BACHELOR OF SCIENCE IN ELECTRONIC AND TELECOMMUNICATION ENGINEERING

WHEELCHAIR NAVIGATION SYSTEM BASED ON VOICE FOR PHYSICALLY CHALLENGED PEOPLE

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DEDICATION

This thesis is dedicated to all of our honorable teachers and parents.

CERTIFICATE OF APPROVAL

The project entitled as "**WHEELCHAIR NAVIGATION SYSTEM BASED ON VOICE FOR PHYSICALLY CHALLENGED PEOPLE**" Submitted by Md. Ali Agar, bearing ID No: T171046, Mehedi Hasan Arpon, bearing ID No: T171051 and Md. Arfan, bearing ID No: T171053, to the Department of Electronics and Telecommunication Engineering (ETE) of International Islamic University Chittagong (IIUC) has been found satisfactory for partial fulfillment of the requirements for the Degree of Bachelor in Electronics and Telecommunication Engineering and approved in terms of style and contents for the examination held on October 3rd, 2021.

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CANDIDATES DECLARATION

It is declared that the work shown here is genuine and has not been submitted for a degree concurrently. The conclusion we arrived at is solely based on our own research/work.

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ABSTRACT

Today's world contains of an expansive variety of individuals. Generally, inability individual is depending upon other for their living. But within the today's quick creating world, individuals are active in work so that they don't have sufficient time for physically challenged individuals. To progress the life of debilitated individuals by utilize of robotized apparatuses, numerous researchers and organizations have been doing inquire about on planning different items. One such brilliantly item is the Voice Controlled Wheelchair. Voice acknowledgment innovation could be another way of human interaction with machine. The proposed framework points at helping individuals with physical inabilities and ancient matured individuals who are not able to move autonomously since of their shortcoming. The proposed framework permits the disabled individuals to live their life autonomously to a degree. The most point this framework physically challenged individuals can move interior the domestic without any inconvenience. In this framework voice acknowledgment framework utilized for physical challenge individuals so individual move from one place to another put with the ease. Within the voice route framework voice from physical crippled coordinate with the predefined store voice at that point the chair will move with acknowledged heading. Concurring to the gotten voice, the wheelchair is naturally caught on conclusion point and the wheelchair moves agreeing to the way which is predefined in framework. It is containing deterrent evasion strategy.

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Chapter 1

Introduction

1.1 Introduction

People in today's world come in all shapes and sizes. Some of them rely on others to carry out their daily activities. However, in today's fast-paced world, no one has time, everyone is busy, and fewer people are available to care for the growing number of physically challenged people. When walking is difficult or impossible due to physical illness, injuries, or disabilities, a wheelchair is used. Wheelchairs come in a variety of styles to meet the needs of their users. Several studies have concluded that powered wheelchairs, manual wheelchairs, and walkers provide independent mobility to all disabled people. Independent mobility expands educational opportunities, fosters self-reliance, and decreases reliance on others. According to the "World Report on Disability," there are 70 million disabled people worldwide. Unfortunately, the number of handicapped people is growing every day as a result of traffic accidents and diseases such as paralysis and quadriplegia. The percentage of physically handicapped people across all disabilities. In India, there are 120 million disabled people, with 41.23 percent of them being physically disabled. The inability to explore and control can lead to a sense of deprivation and lack of motivation, which can lead to feelings of helplessness. Independent movement is an important aspect of self-esteem for the elderly. Because of the need to move around to complete many activities, mobility issues cause a problem with daily activities. Reduced mobility often leads to fewer opportunities, which can lead to social isolation and a variety of mental health issues. While traditional manual or self-automated wheelchairs can meet the needs of many people with physical disabilities, a segment of the disabled community finds it difficult or impossible to use wheelchairs independently. Quadriplegics and people with Multiple Sclerosis have severe disabilities and are unable to drive traditional joystick-operated wheelchairs. People in wheelchairs are a common representation of disability. When people are unable to move without the assistance of others, they use wheelchairs. Because of their age, physical limitations, medical conditions, or other issues, they required personal assistance. Physically challenged people who use a regular wheelchair for navigation usually require the assistance of another person to get around. If an elderly person or a physically challenged person is left alone at home, they may find it difficult to move around the room. This necessitates the use of an automated home navigation system, such as a wheelchair that allows the elderly and physically challenged to move around without the assistance of another person. The projected Home Navigation System can be activated by speaking into a microphone that has been pre-recorded in the system. According to studies, such people forget how to get to different rooms in their house. There is a voice customization option in the system. In this system, each room door is fitted with an IR sensor that continuously transmits a specific data. Each IR sensor at the door transmits a unique data so that the room can be identified, and a receiver is mounted on the chair that receives the data. Another important feature is that the wheelchair's key control, accelerometer, and personal security are all taken into consideration. If a person cannot speak, they can use key control to move around the house. If they are physically unable to use voice recognition or key control, they can use an accelerometer for navigation, which is based on head movement. Because of the acceptance of physical disabilities, wheelchairs have become universal for physically handicapped people. The person's problem was reduced as a result of this. If a person feels unsafe or uneasy, he can use the GSM module to contact an emergency service such as the police or a hospital. They were excluded from social gatherings because they required special attention or someone to look after them. These deplorable circumstances prompted the development of a system that incorporates personal security features and can be used by these unfortunate individuals to navigate without difficulty and without the use of external aids.

1.2 Background

1.2.1 Motorized Wheelchairs: Then and Now

Self-propelled wheelchairs may seem to be a recent development, but they've been around in some form for far longer than you may imagine. Power wheelchairs have always been the pinnacle of human engineering and materials. Personal carriages or hinged designs were formerly thought to be cutting-edge. With the advancement of sensory media, objects, and technology, the term "smart healthcare" is gaining traction in the medical world. While academics have made progress in the study of healthcare services, HMI-based intelligent wheelchairs have received a lot of interest. Recent advancements in assistive technology have shown the viability of employing environmental sensors to enable independent living. Smart interfaces for impaired people have gotten a lot of press recently. Several researchers have created smart wheelchairs using technology that were initially developed for mobile robots. These interfaces were designed with a user in a wheelchair in mind.

1.2.2 The History of Motorized Wheelchairs:

Stephan Farffler, a paraplegic Nuremberg watchmaker, invents the world's first self-propelled wheelchair in 1655. It was powered by a set of cogwheels and hand cranks. The 'Bath Wheelchair' was designed in the 1760s by James Heath of Bath, England. This looked like a little carriage and could be pulled behind a horse or pushed by another person. Despite their unpopularity, they proved a popular choice for English individuals with restricted mobility. In London, the world's first motorized wheelchair is developed, but it is never put into production. Harry C. Jennings, Sr., and his crippled buddy Herbert Everest, two mechanical engineers, decided to update the wheelchair using cutting-edge technology of the time. They designed a wheelchair with a steel frame and comfortable padding that was simple to use, fold, and travel. For most of the twentieth century, their firm, Everest & Jennings, dominated the wheelchair industry. In the 1950s, Canadian inventor George Klein makes the first electrically powered wheelchair to help World War II veterans. Everest & Jennings started mass-producing these electric wheelchairs in 1956.

1.2.3 Electric Wheelchairs of the Future:

Over the next 50 years, with technology growing at a breakneck pace, there will undoubtedly be some incredible advancements in mobility gadgets. Here are a few characteristics that might emerge in the next decades.

1.2.3.1 Brain Control. Brain implants are being tested to see whether they can operate a chair with only their thoughts. This would make these gadgets accessible to persons with a wide range of physical disabilities.

1.2.3.2 Luxurious User Experience. Seat cushions that respond to your movements. Battery life has been extended. Sun and rain protection that can be retracted. The ability to climb stairs. People in the future will be able to go farther and ride more comfortably than ever before.

1.2.3.3 Automation. The same technology that is attempting to provide us with self-driving automobiles may also be used to wheelchairs. Consider a mobility gadget that follows the owner's simple mental command and travels on its own through a pre-programmed GPS path.

1.2.3.4 Voice-Controlled: Voice recognition technology is a novel method of human-machine interaction. Voice recognition is used in this project to operate a wheelchair. It takes input instructions from the user and moves the wheelchair using a speech recognition module that is connected to motors.

1.2.4 Today's Innovations: Quantum Motorized Wheelchairs

Check out Quantum Rehab's Edge 3 Motorized Wheelchair to get a sense of what today's contemporary motorized wheelchair has to offer. This highly customized wheelchair is designed to provide you the most sophisticated power chair experience you've ever had. SRS (Smooth Ride Suspension) has been updated on the Edge 3 for a more pleasant, smoother ride and improved stability. The Edge 3 may be customized to fit your specific seating and placement requirements. On a motorized wheelchair, the TRU-Balance® 3 Power Positioning Systems provide a broad range of medical advantages, including pressure relief, autonomous adjustment, and positioning for greater function and breathing. Power recline, power tilt, iLevel® power adjustable seat height, power articulating foot platform, and power articulating leg rests are just a few of the features featured on TRU-Balance 3. The Edge 3 comes with a 4.5 mph iLevel, which is a first in the industry. At 4.5 mph, you can get up to 12 inches of seat elevation. iLevel improves stability while doing daily chores including reaching, transferring, cooking, grooming, and other activities. Find out more about the advantages of iLevel Electric Wheelchairs. The Edge 3 comes with a number of standard features that cater to your requirements, such as front and rear LED fender lights for increased visibility, a USB charger for your phone, and drive wheel color accents, allowing you to personalize your power wheelchair. Many studies in the subject of voice recognition have been conducted. Computer-based speech processing systems have already achieved complicated structure with great accuracy thanks to advanced signal processing algorithms and powerful CPUs. The task at hand is to maintain standard performance while working with constrained computational and memory resources. The development of a wheelchair control system is still under progress. Many persons with impairments lack the necessary skills to use an electronic wheelchair with a joystick. This might be a significant disadvantage for someone who is unable to move either of their arms or legs. They can use their wheelchair more easily if they utilize voice instructions. Interfacing a microcontroller with a voice recognition IC from a dependent speaker is the method used. In the future, a completely autonomous wheelchair will move automatically depending on the user's expression and behavior.

