problem Statement

Traditional cleaning methods often pose limitations in terms of efficiency, user convenience, and adaptability to modern lifestyles. Manual cleaning processes, while effective to an extent, require significant time and effort, leading to a demand for more innovative and automated solutions.

Moreover, existing robotic cleaning devices, while offering autonomy in cleaning, often lack seamless user interaction and customization options. The absence of direct user control and monitoring capabilities restricts their adaptability to diverse cleaning needs, hindering their optimal utilization.

In addition, conventional cleaning tools and methods may not always provide the level of cleanliness desired, especially concerning persistent dirt, debris, and varied surface types. This inconsistency in cleaning efficiency calls for a more sophisticated and adaptable cleaning technology.

Furthermore, the inability to supervise, schedule, or modify cleaning tasks remotely adds to the inconvenience, particularly in today's fast-paced lifestyles where users seek more control and flexibility in managing household or workspace cleanliness.

The aforementioned challenges emphasize the need for an innovative solution that amalgamates advanced cleaning mechanisms with user-friendly controls and remote monitoring capabilities. The introduction of a Bluetooth-controlled water-dirt cleaning robot aims to bridge these gaps by offering a comprehensive cleaning solution that combines autonomous cleaning capabilities with seamless user interaction, adaptable cleaning modes, and the convenience of remote control.

1.3 Objectives

The objectives of a Bluetooth-controlled water dirt cleaning robot are multifaceted, aiming to address specific needs and challenges while leveraging technological advancements. Here are several key objectives such as:

- To offer an effective and efficient cleaning solution that can navigate spaces and remove dirt, dust, and debris from various surfaces.
- To control and supervise cleaning tasks remotely through Bluetooth connectivity, allowing for easy initiation, monitoring, and customization via a mobile application.
- To achieve a higher level of cleanliness compared to traditional cleaning methods.
- to be adaptable to various indoor environments, such as homes, offices, or commercial spaces, ensuring it can efficiently clean different surfaces and configurations.

1.4 Brief Methodology / Technologies/ Procedures

The methodology for developing a Bluetooth-controlled water dirt cleaning robot involves a structured approach encompassing several key stages. Here's some outline of the methodology:

- Understand and define the specific cleaning requirements in different environments like “home, office, commercial spaces.” Identify the key functionalities needed for efficient cleaning, such as navigation, cleaning mechanisms, and Bluetooth connectivity.
- Develop a conceptual framework outlining the robot's structure, components, and overall functionality.
- Design and assemble the hardware components, including the chassis, cleaning mechanisms and communication modules. Ensure compatibility for Bluetooth integration and reliable performance in various environments.
- Create the robot's control system and user interface. Develop firmware for Bluetooth communication protocols. Design a user-friendly mobile application for remote control.
- Conduct rigorous testing to validate the robot's functionalities, including navigation accuracy, cleaning efficiency, and Bluetooth connectivity. Gather feedback to identify areas for improvement and optimize performance.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

Research into Bluetooth-controlled water dirt cleaning robots has emerged at the intersection of robotics, wireless communication, and smart home technology. Studies in this field delve into various aspects, including the integration of Bluetooth technology for enhanced control and communication in robotic systems. Investigations explore the efficacy of Bluetooth protocols for seamless connectivity between cleaning robots and user devices, enabling remote control and monitoring. Additionally, research focuses on optimizing human-robot interaction through intuitive user interfaces, leveraging Bluetooth-enabled controls to facilitate convenient and user-friendly operation. Navigation algorithms and mapping techniques utilizing Bluetooth connectivity are also areas of interest, aiming to improve the precision of localization and path planning for efficient cleaning.

2.2 Related Research/ Works

Research in the realm of Bluetooth-controlled water dirt cleaning robots represents a dynamic intersection of robotics, wireless communication, and smart home technology. Recent advancements and studies have centered around various critical aspects, laying the groundwork for innovative developments in this field.

One focal point of research involves the seamless integration of Bluetooth technology into the core functionalities of cleaning robots. [1] explored the incorporation of Bluetooth protocols, emphasizing their role in establishing robust communication channels between cleaning robots and user devices. This integration enables remote control and monitoring capabilities, allowing users to initiate, modify, or schedule cleaning tasks effortlessly through intuitive mobile interfaces.

Navigation algorithms and mapping techniques have been a key area of exploration in optimizing the operational efficiency of Bluetooth-enabled cleaning robots [2] and [3] it’s have investigated the utilization of Bluetooth connectivity for precise localization and enhanced path planning. By leveraging Bluetooth signals for improved spatial awareness and navigation, these robots exhibit greater accuracy in maneuvering through diverse environments, efficiently targeting areas that require cleaning.

User-centric design and human-robot interaction have been pivotal in shaping the user experience with Bluetooth-controlled cleaning robots. [4] Emphasized the significance of user interfaces in enhancing user satisfaction and ease of operation. Their research highlighted the importance of intuitive controls and real-time feedback mechanisms accessible through Bluetooth-enabled interfaces, contributing to a more seamless and interactive cleaning experience.

Furthermore, the integration of Bluetooth-controlled cleaning robots within smart home ecosystems has garnered attention. [5] Explored the symbiotic relationship between these robots and other IoT devices, showcasing how Bluetooth connectivity enables seamless interactions. These robots, synchronized with other smart devices, contribute to a comprehensive smart home infrastructure, allowing for coordinated cleaning routines and enhancing overall home automation.

Energy efficiency and power management strategies have also been under scrutiny in the context of Bluetooth-controlled cleaning robots. [6] focused on optimizing power consumption, ensuring prolonged battery life without compromising cleaning performance. These efforts are vital in ensuring sustained and efficient operation of cleaning robots, minimizing downtime for recharging or power-related interruptions.

