FRDMKL25Z based Gesture Controlled Wheelchair

B.E. Project Report

Submitted in partial fulfillment of the requirements

For the degree of

Bachelor of Engineering

(Electronics Engineering)

by

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is a bonafide work done by

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and is submitted in the partial fulfillment of the requirement for the degree of

Bachelor of Engineering
(Electronics Engineering)
to the
University of Mumbai.

Examiner 1 | Examiner 2 | Supervisor

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Abstract

The main objective of this project is to create a hand gesture controlled wheelchair for the physically disabled person so that he/she can move from one place to the other without any physical efforts. For the ease of operation and implementing simplification we had used embedded system freedom board viz., FRDMKL25Z board which consist of on-board accelerometer i.e. 3-axis accelerometer which reads the respective values of x, y and z axis and controls two dc motor.
This wheelchair can move either in forward, reverse, left or right directions based on the values calculated by accelerometer. We used wireless technology for this; the transmitter part sends the accelerometer values to the receiver which further controls the movement of motors. Nrf module is mounted on both the transmitter and the receiver board which helps in sending data wirelessly.

Keywords: FRDM, accelerometer, nrf module

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Abbreviations

UART	Universal Asynchronous receiver transmitter
MCU	Microcontroller unit
PWM	Pulse width modulation
SPI	Serial peripheral Interface
I/O	Inputs and Outputs
I2C	INTER INTEGRATED CIRCUIT
IEEE	Institute of Electrical and Electronic Engineers
ADC	Analog to Digital Converter
USB	Universal serial Bus
GPIO	General purpose input output
DAC	Digital to Analog converter
SDK	system developement kit
SRAM	Static random memory access
RTC	Real time clock
HMI	Human-Machine Interface

List of Components

Name of Component	Quantity
ARM FRDMKL25Z Board	2
DC Motors	2
motor driver kit	1
Bot (2 wheels)	1
shields	2
nRF24L01P	2
Connecting chords	12
Batteries(9V-12V)	1
12V Adapter	1
Power banks (5V, 2.1A)	2

Chapter 1

Introduction

We are all familiar with the concept of the gesture-controlled robot. Basically, a gesture controlled robot is something which uses hand gestures to control something which reduces human efforts. In this project, we have created a gesture-controlled wheelchair which can be used to move from one place to another to reduce human efforts. The FRDM-KL25Z is a low-cost development platform built on ARM Cortex M0+ processor. some of the features of FRDM board include easy access to microcontroller input and output, battery, low power operating modes, a standard form factor with many expansion board options. Therefore the main motive behind making this project is to create a way through which a physically disabled person can travel from one place to the other without taking any physical efforts.

Depending on the direction of the Acceleration, the microcontroller controls the wheelchair directions like LEFT, RIGHT, FRONT, and BACK which is discussed in further chapters. This project can be developed on various platforms using microcontrollers, Arduino, Raspberry pi, Zigbee etc. and also can be either wired or wireless. In this project, we have used wireless communication which consists of transmitter and receiver. Nevertheless, the wheelchair is also equipped with an ultrasonic sensor which avoids a collision against walls or the hard objects coming in the way like tables, bed corners, cupboards, etc. Our principle is to create a hand gesture controlled the wheelchair using embedded system design. The freedom board used consists of an onboard accelerometer or in other words, the tilt sensor that is installed on the hand of the physically disabled person. Therefore, as the user changes the gesture values for forward, reverse, left and right motion the wheelchair is directed accordingly. FRDMKL25Z is a low-cost board built on ARM cortex M0+ which is its biggest advantage and other than that,it consists of an onboard accelerometer.

The biggest advantage of this project is that the programming can be altered and developed according to the needs of the user. In addition to that, person health can be monitored by using heart rate monitoring, ECG(electro-cardiography) process. The idea of the project is to create a hand gesture controlled wheelchair for the physically disabled person so that he/she can move from one place to the other without any physical efforts.This is based on embedded system freedom board frdmkl25z which is a low-cost board consisting of the on-board accelerometer. We have to control the wheelchair using wireless technology by changing respective gesture values. The basic working of the

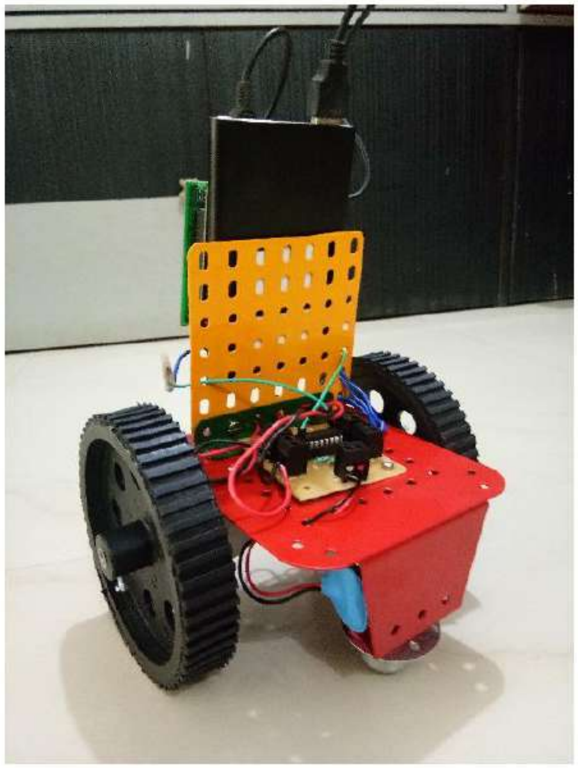

Figure 1.1: Wheelchair

project is split into two parts i.e. transmitter and receiver. The transmitter part will calculate the accelerometer values and send the same to the receiver. Hence, receiver part reads the same and controls 2 dc motors accordingly.

By implementing this project, we can create a platform for the physically handicapped person where he/she can move independently from one place to the other by using only gestures of hands. This project is wireless, so adding to the advantage it is more user friendly than the wheelchairs which are wired. This gesture controlled wheelchair is equipped with ultrasonic sensors which avoids the collision of wheelchair with obstacles such as walls, tables, bed corners, doors etc. It is flexible and the operations of the wheelchair can be changed as per the need of user. The only disadvantage in this project is the power, if the microcontroller board do not receive enough supply the wheelchair will stop working.

The advantages of using a gesture controlled wheelchair is that-

- It is based on microcontroller which is Arm cortex m0+, so if required modifications and developments can be done, ie. changes can be done in the moveent of wheelchair in either left or right directions by changing accelerometer values.

- It can also be used to monitor the health of the person as an biomedical application,
- Wireless communication makes it faster and hence better,
- Parts are available easily and absolutely are inexpensive.

1.1 Motivation

- The motivation behind this project resides in creating cheap products for medical applications including medical instruments required for diagnosing psychological diseases and instruments for aiding paralyzed, amputees and handicapped patients.
- Basic tasks could be the jobs that are harmful to the humans, repetitive jobs that are stressful and tiring on day to day basis. Though robots can be a replacement to humans, they still need to be controlled by people themselves. Robots can be wired or wireless, both having a controller system to complete basic operations. Both have pros and cons associated with them which will overcome in coming years. Beyond controlling the robots through physical devices, the recent methods of gesture controlled robots has become very popular because it reduces human efforts on large scale.
- The main purpose of using gestures is that it provides a more natural way of controlling and provides a rich form of interaction with the robotic system.
- This mainly involves embedded system design, image processing and machine learning for the system or application development. Beyond this, it also requires some kind of hardware for interfacing with the system. The hardware is controlled with the help of software. There are some devices that have been developed in the same field using various technologies. This designs can be implemented on embedded platform to control wheelchair by using an accelerometer or a tilt sensor. This technology can help patients suffering from diseases and can also have huge scope in future.
- The Monitor can be implemented using the design of the wheelchair robot. This Monitor will keep on track and determine the nature of the disease which will provide a fruitful solution for curing the disease. Sleep deprivation has become the focus of health concern and researches are being done on the same. This few additions will help to monitor various sleeping patterns.

