

**DESIGN AND IMPLEMENTATION OF AN INTELLIGENT VOICE CONTROLLED
WHEEL CHAIR**

*Final Year Project Report Submitted in Partial Fulfillment of the Requirements for the Award of
Degree of Bachelor of Science in Electrical & Telecommunication Engineering*

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SEPTEMBER 2018

DECLARATION

We hereby declare that this report represents our ideas and research and where other ideas or words have been included, we have sufficiently cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and our information has not been fabricated or falsified by any data/idea, source in our submission.

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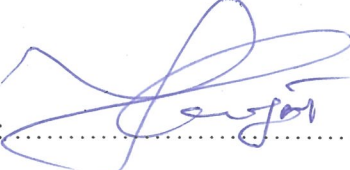
APPROVAL

We have read and at this moment recommend this final year project report “(Design and Implementation of an Intelligent Voice Controlled Wheel Chair)” for acceptance by Kampala international university in partial fulfillment of the requirement for the award of a Bachelor’s degree in Electrical and Telecommunication Engineering.

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ABSTRACT

This project report describes the Design and Implementation of an Intelligent Voice Controlled Wheel Chair for disabled people. The model utilizes an Arduino Voice Recognition Module interfaced with a high level 8-bit AVR Microcontroller to control motorized movements using voice commands. The model provides both a convenient and non-technical solution to navigate in a disabled home for even the critically crippled who can talk. To avoid uncontrolled collisions, the wheel chair includes collision avoidance capabilities based on HC-SR04 Ultrasound Modules.

Chapter one-Introduction: It gives a brief introduction and background of this project.

Chapter two-Literature review: It gives an overview of techniques involving wheel chairs, existing wheel chair technologies and overview of devices used.

Chapter three-Methodology: It explains about the system design i.e. architecture and interfacing of the devices used.

Chapter four-Results and discussion: Describes the results and output of the system.

Chapter five-Recommendation and conclusion: It gives the recommendation and conclusion drawn from this project.

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ACRONYMS / ABBREVIATIONS

ASR:	Automatic Speech Recognition
CMOS:	Complementary Metal-Oxide Semiconductor
CPU:	Central Processing Unit
IR:	Infrared
LCD:	Liquid Crystal Display
LSI:	Large Scale Integration
PIC:	Peripheral Interface Controller

CHAPTER ONE

INTRODUCTION

1.0 Introduction

This chapter gives a brief introduction to the project, as well as discussing the problem statement in detail. Also, the main and specific objectives, significance and scope of the project are presented.

World report on disability” (2011) jointly presented by World Health Organization (WHO) and World Bank says that there are 70 million handicapped people in the world. Unfortunately, day by day the number of handicapped people is going on increasing due to accidents, wars and diseases leading to paralysis. Uganda is one of the African countries with the highest rate of road accidents, a 2016 World Health Organization report on road safety says. Health systems will continue to bear the brunt of injury and disability due to road traffic crashes.

Among people with disabilities, the percentage of physically handicapped persons is most. If a person is handicapped, he/she is dependent on others for his/her day to day work like transport, food, orientation etc.

In a country where disability still carries huge stigma, children face an uncertain future. Their parents must find the strength to reject pressure to abandon their disabled children and fight for their inclusion. But without support, training and the right wheelchairs, many parents struggle to meet their children’s basic needs, leaving them vulnerable to malnutrition, breathing difficulties, spinal deformities and pressure ulcers.

So a voice operated wheel chair that operates automatically on the commands from the handicapped user for movement purposes has been developed. Use of electrical wheelchair leads to a large amount of independence for persons with a physical disability who can neither walk nor operate a mechanical wheelchair alone.

1.1 Background

Around many researches done in the field of speech recognition. Due to sophisticated signal processing algorithms and powerful computers available, computer based speech processing system nowadays have reached complex structure with high accuracy. The challenge is to maintain standard performance while using limited computation and memory resources. Researches in the area of wheelchair control system are still going on. Many people with disabilities do not have the essential skill to control a joystick on an electrical wheelchair. This can be a great drawback for the user who is permanently unable to move any of the arms or legs.

Therefore, this category of people can use the wheelchair easily through voice commands.

In our proposed design, the main idea of using voice activated technology for controlling the motion of the wheelchair, is to prove that it can be an exclusive solution for severely disabled people and patients

1.2 Problem Statement

As the number of patients, old persons and physically disabled persons who need help to move using wheel chair are increasing, only two types of wheel chairs are widely used i.e. those operated by hand and those by joystick. This type needs muscular strength for their operation. Therefore, there is a problem that it is difficult for the old, disabled person e.g. people without hands and legs to use the previous systems. But sometimes such persons face many problems if they do not get any person to move their wheel chair. Therefore, there is need to design a wheel chair which depends on voice command for their movements to overcome such problems.

1.3 Objectives of the Study

1.3.1 Main Objective

To design and implement an Intelligent Voice Controlled Wheel Chair for disabled people at Nalukolongo disabled home.

1.3.2 Specific Objectives

- i. To design a voice controlled wheelchair control circuit.
- ii. To construct and implement a functional of a voice controlled wheelchair.

iii. To test the developed functional prototype.

1.4 Significance of the Project

Patients having injuries and physical disabilities and with good mental health face a lot of difficulty when using the conventional hand powered wheelchair. A hands free operated wheelchair enables able to talk handicapped individuals without hands to navigate without any external help.

1.5 Project Scope

1.5.1 Content Scope

The project focused on development of a voice operated wheelchair for the disabled, old users for movement purposes. The system consists of a voice recognition module, AVR microcontroller, motorized wheels for movement. The robotic wheelchair can be commanded to move forward, backward, left, right or stop using voice commands.

1.5.2 Geographical scope

The system is developed for disabled people at Nalukolongo disabled home.

1.5.3 Time Scope

This project was designed for a period of eight (8) months (Refer to Time Schedule in Appendix B.).

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter will discuss more all of the information related to the project. It discusses the previous history and the present work about the project. We will look at existing systems, their weaknesses, and solutions. The literature review in this chapter is based on the Internet, journals, books, and articles.

Review of the related literature: This section provides a previous study of related work regarding the development of voice controlled wheelchair. People have disabilities with their hands, foot and lower extremities because of which they are unable to perform regular tasks. Many technologies are available to overcome this problem. To overcome this problem, there are several applications in the market which help handicapped people to perform their tasks. Several studies have shown that the independent mobility, which includes power wheelchair, manual wheelchair and walker access the benefit to both children and adults. Independent mobility reduces dependence on caregivers and family members and promotes feelings of self-reliance. Impaired mobility often results in decreased opportunities to socialize, which leads to social isolation, anxiety and depression.

