KANTIPUR ENGINEERING COLLEGE

(Affiliated to Tribhuvan University)

Dhapakhel, Lalitpur

A MINOR PROJECT MID-TERM DEFENCE

ON

"GESTURE CONTROLLED WHEELCHAIR"

Submitted by

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ABSTRACT

Unfortunate happenings with human which may lead to lower body paralysis or unable to walk. It can happen with anyone. Such happenings might be caused by accidents or by birth. The main purpose of this project is to prepare a Hand Gesture Controlled Wheelchair for the physically disabled people who face difficulty in moving from one place to another. Recently, strong efforts have been carried out to develop intelligent and natural interfaces between users and computer based systems based on human gestures. Gestures provide an intuitive interface to both human and computer. Thus, such gesture-based interfaces can not only substitute the common interface devices, but can also be exploited to extend their functionality. Gesture controlled wheelchair is a simply controlled by simple gestures. The user just needs to wear a gesture device which includes a sensor. Further the input from sensor is given to encoder which sends the data wirelessly through the transmitter, then the data is received at the receiver end and the sensor data is decoded and finally given to microcontroller. Based on data received the from accelerometer the microcontroller sends the signal accordingly to relays to move the wheelchair in forward, backward, left, right directions. The wheelchair and the Gesture device are connected wirelessly via radio waves. The wireless communication enables user to interact with the robot in a more friendly way.

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Chapter 1: Introduction

1.1 Background

A wheelchair is a chair with wheels, used when walking is difficult or impossible due to illness, injury, or disability. The earliest record of a wheelchair is in China between around the 5th century to move heavy objects. It may have been used as a form of transport. The earliest records of it being used for transporting disabled people dates to three centuries after. Some time later, Europeans built a similarly designed wheelchair. After many iterations, the design of wheelchairs became more efficient and it came into common use around 1760.

Up until the 16th century, wheelchairs had to be propelled by hands or required aid from another person. However in 1655, the world's first self-propelling wheelchair was invented, which used a system of cranks and cogwheels. The user would operate the cranks with thier hands to operate the wheelchair so it would exhaust the user quickly.

In 1933, the first lightweight and folding portable wheelchair was created and it became very popular. Hence, wheelchairs now became available in two forms, rigid and folding. all the newer folding wheelchairs use the same design with slight variations. They are widely used in hospitals in present times.

Sometime later, powered wheelchairs were introduced, which used different methods of input ranging from a simple joystick to chin-operated control. They use batteries and motors to provide easy form of movement compared to the older mechanical wheelchairs. Powered wheelchairs or powerchairs are easy to operate and provide better movement speed compared to mechanically operated wheelchairs.

Recent technological advances are slowly improving powerchair technology. The powered wheelchairs have been further enchanced in this age by electronics to give birth to gesture controlled wheelchairs which are able to adjust speed in different terrain.

In the context of Nepal, the wheelchairs used are usually mechanically operated due to the high cost of powerchairs versus a low average income. Hence, powerchairs are not very feasible in Nepal. This project's aim is to provide a solution to this problem.

1.2 Project Overview

Wheelchairs are used by ill, injured or disabled people to aid in movement. Moreover, for disabled people, it is a part of thier daily lives. In the context of a poor country like Nepal, it is unfeasible to invest in a motorized wheelchairs as they are very expensive and unaffordable to most Nepali citizens. Another problem is availability, it is difficult to find stores that will sell such electric wheelchairs even if you want to buy them, since they are not very popular in Nepal. As a result, we see disabled people operate mechanical wheelchairs which require a lot of human energy to operate.

This project aims at making a smart powerchair which is also cost effective. The consumers that this project is aimed at are the disabled citizens of Nepal. The wheelchair will provide buttons to control movement which will be very easy to adjust for a first time user. The wheelchair is also smart in the sense that it will automatically adjust its speed when the user is navigating through slopes.

Through this project, we aim to make the lives of disabled people easier and allow them more independence.

1.3 Objectives

1. To create wirelessly gesture control system.
2. To create automatic speed control device.

1.4 Features

1. Effective in implementation.
2. It can be operated very easily.
3. Already available technology such as accelerometer and gyroscope is put to

use combined with programming.

4. Cost effective and portable.
5. Results are consisted, expected and can be reproduce easily due to simplicity of project.
6. Low power consumption and compact size.