Security and privacy considerations in Bluetooth-enabled robotics have been a subject of exploration. Researchers like [7] delved into developing robust security measures to safeguard data transmitted between the cleaning robot and user devices, addressing concerns about unauthorized access or potential cyber threats.

2.3 Compare and Contrast

The Bluetooth-controlled water dirt cleaning robot represents a leap forward in cleaning technology, offering several advantages over traditional manual cleaning methods. In terms of efficiency, the robot surpasses manual cleaning by autonomously navigating spaces and employing sophisticated algorithms and sensors for precise dirt removal. Its adaptability is evident in its ability to traverse various surfaces, utilizing different cleaning modes and schedules tailored to different environments. Moreover, the Bluetooth connectivity feature provides unparalleled convenience, enabling users to initiate, modify, or monitor cleaning sessions remotely via a mobile app or device within Bluetooth range.

2.4 Summary

In summary, the multifaceted research landscape surrounding Bluetooth-controlled water dirt cleaning robots spans various dimensions, encompassing Bluetooth integration, navigation enhancements, user interaction, smart home integration, energy efficiency, and security protocols. These collective efforts aim to propel the evolution of cleaning robotics, fostering smarter, more efficient, and user-friendly solutions for modern living environments.

CHAPTER 3

MATERIALS AND METHODS [OR PROJECT/SYSTEM DESIGN] [OR DESIGN PROCEDURE]

3.1 Introduction

The development of a Bluetooth-controlled water dirt cleaning robot involves a systematic approach integrating hardware, software, and operational procedures. The materials and methods used in creating such a robot entail a blend of components carefully selected for their efficiency, compatibility, and functionality. Commonly employed materials include motors, sensors (proximity, gyroscopes, etc.), a microcontroller unit (MCU) like Arduino, Bluetooth modules for wireless communication, motor drive modules such as the L298 for motor control, power management systems, and protective circuits ensuring safe operation. The methodology encompasses various stages, commencing with system design and hardware assembly. This involves the integration of components and circuits, ensuring seamless communication between the microcontroller, Bluetooth module, motors, and sensors. Software development constitutes a critical aspect, involving firmware creation for the MCU to interpret Bluetooth signals, control motors, manage sensor data, and coordinate cleaning actions based on received commands. Concurrently, the creation of a user-friendly interface, typically through a mobile app, allows users to establish Bluetooth connectivity, control the robot, set schedules, and receive feedback. Safety protocols, error handling mechanisms, and considerations for environmental impact are also integrated throughout the design and development stages, ensuring the robot operates reliably, safely, and addresses sustainability and user requirements.

3.2 Methods and Materials or System Design and Components

Methods

- Construct the robot with appropriate components including motors, cleaning mechanisms, MCU, Bluetooth module, power management systems.
- Design and integrate the circuitry to facilitate communication between the MCU and Bluetooth module, motor driver.

- Establish a secure Bluetooth connection between the robot and user devices. Ensure the robot is discoverable and accessible to authorized users.
- Implement algorithms for efficient cleaning patterns based on the environment and user-defined settings.

Materials

- Microcontroller Unit (MCU)
- Bluetooth Module
- Motor Drivers
- Power Management System

System Design

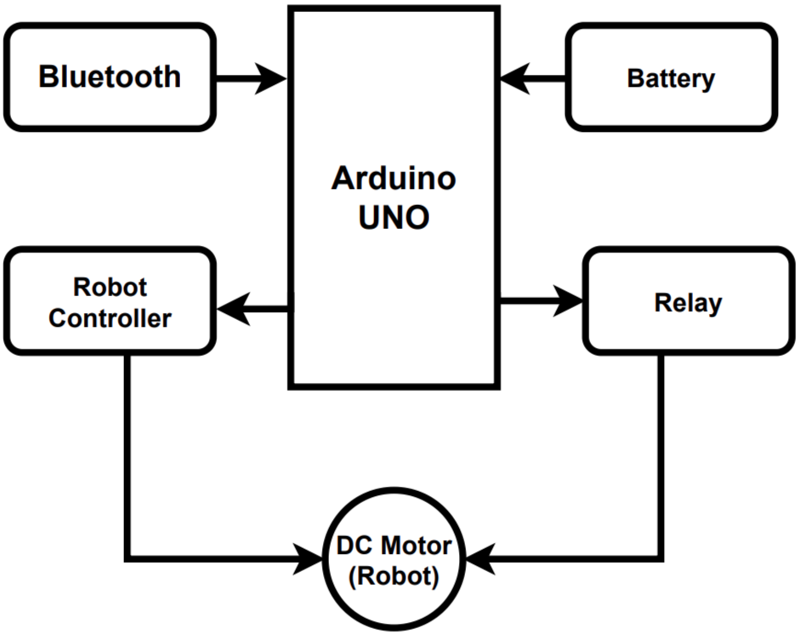

Fig 3.1 Block Diagram of this project

Components

- Arduino UNO

  he Arduino UNO stands as a cornerstone in the world of microcontroller boards, renowned for its accessibility, versatility, and user-friendly design. At its heart lies the ATmega328P microcontroller, offering a suite of digital and analog I/O pins, USB connectivity for easy programming and power supply, and a welcoming environment through the Arduino Integrated Development Environment (IDE). This open-source platform empowers hobbyists, students, and professionals to dive into the realms of electronics, programming, and prototyping with ease. With its expandability through various shields, which add functionalities from wireless communication to sensor integration, the Arduino UNO serves as a robust foundation for a myriad of projects, fostering a vibrant community of enthusiasts, learners, and innovators. Its simplicity coupled with its vast capabilities has made it an invaluable tool for learning, experimentation, and innovation in the realm of embedded systems and DIY electronics.