- **Problems with traditional wheelchairs**
  - ⇒ Moves at slow speeds
  - ⇒ Unable to make fast turns and change directions promptly
  - ⇒ Requires significant human labor to move
  - ⇒ Sometimes an extra person is required to help the person in the wheelchair move
  - ⇒ Difficult for people with disabilities (such as no hands etc.) to use
- **Solutions offered by our proposed voice-controlled wheelchair**
  - ⇒ Can move at significantly higher speeds
  - ⇒ Can change direction of motion significantly faster
  - ⇒ Only human-voice input is needed
  - ⇒ No physical labor is required
  - ⇒ Ideal for people with disabilities

1.3 Motivation

A disabled person with locomotive difficulties needs the use of a wheelchair to complete duties that involve mobility. He may do it manually by pushing the wheelchair with his hands. Many individuals, on the other hand, have weak upper limbs or find manual operation laborious. As a reason, it's preferable to provide them with a motorized wheelchair that they can operate with a joystick or voice instructions. Because the motorized wheelchair can go at a decent pace, the ability to identify and avoid obstacles in real time is crucial. All of this should be done at a reasonable cost for as many disabled persons and organizations as feasible. Based on these criteria, we present an autonomous wheelchair with real-time obstacle avoidance capabilities. For a considerable proportion of persons with impairments, power wheelchair control interfaces are presently inadequate to offer genuinely independent movement. Through study and design, the power wheelchair may be used to manage development as well as ensure safe and effective use of the supply of independence and self-use mobility. People with impairments who use wheelchairs and wish to utilize a voice interface would benefit from this initiative, which will give novel alternatives.

1.4 Objectives

- Voice recognition and conversion to text
- String data transfer from voice recognition app to HC-05 Bluetooth module
- String data transfer from Bluetooth module to STM32 microcontroller
- String parsing and command interpretation on the STM32 microcontroller
- Control command input to the motor driver by microcontroller
- Motor speed control and wheel-chair motion control by the driver

Chapter 2

Literature review

2.1 Introduction

The term "literature" refers to any collection of materials on a topic, not necessarily the world's greatest literary text, and "review" refers to the reader's personal opinion. Similar to an essay, a literature review begins with an introduction that states the research question and explains how it was addressed. It is the process of searching for and evaluating available literature in a specific subject or topic area. It presents the current state of the art in the field of objectives. In a nutshell, it's a comprehensive review of previous research on a particular subject.

2.2 Aim of our Project

To create a wheelchair in which the voice navigation system of a physical handicapped person matches the voice of a predetermined shop, and the chair moves in the approved direction. The wheelchair automatically understands the final point based on the received voice, and it goes along the route that has been pre-programmed in the system. It has a strategy for avoiding obstacles. We implemented Bangla language support so that Bengalis who don't speak English may use the wheelchair by commanding in Bangla.

2.3 Paper Review

1. This paper on "Voice Controlled Wheelchair"

Because it is operated by speech, it is an extremely user-friendly system. In conjunction with the transmitter and receiver, an infrared sensor is employed to ensure appropriate locomotion. It contains some unique features, such as a personal security module, key control, and an accelerometer. Forward, backward, left, and right operation control using key control and accelerometer. The operation is controlled by four keys, and the accelerometer is based on head movement. If necessary, the GSM module will transmit an emergency message. This is extremely beneficial because the elderly or physically challenged may require medical assistance at any point during the day. This low-cost solution is especially beneficial to persons who are physically impaired. The system's efficiency is improved by the multi-control capability.

2. This research paper on "Voice Controlled Wheel Chair for Persons with Disability"

This paper combines a microcontroller, an Android phone, and a control interface board to allow the wheelchair to be maneuvered. Users can operate the wheelchair using the system by simply speaking into the wheelchair microphone. Forward and reverse direction, left and right turns, and stop are all essential movement functions. The system's operations are managed by a Renesas Microcontroller. It communicates with the voice recognition processor to determine the output command to drive the left and right motors based on the words spoken. A programming language program is written and stored in the controller's memory to accomplish this task. In the event of an emergency, the GSM module is used to send an alert message to their caregivers.

3. This paper on "Psubot - A Voice-Controlled Wheelchair for The Handicapped"

PSUBOT (Portland State University roBOT) is a computerized electric wheelchair controlled by speech, according to the study. The following is a broad summary of the current version: control algorithms, navigation, and the human interface. Basic aspects of the next version in development, which will feature computer vision, are also discussed here.

4. this paper on "An Voice Controlled Wheel Chair for Physically Challenged People with Therapy Unit"

The major goal of this project is to advocate using the voice of the person who uses the wheelchair to operate it for their requirements. The device is intended to aid the movement of elderly and disabled persons who are unable to move around freely. The suggested device also incorporates a treatment unit that would provide help to the user's limbs, preventing numbness caused by prolonged rest. The system includes an obstacle sensor that detects the existence of barriers in the course of movement. This system's objective is to assist handicapped people in moving independently and to stop servitude.

5. This paper on "Voice Controlled Autonomous Wheelchair"

This article covers the idea, design and implementation of a microcontroller-based voice-controlled wheelchair. As speech is the preferred form of operation for human being, this study seeks to produce the voice-oriented command phrases for operating wheelchair. Voice recognition module has to be introduced to the wireless network. The voice command is a person independent. The system includes of transmitting and receiving module. Initially, the voice command is saved in the data base with the aid of the function keys. Then the input voice commands are transferred by wifi. The speech received is analyzed in the voice recognition system where the feature of the voice command is extracted and compared with the existing sample in the database. The module detects the voice and transmits control messages to the microcontroller. The programmed microcontroller subsequently analyses the supplied data and switches the relevant direction and motion of motors via linked via driver circuits. In this work complicated operation like how much angle user wishes to rotate its wheelchair has to be implemented and this technique is distinct from other prototype that have been been built or described earlier. This work also includes obstacle avoider circuit that will avoid obstacle accident and it will quickly move away from the obstacle thus this will smart wheelchair for the user.

6. this paper on "Study of Implementation of Voice Controlled Wheelchair"

This study worked enhance the lives of disabled persons by use of automated tools, many scientists and organizations have been undertaking research on creating various goods. One such clever device is the Voice Controlled Wheelchair. Many approaches have been utilized to create it, each method requires a distinct hardware and thereby giving particular functionality. In this work they review several of the implemented approaches and then present a new model based on the notion of Artificial Intelligence which employs Raspberry Pi, for operating the device, infrared and ultrasonic sensors for robust obstacle detection, USB microphone for voice input. Thus, upgrading the hardware utilized in prior generations and at the same time attaining cost efficiency.

7. this paper on "Design of Voice Controlled Smart Wheelchair for Physically Challenged Persons"

The major purpose of this article is to design the smart wheel chair to make the lives simpler of physically challenged folks. This voice controlled smart wheel chair comes with increased features like electric powered, voice control, line follower with obstacle avoidance etc. The smart wheel chair control unit comprises of integration of AVR microcontroller ATmega328 with Bluetooth module, GSM module SIM900, ultrasonic and infrared sensors, temperature sensor LM35 and motor driving circuit for controlling motor's speed.

8. this paper on "Voice Controlled Wheelchair for Physically Disabled People"

This paper's proposed approach allows the disabled persons to live their lives independently to some extent. Voice recognition technology is a new means of human contact with machine. This project employs speech recognition for the controlling of wheelchair. It employs the speech recognition module which is interfaced with motors to accept input commands from the user and move the wheelchair. Also, In this suggested system is interfaced to operate the wheelchair utilizing the android app which is utilized in smartphone. An Arduino microcontroller circuit and DC motors are utilized for the movement of wheel chair and IR Sensors to identify any impediments present in the path of direction.

9. this paper on "Wheelchair Navigation System Based On Voice for Physically Challenged"

The main goal of this strategy is to allow physically challenged people to move about their homes without difficulty. Speech recognition innovation is used in this system for physically challenged people, allowing them to move from one location to another with ease. When the physical handicapped's speech is matched with the pre-programmed shop voice, the chair will move in the acceptable direction. The wheelchair is automatically understood end point based on the received voice, and the wheelchair goes along the route defined in the system. It has a strategy for avoiding obstacles.

10. this paper on "Voice Controlled Wheelchair for Physically Disabled People"

The goal of this research project is to develop and build a voice-controlled wheelchair for those who are physically impaired. The wheelchair control system uses a speech recognition technology to initiate and control all of the wheelchair's motions. It has a microprocessor, Google Assistant voice recognition, and a motor control interface board to propel the wheelchair. Users may operate the wheelchair utilizing the technology by simply speaking and commanding using Google Assistant. Forward and backward directions, left and right twists, and stops are all part of the fundamental working process.

Microchip Technology's PIC controller is used to control the system's activities. It interfaces with Google Assistant via speech recognition and operates with commands saved as a number system controlled from the Ada-fruit cloud. The speech is supplied, and the output instruction to operate the left and right motors is determined. An assembly language program is developed and placed in the controller's memory to do this operation.

11. this paper on "Voice Controlled Intelligent Wheelchair"

We created a voice-controlled wheelchair to aid physically challenged people. Voice instructions, such as "susume (run ahead)" in Japanese, can be used to control the wheelchair. In our system, we employ "Julian," a grammar-based recognition parser. The basic reaction command, the short moving reaction command, and the verification command are the three types of commands available. We tried Julian's voice recognition and got a success rate of 98.3 percent for the moving command and 97.0 percent for the verification command, respectively. The running experiment with three people was conducted in a college room, and the system's usability was demonstrated.

Chapter 3

Hardware Description

3.1 Introduction

The most crucial aspect of a project is its hardware. It's also tough to choose the appropriate gear. This chapter will go through the hardware that was utilized in this project. We'll also go through the functions of the pieces we've picked. By the conclusion of this chapter, you will have a better understanding of why the components utilized in this project were chosen and what they do.