1.5 Feasibility Analysis

1.5.1 Technical Feasibility

All the equipments that we have used int his project are easily available in market. Flex sensor, accelerometer and gyro sensor can be easily interfaced with Arduino as it contains built-in analog to digital converter. Here, nRF24L01 is used to communicate between two section of project. Our project can be used almost all of the time. It uses low power devices so the efficiency is better**.**

1.5.2 Operational Feasibility

Gesture control wheelchair has great area of implementation around the world as number of physically disabled people is high. We have used gesture sensing sensors so by simple hand gesture wheelchair can be operated. Wheelchair can be also cotrolled from different room by using gestures. To use gesture control wheelchair one just has to wear a glove.

1.5.3 Economical Feasibility

This project is very economically feasible as equipments used are available in market in cheap price. Our cost estimation is low and reasonable. Glove needed as controller are not special kind of glove. Wheel chair only consists motors and motor driver as main driving unit which can be found at cheap price. This device consumes low power so battery used won’t need to be charged that often.

CHAPTER 2: LITERATURE REVIEW

The percentage of disabled people has increased in both rural and urban part of Nepal. The disability could be by birth or due to some medical or accidental reason. The aim of this paper is to make a hand gesture controlled wheel chair to help the physically disabled people in moving from one place to another just by giving direction from the hand. Today in Nepal many people are suffering from disability, there are people whose lower half of the body is paralyzed. This Wheelchair will add on to the comfort and make the life of people bit easier. According to census of 2011 there are about 36.3 percent of the disabled population are physically disabled. When an unfortunate event affects the motor capacity of a person, it is necessary to use devices like wheelchairs that offer a means of displacement for patients with motors problems of the lower limbs. Tremendous leaps have been made in the field of wheelchair technology. However, even these significant advances haven't been able to help quadriplegics navigate wheelchair unassisted. Some patients that cannot manipulate the wheelchair with their arms due to a lack of force or psychomotor problems in the superior members, request electric wheelchairs, frequently manipulated with joysticks; however the joystick manipulation is even not practical and frequently it must be handle with the mouth. The present article presents the partial results in the development of a wheelchair controlled by an intuitive interface, where the instructions are given by hand gesture instructions. The advances are presented in the realization of the control software using a Webcam and some distances and presence sensors controlled by a PIC microcontroller that establishes the communication with a program developed in Lab view. Our paper deals with the control of wheelchair motion by hand gesture.

Prof. Chitte p.p., Miss: Khemnar S.B. ,Miss: Kanawade A.A. , Miss:Wakale S.B. introduced " A Hand Gesture Based Wheelchair For Physically Handicapped Person with Emergency Alert System". The system is classified into gesture unit and wheelchair unit. This wheelchair can be control by simple hand gestures. It consist a Accelerometer sensor which is control the wheelchair hand gesture made by the users and clarify the motion consist by user and moves accordingly. The sensor registers values are changed & that values are given to lpc2138 controller.

Depending on the direction of the Acceleration, ARM7 controller controls the wheelchair ways like LEFT, RIGHT, FORWARD, & BACKWARD.

Carl A. Pickering, Keith J. Burnham , Michael J. Richardson introduced " A Research Study of Hand Gesture Recognition Technologies and Applications for Human Vehicle Interaction." This paper describes the primary and secondary driving task together with Human Machine Interface (HMI) trends and issues which are driving automotive user interface designers to consider hand gesture recognition as a realistic alternative for user controls. A number of hand gesture recognition technologies and applications for Human Vehicle Interaction (HVI) are also discussed including a summary of current automotive hand gesture recognition research.

Premangshu Chanda, Pallab Kanti Mukherjee, Subrata Modak, Asoke Nath introduced "Gesture Controlled Robot using Arduino and Android" in International Journal of Advanced Research in Computer Science and Software Engineering. This paper deals with the design and implementation of a wireless gesture controlled Robot using Arduino ATMEGA32 processor and an Android operated application to control the gestures via Bluetooth with minimal, and cheap hardware requirements. The system can be broadly classified into two components: The Hardware part consisting of Arduino Microcontroller, the Adafruit motor Shield, HC-05 Bluetooth module, and the Android Smartphone, and the software part consists of a Java based application run on android.

