UOS SMART
ELECTRONIC WHEELCHAIR

A work submitted in partial fulfillment of the requirements for the degree of
Bachelor of Science in Computer Science

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UOS SMART
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Certificate of Approval

It is certified that the work presented in this Project titled

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Under my supervision and that in my opinion, is fully adequate, in scope and quality, for the degree of BS in Computer Science.

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Asma Zafar

Sabahat Sabir

Saddiqa Javaid

Chapter 1 : Introduction

1.1. Purpose of document

The aim of introducing Smart E-wheelchairs is to facilitate elderlies and physically disabled people. Physically Disable people face problems while going from one place to another place. The wheelchair is one of the most commonly used assistive devices to promote mobility and enhance quality of life for people who have difficulties in walking. Wheelchair provides the user the freedom to move around, allowing the user to perform day to day physical activity. If a disabled person uses simple wheelchair than he/she needs an attendant who helps them to perform the activity. Smart E-wheelchairs is a ride solution to solve the problem faced by disable people. It allows the user to get around and undertake daily activities without assistance. It makes a disabled people independent. They will simply have to install an application on their cell phones and fill an application to get wheelchairs services. By using android smartphone, the user can select the specified direction displayed within the four quadrants on the screen of the android smartphone to control the wheelchair. An Arduino Uno is used to execute all commands. The MD30C motor driver and HC05 Bluetooth module are used in this system. This system is designed to save time and energy of the user.

1.2. Problem Statement

Due to the increased percentage of elderlies and physically disabled people, wheelchairs are the best assistive devices to help them enhance their personal mobility. The traditional wheelchairs have some limitations such as flexibility, bulkiness and limited functions. There are existing technologies which allow the users to use human gestures such as the movements of hands, movements of leg tongue and head and synchronize them with the movements of the wheelchair for a better wheelchair controls for example smart wheelchair. A smart wheelchair is developed to help an elderly or physically disabled person (user) to move from one place to another independently. An android application is developed and installed in the android smartphone.

By using smartphone, the user can determine the wheelchair's movement by selecting the desired direction on the android smartphone phone screen. The command given by the user will be forwarded to the Arduino Uno via Bluetooth. The Bluetooth will convert the commands given by the user in a binary format and send them to the Arduino Uno. Arduino Uno will read and execute the command and lastly send the digital values to the motor driver device. The motor driver will direct the wheelchair according to the command given. When the user selects the "Go" arrow, the wheelchair will move in a forward direction, "Back" arrow prompts the wheelchair to move backward, and "Left" arrow causes the wheelchair to turn left, and "Right" arrow makes the wheelchair turn right. An elderly or physically

challenged person can direct the direction and movement of the wheelchair with the help of the android smartphone in four different directions, left, right, forward, reverse and stop. The wheelchair will move according to the command given by the user.

In this paper will discuss, a smart wheelchair is developed to help an elderly or physically disabled person (user) to move from one place to another independently. An elderly or physically challenged person can direct the direction and movement of the wheelchair with the help of the android smartphone in four different directions, left, right, forward, reverse and stop. The wheelchair will move according to the command given by the user.

1.3. Scope and Objectives

The objective of Smart E-wheelchair System is to make physically disabled student independent.
Movement of wheelchair can be controlled by using android application. With the help of this functionality user don't need any attendant. The electronics wheelchair presents in marketplace are too much costly. A common person cannot afford to buy that wheelchair. The electric wheelchair we are going to make is affordable by a common man.
The following aspects were considered in the choice of a design solution:

- Installation costs
- Time savings
- Reliability
- Power consumption
- Maintenance
- Expandability

A critical consideration is the installation costs, since costs generally determine the feasibility and viability of a project.

Chapter 2 : Research and Requirements

2.1. Functional requirement

- User will provide log in information.
- User must provide valid contact detail.
- User can use application to operate wheelchair.
- User can stop wheelchair by using stop button in application.
- User can move left wheelchair by using left button in application.
- User can move right wheelchair by using right button in application.
- User can move reverse wheelchair by using reverse button in application.
- User can move forward wheelchair by using forward button in application.

2.2. Non-Functional requirement

2.2.1. Performance Requirements

The E_Wheelchair application should have a very quick performance capability to make the system efficient enough to act upon the generated command. All devices connected to it will confirm their duties within Nano seconds or within no time after receiving a notification from it. Talking about performance concerns all devices connected to the system are nicely communicating to each other to send and receive information. All modules are well integrated and process is running in an adequate flow.

2.2.2. Availability

The system will be available 24/7. By using android smartphone, the user can select the specified direction displayed within the four quadrants on the screen of the android smartphone to control the wheelchair.

2.2.3. Security

The application will provide database security. Only the registered person that has been installed E_Wheelchair would be able to log in and can operate wheelchair at any time. User would be able to set log in passwords of their suitable safety requirement.

