Microcontroller Based Automated Wheel Chair

Degree Project Report

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بسم الله الرحمن الرحيم

Acknowledgment

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Dedication

We dedicate our project to our parents, our supervisor Mr. Arslan Qamar and to our dear friend who died, Haroon Rasheed and our close friends Muahmmad Adnan, Mohsin Idrees, Shahzaib Ali, Danish Ali, Feras Mehmood, Saad mehmod, Muhammad Rehan, Fahad Waheed, Faradh Ameen and the rest our class.

Abstract

A wheel chair is an automated tool for special people. People are able to control the wheel chair through a joystick and a voice support system. A joystick is connected to the microcontroller that help's in moving the chair. Microphone generates the input signal for short words wheel chair will move forward and when a sentence is spoken wheel chair moves in the backward direction.

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Introduction

A wheel chair is designed for disabled people and it is automated with the help of an 8052 microcontroller. This tool will be helpful for the disabled people to move anywhere they want without wasting their energy. It has a joystick that will move the chair to the desired locations and for more ease of the person it is equipped with a voice support system. User will provide the input through a microphone and the operation will be performed accordingly. 8052 Microcontroller takes the input and generates output that moves the wheel chair. For the voice support system the wheel chair will only move in the backward and forward directions because it is based on speech time recognition. For short words it will move in forward direction and when the user will speak a sentence it will move in the backward direction. Microcontroller will detect the speech signal that is converted into digital signal and the based on time of audio signal motors will move reverse or forward.

1.1 Features:

- It has a joystick to move the chair.
- It is equipped with a voice support system.(forward and backward)
- Easy to use.
- Rechargeable battery.
- Comfortable seat.

1.2 Advantages:

- The user will become independent.
- Battery is rechargeable so there's no wasting of money.
- It has a normal speed equal to a person walking speed.
- Moves and stops without jerks.

1.3 Intended User:

This tool is made for the people who can't move, especially for the disabled people and people who are aged. They won't be dependent on anyone to take them to any place they want to so this wheel chair makes them independent saves their energy and saves the time of the person pushing the manual wheel chair.

1.4 Business Case:

Effort	Benefits
Microcontroller Based Wheel Chair	User will be independent
Rechargeable Battery	User won't be wasting his/her money on buying new batteries.

Selection of Battery	The battery selected for the wheel chair provides the speed equal to the walking speed of a normal person.
Calculated Voltage	Voltage is very carefully calculated so that it won't give a jerk while moving.

[Table 1.1]

1.5 Software Tools Used:

1.5.1 Keil µvision:

This IDE used for the programming of microcontroller (figure 1) we can write the programs in assembly language and C language it has a debugger function that helps in identifying mistakes in the code that is written for the programming of the microcontroller.

Chapter#2

Analysis of An Existing System

Automatic Wheelchair Guided by a Magnetic Ferrite Marker Lane

2.1 Introduction:

This wheel is designed especially for the severely disabled people. A wheel chair is automated with a sensor that guides with the help of magnetic ferrite that is resistant to dirt. It is for the disabled and old age people to move anywhere they want to. Stopping at desired locations functions is also added for the ease of the user. It has a steering controller also user can move the wheel chair manually. Different features are added to the wheel chair for more ease of the user like automatic stop and automatic safety stop.

2.2 Features:

- Technique Used To Guide.
- Automated Stop Operation.
- Safety Stop Operation.

2.3 Technique Used To Guide:

Wheel chair can move quickly on the magnetic ferrite marker by recognizing the marker position by magnetic sensor. An automated wheelchair is guided with the help of a magnetic ferrite marker which is not influenced by dirt or mud that makes it easy to be used by severely disabled people and it will be easy to use with the help of manual steering.