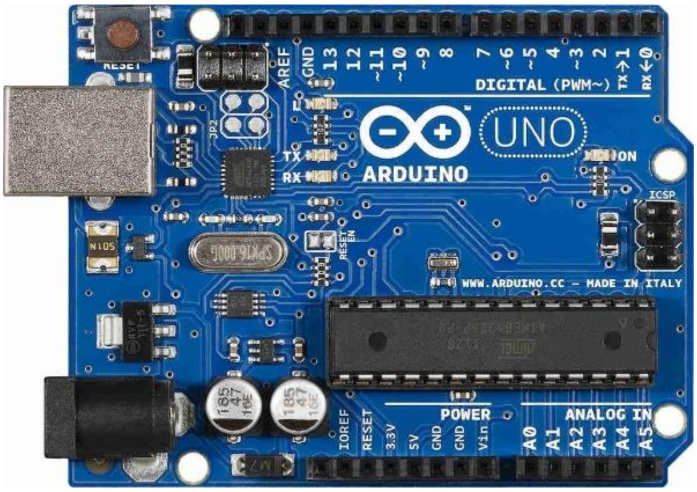

Fig 3.2 Arduino UNO

- **HC-05 Bluetooth Module:**

  The HC-05 Bluetooth module is a versatile and widely used wireless communication module that enables seamless Bluetooth connectivity in various electronic projects. Featuring a Serial Port Protocol (SPP) profile, it facilitates simple and transparent serial communication between devices, offering a cost-effective solution for wireless data transmission. With its ease of integration and compatibility with a range of microcontrollers, including Arduino boards, the HC-05 serves as a reliable bridge for enabling Bluetooth capabilities in projects such as remote-control systems, IoT applications, and data transmission between devices. Its adaptable nature, accessible configuration through AT commands, and support for both master and slave modes make the HC-05 a favored choice for hobbyists, makers, and professionals seeking to incorporate Bluetooth connectivity into their electronic designs effortlessly.

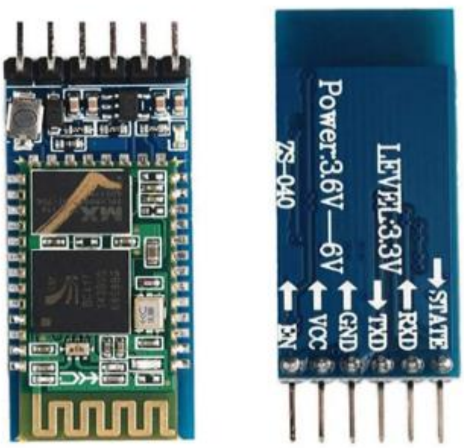

Fig 3.3 HC-05 Bluetooth Module

- **L298 Motor Drive Module:**

  The L298 Motor Drive Module is a robust and versatile motor driver commonly used in various robotics and automation projects. This module incorporates an H-bridge configuration, allowing it to drive two DC motors bidirectionally or a single stepper motor with ease. Its dual H-bridge design provides independent control of motor direction and speed, making it suitable for applications requiring precise motor control. With its high voltage and current capabilities, the L298 module is adept at handling medium to high-power motors. Additionally, its compatibility with various microcontrollers, such as Arduino, Raspberry Pi, and other embedded systems, makes it a popular choice among hobbyists and engineers seeking a reliable motor driver for their projects. The module's built-in protection features, including overcurrent and overtemperature protection, enhance its reliability and safety during operation, contributing to its widespread use in robotics, automation, and mechatronics applications.

Fig 3.4 L298 Motor Drive Module

- **DC gear motor:**

  DC gear motors are versatile electromechanical devices extensively used in robotics, automation, and various industrial applications due to their reliability and adaptability.

Fig 3.5 DC gear motor

These motors consist of a DC motor combined with a gearbox, providing increased torque and reduced speed output compared to regular DC motors. The gearbox, containing gears of different sizes and configurations, allows for torque multiplication or reduction while maintaining a steady output speed. This characteristic makes DC gear motors suitable for tasks requiring precise control, such as in conveyor systems, robotics, electric vehicles, and appliances. Their compact size, high torque capabilities, and compatibility with various motor drivers and control systems make DC gear motors indispensable in a wide array of projects and industries, offering an efficient solution for applications demanding controlled motion and strength.

- **Li-On Battery:**

  Lithium-ion (Li-ion) batteries stand at the forefront of modern portable power solutions, acclaimed for their high energy density, lightweight design, and rechargeable nature. These batteries utilize lithium ions moving from the negative electrode to the positive electrode during discharge and vice versa during charging, allowing for efficient energy storage and release. They power a vast array of devices, from smartphones and laptops to electric vehicles and renewable energy storage systems. The compact size and higher energy density of Li-ion batteries make them favorable in applications where weight and space are critical considerations. Despite their advantages, Li-ion batteries require careful management to ensure safe charging, usage, and disposal due to their sensitivity to overcharging, overheating, and improper handling. Their prevalence in modern technology underscores their pivotal role in powering our increasingly mobile and connected world, offering a balance between energy capacity, size, and reliability.

Fig 3.6 Li-On Battery

3.3 Design Specifications. Standards and Constraints

Here in this section, we present our system circuit diagram.