1.2 Problem Definition

- Our task is to create a wheelchair for the physically disabled person so that he/she could move in any direction by controlling the gestures of his hands.
- For the purpose of ease in handling and fast response the project is done using wireless technology.
- Controlling of speed of motors so that wheelchair does not collapse while taking turns.
- Applying stop condition at default position.
- Also make sure that the wheelchair executes stop condition before moving from left turn condition to the right turn condition, otherwise it may imbalance and collapse.

1.3 Organization of Report

The report is organized as follows:

- Chapter 1: Includes introduction along with motivation, objectives, problem definition and organization of report.
- Chapter 2: Includes literature survey along with the research work of gesture controlled wheelchair.
- Chapter 3: contains hardware implementation of project
- Chapter 4: contains software implementation of project
- Chapter 5: includes Result of the project
- Chapter 6: includes Conclusion of project

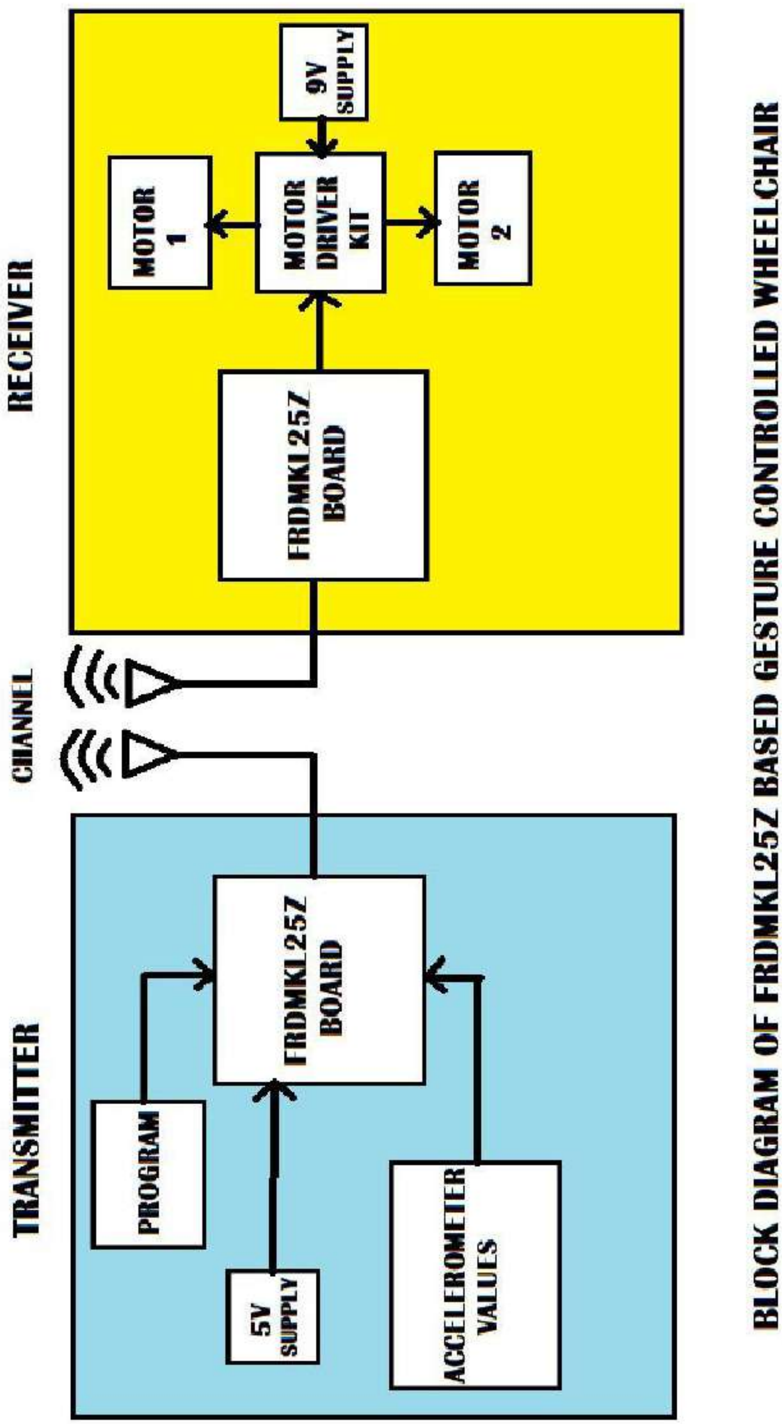

Figure 1.2: block diagram

Chapter 2

Literature Survey

Recently research work has been going on hand gesture control technology in many ways for the devices to be more easy to operate. There are two types of Gesture Recognition methods which are well-known .ie. Vision-based technique and MEMS (Micro-electro-mechanical system) based method. After so many years of research on Vision-based technology, many applications for Home automation and controlling machines mechanisms has been developed using these various methods. In vision based method, controls of devices can be done by taking signs made by Eyes, pulses, head and arms. But there are many limitations with this techniques, so research has been turned into MEMS method in the early years. MEMS technology uses two motion sensors or the accelerometers and Gyroscopes can be used for Gesture Recognition device. But no methods exist using gyroscopes technique because of system and programming difficulties. An accelerometer device is the best-suited motion sensor for Gesture recognition based applications in MEMS technology.

Some researchers made an attempt to develop a portable system for the Disabled persons and also for the Handicapped and amputees people so that they can move the wheelchair with simple hand gestures. One such system is the system of MEMS Accelerometer Hand Gesture Recognition. Here in this process, Gesture Segmentation and Feature extraction are followed in which Basic operation of the wheelchair are through the gestures made by the person, which include a long process of signal processing; but otherwise, the main aim of any system is to reduce the computational and programming burden. Therefore, the principle of the accelerometer in embedded systems has been considered for the Gesture recognition using 3-axis values of Accelerometer ie. X axis, y-axis, and z-axis.

The generated gesture recognition data from an accelerometer is a recently popular technique for gesture-based interaction after the large development of the MEMS devices technology. But the accelerometers are embedded in most of the new personal electronic devices such as mobiles, embedded boards, Apple iPhones, Nintendo Wiimote which provides new possibilities for interaction in a wide range of applications, such as home appliances, television systems, offices, video games and most important in hospitals. Hand Gesture recognition has been extensively investigated. The vast work has focused on detecting the contour of hand movement. Computer techniques in different formats have been rigorously discovered in this path. The Wiimote has a camera that is, an IR sensor inside the remote and detects motion by tracking the relative movement of IR transmitters mounted on the display screen.