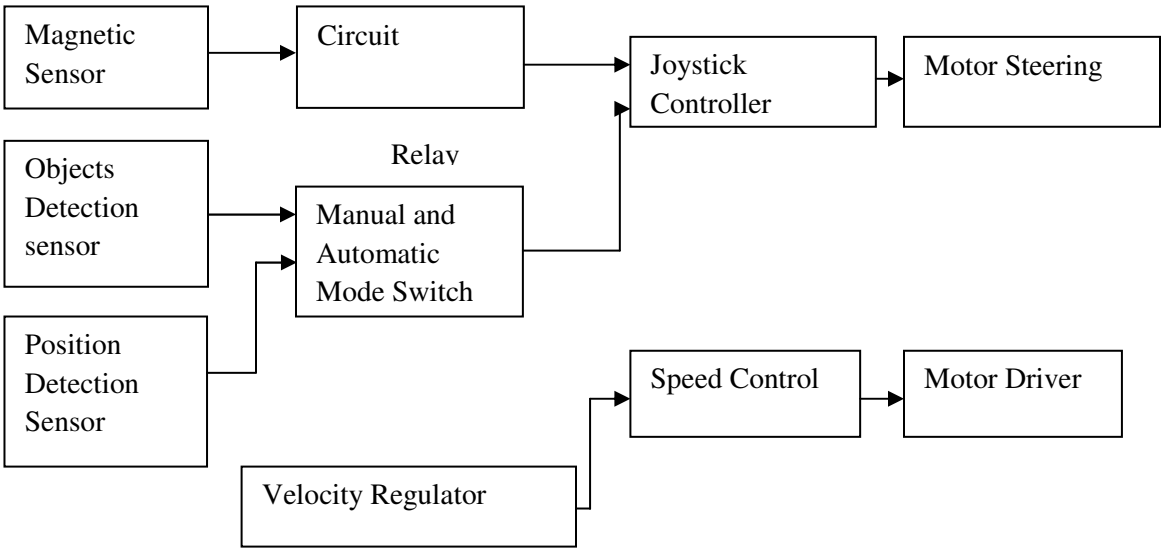
2.4 Automatic Stop Operation:

Users might be visually disabled or they might not be able to use the wheel chair with their own hands. Whenever they need to move to different locations an automatic stop operation is required at some fixed positions. We can set up the route before our wheel chair starts moving. So that our

wheel chair won't stop at locations we don't want to. The infrared position detector sensor system has been installed that identifies the reflection of the tape that was placed before on the floor. Whenever the reflecting tape is detected by the reflection sensor it will stop the wheel chair automatically. The sensor counts the number of tape markers while going to several locations as the wheelchair passes them that helps the user move easily to a desired location.

2.5 Safety Stop Operation:

Providing safety is important for every user of the wheel chair. To avoid a collision with people or walls etc two infrared obstacle detection sensors are made and installed in front of the wheel chair whenever a obstacle is detected by the sensors it automatically stops until the obstacle is moved out of the way. User is provided with automatic and manual mode for more flexibility with the help of a switch the user can choose automatic and manual mode. In manual mode the user will be able to move the wheel chair in different locations even where the lane has not been set. Whenever a obstacle is detected on the tape the controller will automatically switch the mode to manual so if the user is willing to move the wheel chair own its own will he/she will be able to Manual mode allows the user to control the speed and move the wheel chair with the help of a joystick that will make it easier for the user to use the wheel chair but the severely disable user will not be able to access the manual mode of the wheel chair.



2.6 Dataflow Diagram

2.7 Drawbacks:

The drawback in this wheel chair is that it is dependent on a magnetic ferrite. If the magnetic sensor that detects the magnetic ferrite line stops working the severely damaged person won't be able to move the wheel chair. It is resistant to dirt to some extent but in Asian countries we have a lot of dirt issues as compared to Europe that might become a problem for the sensor to detect. Automatic stop operation is a good thing in the wheel chair for the disabled people but it becomes annoying stopping at different places again and again.