3.2 Component's list

- STM32 Microcontroller
- USB to TTL converter
- HC05 Bluetooth Module
- L298n Motor Driver
- 12V battery
- DC Motors, 2x (300 rpm)
- Caster Ball
- Wheels, 2x
- PVC Board

3.3 STM32 Microcontroller

The STM32 microcontroller IC family consists of 32-bit RISC ARM Cortex-M33F, Cortex-M7F, Cortex-M4F, Cortex-M3, Cortex-M0+, and Cortex-M0 microcontrollers. STMicroelectronics has licensed the ARM Processor IP from ARM Holdings. The ARM core designs provide a variety of customizable possibilities, and ST chooses the optimal one for each design. ST adds their own peripherals to the core before converting the design to a silicon device. The tables below describe the STM32 microcontroller family. STM32 microcontrollers come with a plethora of serial and parallel communication peripherals that may be used to connect to a variety of electrical components such as sensors, displays, cameras, motors, and more. Internal Flash memory and RAM are included in all STM32 models. As previously mentioned, the STM32F405 Processor is based on the high-performance ARM® Cortex®-M4 32-bit RISC core and runs at a frequency of up to 168 MHz. A single precision floating point unit (FPU) in this core can handle all ARM single precision data processing instructions and data types. To boost application security, it also features a memory protection unit (MPU) and a complete range of DSP instructions. This Processor Board comes with a variety of enhanced I/Os and peripherals, as well as the DFU bootloader for code uploading. We've also put a 128MB (16MB) serial flash memory chip to the underside of the board to compliment the STM32F405 processor.

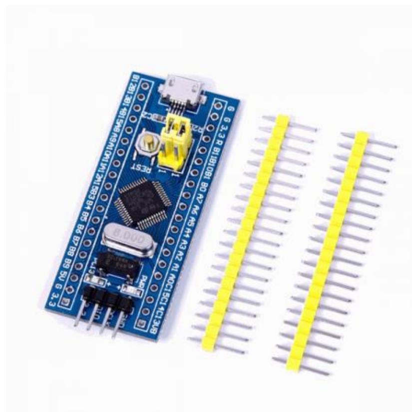

Figure-3.1: STM32 Microcontroller [12]

Table 3.1: STM32 microcontroller families

STM32 Series	**ARM CPU Core**
L5, U5	Cortex-M33F
F7, H7	Cortex-M7F
F3, F4, G4, L4, L4+, WB	Cortex-M4F
WL	Cortex-M4
F1, F2, L1	Cortex-M3
G0, L0	Cortex-M0+
F0	Cortex-M0

3.3.1 STM32 Pin Diagram

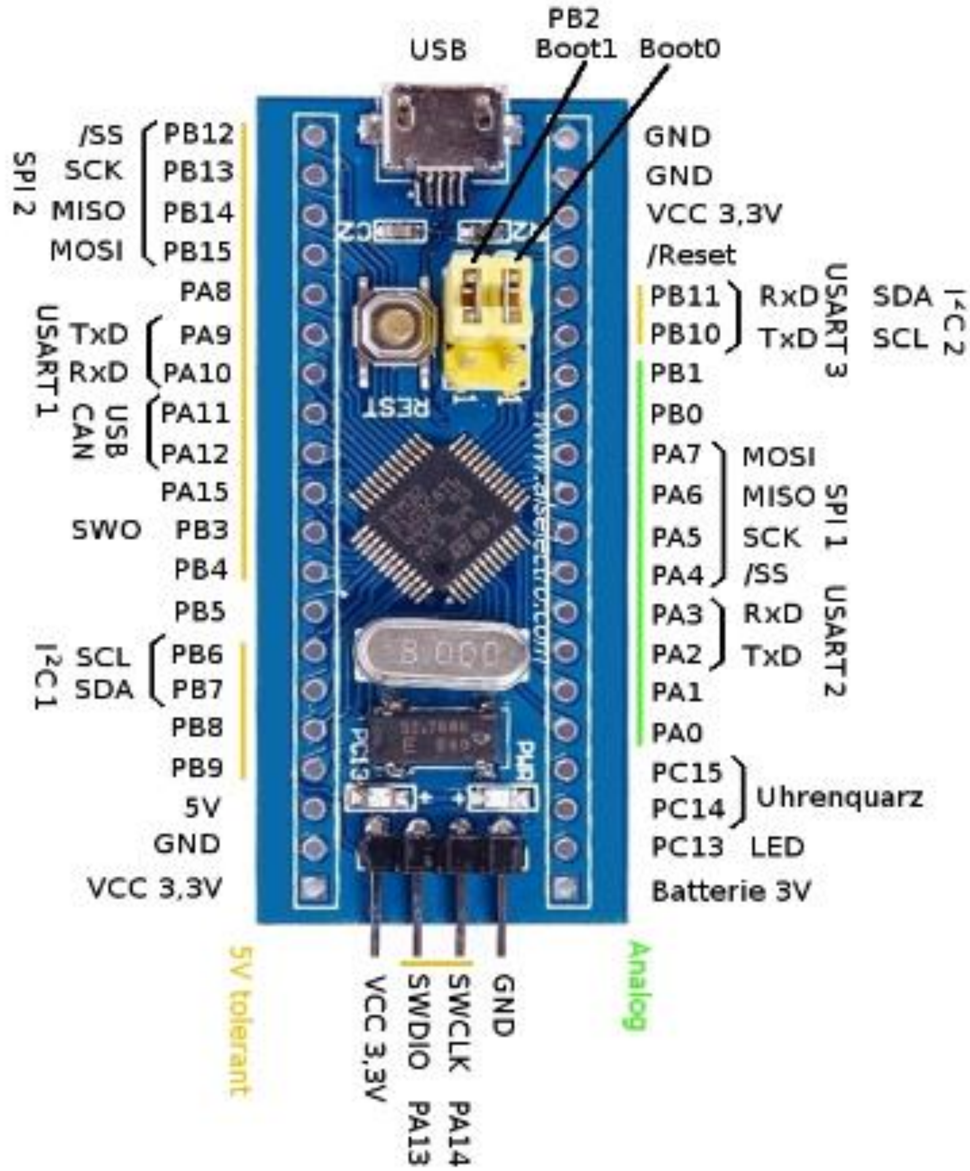

Figure-3.2: STM32 Microcontroller pin diagram [13]

3.3.2 Language

STM32 used C programming language. The time will come for that once you get the C language

3.3.3 Cortex-M Microcontroller Cores

Silicon IP is used to create the Cortex-M core (Intellectual Property). It is licensed to multiple silicon vendors, who incorporate it into their own products, by a firm called ARM Holdings. ST Microelectronics, TI, Microchip, NXP, Nordic, Qualcomm, and a number of other companies have licensed similar cores in some way.

Arm® Cortex®-M7 – 480 MHz

CORE, MEMORIES AND ACCELERATION
- Single-core Cortex-M7 480 MHz
- Dual-core Cortex-M7 480 MHz and Cortex-M4 240 MHz (STM32H7x5 and STM32H7x7 only)
- Flash and RAM acceleration
- SP-FPU and DP-FPU
- 4 x DMA

CONNECTIVITY
- 2 x USB2.0 OTG FS/HS
- 2 x SDMMC
- USART, UART, SPI, I^2C
- 2 x CAN (1 x FD and 1 x TT)
- HDMI-CEC
- FMC, Dual-mode Quad-SPI
- Ethernet MAC IEEE1588
- Camera I/F
- Analog (comp, AOP)

AUDIO
- 3 x I^2S + audio PLL
- 4 x SAI
- 2 x 12-bit DAC
- SPDIF-RX

GRAPHIC
- Chrom-ART Accelerator™

OTHER
- Crypto/Hash (except H742)[1]
- Security services (except H742)
- TRNG
- DFSDM
- 16- and 32-bit timers
- 3 x 16-bit ADC (up to 3.6 MSPS)
- Voltage range 1.62 to 3.6 V (except 100-pin package : 1.71 to 3.6 V)
- Multi-power domains

STM32 H7 Product line	f_{CPU} (MHz)	Dual-Bank Flash memory (bytes)	RAM (bytes)	Graphic	Power supply	Ambiant temperature range
Dual-core lines						
STM32H7x7	480 + 240	Up to 2 Mbytes	1 Mbyte (incl.128 Kbytes DTCM + 64 Kbytes ITCM + 64 Kbytes backup1) + 4 Kbytes backup2	TFT-LCD JPEG codec MIPI-DSI	DCDC + LDO	Standard 85 °C
STM32H7x5	480 + 240	Up to 2 Mbytes	1 Mbyte (incl.128 Kbytes DTCM + 64 Kbytes ITCM + 64 Kbytes backup1) + 4 Kbytes backup2	TFT-LCD JPEG codec	DCDC + LDO	Standard 85 °C (Opt. Industrial CPN 125 °C)[2]
Single-core lines						
STM32H7x3	480	Up to 2 Mbytes	1 Mbyte (incl.128 Kbytes DTCM + 64 Kbytes ITCM + 64 Kbytes backup1) + 4 Kbytes backup2	TFT-LCD JPEG codec	LDO	Standard 85 °C
STM32H742	480	Up to 2 Mbytes	692 Kbytes (incl.128 Kbytes DTCM + 64 Kbytes ITCM + 16 Kbytes backup1) + 4 Kbytes backup2	no	LDO	Standard 85 °C
Value line						
STM32H750	480	128 Kbytes	1 Mbyte (incl.128 Kbytes DTCM + 64 Kbytes ITCM + 64 Kbytes backup1) + 4 Kbytes backup2	TFT-LCD JPEG codec	LDO	Standard 85 °C

Figure-3.3: Current members of the STM32H7 family and their salient features [14]