2.1 Existing System

There are many technologies developed in wheel chair design. The most commonly available types of wheel chair on market are those operated by joystick (power wheel chair) and manual wheel chair.

2.1.1 Powered Wheel Chair

These are battery powered motorized version of standard manual wheel chairs propelled by means of an electric motor rather than manual power. This system has the following drawbacks.

Size: Larger than manual wheel chairs and may not be suitable at every one's home

Limited power: If battery packs are not recharged properly, you may end up with a dead battery before reaching home.

Difficult for others to manoeuvre: If you become unable to move your electric wheel chair on your own, pushing it is very difficult because of its weight

2.1.2 Manual Wheel Chairs

This is a type of wheel chair that a person must move themselves without help of a battery. They are of two types i.e.

Self-propel which requires the user to propel themselves with the help of their limbs.

Companion propel. This requires that you must have another person to push you.

This system has a drawback that it requires someone's physical strength to operate

Below is the list of evolution of voice controlled wheel chair:

In 2002, Simpson R.C. et al, described an experiment that compares the performance of able-bodied subjects using voice control to operate a power wheelchair both with and without navigation assistance. [1]

In 2007, Nishimori M., et al, presented a grammar-based recognition parser named "Julian". Three type commands, the basic reaction command, the short moving reaction command, and the verification command, were given. They obtained a recognition rate of 98.3%, 97.0% of the movement command and the verification command, respectively. [3]

Also in 2007, Asakawa T., et al, proposed a voice-controlled electric wheelchair with a system for detecting the position and direction. They found that it is very effective to memorize one of the possible stopping positions and the angles of rotations to desired directions to assist the movement of a wheelchair. [10]

In 2008, Fezari M., et al, H.R. Singh, Abdul Mobin, Sanjeev Kumar, Sundeep Chauhan" and S.S. Agrawal designed a system based on grouping a microcontroller with a voice recognition processor for isolated word and speaker dependent and a set of ultrasonic modules. The input of the system are a set of eight Arabic words used to control the movement of the wheelchair, a vector of information on the context given by a set of sensors and a joystick for security actions. [8]

In 2009, Murai A., et al, presented a wheelchair with a high voice delay leading to wall collisions. So, he obligated to apply a collision avoidance function. [5]

In 2012, Ruzaij M.F., et al, presented an automatic obstacle detection using an ultrasound system which helps the patient to apply a temporary brake in case any obstacle suddenly comes in the way of the wheelchair. The design provided protection from obstacle collision if any voice mistake happens. [7]

In 2013, Kumaran M.B., et al, presented a speaker dependent voice recognition system for identifying individual words. PIC microcontroller captures signals from speech recognition module and wait for the ultrasonic sensor that satisfies obstacle detection in its path. [12]

Klabi I., et al (2014), controlled movement of wheelchair in different directions by monitoring voice commands and also the simple movement of the patient's face. Automatic obstacle detection and avoidance had been done using ultrasonic and infrared sensors which helps the patient to apply a temporary brake in case any obstacle suddenly comes in the way of the wheelchair. Also wall tracking and target tracking algorithms had been developed in the wheelchair. A Fuzzy Logic Control of the wheelchair had been also designed in such a way that it can be controlled by the patient. But all the system was implemented using a PC interfaced with an embedded microcontroller platform the matter that may restrict, complex, and raised the cost of wheelchair. [16]

In 2014, Anousouya D, et al, used a Hybrid BCI in order to provide large number of commands with increased accuracy to the BCI user. The voice and the brain signals were synchronized and converted to a movement towards, left, right, accelerating, and decelerating. Each one of the works above has its limitation and weakness. The work of this paper presents a simple package with very cheap electronics that would not complex the wheelchair and with high efficiency voice recognizer that could reach sometimes to 100% of 10 Klabi I.

2.2 Proposed System

There are many researches done in the field of speech and voice recognition. Due to sophisticated signal processing algorithms and powerful computers and components available, computer based speech processing system nowadays have reached high accuracy

with complex structure. The challenge is to maintain standard performance while using limited computation and memory resources. Researches in the area of wheelchair control system are still going on. Many people with disabilities do not have the skill as required to control a joystick on an electrical wheelchair.

The proposed work is to design and develop a wheelchair which operate on voice commands. It can be used efficiently with less effort by the users i.e. People who have disabilities with their hands, foot and lower extremities of which they are unable to perform regular tasks.

There are many advantages to such this system like:

- ❖ It reduces human efforts.
- ❖ The device is helpful to physically disabled people who cannot be able to operate home appliances that require moving to different locations. This will help to save energy to some extent, since some people feels lazy to go and switch off the appliances manually.

2.3 Other Voice Activation Applications

2.3.1 Voice Actuated technology

In this technique user speak in microphone and the voice recognition system compares the voice command with pre-stored memory and generates a control signal to control the movements of wheels.

2.3.2 Touch Screen Controlled Technology

The mode of input control to the wheelchair is touch screen. When user wants to change the direction, the touch screen sensor is modelled by pressing finger against the various quadrants on the touch screen, which has different values for different direction.

2.3.3 Accelerometer Based Technology

In accelerometer based wheelchair, we have an acceleration sensor that is also known as tilt sensor. When we tilt the object, the values registered by sensor are changed and these values are given to microcontroller. Depending on the direction of the tilt, microcontroller controls the wheelchair directions as LEFT, RIGHT, FRONT and BACK.

2.3.4 Head Orientation Tracking Technique

Here in this method, head movements are transformed into cursor movements on the screen. Cursor movements are proportional to head movements. Head movements are calculated by

different methods like accelerometer placed in a patient's cap or by capturing video of head movements. But the problem with this technique is that differentially able people of certain categories such as cerebral palsy patients cannot even move their head comfortably. Another problem of this technique is that forehead continuously needs to face the camera.

2.3.5 Sip-n-Puff Technology

In this method using air presser to generates control signals by sipping (inhaling) or puffing (exhaling) in a tube. This technology generates four control signals for motorized wheelchair which are initial hard puffs, hard sip, initial hard sip, and hard puff. It is mostly used for quadriplegics having injury in their spinal cord. But this is not good for individual with weak breathing.

