Sponsored Thesis Project Competition on

"RE-IMAGINING URBAN RIVERS"

Season- 3

Project Title : IoT Based trash collecting boat

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SUMMARY

The main of this project is to collect trash over the certain area of the Musi river. This will be executed with IoT Based technology . The IoT-based trash collecting boat is an innovative solution that combines Internet of Things (IoT) technology with marine waste management. This boat is designed to autonomously collect and remove trash and debris from water bodies, such as rivers, lakes, and oceans, thereby addressing the growing problem of water pollution caused by litter and garbage. The IoT-based trash collecting boat represents a significant step forward in the fight against water pollution, offering an efficient and sustainable solution to help keep our oceans and waterways clean.

ACKNOWLEDGEMENT

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BY

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURE

ABBREVIATIONS

SRAM	-	Static random-access memory
BIF	-	Bitmap Image File
UART	-	Universal Asynchronous Receiver Transmitter
SPI	-	Serial Peripheral Interface
PDIP	-	Program Development integration Plan
TQFP	-	A thin quad flat pack
VCC	-	Voltage Common Collector
Ram	-	Random Acess Memory
LED	-	Light Emitting Diode
PC	-	Personal Computer
IDE	-	Integrated Drive Electronics
MQTT	-	Message Queuing Telemetry Transport

GLOSSARY OF TERMS

Internet of Things	Refers to the collective network of connecteddevices and the technology that facilitates communication between devices and the cloud, as well as between the devices themselves.
Arduino UNO	Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button.
ESP32 Camera	the ESP32-CAM is a small size, low power consumption camera module based on ESP32. It comes with an OV2640 camera and provides onboard TF card slot. The ESP32-CAM can be widely used in intelligent IoT applications such as wireless video monitoring, WiFi image upload, QR identification, and so on.
L293d motor drive	L293D motor Driver IC is an integrated circuit that can drive two motors simultaneously and is usually used to control the motors in an autonomous system. This motor driver IC enables us to drive a DC motor in either direction and also control the speed of the motor.
Buzzer	A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.
IR Sensor	IR sensors are now widely used in motion detectors, which are used in building services to switch on lamps or in alarm systems to detect unwelcome guests. In a defined angle range, the sensor elements detect the heat radiation (infrared radiation) that changes over time and space due to the movement of people.
LM2596	The LM2596 series of regulators are monolithic integrated circuits that provide all the active functions for a step-down (buck) switching regulator, capable of driving a 3-A load with excellent line and load regulation.
Ultrasonic sensor	An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal

CHAPTER 1

INTRODUCTION TO IMPORTANCE OF RIVERS

1.1 Introduction

In this culture, we did not see rivers as just water bodies. We see them as life-giving gods or goddesses. We never saw rivers as just geographical happenings. We always saw them as life-making material because over 70% of our body itself is water. Whenever we look for life, we look for a drop of water first!

June is considered as National Rivers Month, a time to celebrate the importance of rivers to our planet. Rivers are our planet's lifeblood, providing essential services, including water, food, recreation, and transportation. Rivers also play a vital role in the global climate system by moderating temperatures and storing carbon dioxide.

1.2 National River of India

Ganga River or Ganges River was declared as the National River of India on November 4, 2008, by the Indian Prime Minister Manmohan Singh. Since then, it has been a part of the National symbols of India.

1.3 Why was Ganga declared as Indian National River?

To achieve the objectives of the Ganga Action Plan (GAP), Indian Prime Minister declared Ganga as the National River in 2008. Ganga is also revered as the holiest river of India and signifies purity and spirituality.

1.4 Gange Mahotsav

Ganges has always been the not only the lifeline of India but also the felicitator and nourishment of the Indian Civilization. The river Ganges, though, considered a thing of reverence by the Hindus has in the course of history defined the psyche of the Indian society as a whole, irrespective of religion. It not only nourishes the population that lives by its kingdom but also give them a sense of separate identity and belonging. To mark this contribution of River Ganges, an annual festival is organized that has been christened 'Ganga Mahotsava'. Figure 1.1 shows the Ganga Mahotsava in Varanasi. Ganga Mahotsava is a 5-day festive event held on the banks of Ganges in Varanasi. Ganga Mahotsava tends to promote Varanasi and Ganga as the cultural capital and lifeline of India respectively. The event gives stress on the promotion of the classical style of Indian music & dance.

Fig 1.1 The Gange Mahotsav in Varanasi

1.5 Celebrating Rivers of India

Celebrating the rivers of India is a way to appreciate the rich cultural, historical, and ecological significance they hold for the country. India's rivers play a crucial role in shaping its landscape, supporting livelihoods, providing water for agriculture and industries, and carrying the legacy of ancient civilizations. Celebrating these rivers involves not only recognizing their importance but also taking concrete steps to protect and preserve them for future generations. Awareness campaigns, clean-up drives, and sustainable water management initiatives are essential to safeguard these precious natural resources. Here are some of the most prominent rivers in India that are celebrating:

1.5.1 Ganges (Ganga)

The Ganga originates as Bhagirathi from the Gangotri glaciers in the Himalayas at an elevation of about 7010m in Uttarkashi district of Uttarakhand and flows for a total length of about 2525 km up to its outfall into the Bay of Bengal through the former main course of Bhagirathi. In India, it covers states of Uttar Pradesh, Madhya Pradesh, Rajasthan, Bihar, West Bengal, Uttarakhand, Jharkhand, Haryana, Chhattisgarh, Himachal Pradesh and Union Territory of Delhi draining an area of 8,61,452 Sq.km which is nearly 26% of the total geographical area of the country. The Ganges is one of the most sacred and revered rivers in India. The Ganges is not just a river but a symbol of spirituality, and millions of people come to its banks for religious ceremonies and to take a holy dip.

1.5.2 Yamuna

The Yamuna is another important and holy river in India, it is originating from the slopes of Bandarpunch massif in the Great Himalayas Yamunotri Glacier in Uttarakhand. It flows through the states of Delhi, Haryana, and Uttar Pradesh before merging with the Ganges at Allahabad. The Yamuna is also closely associated with Hindu mythology and history.

1.5.3 Brahmaputra

The river originates from the Kailash ranges of Himalayas at an elevation of 5300 M Origin in Tibet, the Brahmaputra River flows through north eastern India and enters Bangladesh, where it is known as the Jamuna. After flowing through Tibet it enters India through Arunachal Pradesh and flows through Assam and Bangladesh before it joins Bay of Bengal. It is the lifeline for many regions in Assam and provides sustenance to the rich biodiversity of the region.

1.5.4 Godavari

The Godavari River rises in north western Maharashtra state in the Western Ghats range, only about 50 miles (80 km) from the Arabian Sea, and flows for most of its course generally eastward across the broad plateau of the Deccan (peninsular India). After traversing central Maharashtra it enters northern Telangana state northwest of Nizamabad and continues through a broad valley and forms a short stretch of Telangana's north eastern border with Maharashtra. The Godavari is the second-longest river in India. It is often referred to as the "Dakshina Ganga" or "Ganga of the South" and is a significant source of water for irrigation. Godavari River, sacred river of central and south eastern India. One of the longest rivers in India, its total length is about 910 miles (1,465 km), and it has a drainage basin of some 121,000 square miles (313,000 square km).

1.5.5 Krishna

Krishna River, formerly Kistna, river of south-central India. The Krishna River is one of the major rivers of southern India, It has a total course of about 800 miles (1,290 km) originating from the Western Ghats and flowing through Maharashtra, Karnataka, and Andhra Pradesh. It is essential for irrigation and hydropower generation. The river rises in western Maharashtra state in the Western Ghats range near the town of Mahabaleshwar, not far from the coast of the Arabian Sea. It flows east to Wai and then in a generally south easterly direction past Sangli to the border of Karnataka state.

1.5.6 Narmada

Narmada River, also called Narbada or Nerbudda, river in central India that has always been an important route between the Arabian Sea and the Ganges (Ganga) River valley. The Narmada River, originating from Amarkantak in Madhya Pradesh, flows westward through Gujarat and into the Arabian Sea. It holds great religious importance, and the Narmada Parikrama is a significant pilgrimage route.

1.5.7 Kaveri (Cauvery)

It rises on Brahmagiri Hill of the Western Ghats in southwestern Karnataka state, flows in a south easterly direction for 475 miles (765 km) through the states of Karnataka and Tamil Nadu, and descends the Eastern Ghats in a series of great falls. The kaveri is one of the most important rivers in South India. It is revered as a life-giving river and is vital for agriculture in the region.

1.5.8 Indus

The Indus also is known as the Sindhu, is the westernmost of the Himalayan rivers in India. It originates from a glacier near Bokhar Chu (31°15' N latitude and 81°40' E longitude) in the Tibetan region at an altitude of 4,164 m in the Kailash Mountain range. While the majority of the Indus River lies outside India's borders, it holds historical significance as the cradle of the ancient Indus Valley Civilization, one of the world's oldest civilizations.

1.6 Importance of Rivers

Rivers are of immense importance to both the natural environment and human societies. They play

a crucial role in shaping landscapes, ecosystems, and the well-being of communities

1.6.1 Country's Economy

Firstly, rivers carry an abundance of minerals and sediments that are useful. Further, they provide an economical mode of valuable transportation for trade and commerce. Rivers also have waste and help in the waste management of a whole town or city. Also, the water from the rivers is used for crop irrigation, which allows the country's agriculture sector.

- Rivers, which have fish and other aquatic life, are also full of food.
- They also carry water and nutrients to different parts of the earth**.**
- They are particularly significant in the water cycle because they serve as surface water drainage pathways.
- Hydroelectricity is another aspect where rivers come to the rescue.
- They help develop this efficient and economical form of electricity, which is helpful for any country.

1.6.2 To Survive

It goes without saying, but fresh, clean water is essential for humans and nature to survive. Rivers are precious sources of fresh drinking water for people across the world. And when rivers are so badly polluted by industry or unevenly distributed by poor water management practices, it can be a case of life-or-death. This unfortunately happens across the world.

1.6.3 Home To Some Of The Most Diverse And Endangered Wildlife On Earth:

Freshwater habitats account for some of the richest biodiversity in the world, and rivers are a vital, vibrant ecosystem for many species. But even in the UK, over three quarters of our rivers fail to meet required health standards and face multiple threats – putting an increasing pressure on the diverse wildlife that call our beautiful rivers home: from kingfishers to otters and brown trout.