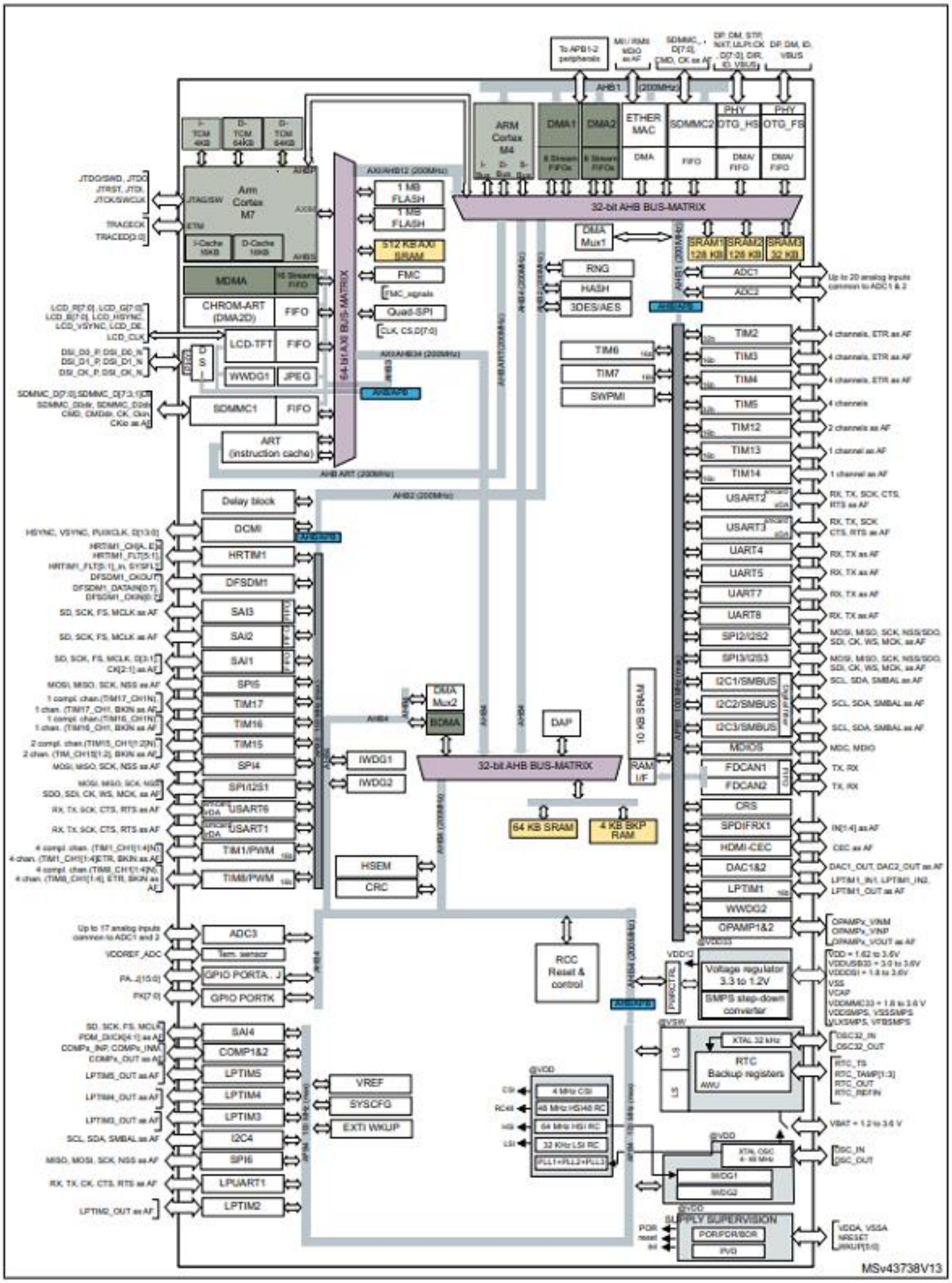

Figure-3.4: Internal block diagram of the dual core SMT32H757 microcontroller [15]

The IP consists of the primary processor core, memory protection unit, memory interfaces, caches, internal bus matrix system, and other components. For example, the Cortex-M cores are 32-bit Reduced Instruction Set Computer (RISC) cores that come in a number of configurations, such as the M0, M0+, M1, M3, M4, M7, and others. Models differ in terms of floating point units (FPU), digital signal processing (DSP), hardware multipliers, and other hardware characteristics. The STM32 series is split into four divisions, each focusing on a different market category. The four categories are High Performance, Mainstream, Ultra-low Power, and Wireless. This website provides access to the whole family. The STM32H7 is the best in the High-Performance category. It's a single-core or dual-core microcontroller with a Cortex M7 core running at 480MHz and a Cortex M4 core running at 240MHz for dual-core devices. The best code execution and data transmission performance is found in the High Capabilities group. It also has the greatest performance and most sophisticated peripherals within the STM32 series. Figure 3.2 summarizes the essential characteristics of the different STM32H7 models. Figure 3.3 shows the internal block diagram of the high-end twin core STM32H757.

3.4 USB to TTL converter

Although serial ports are no longer found on most laptops and desktop computers, many development boards still require one for debugging, console access, or even software download. Instead of RS-232 serial port signals, development boards' serial ports typically give "logic level" signals.

This implies that connecting a development board to a laptop is difficult. The USB to TTL converter solves this difficulty by allowing a serial port connection to be established between a host computer and a development board, with the appropriate interfaces and signal levels for each. Details are provided below.

3.4.1 TTL signal

TTL Signals are a type of hardware interface standard based on TTL's electrical features (Transistor-Transistor Logic). For a TTL input, this means that anything below 0.8 volts is a "zero," and anything above 2.4 volts is a "one," and that the load on the driving circuit is less than 1.6ma. Typically, a TTL output can drive ten TTL inputs while maintaining the right voltage levels for "zero" and "one."

3.4.2 Using a USB to TTL converter

Figure-3.5: PL2303 USB to TTL Converter [16]

The term "USB to TTL converter" is a misnomer. It utilizes the terms TTL and converter incorrectly. A USB Serial Port to CMOS Logic-Level Serial Port converter is what the so-called USB to TTL converter is. It has a USB connector on one end and four wires that connect to terminal posts on the other. It has a chip that can deceive your laptop into believing it has a serial port installed. When you connect the USB port to your laptop, it appears as a new serial port. It makes use of conventional USB serial port device drivers for laptops. The four wires are connected to power, ground, serial RX, and serial TX on an Arduino or other development board; these signals use the correct voltage levels for the development board rather than standard RS-232 levels, and your Arduino thinks something is talking to it over its serial port.

3.5 HC05 Bluetooth Module

The HC-05 Bluetooth Module is a straightforward Bluetooth SPP (Serial Port Protocol) module that enables the creation of a transparent wireless serial link. It interfaces with a controller or PC through serial transmission, making it easy to attach. You can switch between master and slave mode on the HC-05 Bluetooth module, which means you may use it to receive and send data.

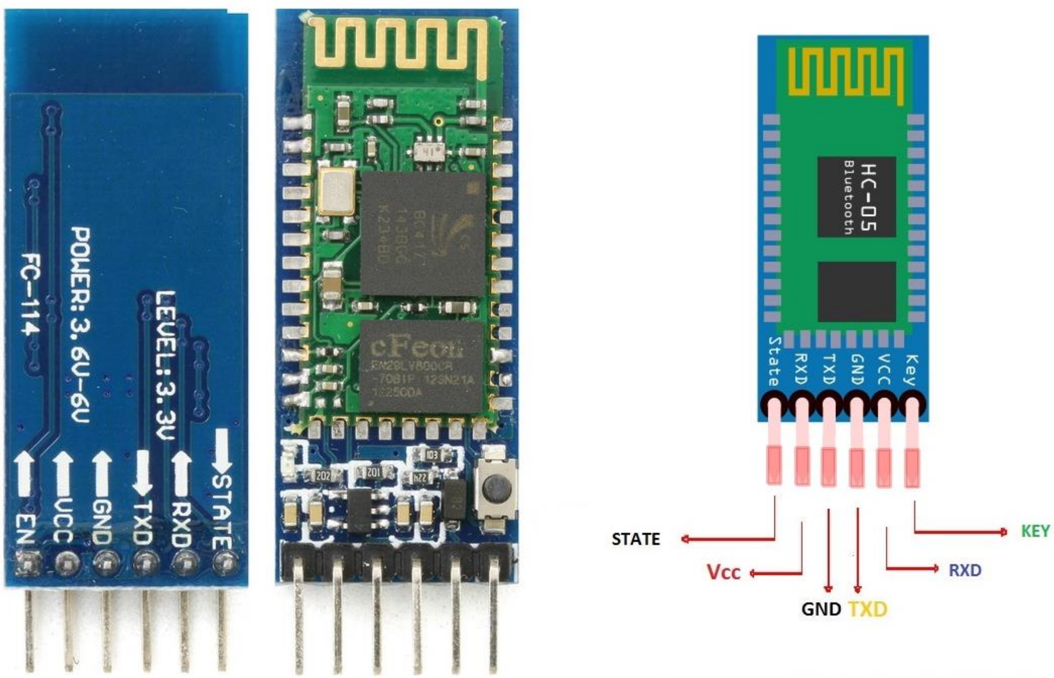

Figure-3.6: HC05 Bluetooth Module with pin diagram [17]

CSR Bluecore 04 outer single-chip Bluetooth system with CMOS (complementary metal-oxide-semiconductor) technology is used in the HC05 Bluetooth Module. The Bluetooth V2.0+EDR technology is also supported by this module.

- The HC-05 Bluetooth Module is a low-cost, simple-to-operate, and small-sized Bluetooth module for wireless communication.
- It supports the Serial Port Protocol (SPP), which aids in data transmission to and from a microcontroller (i.e., Arduino UNO).
- The default baud rate for data communication is 9600, and for command mode communication it is 38400.

- Because the HC05 may operate in master/slave mode, a single master node can control numerous slave nodes (called mesh networking).
- TX (transmitter) and RX (receiver) pinouts control "AT commands" on the HC-05.

Table 3.2: Pinout of HC-05

HC-05 Pinout

Pin	Pin Name	This pinout is used to establish data values at high and low levels.
Pin-1	Enable Pin	The purpose of this pinout is to set data value at a high and low level.
Pin-2	V_{cc}	At this pinout, the input supply is provided to the module. Its operating voltage is plus five volts.
Pin-3	GND	Ground 0V
Pin-4	TX	Serial Transmitting Pin
Pin-5	RX	Serial Receiving Pin
Pin-6	State	This Pin is connected to an LED, shows the operating state of the HC-05 Bluetooth module.