CHAPTER THREE

METHODOLOGY

This section describes the different methods, tools, languages and techniques which have been used in order to achieve the project objectives. Several methods have been used to achieve the objectives set for this project and they are as below;

3.1 Analysis of Already Existing Robotic Technologies

Literature review about the system was carried out. This aimed at gathering requirements and understanding existing systems with their different components and the loopholes in them. The literature search involved reading documents published on internet, journals, text books and newspapers. Personal interviews were also be carried out. This helped in understanding how current systems work and the requirements for the system in order to simplify system design.

3.2 Research Design

The data collection involved gathering the requirement; functional and non-functional requirements, which were necessary for the system to be implemented. Functional requirements including voice recognition, motor direction control, and collision avoidance among others were given priority as they determined the success of the project work.

3.2.1 Development of Circuitry

Scientific calculations were carried out to determine the ratings of components required for the development of a voice controlled wheelchair. The selection of the various components to be used to develop the circuitry was carried out depending on the results of the calculations. A circuit was designed on paper and later in Proteus software.

3.2.2 Development of Control Logic

This involved development of system flow charts and system block diagrams. These were translated into algorithms for system control, and the relevant C++ pseudo code.

3.3 Study Area and Population

The study was carried out at Nalukolongo disabled home in Rubaga Division, a suburb of Kampala, and the target group for the study was people who are physically unable to operate wheelchairs by hands.

3.4 Data collection.

In order to fully understand the project requirements, data was collected. This data included literature about similar or related research that has been done before, technical documents detailing how a few of the system designs could be achieved and users' views about the proposed system. Below is a brief about the data collection methods, which were used throughout the entire research project.

3.4.1 Publications

Here, on-line search for available and relevant publications was carried out. Electronic journals, components datasheets, text books, and other articles have been utilized. These provided core reference information especially during project circuits design and identifying values of components appropriate for the design.

3.4.2 World Wide Web

For the past years, the web has proven to contain information on everything about the world around us. Therefore, the World Wide Web was utilized as a source of most of the technical work that could seem not available from other literature sources. The web was also used to acquire some of the technical books and journals to be used to guide throughout the whole design process.

3.5 System Analysis and Design

System analysis and design gives a more elaborative description and analysis of the developed system, project requirements, project design and its implementation in detail. The following sub-sections explain how several system components work together into a function prototype:

3.6 Voice Recognition Module

ELECHOUSE Voice Recognition Module is a compact and easy-control speaking recognition board. This product is a speaker-dependent voice recognition module that supports up to 80 voice commands in all. Max 7 voice commands could work at the same time. Any sound could be trained as command. Users need to train the module first before let it recognizing any voice command.

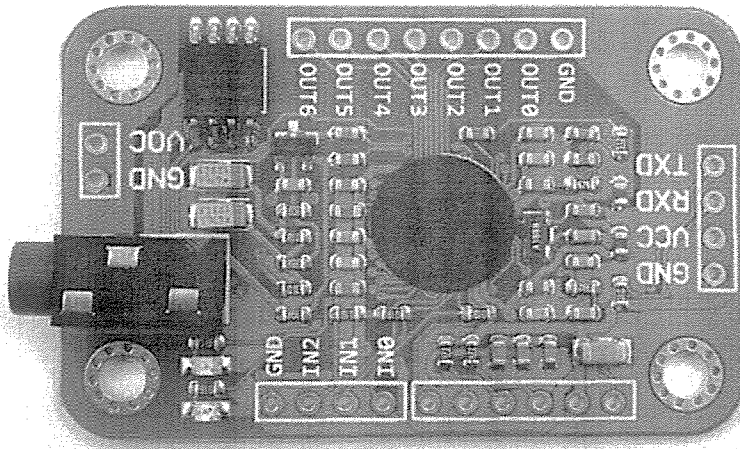
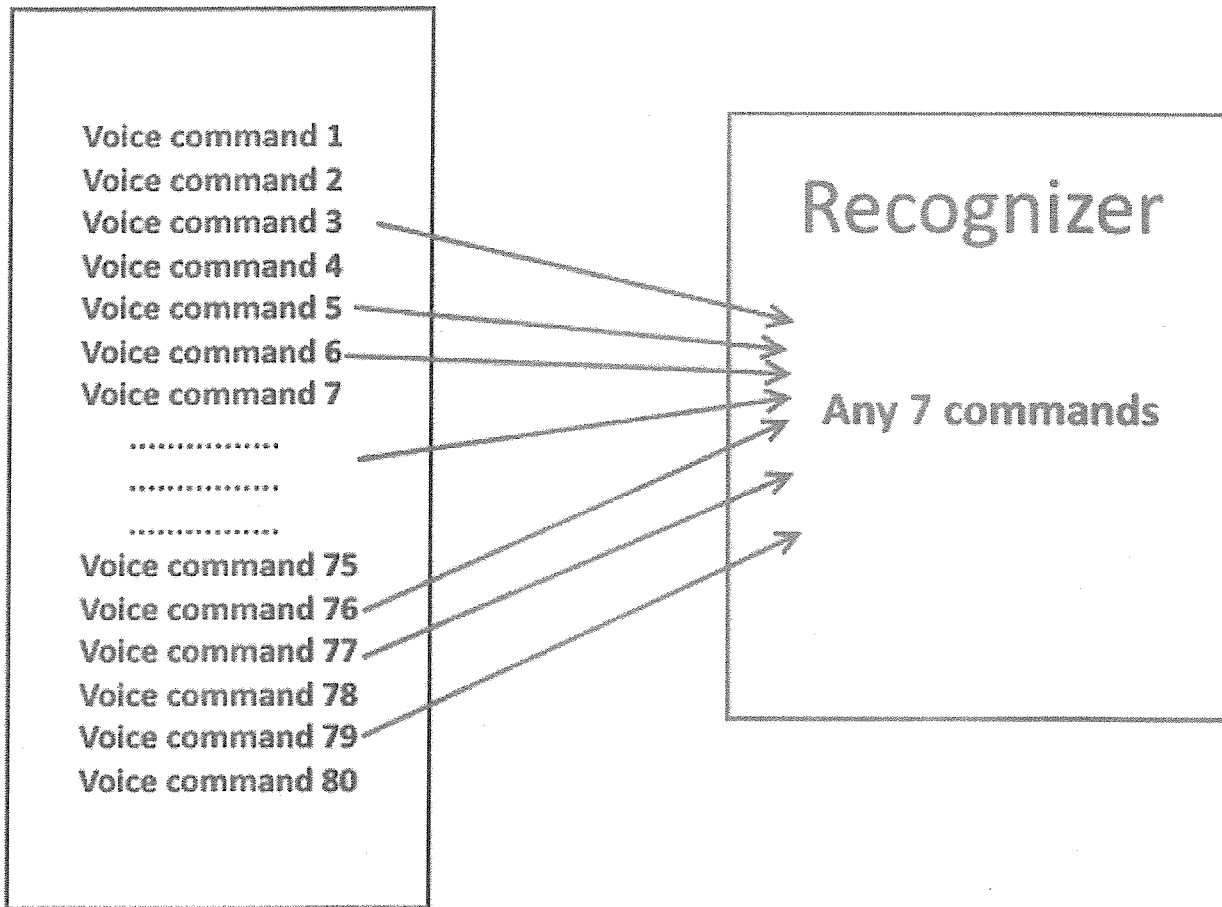