1.7 Rivers of India

The rivers of India can be classified into four groups viz., Himalayan rivers, Deccan rivers, Coastal rivers, and Rivers of the inland drainage basin.

- The Himalayan Rivers are formed by melting snow and glaciers and therefore, continuously flow throughout the year. During the monsoon months, Himalayas receive very heavy rainfall and rivers swell, causing frequent floods. The Deccan Rivers on the other hand is rain fed and therefore fluctuate in volume. Many of these are non-perennial. The Coastal streams, especially on the west coast are short in length and have limited catchment areas. Most of them are non-perennial. The streams of inland drainage basin of western Rajasthan are few. Most of them are of an ephemeral character.

  The main Himalayan river systems are those of the Indus and the Ganga-Brahmaputra-Meghna system. The Indus, which is one of the great rivers of the world, rises near Mansarovar in Tibet and flows through India, and thereafter through Pakistan, and finally falls in the Arabian Sea near Karachi. Its important tributaries flowing in Indian Territory are the Sutlej (originating in Tibet), the Beas, the Ravi, the Chenab, and the Jhelum. The Ganga-

Brahmaputra-Meghna is another important system of which the principal sub-basins are those of Bhagirathi and the Alaknanda, which join at Dev Prayag to form the Ganga. It traverses through Uttarakhand, Uttar Pradesh, Bihar, and West Bengal. Below Rajmahal hills, the Bhagirathi, which used to be the main course in the past, takes off, while the Padma continues eastward and enters Bangladesh.

The Yamuna, the Ramganga, the Ghaghra, the Gandak, the Kosi, the Mahananda and the Sone are the important tributaries of the Ganga. Rivers Chambal and Betwa are the important sub-tributaries, which join Yamuna before it meets the Ganga. The Padma and the Brahmaputra join inside Bangladesh, and continue to flow as the Padma or Ganga. The Brahmaputra rises in Tibet, where it is known as Tsangpo and runs a long distance till it crosses over into India in Arunachal Pradesh under the name of Dihang. Near Passighat, the Debang and Lohit join the river Brahmaputra and the combined river runs all along the Assam valley. It crosses into Bangladesh downstream of Dhubri.

The principal tributaries of Brahmaputra in India are the Subansiri, Jia Bhareli, Dhansiri, Puthimari, Pagladiya and the Manas. The Brahmaputra in Bangladesh receives the flow of Tista, etc., and finally falls into Ganga. The Barak River, the Head stream of Meghna, rises in the hills in Manipur. The important tributaries of the river are Makku, Trang, Tuivai, Jiri, Sonai, Rukni, Katakhal, Dhaleswari, Langachini, Maduva and Jatinga. Barak continues in Bangladesh till the combined Ganga-Brahmaputra join it near Bhairab Bazar.

The major Himalayan rivers rise north of the mountain ranges and flow through deep gorges that generally reflect some geologic structural control, such as a fault line. The rivers of the Indus system as a rule follow north westerly courses, whereas those of the Ganges-Brahmaputra systems generally take easterly courses while flowing through the mountain region. Figure 1.2 shows the Himalayan rivers in India.

Fig 1.2 The Himalayan Rivers in India

- In the Deccan region, most of the major river systems flowing generally in east direction fall into Bay of Bengal. The major east flowing rivers are Godavari, Krishna, Cauvery, Mahanadi, etc. Narmada and Tapti are major West flowing rivers. Figure 1.3 shows the Deccan Rivers in India.

Fig 1.3 The Deccan Rivers in India

- The Godavari in the southern Peninsula has the second largest river basin covering 10 per cent of the area of India. Next to it is the Krishna basin in the region, while the Mahanadi has the third largest basin. The basin of the Narmada in the uplands of the Deccan, flowing to the Arabian Sea, and of the Cauvery in the south, falling into the Bay of Bengal are about the same size, though with different character and shape.

  There are numerous coastal rivers, which are comparatively small. While only handful of such rivers drain into the sea near the delta of east cost, there are as many as 600 such rivers on the west coast.

  A few rivers in Rajasthan do not drain into the sea. They drain into salt lakes and get lost in sand with no outlet to sea. Besides these, there are the Desert Rivers which flow for some distance and are lost in the desert. These are Luni and others such as, Machhu, Rupen, Saraswati, Banas, Ghaggar and others. Figure 1.4 shows the Rivers of the inland drainage basin. Figure 1.4 shows the rivers of inland drainage system.

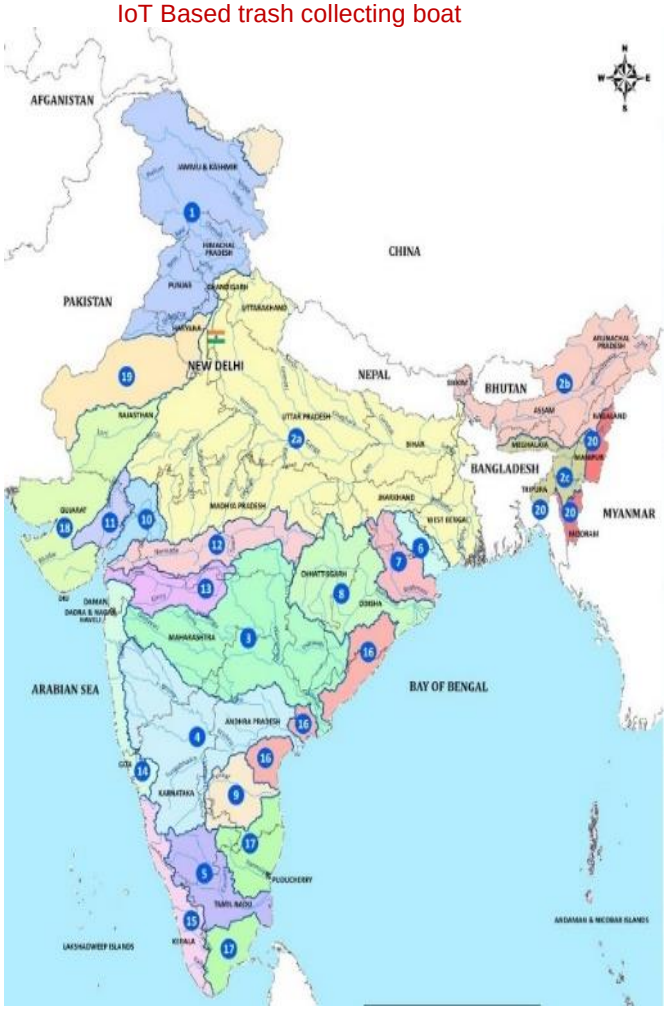

Fig 1.4 The Rivers of the inland drainage basin

Table 1.1 shows the Rivers and its length

Sl.NO.	River	Length(km)
1.	Indus	2,900
2.	Brahmaputra	2,900
3.	Ganga	2,510
4.	Godavari	1,450

5.	Narmada	1,290
6.	Krishna	1,290
7.	Mahanadi	890
8.	Kaveri	760

1.8 Summary:

Rivers are essential components of the Earth's hydrological cycle and play a crucial role in supporting life and ecosystems. River festivals provide an opportunity for people to connect with nature, appreciate the significance of rivers, and promote sustainable practices. As they celebrate the life-giving properties of rivers, these festivals remind us of the need to preserve and protect these vital natural resources for future generations. India is a land blessed with a vast network of rivers, each contributing significantly to the country's cultural, economic, and ecological diversity. These rivers, along with numerous other smaller rivers and their tributaries, form a crucial lifeline for India, supporting a vast range of ecosystems, providing water for irrigation and domestic use, and playing a central role in the cultural and spiritual life of its people. Protecting and conserving these rivers is of utmost importance to ensure sustainable development and the well-being of India's diverse population.

CHAPTER 2

HISTORY OF MUSI RIVER

2.1 Introduction

The Musi River is a significant river in the southern Indian state of Telangana. The Musi River also known as the Musa River, it is a major tributary of the Krishna River in the Deccan Plateau, flowing through Telangana, India. Hyderabad stands on the banks of the Musi River, which divides the historic Old City from the new city. The Musi River flows into Himayat Sagar and Osman Sagar, which are artificial lakes that act as reservoirs that once supplied the twin cities of Hyderabad and Secunderabad with drinking water. It originates in the Ananthagiri Hills, near Vikarabad. It generally flows towards the east, turning south at Chittaloor. It flows into the Krishna River at Vadapally near Miryalaguda in Nalgonda district. It has played a prominent role in the history and development of the region. Figure 2.1 shows the site map for Musi River stretch with the sampling sites (site U1 : Uppal; site U2 : Peerzadiguda; site U3 : Masjidpuram; and site U4 : Nallacheruvu, near Hyderabad in Andhra Pradesh, India.

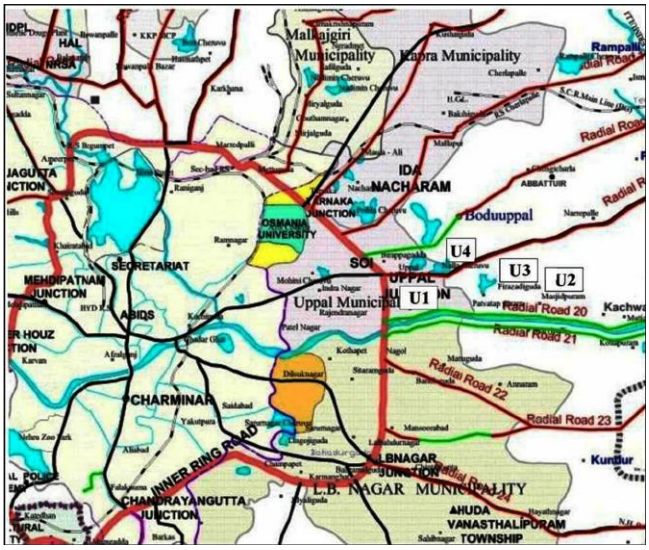

Fig 2.1 The site map for Musi River

In ancient times The Musi River has been a lifeline for settlements in the region since ancient times. It finds mention in historical texts like the Puranas and was known as Muchukunda River during the Satavahana dynasty (2nd century BCE - 3rd century CE). During the 12th and 13th centuries, the Kakatiya dynasty ruled over the region, with their capital at Warangal. The Musi River played a crucial role in their irrigation system, and facilitating agriculture and the growth of settlements along its banks. Figure 2.2 shows the Musi River in 12th and 13th century.

Fig 2.2 The Musi River in 12th and 13th century.

