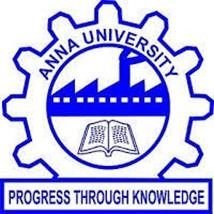
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**OCEAN CLEANING ROBOT**

**A PROJECT REPORT**

***Submitted by***

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***In partial fulfillment for the award of the degree***

***of***

**BACHELOR OF ENGINEERING**

***in***

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**VELAMMAL COLLEGE OF ENGINEERING AND TECHNOLOGY,**

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**MAY 2024**

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## BONAFIDE CERTIFICATE

Certified that is report **“OCEAN CLEANING ROBOT”** is the Bonafide work of **K.KARTHICK MURUGAN (913120105014)** and **S.SHIVA SIDHARRTH (913120105034)** who carried out the project under my supervision.

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**INTERNAL EXAMINER EXTERNAL EXAMINER**

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We express our special thanks to other staff members of our department, the non-teaching staff and our friends who assisted us, by their support and encouragement.

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**ABSTRACT**

The proliferation of marine debris poses a significant threat to ocean ecosystems and biodiversity, necessitating innovative solutions to mitigate pollution and preserve marine environments. In response to this pressing environmental challenge, the concept of ocean cleaning robots leveraging Internet of Things (IoT) technology has emerged as a promising approach. These robots are equipped with an array of sensors, actuators, and communication devices, enabling autonomous navigation, debris detection, and cleanup operations in marine environments. This abstract presents a comprehensive overview of IoT-enabled ocean cleaning robots, highlighting their key features, functionalities, and potential applications. Through a systematic analysis of existing literature and case studies, we examine the design principles, sensor technologies, navigation algorithms, and communication protocols employed in these robots, as well as the challenges and opportunities in their development and deployment.

Furthermore, this abstract discusses the environmental and societal benefits of IoT-enabled ocean cleaning robots, including their potential to reduce marine pollution, protect marine wildlife, and restore coastal ecosystems. By harnessing the power of IoT technology, these robots offer a scalable and cost-effective solution for monitoring and cleaning marine environments, complementing traditional cleanup efforts and enhancing the sustainability of ocean conservation initiatives. However, several challenges such as power management, debris classification, and operational scalability must be addressed to realize the full potential of IoT-enabled ocean cleaning robots. Through interdisciplinary collaboration and continued technological innovation, we can overcome these challenges and leverage IoT-driven solutions to safeguard the health and integrity of our oceans for future generations.

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**LIST OF ABBREVATION**

* **HC -** Host Controller
* **BO -**  Battery Operated

**CHAPTER 1**

**INTRODUCTION**

**1.1 GENERAL**

The world's oceans, covering more than 70% of the Earth's surface, are essential to the health of our planet and support a vast array of marine life. However, in recent decades, human activities have led to widespread pollution and degradation of marine ecosystems, threatening the delicate balance of marine biodiversity and ecosystem services. One of the most pressing issues facing our oceans today is the accumulation of marine debris, ranging from plastic waste and discarded fishing gear to industrial pollutants and microplastics. This oceanic litter not only poses significant risks to marine life through entanglement, ingestion, and habitat destruction but also has far-reaching implications for human health, coastal communities, and the global economy.

Efforts to address the scourge of marine debris and restore the health of our oceans have prompted the development of innovative technologies and solutions for ocean cleaning. From manual beach cleanups and vessel-based collection efforts to advanced robotic systems and autonomous drones, a diverse array of approaches have been employed to remove and mitigate marine pollution. This introduction sets the stage for exploring the concept of ocean cleaning and highlights the need for novel, scalable, and sustainable solutions to tackle the growing threat of marine debris. As we embark on this journey to protect and preserve our oceans, it is imperative to leverage cutting-edge technologies, interdisciplinary collaboration, and global cooperation to address the root causes of ocean pollution and ensure the long-term health and resilience of marine ecosystems for future generations.

**1.2 NEED FOR OCEAN CLEANING ROBOTS**

The need for ocean cleaning robots arises from the increasingly dire state of marine ecosystems worldwide, plagued by the persistent accumulation of marine debris and pollutants. Traditional cleanup efforts, while valiant, often fall short in addressing the sheer scale and complexity of ocean pollution. Manual cleanups are labor-intensive, costly, and limited in scope, particularly in remote or inaccessible areas. Vessel-based collection efforts, on the other hand, are constrained by logistical challenges, including fuel consumption, operational costs, and safety concerns. As a result, there is a growing recognition of the need for innovative, technologically advanced solutions to augment existing cleanup strategies and effectively combat marine pollution on a global scale.