In the paper by J.S. Kim, a gesture pattern recognizing algorithm has been used to study the various hand gesture techniques. Also, there are many papers where training of gestures for using a large database of near about 5k-10k positive and negative images are considered. But this procedure is time-consuming. In Paper by Garcia Valdez, a three-axis accelerometer has been used to read different types of gestures made by an arm. Thus, by accessing the extra circuitry on the arms based on gesture techniques involves reattaching a number of accelerometers with the arm, which causes difficulty in understanding the connections which lead to a loose connection. In the International Journal of Scientific Engineering and Technology says the system which may result in incorrect outputs. Hand gesture recognition using image processing algorithms much time involve the use of color gloves for color detection. By tracking this color glove different hand gestures can be interpreted as described by Francesco Camastra in their paper. Here, they had modeled a color classifier performed by a technique of Learning Vector Quantization. In the paper by Sisil Mehta, a combination of accelerometer and gyroscope readings and the same are taken into for recognizing the gestures made by an arm. Thus, the accelerometer is dedicated to collect dynamic and static change in a vector of hand and interfere with the movement of mouse whereas gyroscope has been used for the rotation of the object. There are many papers where gestures are being analyzed using a color glove techniques.

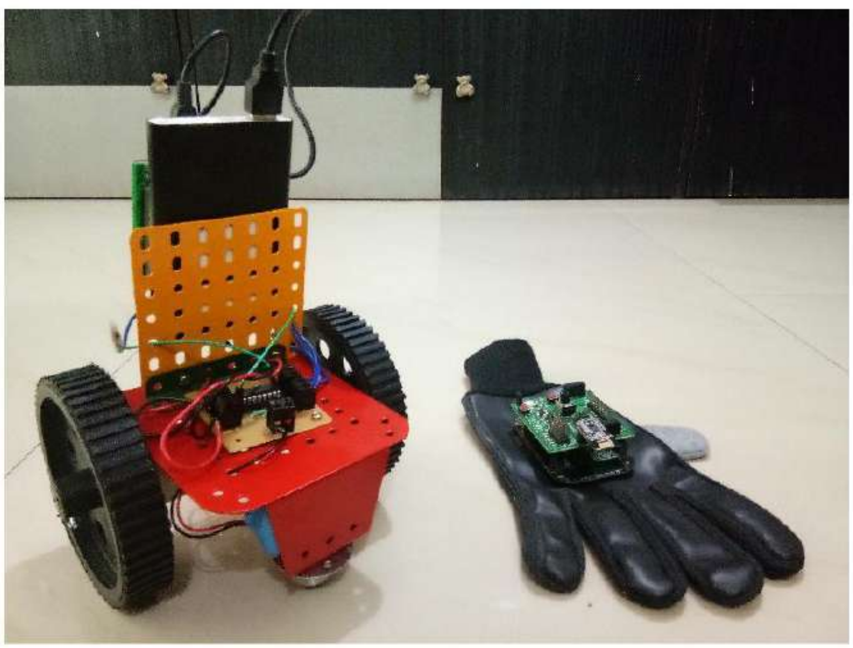

Figure 2.1: Wheelchair setup

Chapter 3

Hardware Implementation

3.1 FRDM Board

The FRDM-KL25Z is an low-cost development platform for Kinetis L Series KL1x (KL14/15) and KL2x (KL24/25) MCUs built on ARM Cortex M0+ processor. Features include easy access to MCU I/O, battery-ready, low-power operation, a standard-based form factor with expansion board options and a built-in debug interface for flash programming and run-control. The FRDM-KL25Z is supported by a range of NXP and third-party development software. The FRDM-KL25Z has been designed by NXP in collaboration with mbed for prototyping all sorts of devices, especially those requiring the size and price point offered by Cortex-M0+ and the power of USB Host and Device. It is packaged as a development board with connectors to break out to strip board and breadboard, and includes a built-in USB FLASH programmer. It is based on the NXP KL25Z, with a 32-bit ARM Cortex-M0+ core running at 48MHz. It includes 128KB FLASH, 16KB RAM and lots of interfaces including USB Host, USB Device, SPI, I2C, ADC, DAC, PWM, Touch Sensor and other I/O interfaces. The FRDM-KL25Z is fully supported in the mbed platform, so it gets access to the free tools and SDK that provides experienced embedded developers with powerful and productive tools for building proof-of-concepts. The pinout above shows the commonly used interfaces and their locations. The Free-scale Freedom development platform is a set of software and hardware tools for evaluation and development. It is ideal for rapid prototyping of micro controller based applications. The Free-scale Freedom KL25Z hardware, FRDM-KL25Z, is a simple, yet sophisticated design featuring a Kinetis L series micro controller, the industry's first micro controller built on the ARM Cortex M0+ core. FRDM-KL25Z can be used to evaluate the KL1 and KL2 Kinetis L series devices. It features a KL25Z128VLK, a KL2 family device boasting a max operating frequency of 48MHz, 128KB of flash, a full speed USB controller, and loads of analog and digital peripherals. The FRDMKL25Z hardware is form factor compatible with the Arduino R3 pin layout, providing a broad range of expansion board options. The on-board interfaces include an RGB LED, a 3-axis digital accelerometer, and a capacitive touch slider. The FRDMKL25Z is the first hardware platform to feature the Freescale open standard embedded serial and debug adapter known as OpenSDA. This circuit offers several options for serial communications, flash programming and run-control debugging.

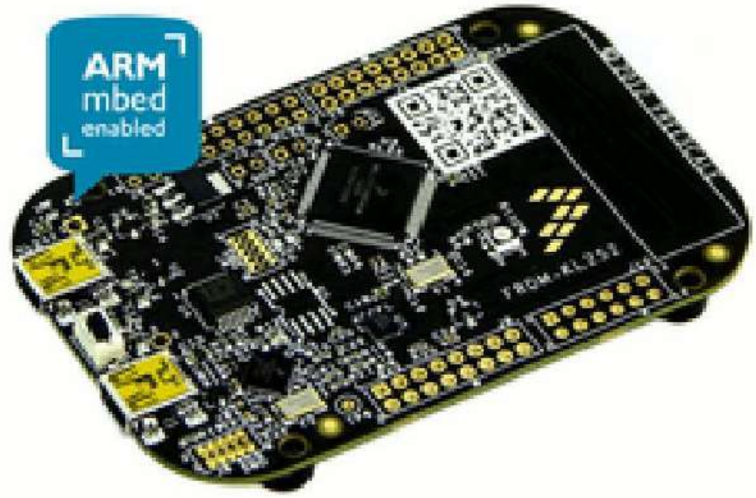

Figure 3.1: FRDMKL25Z Board

3.1.1 FRDMKL25Z Features

The main features of FRDMKL25Z board are as follows:

It uses high performance ARM Cortex M0+ processor
Operating frequency of FRDMKL25Z is 48MHz.
It has 16KB RAM and 128KB FLASH
Contains USB interface(Host/Device)
Contains 2 SPI interfaces.
Includes 2 I2C interfaces.
Three UART interfaces which helps in the conversion of computer data the language that microcontroller understands.
PWM (pulse width modulation)
It has 16 bit ADC (analog to digital converter)
Also one 12 bit DAC (Digital to analog conveter)
Touch Sensor controlled by capacitances
66 general purpose input output pins
3 axis accelerometer to read x, y and z axis values respectively
Capacitive touch sensor
Can be powered by using a USB or 4.5-9 external power supply
FLASH programmer
Dvelopment tools are avaiable online
Programming is easy (embedded C) Consists of huge amount of built in libraries which makes overall operations easy.