In the 16th century, the Qutb Shahi dynasty established the Golconda Sultanate, with Hyderabad as its capital. The Musi River flowed through the heart of the city and was an integral part of its fortification system. Figure 2.3 shows the Musi River in 16th century.

Figure 2.3 The Musi River in 16th century.

The history of the Musi River is marked by a tragic event known as the "Great Musi Flood" that occurred on September 28, 1908 in Hyderabad. The city of Hyderabad was the capital of the Hyderabad State, ruled by the Nizam, Mir Mahbub Ali Khan. Heavy rainfall caused the Hussain Sagar Lake , which is connected to the Musi River, to overflow. The flood, locally known as Thughyani Sitambar, shattered the life of the people living in Hyderabad, killing 50,000 people and causing extensive damage to property. It washed away three bridges - the Afzal, Mussallam

Jung and Chaderghat - the Puranapul became the only link between two parts of the city. Figure 2.4 shows the broken bridge and the scattered people.

Figure 2.4 The broken bridge and the scattered people.

The Musi River was the cause of frequent flood devastation of Hyderabad city till early 20th century. It had begun to swell dangerously on 27 September. The first flood warning came at 2 AM when the water flowed over Puranapul bridge. By 6 AM there was a cloudburst. The flood breached on Tuesday, 28 September 1908: The river rose 60 feet, flowing through the city. In 36 hours, 17 inches of rainfall was recorded, and the water level at Afzalgunj was about 11 feet (3.4 m) high and in other places even higher. The worst hit area was Kolsawadi and Ghansi Bazar in Afzal Gunj. The flood razed over 80,000 houses, making a fourth of the population homeless. It completely destroyed the Nizam Hospital, burying the patients. It washed away the Afzal, Mussallam Jung and Chaderghat bridges, all built in the 1860s.Figure 2.5 shows the Great Musi flood of 1908.

Fig 2.5 The Great Musi flood of 1908.

After India gained independence from British rule in 1947, the state of Andhra Pradesh was formed, and Hyderabad became its capital. The Musi River continued to be significant for the

city's water supply, irrigation, and drainage systems. Figure 2.6 shows the Palembang Landing Craft on the Musi river (July 9470).

Fig 2.6 The Palembang Landing Craft on the Musi river (July 9470).

In recent decades, Due to indiscriminate urbanization and lack of planning, the river had earlier become a receptacle of untreated domestic and industrial waste dumping out of Hyderabad. It was estimated that nearly 350 MLD of polluted water and sewage originating from Hyderabad and Se cunderabad flow into the river. Efforts are being made to revive the river and restore its ecological balance through various restoration projects and awareness campaigns. Efforts to clean it have failed. The river water downstream of the cities remained highly polluted and considered to be a major disaster in Hyderabad. Figure 2.7 shows the present situation of Musi river.

Fig 2.7 The present situation of Musi river.

Musi is now one of the most polluted rivers in India. Recent studies have shown the presence of super bugs in the water of Musi. Researchers and some drug company employees say the presence of more than 300 drug firms, combined with lax oversight and inadequate water treatment, has left the river laced with antibiotics, making this a giant Petri dish for anti-microbial resistance. Drug makers including large Indian firms Dr Reddy's Laboratories Ltd REDY.NS, Aurobindo Pharma Ltd ARBN.NS and Hetero Drugs Ltd, and U.S. giant Mylan Inc MYL.O discharge effluents into waterways, Musi is now "critically polluted". These drug-resistant superbugs are a serious threat to people as these bacteria are resistant to almost every known antibiotic. Despite the challenges it faces, the Musi River remains an important water body in the region, playing a crucial role in the socio-economic development of Hyderabad and its surrounding areas. The Musi River in Telangana has now turned into a stream of toxic liquids and effluents. Starting in the Anantagiri hills in Vikarabad district, the Musi joins the Krishna River in Vadavalli in Nalgonda district. It fulfils the drinking water and irrigation needs of the people of Hyderabad, Rangareddy, and the united Nalgonda districts. Historically linked with the lives of the people of these districts, the river's water was pristine clear even 40 years ago. Companies that have come up on the banks of the Musi in the industrial areas of Patancheru, Jeedimetla and Nacharam are freely releasing industrial waste into the river. Similarly, civic waste is dumped in the Musi. In the city, the river has disappeared and become a dumping yard. Figure 2.8 shows the pollutants in Musi rise, river becomes sewage.

Fig 2.8 The pollutants in Musi rise, river becomes sewage.

2.2 Summary:

The Musi River is a significant river in southern India, flowing through the state of Telangana and the city of Hyderabad. The Musi River has a long history dating back to ancient times. During the medieval period, the Musi River played a crucial role in the water supply and irrigation systems established by the Kakatiya dynasty rulers in Telangana. Over the centuries, the Musi River witnessed several historical events, including the Siege of Golconda during

the Mughal invasion in the 17th century. As Hyderabad grew into a major urban center, the Musi River played a significant role in supplying water for drinking, irrigation, and industrial purposes. However, rapid urbanization led to environmental degradation and pollution of the river. The Musi River has been prone to occasional floods, and a significant flood disaster occurred in 1908, which resulted in widespread destruction and loss of life.

CHAPTER 3

HARDWARE DESIGN

3.1 Introduction

This project aims design and implementation of IOT enabled robotic trash boat to cleaning the ocean or lake or river. This Garbage Boat is a machine which involves collecting debris (trash) from water surface. Clean water is a basic need for all living beings but water gets polluted due to many reasons like sewage waste, industry waste and garbage waste. The lakes in many villages in India are not used for any day-to-day usage because of garbage stagnant. This is the reason which motivates to design and implement this project.

Transformer is used to charge the battery through charging circuit and this battery power is used run this robot. The boat movement along with conveyor belt and head light can be controlling from web browser while seeing the video by using WEB mobile application**.** This robot consists of ultrasonic sensor to detect and avoid the obstacle while moving on the water surface. Once the trash has been filled the IR sensor will detect it. When IR sensor gives out this information automatically the boat will give the RED LED indication on camera module along with buzzer indication.

This system will be more advanced as this would collect down the floating trash with the help of moving belt which consist of teeth to collect the trash on water surface. The main controlling device of the project is Arduino UNO. To achieve this task Arduino loaded program written in C language.

The objectives of the project

1. Design an IOT based garbage collecting boat.
2. IR sensor-based trash detecting system.
3. Alerts in the form of Buzzer and RED LED.
4. Ultrasonic sensor-based obstacle detection and avoidance system.
5. To collect the trash using Conveyor belt setup.

3.2 Embedded Systems

An embedded system is a computer system designed to perform one or a few dedicated functions often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. By contrast, a general-purpose computer, such as a personal computer (PC), is designed to be flexible and to meet a wide range of end-user needs. Embedded systems are controlled by one or more main processing cores that are typically either microcontrollers or digital signal processors (DSP). Physically embedded systems range from portable devices such as digital watches and MP3 players, to large stationary installations like traffic lights, factory controllers, or the systems controlling nuclear power plants. Figure 3.1 shows Embedded system.

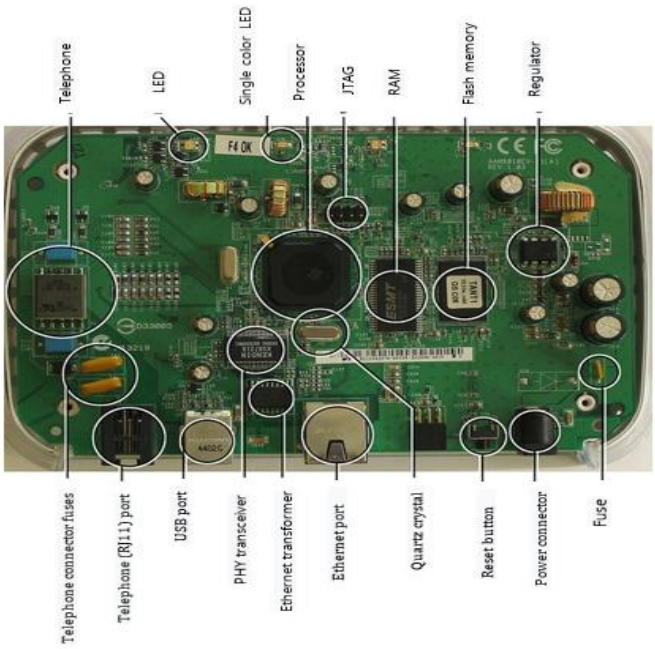

Fig 3.1 Embedded system

Embedded systems programming is not like normal PC programming. In many ways, programming for an embedded system is like programming PC 15 years ago.

The hardware for the system is usually chosen to make the device as cheap as possible. Spending an extra dollar, a unit in order to make things easier to program can cost millions. Hiring a programmer for an extra month is cheap in comparison. This means the programmer must make do with slow processors and low memory, while at the same time battling a need for efficiency not seen in most PC applications. Below is a list of issues specific to the embedded field.

One of the first recognizably modern embedded systems was the Apollo Guidance Computer, developed by Charles Stark Draper at the MIT Instrumentation Laboratory.

3.3 Hardware Description

An IoT-based trash collecting boat is a specialized watercraft equipped with various hardware components and sensors to autonomously or remotely collect and remove trash and debris from water bodies, such as rivers, lakes, and oceans. The boat is designed with various hardware components to leverage the capabilities of the Internet of Things (IoT) to optimize waste collection efficiency and environmental impact. Figure 3.2 shows the Block diagram of trash collect boat.