CHAPTER 3: SYSTEM REQUIREMENTS

3.1 SOFTWARE REQUIREMENTS

1. Arduino IDE
2. Proteus

3.1.1 Arduino IDE

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open-source software. This software can be used with any Arduino board. The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub *main()* into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program *avrdude* to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

3.1.2 Proteus

The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards. The Proteus Design Suite is a Windows application for schematic capture, simulation, and PCB (Printed Circuit Board) layout design. After simulating your circuit using Proteus Software you can directly make PCB design with it so it is an all in one package for students and hobbyists.

3.2 Hardware Requirements

1. Arduino UNO
2. Arduino Lilypad
3. Accelerometer
4. Gyro Sensor
5. nRF24L01 Module
6. Servo Motor
7. Flex Sensor
8. Glove
9. Circuit components like Resistors, capacitors, jumper cables.
10. Male-female connectors
11. Battery 9V
12. Wheels

3.2.1 Arduino UNO

Arduino Uno is a microcontroller board developed by Arduino.cc and based on Atmega328. Arduino Uno is a very valuable addition in the electronics that consists of USB interface, 14 digital I/O pins, 6 analog pins, a 16 MHz quartz crystal, USB connection and Atmega328 microcontroller. It also supports serial communication using Tx and Rx pins. We can simply connect it to a computer with a USB cable or power it with AC-to-DC adapter or battery to get started. Also, USB can be used to upload the program in the Arduino UNO.

Figure 3.2.1-Arduino UNO

3.2.2 Arduino Lilypad

The LilyPad Arduino 328 Main Board is an Arduino-programmed microcontroller designed to be easily integrated into e-textiles and wearable projects. It offers the same functionality you find in other Arduino boards, in a lightweight, round package designed to minimize snagging and profile, with wide tabs that can be sewn down and connected with conductive thread. The LilyPad Arduino consists of an ATmega328 with the Arduino bootloader and a minimum number of external components to keep it as small (and as simple) as possible. This board will run from 2V to 5V and offers large pin-out holes that make it easy to sew and connect. Each of these pins, with the exception of (+) and (-), can control an attached input or output device (like a light, motor, or switch).

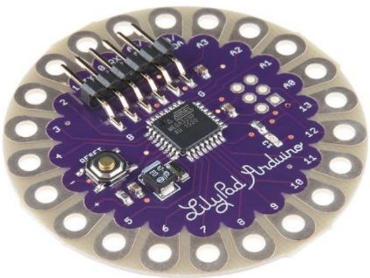

Figure 3.2.2-Arduino Lilypad

3.2.3 Flex Sensor

A flex sensor or bend sensor is a sensor that measures the amount of deflection or bending. Usually, the sensor is stuck to the surface, and resistance of sensor element is varied by bending the surface. Since the resistance is directly proportional to the amount of bend it is used as goniometer, and often called flexible potentiometer.

Figure 3.2.3-Flex Sensor

3.2.4 Gyro Sensor

Gyro sensor is one of the types of a motion sensor. Motion sensors are the sensors, which senses the movements, such as tilt, shake, rotation, or swing. Gyro sensors are the type of sensors used to sense the angular rate or angular velocity. Gyro sensors can sense rotational motion and changes in orientation and therefore augment motion. Vibration gyro sensors can sense angular velocity due to the Coriolis force applied to a vibrating element. This motion produces a potential difference from which angular velocity is sensed. The angular velocity results in an electrical signal output.

Figure 3.2.4-Gyroscope Sensor

3.2.5 Accelerometer

An accelerometer is a device that measures changes in gravitational acceleration in a device it may be installed in. Accelerometers are used to measure acceleration, tilt and vibration in numerous devices. Accelerometers are useful for sensing vibrations in systems or for orientation applications. An accelerometer is able to detect acceleration through a micro-electromechanical system (MEMS), which changes electrical properties such as voltage. These changes are translated into signals, which are sent to the appropriate software for processing.

Figure 3.2.5-Accelerometer

3.2.6 nRF24L01 Module

nRF24L01 is a single chip radio transceiver for the world wide 2.4 - 2.5 GHz ISM band. The transceiver consists of a fully integrated frequency synthesizer, a power amplifier, a crystal oscillator, a demodulator, modulator and Enhanced Shock Burst protocol engine. Output power, frequency channels, and protocol setup are easily programmable through a SPI interface. Built-in Power Down and Standby modes makes power saving easily realizable.

