DESIGN AND FABRICATION OF RIVER CLEANING BOAT



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APPROVAL

This is to certify that the project on "Deign & Fabrication of River Cleaning Boat.” By Sanchay Tripura (ID No: ME2103025215), MD Ahmed Jubayer Rafi (ID No: ME2102024172), Antu Acharjee (ID No: ME2003022022), Sabbir Hosain Rifat (ID No: ME2103025234), Saburuzzaman Shantu (ID No: ME2103025476) has been carried out under our supervision. The project has been carried out in partial fulfillment of the requirements of the degree of Bachelor of Science (B.Sc.) in Mechanical Engineering of the year 2025 and has been approved as to its style and contents.

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DECLARATION

We do hereby solemnly declare that, the work presented here in this project report has been carried out by us and has not been previously submitted to any University Organization for award of any degree or certificate we hereby ensure that the works that has been prevented here does not breach any existing copyright.We further undertake to indemnify the university against any loss or damage arising from breach of the foregoing obligation.

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ABSTRACT

The River Cleaning Boat is an innovative solution designed to tackle water pollution and maintain the ecological balance of river bodies. Utilizing advanced technology, the boat is equipped with a conveyor mechanism, filtration system, and monitoring to collect and segregate floating debris, plastics, and organic waste. The automated system enables real-time data collection on waste accumulation, enhancing efficiency in waste management and environmental protection. Energy-efficient motors, the boat to operate sustainably with minimal environmental impact. The collected waste is stored in designated compartments for proper disposal or recycling, contributing to the reduction of river pollution. The River Cleaning Boat not only improves water quality but also prevents hazards to aquatic life and supports cleaner, navigable waterways. Its scalable design allows deployment in rivers of varying sizes, making it a versatile tool for urban and rural water management. This innovation represents a step forward in sustainable environmental conservation, aligning with global initiatives for cleaner water bodies and a healthier ecosystem.

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CHAPTER 1
INTRODUCTION

1.1 Overview

Water is the source of life. Though 70% of the earth is covered with water, about 97% of it is in the form of oceans and hence not fit for human consumption. The remaining 3% is stored in various sources like glaciers, rivers, lakes and underground aquifers. Rivers and lakes, which are found on the earth's surface are very much essential for the mankind. River water is used for irrigation which in return gives food to the people. Rivers also maintain the ecology of the region and bring in prosperity. Unfortunately, most of the rivers and lakes are getting polluted. This is due to human actions like letting domestic and industrial wastes into such water bodies. Thus rivers like Ganges, Yamuna and Narmada have become highly polluted. Even the South Indian River Kaveri is affected by pollution. Solid waste which floats on the river surface is a cause of serious concern. Disposal of solid waste is the first step towards minimizing surface water pollution. Some machines have been developed to clear the solid waste found on the surface of the water bodies

Most importantly, this problem can bring forth some innovative yet cost-effective solutions, especially where there is limited access to large-scale clean-up equipment. Such innovations include the water-cleaning RC boat. It is a small, remote-controlled vessel water cleaning by scavenging floating debris, plastics, and contaminants from water surfaces.

It is said to be effective, scalable, and affordable compared with existing alternatives for cleaning water. The boat that is controlled remotely operates in water bodies, targeting highly polluted areas which cannot be reached by using larger equipment. It incorporates principles of robotics, engineering, and environmental science in order to produce solutions sustainable for future water cleanup. It has a built-in collection mechanism (nets and conveyor belts), propulsion system, and sensors installed in the RC boat for effective waste collection with reduced labor costs and manual intervention while operated remotely. Above all, it was aptly compact and mobile so that even urban water bodies, nearly surrounded by infrastructure, can house very limited services to deploy larger scouring systems. In addition, it is energy efficient with the recent design considering solar panel incorporation as an example of rechargeable batteries, which minimizes evil into the environment. This water-cleaning RC boat is also

contributing in making the environment cleaner and greener by fighting surface-level pollution to create better impact on the freshwater ecosystem toward waste effects.

1.2 Problem Statement

Rivers are vital natural resources that support ecosystems, agriculture, and human communities. However, rising pollution levels caused by plastics, debris, and other waste materials threaten their health and sustainability. Traditional cleaning methods are labor-intensive, costly, and often ineffective in reaching inaccessible areas where waste accumulates. Furthermore, manual cleanup efforts are limited in scale and frequency, allowing pollutants to persist and harm aquatic life.

The River Cleaning Boat project addresses this critical issue by providing an automated, energy-efficient solution for collecting floating waste from river surfaces. Designed to operate continuously without reliance on conventional energy sources, it ensures sustainable waste removal, reduces human intervention, and improves the cleanliness of waterways. This innovation aims to enhance water quality, protect ecosystems, and promote long-term environmental conservation in both urban and rural regions.

1.3 Objectives

The objectives of this project are

- To study, design, and construct the Design & Fabrication of River Cleaning Boat**.**
- To efficiently collect floating waste like plastics, debris, and organic matter from river surfaces.
- To improve water quality and protect aquatic life by preventing waste accumulation.
- To contribute to long-term environmental conservation and cleaner waterways.

CHAPTER 2
LITERATURE REVIEW

2.1 Literature Review

Dr. Imran A. Khan et al. [1] "Design of River Cleaning Machine." In this paper author has designed and implemented a River cleanup machine that can carry the waste surface trash from the water bodies, which may ultimately lead to reduction of pollution. Arms are hooked up to boat for cutting purpose of the plants which arms the aquatic life.

T. Deng, X. Xu et al [2], "Automatic Collaborative Water Surface Coverage and Cleaning Strategy of UAVs and USVs." This paper addresses the challenge of utilizing unmanned equipment for water inspection and cleaning, proposing an automatic cleaning strategy based on UAV-USV collaboration. We developed a partition-based coverage algorithm and an autonomous obstacle-avoidance trajectory planning algorithm. To optimize task allocation, we employed a balancing factor with the particle swarm algorithm and proposed a multi-ship scheduling and assignment algorithm. Experimental results demonstrate the computational efficiency and cleaning effectiveness of our algorithms. These advantages are significant, but further work is needed to address challenges such as accounting for water flow and wind, which impact path planning accuracy and image quality.

Akash Shahu et al [3], The "Remote Controlled Unmanned River Cleaning Boat" project tackles India's growing water pollution problem, particularly in rivers and ponds, by collecting floating waste efficiently. Unlike conventional methods, which are labor-intensive, costly, and time-consuming, this eco-friendly boat operates on renewable energy and eliminates the need for manpower. This project is ideally suited for cleaning bodies of water, such as the Ganga River. The project supports government initiatives, such as "Namami Ganga" and "Narmada Bachao," and contributes to reduced pollution, improved human health, and protected aquatic life.

M. Mohamed Idhris et al, [4] "Design and Fabrication of River Waste Cleaning Machine" The current state of India's national rivers, plagued by sewage and pollutants, prompted this project. The government has initiated several river cleaning projects, including "Namami Gange" and "Narmada Bachao." This machine aims to clean river water surfaces. Automation plays a

crucial role in modern manufacturing, enabling faster production rates. This project involves fabricating a remote-operated river cleaning machine to reduce manual labor and time consumption .The machine utilizes a motor and chain drive arrangement for automated operation. RF transmitters and receivers control the cleaning machine. Automation can be achieved through various means, including pneumatics, which offer a low-cost solution. India's religious festivals, such as Ganesh Visarjan and Kumbh Mela, significantly contribute to water pollution in rivers like the Godavari. This pollution poses a threat to aquatic life and human health. The proposed "River Cleanup Machine" aims to remove waste debris from water surfaces and safely dispose of it. The machine harnesses hydropower to extract waste, plastics, and garbage from rivers.