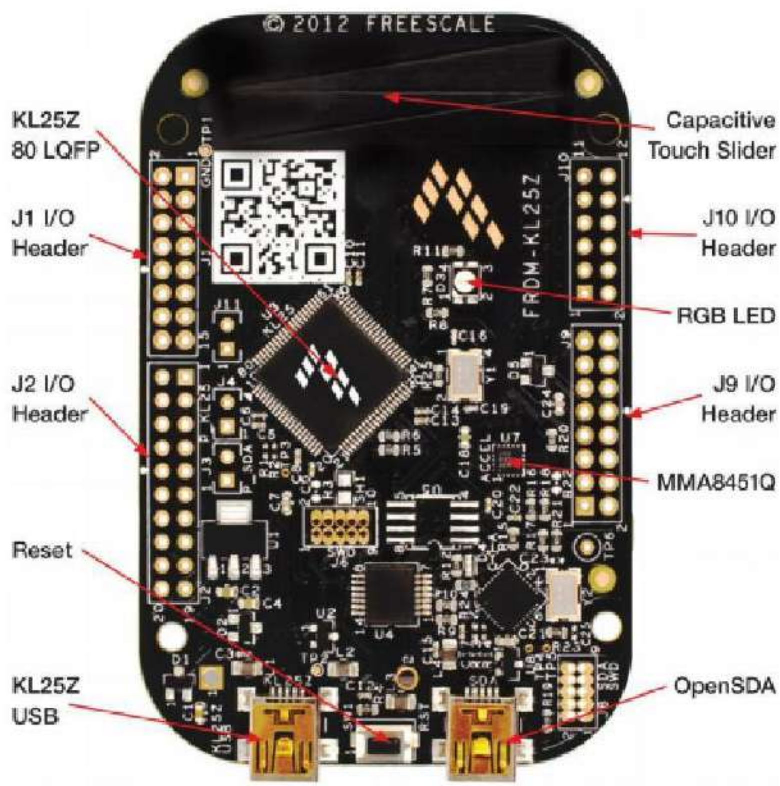

Figure 3.2: On-board components

3.1.2 FRDMKL25Z board Power features

FRDMKL25Z can be powered by using either an USB which comes directly from the computer and provides 5V supply which is enough to power up the frdm board or else an external 9V battery supply or power bank can be used from the pin $16_{v}in_{9}vpinonfrdm.$
$Theperipheralboardcanbepoweredbytheregulatedoutputvoltageof3.3volts.$
$Externalpowerbanksofmaximumvoltageratingsof5Vandmaximumcurrentratingsof2.1Acanbeus$
$DigitalGPIOs(Generalpurposeinputoutputpins)are3.3Vand4mAeach, whichmakes400mAinall.$

3.1.3 FRDM microconttroller

The target microcontroller of the FRDM-KL25Z is the KL25Z128VLK4, a Kinetis L series device in an 80 LQFP package. The KL25Z MCU features include:

ARM Cortex-M0+ core

It is a 32-bit processor wihch works on the operating frequency of 48Mhz.
Contains single-cycle fast I/O access port.

Memories

Contains 128 KB FLASH drive
SRAM of 16 KB

System integration

-provides power management and mode controllers - Low-leakage wakeup unit
- Bit manipulation engine for peripheral operations
- Contains direct memory access (DMA controller) - Computer operating properly (COP) Watchdog timer included

Clocks

- Clock generation module with FLL and PLL for system and CPU clock generation
-Has 4 MHz and 32 kHz internal reference clock
- System oscillator supporting external resonator
- Low-power 1kHz RC oscillator for COP watchdog

Analog peripherals

- 16-bit SAR ADC DMA support
- 12-bit DAC DMA support
- Faster high speed comparators

Communication peripherals

- Two 8-bit SPI
- USB with built-in FS/LS transceiver
- USB voltage regulator
- 2 I2C modess
- One low-power UART and two standard UART modules

Timers

- One 6-channel Timer module
- Two 2-channel Timer modules
- 2-channel PIT
- Real time clock (RTC)
- Low-power Timer (LPT)
- System tick timer

Human-Machine Interfaces (HMI)

- General purpose input/output controller
- Capacitive touch sense input interface hardware module

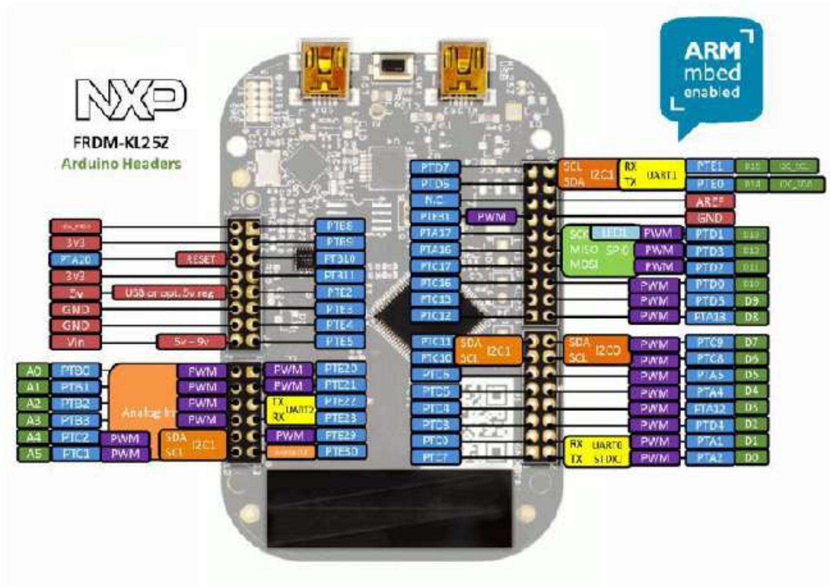

Figure 3.3: FRDM pin-out

3.2 On-board Accelerometer

The accelerometer chip contained on FRDM board is a MMA8451Q chip IC. It is a three axis accelerometer. The MMA8451Q chip is of 8 bit/14 bit digital accelerometer.

The resolution of this accelerometer is of 14 bits. MM8451Q is a cheap low power consuming accelerometer which is flexible with user programmable software.
It is of 3 axis which calculates the tilt values of x axis, y axis and z axis respectively. The advantage of using FRDMKL25Z board is that it had the facility of onboard digital accelerometer. Therefore handling, implementing and programming was not a huge task. Otherwise in other embedded system boards, accelerometer is not onboard, therefore user have to interface tyhe same with the appropriate required tilt sensor module.

This accelerometer is available in a 16-pin configuaration along with the dimention of 3mm x 1mm x 1mm.