Figure 1: Voice recognition module V3

This board has 2 controlling ways: Serial Port (full function), General Input Pins (part of function). General Output Pins on the board could generate several kinds of waves while corresponding voice command was recognized.

It's a 48-pin single chip CMOS voice recognition LSI circuit with on-chip analog front end. In this system, the voice recognition module is trained and it takes the input from mic available in the system. The wheelchair uses the voice recognition module interfaced with the AVR microcontroller to convert the voice commands into motor understandable instructions to move the wheelchair as commanded by the user.

On V3, voice commands are stored in one large group like a library. Any 7 voice commands in the library could be imported into recognizer. It means 7 commands are effective at the same time.



Hardware and Software Preparation

1. Connect your Voice Recognition V3 Module with Arduino, By Default:
2. Download VoiceRecognitionV3 library. (Download zip file or use git clone <https://github.com/elechouse/VoiceRecognitionV3.git> command)
3. If using zip file, extract **VoiceRecognitionV3.zip** to Arduino Sketch\libraries folder, or if you use git clone command copy **VoiceRecognitionV3** to Arduino Sketch\libraries.

Train

1. Open **vr_sample_train** (File -> Examples -> VoiceRecognitionV3 -> vr_sample_train)
2. Choose right Arduino board (Tool -> Board, UNO recommended), Choose right serial port.
3. Click **Upload** button, wait until Arduino is uploaded.
4. Open **Serial Monitor**. Set baud rate 115200, set send with **Newline** or **Both NL & CR**
5. Train Voice Recognition Module. Send train 0 On command to train record 0 with signature "On". When Serial Monitor prints "Speak now", you need speak your voice (can be any word, meaningful word recommended, may be 'On' here), and when Serial Monitor prints "Speak again", you need repeat your voice again. If these two voice are matched, Serial

Monitor prints "Success", and "record 0" is trained, or if are not matched, repeat speaking until success.

When training, the two LEDs on the Voice Recognition Module can indicate your training process. After sending the training command, the SYS_LED (yellow) is blinking fast which remind you to get ready. Speak your voice command as soon as the STATUS_LED (red) light lights on. The recording process ends once when the STATUS_LED (red) lights off. Then the SYS_LED is blinking again, get ready for next recording process. When the training process ends successful, SYS_LED and STATUS_LED blink together. If the training fails, SYS_LED and STATUS_LED blink together, but quickly.

3.7 L293 Motor Driver

The L293 and L293D are quadruple high-current half-H drivers. These devices are designed to drive a wide array of inductive loads such as relays, solenoids, DC and bipolar stepping motors, as well as other high-current and high-voltage loads. All inputs are TTL compatible and tolerant up to 7 V.

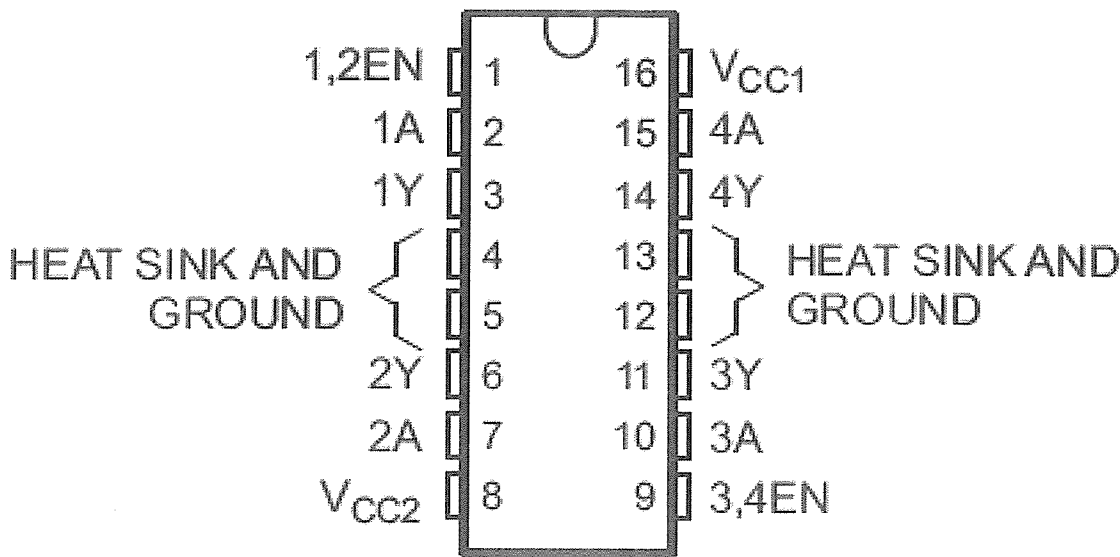


Figure 2: NE-package 16-DIP top view. Source: *device datasheet*.

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.