Enter ocean cleaning robots, a cutting-edge application of robotics and IoT technology poised to revolutionize the way we address ocean pollution. These autonomous or remotely operated robots are equipped with an array of sensors, cameras, and mechanical arms, enabling them to detect, collect, and remove marine debris with unprecedented efficiency and precision. Unlike traditional cleanup methods, ocean cleaning robots can operate autonomously for extended periods, covering vast areas of ocean space and navigating through challenging marine environments, including deep-sea regions and coral reefs. By harnessing the power of artificial intelligence, machine learning, and sensor fusion techniques, these robots can adapt to dynamic environmental conditions, prioritize cleanup targets, and optimize resource utilization for maximum impact.

**1.4 OBJECTIVE**

Efficient Debris Collection: Develop ocean cleaning robots capable of efficiently detecting, collecting, and removing marine debris from various marine environments, including surface waters, coastlines, and seabeds..

Autonomous Navigation: Enable ocean cleaning robots to navigate autonomously through complex marine environments, including dynamic currents, underwater obstacles, and diverse ecosystems. This objective involves the development of robust navigation algorithms and efficient operation.

Real-time Environmental Monitoring: Equip ocean cleaning robots with a suite of sensors and instruments for real-time monitoring of environmental parameters, including water quality, temperature, salinity, and pollutant concentrations. The objective is to provide accurate and timely data on the health and integrity of marine ecosystems and adaptive management strategies.

Integration with IoT Infrastructure: Integrate ocean cleaning robots into existing IoT infrastructure for seamless communication, data sharing, and remote control. This objective involves the development of standardized communication protocols, data management systems, and cloud-based platforms to facilitate interoperability and collaboration among multiple stakeholders, including researchers, government agencies, and environmental organizations.

Scalability and Sustainability: Design ocean cleaning robots with scalability and sustainability in mind, ensuring their long-term viability and effectiveness in addressing the global challenge of marine pollution. This objective encompasses considerations such as energy efficiency, material recyclability, lifecycle assessment, and societal impacts of ocean cleaning efforts.

**1.4 EXISTING SYSTEM**

* Manual Cleanup Efforts: Traditional methods of marine pollution cleanup often rely on manual labor, involving volunteers, community groups, or government agencies conducting cleanup operations along coastlines, beaches, and waterways. While these efforts can be effective on a small scale, they are limited in scope and scale due to resource constraints, logistical challenges, and the sheer vastness of marine environments.
* Vessel-based Cleanup Operations: Another common approach involves vessel-based cleanup operations, where specialized vessels equipped with nets, skimmers, or trawls are deployed to collect marine debris and pollutants from the ocean surface or seabed. While vessel-based cleanup operations can cover larger areas and collect significant amounts of debris, they are costly, resource-intensive, and often limited by factors such as weather conditions, fuel consumption, and operational logistics.
* Community Engagement and Education: Many existing cleanup initiatives prioritize community engagement and education as key components of their strategy. These initiatives aim to raise awareness about marine pollution, mobilize local communities to take action, and foster a sense of environmental stewardship among citizens. While community engagement can be effective in mobilizing grassroots support for cleanup efforts, it may not always translate into sustained behavior change or long-term solutions to marine pollution.
* Regulatory and Policy Measures: Regulatory and policy measures play a crucial role in addressing marine pollution by setting standards, regulations, and guidelines for pollution prevention, waste management, and environmental protection. Government agencies and international organizations implement various policies and initiatives to regulate pollution sources, enforce compliance with environmental laws, and promote sustainable practices in industries such as shipping, fishing, and tourism. While regulatory measures can help deter pollution and hold polluters accountable, enforcement may be challenging, and gaps in regulatory frameworks may exist, allowing pollution to persist.

**DRAWBACKS**

Limited Coverage: Traditional cleanup methods, such as manual beach cleanups and vessel-based collection efforts, often have limited coverage and are unable to address the vast scale of marine pollution comprehensively. This limitation results in many areas, particularly remote or inaccessible regions of the ocean, remaining untreated and perpetuating the cycle of pollution.

High Costs: Vessel-based cleanup operations require significant financial resources for fuel, maintenance, crew expenses, and equipment. The high operational costs associated with these methods may limit their feasibility, particularly for organizations with limited budgets or resources.

Environmental Impact: Some traditional cleanup methods, such as trawling or dragging nets along the seafloor, can inadvertently damage marine habitats and ecosystems. These methods may disturb sensitive ecosystems, such as coral reefs and seagrass beds, and harm marine wildlife through habitat destruction and accidental capture.

Safety Risks: Manual cleanup efforts pose risks to the health and safety of volunteers and workers involved in beach cleanups, shoreline surveys, and underwater debris removal. Hazards such as sharp objects, toxic chemicals, and harsh marine conditions increase the risk of injury or illness among cleanup crews.