FEATURES
supply voltage is of 1.95V to 3.6V
interface voltage is 1.6V to 3.6V
2 g/4 g/8 g dynamically selectable full scale as an advantage
Output data rates from 1.56 Hz to 800 Hz
99 g/Hz noise
digital output is in the range of 14 bit or 8 bit
I2C digital output interface
Orientation detection in terms or portrait or landscape views.
Current consumption: 6 A to 165 A

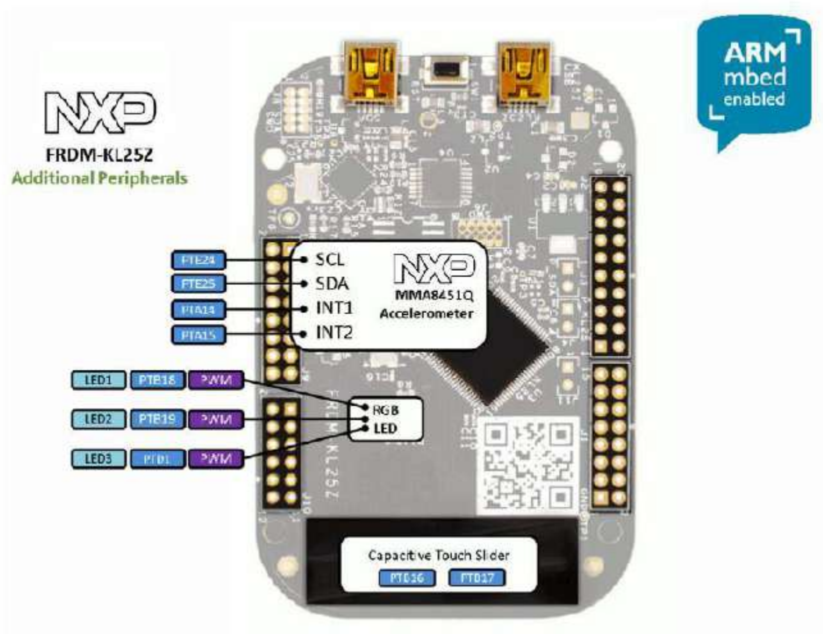

Figure 3.4: FRDM Accelerometer

It contains 2 pins viz. SDA and SCL which are at PTE24 and PTE25.

3.3 Motor Driver Kit

L293D is a typical Motor driver which allows DC motor to drive on either direction independently. IC L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC. Dual H-bridge Motor Driver integrated circuit (IC).

The l293d can drive small and large motors as well. L293D works on the concept of H-bridge which is a circuit that allows the voltage to be flown in either direction. As you know voltage need to change its direction for being able to rotate the motor in clockwise or anticlockwise direction, Hence H-bridge IC are ideal for driving a DC motor.

In a single L293D chip there are two h-Bridge circuit inside the IC which can rotate two dc motor independently. Due its size it is very much used in robotic application for controlling DC motors.

Lets consider a Motor connected on left side output pins (pin 3,6). For rotating the motor in clockwise direction the input pins has to be provided with Logic 1 and Logic

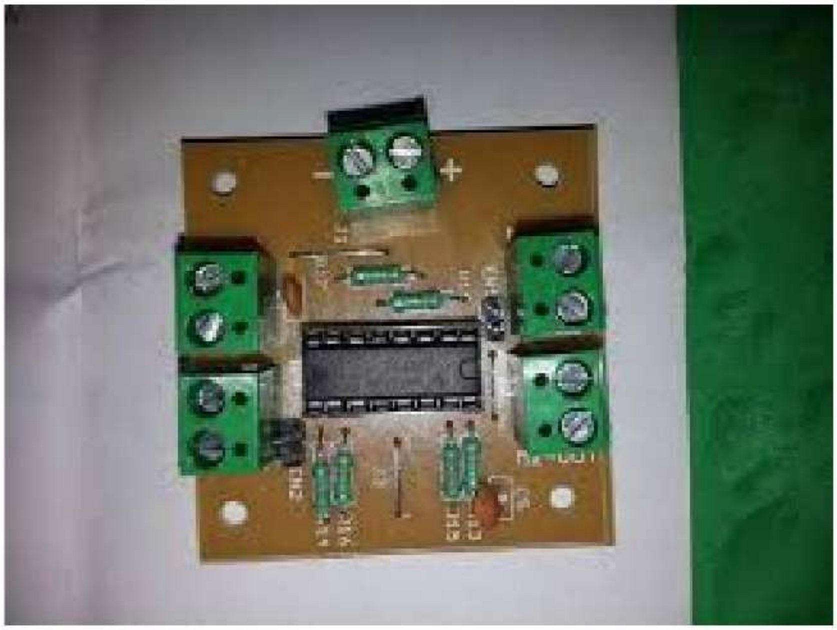

Figure 3.5: Motor Driver Kit

0. Th maximum voltage supppy of motor driver kit is 36 volts and the maximum output current is 600 mA.

- When m1 = 0 and m2 = 0, then both the motors will be stop and the wheelchair wont movie.
- When m1 = 1 and m2 = 1, then both the motors will move in forward direction.
- When m1 = 1 and m2 = 0, the wheelchair will move in left direction.
- When m1 = 0 and m2 = 1, the wheelchair will move in right direction.
- When m1 = -1 and m2 =-1, the wheelchair will movie in reverse direction.

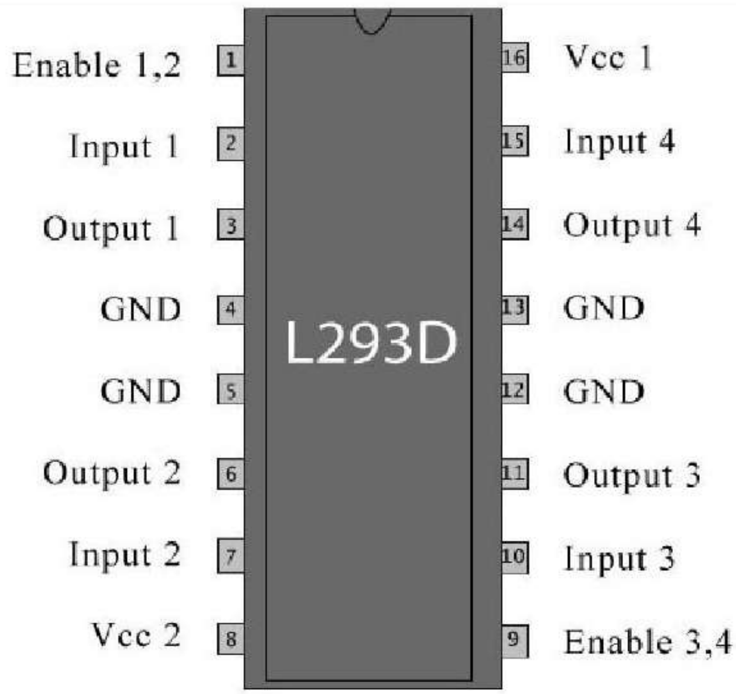

Figure 3.6: IC L293D

3.4 DC Motors

A DC motor is an electrical machine that converts direct electrical energy into mechanical energy.
This type of motor operates on the prescribed voltage of 9V-12V only. If the voltage above this range is provided, the motor may get damaged.
In this project we have to use two dc motors which will operate independently. Therefore motor driver kit is required. The motor driver kit consists of IC L293D which has internal circuitry of 2 H-bridges that helps to driver two motors independently. ie. if m1 turns in forward direction, m2 can turn in reverse direction.
L293D is a 16 pin IC. Small shaft with matching wheels give optimized design for your application or robot. Mounting holes on the body light weight makes it suitable for in-circuit placement.

The specifications of DC motors are as follows:

- The operating voltage of DC motors is in the range of 3v to 12v respectively.
- The DC motors works on about 100 RPM.
- The no load current is about 40-80 mA.

Figure 3.7: Single shaft DC motor

- Weight of DC motor approximately 50 gm.
- The output torque is 3.5 Kgf-cm

3.5 Wireless Communication

Wireless communication is technologys biggest contributions to mankind. It involves the transmission of information over a distance without help of wires, cables. The examples of wireless communication are Bluetooth, Zigbee etc. The transmitted distance can be anywhere between a few meters (for example, a televisions remote control) and thousands of kilometres (for example, radio communication).