Chapter#3

Hardware Description

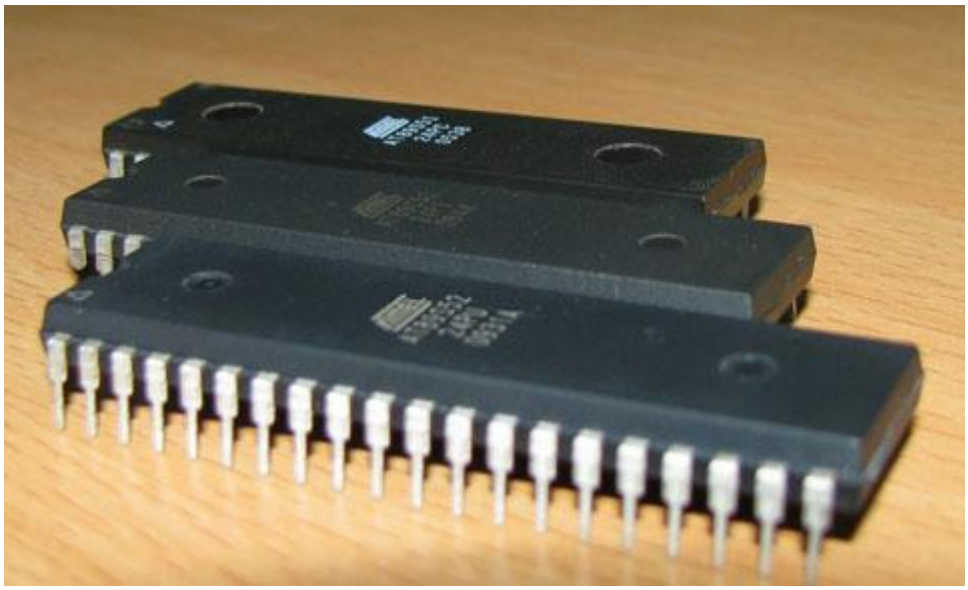


Figure 1

Microcontroller

3.1 Microcontroller:

Microcontroller is a mini computer on a chip with integrated circuitry with a processor, memory, RAM, ROM, inputs and outputs. Microcontroller is widely used in automatically controlled devices like automatic car ignition, joystick (figure 2), printer, toys.

3.1.1 AT89C52 Microcontroller:

3.1.2 Features:

- It is compatible with MCS-51 products.
- With 8 interrupt sources.
- 8Kilo bytes flash memory.
- 32 programmable input and output lines.

3.1.3 Description:

AT89C52 is a low power microcontroller, CMOS 8-bit microcomputer with high performance and has a 8kilo bytes of PEROM (programmable erasable read only memory).It is a powerful microcontroller that is cost effective and very flexible.

3.1.4 Pin Description:

- VCC for supplying voltage
- GND is ground
- Port 0 it is and 8 bit input output port. Each pin sinks TTL(transistor-Transistor Logic).
- It has internal pull-ups.
- Port 1 is also and 8 bit input output port.
- Its output buffers can sink four TTL inputs.
- Port 2, 3 has same input and output pins.

3.1.5 Timers:

Timer 0 and timer 1 are 8 bit timers. Whereas timer 2 is a 16 bit timer or counter that operates as a timer or it can be a event counter.

3.1.6 Use of Microcontroller:

Microcontroller (figure 1) provides good amount of current when it is used on 0 logic. That's why we are using 0 logic in our project and practically 0 logic is given more priority. Microcontroller (figure 1) is doing all the work in this project. Microcontroller (figure 1) gets the input from the joystick (figure 2) on port 3 and generates the output from port 0. That will activate the relays accordingly and the motors will move in the forward or reverse direction.

Voltage regulators (figure 13) are used to provide the microcontroller with a +5v constant dc voltage.

Figure 2

Joystick

3.2 Joystick:

Joystick generates a binary input. Microcontroller (figure 1) detects the input and generates the output accordingly. It has a total of 8 pins but only 6 of them are used. 4 pins are used for the input functions that are forward, reverse, left, right, 5^{th} pin is used for voltage and 6^{th} pin is used for ground.

3.2.1 Use of Joystick:

Joystick is connected to the microcontroller (figure 1) that moves the wheel chair in the desired locations. It will move in the forward, reverse, left, right directions

Figure 3

Resistor

3.3 Resistor:

Resistor is an electrical component that resists current. The current all the way through a resistor is in straight proportion to the voltage across the resistor's ends. The ratio of the voltage applied from corner to corner to a resistor's terminal to the amount of current through the circuit is called resistance. The relation by Ohm's law is

$$I = \frac{V}{R}$$

where I is the current through the conductor in units of amps, V is the potential divergence calculated across the conductor in volts, and R is the resistance of the conductor in units of ohm.

3.3.1 Use of Resistor:

Resistors of 220ohm and 10k are used in the circuit to prevent the components from getting fused resistors are connected to the LED's (figure 8,9) to prevent them from getting short and they are connected to transistors (figure 6,7) to provide a fixed amount of current to them.

Figure 4

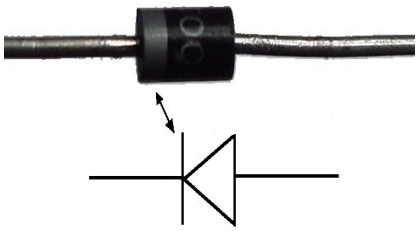


Figure 5

Diode

3.4 Diode:

It is a two terminal component it is a semi-conductor. It has two biasing regions.