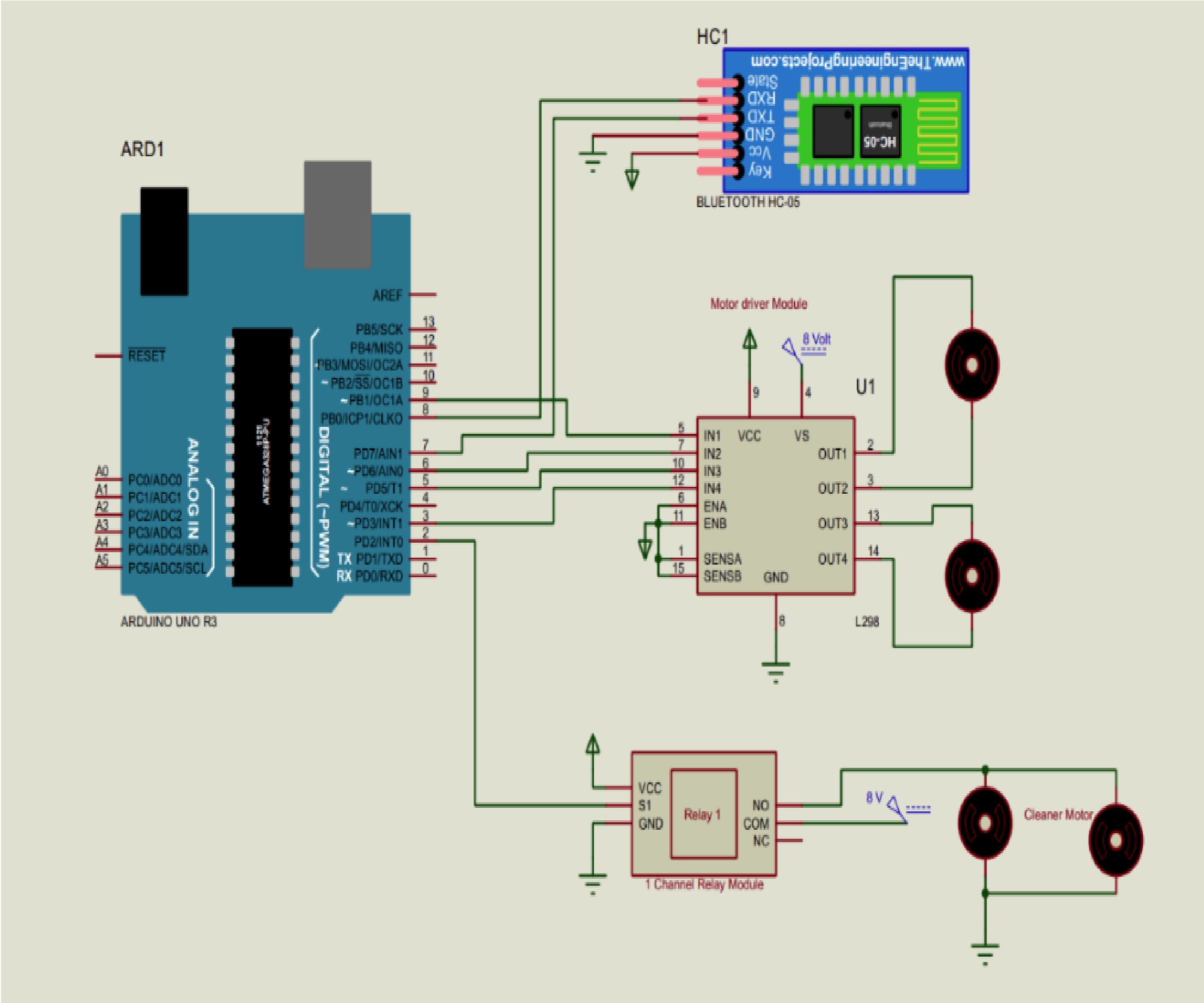

Fig. 3.7 Circuit diagram of this project

Here in this system main control unit uses Arduino UNO. Here in the circuit diagram, we saw the Bluetooth module connect Arduino UNO external define serial communication pin 7 with HC-05 TX and 8 with HC-05 RX. The motor driver connect module connects with Arduino PWM (pulse width modulation) pins 3, 5, 6, and 9. The relay is connected with Arduino pin 2 and two roller motors are connected with the relay module.

3.4 System Analysis or Design Analysis

Here in this section discourse about system analysis.