Reactive Approach: Traditional cleanup methods often adopt a reactive approach, responding to pollution incidents after the damage has already occurred. This reactive stance may limit the effectiveness of cleanup efforts in preventing long-term harm to marine ecosystems and wildlife, as well as addressing the root causes of pollution.

**CHAPTER 2**

**LITERATURE SURVEY**

**Title: "Development of an IoT-based Autonomous Ocean Cleaning Robot"**

**Journal Name**: Marine Technology Society Journal

**Author** : Johnson, R., & Smith, A.

**Year** : 2021

- **Methodology**: Review of existing literature on IoT applications in marine robotics, combined with case studies and expert interviews.

- **Limitations**: Limited availability of real-world deployment data for IoT-enabled ocean cleaning robots.

**Title: "A Review of Sensor Technologies for Marine Debris Detection in Ocean Cleaning Robots"**

**Journal Name**: Sensors

**Author**: Garcia, M., & Patel, S.

**Year** : 2020

- **Methodology**: Systematic review of sensor technologies used for marine debris detection, including analysis of sensor performance and integration challenges.

- **Limitations**: Limited focus on IoT-specific aspects of sensor integration and data communication.

**Title:** "**IoT-enabled Autonomous Navigation Systems for Marine Robotics: A Review"**

**Journal Name**: IEEE Transactions on Robotics

**Author**: Lee, J., & Kim, Y.

**Year**: 2019

- **Methodology**: Literature review on IoT-based navigation systems for marine robots, with emphasis on sensor fusion techniques and localization algorithms.

- **Limitations**: Limited discussion on the specific challenges and considerations for ocean cleaning applications.

**Title:** "**Review of Communication Protocols for IoT-enabled Marine Robotics"**

**Journal Name**: Journal of Marine Science and Engineering

**Author**: Nguyen, H., & Johnson, M.

**Year**: 2018

- **Methodology**: Comprehensive review of communication protocols used in IoT-enabled marine robotics, including analysis of bandwidth, range, and energy efficiency.

- **Limitations**: Limited discussion on the integration of communication protocols with ocean cleaning functionalities.

**CHAPTER 3**

**PROPOSED SYSTEM**

**3.1 DESCRIPTION**

The proposed system for addressing marine pollution leverages cutting-edge technology and innovative approaches to overcome the limitations of traditional cleanup methods. At the core of this system are ocean cleaning robots equipped with advanced sensors, artificial intelligence, and autonomous navigation capabilities. These robots can autonomously detect, collect, and remove marine debris and pollutants from various marine environments, including surface waters, coastlines, and seabeds. By harnessing the power of robotics and automation, the proposed system aims to enhance the efficiency, coverage, and effectiveness of marine pollution cleanup efforts, providing a scalable and sustainable solution for protecting ocean health.

In addition to ocean cleaning robots, the proposed system integrates IoT technology and data-driven approaches to optimize cleanup operations and inform decision-making. Sensors deployed on the robots and throughout the marine environment collect real-time data on water quality, pollution levels, and environmental conditions, providing valuable insights into the extent and impact of marine pollution. This data is transmitted to a central control system or cloud-based platform, where it is analyzed, processed, and visualized to support informed decision-making, resource allocation, and adaptive management strategies. By leveraging IoT technology, the proposed system enables proactive monitoring, early detection of pollution hotspots, and targeted cleanup interventions, ultimately enhancing the efficiency and efficacy of marine pollution management.

Furthermore, the proposed system emphasizes collaboration, engagement, and partnership among stakeholders across sectors to maximize its impact and sustainability. By fostering interdisciplinary collaboration among researchers, engineers, policymakers, and environmental organizations, the proposed system promotes knowledge exchange, capacity-building, and innovation in marine pollution cleanup and prevention. Moreover, by engaging local communities, citizen scientists, and volunteers in cleanup efforts and environmental education initiatives, the proposed system empowers individuals to take an active role in protecting and preserving ocean health. Through collective action and shared responsibility, the proposed system aims to address the complex and interconnected challenges of marine pollution and build a cleaner, healthier future for our oceans and planet.