Jignesh Vaghasia et al, [5] “Experimental Working Model of River Cleaning and Trash Cleaning Boat." This study presents a novel river cleaning boat design, specifically engineered to mitigate floating debris in aquatic environments. The proposed boat design incorporates a unique dust lifting mechanism, linked to a waste collection system, to enhance surface debris collection efficiency. The strategic integration of advanced conveyor technologies and materials can significantly augment waste collection efficiency. Future research endeavors will focus on optimizing the boat's design parameters and exploring innovative strategies to enhance its operational efficiency.

Prof. N.G. Jogi et al [6] mentioned that the Ganges in India is one of the most polluted rivers. About 29 crore liters of sewage is dumped in the Ganges along with toxins. They have suggested the usage of pedal operated boat with the conveyor attached to it for collecting garbage from the lake. With the help of this conveyor it is possible to collect the garbage like plastic bags, plastic bottles, beverage cans, food wrappers, paper bags, straws, (marine debris) etc. With this methodology no fuel is involved.

Mr. P. M. Sirsat et al [7] mentioned that in accordance with the river cleaning projects like “Namami Gange”, ‘’Narmada Bachao” and many major and medium projects in various cities like Ahmadabad, Varanasi etc. a machine is designed to clean river water surface. This machine consists of DC motors, RF transmitter and receiver, propeller, PVC pipes and chain drive with the conveyor attached to it for collecting wastage from water bodies. It also consists of a collecting plate which is coupled with conveyor belt and chain drives which rotate by the PMDC motor. The collected waste is thrown on the collecting tray. Propeller is used to drive

the machine on the river & run with help of PMDC motor. The total electrical devices are controlled by RF transmitter and receiver which are used to control the machine remotely. This machine has been designed from an economical point of view and is easy to operate and helpful for water cleaning.

Sheikh Md Shahid Md Rafique and Dr. Akash Langde [8] have "fabricated the remotely operated river cleaning machine." The collecting plate and chain drives are rotating continuously by the motor. The collecting plate is coupled between the two chain drives to collect the waste materials from the river. The collected waste is thrown onto the collecting tray with the help of a conveyor. The machine has a propeller that is used to drive the machine on the river. The propeller is run with the help of two PMDC motors. The total electrical device is controlled by an RF transmitter and receiver, which are used to control the machine remotely.

M. Mohamed Idris et al [9] explained that the motive of the project is to automate the sewage cleaning process in drainage. A machine consisting of a chain and sprocket, and driven by a motor, is used in the cleaning process. When the motor runs, the chain starts to circulate, and it makes the lifter move upwards. The waste material is lifted by lifter teeth and stored in a collector bin. Once the collecting bin is full, the waste material is removed from the bin manually.

Pankaj Singh Sirohi et al [10] have fabricated a river cleaning machine that is made of a turbine driven alternator to produce electricity. When water flowing in the river falls on the turbine the turbine begins to rotate. The alternator generates electricity. This drives the vertical conveyor belt and horizontal conveyor belt through timing chains and sprockets. With the help of spur gears both the conveyor belts are connected with each other.

In this paper (Chandan R et al. 2023) [11] proposed to present an innovative surface water trash collection system. The robot, controlled via Bluetooth and a mobile app called Bluetooth Electronics, features a fabric net for collecting floating debris like plastic and leaves. An Arduino microcontroller, motor driver, and Bluetooth module enable precise movements via app commands. The net gathers waste and can be emptied as needed, ensuring 24/7 operation with minimal human intervention. This design promotes efficient and continuous water body cleaning.

In this paper (A. Sujatha Reddy et al.2023) [12] proposed a system that floats on water and moves in all directions to collect floating debris, storing it in a collector bin This programmable prototype can be scaled to any size and operated remotely. It includes a camera for monitoring, a power supply for operation, and motor drivers for directional and speed control. Controlled via the Arduino Bluetooth Controller app, users can navigate with commands: F (forward), B (backward), R (right), L (left), Start, and Stop.

In this paper (S.N Agrawal et al. 2024) [13] proposed a system features a water garbage collector with an Android app, Bluetooth module, motor, and small dustbin, all connected to a kit. The Node MCU Wi-Fi module acts as a mediator between the app and Arduino Uno. When a button is pressed, the Node MCU receives the message, relays it to the Arduino Uno, which then directs the motor shield to execute the function. This allows for effective and remote control of the cleaning process the available space.

In this paper (Dharmesh N. Kandare et al. 2018) [14] proposed that India is a sacred nation that celebrates a number of holidays, including Ganesh Visarjan, Navratri, Durga Pooja, Chhath Puja, and primarily Siahnsth Kumbhmela, where there is a lot of water pollution. One solution to prevent water pollution is to use a River Clean Up machine.

In this paper (Ayathari.J et al.2024) [15] proposed that the design, operation, and possible effects of smart water surface cleaning boats are examined in this research. It seeks to clarify the revolutionary significance that these cutting-edge platforms play in environmental conservation efforts by a thorough examination of their working principles, technological underpinnings, and practical applications. Smart boats promise a cleaner, healthier future for our world because of their flexibility to operate remotely and adapt to a variety of water conditions. They also represent a paradigm shift in the way we approach water surface cleaning. The subsequent sections explore the salient characteristics and functionalities of intelligent water surface cleaning vessels, scrutinizing their efficaciousness, advantages for the environment, and drawbacks.

CHAPTER 3

METHODOLOGY

3.1 Methodology

Our used methodology for the project:

- Creating an idea for the design and construction of a Design & Fabrication of River Cleaning Boat. And designing a block diagram & circuit diagram to know which components we need to construct it.
- Collecting all the components and programming the microcontroller to control the whole system.
- Setting up all the components on a PCB board & then soldering. Lastly, assembling all the blocks in a board and to run the system & for checking purposes.

3.2 Block Diagram

Here is the block diagram of the Design & Fabrication of River Cleaning Boat with all the essential components. All of the components are shown in below as a block in this diagram. Here we use an Arduino Nano microcontroller in our project. Other equipment's are attached with this microcontroller and works together for perform as our desired outcome.