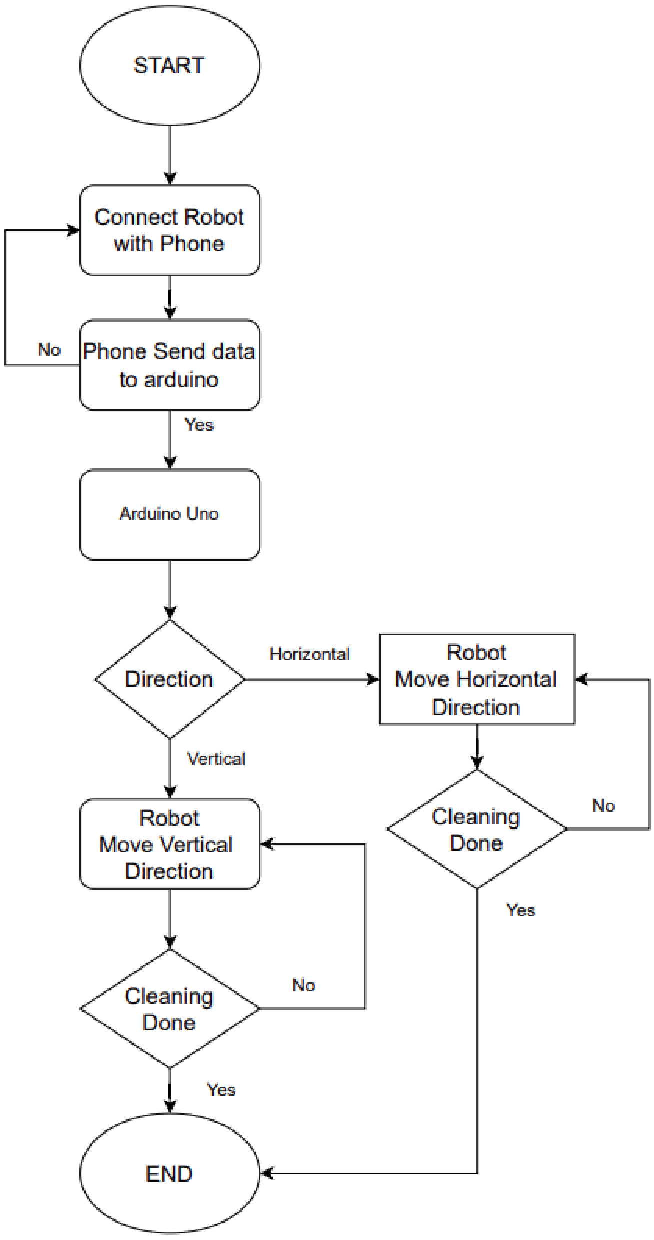

Fig. 3.8 Flowchart of this project

Here this robot first connects with the phone. Then phone sends data to Arduino via Bluetooth module. Arduino control robot and cleaning wheel biased on phone control command.

3.5 Implementation

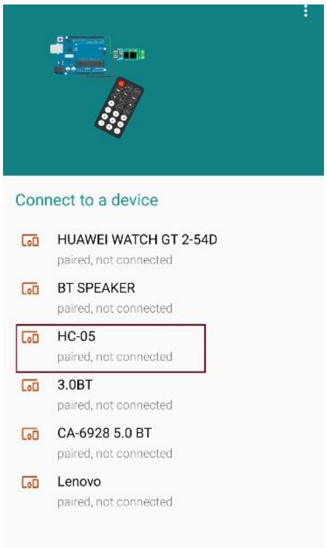

Fig. 3.9 Connect with Bluetooth module

Here Arduino Bluetooth controller is used as an app for robot control. First, open the app and connect with the Bluetooth module.

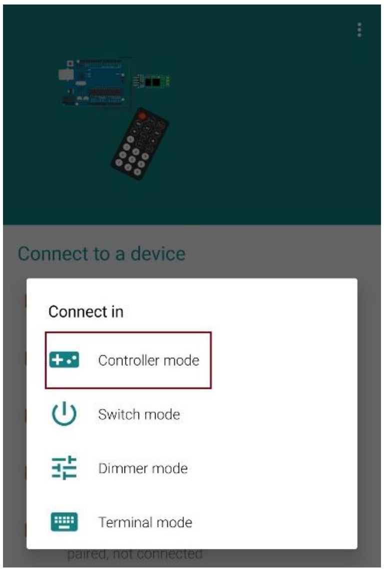

Fig. 3.10 Enter control mode

Then press on HC-05 to enter control mode.

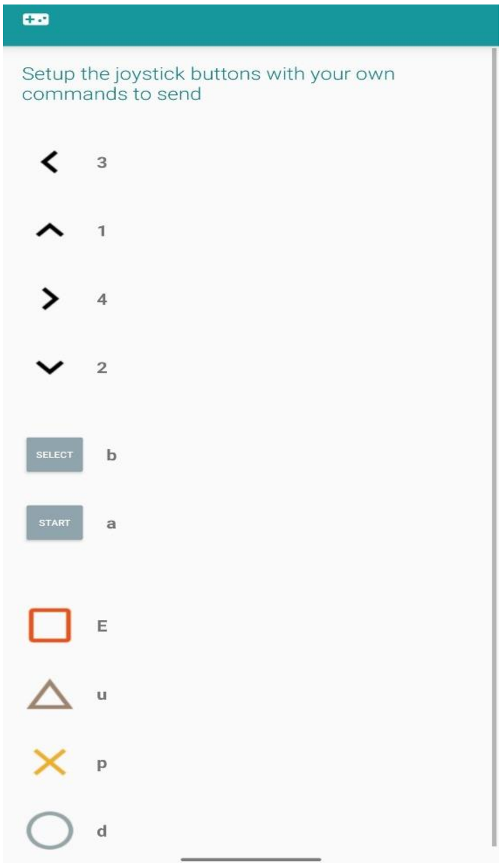

Fig. 3.11 Command Set

Then you have to set different comments for the robot control. For example, robot movement should be set to 1 for forward, 2 for backward, 3 for left, 4 for right, and E for stopping the robot. Then set a and b to turn off and on the robot's dust collection system.

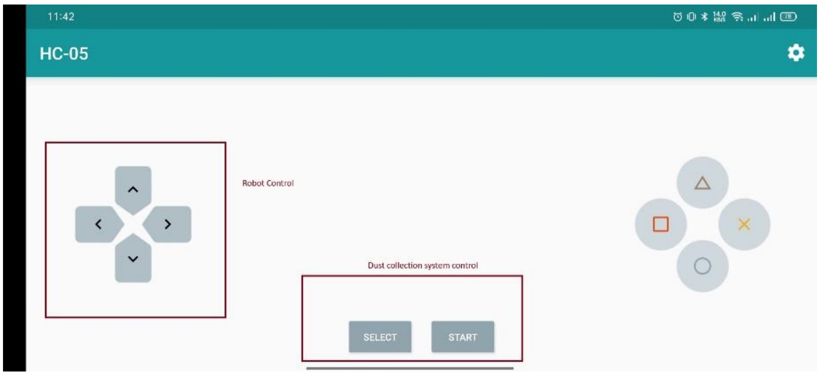

Fig. 3.12 Control Panel

Here the robot is controlled through the bang side and the dust collection system is turned off through the bottom button.

up.