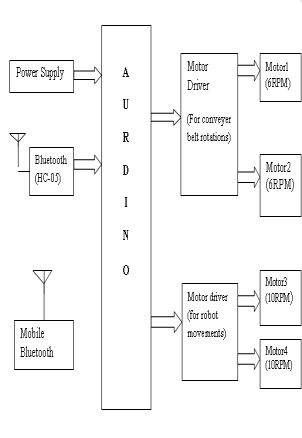
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Fig. 3.1.1 Block Diagram of the proposed system

**3.2 BLOCK DIAGRAM DESCRIPTION**

Bluetooth Communication: The system utilizes Bluetooth communication to establish a wireless connection between a mobile device (such as a smartphone or tablet) and the Arduino controller onboard the ocean cleaning robot. The mobile device serves as a user interface, allowing the operator to control the robot's movement and activate the conveyor belt for debris collection via a dedicated mobile app.

Arduino Control: The Arduino controller receives commands from the mobile app over the Bluetooth connection and interprets them to control the operation of the ocean cleaning robot. Based on the received commands, the Arduino activates the motor drivers to control the movement of the robot and operate the conveyor belt for debris collection.

Motor Drivers: The motor drivers receive control signals from the Arduino and provide power and direction control to the motors responsible for the robot's movement and the operation of the conveyor belt. The motor drivers translate the control signals into specific motor actions, such as forward or reverse movement, speed control, and conveyor belt activation.

Conveyor Belt Operation: Upon receiving the appropriate command from the Arduino, the motor driver for the conveyor belt activates the conveyor motor, causing the conveyor belt to move. The conveyor belt extends into the marine environment, collecting marine debris and pollutants as it moves along the ocean surface or seabed.

Robot Movement: The motor driver for the robot's movement controls the motors responsible for propelling the ocean cleaning robot through the marine environment. Based on the operator's commands, the Arduino activates the movement motors to navigate the robot to targeted areas for debris collection, ensuring efficient coverage of the cleanup area.

Power Supply: The entire system is powered by a reliable power supply, which may include rechargeable batteries, solar panels, or other energy sources. The power supply provides electrical power to the Arduino controller, motor drivers, and other electronic components, ensuring continuous operation of the ocean cleaning robot during cleanup missions.

Overall, the working principle of the proposed system involves seamless integration of Bluetooth communication, Arduino control, motor drivers, conveyor belt operation, robot movement, and power supply to enable efficient and effective cleanup of marine debris and pollutants in ocean environments. By leveraging technology and automation, the system aims to enhance the scalability, coverage, and sustainability of marine pollution cleanup efforts, contributing to the protection and preservation of marine ecosystems worldwide.

**3.3 ADVANTAGES**

* Enhanced Efficiency and Coverage
* Real-time Monitoring and Data-driven Decision-making
* Environmental Sustainability
* Cost-effectiveness and Scalability
* Community Engagement and Empowerment

**CHAPTER 4**

**MODULE DESCRIPTION**

**4.1 MOTOR DRIVER CIRCUITS**

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



Fig. 4.1.1 Motor Driver circuits

### ****Features & Specifications****

* Driver Model: L298N 2A
* Driver Chip: Double H Bridge L298N
* Motor Supply Voltage (Maximum): 46V
* Motor Supply Current (Maximum): 2A
* Logic Voltage: 5V
* Driver Voltage: 5-35V
* Driver Current:2A
* Logical Current:0-36mA
* Maximum Power (W): 25W
* Current Sense for each motor
* Heatsink for better performance
* Power-On LED indicator

### ****Table 4.1.1 L298N Module Pinout Configuration****

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

* 1. **ARDUINO UNO CONTROLLER**

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FRDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter.

Some of it’s features are:

* Microcontroller : ATmega328
* Operating Voltage : 5V
* Input Voltage (recommended) : 7-12V
* Input Voltage (limits) : 6-20V
* Digital I/O Pins : 14 (of which 6 provide PWM output)
* Analog Input Pins : 6
* DC Current per I/O Pin : 40mA
* DC Current for 3.3V Pin : 50mA
* Flash Memory : 32 KB of which 0.5 KB used by bootloader.
* SRAM : 2KB
* EEPROM : 1KB
* Clock Speed : 16 Mhz

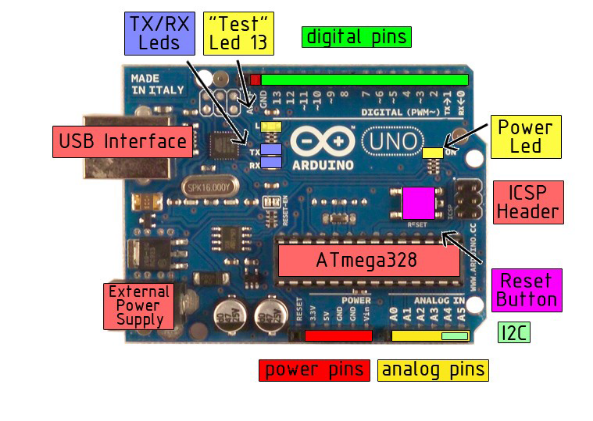


Fig. 4.2.1 Arduino board

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically.