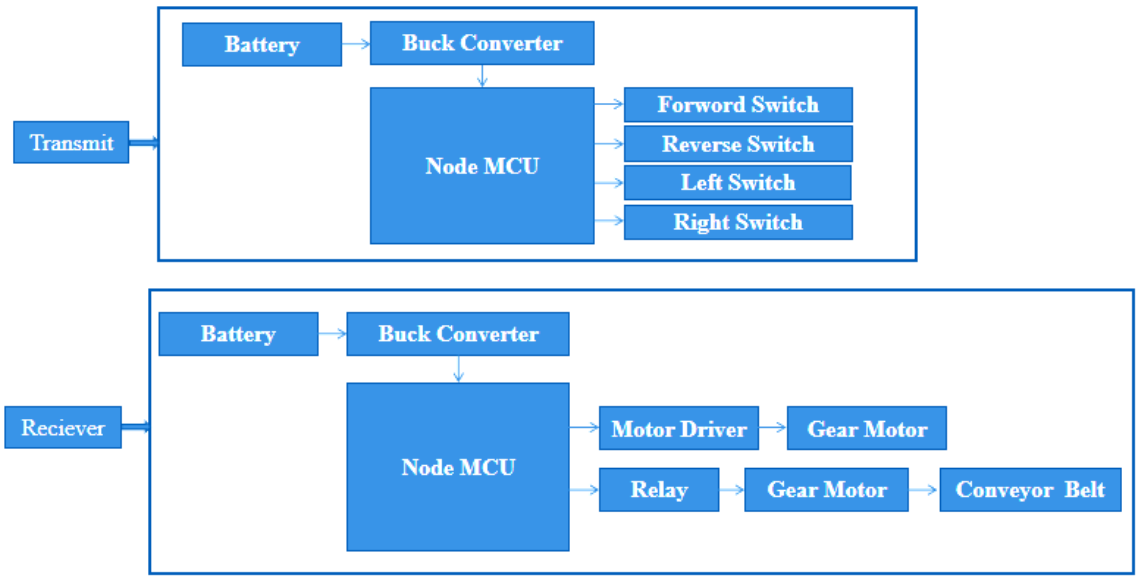


Figure 3.1: Block Diagram of Our Project

3.3 Circuit Diagram

In this part we show our project circuit design and connect out instrument through standard wire

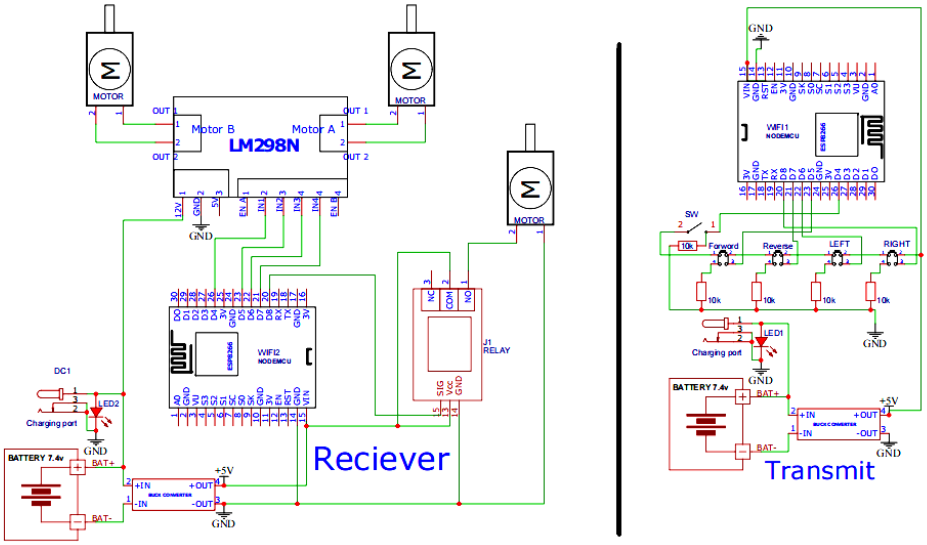


Figure 3.2 : Schematic Design of our Project

3.4 Working principle

The River Cleaning Boat operates through a remote-controlled system divided into two main sections: Transmitter Side and Receiver Side.

On the Transmitter Side, a Battery powers the NodeMCU, which is regulated by a Buck Converter. The NodeMCU is connected to four control buttons: Forward, Reverse, Left, and Right. When a button is pressed, the command is wirelessly transmitted to the Receiver Side.

On the Receiver Side, a separate Battery supplies power through a Buck Converter to the NodeMCU, Motor Driver, and Gear Motors. The NodeMCU receives signals and activates the Motor Driver to move the boat in the desired direction. A Relay is used to control the Conveyor Belt, which is powered by a Gear Motor. When waste collection is required, the relay switches on the conveyor system to collect debris efficiently.

3.5 Cost Analysis

Table 1: List of Component with Price

Sl.no	Particulars	Specification	Qty.	Unit Price (Taka)	Total Price (Taka)
1	Battery	3.7V	4	100	400
2	Node MCU	ESP8266	2	650	1300
3	Buck Converter	LM2596	2	200	400
4	Gear Motor		3	400	1200
5	Motor Driver	L298N	1	350	350
6	Relay		1	200	200
7	Conveyor Belt			200	200
8	Button		4	20	80
9	Others				2000
				Total	6130/=

3.6 Final Project

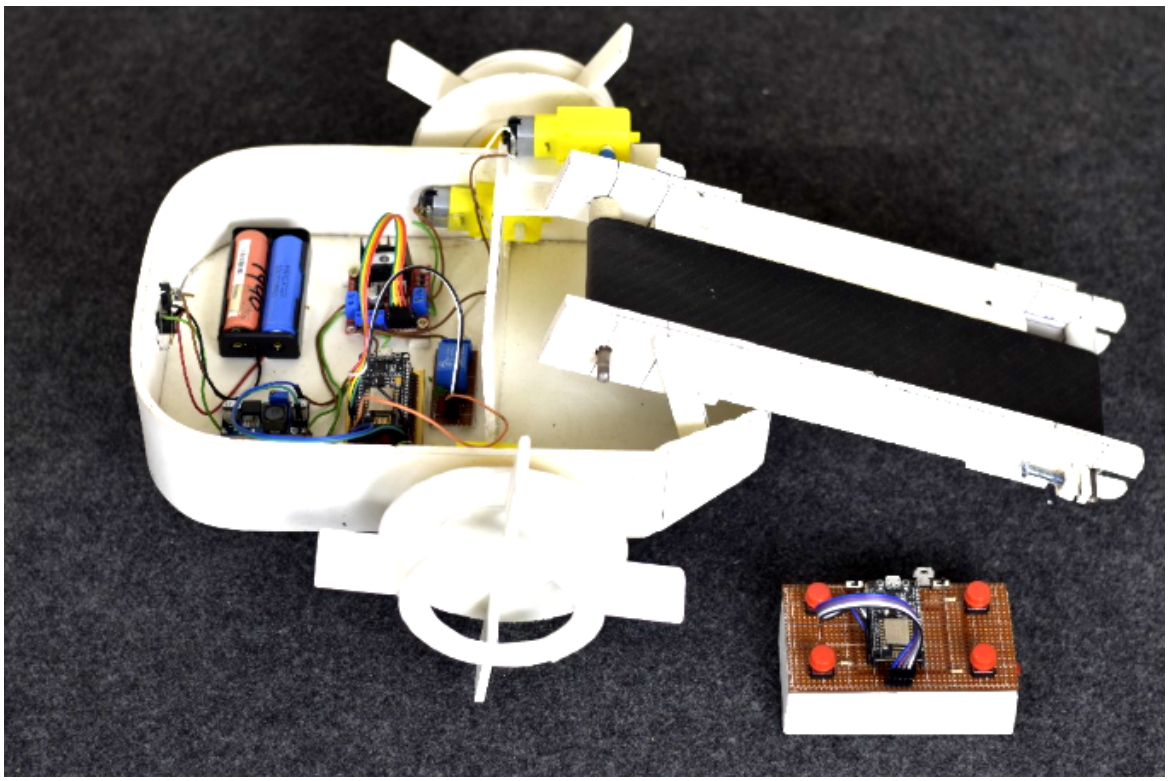


Figure 3.3: River Cleaner Boat

CHAPTER 4
HARDWARE ANALYSIS

4.1 Hardware

Hardware

- Node MCU
- Battery
- Buck Converter
- Gear Motor
- Motor Driver
- Relay
- Conveyor Belt

4.2 Node MCU

Node MCU is an open source firmware for which open source prototyping board designs are available. The name "Node MCU" combines "node" and "MCU" (micro-controller unit). Sand built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson and SPIFFS. Due to resource constraints, users need to select the modules relevant for their project and build a firmware tailored to their needs. Support for the 32-bit ESP32 has also been implemented.