2.2.4. User Documentation

On first startup of website application. There will be a small description or a graphical slider will be shown in order to guide the particular customer so that he could easily navigate through the system and could make changes when or how he feels suitable or when required regarding field necessity. User will be guided through proper guideline. Step wise understanding would be tried to facilitate the users. Any complexity would be avoided that can be cause of worry for an E_Wheelchair user. Also a YouTube tutorial URL will be provided (if possible) that will teach how to use the Electronic Wheelchair.

2.3. External Interface Requirement

2.3.1. Hardware Requirement

Hardware requirement includes following:

Sr.No	component	Description
1	Motor driver	L298N
2	DC motor	350W,24V,2600rpm
3	Bluetooth module	HC-05 or HC-06
4	Microcontroller	AVR(Arduino Uno)
5	Power supply	24V/7.0Ah lead acid and 9V battery
6	Wheelchair	Used in project
7	Personal computer	Used for coding and testing. PC must have at least 8 GB RAM. Here we work on window operating system
8	Wire	Used in project
9	Button	Used in project
10	capacitor	Used in project
11	LM7809	Used in project

Table 2: The Table of Components

2.3.2. Software Requirement

Sr.No	component	Description
1	Software used in project	Arduino, Android studio

Table 3: The Table of Components

2.4. Assumptions and Dependencies

It is assumed that the user is familiar with the windows operating system. It is assumed that information collected through experiment will be used for providing the demo for the presentations. There is a need for the smartphone. It will be assumed that the users will a smartphone.

Chapter 3 : Detailed Design and System Architecture

3.1. System Level Architecture

3.1.1. System Block Diagram

Diagram shows separate control architecture for target wheelchair. The first one shows, controlling data communication architecture from android to wheelchair receiving unit over Bluetooth link. After that separate controlling data will communicate with the device. The concept of Android control architecture is like an Android game that we play on our Android phone.