3.5.1 nRF Module

The nRF module works on frequnecy of 2.4GHz.This transceiver IC has many new features. The nRF24L01 is a single chip 2.4GHz transceiver with an embedded baseband protocol engine designed for ultra low power wireless applications. The nRF24L01 is designed for operation in the world wide ISM frequency band at 2.400 - 2.4835GHz. An MCU (microcontroller) and very few external passive components are needed to design a radio system with the nRF24L01. The nRF24L01 is configured and operated through a Serial Peripheral Interface (SPI.) Through this interface the register map is available.

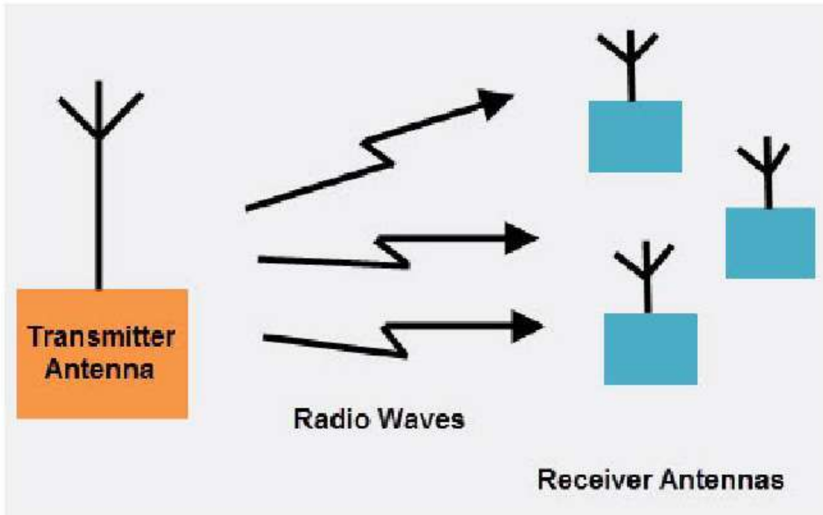

Figure 3.8: Principle of Wireless Communiation

The register map contains all configuration registers in the nRF24L01 and is accessible in all operation modes of the chip.
The embedded baseband protocol engine is based on packet communication and supports various modes from manual operation to advanced autonomous protocol operation. Internal FIFOs ensure a smooth data flow between the radio front end and the systems MCU. reduces system cost by handling all the high-speed link layer operations. The radio front end uses GFSK modulation. It has user configurable parameters like frequency channel, output power and air data rate.
The air data rate supported by the nRF24L01 is configurable to 2Mbps. The high air data rate combined with two power saving modes makes the nRF24L01 very suitable for ultra low power designs. Internal voltage regulators ensure a high Power Supply Rejection Ratio (PSRR) and a wide power supply range.

Features:

- It has operating Voltage in the range between 3 to 3.6V (recommended 3.3V) V
- The Maximum output power of nRF tranceiver is +20dBm
- The nRF transceiver has Emission mode current(peak) of 115 mA
- Its Receiver Mode Current(peak) is 45 mA
- Power-down mode current of nRF is very less and it is 4.2 uA.

Figure 3.9: nRF module pinout

Applications of nRF module:

- Wireless PC Peripherals
- Mouse, keyboards and remotes
- 3-in-one desktop bundles
- Advanced Media center remote controls
- VoIP headsets
- Game controllers
- Sports watches and sensors
- RF remote controls for consumer electronics
- Home and commercial automation
- Ultra low power sensor networks