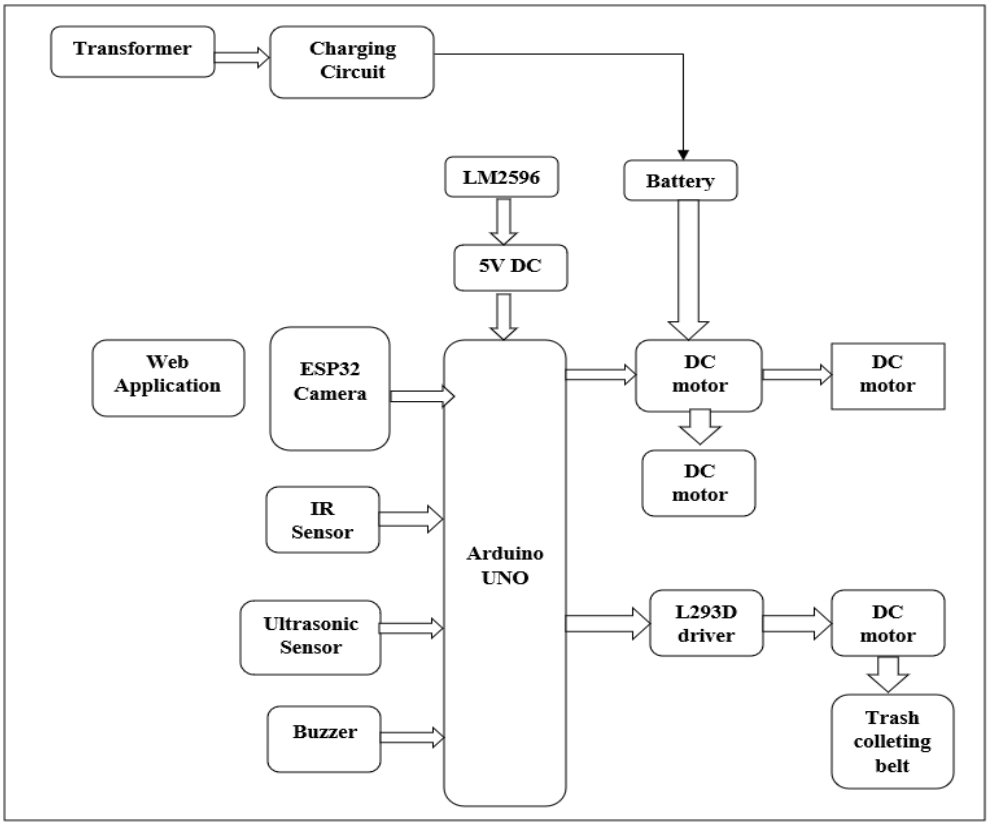

Fig 3.2 Block diagram of trash Collecting Boat

3.4 The main blocks of this project are

An IoT-based trash collecting boat is a smart and environmentally-friendly solution designed to clean water bodies such as lakes, rivers, or seas by autonomously collecting and removing floating debris and garbage. The boat employs Internet of Things (IoT) technology, which allows it to be remotely controlled, monitor its surroundings, and efficiently perform its cleaning tasks.

3.4.1 ESP32 CAMERA

The ESP32-CAM is a popular development board based on the ESP32 microcontroller, which includes built-in Wi-Fi and Bluetooth capabilities. The "CAM" in its name refers to the fact that it comes with a camera module attached, making it suitable for various IoT and embedded projects that involve image and video processing. Figure 3.3 shows the ESP32 Camera.

Fig 3.3 ESP32 CAMERA

- The smallest 802.11b/g/n Wi-Fi BT SoC module.
- Low power 32-bit CPU, can also serve the application processor.
- Up to 160MHz clock speed, summary computing power up to 600 DMIPS.
- Built-in 520 KB SRAM, external 4MPSRAM.
- Supports UART/SPI/I2C/PWM/ADC/DAC.
- Support OV2640 and OV7670 cameras, built-in flash lamp.
- Support image Wi-Fi upload.
- Supports TF card.
- Supports multiple sleep modes.
- Embedded Lwip and Free RTOS.
- Supports STA/AP/STA+AP operation mode.
- Support Smart Config/AirKiss technology.

Support for serial port local and remote firmware upgrades (FOTA).

Specifications

- Wireless Module: ESP32-S WiFi 802.11 b/g/n + Bluetooth 4.2 LE module with PCB antenna, u.FL connector, 32Mbit SPI flash, 4MBit PSRAM.
- External Storage: micro SD card slotup to 4GB.
- Camera
- FPC connector.
- Support for OV2640 (sold with a board) or OV7670 cameras.
- Image Format: JPEG(OV2640 support only), BMP, grayscale.
- LED flashlight.
- Expansion: 16x through-holes with UART, SPI, I2C, PWM.
- Misc: Reset button.
- Power Supply: 5V via pin header.
- Power Consumption.
- Dimensions (ESP32): 40 x 27 x 12 (LxWxH) mm.
- Temperature Range: Operating: -20 ~ 85 ; storage: -40 ~ 90 @ <90%RH.

SL.NO	Name of the component	Quantity (in Amps)	Quantity (in volts)
1.	Flash LED off	180mA	5v
2.	Flash LED on	310mA	5v
3.	Deep-sleep	6mA	5v
4.	Modem-sleep	20mA	5v
5.	Light-sleep	6.7mA	5v

3.4.2 Arduino UNO

Arduino Uno is one of the most popular and widely used development boards in the Arduino family. It is designed for beginners and hobbyists, offering an easy-to-use platform for prototyping and building electronic projects. Arduino Uno is based on the Atmel ATmega328P microcontroller and comes with a simple and straightforward development environment that makes it accessible to users with varying levels of programming experience. Figure shows the Arduino UNO board.

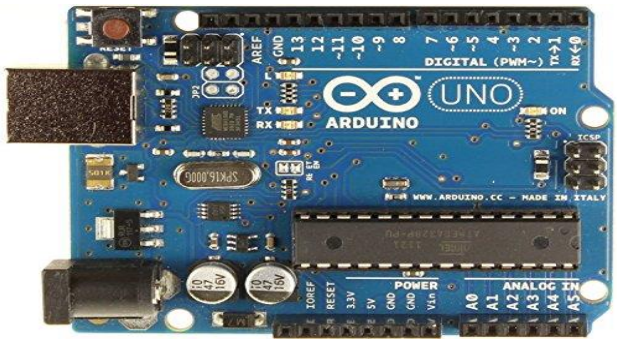

Fig 3.4 Arduino UNO

- The Arduino Uno is a microcontroller board which has ATmega328 from the AVR family. There are 14 digital input/output pins, 6 Analog pins and 16MHz ceramic resonator.

- USB connection, power jack and also a reset button is used. Its software is supported by a number of libraries, which makes the programming easier.

3.4.3 ATMEGA328:

- High Performance, Low Power AVR® 8-Bit Microcontroller
- Advanced RISC Architecture

– 131 Powerful Instructions – Most Single Clock Cycle Execution

– 32 x 8 General Purpose Working Registers

– Fully Static Operation

– Up to 20 MIPS Throughput at 20 MHz

– On-chip 2-cycle Multiplier

• High Endurance Non-volatile Memory Segments

– 4/8/16/32K Bytes of In-System Self-Programmable Flash progam memory

▪ (ATmega48PA/88PA/168PA/328P)

– 256/512/512/1K Bytes EEPROM (ATmega48PA/88PA/168PA/328P)

– 512/1K/1K/2K Bytes Internal SRAM (ATmega48PA/88PA/168PA/328P)

– Write/Erase Cycles: 10,000 Flash/100,000 EEPROM

– Data retention: 20 years at 85°C/100 years at 25°C(1)

– Optional Boot Code Section with Independent Lock Bits

▪ In-System Programming by On-chip Boot Program

▪ True Read-While-Write Operation

– Programming Lock for Software Security

Peripheral Features

– Two 8-bit Timer/Counters with Separate Prescaler and Compare Mode
– One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture Mode
– Real Time Counter with Separate Oscillator
– Six PWM Channels
– 8-channel 10-bit ADC in TQFP and QFN/MLF package
Temperature Measurement
– 6-channel 10-bit ADC in PDIP Package
Temperature Measurement
– Programmable Serial USART
– Master/Slave SPI Serial Interface
– Byte-oriented 2-wire Serial Interface (Philips I2C compatible)
– Programmable Watchdog Timer with Separate On-chip Oscillator.
– On-chip Analog Comparator
– Interrupt and Wake-up on Pin Change

Special Microcontroller Features

– Power-on Reset and Programmable Brown-out Detection
– Internal Calibrated Oscillator
– External and Internal Interrupt Sources
– Six Sleep Modes: Idle, ADC Noise Reduction, Power-save.

• I/O and Packages
– 23 Programmable I/O Lines
– 28-pin PDIP, 32-lead TQFP, 28-pad QFN/MLF and 32-pad QFN/MLF
• Operating Voltage:

– 1.8 - 5.5V for ATmega48PA/88PA/168PA/328P

Temperature Range:

– -40°C to 85°C

• Speed Grade:

– 0 - 20 MHz @ 1.8 - 5.5V

• Low Power Consumption at 1 MHz, 1.8V, 25°C for ATmega48PA/88PA/168PA/3 2P:

– Active Mode: 0.2 mA

– Power-down Mode: 0.1 µA

– Power-save Mode: 0.75 µA (Including 32 kHz RTC)

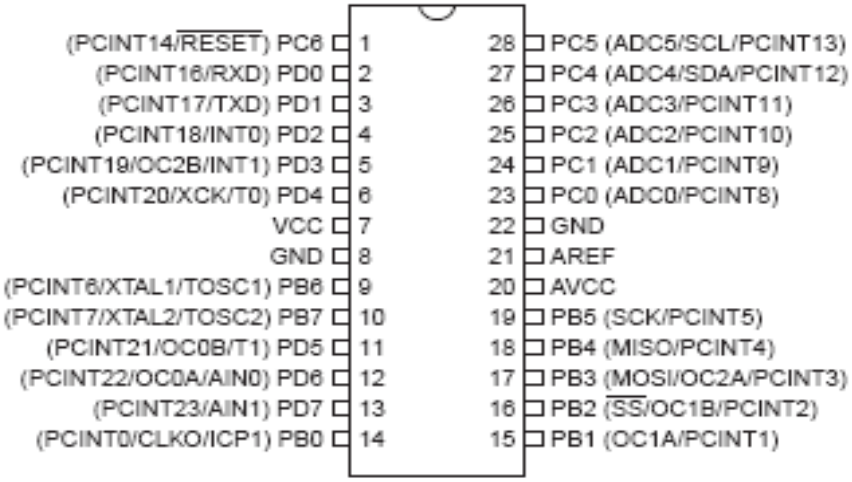

Fig 3.5 Single chip microcontroller

- **VCC** Digital supply voltage.
- **GND** Ground.
- **Port B (PB7:0) XTAL1/XTAL2/TOSC1/TOSC2**

  Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each it). 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/Counter2 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 it). 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 RSTDISBL 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.

- **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 through 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.

3.4.4 Battery Power Supply

A DC battery is a type of direct current (DC) power source that provides an electrical output voltage of 12 volts. These batteries are widely used in various applications due to their portability, versatility, and ability to store electrical energy for later use. 12v 2amh battery is used to give the

power supply of the robot. Figure 3.6 shows the battery.