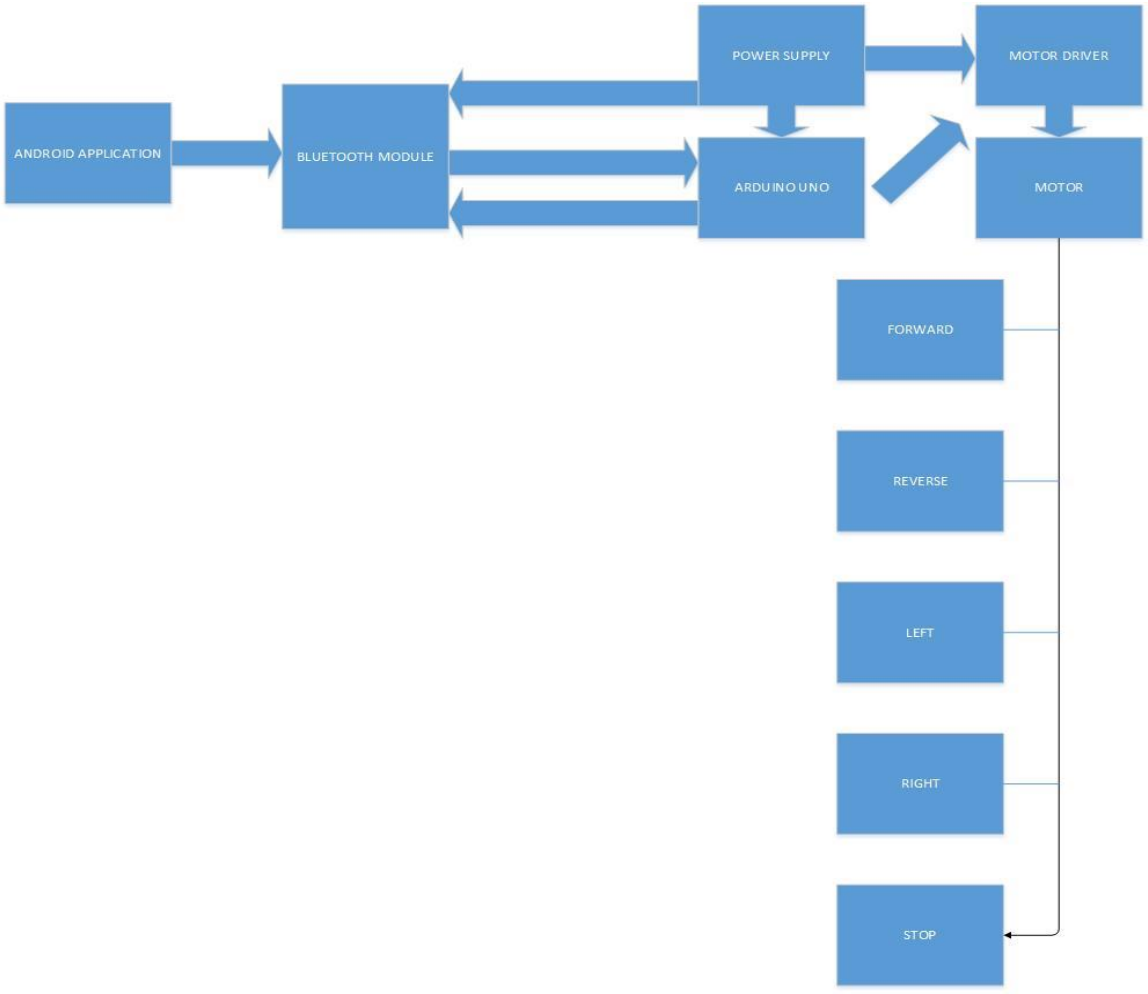

Figure 1: System Block Diagram

3.1.2. Activity Diagram of System

Our product will consist of wheelchair infrastructure and an android application that work and communicate effectively with each other.

By using smartphone, the user can determine the wheelchair's movement by selecting the desired direction on the android smartphone phone screen. The command given by the user will be forwarded to the Arduino Uno via Bluetooth. The Bluetooth will convert the commands given by the user in a binary format and send them to the Arduino Uno. Arduino Uno will read and execute the command and lastly send the digital values to the motor driver device. The motor driver will direct the wheelchair according to the command given. When the user selects the "Go" arrow, the wheelchair will move in a forward direction, "Back" arrow prompts the wheelchair to move backward, and "Left" arrow causes the wheelchair to turn left, and "Right" arrow makes the wheelchair turn right. Figure shows activity diagram of system level architecture.