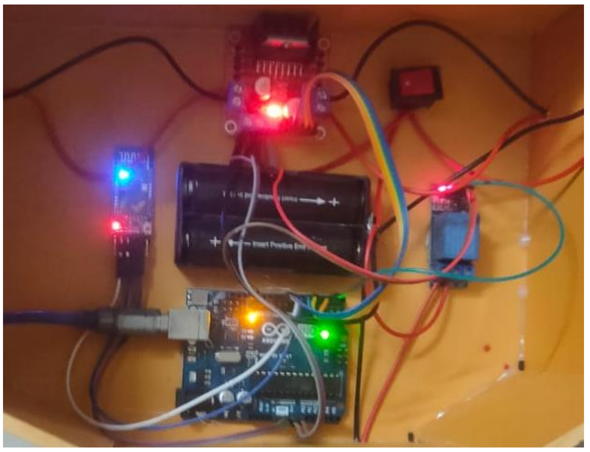

Fig. 3.13 Control Panel

It is the main system of hardware through which the total system is controlled.

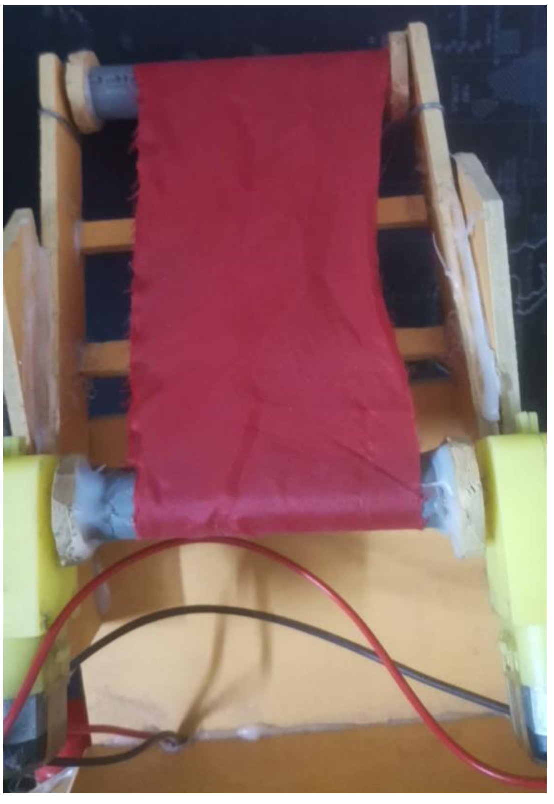

Fig. 3.14 Dust collection wheel

It is the garbage collection system. There is a roller through which the garbage is pulled up.

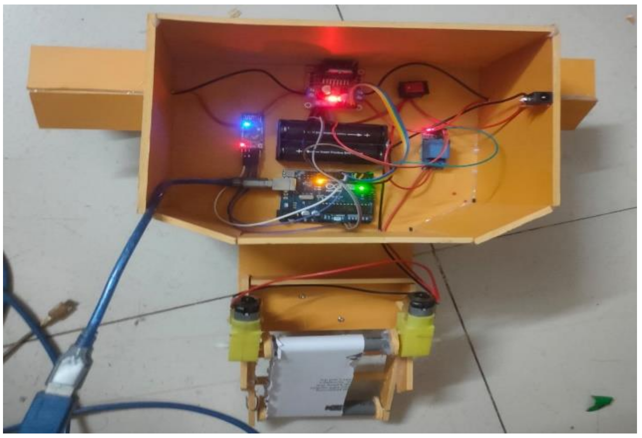

Fig. 3.15 Project Picture

3.6 Summary

The materials and methods employed in developing a Bluetooth-controlled water dirt cleaning robot encompass a multidimensional approach involving both hardware and software integration. In terms of materials, the robot typically incorporates components such as motors, sensors (proximity, gyroscopes, etc.), a microcontroller unit (MCU), Bluetooth modules, motor drive modules (like the L298), power management systems, and protective circuits. The selection of these materials revolves around factors like efficiency, compatibility, power consumption, and safety.

Regarding the methodology, the process includes stages such as system design, hardware assembly, circuit integration, and software development. This involves configuring the hardware, integrating circuits for seamless communication between components, developing firmware for the MCU to interpret Bluetooth signals, control motors, manage sensors, and coordinating cleaning actions based on received commands. The software development also includes user interface creation for Bluetooth connectivity, remote control functionalities, and feedback mechanisms. Additionally, methodologies for safety protocols, error handling, and environmental impact assessment are considered throughout the design and development stages. This comprehensive approach ensures that the robot operates effectively, safely, and reliably while addressing sustainability and user requirements.

CHAPTER 4
RESULTS AND DISCUSSIONS

4.1 Results

The results of such a robot's performance encompass a range of factors, including cleaning efficiency, navigation capabilities, user experience, power management, safety protocols, and environmental impact. The evaluation involves testing the robot's ability to effectively clean different surfaces, adapt to various environments, and navigate spaces while avoiding obstacles. Assessing the ease and reliability of the Bluetooth interface for remote control functionalities, scheduling, and monitoring tasks is crucial for user satisfaction. Additionally, analyzing energy efficiency, battery life, and power consumption during cleaning operations determines the robot's practicality and sustainability. Ensuring robust safety measures and error handling mechanisms are in place to prevent accidents and effectively manage system errors is equally important. Furthermore, evaluating the environmental impact in terms of energy consumption, materials used, and sustainability in cleaning practices is essential for understanding the robot's ecological footprint. The results obtained from these assessments contribute to refining and improving the robot's design, functionalities, and overall performance compared to traditional cleaning methods, thereby shaping its practicality, efficiency, and usability in real-world applications.