3.6 L298n Motor Driver

This L298N Motor Driver Module is a high-performance DC and Stepper Motor Driver Module. This module is made up of an L298 motor driver IC and a 78M05 5V regulator. Up to four DC motors may be controlled by the L298N Module, or two DC motors with directional and speed control.

Table3.3: L298N Module Pinout Configuration

Pin Name	**Description**
Input1 & Input2	Motor A input pins. Used to control the spinning direction of Motor 1
Input3 & Input4	Motor B input pins. Used to control the spinning direction of Motor 2
ENA	Enables PWM signal for Motor 1
ENB	Enables PWM signal for Motor 2
OUT1 & OUT2	Output pins of Motor 1
OUT3 & OUT4	Output pins of Motor 2
12V	12V input
5V	Supplies power for the switching logic circuitry inside L298N IC
GND	Ground pin

3.6.1 L298 Module Features & Specifications

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

3.6.2 Brief about L298N Module

The L298N Motor Driver module comprises an L298 Motor Driver IC, a 78M05 Voltage Regulator, resistors, capacitors, a Power LED, and a 5V jumper in an integrated circuit.

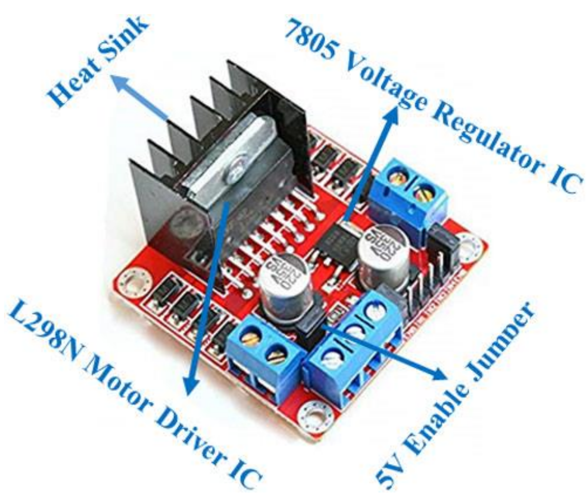

Figure-3.7: L298N Motor Driver module [18]

The 78M05 Voltage Regulator is only activated when the jumper is connected. When the power supply is lower than or equal to 12V, the internal circuitry will be powered by the voltage regulator, and the 5V pin may be used as like an output pin to power the microcontroller. When the power supply is greater than 12V, the jumper should be removed and a separate 5V supplied to the internal circuitry through the 5V connection. Motor 1 and Motor 2's speeds are controlled by the ENA and ENB pins, while their directions are controlled by the IN1& IN2 and IN3& IN4 pins.

Internal circuit diagram of L298N Motor Driver module is given below:

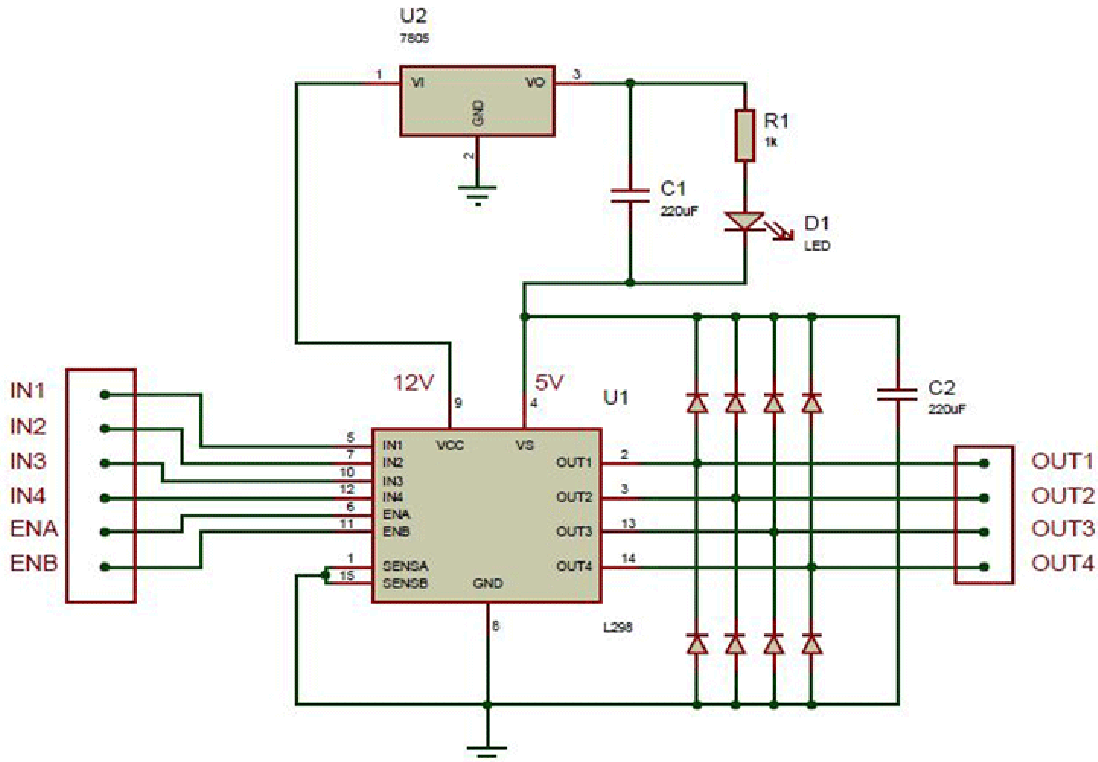

Figure-3.8: Internal circuit diagram of L298N Motor Driver [19]

3.6.3 Applications of L298N Module

- Drive DC motors.
- Drive stepping motors
- In Robotics

3.7 12V battery

RV, boat, and other automotive systems frequently employ 12-volt batteries. A battery, from a technical standpoint, consists of one or more cells that allow a chemical reaction to occur, resulting in the flow of electrons in a circuit. Batteries do not generate their own energy or electricity.

Figure-3.9: 12V battery [20]

3.8 DC Motors, 2x (300 rpm)

3.8.1 DC Motor

A DC motor is a rotating electrical motor that transforms direct current electrical energy into mechanical energy. Magnetic fields are used to generate forces in the most frequent kinds. Almost all DC motors include an internal device, either electromechanical or electronic, that periodically switches the current direction in a segment of the motor. DC motors were the first kind of motor to become extensively used because they could be powered by existing direct-current lighting power distribution networks. A DC motor's speed may be adjusted across a wide range by altering the supply voltage or the current intensity in the field windings. Small DC motors are used in tools, toys, and appliances. The universal motor is a small brushed motor that runs on direct current and is often seen in portable power tools and appliances. Electric vehicle propulsion, elevator and hoist drives, and steel rolling mill drives are all using larger DC motors. It is now feasible to replace DC motors with AC motors in a range of applications thanks to the emergence of power electronics.

3.8.2 12V DC Motor 300 rpm

Figure-3.10: 12V DC 300 RPM High Torque Gear Motor [21]

Replace a worn-out or defective gear box motor with this fresh new, high-quality 37mm, 12V, 300RPM replacement and breathe new life into your electrical and testing equipment. This motor is well-built and suitable to use in a variety of applications, thanks to its high torque and low noise.

- Motor height: 73mm
- Motor Diameter: 35 mm
- Output shaft diameter: 5 mm
- Voltage: 12 V
- Speed: 300RPM

3.9 Caster Ball

A ball caster is a 'wheel' that enables for smooth movement in any direction. A small ball caster would be an excellent addition to a light-seeking BEAM robot, as it would reduce the friction caused by a tail-dragging capacitor. Also, for other wheeled bots, it serves as an alternative to a tail wheel.

Figure-3.11: Caster Ball [22]

3.10 Wheels, 2x

Many people confuse the phrases wheel and rim, although they are not interchangeable. The rim, in fact, is one of several components that make up the wheel. It's where the tire sits on the outside edge of the wheel. After-market or decorative wheels, such as aluminum alloy wheels, are commonly referred to as rims.

Figure-3.12: Wheel [23]

3.11 PVC Board

Expanded polyvinyl chloride (PVC) foam board, commonly known as expanded PVC foam board, is a lightweight, rigid kind of expanded foam polyvinyl chloride. Commercial applications include digital and screen printing, lamination, vinyl lettering, signs, and more.

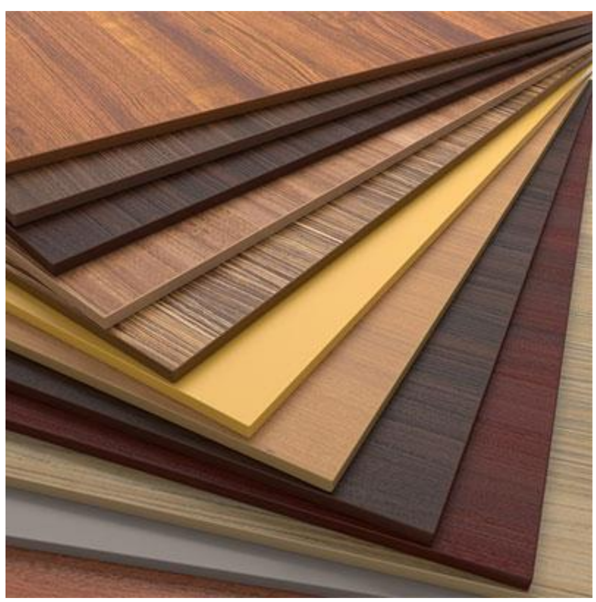

Figure-3.13: PVC Board sample [24]

Chapter 4

Software Description

4.1 Introduction

Software is a collection of instructions, data, or programs that are used to operate computers and execute certain tasks. Hardware, on the other hand, refers to the actual components of a computer. Software refers to all applications, scripts, and programs that run on a device.