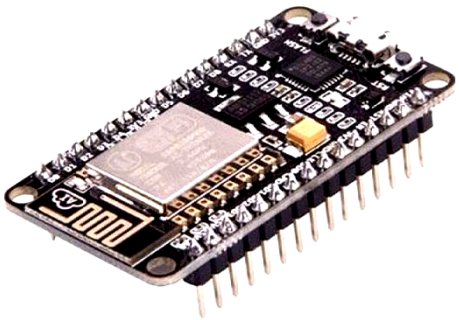


Figure 4.1: Node MCU

The prototyping hardware typically used is a circuit board functioning as a dual in-line package (DIP) which integrates a USB controller with a smaller surface-mounted board containing the MCU and antenna. The choice of the DIP format allows for easy prototyping on breadboards. The design was initially was based on the ESP-12 module of the ESP8266, which is a Wi-Fi

SoC integrated with a Tensilica Xtensa LX106 core, widely used in IoT applications. This an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Express if Systems, and hardware which is based on the ESP-12 module. The term "Node MCU" by default refers to the firmware rather than the development kits. The firmware uses the Luascripting language. It is based on the eLua project, and built on the Es press if Non-OS SDK for ESP8266. Node MCU was created shortly after the ESP8266 came out.

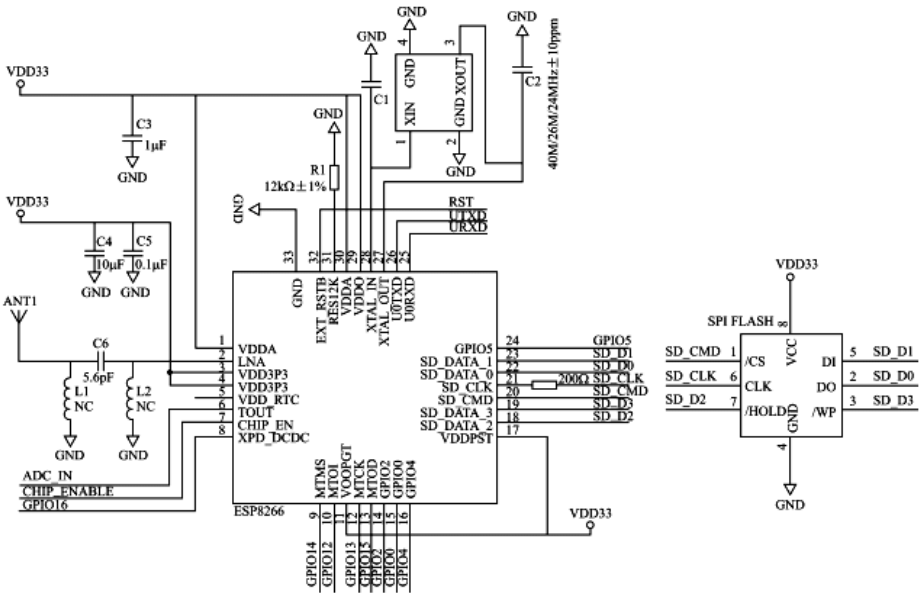


Figure 4.2: Node MCU Schematic Diagram

Another important update was made on 30 Jan 2015, when Devsaurus ported the u8glibto Node MCU project, enabling Node MCU to easily drive LCD, Screen, OLED, even VGA displays. In summer 2015 the creators abandoned the firmware project, and a group of independent contributors took over. By summer 2016 the Node MCU included more than 40 different modules. Due to resource constraints users need to select the modules relevant for their project and build a firmware tailored to their needs.

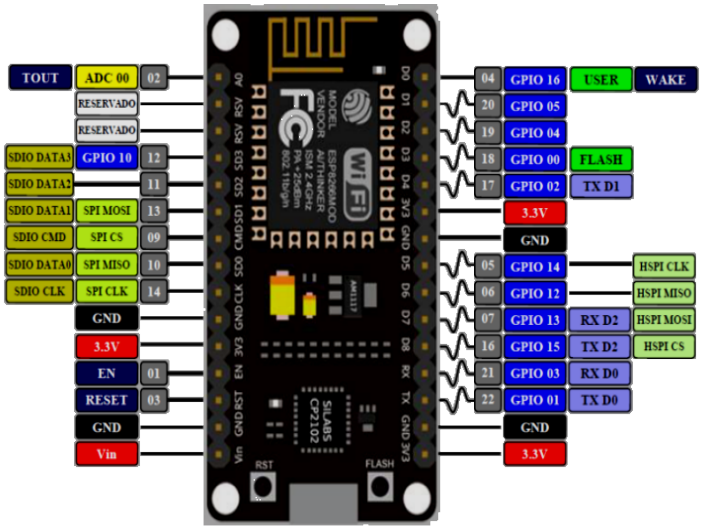


Figure 4.3: Node MCU Pin Out

Node MCU V3 ESP8266 ESP-12E is Wi-Fi development board that helps you to prototype your IoT product with few Lua script lines, or through Arduino IDE. The board is based on ESP8266 ESP-12E variant, unlike other ESP-12E, you won't need to buy a separate breakout board, usb to serial adapter, or even solder it to a PCB to get started, you will only need a usb cable (Micro USB).

Features

1. Communication interface voltage: 3.3V.
2. Antenna type: Built-in PCB antenna is available.
3. Wireless 802.11 b/g/n standard
4. Wi-Fi at 2.4GHz, support WPA / WPA2 security mode
5. Support STA/AP/STA + AP three operating modes
6. Built-in TCP/IP protocol stack to support multiple TCP Client connections (5 MAX)
7. D0 ~ D8, SD1 ~ SD3: used as GPIO, PWM, IIC, etc., port driver capability 15mA
8. AD0: 1 channel ADC
9. Power input: 4.5V ~ 9V (10VMAX), USB-powered
10. Current: continuous transmission: ≈70mA (200mA MAX), Standby: <200uA
11. Transfer rate: 110-460800bps
12. Support UART / GPIO data communication interface
13. Remote firmware upgrade (OTA)

4.3 Gear Motor

Gear motors are mechanisms that adjust the speed of electric motors, leading them to operate at a certain speed. They are composed of a series of gears that make up a kinematic chain, working on a set of rotary parts. Their main purpose is to allow the reduction from an initial high speed to a lower one without negatively affecting the mechanism. In addition to this adjustment, a gear motor is in charge of adjusting the mechanical power of a system.



Figure 4.4: Gear Motor

Mechanical components that complement gear motors

Gear motors are composed of an electric motor and gears, which form the kinematic chain – the fundamental component of the gear ratio.

Kinematic chain

A motor's speed reducer is composed of a speed reducer and its gears. This speed reducer is basically a variable speed drive that allows for the speed to be reduced and increased at the output shaft.

Gears

Gears are toothed wheels made of metal or plastic (and new materials with each passing day) that transmit motion when meshing with each other. They are defined by their number of teeth and their size. In addition, they may have straight-cut or helical teeth.