Figure 3.2.6-nRF24L01 Module

3.2.7 Servo Motor

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. A servomotor is a closed loop servomechanism that uses position feedback to control its motion and final position. The input to its control is a signal (either analogue or digital) representing the position commanded for the output shaft. The motor is paired with some type of encoder to provide position and speed feedback. In the simplest case, only the position is measured. The measured position of the output is compared to the command position, the external input to the controller. If the output position differs from that required, an error signal is generated which then causes the motor to rotate in either direction, as needed to bring the output shaft to the appropriate position. As the positions approach, the error signal reduces to zero and the motor stops.

Figure 3.2.7-Servo Motor

CHAPTER 4: METHODOLOGY

This device consists of two parts i.e. transmitting part and receiving part. In transmitting, it consists of accelerometer, flex sensor, Arduino Lilypad and nRF24 module whereas receiving circuit consists of Arduino, nRf24 module. Transmitting circuit is present in the hand of user, according to whose hand gesture device is controlled. Receiving circuit is present in device to be controlled. According to motion of hand and finger of user sensors present in hand provides input signal to Lilypad Arduino where signal are processed and desire result is transmitted through transmitter. Then receiver receives the signal from hand motion and supplies it to the Arduino where again data are processed and according to data it controls the behavior of motor.

Circuit for this hand gesture control device is simple. A nRF24L01 pair is used for communication between Arduino. Arduino then control the motors according to what type of data it receives. Here we used the servo motor to drive wheelchair. One motor is connected to digital pin 3 of arduino while another to 9. A 9V battery is used to power the motor for driving motors.

Gesture controlled wheelchair moves according to hand and finger movement. When we tilt hand sidewise then wheelchair moves either left or right direction and when we bend or stretch one finger connected to flex sensor it moves forward or backward. And to stop or keep it in stable position we keep hand stable and finger straight. while moving towards uphill or downhill according to data of gyroscope and accelerometer in wheelchair speed of motors are controlled. When going downhill wheelchair automatically reduces its speed by the readings from gyroscope and accelerometer. In this way, the movement of wheelchair can be controlled by simple gesture of hand.