- Active RFID
- Asset tracing systems
- Toys

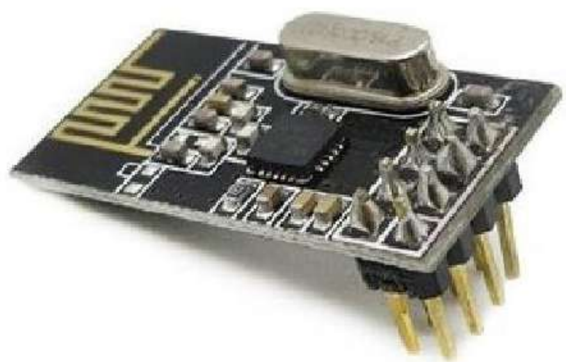

Figure 3.10: nrf module

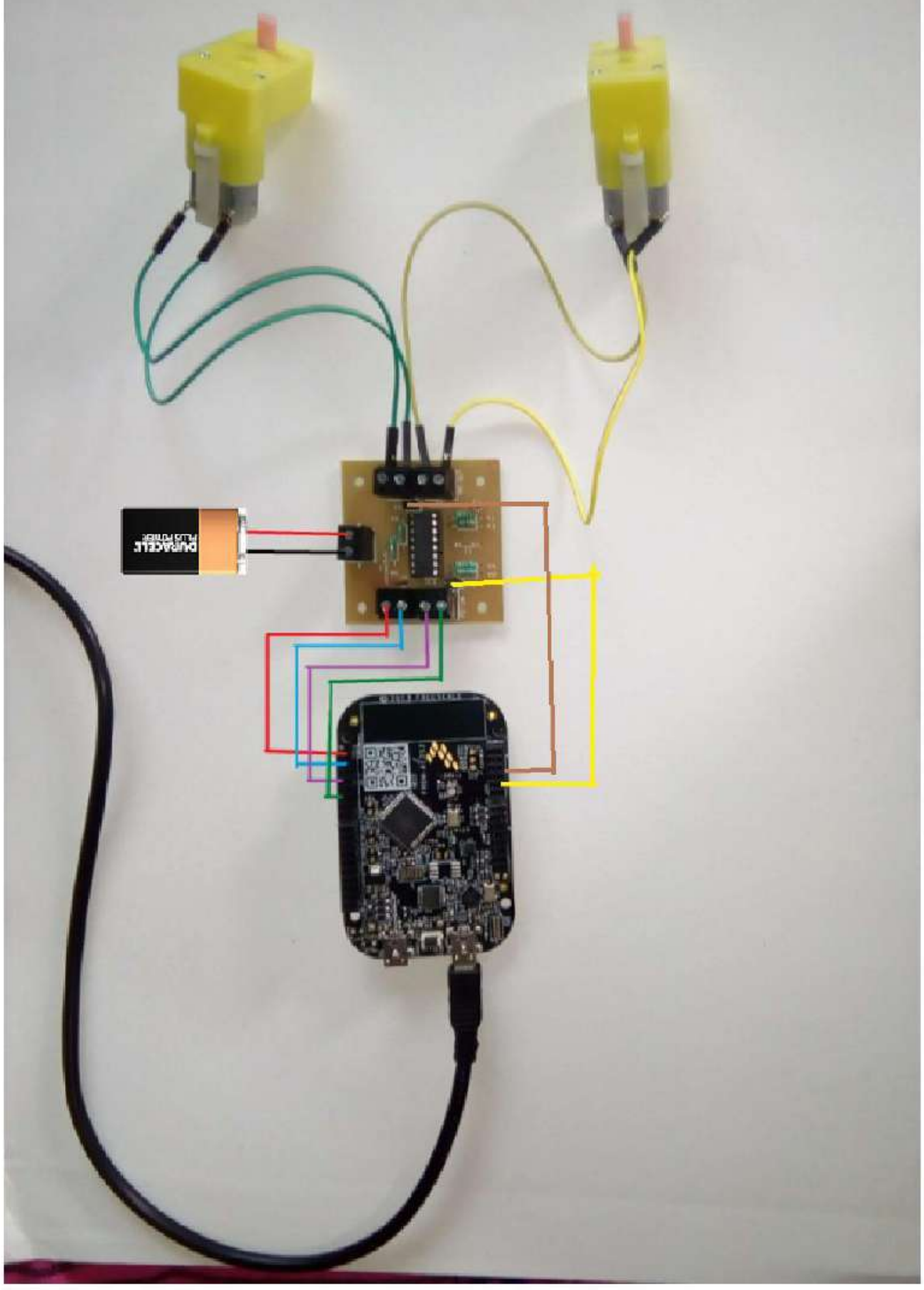

Figure 3.11: Connection at receiver side

Figure 3.12: Connection at transmitter side

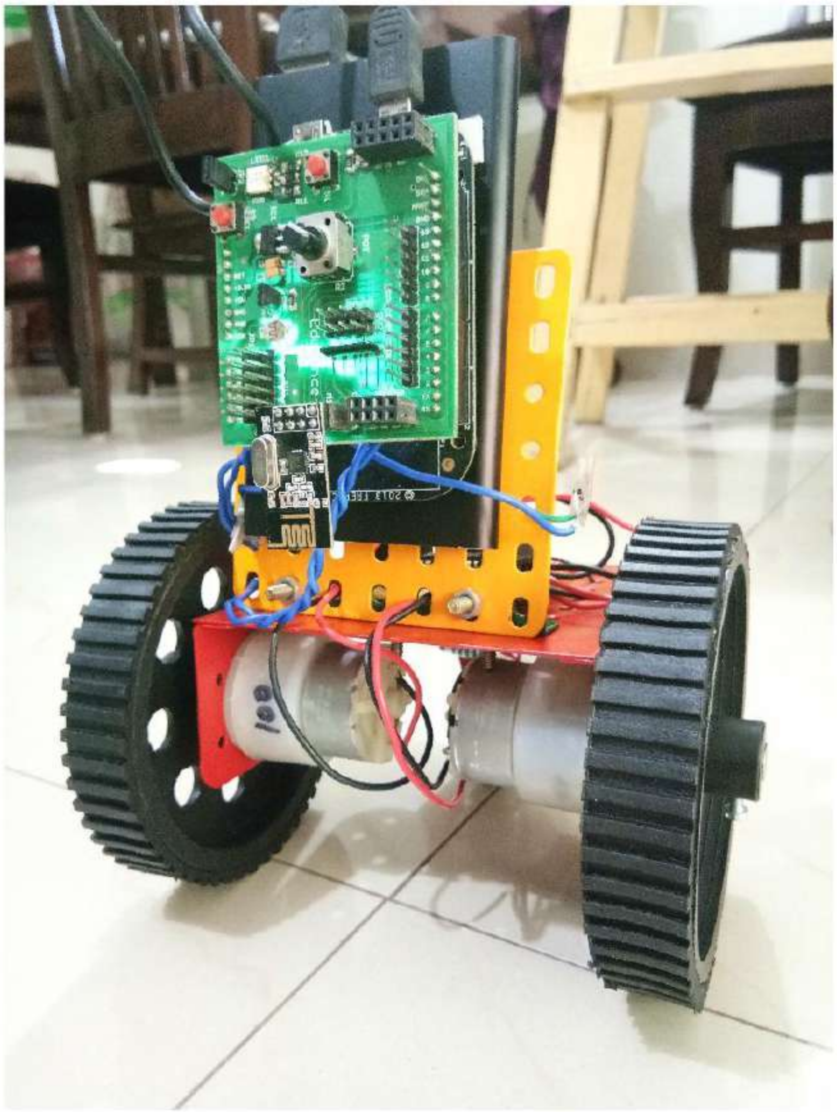

Figure 3.13: FRDM pin-out

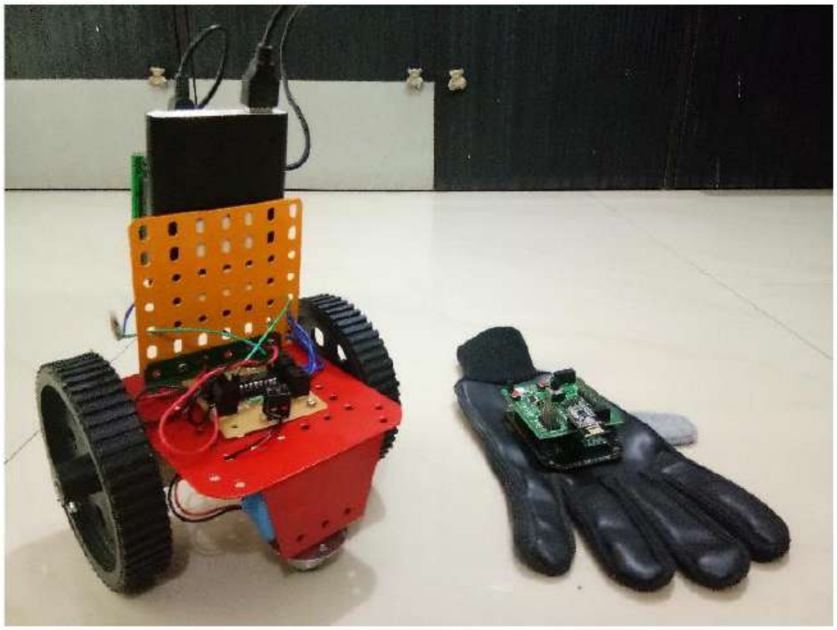

Figure 3.14: FRDM pin-out

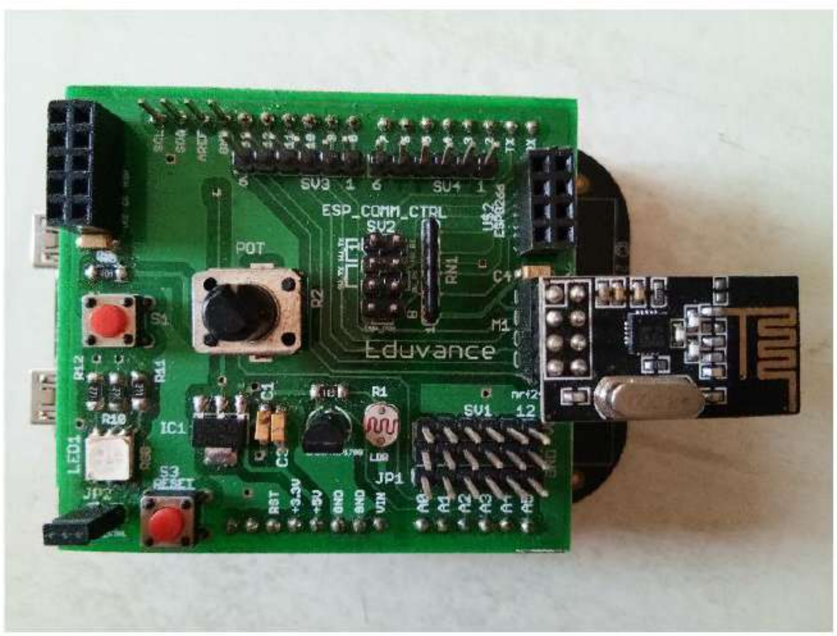

Figure 3.15: FRDM pin-out

Figure 3.16: FRDM pin-out

Chapter 4

Software Implementation

4.1 Transmitter Code

#include "mbed.h"