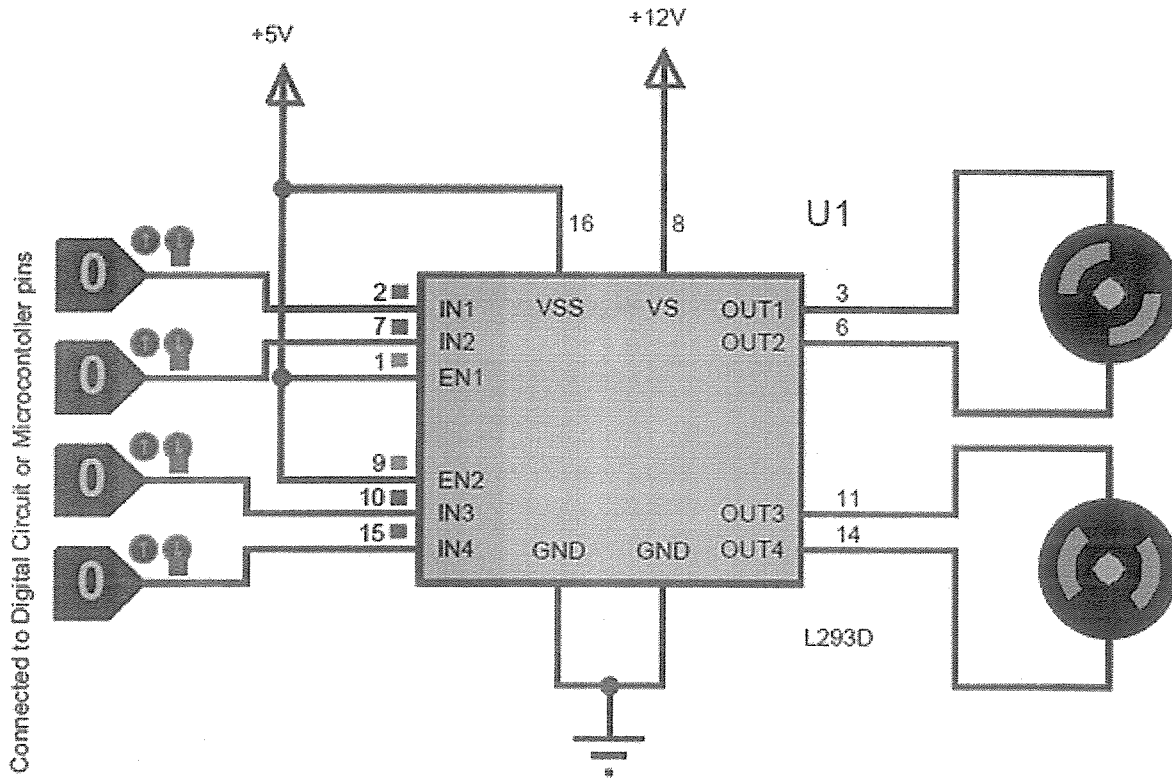


Figure 3: 2 DC motors drive circuit using L293D

On the L293D, external high-speed output clamp diodes should be used for inductive transient suppression. On the L293D, these diodes are integrated to reduce system complexity and overall system size. A VCC1 terminal, separate from VCC2, is provided for the logic inputs to minimize device power dissipation. The L293 and L293D are characterized for operation from 0°C to 70°C.

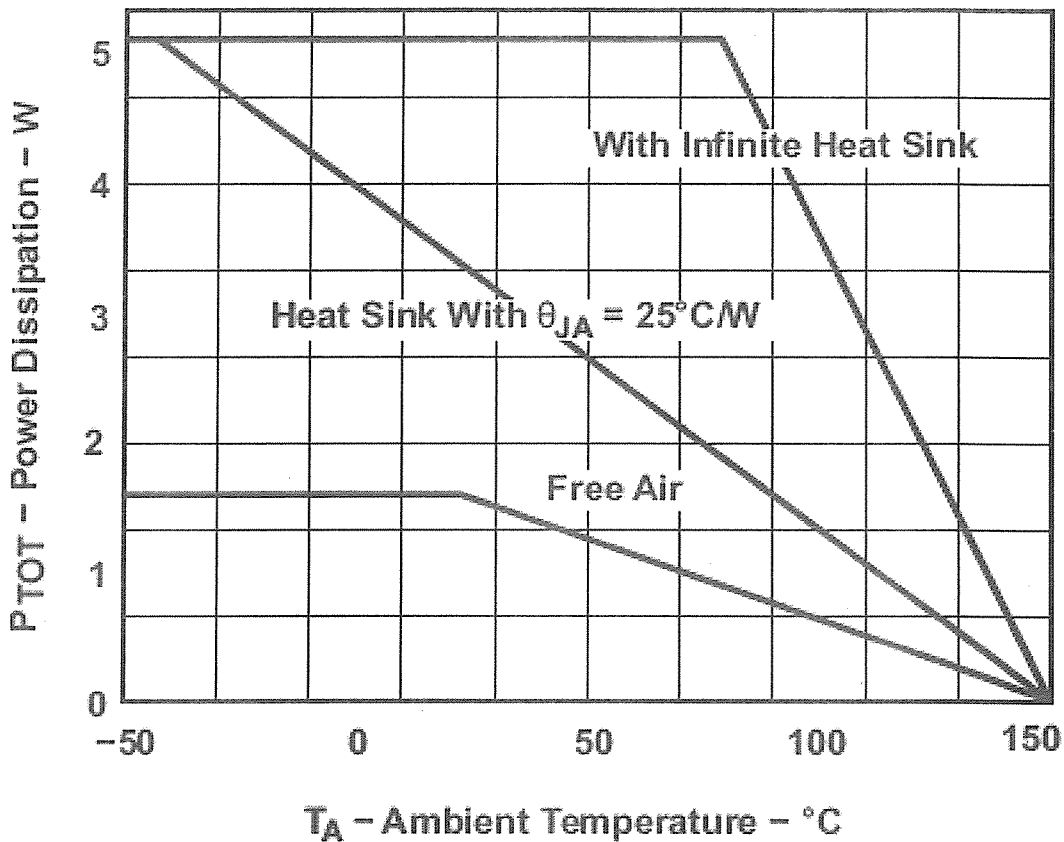


Figure 4: Maximum Power Dissipation vs. Ambient Temperature

3.8 ATMEGA328P-PU MCU:

The ATmega328P is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the Atmega328P achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed. The AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.