1. Forward Bias.
2. Reverse Bias.

It acts as a switch. It will only allow one sided flow of current. When the current is able to flow in one direction the diode is known to be in the form of forward bias and when the negative flow of current will occur it will act as a open circuit and will not allow any current pass from it preventing the circuitry from getting damaged this mode of diode is known as reverse bias.

3.4.1 Use of Diode:

Diode is connected at different places in our circuit it is connected with relay's (figure 12), it is connected with voltage regulator (figure 13) to prevent the negative flow of current and diodes (figure 4,5) will act as open circuit so, no negative flow of current will be able to pass and there are no chances of getting any circuitry damaged or burnt. Whenever a negative flow of current will occur diode (figure 4,5) will act as a open switch.

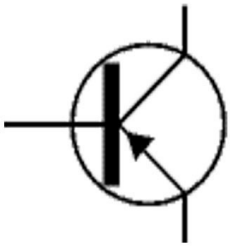


Figure 6

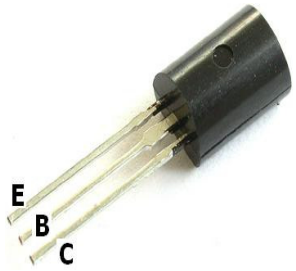


Figure 7

Transistor

3.5 Transistor:

It is a semiconductor component that is used for amplification and switching of electronic signals. It has 3 terminals. There are two types of transistors.

- PNP
- NPN.

3.5.1 Use of Transistor:

In our project we are using PNP transistors (figure 6,7) because our microcontroller (figure 1) is working on 0v logic. When the microcontroller (figure 1) will provide output to the transistors (figure 6,7) they will provide +5v to the relay's (figure 12) and with the process of induction the switch inside the relay will get connected to the +12v pin this will allow a large amount of current and voltage to pass through relay's.

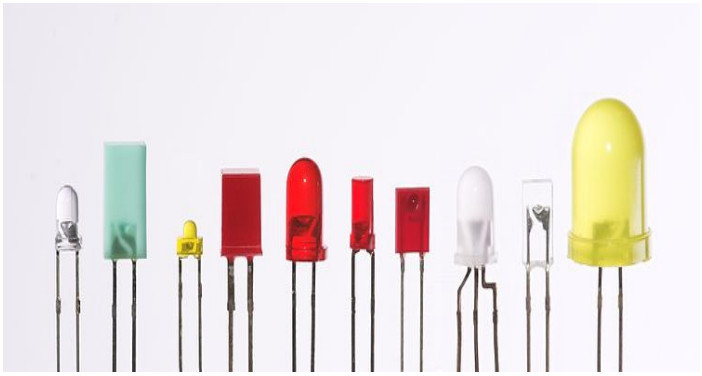


Figure 8

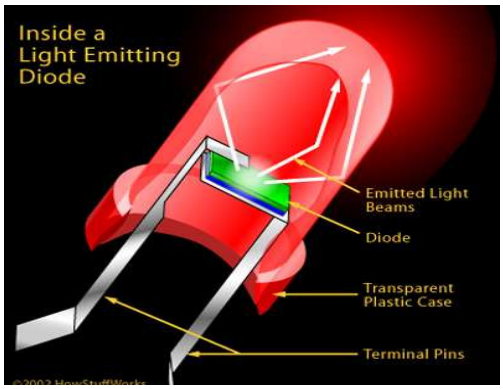


Figure 9

Light Emitting Diode (LED)

3.6 Light Emitting Diode:

It is a light source and a semiconductor widely used for lighting purposes. When the LED is in the forward bias region this allows the electrons to combine with the electron holes and when they are combined they release energy in the form of photons this process is known as electroluminescence.

3.6.1 Use Of LED:

A LED is connected to the microcontroller (figure 1) that will continuously blink to let us know that microcontroller (figure 1) is in active mode and is receiving voltage further more LED's are connected to the Relay's (figure 12) whenever the input from joystick (figure 2) is generated it is shown on the LED's connected to the microcontroller (figure 1) for the ease to get to know which relay's (figure 12) are working for testing purpose.

Figure 10

Figure 11

Capacitor

3.7 Capacitor:

It is a two terminal element that is used in an electrical field to store energy. There are many types of capacitors but every capacitor contains at least two conductors that are separated with the help of an insulator (dielectric). One common type of capacitors consists of metal foils that are separated by a thin layer of insulating film. Energy in the capacitor it is stored in the form of

electrostatic field. A capacitor is characterized by a constant value, capacitance and it is measured in farads.