4.2 List of Software Requirement for this project

- ✓ STM32CubeIDE
- ✓ Arduino IDE
- ✓ Virtual Serial Port Driver
- ✓ Proteus
- ✓ EasyEDA Tool

4.3 STM32CubeIDE

STM32CubeIDE is a multi-OS development environment that is part of the STM32Cube software ecosystem. Photo of the STM32CubeIde board STM32CubeIDE is a comprehensive C/C++ programming environment for STM32 microcontrollers and microprocessors that includes peripheral setup, code creation, code compilation, and debug tools. For development, it uses the Eclipse®/CDTTM framework and GCC toolchain, as well as GDB for debugging. It enables the integration of the hundreds of existing plugins that extend the Eclipse® IDE's capability. STM32CubeIDE combines STM32 setup and project creation functionality with STM32CubeMX to provide an all-in-one tool experience while reducing installation and development time. The project is created and initialization code produced after selecting an empty STM32 MCU or MPU, or a preset microcontroller or microprocessor from the selection of a board or an example. The user may go back to the initialization and configuration of the peripherals or middleware at any time during development and rewrite the initialization code without affecting the user code.

STM32CubeIDE has build and stack analyzers that offer useful information about the project's status and memory requirements. STM32CubeIDE also includes a variety of standard and advanced debugging tools, such as views of CPU core registers, memory, and peripheral registers, as well as a live variable watch, Serial Wire Viewer interface, and fault analyzer.

4.4 Arduino IDE

The Arduino Integrated Development Environment (IDE) is a cross-platform software for Windows, macOS, and Linux that was written in C and C++ functions. It's used to write and upload applications to Arduino-compatible boards as well as other vendor development boards with third-party core compatibility. The source code of the IDE is licensed under the GNU General Public License, version 2. To support the languages C and C++, the Arduino IDE contains certain code structure rules. The Wiring project is a software library that comes with the Arduino IDE and allows you to do a variety of typical input and output tasks. To start the sketch and the main program loop, user-written code only requires two basic functions, which are built and linked into an executable cyclic executive program using the GNU toolchain, which is also included with the IDE release. The avrdude program in the Arduino IDE converts executable code to a text file in hexadecimal encoding, which is subsequently loaded into the Arduino board's firmware via a loader program. The uploading tool for flashing user code onto official Arduino boards is Avrdude by default. The Arduino IDE is a clone of the Processing IDE, however as of version 2.0, it will be replaced by the Eclipse Theia IDE framework, which is based on Visual Studio Code.

4.5 Virtual Serial Port Driver

Electronic Team's Virtual Serial Port Driver is a software program that acts as a virtual COM port emulator on Windows PCs. You can use the software to construct virtual COM ports that can be connected in pairs through a virtual null-modem connection. Your serial apps will talk with each virtual serial port you build as though they were physical ports.

4.6 Proteus

The Proteus Design Set is a proprietary software tool package mainly used for electrical design automation. The program is used by electronic design specialists and technicians to create schematics and electronic prints for printed circuit board manufacturing.

4.7 EasyEDA Tool

EasyEDA is a web-based EDA tool suite that enables hardware engineers to both openly and privately develop, simulate, trade, and discuss schematics, simulations, and printed circuit boards. A bill of materials, Gerber and pick-and-place files, as well as documentation outputs in PDF, PNG, and SVG formats, are among the other features. EasyEDA allows you to create and edit schematic diagrams, simulate mixed analogue and digital circuits using SPICE, and design and modify printed circuit board layouts, as well as fabricate printed circuit boards if needed. The entire public, as well as a limited number of private businesses, may join without paying a subscription. The number of private projects may be increased by contributing high-quality public projects, schematic symbols, and PCB footprints, as well as paying a monthly charge. Users may get Gerber files for free from the application, however EasyEDA also provides a PCB fabrication service for a fee. Gerber files from third-party programs may also be accepted by this service.

Chapter 5

System Design

5.1 Introduction

The design of a wheelchair navigation system has progressed, taking into consideration conceptual work and, in particular, usability, acceptability, efficiency, security, and cost factors. In particular, the USER fit contains information and suggestions on how to improve the design of assistive technology solutions. The navigation module was designed with the usability requirement in mind for the user interface design. In reality, using this allows for a quick and low-cost replacement of the user command devices, which is dependent on the types of remaining functional skills of the user, without requiring the system's other modules to be re-adapted. The user interface was designed to be flexible and easy to use when it came to the controls and activities that were most important to the user.

These debates were about systems that had a similar problem to the wheelchair. Although the system has not yet been authenticated with users, the functioning requirements of the navigation module were differentiated based on the talks, thus it is reasonable to anticipate that the target audience will accept the system's control modalities. To improve the system's efficiency, a flexible design approach was employed. For the user, it was decided to utilize a commercial wheelchair. The possibility of adapting the system's direction to different classes of severe debilitating disorders was also studied, as was the deployment of suitable internal and exterior sensor systems.

The selection of commercial devices made specifically for the purpose of mobility for individuals with impairments also took security into mind. At the start, concerns about the wheelchair's stability and mobility were addressed. Additional security features were added to the commercial wheelchair's standard levels by combining internal and external/environmental sensors that can store information about the environment with a high level of reliability. This allowed for a better understanding of a number of autonomy levels that ensure the avoidance of various impediments in a nanostructured user environment, thereby enhancing the overall system's security. The decision to use a commercial wheelchair was also made to save money. Though the whole system is not inexpensive, special attention was devoted to reducing the expenses of customizing the system to the user's degree of impairment as well as the costs of re-adapting the system in the event that the user's functional skills change over time. These stages were achieved by referring to conventional communication protocols between the mobile base and the user interface, as well as assigning varying levels of autonomy to the navigation module.

5.2 Block Diagram

Our system designed with using various item of component as given list of components chapter. First of all, our voice recognition module added. It can be a mobile phone also or

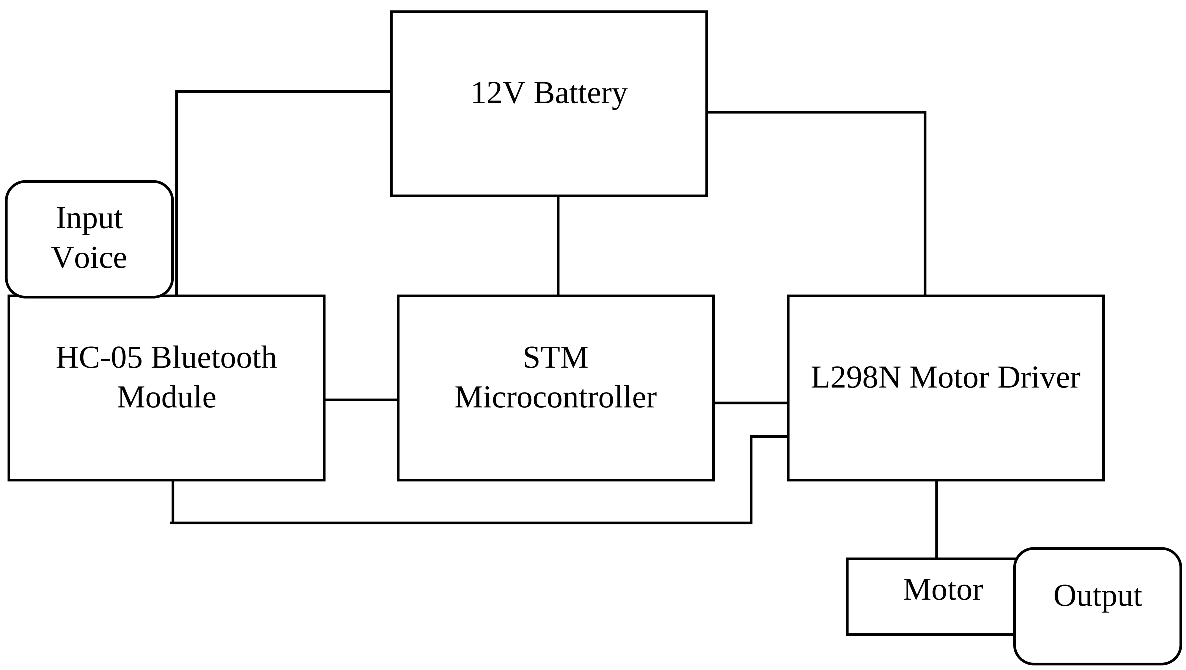

Figure-5.1: Block Diagram of our System

a Bluetooth module. Then it transfers the voice into signal. Then STM32 Microcontroller will response with its inelegancy and pass the command to the moto drivers and the motor driver will response direction of driver module. This is our design module as you can se figure 5.1.