Fig 3.6 Battery

3.4.5 DC Motor:

A dc motor uses electrical energy to produce mechanical energy, very typically through the interaction of magnetic fields and current-carrying conductors. The reverse process, producing electrical energy from mechanical energy, is accomplished by an alternator and generator or dynamo. Many types of electric motors can be run as generators, and vice versa. The input of a DC motor is current/voltage and its output is torque (speed). Figure 3.7 shows the DC Motor.

Fig 3.7 DC Motor

The DC motor has two basic parts: the rotating part that is called the armature and the stationary part that includes coils of wire called the field coils. The stationary part is also called the stator. Figure shows a picture of a typical stator. From the picture you can see the armature is made of coils of wire wrapped around the core, and the core has an extended shaft that rotates on bearings. You should also notice that the ends of each coil of wire on the armature are terminated at one end of the armature. The termination points are called the commutator, and this is where the brushes make electrical contact to bring electrical current from the stationary part to the rotating part of the machine.

Table 3.1 shows the Rating and quantity of each component

Sl. No	Name of the equipment/component	Rating	Quantity
1.	Ultrasonic sensor	2cm to 400cm (0.8inch to 157) inch	1
2.	ESP32 Camera	(520KB+4M) RAM, 2484 MHz	1
3.	L293d motor driver	1v-36v	1
4.	Buzzer	5v	1
5.	Bread board	---	1
6.	LM2596	3A	1
7.	Arduino UNO (R3)	---	1
8.	Rechargeable DC battery pack	12v, 2A	6
9.	Transformer	12v, 3A	1
10.	IR Sensor	---	1
11.	Charging circuit	12v	1
12.	Battery	9v	1
13.	DC motor	6v-12v, 5600rpm	2
14.	Trash collecting belt	----	---

3.5 Summary

The IoT-based trash collecting boat is a smart and environmentally friendly solution designed to clean water bodies by autonomously collecting floating debris and garbage. Its hardware components and features enable efficient and remote-controlled operation. The boat is designed to be sturdy and stable with a loading area to hold collected trash. The boat is equipped with various IoT hardware components, including microcontrollers, sensors, GPS modules, communication . The boat is equipped with various sensors such as ultrasonic sensors to detect obstacles and avoid collisions and trash detection sensors to identify and differentiate debris and garbage. It is equipped with cameras to assist in identifying and locating trash in the water. Operators can remotely control the boat using a web-based mobile application, allowing them to control movements and receive real-time updates. The boat is equipped with a trash collection mechanism, such as a conveyor belt or collection arm, which lifts debris and garbage from the water and deposits it into a storage compartment on the boat.

CHAPTER 4

OPERATION

4.1 Operation

The DC motor you will find in modem industrial applications operates very similarly to the simple DC motor described earlier in this chapter. Notice that the DC voltage is applied directly to the field winding and the brushes. When voltage is applied to the motor, current begins to flow through the field coil from the negative terminal to the positive terminal. This sets up a strong magnetic field in the field winding. Current also begins to flow through the brushes into a commutator segment and then through an armature coil. The current continues to flow through the coil back to the brush that is attached to other end of the coil and returns to the DC power source. The current flowing in the armature coil sets up a strong magnetic field in the armature. Figure shows the electrical diagram of DC motor.

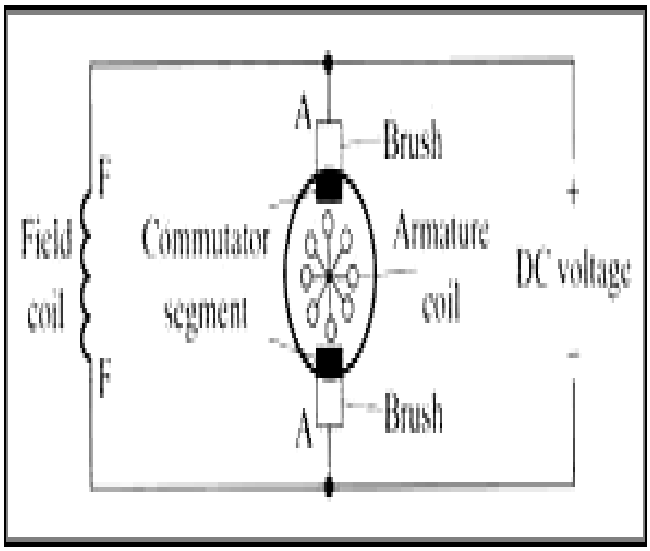

Fig 4.1 Electrical diagram of DC motor

The magnetic field in the armature and field coil causes the armature to begin to rotate. This occurs by the unlike magnetic poles attracting each other and the like magnetic poles repelling each other. As the armature begins to rotate, the commutator segments will also begin to move under the brushes. As an individual commutator segment moves under the brush connected to positive voltage, it will become positive, and when it moves under a brush connected to negative voltage it will become negative. In this way, the commutator segments continually change polarity from positive to negative continually from north pole to south pole. Figure shows the operation of DC Motor.

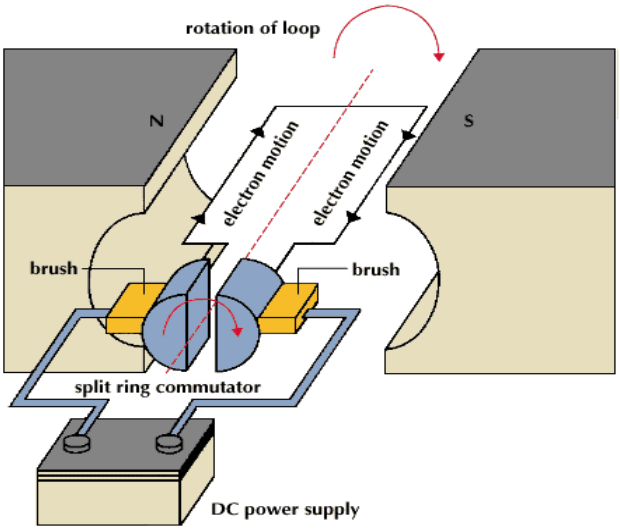

Fig 4.2 Operation of a DC Motor

The commutator segments and brushes are aligned in such a way that the switch in polarity of the armature coincides with the location of the armature's magnetic field and the field winding's magnetic field. The switching action is timed so that the armature will not lock up magnetically with the field. Instead the magnetic fields tend to build on each other and provide additional torque to keep the motor shaft rotating. When the voltage is de-energized to the motor, the magnetic fields in the armature and the field winding will quickly diminish and the armature shaft's speed will begin to drop to zero. If voltage is applied to the motor again, the magnetic fields will strengthen and the armature will begin to rotate again.

4.2 DC Motor Driver

The L293 and L293D are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications.

All inputs are TTL compatible. Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo-Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4EN.When an enable input is high, the associated drivers are enabled and their outputs are active and in phase with their inputs.

When the enable input is low, those drivers are disabled and their outputs are off and in the high-impedance state. With the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications. On the L293, external high-speed output clamp diodes should be used for inductive transient suppression. A VCC1 terminal, separate from VCC2, is provided for the logic inputs to minimize device power

dissipation. The L293and L293D are characterized for operation from 0°C to 70°C. Figure 4.3 shows the L293D IC

Fig 4.3 L293D IC

4.3 Pin Diagram of L293D motor driver

The L293D is a popular motor driver IC (integrated circuit) used to control the direction and speed of small DC motors. It is commonly used in robotics, automation, and other electronic projects where precise motor control is required. The L293D can drive two DC motors simultaneously in both forward and reverse directions, making it ideal for applications like motorized vehicles, robots, and motor-controlled systems. Figure 4.4 shows the L293D pin diagram.

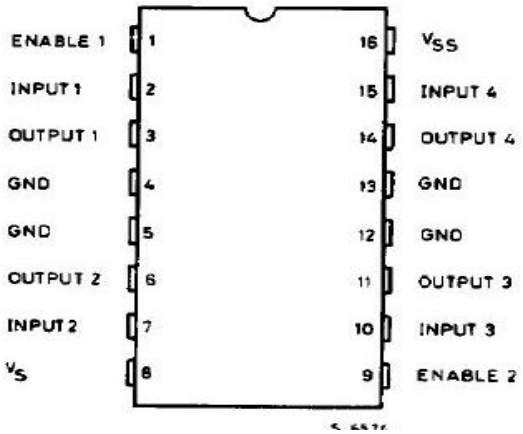

Fig 4.4 L293D pin diagram

Features of L293D

- 600mA Output current capability per channel
- 1.2A Peak output current (non repetitive) per channel

- Enable facility
- Over temperature protection
- Logical "0"input voltage up to 1.5 v
- High noise immunity
- Internal clamp diodes

4.4 IR Sensor

An IR (Infrared) sensor is a type of electronic device that detects infrared radiation or IR light. Infrared radiation is electromagnetic radiation with wavelengths longer than those of visible light, making it invisible to the human eye. IR sensors are widely used in various applications, including remote controls, motion detection, proximity sensing, and temperature measurement.

4.4.1 IR Sensor Module

An IR sensor module is a pre-assembled package that contains an infrared sensor and other components, designed to simplify the integration of infrared sensing into electronic projects. These modules are widely used in applications like obstacle detection, proximity sensing, line following robots, and automated lighting control. They provide a ready-to-use solution, requiring minimal circuitry and programming knowledge. Figure 4.5 shows IR sensor Module pinout.

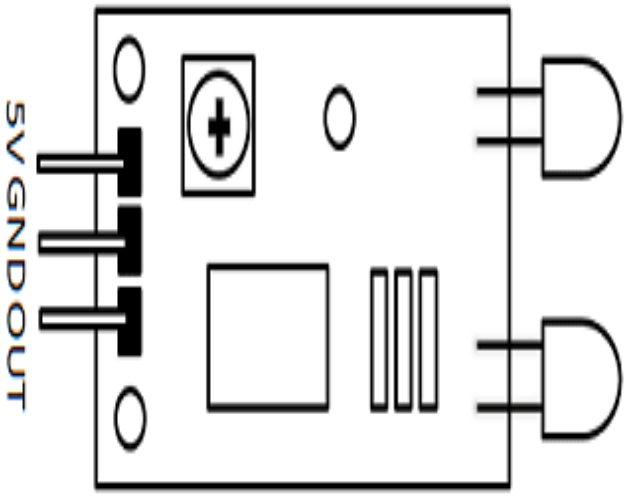

Fig 4.5 IR Sensor Module Pinout

Pin Configuration

Pin Name	Description
VCC	Power Supply Input

GND	Power Supply Ground
OUT	Active High Output

4.4.2 IR Sensor Module Features

- 5VDC Operating voltage
- I/O pins are 5V and 3.3V compliant
- Range: Up to 20cm
- Adjustable Sensing range
- Built-in Ambient Light Sensor
- 20mA supply current
- Mounting hole

4.4.3 Brief about IR Sensor Module

The IR sensor module consists mainly of the IR Transmitter and Receiver, Opamp, Variable Resistor (Trimmer pot), output LED in brief. Figure 4.6 shows IR sensor module.