Motors

The five types of motors that see the most use in gear motors are:

- Brushed motors, with brushes normally made out of carbon. They are bidirectional and may be used with DC or AC. They have a service life of about 3000 hours.
- Asynchronous motors, which are brush less single-direction motors. They are highly limited.
- Synchronous brush less motors, which may be single-direction or bidirectional. They have a constant speed if the frequency of the power source is stable.
- Brush less DC motors that use a driver and can attain high speeds.
- Stepper DC brush less motors. They can be positioned with an average precision of 7.5º.

4.4 Motor Driver

The L293D is a popular 16-pin Motor Driver IC. As the name suggests, it is mainly used to drive motors. A single L293D IC is capable of running two DC motors at the same time, the direction of these two motors can be controlled independently.

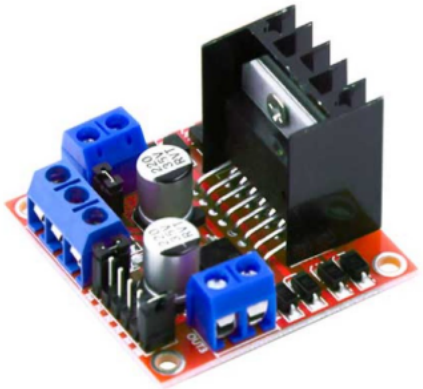


Figure 4.5: Motor driver IC L293D

Working Process

L293D IC is a typical Motor Driver IC that allows the DC motor to drive on any direction. This IC consists of 16-pins which are used to control a set of two DC motors instantaneously in any direction. It means, by using a L293D IC we can control two DC motors.

L293D Pin Configuration

Table 2: Pin Configuration of Motor Driver

Pin Number	Pin Name	Description
1	Enable 1,2	This pin enables the input pin Input 1(2) and Input 2(7)
2	Input 1	Directly controls the Output 1 pin. Controlled by digital circuits
3	Output 1	Connected to one end of Motor 1
4	Ground	Ground pins are connected to ground of circuit (0V)
5	Ground	Ground pins are connected to ground of circuit (0V)
6	Output 2	Connected to the other end of Motor 1
7	Input 2	Directly controls the Output 2 pin. Controlled by digital circuits
8	Vcc2 (Vss)	Connected to the Voltage pin for running motors (4.5V to 36V)
9	Enable 3,4	This pin enables the input pin Input 3(10) and Input 4(15)
10	Input 3	Directly controls the Output 3 pin. Controlled by digital circuits
11	Output 3	Connected to one end of Motor 2
12	Ground	Ground pins are connected to ground of circuit (0V)
13	Ground	Ground pins are connected to ground of circuit (0V)
14	Output 4	Connected to another end of Motor 2
15	Input 4	Directly controls the Output 4 pin. Controlled by digital circuits
16	Vcc2 (Vss)	Connected to +5V to enable IC function

Features

- Can be used to run Two DC motors with the same IC.
- Speed and Direction control is possible
- Motor voltage Vcc2 (Vss): 4.5V to 36V
- Maximum Peak motor current: 1.2A
- Maximum Continuous Motor Current: 600mA
- Supply Voltage to Vcc1(vss): 4.5V to 7V
- Transition time: 300ns (at 5Vand 24V)
- Automatic Thermal shutdown is available

Use of a L293D Motor Driver IC

Using this L293D motor driver IC is very simple. The IC works on the principle of Half H-Bridge, let us not go too deep into what H-Bridge means, but for now just know that H-Bridge is a setup which is used to run motors both in clockwise and anti-clockwise direction. As said earlier this IC is capable of running two motors at any direction at the same time, the circuit to achieve the same is shown below.

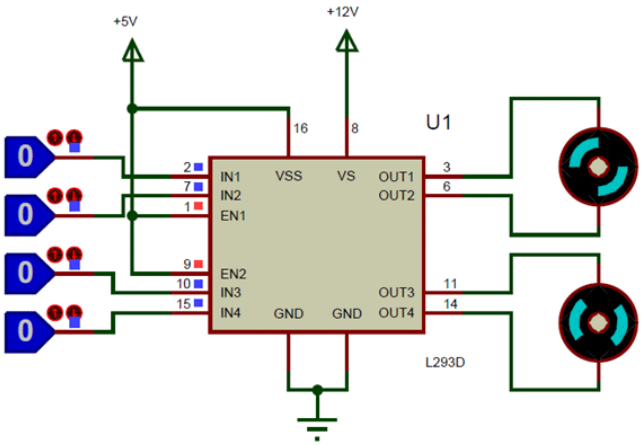


Figure 4.6: L293D circuit Diagram

All the Ground pins should be grounded. There are two power pins for this IC, one is the Vss(Vcc1) which provides the voltage for the IC to work, this must be connected to +5V. The other is Vss(Vcc2) which provides voltage for the motors to run, based on the specification of your motor you can connect this pin to anywhere between 4.5V to 36V, here I have connected to +12V.

The Enable pins (Enable 1, 2 and Enable 3, 4) are used to Enable Input pins for Motor 1 and Motor 2 respectively. Since in most cases we will be using both the motors both the pins are held high by default by connecting to +5V supply. The input pins Input 1, 2 are used to control the motor 1 and Input pins 3, 4 are used to control the Motor 2. The input pins are connected to any Digital circuit or microcontroller to control the speed and direction of the motor.

4.5 Battery

Lithium batteries are primary batteries that have metallic lithium as an anode. These types of batteries are also referred to as lithium-metal batteries. They stand apart from other batteries in their high charge density and high cost per unit. Depending on the design and chemical compounds used, lithium cells can produce voltages from 1.5 V (comparable to a zinc–carbon or alkaline battery) to about 3.7 V.

Disposable primary lithium batteries must be distinguished from secondary lithium-ion or a lithium-polymer, which are rechargeable batteries. Lithium is especially useful because its ions can be arranged to move between the anode and the cathode, using an intercalated lithium compound as the cathode material but without using lithium metal as the anode material. Pure lithium will instantly react with water, or even moisture in the air; the lithium in lithium-ion batteries is in a less reactive compound.



Figure 4.7: 3.7V Battery

Lithium batteries are widely used in portable consumer electronic devices. The term "lithium battery" refers to a family of different lithium-metal chemistry, comprising many types of cathodes and electrolytes but all with metallic lithium as the anode. The battery requires from 0.15 to 0.3 kg of lithium per kWh. As designed these primary systems use a charged cathode

that being an electro-active material with crystallographic vacancies that are filled gradually during discharge.

Product Specification

Table 3: Specification for Battery

Voltage	3.7 V
Product Type	Lithium-Ion
Battery Capacity	2200mAh
Weight	45 g
Model Number	ICR 18650

4.6 Buck Converter

A buck converter (step-down converter) is a DC-to-DC power converter which steps down voltage (while drawing less average current) from its input (supply) to its output (load). It is a class of switched-mode power supply (SMPS) typically containing at least two semiconductors (a diode and a transistor, although modern buck converters frequently replace the diode with a second transistor used for synchronous rectification) and at least one energy storage element, a capacitor, inductor, or the two in combination. To reduce voltage ripple, filters made of capacitors (sometimes in combination with inductors) are normally added to such a converter's output (load-side filter) and input (supply-side filter). It is called a buck converter because the voltage across the inductor "bucks" or opposes the supply voltage.