4.1 Hardware Development

4.1.1 Block Diagram

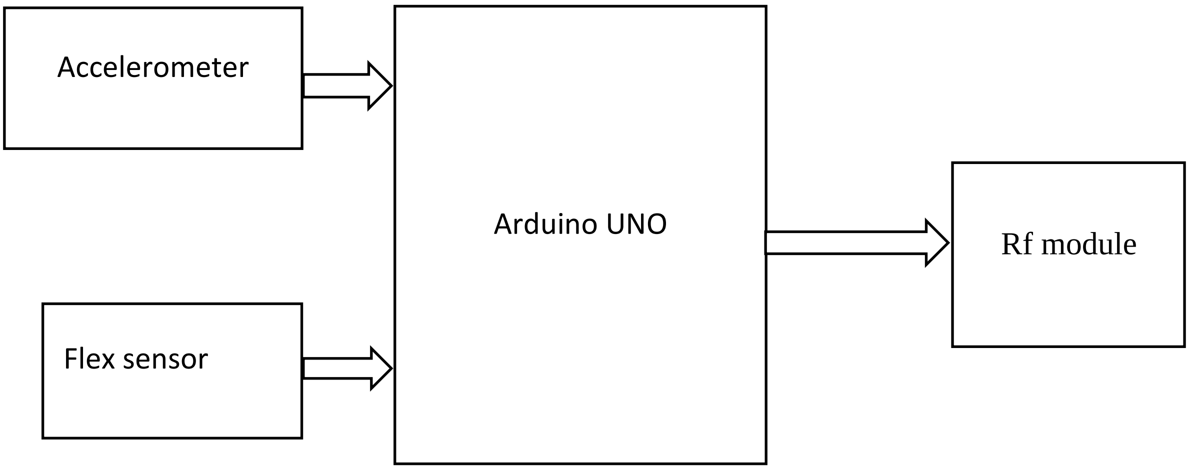

Figure 4.1.1(a)-Block diagram of controller

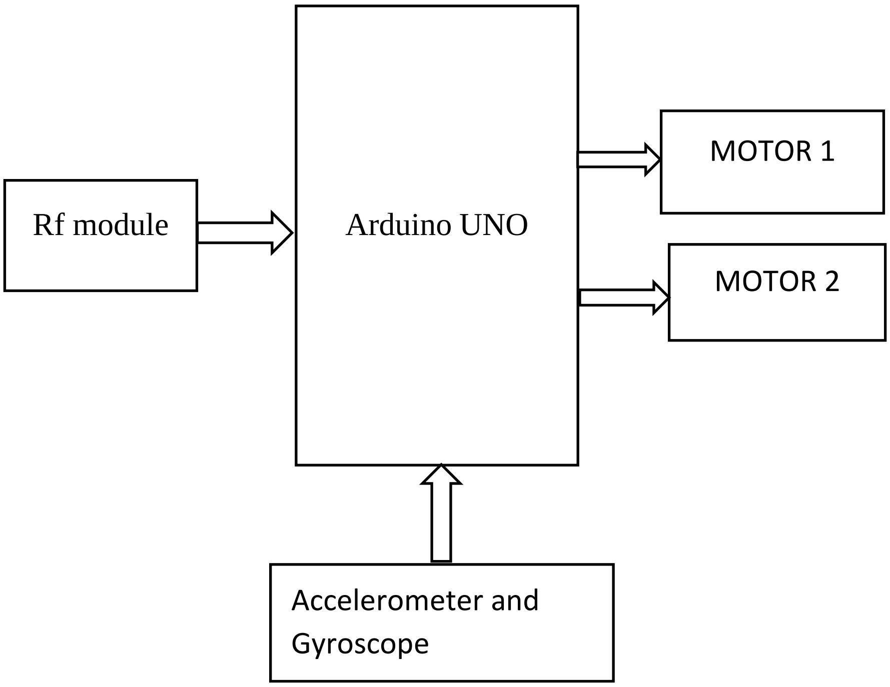

Figure 4.1.1(b)-Block diagram of wheelchair

4.2 Software Development

4.2.1 Flow Chart

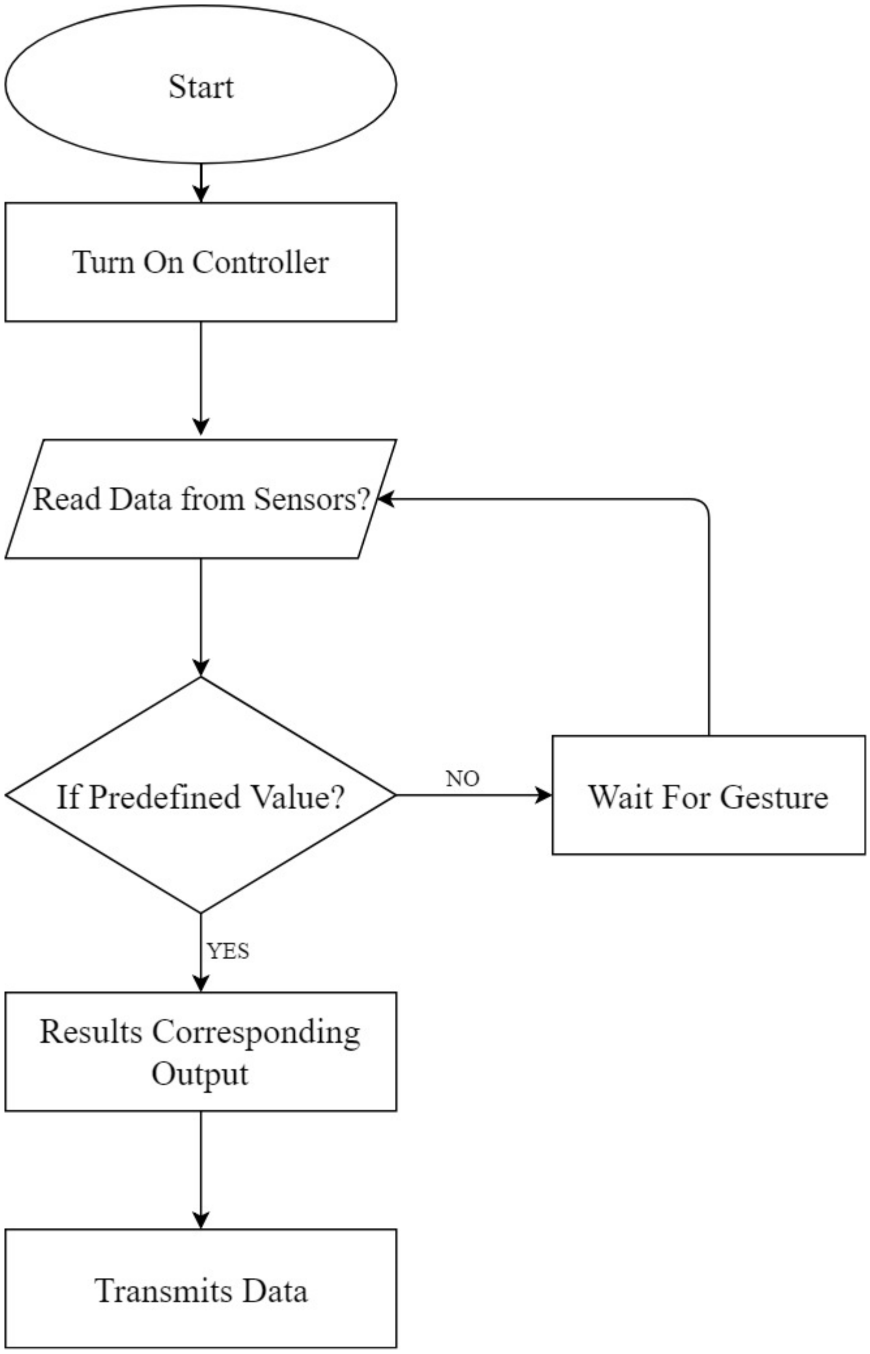

Figure 4.2.1(a)-Flow chart of controller

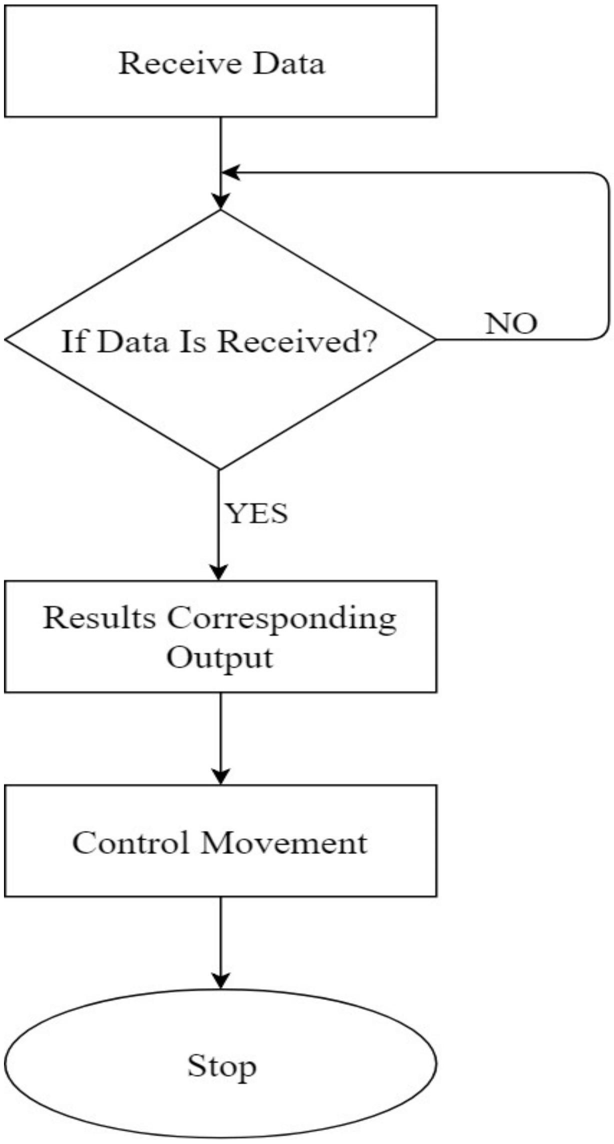

Figure 4.2.1(b)-Flow chart of wheelchair

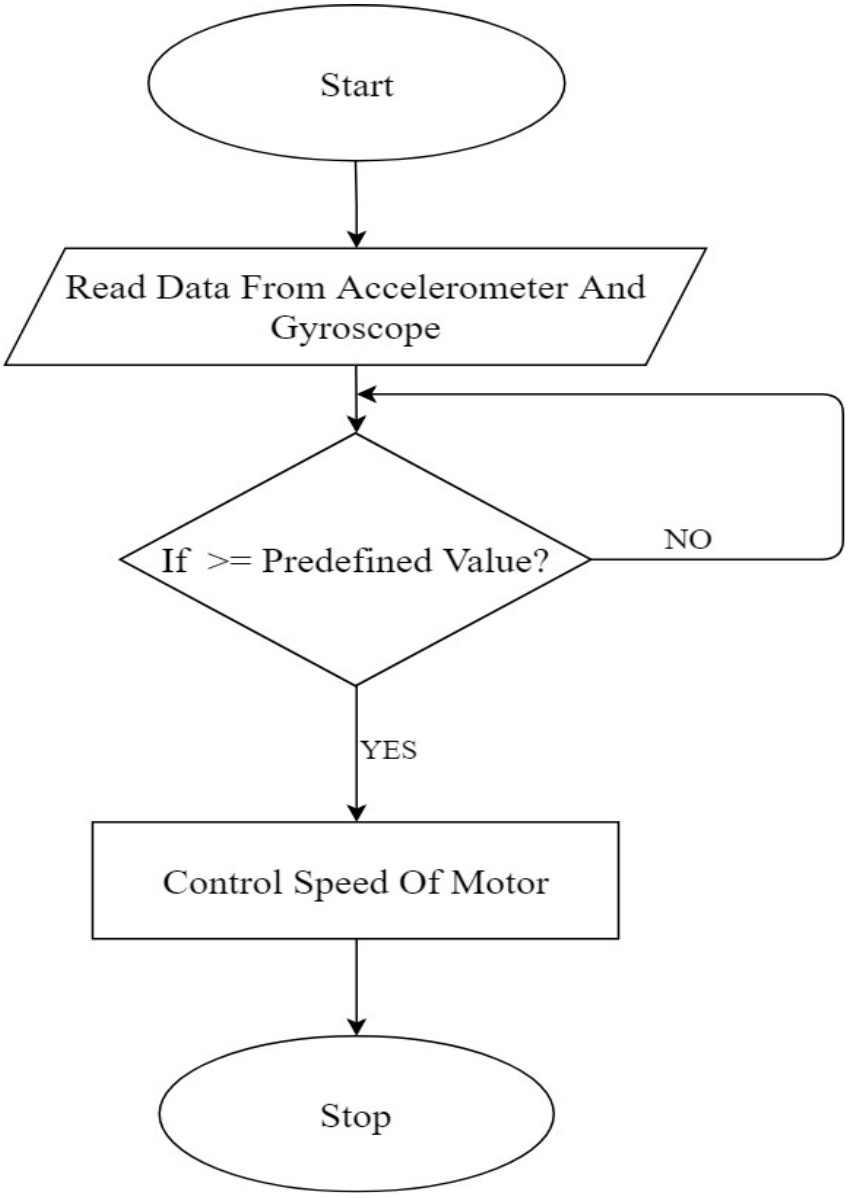

Figure 4.2.1(c)-Flow chart for speed control

4.3 Project Plan

S.NO	Works	Time(month)								
		1	2	3	4	5	6	7	8	9
1	Research									
2	Familiarization of Equipment									
3	Designing									
4	Learning and Coding									
5	Testing and Debugging									
6	Documentation and Report									