Capacitors mostly are used to block direct current and allow alternating current to flow, they are also used to filter signals, and to filter the output of power supplies and tune particular frequencies.

3.7.1 Use Of Capacitor:

Capacitors of different values are used in our circuitry a capacitor is connected to the pin 9 of microcontroller(figure1) what this does is whenever our microcontroller(figure 1) will start it will be restarted and the program will execute from the start and it is connected to filter noise when the voltage regulator (figure 13) gets heated it generates thermal heat that generates sinusoidal signals it blocks them and capacitors are connected with relays because when motors (figure 18) run they produce electro motive force and a negative voltage capacitor blocks it.

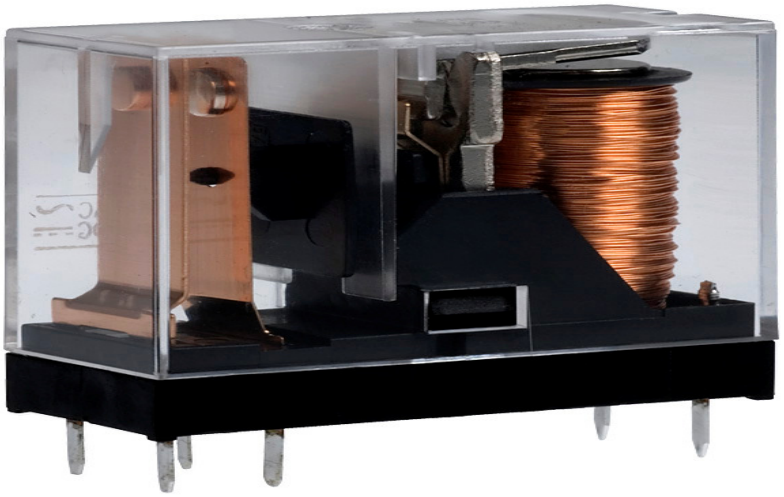


Figure 12

Relay

3.8 Relay:

A relay is a switch that is electrically operated most of them use electromagnet to operate the switching function. When +5v is provided to the relay due to induction the switch gets connected

and maximum amount of voltage and current passes by. A relay that is used to control a motor that requires high power is known as contactor.

3.8.1 Types Of Relays:

1. Latching Relay.
2. Reed Relay.
3. Mercury Wetted Relay
4. Polarized Relay.
5. Machine Tool Relay.
6. Ratchet Relay.
7. Contractor Relay.
8. Solid-state Relay.
9. Forced Guided Contacts Relay.
10. Overload Protection Relay.

3.8.2 Use Of Relay:

Relays are connected in the form of H to make an H-bridge (figure 14) circuit that is used to drive motors (figure 18). With the help of relay's we'll be able to use heavy DC motors (figure 18) because a large amount of current and voltage will pass through. A small model of H-bridge circuit is implemented with transistors and we can use transistors when we have small motors to control. Diodes (figure4) are connected to all the relays because every relay is working to move the wheel chair in forward, reverse, left or right so to prevent any negative voltage to flow from the circuit that will be generated when motors 9figure 18) will start we have used them and they will act as open circuit if the voltage across their terminals is changed (negative voltage).Transistors (figure6,7) act as switches for the relays (figure 12).