#include "nRF24L01P.h"

#include "MMA8451Q.h"

#define MMA8451$_I2C_ADDRESS(0x1d << 1)$

$\#include"motordriver.h"$

$MMA8451Qacc(PTE25, PTE24, MMA8451_I2C_ADDRESS);$

$Serialpc(USBTX, USBRX);$

$MotorA(PTE21, PTC7, PTC0, 1); //pwm, fwd, rev, canbrake$

$MotorB(PTE20, PTC3, PTC4, 1); //pwm, fwd, rev, canbrake$

$PwmOutled1(LED1);$

$PwmOutled2(LED2);$

$PwmOutled3(LED3);$

$\#defineACC_add(0x1d << 1)$

$nRF24L01Pmy_nrf24l01p(PTD2, PTD3, PTD1, PTD0, PTD5, PTD4);$

$//mosi, miso, sck, csn, ce, irq$

$//TSISensortsi;$

$//MMA8451Qacc(PTE25, PTE24, ACC_add);$

```
int main()
{
char count[3];
char TxDataCnt;
char temp;
my_nrf24l01p.powerUp();
my_nrf24l01p.setRfFrequency(2445);
TxDataCnt = 2;
my_nrf24l01p.setTransferSize(TxDataCnt);
my_nrf24l01p.enable();
wait(1);

while (1)
{
int xaxis=(acc.getAccX()+1)*100;
int yaxis=(acc.getAccY()+1)*100;
// int value=tsi.readPercentage()*255;
count[0] = xaxis;
count[1] =yaxis;
//count[2] =value;

// Send the Transmit buffer via the nRF24L01+
temp = my_nrf24l01p.write(NRF24L01P_PIPE_P0, count, TxDataCnt);
}
```

}

4.2 Receiver Code

```
#include "mbed.h"
#include "nRF24L01P.h"
//include "USBMouse.h"
//USBMouse mouse;
#include "MMA8451Q.h"
#define MMA8451_I2C_ADDRESS(0x1d << 1)
#include"motordriver.h"
MMA8451Qacc(PTE25, PTE24, MMA8451_I2C_ADDRESS);
Serialpc(USBTX, USBRX);
MotorA(PTE21, PTC7, PTC0, 1); //pwm, fwd, rev, canbrake
MotorB(PTE20, PTC3, PTC4, 1); //pwm, fwd, rev, canbrake
PwmOutled1(LED1);
PwmOutled2(LED2);
PwmOutled3(LED3);
nRF24L01Pmy_nrf24l01p(PTD2, PTD3, PTD1, PTD0, PTD5, PTD4);
//mosi, miso, sck, csn, ce, irq
intmain()
{
charcount[3];
charRxDataCnt;
chartemp;
```

$my_nrf24l01p.powerUp();$

$my_nrf24l01p.setRfFrequency(2445);$

$RxDataCnt = 2;$

$my_nrf24l01p.setTransferSize(RxDataCnt);$

$my_nrf24l01p.setReceiveMode();$

$my_nrf24l01p.enable();$

$while(1)$

$\{$

$//Ifwe'vereceivedanythinginthenRF24L01 + ...$

$if(my_nrf24l01p.readable())$

$\{$

$//...readthedataintothereceivebuffer$

$temp = my_nrf24l01p.read(NRF24L01P_PIPE_P0, count, RxDataCnt);$

$intxaxis = count[0];$

$intyaxis = count[1];$

$//floatvalue = float(count[2])/255;$

$//mouse.move(xaxis, yaxis);$

$if(xaxis < 60)//forwardmove$

$\{$

$A.speed(1);$

$B.speed(1);$

$wait(0.1);$

$led1 = 0;$

$led2 = 1;$

```
led3 = 1;

elseif(xaxis > 140)//reversemove
{
A.speed(−1);
B.speed(−1);
wait(0.1);
led1 = 1;
led2 = 0;
led3 = 1;
}
elseif(yaxis > 140)//reversemove
{
A.speed(1);
B.speed(0);
wait(0.1);
led1 = 1;
led2 = 1;
led3 = 0;
}
elseif(yaxis < 40)//rightmove
{
A.speed(0);
B.speed(1);
```

$wait(0.1);$

$led1 = 0;$

$led2 = 0;$

$led3 = 0;$

$\}$

$elseif((xaxis > 60\&\&xaxis < 140)||(yaxis > 40\&\&yaxis < 140))$

$\{A.speed(0);$

$B.speed(0);$

$wait(0.1);$

$led1 = 0;$

$led2 = 0;$

$led3 = 1; \}$

$\}$

$\}$

$\}$

Chapter 5

Advantages and Disadvantages

5.1 Advantages of FRDMKL25Z based Gesture Controlled Wheelchair

- It is based on microcontroller, therefore, if any modifications or developments are required it can be done by reprogramming the board according to the needs of user.
- The wheelchair is equipped with an ultrasonic sensor to avoid accidents and collision with table, doors etc.
- The components/parts are easily available and are cheap.
- The FRDMKL25Z board consists of on-board accelerometer, therefore it is easier to extract accelerometer values based on gestures.
- This wheelchair can be further use to monitor the health of the person as an biomedical application. For example, heart rate monitoring system, ECG(electrocardiogram) system, etc.
- Wireless communication is an advantage, as it is faster than wired communication and it avoids issues like tangling of wires, etc.
- It is portable, so it can be transported from one place to the other easily.

5.2 Disadvantages of FRDMKL25Z based Gesture Controlled Wheelchair

- Failure of any component may cause fatal accidents.
- The wheelchair can collapse while taking sudden turns.
- If power supply fails, the system will stop working.
- The transmitter and receiver must operate on same frequency otherwise the transmitter won't transmit the data.

Chapter 6

Future developments

- The wheelchair can also be equipped with ultrasonic distance measurement sensor which can prevent fatal accidents or also protect the wheelchair from colliding to tables, bed corners, walls etc.

- Also, health monitoring of a person using ECG or heart rate monitoring can be done as additional advantages by which doctors can monitor the health of the patient on regular basis.

- The overall power capacity of the system can be improved.

Figure 6.1: Wheelchair with ECG

Chapter 7

Result

- When xaxis value is less than 60 then both m1=m2=1 and the wheelchair moves in forward direction.

- When xaxis value is greater than 140 then both m1=m2=-1 and the wheelchair moves in reverse direction.

- When yaxis value is greater than 140 then m1=1 m2=0 and the wheelchair moves in left direction.

- When yaxis value is less than 140 then m1=0 m2=1 and wheelchair moves in right direction.

- When xaxis value is greater than 60 and less than 140 or yaxis value is gretaer than 40 and less than 140.

Chapter 8

Conclusion

- By implementing this project, we can create a platform for the physically handicapped person where he/she can move independently from one place to the other by using only gestures of hands.

- This project is wireless, so adding to the advantage it is more user friendly than the wheelchairs which are wired.

- This gesture controlled wheelchair is equipped with ultrasonic sensors which avoids the collision of wheelchair with obstacles such as walls, tables, bed corners, doors etc.

- It is flexible and the operations of the wheelchair can be changed as per the need of user. The only disadvantage in this project is the power, if the microcontroller board do not receive enough supply the wheelchair will stop working