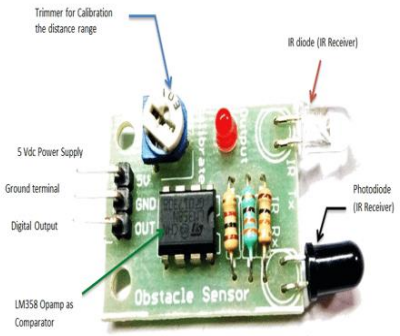

Figure 4.6 IR Sensor Module

4.4.4 IR LED Transmitter

IR LED emits light, in the range of Infrared frequency. IR light is invisible to us as its wavelength (700nm – 1mm) is much higher than the visible light range. IR LEDs have light emitting angle of approx. 20-60 degree and range of approx. few centimeters to several feets, it depends upon the type of IR transmitter and the manufacturer. Some transmitters have the range in kilometers. IR LED white or transparent in colour, so it can give out amount of maximum light.

4.4.5 Photodiode Receiver

Photodiode acts as the IR receiver as its conducts when light falls on it. Photodiode is a semiconductor which has a P-N junction, operated in Reverse Bias, means it start conducting current in reverse direction when Light falls on it, and the amount of current flow is proportional to the amount of Light. This property makes it useful for IR detection. Photodiode looks like a

LED, with a black colour coating on its outer side; Black colour absorbs highest amount of light.

4.4.6 LM358 Opamp

LM358 is an Operational Amplifier (Op-Amp) is used as voltage comparator in the IR sensor. the comparator will compare the threshold voltage set using the preset (pin2) and the photodiode's series resistor voltage (pin3).

Photodiode's series resistor voltage drop > Threshold voltage = Opamp output is High

Photodiode's series resistor voltage drop < Threshold voltage = Opamp output is Low

When Opamp's output is high the LED at the Opamp output terminal turns ON (Indicating the detection of Object).

Variable Resistor

The variable resistor used here is a preset. It is used to calibrate the distance range at which object should be detected.

4.5 Buzzer

Basically, the sound source of a piezoelectric sound component is a piezoelectric diaphragm. A piezoelectric diaphragm consists of a piezoelectric ceramic plate which has electrodes on both sides and a metal plate (brass or stainless steel, etc.). A piezoelectric ceramic plate is attached to a metal plate with adhesives. Applying D.C. voltage between electrodes of a piezoelectric diaphragm causes mechanical distortion due to the piezoelectric effect. For a misshaped piezoelectric element, the distortion of the piezoelectric element expands in a radial direction. And the piezoelectric diaphragm bends toward the direction. The metal plate bonded to the piezoelectric element does not expand. Conversely, when the piezoelectric element shrinks, the piezoelectric diaphragm bends in the direction. Thus, when AC voltage is applied across electrodes, the bending is repeated, producing sound waves in the air.

To interface a buzzer the standard transistor interfacing circuit is used. Note that if a different power supply is used for the buzzer, the 0V rails of each power supply must be connected to provide a common reference.

If a battery is used as the power supply, it is worth remembering that piezo sounders draw much less current than buzzers. Buzzers also just have one 'tone', whereas a piezo sounder is able to create sounds of many different tones.

To switch on buzzer -high 1

To switch off buzzer -low 1. Figure 4.7 shows Buzzer.

Figure 4.7 Buzzer

4.6 Ultrasonic sensor:

Ultrasonic sensors (also known as transceivers when they both send and receive, but more generally called transducers) work on a principle similar to radar or sonar which evaluates attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object.

This technology can be used for measuring: wind speed and direction, tank or channel level, and speed through air or water. For measuring speed or direction a device uses multiple detectors and calculates the speed from the relative distances to particulates in the air or water. To measure tank or channel level, the sensor measures the distance to the surface of the fluid. Further applications include: humidifiers, sonar, medical ultrasonography, burglar alarms and non-destructive testing.

Systems typically use a transducer which generates sound waves in the ultrasonic range, above 18,000 hertz, by turning electrical energy into sound, then upon receiving the echo turn the sound waves into electrical energy which can be measured and displayed. Figure 4.8 shows Ultrasonic sensors and Figure 4.9 shows Ultrasonic sensor timing diagram.

Fig 4.8 Ultrasonic sensor

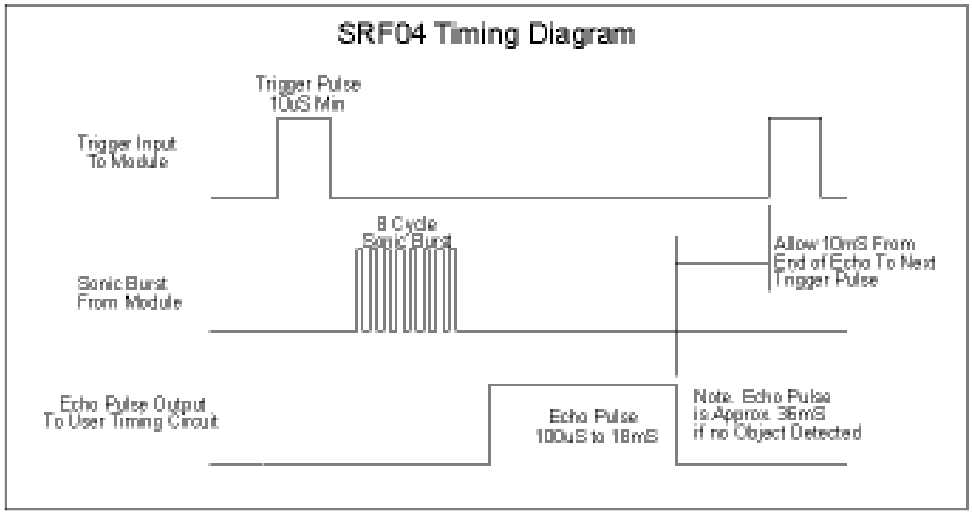

Fig 4.9 Ultrasonic sensor timing diagram

- Devices with TEACH-IN functionality for fast and simple installation
- ULTRA 3000 software for improved adaptation of sensors to applications
- Adjustable sensitivity to the sound beam width for optimized adjustment of the sensor characteristics according to the application
- Temperature compensation - compensates for sound velocity due to varying air temperatures
- Synchronization input to prevent cross-talk interference when sensors are mounted within close proximity of each other
- Sensors with digital and/ or analog outputs. Figure 4.10 shows Ultrasonic sensor.

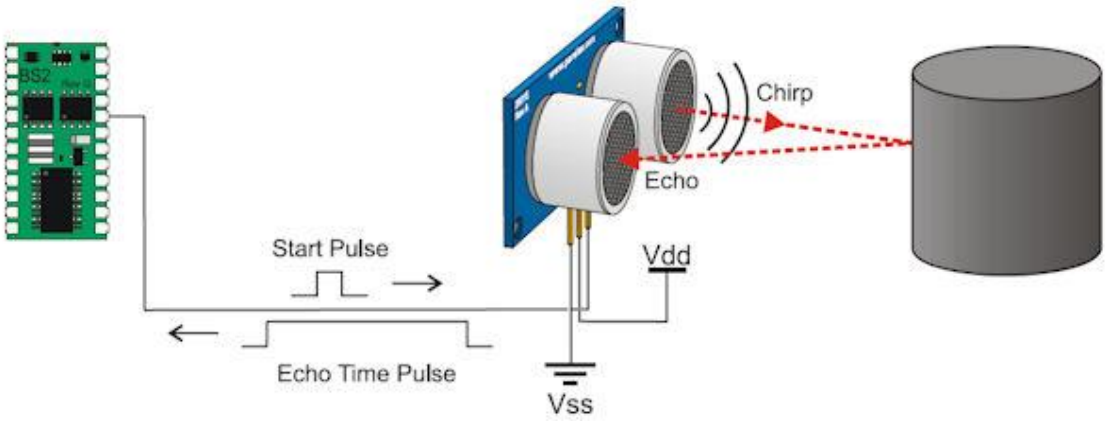

Fig 4.10 Ultrasonic sensor

4.7 Electrical connection

The SRF004 ultrasonic range finder has 5 connections pins. The power supply is connected to the 5V and 0V ground connections on the SRF004. (Note that BOTH the 'Mode' (hole 4) and '0V Ground' (hole 5) connections **MUST** be connected to 0V for correct operation with the PICAXE

system). Take care not to overheat, and therefore damage, the solder connection pads whilst making connections.

The SRF004 **Trigger Input** is connected to a PICAXE **output** pin.

The SRF004 **Echo Output** is connected to a PICAXE **input** pin. Below figure 4.11 shows the pin configuration of Ultrasonic sensor module.

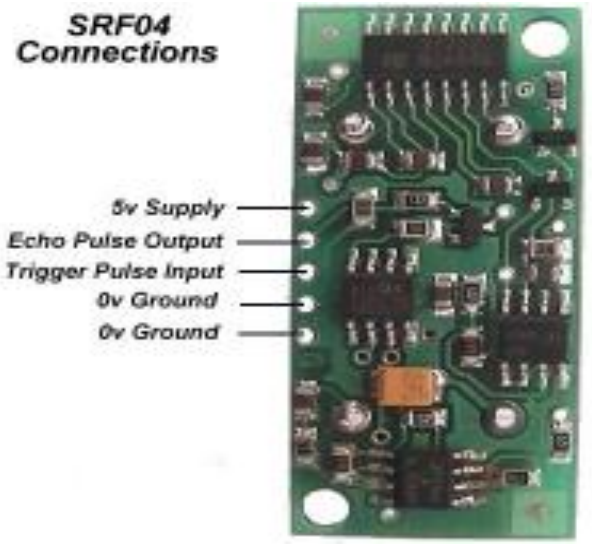

Fig 4.11 Pin configuration of ultrasonic sensor module

The SRF004 must be mounted above the buggy (e.g. by using a small home-made aluminum bracket (not supplied)). The SRF004 has five solder connections which must be connected via wires to the solder joints on the bottom of the buggy PCB.