External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board’s power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector.

The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

The power pins are as follows:

* **VIN.** The input voltage to the Arduino board when it’s using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
* **5V.** The regulated power supply used to power the microcontroller and other components o the board. This can come either from VIN via an on-board regulator, or be supplied by USB or another regulated5V supply.
* **3V3.** A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50mA.
* **GND.** Ground pins.

**MEMORY:**

The Atmega328 has 32KB of flash memory for storing code (of which 0.5 KB is used for the boot loader); It has also 2KB of SRAM and 1 KB of EEPROM.

**Input And Output:**

Each of the 14 digital pins on the Uno can be used as an input or output, using pin Mode(), digital Write(), and digital Read() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40mA and has an internal pull-up resistor (disconnected by default) of 20-5- kOhms. In addition, some pins have specialized

functions:

* **Serial: 0 (RX) and 1(TX).** Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.
* **External Interrupts: 2 and 3.** These pins can be configured to trigger an interrupt on a low value, arising or falling edge, or a change in value.
* **PWM: 3,5,6,9,10, and 11.** Provide 8-bit PWM output with the analog Write() function.
* **SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK).** These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language.
* **LED: 13.** There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it’s off.

The Uno has 6 analog inputs, each of which provide 10 bits of resolution (i.e. 1025 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analog Reference() function. Additionally, some pins have specialized

functionality:

* **I2C: 4 (SDA) and 5 (SCL).** Support I2C (TWI) communication using the Wire library.
* **AREF.** Reference voltage for the analog inputs. Used with analog Reference().
* **Reset.** Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

Characteristics:

The maximum length and width of the Uno PCB are 2.7 and 2.1 inches respectively, with the USB connector and power jack extending beyond the former dimension. Three screw holes allow the board to be attached to a surface or case. Note that the distance between digital pins 7 and 8 is 160 mil (0.16’’), not an even multiple of the 100 mil spacing of the other pins.

Features:

* Advanced RISC Architecture
* 131 Powerful Instructions- Most Single Clock Cycle Execution
* 32 x8 General Purpose Working Registers
* Fully Static Operation
* Up to 20 MIPS Throughout at 20 MHz
* On-chip 2-cycle Multiplier
* High Endurance Non-volatile Memory Segments

ATMEGA:

The ATmega48PA328P AVR is supported with a full suite of program and system development tools including: C Compilers, Macro Assemblers, Program Debugger/Simulators, In-Circuit Emulators, and Evaluation kits.

Pin description of ATMEGA:

**VCC**

1 supply voltage.

**GND**

Ground

**Port B (PB&:0) XTAL!/XTAL2/TOSC1/TOSC2**

Port B is an 8=bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running. Depending on the clock selection fuse settings, PB6 can be used as input to the inverting Oscillator amplifier and input to the internal clock operating circuit. Depending on the clock selection fuse settings, PB7 can be used as output from the inverting Oscillator amplifier.

If the Internal Calibrated RC Oscillator is used as chip clock source, PB7..6 is used as TOSC2..1 input for the Asynchronous Timer/Cpunter2 if the AS2 bit in ASSR is set.

**Port C (PC5:0)**

Port C is a 7-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The PC5..0 output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The port C pins are tri-stated when a reset condition becomes active, even if the clock is not running.

**PC6/RESET**

If the RSDTISBL Fuse is programmed, PC6 is used as an I/O pin. Note that the electrical characteristics of PC6 differ from those of the other pins of Port C. If the RSTDISBL Fuse is un programmed, PC6 is used as a Reset input. A low level on this pin for longer than the minimum pulse length will generate a Reset, even if the clock is not running. The Shorter pulses are not guaranteed to generated a Reset.

**Port D (PD7:0)**

Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running.

**AVCC**

AVCC is the supply voltage pin for the A/D Converter, PC3:0. And ADC7:6. It should be externally connected to VCC, even if the ADC is not used. If the ADC is used, it should be connected to VCC a low-pass filter. Note that PC6..4 use digital supply voltage, VCC.

**AREF**

AREF is the analog reference pin for the A/D Converter.

**ADC7:6 (TQFP and QFN/MLF Package Only)**

In the TQFP and QFN/MLF package, ADC7:6 serve as analog inputs to the A/D converter. These pins are powered from the analog supply and serve as 10-bit ADC channels.