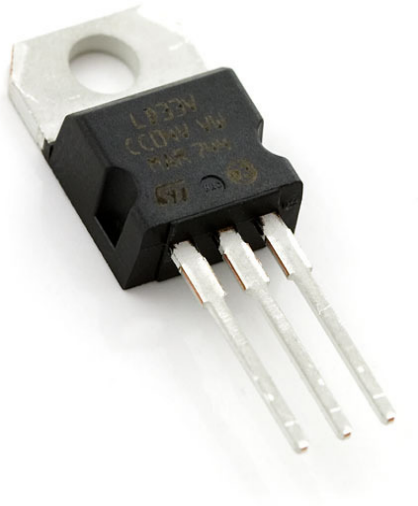


Figure 10

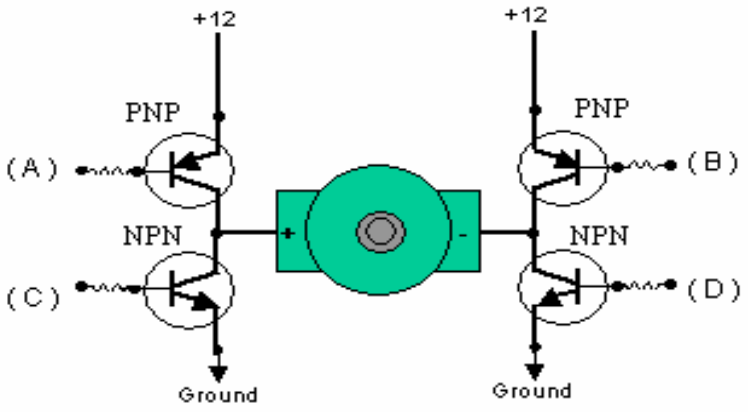
Voltage Regulator

3.9 Voltage Regulator:

It is an electrical component designed to regulate the voltage automatically and maintain a constant voltage level. It is used to regulate Ac and Dc voltages. Voltage Regulators are widely used in Power supplies to stable the DC voltage levels.

3.9.1 Use Of Voltage Regulator:

We are using this voltage regulator(figure 13) to maintain a constant voltage level to feed the microcontroller (figure 1) with a constant +5v dc because microcontrollers (figure 1) require constant voltage with no ups and downs in the voltage.



A	B	C	D	Function
-	-	-	-	----------
1	0	0	1	Forward
0	1	1	0	Reverse
1	1	0	0	Brake
1	0	1	0	Fuse test :-)
0	1	0	1	Fuse test :-)
Don't do the fuse tests				

Figure 11

H-Bridge Circuit

3.10 H-Bridge Circuit:

An H bridge is a circuit that allows the voltage to be applied across a load in a direction. This circuit is widely used in robotics to run DC motors (figure 18) in the forward and reverse direction. Basically H-bridge (figure 14) is a graphical representation of a circuit. H-bridge circuit (figure 14) is build with the help of four switches. When the switches S1 and S4 are closed a positive voltage will pass through the switches causing the motor to run in the forward direction and when S2 and S3 are closed but S1 and S4 are kept open will allow negative voltage to flow causing the motors move in reverse direction. Using the nomenclature above, the switches S1 and S2 should never be closed at the same time, as this would cause a short circuit on the input voltage source. The same applies to the switches S3 and S4. This condition is known as shoot-through.

3.10.1 Use Of H-bridge Circuit:

In our project we have used H-bridge (figure 14) circuit to run two motors (figure 18) in the forward and reverse direction. These motors (figure 18) are also used for turning the wheel chair in left and right directions because we have two motors (figure 18) on our wheel chair when we need to turn right we'll activate the left motor and when we need to turn left we'll activate the right motor and when all the switches are closed the motors (figure 18) will not move. On the small scale we used transistors (figure 6,7) and made a H –bridge (figure 14) circuit to see how the motors (figure 18) work this is the simples motor driver circuit.

Figure 12

Microphone:

3.11 Microphone:

Microphone is an electrical component that converts the auditory signal into electrical signal. Microphones are used in telephones, mobile phones, recorders.

3.11.1 Use of Microphone:

Microphone is used to generate input for speech time based recognition so that the wheel chair can move in the forward or reverse direction according to the input given by the user. Input will pass through LM358 (figure16) that will amplify the audio signals. Microphone is converting the audio signals into electrical.