1. Hole 1 – 5v Supply – to PIC chip leg 14 (V+ Supply)

2. Hole 2 – Echo Output – to PIC chip leg 15 (input 6)

3. Hole 3 – Trigger Input – to PIC chip leg 9 (output 3)

4. Hole 4 – Mode – to PIC chip leg 5 (0V Ground)

5. Hole 5 – 0V Ground – to PIC chip leg 5 (0V Ground)

Note that **both** holes 4 and 5 must both be connected to 0V.

4.8 Working of charging circuit

Above circuit diagram take the input from 12v 15watt Solar panel and, we can see that the 12v dc is being stored into the battery with the help of rectifier and 1000MF capacitor used. We can get 12V,2ahm Steady DC at the output terminal is fed to the rechargeable battery which can be indicated if the LED glows. Here we are using diodes for reverse current protection. Diodes will conduct in forward bias.

4.9 SOFTWARE DESCRIPTION

4.91 Arduino IDE Compiler

This instructible adds to any of the Arduino on a Breadboard instructible.

1. We need a microcontroller with a pre-loaded Bootloader, or must load your own
2. Not all ATmega328's is equal

4.92 Procedural steps for compilation, simulation and dumping:

Compilation and simulation steps:

- **Step 1:** Parts
  1 x Arduino on a Breadboard
  1 x Arduino UNO
  Connecting Wires
  Arduino IDE installed on your PC

- **Step 2:** Program your Arduino UNO as an ISP

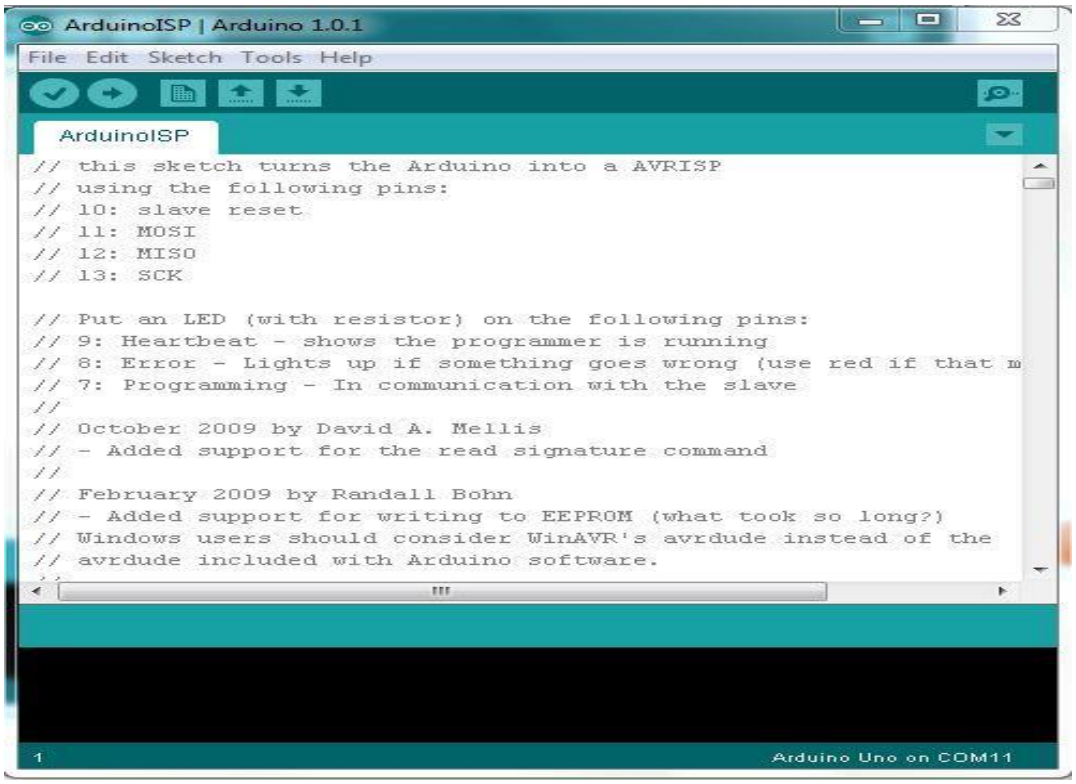

Fig 4.12 Program to Arduino UNO

We need to program the Arduino UNO to act as an ISP (In-System Programmer), so that it can burn the bootloader onto the Breadboard chip.

1. Open the Arduino IDE

2. Open the ArduinoISP sketch (under File, Examples)
3. If you're using version 1.0 of the IDE:

Search for *void heartbeat* and change the line that reads: *delay(40);*
to
delay(20);
Connect your UNO to the PC, making sure it's not connected to the Arduino on a Breadboard.Ensure your UNO is selected under the Boards menu option, and upload the sketch.

- **Step 3**: Which ATmega328 are you using?

Fig 4.13 ATmega328

The two variants that are of interest to us are the ATmega328-PU and the ATmega328P-PU. The **-PU** suffix means that the chips are in a PDIP package, the format we need for our breadboard.
The **328P** is a Pico Power processor, designed for low power consumption, and is used on the Arduino boards.
The **328** does *not* have Pico Power technology, and is not used on the Arduino boards and is not explicitly supported by the Arduino IDE.
What this means is that we can easily bootload the ATmega328P, but not the ATmega328. Unfortunately the websites that sell these chips don't always differentiate between them and forums are filled with people struggling to use the ATmega328-PU.

- **Step 4**: Connect your ATmega328

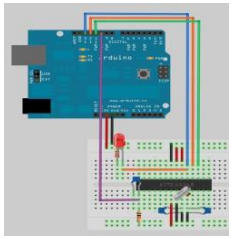

Fig 4.14:Connecting UNO board to ATmega328

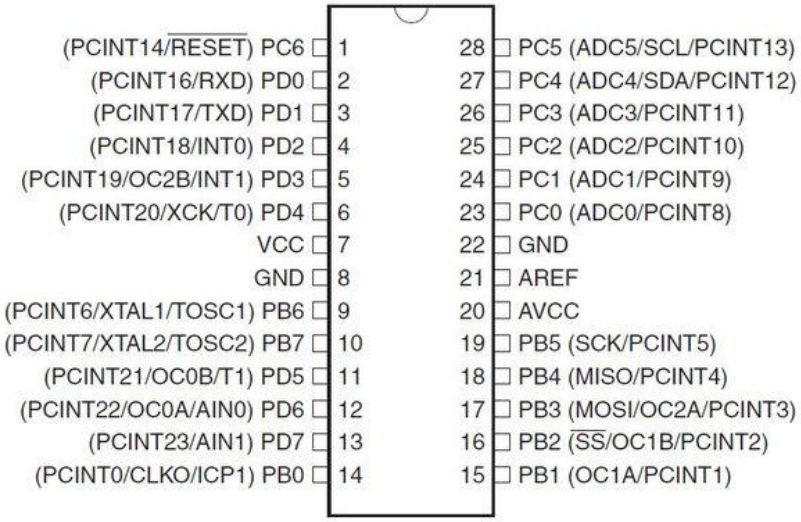

Fig 4.15 single chip microcontroller

Now connect your ATmega to your UNO as follows:

- UNO 5v ---> ATmega pin 7 (VCC)
- UNO GND ---> ATmega pin 8 (GND)
- UNO pin 10 ---> ATmega pin 1 (RESET)
- UNO pin 11 ---> ATmega pin 17 (MOSI)
- UNO pin 12 ---> ATmega pin 18 (MISO)
- UNO pin 13 ---> ATmega pin 19 (SCK)

- **Step 5:** ATmega328-PU workaround

Fig 4.16 ATmega328-PU workaround

Each microprocessor has a signature – a unique code that identifies its model. When you bootload a chip (or even upload a sketch) the Arduino IDE checks that the chip selected matches the type it's connected to. Even though the ATmega328-PU in essence functions in the same way as the ATmega328P-PU, it has a different signature, and one that isn't recognised by the Arduino IDE.

In your Arduino folder, find the subfolder: *\hardware\tools\avr\etc*

1. Make a backup copy of the file: *avrdude.conf*
2. Open the file *avrdude.conf* in a text editor
3. Search for: *"0x1e 0x95 0x0F"* (this is the ATmega328P signature)
4. Replace it with*: "0x1e 0x95 0x14"* (this is the ATmega328 signature)
5. Save the file
6. Restart the Arduino IDE
7. Continue with the rest of the steps in the instructable, and once bootloading is complete restore the backup copy you made.

- **Step 6**: Bootload the ATmega328

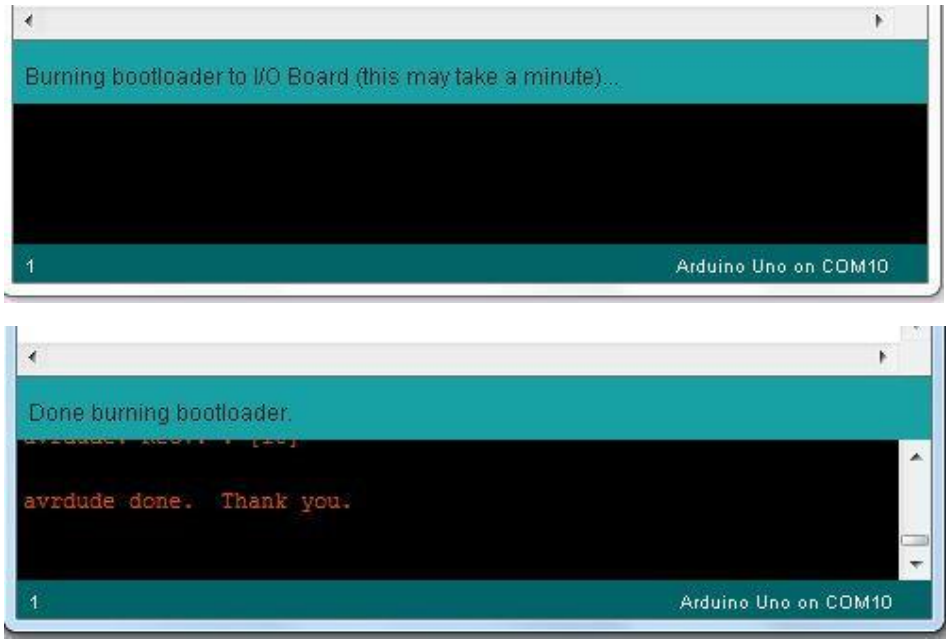

Fig 4.17 Bootload the ATmega328

In the Arduino IDE, from the *Tools* menu:

- Under the *Board* option choose *Arduino UNO*
- Under the *Serial Port* option ensure the correct port is selected

- Under the *Programmer* option choose *Arduino as ISP*

To burn the Bootloader, choose *Burn Bootloader* from the *Tools* menu
You should see a message *"Burning bootloader to I/O Board (this may take a minute)"*
Once the bootloader has been burned, a message of confirming the success gets displayed.