Fig. 4.1 Robot on Water.

This robot floating on water.

Fig. 4.2 Robot going to collect water dust.

This robot going to collect water dust from water.

Fig. 4.3 Robot collecting water dust.

The robot collecting water dust from water.

4.2 Discussions

Conversations delve into the innovative features of the robot, highlighting its use of Bluetooth technology for remote control, and seamless connectivity with user devices. Discussions also focus on the integration of sensors, motors, and sophisticated algorithms enabling autonomous navigation and effective cleaning operations.

The robot's versatility in various settings prompts discussions on its applicability in homes, offices, industries, and public spaces. Conversations explore how it simplifies cleaning tasks, enhances efficiency, and contributes to maintaining cleaner environments with minimal human intervention.

Discussions emphasize the user-centric design, evaluating the ease of use of the mobile app or interface for Bluetooth control, scheduling, and monitoring. Evaluations consider how accessible and intuitive the system is for users with diverse technical expertise.

In-depth analyses assess the robot's cleaning efficiency, including its ability to navigate diverse environments, adapt to different surfaces, and effectively remove dirt or debris. Conversations may compare its performance against traditional cleaning methods, addressing its strengths and limitations.

Discussions focus on safety protocols embedded within the system, highlighting fail-safe mechanisms, obstacle avoidance capabilities, and error handling procedures. Evaluations emphasize the reliability and robustness of the robot in various scenarios.

Considerations regarding the robot's energy efficiency, use of sustainable materials, and impact on reducing water or chemical consumption in cleaning routines emerge in discussions. Conversations explore how the robot aligns with sustainability goals and minimizes its ecological footprint.

CHAPTER 5
PROJECT MANAGEMENT

5.1 Task, Schedule and Milestones

All things together there were very few resources. This project had to be completed by combining parts from various sources. It is the superior know-how of C++ and Python that has helped the most in its creation.

Research and Analysis (Week 1-4)
Task: Research Bluetooth communication with Arduino
Schedule: 4 weeks
Milestone: Completion of research and analysis report

Design and Development (Week 5-8)
Task: Design the System platform and develop the platform architecture
Schedule: 4 weeks
Milestone: Completion of the design and development of the platform

Deployment and Testing (Week 9-12)
Task: Deploy the platform to a small group of early adopters for additional feedback
Schedule: 4 weeks
Milestone: Completion of the deployment and testing phase

Data Analytics and Visualization (Week 13-16)
Task: Develop data analytics and visualization tools
Schedule: 4 weeks
Milestone: Completion of data analytics and visualization tools

Launch and Maintenance (Week 17-20)
Task: Launch the platform to the public
Schedule: 4 weeks
Milestone: Completion of the launch and maintenance phase.

5.2 Resources and Cost Management

1	Arduino Uno	800
2	Bluetooth Module	400
3	Motor Driver Module	250
4	DC Gear Motor	800
5	Wire	100
6	Battery	400
7	Relay Module	100
8	Other	1000
Total		3850

CHAPTER 6
IMPACT ASSESSMENT OF THE PROJECT

6.1 Economical, Societal and Global Impact

The introduction and integration of Bluetooth-controlled water dirt cleaning robots have sparked significant impacts across economic, societal, and global landscapes. Economically, these robots revolutionize traditional cleaning methodologies, streamlining operations and reducing labor costs for businesses. Their efficiency in autonomously navigating spaces and performing cleaning tasks leads to heightened productivity, allowing human labor to be redirected to more specialized roles, thus fostering overall economic growth. Moreover, the development and adoption of these robots stimulate technological innovation and job creation in fields related to robotics, software development, and maintenance. On a societal level, these robots enhance hygiene standards, contributing to public health by ensuring cleaner environments, which can reduce the spread of illnesses. Their accessibility and inclusive nature benefit individuals with physical limitations, ensuring everyone has access to cleaner living and working spaces. Globally, the adoption of such technology aligns with sustainability initiatives, promoting eco-friendly cleaning practices, reduced resource consumption, and standardized cleaning methods across different regions. Overall, the introduction of Bluetooth-controlled water dirt cleaning robots marks a transformative step forward, offering multifaceted benefits that extend from local businesses to global sustainability efforts.

6.2 Environmental and Ethical Issues

The introduction of Bluetooth-controlled water dirt cleaning robots presents both environmental and ethical considerations that warrant attention. Environmentally, these robots may contribute to energy consumption and electronic waste generation, particularly if not designed for energy efficiency or proper disposal practices. Chemicals used in cleaning solutions could pose environmental risks if not managed responsibly. Ethically, concerns arise around potential job displacement due to automation, necessitating fair labor transitions and retraining opportunities. Privacy and data security also come into focus with Bluetooth connectivity, demanding robust measures to safeguard user information collected or accessed by these robots. Additionally, ensuring equitable access and affordability for diverse populations becomes crucial to prevent exclusivity. Addressing these concerns requires a delicate balance between technological innovation, sustainability in design and materials, ethical labor practices, data privacy measures, and accessibility considerations for a more responsible and inclusive adoption of Bluetooth-controlled water dirt cleaning robots.

CHAPTER 7
CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

The emergence of Bluetooth-controlled water dirt-cleaning robots marks a significant leap forward in cleaning technology, revolutionizing traditional cleaning methodologies. These robots offer unparalleled efficiency, adaptability, and convenience, redefining the way cleaning tasks are performed across various sectors. With their autonomous navigation capabilities and sophisticated cleaning mechanisms, they streamline operations, ensuring thorough cleaning while allowing users to multitask or manage cleaning remotely. However, while these robots offer tremendous advantages, consideration must be given to environmental impact, ethical implications, and the need for adherence to established standards. Addressing energy consumption, material usage, chemical disposal, job displacement, data privacy, and equitable access remains imperative for responsible adoption.