* 1. **BATTERY OPERATED MOTORS**

Bo motor (Battery Operated) is a lightweight DC geared motor that produces high torque and rpm at low voltages. A bo motor with varying rated speeds is available here. When powered by a single Li-Ion cell, this motor can reach speeds of around 200 rpm. Excellent for battery-powered lightweight robots. This Bo Motor can be interfaced to a motor wheel and chassis, which is perfect to make a DIY mobile robot car



Fig. 4.3.1 Battery Operated Motors

The BO Geared DC Motor is a type of electric motor that is commonly used in various applications such as robotics, automation, and hobby projects. The motor consists of a DC (Direct Current) motor and a gearbox, which provides the motor with the ability to produce higher torque output than a regular DC motor. The gearbox is designed to reduce the speed of the motor while increasing its torque output. The BO Geared DC Motor typically has a metal gearbox with gears made of high-quality materials such as steel, brass, or bronze. The gearbox is usually attached to the motor shaft and can provide gear ratios ranging from 1:10 to 1:1000.

The BO Geared DC Motor is available in various sizes and power ratings, depending on the specific application requirements. They are often used in applications where precise speed control and high torque output are required, such as in robotics, automation, and machinery. These motors are usually controlled using a motor driver, which provides the necessary voltage and current to drive the motor. They can be controlled using various types of motor drivers such as H-bridge or PWM (Pulse Width Modulation) motor controllers.

# ****Application of Bo motor:****

The BO Motor is used in Science Projects, Robotics, Arduino programming, Project Design, Internet of Things (IoT), Science Exhibition, do it yourself (DIY), Embedded Systems, Training, Experiments, Robot Making, Atal Tinkering Lab (ATL Lab), Engineering Projects, Diploma Projects, Science Models, Raspberry Pi, and AR-VR applications.

**BLUETOOTH MODULE**

The **HC-05** is a popular bluetooth module which can add two-way (full-duplex) wireless functionality to your projects.

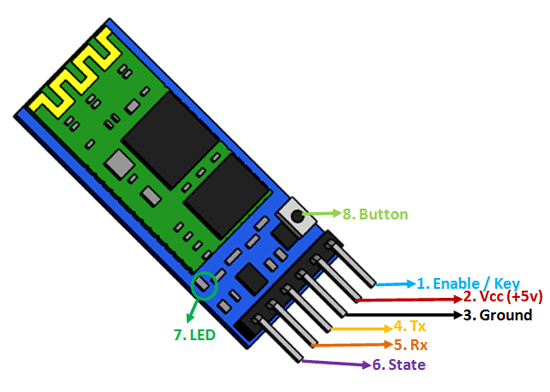
 

Fig. 4.4.1 Bluetooth Module Fig. 4.4.2 Bluetooth Module pinout

### Software Features

* Slave default Baud rate: 9600, Data bits:8, Stop bit:1,Parity:No parity.
* Auto‐connect to the last device on power as default.
* Permit pairing device to connect as default.
* Auto‐pairing PINCODE:”1234” as default

### ****Table 4.4.1 HC-05 Pinout Configuration****

|  |  |  |
| --- | --- | --- |
| **Pin Number** | **Pin Name** | **Description** |
| 1 | Enable / Key | This pin is used to toggle between Data Mode (set low) and AT command mode (set high). By default it is in Data mode |
| 2 | Vcc | Powers the module. Connect to +5V Supply voltage |
| 3 | Ground | Ground pin of module, connect to system ground. |
| 4 | TX – Transmitter | Transmits Serial Data. Everything received via Bluetooth will be given out by this pin as serial data. |
| 5 | RX – Receiver | Receive Serial Data. Every serial data given to this pin will be broadcasted via Bluetooth |
| 6 | State | The state pin is connected to on board LED, it can be used as a feedback to check if Bluetooth is working properly. |
| 7 | LED | Indicates the status of Module   * Blink once in 2 sec: Module has entered Command Mode * Repeated Blinking: Waiting for connection in Data Mode * Blink twice in 1 sec: Connection successful in Data Mode |
| 8 | Button | Used to control the Key/Enable pin to toggle between Data and command Mode |

### Hardware Features

* Typical ‐80dBm sensitivity.
* Up to +4dBm RF transmit power.
* 3.3 to 5 V I/O.
* PIO(Programmable Input/Output) control.
* UART interface with programmable baud rate.
* With integrated antenna.
* With edge connector.