Figure 4.8: DC -DC Buck Converter

DC-DC Buck Converter Step down Module LM2596 Power Supply is a step-down (buck) switching regulator, capable of driving a 3-A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3 V, 5 V, 12 V, and an adjustable output version. The LM2596 series operates at a switching frequency of 150 kHz, thus allowing smaller sized filter components than what would be required with lower frequency switching regulators.

Specifications of DC-DC Buck Converter Step Down Module LM2596 Power Supply:

- Conversion efficiency: 92% (highest)
- Switching frequency: 150 KHz
- Output ripple: 30mA9 maximum)
- Load Regulation: ± 0.5%
- Voltage Regulation: ± 0.5%
- Dynamic Response speed: 5% 200uS
- Input voltage:4.75-35V
- Output voltage:1.25-26V(Adjustable)
- Output current: Rated current is 2A, maximum 3A (Additional heat sink is required)
- Conversion Efficiency: Up to 92% (output voltage higher, the higher the efficiency)
- Switching Frequency: 150 KHz
- Rectifier: Non-Synchronous Rectification
- Module Properties: Non-isolated step-down module (buck)
- Short Circuit Protection: Current limiting, since the recovery
- Operating Temperature: Industrial grade (-40 to +85) (output power 10W or less)

4.7 Relay

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

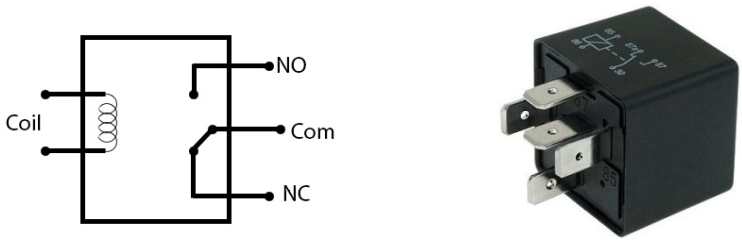


Figure 4.9: Relay

A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protective relays".

Magnetic latching relays require one pulse of coil power to move their contacts in one direction, and another, redirected pulse to move them back. Repeated pulses from the same input have no effect. Magnetic latching relays are useful in applications where interrupted power should not be able to transition the contacts. Magnetic latching relays can have either single or dual coils. On a single coil device, the relay will operate in one direction when power is applied with one polarity, and will reset when the polarity is reversed. On a dual coil device, when polarized voltage is applied to the reset coil the contacts will transition. AC controlled magnetic latch relays have single coils that employ steering diodes to differentiate between operate and reset commands. The relay module is the one in the figure below.

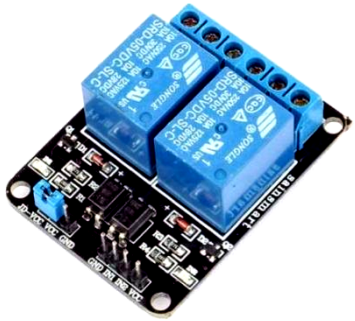


Figure 4.10: Relay Module.

This module has two channels (those blue cubes). There are other varieties with one, four and eight channels.

Main's voltage connections.

In relation to mains voltage, relays have 3 possible connections:

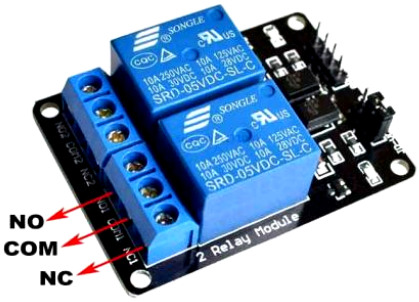


Figure 4.11: Main's voltage connections.

COM: Common pin

NO (Normally Open): There is no contact between the common pin and the normally open pin. So, when you trigger the relay, it connects to the COM pin and supply is provided to a load

NC (Normally Closed): There is contact between the common pin and the normally closed pin. There is always connection between the COM and NC pins, even when the relay is turned off. When you trigger the relay, the circuit is opened and there is no supply provided to a load.



Figure 4.12: Voltage Connections

Pin wiring

The connections between the relay module and the Arduino are really simple:

GND: Goes to ground

IN: Controls the first relay (it will be connected to an Arduino digital pin)

IN2: Controls the second relay (it should be connected to an Arduino digital pin if you are using this second relay. Otherwise, you don't need to connect it)

VCC: Goes to 5V

4.8 Conveyor Belt

A conveyor belt is the carrying medium of a belt conveyor system (often shortened to belt conveyor). A belt conveyor system is one of many types of conveyor systems. A belt conveyor system consists of two or more pulleys (sometimes referred to as drums), with a closed loop of carrying medium—the conveyor belt—that rotates about them. One or both of the pulleys are powered, moving the belt and the material on the belt forward. The powered pulley is called the drive pulley while the unpowered pulley is called the idler pulley.

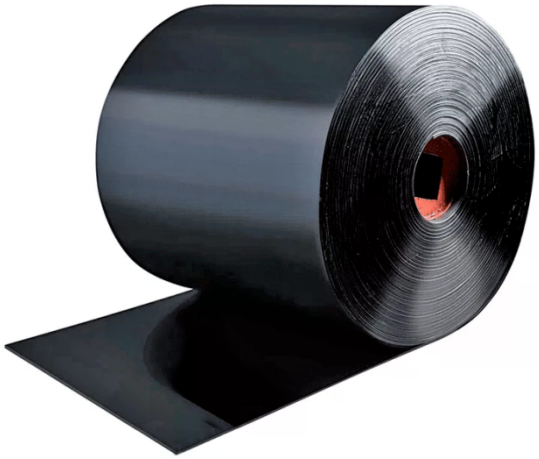


Figure 4.13: Conveyor Belt

Types of Conveyor Belt

"There are three different types of conveyor belts: the basic belt, snake sandwich belt and long belt. A basic belt conveyor consists of two or more pulleys that hold one continuous length of material. These types of belts can be motorized or require manual effort.

CHAPTER 5
SOFTWARE ANALYSIS

5.1 Software

- Arduino IDE
- Easy EDA

5.2 Arduino IDE

The digital microcontroller unit named as Arduino UNO can be programmed with the Arduino software IDE. There is no any requirement for installing other software rather than Arduino. Firstly, Select "Arduino UNO from the Tools, Board menu (according to the microcontroller on our board). The IC used named as ATmega328 on the Arduino UNO comes pre burned with a boot loader that allows us to upload new code to it without the use of an external hardware programmer.

Communication is using the original STK500 protocol (reference, C header files). We can also bypass the boot loader and programs the microcontroller through the ICSP (In Circuit Serial Programming) header. The ATmega16U2 (or 8U2 in the rev1 and rev2 boards) firmware source code is available. The ATmega16U2/8U2 is loaded with a DFU boot loader, which can be activated by:

On Rev1 boards: connecting the solder jumper on the back of the board (near the map of Italy) and then resetting the 8U2. On Rev2 or later boards: there is a resistor that pulling the 8U2/16U2 HWB line to ground, making it easier to put into DFU mode. The Arduino UNO is one of the latest digital microcontroller units and has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL at (5V) with serial communication, which is available on digital pins 0 -(RX) for receive the data and pin no.1 (TX) for transmit the data. An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer.

The '16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, an .in file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board.