4.10 Working Principle

The IoT-based trash collecting boat is designed to autonomously navigate water bodies, detect and collect floating trash, and transport it to a designated collection point. The boat consists of various components like a 12V DC rechargeable battery, LM2596, L293d motor driver, ultrasonic sensor, buzzer, PCB board, ESP32 camera, conveyor belt, and three motors, Arduino UNO

- The boat is placed in the water body where trash collection is required.
- The ultrasonic sensor continuously measures the distance to the water surface and ensures the boat maintains an appropriate depth.
- The ESP32 camera captures images or video of the water surface, and image processing algorithms are employed to detect trash in the captured frames.
- The Arduino Uno board processes the data from the ultrasonic sensor and camera, deciding the boat's movement and trash collection actions.
- If trash is detected, the boat maneuvers to the trash location using the propulsion motors, and the conveyor belt motor is activated to collect the trash from the water surface onto the conveyor belt.
- The IR sensor monitors the conveyor belt to ensure trash is correctly picked up and transported to the trash container.
- The boat can collect trash continuously as it navigates the water body, and the trash container stores the collected trash.
- If necessary, the boat can be remotely monitored and controlled through IoT connectivity, allowing users to check its status, location, or even manage its movements.

Overall, the seamless integration of multiple components, including sensors like the ultrasonic sensor and ESP32 camera, motors, motor driver like the L293d, LM2596 and the Arduino UNO-based controller, enables the IoT-based trash collecting boat to function autonomously and effectively tackle trash accumulation in water bodies, thereby promoting environmental preservation and sustainable waste management practices.

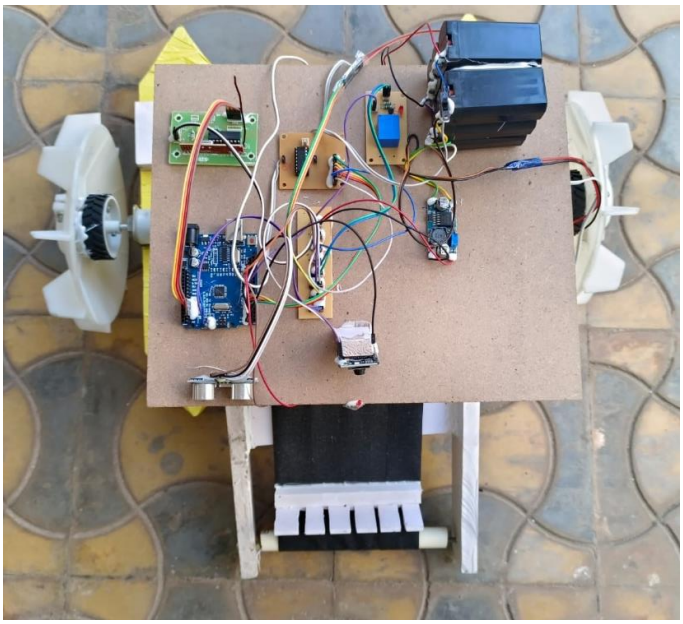

Fig 4.18 Top view of the hardware

Fig 4.19 Front view of the hardware

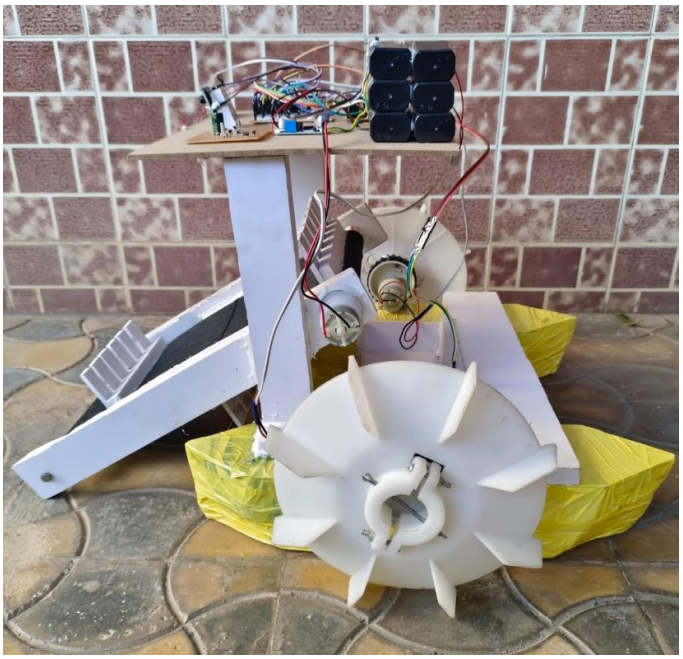

Fig 4.20 side view of the hardware

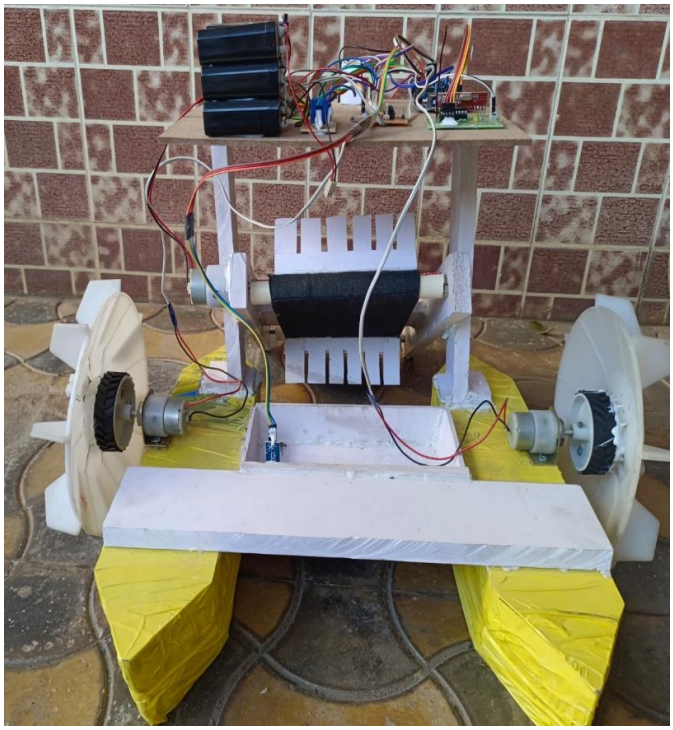

Fig 4.21 back view of the hardware

4.11 Advantages

- Low cost.
- Simple design.
- Operating of Boat and belt wirelessly through IOT.
- Automatic obstacle detection.
- IR based trash detection and alerting system.

4.12 Applications

- Rivers.
- Oceans.

Fig 4.22 Field visit at Musi River

Fig 4.23 Field work trails

4.13 Summary:

Programming an Arduino Uno for an IoT-based trash collecting boat involves utilizing sensors, actuators, and communication modules to enable autonomous operation and remote control. Uses the Arduino IDE to develop the code and install necessary libraries for sensor and communication module integration. Implementing code to read data from sensors to determine the boat's location, detect obstacles, and monitor environmental conditions. Developing logic to process sensor data and enable the boat to navigate autonomously, avoiding obstacles and following predefined routes. Establishing a communication link (e.g., MQTT, HTTP) with an IoT platform or cloud server for real-time data transmission and remote control. Creating a user interface or mobile app to remotely monitor the boat's status, location, and collected trash data, and send commands for remote control. By integrating these steps, an Arduino Uno-powered IoT-based trash collecting boat can efficiently collect trash, navigate water bodies autonomously, and provide remote access for monitoring and control, contributing to cleaner and healthier water ecosystems.

CHAPTER 5

CONCLUSUION

5.1 Result and Conclusion

Transformer is used to charge the battery through charging circuit and this battery power is used run this robot. The boat movement along with conveyor belt and head light can be controlling from web browser while seeing the video by using WEB mobile application. This robot consists of ultrasonic sensor to detect and avoid the obstacle while moving on the water surface. Once the trash has been filled the IR sensor will detect it. When IR sensor gives out this information automatically the boat will give the RED LED indication on camera module along with buzzer indication.

This system will be more advanced as this would collect down the floating trash with the help of moving belt which consist of teeth to collect the trash on water surface. The main controlling device of the project is Arduino UNO. To achieve this task Arduino loaded program written in C language.

Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC's with the help of growing technology, the project has been successfully implemented. Thus the project has been successfully designed and tested.

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APPENDIX

Sl. No	Name of the equipment/component	Rating	Quantity
1.	Ultrasonic sensor	2cm to 400cm (0.8inch to 157) inch	1
2.	ESP32 Camera	(520KB+4M) RAM, 2484 MHz	1
3.	L293d motor driver	1v-36v	1
4.	Buzzer	5v	1
5.	Bread board	---	1
6.	LM2596	3A	1
7.	Arduino UNO (R3)	---	1
8.	Rechargeable DC battery pack	12v, 2A	6
9.	Transformer	12v, 3A	1
10.	IR Sensor		1
11.	Charging circuit	12v	1
12.	Battery	9v	1
13.	DC motor	6v-12v, 5600rpm	2
14.	Trash collecting belt	----	---

CERTIFICATE OF COMPLETION

This is to certify that this thesis project titled "**IoT Based trash collecting boat**" was carried out by Shri. **JALLI RADHIKA**, a student of **Bachelor of Technology**, at the **Vignana Bharathi Institute of Technology**. The research for this project was undertaken under the guidance of the afore-mentioned institute and completed during the period of **January 2023** to **June 2023**.

This project was shortlisted under the *Sponsored Thesis Project Competition on "RE-IMAGINING URBAN RIVERS" (Season- 3)* hosted by the National Institute of Urban Affairs (NIUA) and the National Mission for Clean Ganga (NMCG).

This report has been submitted by the student as a final deliverable under the competition. All parts of this research can be used by any of the undersigning parties.

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