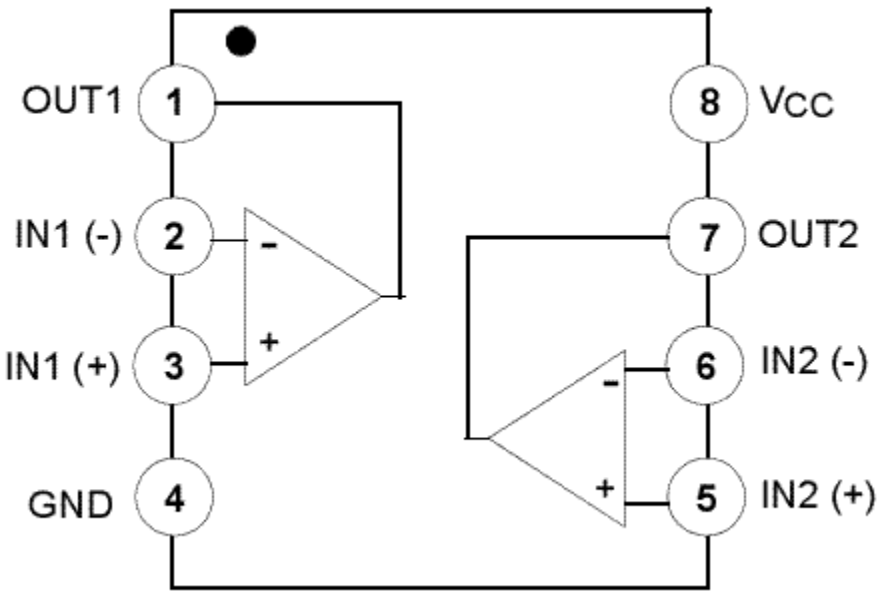


Figure 13

LM358

3.12 LM358:

LM358 is an operational amp used to amplify the audio signals.

3.12.1 Description of LM358:

- It has a total of 8 pins.
- 1st and 7th pin are output.
- 8th pin is for VCC.
- 4th pin is for ground.
- 2nd, 3rd, 6th, 5th, pins are input.

3.12.2 Use of LM358:

Microphone (figure 15) is connected to the 2nd pin of LM358 when the input is received the output is then generated in the form of 4volts and the audio signal is amplified and the signal is in analog form and then the signal is sent to the operational amplifier to further convert it into digital form.

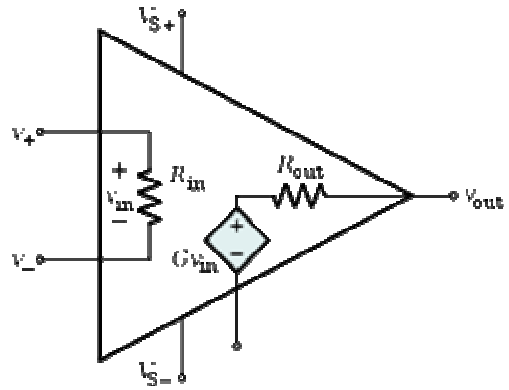


Figure 14

Operational Amplifier

3.13 Operational Amplifier:

It is a high-gain electronic voltage amplifier it has a single output. An op-amp generates the output voltage that is very higher than the voltage difference on its input terminals.

3.13.1 Use of Operational Amplifier:

Operational amplifier helps in getting the signal converted from analog to digital because microcontroller reads digital signals. One the audio signal from LM358 (figure16) is received it is then passed to the operational amplifier(figure 17) It will convert the analogue signal to digital signal to make it easier for microcontroller (figure 1) to read the signal. received.

Figure 15

Motors

3.14 Motor:

Dc motors are direct current motors they require dc voltage to work. DC motors are often used in steam engines or automated machinery like powered wheel chairs . DC motors are in smaller applications also like CD-ROMS VCR's.

3.14.1 Use Of Motors:

2 DC motors of 12volts are used in the wheel chair to take the user to the desired location. They can handle weight up to 100 kg's these motors will work on the circuitry shown in figure14. These motors require 12 volts to operate.

- 4 amp current.
- High torque.
- Low RPM 20-300.

We are using these motors because they have low RPM and voltage that will be used to run them is also low that means when our wheel chair will move it will move without causing any jerk and move slowly at a normal speed.

Chapter#4

Implementation

4.1 How It Works:

- Microcontroller (figure 1) is the main component of the project.
- Batteries of 12v are used but microcontrollers (figure 1) work on 5v so to provide them with a constant 5v dc voltage regulators (figure 13) are used.
- Diodes (figure 4,5) are connected with voltage regulator (figure 13) and relay's (figure 12) so no negative current will be able to flow.
- Capacitor (figure 11,12) is connected to the voltage regulator because voltage regulator (figure 13) gets heated and generates thermal heat that becomes the reason of sinusoidal signals to block them we have used capacitors and capacitor is connected to pin9 of the microcontroller it is by default mentioned to connect the capacitor at pin9 of the microcontroller so whenever the microcontroller starts the program will execute from the start.
- LED is connected to the microcontroller that keeps blinking when the microcontroller is active and it shows that microcontroller is in the working condition and they are connected to the relay's for identification which relays are working at the moment according to the input.
- Microcontroller is working on 0 logic because it provide a good output current that's why PNP transistors are used whenever 0V is provided PNP transistors works as a switch and relay's work according to the input of the joystick.
- 4 relays (figure 12) are connected in the form of H-bridge circuit and 4 PNP transistors (figure 6,7) are used and they work as a switch for the relays.
- When 1 and 3 relays are activated motors move in the forward direction and when 2,4 are activated motors move in the reverse direction.