5.3 Circuit Diagram

Once the system is on the go, the voice capture module waits for the input from the person. Then the input for capture module is voice of that person, that voice from the person which will compare with recorded voice in module. The voice capture and recognized. The

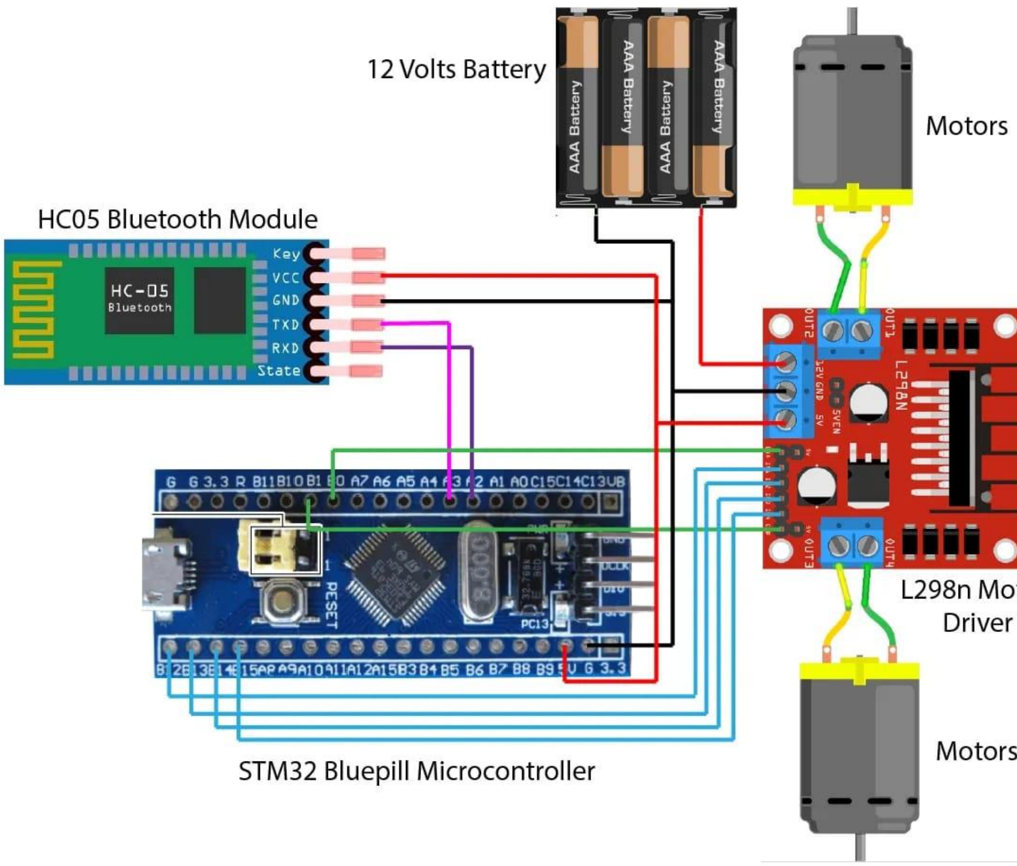

Figure-5.2: Circuit Diagram of our system

capture voice gives the particular location of place like bedroom, toilet , hall, restroom etc. The voices indicate any room in the house, then the navigation module takes over the control of the wheel chair. Through the System module the motors are driven in particular routes and thus the wheelchair moves to the specific room is reached. Then anyone can control it like that.

5.4 Flow Chart of the system

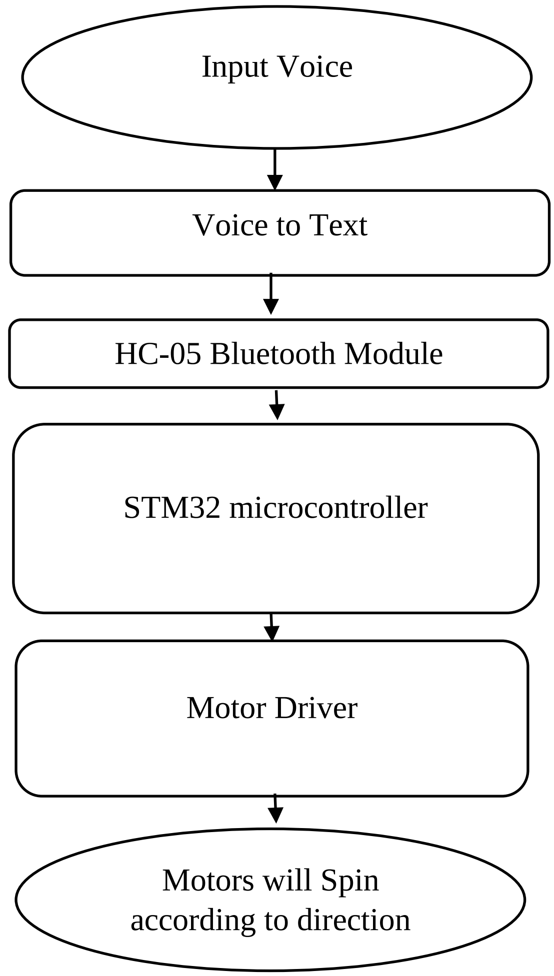

Figure-5.3: Flowchart of the system

5.5 Proteus Schematic (Software Simulation)

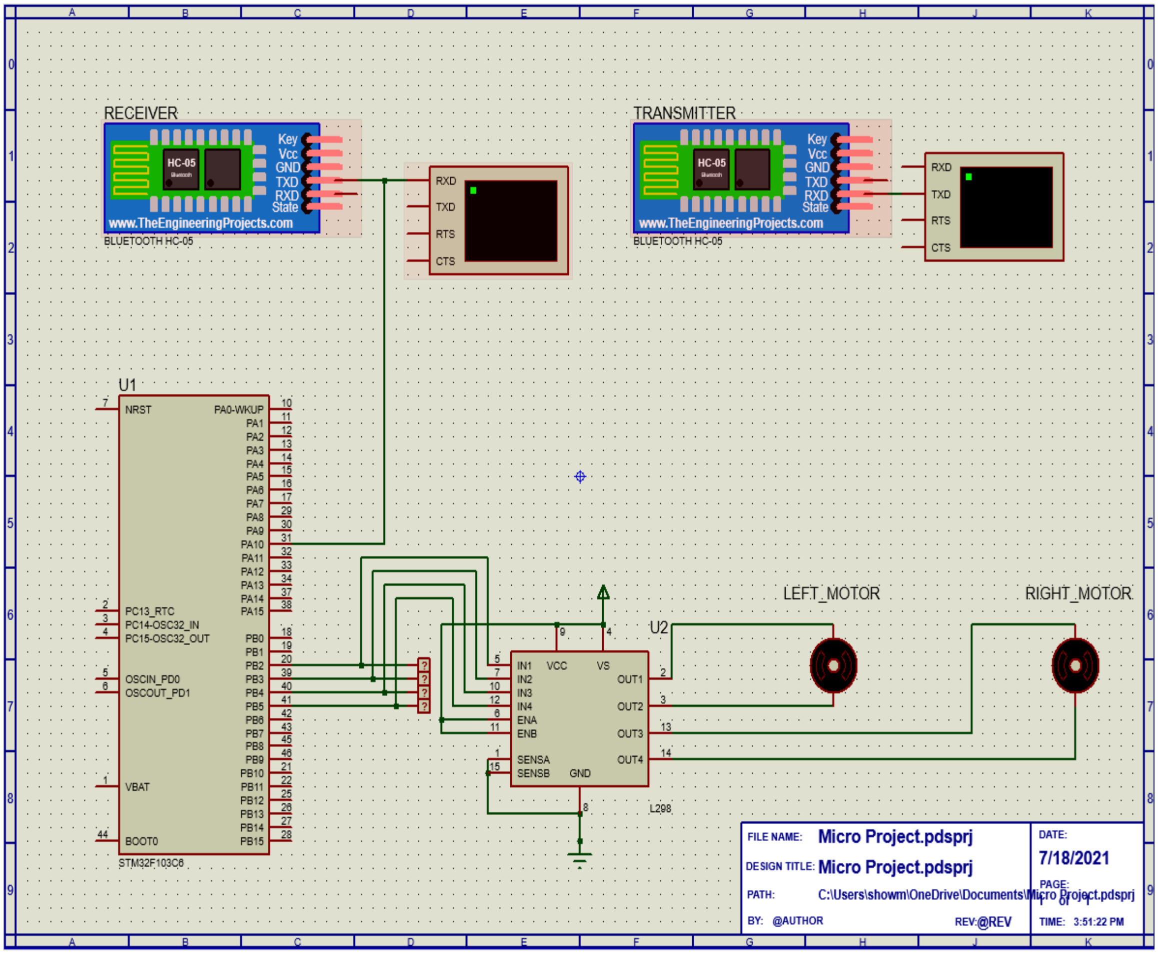

Figure-5.4: This Proteus software simulation of the project

Chapter 6

System implements and Results

6.1 Introduction

In this chapter, the complete implementation and we will show the result of our project.

6.2 Implementation Procedure step by step

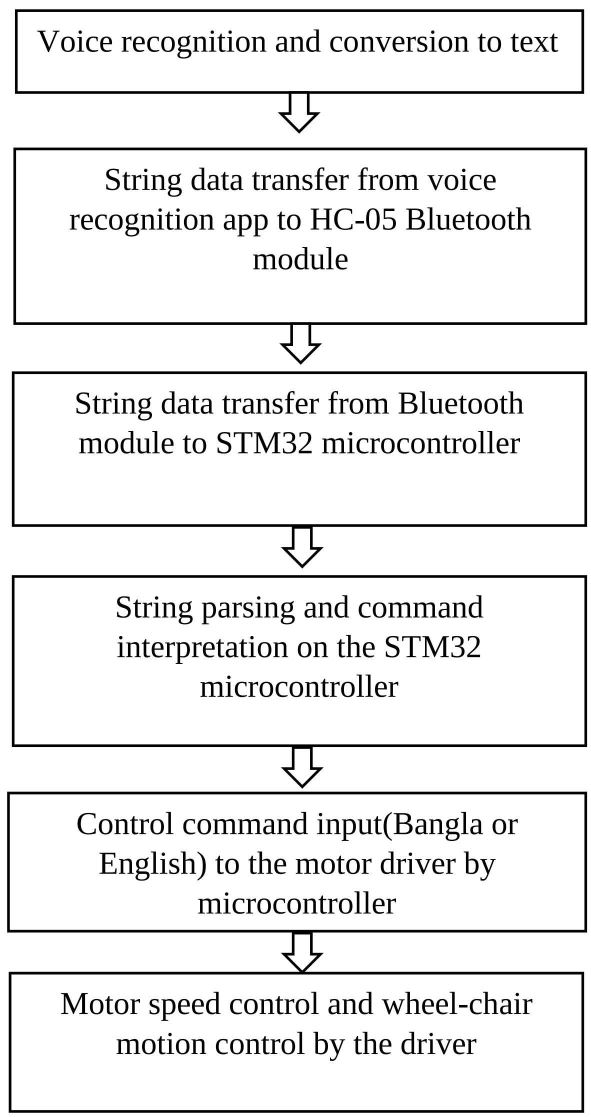

Figure-6.1: Implementation Procedure

6.3 Using google Voice API Speech to text Conversion

- Uses Google Voice API
- Converts voice input into text string
- Sends it to the connected Bluetooth device