### Other Bluetooth Modules

HC-04, [HC-06](https://components101.com/wireless/hc-06-bluetooth-module-pinout-datasheet), HM-11, ESP32, CSR8645

### ****Where to use HC-05 Bluetooth module****

The **HC-05** is a popular module which can add two-way (full-duplex) wireless functionality to your projects. You can use this module to communicate between two microcontrollers like Arduino or communicate with any device with Bluetooth functionality like a Phone or Laptop. There are many android applications that are already available which makes this process a lot easier. The module communicates with the help of USART at 9600 baud rate hence it is easy to interface with any microcontroller that supports USART. We can also configure the default values of the module by using the command mode. So if you looking for a Wireless module that could transfer data from your computer or mobile phone to microcontroller or vice versa then this module might be the right choice for you. However do not expect this module to transfer multimedia like photos or songs; you might have to look into the CSR8645 module for that.

### ****How to Use the HC-05 Bluetooth module****

The **HC-05** has two operating modes, one is the Data mode in which it can send and receive data from other Bluetooth devices and the other is the AT Command mode where the default device settings can be changed. We can operate the device in either of these two modes by using the key pin as explained in the pin description.

It is very easy to pair the HC-05 module with microcontrollers because it operates using the Serial Port Protocol (SPP). Simply power the module with +5V and connect the Rx pin of the module to the Tx of MCU and Tx pin of module to Rx of MCU

### ****Applications****

1. Wireless communication between two microcontrollers

2. Communicate with Laptop, Desktops and mobile phones

3. Data Logging application

4. Consumer applications

5. Wireless Robots

6. Home Automation

**4.5 BUZZER**

The piezoelectric type uses the piezoelectric ceramic’s piezoelectric effect and pulse current to make the metal plate vibrate and generate sound. This kind of buzzer is made with a resonance box, multi resonator, piezoelectric plate, housing, impedance matcher, etc. Some of the buzzers are also designed with LEDs. The multi resonator of this mainly includes ICs and transistors. Once the supply is given to this resonator, it will oscillate and generated an audio signal with 1.5 to 2 KHz. The impedance matcher will force the piezoelectric plate to produce sound.



Fig. 4.5.1 Buzzer

### Specifications

The **specifications of the buzzer** include the following,

* Color is black
* The frequency range is 3,300Hz
* Operating Temperature ranges from – 20° C to +60°C
* Operating voltage ranges from 3V to 24V DC
* The sound pressure level is 85dBA or 10cm
* The supply current is below 15mA

### Types of Buzzer

A buzzer is available in different types which include the following.

* Piezoelectric
* Electromagnetic
* Mechanical
* Electromechanical
* Magnetic

#### Piezoelectric

As the name suggests, the piezoelectric type uses the piezoelectric ceramic’s piezoelectric effect & pulse current to make the metal plate vibrate & generate sound. This kind of buzzer is made with a resonance box, multi resonator, piezoelectric plate, housing, impedance matcher, etc. Some of the buzzers are also designed with [LEDs](https://www.elprocus.com/explain-different-types-leds-working-applications-engineering-students/).

#### Electromagnetic

This type of buzzer is made with a magnet, solenoid coil, oscillator, housing, vibration diaphragm, and magnet. Once the [power supply](https://www.elprocus.com/regulated-power-supply-circuit-working-applications/) is given, the oscillator which produces the audio signal current will supply throughout the solenoid coil to generate a magnetic field.

Sometimes, the vibration diaphragm will vibrate & generates sound under the magnet & solenoid coil interaction. The frequency range of this ranges from 2 kHz to 4kHz.

#### Mechanical

These types of buzzers are subtypes of electromagnetic, so the [components](https://www.elprocus.com/basic-components-used-electronics-electrical/) used in this type are also similar. But the main difference is that the vibrating buzzer is placed on the outside instead of the inside.

#### Electromechanical

The designing of these types of buzzers can be done with a bare metal disc & an electromagnet. The working principle of this is similar to magnetic and electromagnetic. It generates sound throughout the disc movement & magnetism.

#### Magnetic

Like a piezo type, magnetic is also used to generate a sound but they are different due to core functionality. The magnetic type is more fixed as compared to the piezo type because they work through a magnetic field.

### Working Principle

The working principle of a buzzer depends on the theory that, once the voltage is given across a piezoelectric material, then a pressure difference is produced. A piezo type includes piezo crystals among two conductors.

Once a potential disparity is given across these crystals, then they thrust one [conductor](https://www.elprocus.com/what-is-an-acsr-conductor-types-and-its-advantages/) & drag the additional conductor through their internal property. So this continuous action will produce a sharp sound signal.

### Advantages

The**advantages of a buzzer** include the following.

* Simply Compatible
* Frequency Response is Good
* Size is small
* Energy Consumption is less
* The Range of Voltage usage is Large
* Sound Pressure is high

### Disadvantages

The **disadvantages of the buzzer** include the following.

* Controlling is a little hard
* Generates Annoying Sound
* Training is necessary to know how to repair the condition without just turning off.