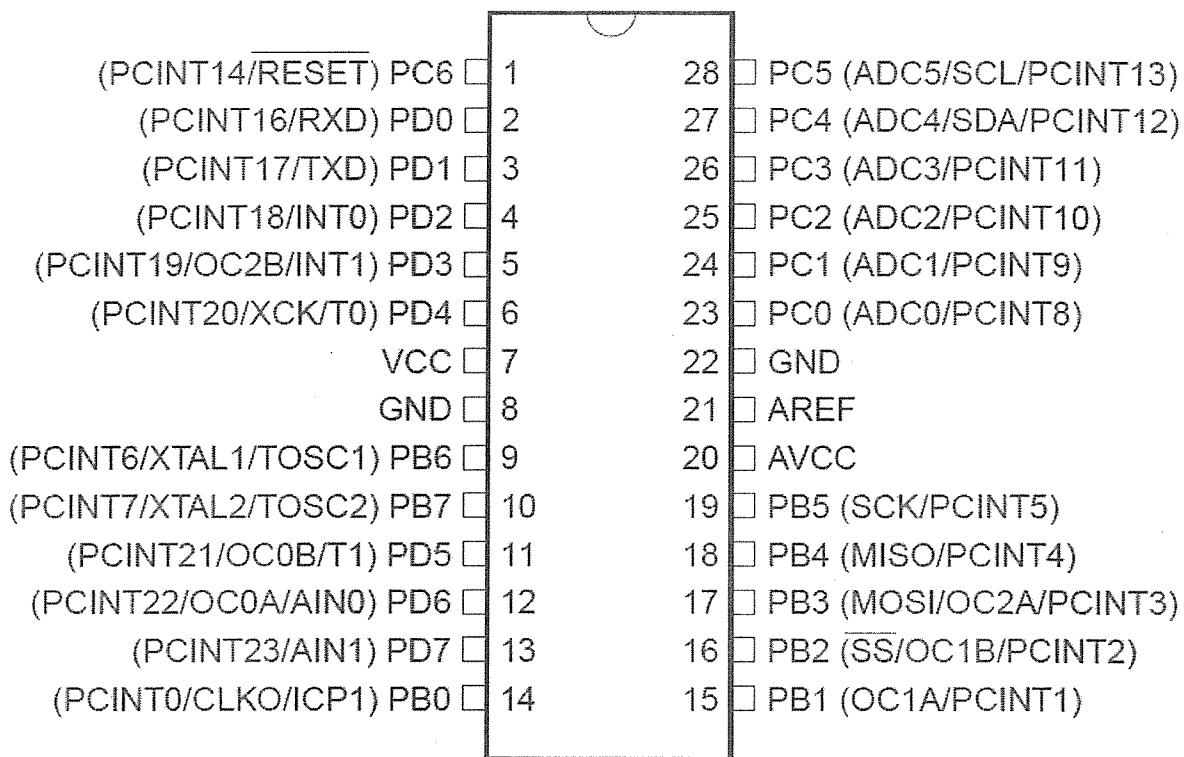


Figure 5: ATMEGA328P 28-DIP Top-view

The Atmega328P provides the following features: 32Kbytes of In-System Programmable Flash with Read-While-Write capabilities, 1Kbytes EEPROM, 2Kbytes SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible Timer/Counters with compare modes, internal and external interrupts, a serial programmable USART, a byte-oriented 2-wire Serial Interface, an SPI serial port, a 6-channel 10-bit ADC (8 channels in TQFP and QFN/MLF packages), a programmable Watchdog Timer with internal Oscillator, and five software selectable power saving modes. The Idle mode stops the CPU while allowing the SRAM, Timer/Counters, USART, 2-wire Serial Interface, SPI port, and interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next interrupt or hardware reset. In Power-save mode, the asynchronous timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except asynchronous timer and ADC, to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator Oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low power consumption.

AVR Reset

The AVR RESET mode is an active low module on RESET pin. Pulling the RESET pin HIGH disables the unwanted system resets. Pull-up resistors on the dW/(RESET) line must not be smaller than 10k (datasheet page 256). The pull-up resistor is not required for debug WIRE functionality. However, connecting the RESET pin directly to VCC will not work in disabling the reset mode.

Clock Sources

The device has the following clock source options, selectable by Flash Fuse bits as shown below. The clock from the selected source is input to the AVR clock generator, and routed to the appropriate modules.

Table 1: Device Clocking Options Select. Source: device datasheet

Device Clocking Option	CKSEL3...0
Low Power Crystal Oscillator	1111 - 1000
Full Swing Crystal Oscillator	0111 - 0110
Low Frequency Crystal Oscillator	0101 - 0100
Internal 128kHz RC Oscillator	0011
Calibrated Internal RC Oscillator	0010
External Clock	0000
Reserved	0001

Note: 1. For all fuses "1" means unprogrammed while "0" means programmed.

The device is shipped with internal RC oscillator at 8.0MHz and with the fuse CKDIV8 programmed, resulting in 1.0MHz system clock. The startup time is set to maximum and time-out period enabled. (CKSEL = "0010", SUT= "10", CKDIV8 = "0"). The default setting ensures that all users can make their desired clock source setting using any available programming interface.

Low Power Crystal Oscillator

Pins XTAL1 and XTAL2 are input and output, respectively, of an inverting amplifier which can be configured for use as an On-chip Oscillator.

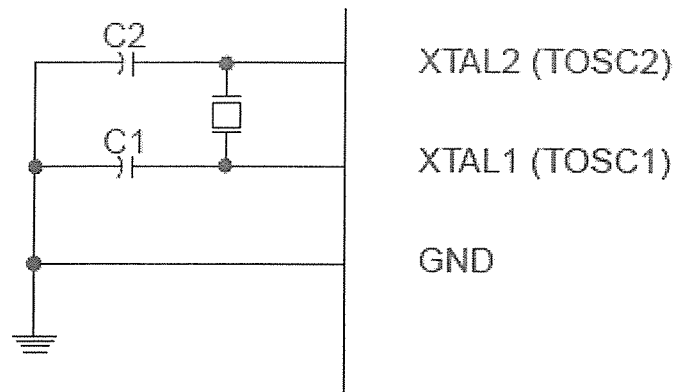


Figure 6: Crystal Oscillator Connections:

Either a quartz crystal or a ceramic resonator may be used. This Crystal Oscillator is a low power oscillator, with reduced voltage swing on the XTAL2 output. It gives the lowest power consumption, but is not capable of driving other clock inputs, and may be more susceptible to noise in noisy environments. C1 and C2 should always be equal for both crystals and resonators. The optimal value of the capacitors depends on the crystal or resonator in use, the amount of stray capacitance, and the electromagnetic noise of the environment. Some initial guidelines for choosing capacitors for use with crystals are given below:

Table 2: Low Power Crystal Oscillator Operating Modes. Source: *Table 9-3 on Page 30 of device datasheet.*

Frequency Range (MHz)	Recommended Range for Capacitors C1 and C2 (pF)	CKSEL3...1 ⁽¹⁾
0.4 - 0.9	–	100 ⁽²⁾
0.9 - 3.0	12 - 22	101
3.0 - 8.0	12 - 22	110
8.0 - 16.0	12 - 22	111

For ceramic resonators, the capacitor values given by the manufacturer should be used.