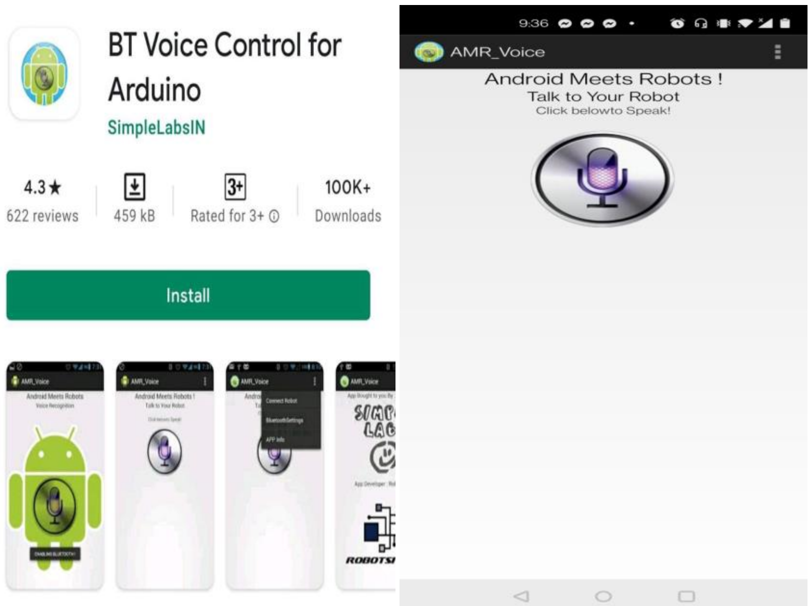

Figure-6.2: Google Voice API

6.4 Project Overview

The complete project overview has shown in Fig 5.1.

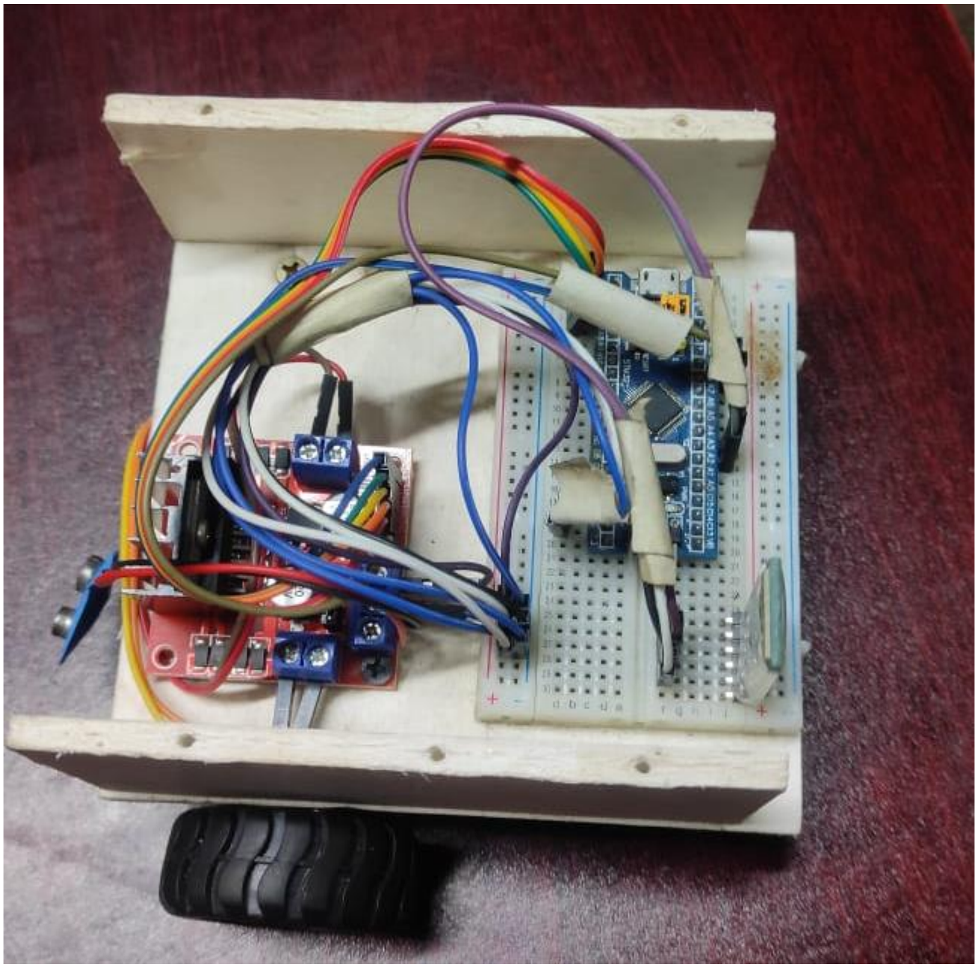

Figure-6.3: The Complete Porject

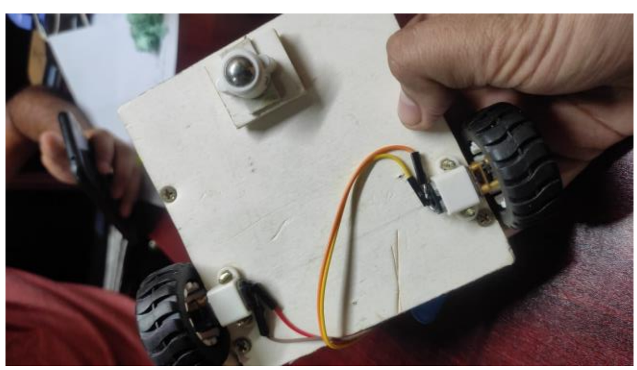

Figure-6.4: The Down side of the project

6.5 Results

We achieved our objectives

- ❑ We Build a Voice Control Wheelchair
- ❑ Connecting with Cell Phone or Any Bluetooth Devices
- ❑ Made understandable with Bengali Command
- ❑ Made understandable with English Command

Chapter 7

Conclusion and Future Works

7.1 Conclusion

Because it is operated by speech, it is an extremely user-friendly system. In conjunction with the transmitter and receiver, SMT microcontroller is employed to ensure appropriate locomotion. It contains some unique features, such as a personal security module, key control, Voice command, Bangla voice command and an accelerometer. Forward, backward, left, and right operation control using key control and accelerometer. The operation is controlled by four keys, and the accelerometer is based on head movement. This is extremely beneficial because the elderly or physically challenged may require medical assistance at any point during the day. This low-cost solution is especially beneficial to persons who are physically impaired. The system's efficiency is improved by the multi-control capability.

5.2 Future Works

- ✓ Building the voice dataset on our own rather than using Google API and incorporating Deep Learning techniques for better performance
- ✓ Adding some sensors to protect wheel chair from unwanted damage
- ✓ Adding a feature to recognize unique voice of the owner for trusted command reception and recognition

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Appendix

Appendix A: Source Code (Hardware Implementation)

```
//A for Left Wheel
//B for Right Wheel
const int enA = PB0;
const int enB = PB1;
const int inA1 = PB12;
const int inA2 = PB13;
const int inB1 = PB14;
const int inB2 = PB15;
String voice;

void Left_Motor_FWD();
void Left_Motor_BWD();
void Right_Motor_FWD();
void Right_Motor_BWD();
void Left_Motor_Stop();
void Right_Motor_Stop();


void setup() {

Serial2.begin(9600);

pinMode(enA,OUTPUT) ; //we have to set PWM pin as output
pinMode(enB,OUTPUT) ; //we have to set PWM pin as output
pinMode(inA1,OUTPUT) ;//Logic pins are also set as output
pinMode(inA2,OUTPUT) ;//Logic pins are also set as output
```

```
pinMode(inB1,OUTPUT) ;//Logic pins are also set as output
pinMode(inB2,OUTPUT) ;//Logic pins are also set as output
}

void loop() {

while(Serial2.available()) {
delay(10);
char c=Serial2.read();
if (c == '#')
{
break; //Exit the loop when the # is detected after the word
}
voice += c;
}

if (voice.length() > 0)
Serial2.println(voice);
{

if((voice[1] == 'B') || (voice == "*left"))

{

analogWrite(enA,80);
analogWrite(enB,80);

Left_Motor_FWD();
```

```
Right_Motor_BWD();

delay(1000);
voice = "*Samne";

}

else if((voice[1] == 'D') || (voice[1] == 'g') || (voice[1] == 'd') || (voice == "*right"))

{

analogWrite(enA,80);
analogWrite(enB,80);

Left_Motor_BWD();
Right_Motor_FWD();

delay(1000);
voice = "*Samne";
}

else if(voice == "*turn")

{

analogWrite(enA,80);
analogWrite(enB,80);
```

```
Left_Motor_FWD();
Right_Motor_BWD();

delay(2000);
voice = "*Samne";
}
if(voice[1] == 'S' || (voice == "*forward"))

{

analogWrite(enA,255);
analogWrite(enB,255);

Left_Motor_FWD();
Right_Motor_FWD();
}



else if(voice[1] == 'P' || (voice == "*backward"))

{

analogWrite(enA,255);
analogWrite(enB,255);

Left_Motor_BWD();
Right_Motor_BWD();
```

```
}

else if(voice == "*break")

{

Left_Motor_Stop();
Right_Motor_Stop();

}
voice = "";
}
}

void Left_Motor_FWD()
{
digitalWrite(inA1,HIGH);
digitalWrite(inA2,LOW);
}
void Left_Motor_BWD()
{
digitalWrite(inA1,LOW);
digitalWrite(inA2,HIGH);
}
void Right_Motor_FWD()
{
digitalWrite(inB1,HIGH);
digitalWrite(inB2,LOW);
```

```
}
void Right_Motor_BWD()
{
digitalWrite(inB1,LOW);
digitalWrite(inB2,HIGH);
}
void Left_Motor_Stop()
{
digitalWrite(inA1,HIGH);
digitalWrite(inA2,HIGH);

}
void Right_Motor_Stop()
{
digitalWrite(inB1,HIGH);
digitalWrite(inB2,HIGH);
}
```