The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial Communication on pins 0 and 1). A Software Serial library allows for serial communication on any of the Uno digital pins. The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus. Arduino programs are written in C or C++ and the program code written for Arduino is called sketch. The Arduino IDE uses the GNU tool chain and AVR Lab to compile programs, and for uploading the programs it uses argued. As the Arduino platform uses Atmel microcontrollers, Atmel's development environment, AVR Studio or the newer Atmel Studio, may also be used to develop software for the Arduino.

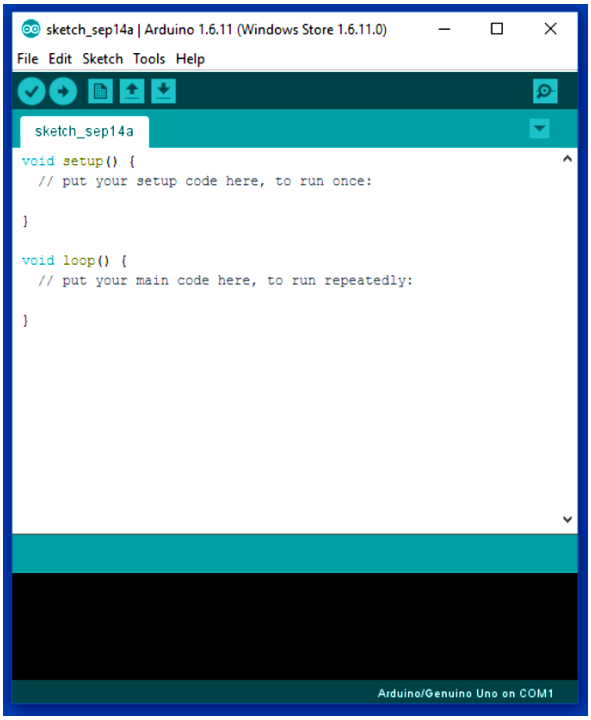


Figure 5.1: Arduino Software Interface IDE

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

Writing Sketches

Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

Sketchbook

The Arduino Software (IDE) uses the concept of a sketchbook: a standard place to store your programs (or sketches). The sketches in your sketchbook can be opened from the File > Sketchbook menu or from the Open button on the toolbar. The first time you run the Arduino software, it will automatically create a directory for your sketchbook. You can view or change the location of the sketchbook location from with the Preferences dialog. Beginning with version 1.0, files are saved with a .ino file extension. Previous versions use the .pde extension. You may still open .pde named files in version 1.0 and later, the software will automatically rename the extension to .ino.

Tabs, Multiple Files, and Compilation

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

Uploading

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

When you upload a sketch, you're using the Arduino boot loader, a small program that has been loaded on to the microcontroller on your board. It allows you to upload code without using any additional hardware. The boot loader is active for a few seconds when the board resets; then it starts whichever sketch was most recently uploaded to the microcontroller. The bootloader will blink the on-board (pin 13) LED when it starts (i.e. when the board resets).

Libraries

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

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

Third-Party Hardware

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

For details on creating packages for third-party hardware, see the Arduino IDE 1.5 3rd party Hardware specification.

Serial Monitor

This displays serial sent from the Arduino or Genuino board over USB or serial connector. To send data to the board, enter text and click on the "send" button or press enter. Choose the baud rate from the drop-down menu that matches the rate passed to Serial.begin in your sketch. Note that on Windows, Mac or Linux the board will reset (it will rerun your sketch) when you connect with the serial monitor. Please note that the Serial Monitor does not process control characters; if your sketch needs a complete management of the serial communication with control characters, you can use an external terminal program and connect it to the COM port assigned to your Arduino board.

5.3 Easy EDA

Easy EDA is a web-based EDA tool suite that enables hardware engineers to design, simulate, share-publicly and privately-and discuss schematics, simulations and printed circuit boards. Other features include the creation of a bill of materials, Gerber files and pick and place files and documentary outputs in PDF, PNG and SVG formats. Easy EDA allows the creation and editing of schematic diagrams, SPICE simulation of mixed analogue and digital circuits and the creation and editing of printed circuit board layouts and, optionally, the manufacture of printed circuit boards.

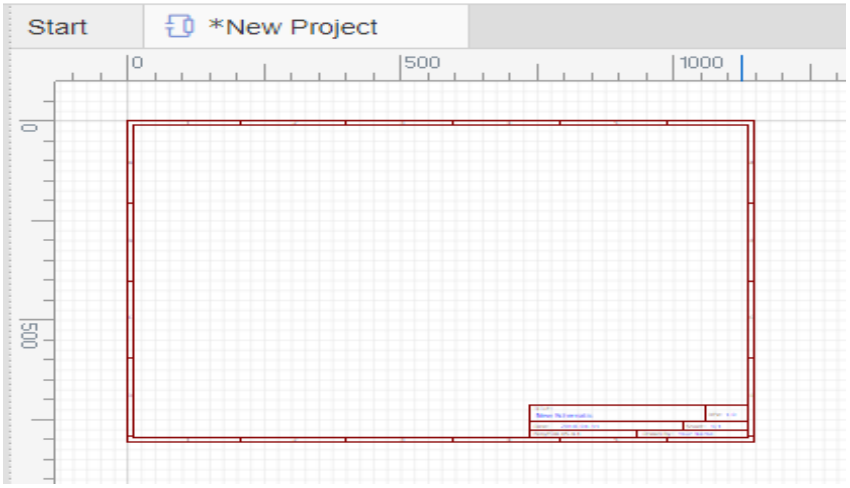


Figure 5.2: Easy EDA Software Interface

Subscription-free membership is offered for public plus a limited number of private projects. The number of private projects can be increased by contributing high quality public projects, schematic symbols, and PCB footprints and/or by paying a monthly subscription. Registered users can download Gerber files from the tool free of charge; but for a fee, Easy EDA offers a PCB fabrication service. This service is also able to accept Gerber file inputs from third party tools.

CHAPTER 6
RESULT & DISCUSSION

6.1 Result

After finally completing this project, we ran it & we observed the output of this project. We can see that it is working well as expected. After making our project we observe it very careful. It works as we desire. Our project give output perfectly and all equipment are work perfectly. We check how much it works and we get perfect output from this project.

- Finally, we have completed our project successfully & check our project its run accurately according to our objective.
- At first, we start our system.
- Following are the outputs of our project.
- Successfully collects floating waste like plastics and debris from river surfaces.
- Efficiently navigates through varying water currents with smooth remote control operations.
- Conveyor belt mechanism reliably transfers waste to storage compartments for easy disposal.
- Reduces manual labor and operational costs compared to traditional cleanup methods.
- Enhances water quality and protects aquatic life by preventing pollutant accumulation.

Data Table

Waste material	Weight	Distance	Time
Dry leaves	2gm	5cm	2sec
Plastic	2gm	5cm	2sec
Small wood piece	4gm	5cm	3sec

6.2 Advantages

There are certainly many advantages of our project and some of the major ones have been given below -

- Eco-friendly.
- Efficient Waste Collection
- Conveyor Mechanism Efficiency
- Aquatic Life Protection
- Pollution Reduction
- Sustainable Waterway Management
- Remote Control
- Low installation cost.
- Low maintenance cost.
- Simple in construction.
- Reduces manual labor
- User-Friendly

6.3 Limitation

It is a demo project so we found some limitation. In future we will work for reduce this kind of limitation. These limitations are -

- This project can now be only used for small scale purposes
- No energy backup.
- Cannot collect submerged or heavily entangled waste.
- Inability to detect obstacles automatically without sensor integration.
- Node MCU requires a stable internet connection for remote operation.