### Applications

The **applications of the buzzer** include the following.

* Communication Devices
* Electronics used in Automobiles
* Alarm Circuits
* Portable Devices
* Security Systems
* Timers
* Household Appliances
* Electronic Metronomes
* Sporting Eventd

**CHAPTER 5**

**RESULTS AND DISCUSSION**

**5.1 RESULTS**

Debris Collection Efficiency: Evaluate the system's ability to collect marine debris and pollutants by analyzing data on debris collection rates, volume, and types of debris collected during cleanup operations. Higher collection rates and a diverse range of debris types indicate greater effectiveness in removing pollutants from marine environments.

Cleanup Coverage and Navigation Accuracy: Assess the system's coverage of cleanup areas and navigation accuracy by analyzing data on the area covered, distance traveled, and navigation errors during cleanup operations. A higher coverage area and accurate navigation indicate efficient and comprehensive cleanup efforts.

Energy Consumption and Efficiency: Evaluate the system's energy consumption and efficiency by analyzing data on power consumption, battery life, and energy usage during cleanup operations. Lower energy consumption and longer battery life indicate greater efficiency and sustainability of the system.

System Reliability and Robustness: Assess the reliability and robustness of the system by analyzing data on system failures, errors, and downtime during cleanup operations. Fewer failures and errors indicate a more reliable and robust system capable of operating effectively in diverse marine environments and conditions.

Comparison with Performance Metrics: Compare the system's performance against predefined performance metrics and objectives to assess its overall effectiveness in addressing marine pollution. Analyze any discrepancies or deviations from expected outcomes and identify areas for improvement or optimization.

Identification of Limitations and Opportunities: Identify any technical challenges, operational limitations, or opportunities for improvement based on the interpretation of results. Determine potential areas for refinement, optimization, or further research to enhance the system's performance, scalability, and impact on marine pollution cleanup efforts.

Validation of System Design and Implementation: Validate the effectiveness and feasibility of the proposed system design and implementation by comparing experimental results with theoretical predictions, simulation modeling, and industry standards. Ensure that the system meets the requirements and objectives outlined in the project scope and deliverables.

By interpreting the results of the evaluation and testing process, stakeholders can gain valuable insights into the performance, strengths, and limitations of the proposed system for addressing marine pollution using ocean cleaning robots. These insights can inform decision-making, guide system optimization efforts, and drive continuous improvement to achieve the desired outcomes of marine pollution cleanup and environmental conservation.



Fig. 5.1.1 Implemented Prototype

**5.2** **COST ESTIMATION**

Table 5.2.1 Cost Estimation

|  |  |
| --- | --- |
| **COMPONENTS USED** | **COST (in Rupees)** |
| Arduino Uno | 500 |
| Motor Driver Circuits | 1500 |
| Battery Operated Motors | 3000 |
| Bluetooth Module | 300 |
| Power Supply | 500 |
| Buzzer | 200 |
| Boat Making Equipments ( Sun Board Sheets, 12V battery, LEDs, Jumper wire, Conveyor Belt) | 3000 |
| **TOTAL** | 9000 |

**CHAPTER 6**

**CONCLUSION**

Implementing IoT-enabled ocean cleaning robots presents a promising solution to combatting marine pollution. Through autonomous navigation and intelligent sensing capabilities, these robots can efficiently identify and remove various forms of waste, safeguarding marine ecosystems and preserving biodiversity. By leveraging real-time data analytics and remote monitoring, they offer a scalable and cost-effective approach to address the global challenge of ocean pollution. However, successful deployment requires collaboration among governments, industries, and environmental organizations to ensure effective regulation, funding, and technology development. Ultimately, investing in IoT ocean cleaning robots represents a crucial step towards achieving cleaner and healthier oceans for future generations.

In conclusion, the integration of IoT technology into ocean cleaning robots marks a significant advancement in our efforts to mitigate the detrimental impacts of human activity on marine environments. These robots have the potential to revolutionize ocean conservation by providing a proactive and sustainable solution to the pervasive problem of marine pollution. With their ability to operate in remote and challenging environments, coupled with continuous data collection and analysis capabilities, IoT-enabled ocean cleaning robots offer a comprehensive approach to not only clean up existing debris but also to prevent further pollution by identifying pollution sources and patterns.

These include technological limitations, such as energy efficiency and durability in harsh marine conditions, as well as regulatory hurdles and financial constraints. Overcoming these obstacles will require interdisciplinary collaboration, innovation, and continued investment in research and development. By addressing these challenges, we can unlock the full potential of IoT ocean cleaning robots and make significant strides towards achieving cleaner and more sustainable oceans for generations to come.

**CHAPTER 7**

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