Figure 4.3-Gantt chart

4.4 Budget Analysis

MATERIALS	QUANTITY	COST ESTIMATION(NRS.)
Arduino UNO	1	1500
Arduino Lilypad	1	1000
Flex Sensor	1	1000
Accelerometer	2	500
Gyro Sensor	1	500
Servo Motor	2	2000
nRF24L01 Module	2	600
Glove	1	200
Resistors, Capacitors	-	50
Connecting Wires	-	50
Wheels	2	500
Battery 9V	3	750
Total		7650

Chapter 5. Epilogue

5.1 Work Completed

1. We got familiarized with the hardware and software requirement of our project.
2. We studied about speed control of motors from signal provided by PWM from Arduino.
3. We studied about wireless communication using RF module.
4. We learned to interface sensor and Rf module in Arduino.
5. We took accelerometer, Rf module and Arduino.
6. We plotted the accelerometer reading in serial monitor.

5.2 Application

1. Helps disabled people to move easily and freely.
2. Can be controlled by another person.
3. Speed can be controlled in inclined surface.

5.3 Expected Outcomes

After the completion of our minor project on gesture controlled wheelchair we expect to control the movement of wheelchair the gesture of our hand. When we tilt our hand towards left the wheelchair must move towards left and similarly when we tilt our hand towards right the wheelchair must move in right direction. And by the movement of our finger the wheelchair must move forward and backward direction. And when there is downhill the wheelchair must automatically reduce its speed.

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