6.4 Application

Some of the application areas of the project has been pointed out below-

- River Pollution Control
- Waterway Maintenance
- Floating Waste Collection
- Municipal Waste Management
- Lake and Pond Maintenance
- Flood Debris Removal

6.5 Discussion

While working on our project, we did face some difficulties as it is a very complex system but the end results, we came up with were quite satisfactory. We have put the whole system through several tasks to validate our work and also have taken necessary notes for future improvements. Some future recommendations that we have involves improvement in system design and wiring, adding features for more efficient.

The River Cleaning Boat project represents an innovative solution for combating water pollution in rivers and waterways. Its design focuses on sustainability. The remote-controlled system allows efficient navigation, enabling the boat to access polluted areas easily. The integrated conveyor mechanism effectively collects floating waste, ensuring cleaner water surfaces and protecting aquatic life. However, the absence of sensors limits obstacle detection and submerged waste collection. Despite these limitations, the project demonstrates significant potential for scalable deployment in urban and rural settings, contributing to environmental conservation and sustainable waterway management.

CHAPTER 7
CONCLUSION

7.1 Conclusion

The River Cleaning Boat project provides a practical and efficient solution to address the growing issue of water pollution in rivers. With its simple yet effective design, the boat collects floating waste such as plastics, debris, and organic matter, significantly improving the cleanliness of water surfaces. The remote-controlled navigation system allows the boat to reach difficult-to-access areas, ensuring thorough cleaning of the waterway. The conveyor belt mechanism efficiently transfers collected waste into designated compartments, making disposal and recycling more organized.

It operates cost-effectively with minimal maintenance. The system's reliance on a remote-controlled operation reduces manual labor, making it a more efficient option compared to traditional cleaning methods. Its scalability makes it suitable for deployment in various water bodies, including rivers, lakes, and ponds, promoting cleaner environments and the protection of aquatic ecosystems.

While there are limitations, such as the inability to collect submerged waste or detect obstacles without sensors, the project offers a sustainable approach to waterway maintenance. In conclusion, the River Cleaning Boat is a valuable contribution to environmental conservation, providing an accessible, low-cost solution for river cleaning that can be expanded to address larger-scale water pollution issues in the future.

7.2 Future Scope

We are thinking about adding many features to our project in the future to get more desirable out comes. Some of the steps that we are thinking about taking are given below:

- In future development this project can be develop by more sensor & alarm system.
- In future, I will try it to apply in real field.
- In Future we will add extra power system.

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APPENDIX

Micro-Controller Programming Code (Transmitter):

```
#include <ESP8266WiFi.h> // Transmitter

const char* ssid = "abcde";
const char* password = "123456789";
const char* host = "192.168.4.1"; // Default IP of ESP AP mode

// Define switch pins
const int switchF = D5; // Forward
const int switchB = D6; // Backward
const int switchL = D7; // Left
const int switchR = D1; // Right
const int switchS = D2; // Stop or special function

void setup() {
  Serial.begin(115200);

  // Set switch pins as INPUT_PULLUP
  pinMode(switchF, INPUT_PULLUP);
  pinMode(switchB, INPUT_PULLUP);
  pinMode(switchL, INPUT_PULLUP);
  pinMode(switchR, INPUT_PULLUP);
  pinMode(switchS, INPUT_PULLUP);

  WiFi.begin(ssid, password);
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("\nConnected to Receiver");
}

void loop() {
  // Read switches
  bool stateF = digitalRead(switchF);
  bool stateB = digitalRead(switchB);
  bool stateL = digitalRead(switchL);
  bool stateR = digitalRead(switchR);
  bool stateS = digitalRead(switchS);

  String cmd = "S"; // Default command

  if (stateF == HIGH) cmd = "F"; // Forward
  else if (stateB == HIGH) cmd = "B"; // Backward
```

```
  else if (stateL == HIGH) cmd = "L"; // Left
  else if (stateR == HIGH) cmd = "R"; // Right
  else if (stateS == LOW) cmd = "D"; // Stop or Special command
 else if (stateS == HIGH) cmd = "A"; // Stop or Special command
  // Print switch states
  Serial.print("Switch States -> ");
  Serial.print("F: "); Serial.print(stateF == HIGH ? "ON" : "OFF"); Serial.print(" | ");
  Serial.print("B: "); Serial.print(stateB == HIGH ? "ON" : "OFF"); Serial.print(" | ");
  Serial.print("L: "); Serial.print(stateL == HIGH ? "ON" : "OFF"); Serial.print(" | ");
  Serial.print("R: "); Serial.print(stateR == HIGH ? "ON" : "OFF"); Serial.print(" | ");
  Serial.print("S: "); Serial.println(stateS == HIGH ? "ON" : "OFF");

  Serial.println("Sent command: " + cmd);

  // Send command to receiver
  WiFiClient client;
  if (client.connect(host, 80)) {
    client.print(String("GET /?cmd=") + cmd + " HTTP/1.1\r\nHost: " + host +
"\r\nConnection: close\r\n\r\n");
    client.stop();
  }

  delay(300);
}
```

Micro-Controller Programming Code (Receiver):

```
#include <ESP8266WiFi.h>
#include <ESP8266WebServer.h>//Receiver

ESP8266WebServer server(80);

// Motor pins
#define IN1 D1
#define IN2 D2
#define IN3 D5
#define IN4 D6

#define r D7

void setup() {
  Serial.begin(115200);

  // Motor pins
  pinMode(IN1, OUTPUT);
  pinMode(IN2, OUTPUT);
  pinMode(IN3, OUTPUT);
```

```
  pinMode(IN4, OUTPUT);
  pinMode(r, OUTPUT);

  WiFi.mode(WIFI_AP);
  WiFi.softAP("abcde", "123456789");
  Serial.println("Receiver ESP Ready. AP: ReceiverESP");

  server.on("/", HTTP_ANY, handleRequest);
  server.begin();
}

void loop() {
  server.handleClient();
}

void handleRequest() {
  String command = server.arg("cmd");
  Serial.println("Received: " + command);

  if (command == "F") moveForward();
  else if (command == "B") moveBackward();
  else if (command == "L") turnLeft();
  else if (command == "R") turnRight();
  else stopCar();
 if (command == "A") relayon();
  else if (command == "D") relayoff();
  server.send(200, "text/plain", "Command received");
}

void moveForward() {
  digitalWrite(IN1, HIGH); digitalWrite(IN2, LOW);
  digitalWrite(IN3, HIGH); digitalWrite(IN4, LOW);
}

void moveBackward() {
  digitalWrite(IN1, LOW); digitalWrite(IN2, HIGH);
  digitalWrite(IN3, LOW); digitalWrite(IN4, HIGH);
}

void turnLeft() {
  digitalWrite(IN1, LOW); digitalWrite(IN2, HIGH);
  digitalWrite(IN3, HIGH); digitalWrite(IN4, LOW);
}

void turnRight() {
  digitalWrite(IN1, HIGH); digitalWrite(IN2, LOW);
  digitalWrite(IN3, LOW); digitalWrite(IN4, HIGH);
}

void stopCar() {
```

```
  digitalWrite(IN1, LOW); digitalWrite(IN2, LOW);
  digitalWrite(IN3, LOW); digitalWrite(IN4, LOW);
}

void relayon(){
  digitalWrite(r,HIGH);
  }
  void relayoff(){
  digitalWrite(r,LOW);
  }
```