- A joystick (figure 2) has a total of 8 pins but 6 pins are connected to the microcontroller (figure 1)
- 1st pin is for forward, 2nd for reverse, 3rd for right and 4th for left 5th pin is for voltage and the 6^{th} pin is for ground.
- When the controller gets the input from the joystick (figure 2) to move the wheel chair in the forward direction the controller gives and output in 0v to the PNP transistors (figure 6,7) 1 and 3 relays (figure 12) are activated that moves the wheel chair.
- If the user wants to turn left, right motor (figure 18) will be activated.
- User can also move the wheel chair with the help of speech recognition that is based on time.
- Whenever the user will speak a small word the wheel chair will move in the forward direction and when a sentence will be spoken it will move in the reverse direction.
- A microphone (figure 15) is attached for the input
- The IC LM358 (figure 16) gets the audio signal that is converted into electrical form from microphone (figure15) and amplifies it the signal is still in the form of analogue.
- A threshold is connected so noise won't affect the input of the user.
- An operational amplifier (figure 17) is connected that converts the analogue signal into digital form and through a PNP transistor (figure 6,7)it is sent to the microcontroller (figure 1).
- Microcontroller (figure 1) will now check the time limit of the audio signal if it's just spoken forward or any word that'll take less than a second or closer to it the motors (figure 18) will start running in the forward direction and If the controller detects the time of input audio signal more than a second motors will start running in the reverse direction.

- For joystick (figure 2) control a separate controller is used and for the speech time based movements are separate controller is used.

- 2 DC motors (figure 18) are connected with the wheel chair and two batteries of 12 volts are connected making it a total of 24 volts to run the wheel chair.

Chapter#5

Conclusion & Future Enhancement

Conclusion:

Fist we did a detailed study on an existing wheel chair and the components that were used to complete it. Then we designed the dataflow diagram, designed the simulation of the hardware, started implementing the hardware, used our own logic for programming and then integrated both software and hardware to get our final working project..

To complete this project we went through the whole learning phase which benefited us a lot following are some benefits:

- Project Management.
- Assembly Language and C language.
- Keil µvision.
- Documentation.
- Interfacing of microcontroller with hardware.

Future Enhancement:

We will try to improve our wheel chair by adding these features to it

- User will think of moving and the wheel chair will move in the direction that was thought.
- User will be able to move the wheel chair with their eyes it will be retina based.
- Touch screen will be added to the wheel chair and with a finger the wheel chair will be move

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- Figure 2

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- Figure 3

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- Figure 4

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- Figure 5

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- Figure 6

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- Figure 7

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- Figure 8

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- Figure 9

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- Figure 10

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- Figure 11

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- Figure 12

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- Figure 13

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Appendices:

Code:

```
#include <AT89X52.H>

sbit led1    = P1^0; //cam

sbit led2    = P1^1;//captur

sbit led3    = P1^2; //cam

sbit led4    = P1^3;//captur

sbit Blink     = P2^0;

 unsigned int n;

 void Delay(unsigned int x)

{

        unsigned int i,j;

        for(i=0;i<=x;i++)

        for (j=0;j<=500;j++);

        }

void main()

   {
```

```
    Blink = 0;
    n     = 0;
    while(1)
     {
           n++;
           if(n == 25000)
             {
                  n = 0;
        Blink =~ Blink;
                  }
 ////////////////////////////////////////////////////////////////////////////
if(P3_1 == 0 )
    {
     led1 = 0; //fff
   led3 = 0;
   Delay(200);
   led3 = 1;
   led1 = 1;
    }
////////////////////////////////////////////////////////////////////////////
if(P3_2 == 0 )
```

```
    {
   led2 = 0;//rrr
   led4 = 0;
   Delay(200);
   led4 = 1;
   led2 = 1;
 }
////////////////////////////////////////////////////////////////////////////
if(P3_3 == 0 )//lll
    {
   led1 = 0;
   Delay(200);
   led1 = 1;
    }
////////////////////////////////////////////////////////////////////////////
if(P3_4 == 0 )///rrr
    {
   led3 = 0;
   Delay(200);
  led3 = 1;
    }
```

```
    }

}
```