7.3 Future Recommendations

The future of Bluetooth-controlled water dirt-cleaning robots lies in striking a balance between technological innovation, sustainability, ethical considerations, and inclusivity. Collaborative efforts between manufacturers, policymakers, environmentalists, ethicists, and users are crucial to steer the evolution of these robots toward sustainable, ethical, and inclusive advancements. Through mindful design, adherence to standards, and ethical practices, these robots have the potential to enhance cleanliness, productivity, and accessibility while contributing positively to environmental sustainability and societal well-being. As they continue to evolve, these robots promise a future where cleaning tasks are not just efficient but also environmentally conscious and ethically driven, catering to diverse needs while upholding safety, reliability, and sustainability.

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APPENDIX A
TURNITIN REPORT

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APPENDIX B

COMPLEX ENGINEERING PROBLEM SOLVING AND ENGINEERING ACTIVITIES

Provide your statement on which and how the complex engineering problems are being solved in the designed project. P1 is mandatory and some or all from P2 to P7.

Complex Engineering Problems (P) Solving		
	Attributes	Statement from students
P1	Depth of Knowledge	Programing, Electronics and Electrical.
P2	Conflicting requirement	Here using IoT live monitoring and control would be good. Otherwise, can be used Solar system for green energy.
P3	Depth of analysis	This System has helped me in many courses like Engineering Drawing, Electronics circuits, Electronics, Computer programming, Digital Electronics, Microprocessor and interfacing, etc.
P4	Familiarity issue	In this project make need to gain extra knowledge like Arduino programming, and various types of instrumental behavior.
P5	Extend of applicable code	• Implement error handling and validation for received commands. • Add additional commands for more functionalities (e.g., adjusting cleaning intensity, checking battery levels, etc.). • Incorporate feedback mechanisms to send status updates back to the controlling device (e.g., confirmation of actions performed, battery status).
P6	Extend of stakeholder involvement and conflicting	N/A
P7	Interdependence	N/A

Provide your statement on which of the complex engineering activities are being solved in the designed project. Mention some or all of the following characteristics.

Complex Engineering Activities (A) Solving		
	Attributes	Statement from students
A1	Rainge of Resources or Diverse Resources	This project made me first get ideas from YouTube after getting more information from various journals and websites.
A2	Level of interaction between conflicting issues	As it is designed to clean our environment, especially water. And it can be controlled from a distance to be remotely controlled so that there is no

		risk of the tide after water. So, we think water will play a big role in cleaning us in the days ahead.
A3	Innovation	Earlier, people used to clean water by hand which was very risky and time-consuming. Now that the system is remote-controlled, it can be done quickly and without risk.
A4	Consequences to the Society and Environment	It is not harmful to our society and Environment but it is working to keep our society clean.
A5	Familiarity of issues	If it goes out of Bluetooth range it has to be brought back manually. Being battery operated, the power chole can be won at any time. Then it takes time to charge the battery.

APPENDIX C

PROGRAM CODE

```
#include <SoftwareSerial.h>
SoftwareSerial android(7, 8);

char command ;
int motorR1 = 3;
int motorR2 = 5;
int motorL1 = 6;
int motorL2 = 9;
int pump = 2;
int pump1 = 4;
int pump2 = 10;

void setup() {
  pinMode(motorR1, OUTPUT);
  pinMode(motorR2, OUTPUT);
  pinMode(motorL1, OUTPUT);
  pinMode(motorL2, OUTPUT);
  pinMode(pump,OUTPUT);
  pinMode(pump1,OUTPUT);
  pinMode(pump2,OUTPUT);

  digitalWrite(pump,HIGH);
  digitalWrite(pump1,HIGH);
  digitalWrite(pump2,HIGH);

  Serial.begin(9600);
  android.begin(9600);// Starts the serial communication
}

void loop() {


  // for bluetooth

  if (command == 'e')
  {
    digitalWrite(pump,HIGH);
    digitalWrite(pump2,HIGH);
  }

  if (command == 'b')
  {
    digitalWrite(pump1,HIGH);
  }
```

```
if (command == 'c')
{
  digitalWrite(pump,LOW);
}
if (command == 'd')
{
  digitalWrite(pump1,LOW);
}

if (command == 'a')
{
  digitalWrite(pump2,LOW);
}

if (command == '1') //forward
{
  analogWrite(motorR1, 100);
  analogWrite(motorR2, 0);
  analogWrite(motorL1, 100);
  analogWrite(motorL2, 0);

}
else if (command == '2') //Reverse
{
  analogWrite(motorR1, 0);
  analogWrite(motorR2, 100);
  analogWrite(motorL1, 0);
  analogWrite(motorL2, 100);
  //digitalWrite(spker, LOW);
}

else if (command == '3') //Left
{
  analogWrite(motorR1, 20);
  analogWrite(motorR2, 0);
  analogWrite(motorL1, 100);
  analogWrite(motorL2, 0);

}
else if (command == '4') //Right
{
  analogWrite(motorR1, 100);
  analogWrite(motorR2, 0);
  analogWrite(motorL1, 20);
  analogWrite(motorL2, 0);

}
else if (command == 'E') //stop
{
```

```
    analogWrite(motorR1, 0);
    analogWrite(motorR2, 0);
    analogWrite(motorL1, 0);
    analogWrite(motorL2, 0);
  }
  //command = 's';
}
```

APPENDIX D

DATASHEET OF COMPONENTS

[Put datasheet of components used]