3.9 7805 Voltage regulator (12 DC power supply).

The L7805 series of three-terminal positive regulators is available in TO-220 TO-220FP TO-3 and D2PAK packages and 5V fixed output voltage, making it useful in a wide range of applications. These regulators can provide local on-card regulation, eliminating the

distribution problems associated with single point regulation. This regulator type employs internal current limiting, thermal shut-down and safe area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents. The device outputs a stable 5V for any input in range of 7V to 18V DC.

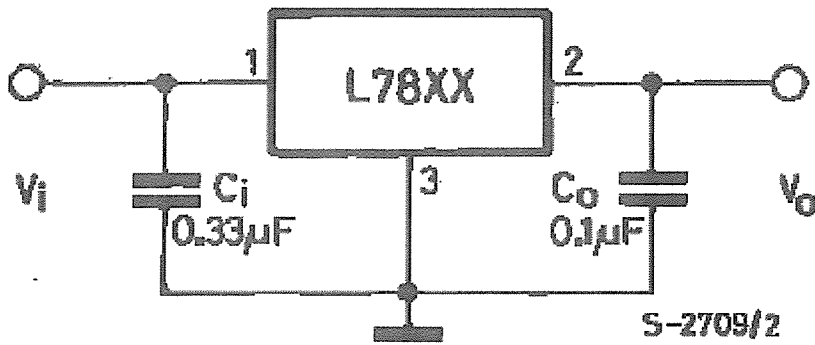


Figure 7: 7805 TOP VIEW

3.10 Project Block and Circuit Diagrams:

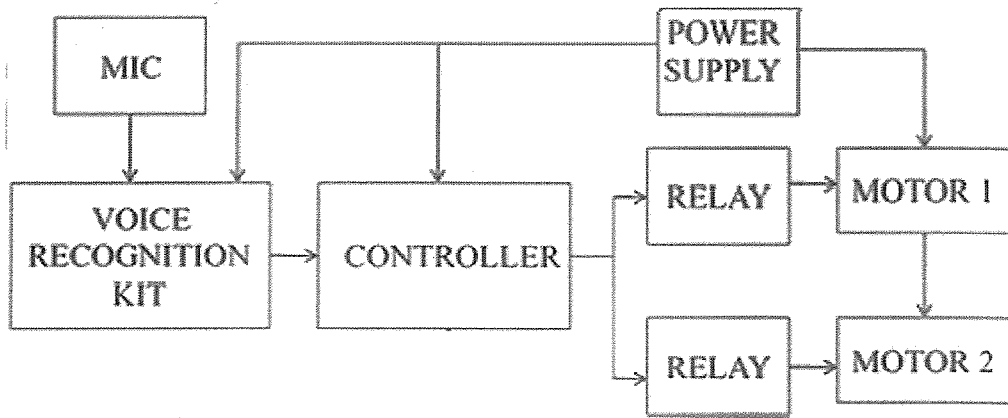


Figure 8: Project block diagram

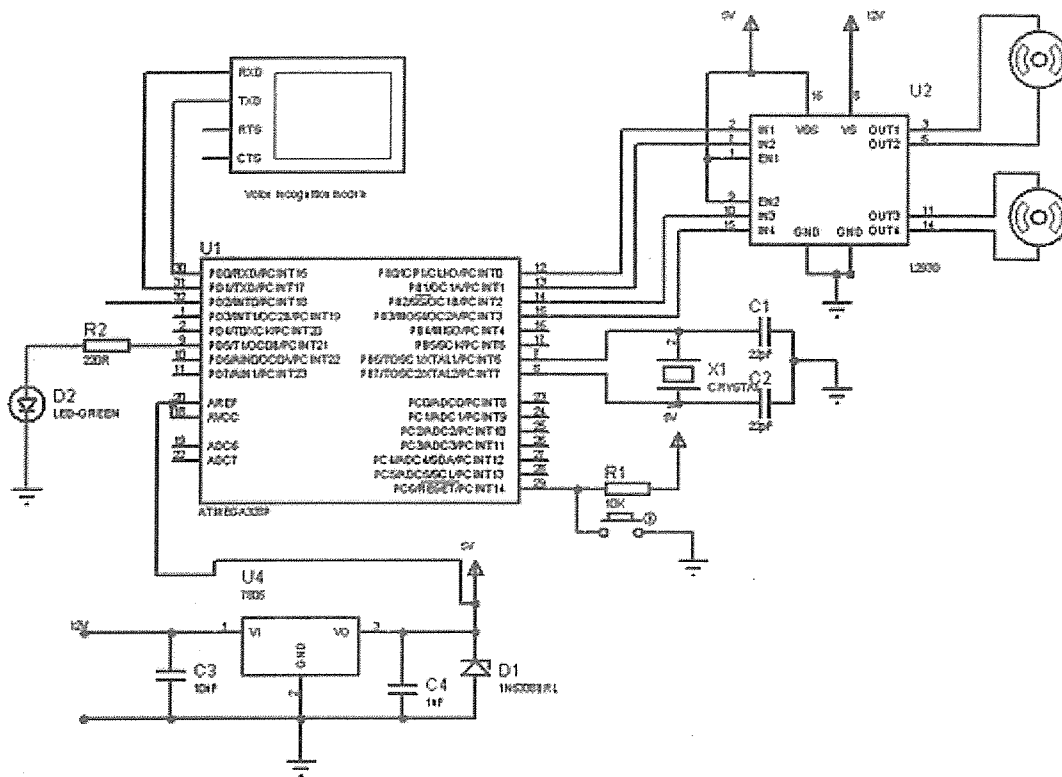


Figure 9: Project block and circuit diagram

3.11 Softwares Used

- *Proteus*. For simulation.
- *Keil vision4*. The new keil vision4 IDE has been designed to enhance developer's productivity, enabling faster, more efficient program development. Vision4 introduces flexible windows management system, enabling you to drag and drop individual windows anywhere on the visual surface, including support for multiple monitors.

The vision IDE from Keil combines the project management, make facilities, source code editing, and program debugging and complete simulation in one powerful environment.

- *Eagle*. Eagle contains a schematic editor, for designing circuit diagrams

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Introduction

This chapter discusses the results of the system design, implementation, testing and validation of the system.

4.1 Summary of Work Done.

The main objective of this project was to design and implement an intelligent voice controlled wheelchair. The system was able to control movement of two DC motors for Forward, Backward, Right and Left turning directions depending on the input voice command. For each command that is known to the system, a green LED is activated as a command success status indicator.

4.2 Critical Analysis /Appraisal of the Work

We have been committed for a period of eight months while working on wheel chair control board that uses voice commands. The system has been tested, validated and proven to work and it can now be used in a functional wheelchair. The system as a whole has also achieved the main objective as it was proposed. The system at hand is fully operational and its guidelines on future usage are provided in the recommendation. We are convinced beyond doubt that this system is going to help people with disabilities spanning to lack of limbs to control wheel chairs.

CHAPTER FIVE

RECOMMENDATION AND CONCLUSION

5.0 Recommendation

We recommend that the system should be enhanced with speed controllers also known as speed governors to mitigate risks related to over speeding. The system should also be installed with brake systems to enhance stopping where need is.

5.1 Conclusion

This project work has successfully designed and implemented an intelligent voice controlled wheel chair for disabled people. However, the model had very poor response to commands related to noise and change of pitch in the voice of the operator. The model however successfully responded to simple one (1) second commands.

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APPENDIX

Appendix A: Bill of Quantity

Table 3: Bill of Quantity

S/N	Items	Quantity	Unit Cost(UGX)	Amount (UGX)
1.	Transformer	1	25,000	25,000
2.	Diodes	4	1,500	6,000
3.	Capacitor	4	1,000	4,000
4.	Regulator	1	6,000	6,000
5.	Resistors	7	500	3,500
6.	Sensors	2 pairs	7,000	14,000
7.	Microcontroller	1	150,000	150,000
8.	LCD	1	25,000	25,000
9.	Jumper wires	3	1,000	3,000
10.	Soldering lead	1 roll	10,000	10,000
11.	Soldering iron	1	14,000	14,000
12.	Printed Circuit Board	2	5,000	10,000
13.	Bread board	1	15,000	15,000
14.	Chair modelling		150,000	150,000
15.	Casing (glue, nail, boards)		20,000	20,000
16.	Paint	1	6,000	6,000
17.	Voice Recognition Module	1	450,000	450,000
18.	DC stepper motors	2	150,000	300,000
19.	Miscellaneous		200,000	200,000
TOTAL				1,411,500

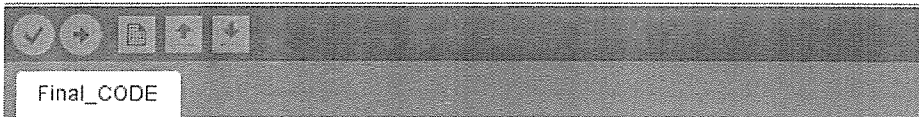
Appendix B: Time Schedule

NO.	A c t i v i t y / t a s k	Time period							
		2	0	1	8				
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
1	Title identification								
2	Problem statement identification								
3	REPORT writing								
5	S y s t e m d e s i g n								
6	System implementation								
7	Testing and validation								
9	Final report submission								

Appendix C: Project code



File Edit Sketch Tools Help

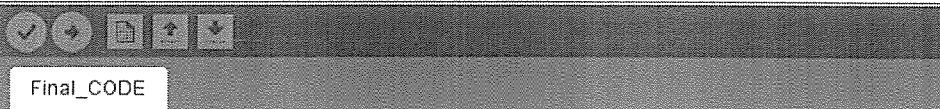


Final_CODE

```
15
16 #include <SoftwareSerial.h>
17 #include "VoiceRecognitionV3.h"
18
19 /**
20  Connection
21  Arduino    VoiceRecognitionModule
22  2  ----->    TX
23  3  ----->    RX
24  */
25 VR myVR(2,3);    // 2:RX 3:TX, you can choose your favourite pins.
26
27 uint8_t records[7]; // save record
28 uint8_t buf[64];
29
30 int led = 13;
31
32 #define back    (0)
33 #define forward (1)
34 #define left   (2)
35 #define right  (3)
36 #define stopp  (4)
```



File Edit Sketch Tools Help



Final_CODE

```
43 @param  buf    --> command length
44         len    --> number of parameters
45 */
46 void printSignature(uint8_t *buf, int len)
47 {
48     int i;
49     for(i=0; i<len; i++){
50         if(buf[i]>0x19 && buf[i]<0x7F){
51             Serial.write(buf[i]);
52         }
53         else{
54             Serial.print("[");
55             Serial.print(buf[i], HEX);
56             Serial.print("]");
57         }
58     }
59 }
60
```

File Edit Sketch Tools Help

Final_CODE

```

71 void printVR(uint8_t *buf)
72 {
73   Serial.println("VR Index\tGroup\tRecordNum\tSignature");
74
75   Serial.print(buf[2], DEC);
76   Serial.print("\t\t");
77
78   if(buf[0] == 0xFF){
79     Serial.print("NONE");
80   }
81   else if(buf[0]&0x80){
82     Serial.print("UG ");
83     Serial.print(buf[0]&(~0x80), DEC);
84   }
85   else{
86     Serial.print("SG ");
87     Serial.print(buf[0], DEC);
88   }
89   Serial.print("\t");
90
91   Serial.print(buf[1], DEC);
92   Serial.print("\t\t");
93   if(buf[3]>0){
94     printSignature(buf+4, buf[3]);
95   }
96   else{
97     Serial.print("NONE");
98   }

```

File Edit Sketch Tools Help

Final_CODE

```

98   }
99   Serial.println("\r\n");
100 }
101
102 void setup()
103 {
104   /** initialize */
105   myVR.begin(9600);
106   pinMode(9, OUTPUT);
107   pinMode(6, OUTPUT);
108   pinMode(10, OUTPUT);
109   Serial.begin(115200);
110   Serial.println("Elechouse Voice Recognition V3 Module\r\nControl LED sample");
111
112   pinMode(led, OUTPUT);
113
114   if(myVR.clear() == 0){
115     Serial.println("Recognizer cleared.");
116   }else{
117     Serial.println("Not find VoiceRecognitionModule.");
118     Serial.println("Please check connection and restart Arduino.");
119     while(1);
120   }
121
122   if(myVR.load((uint8_t)back) >= 0){
123     Serial.println("back loaded");
124   }

```