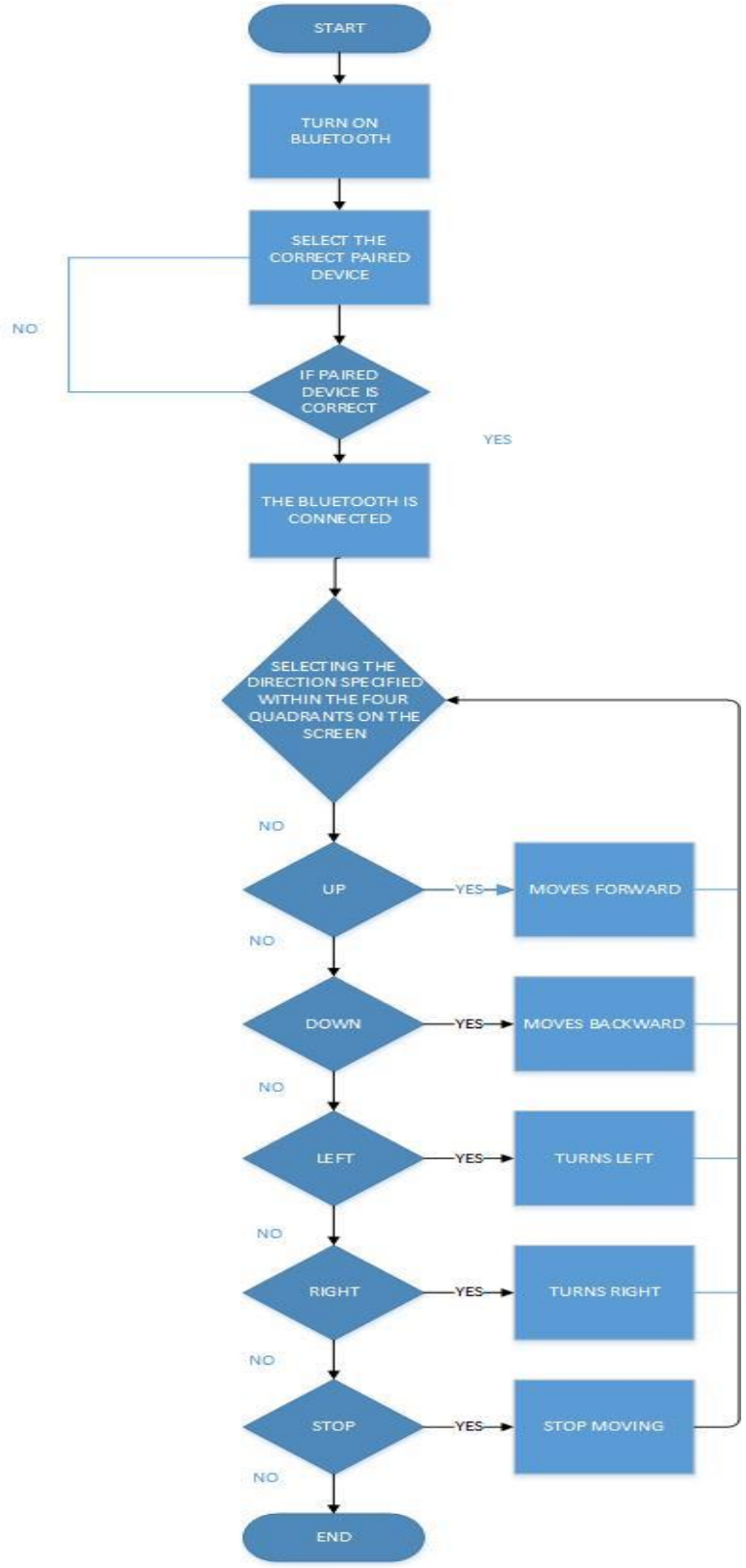

Figure 2: Activity Diagram of System

3.1.3. Use Case Diagram of System

In Figure-7 shows Use Case diagram of system level architecture.

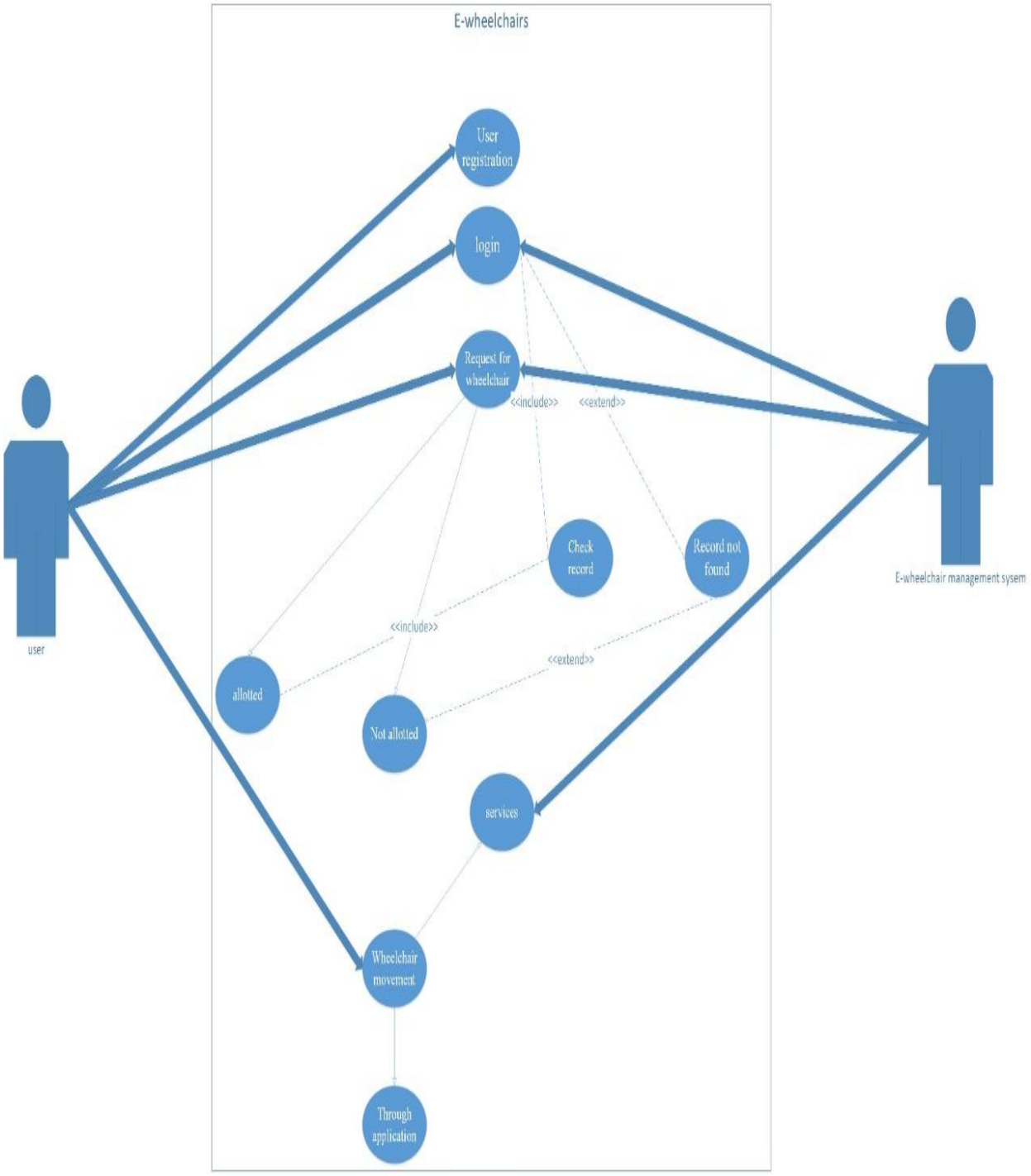

Figure 3: Use Case Diagram of System

3.1.4. Entity Relationship Diagram of System

In Figure Entity Relationship diagram show the whole system working.

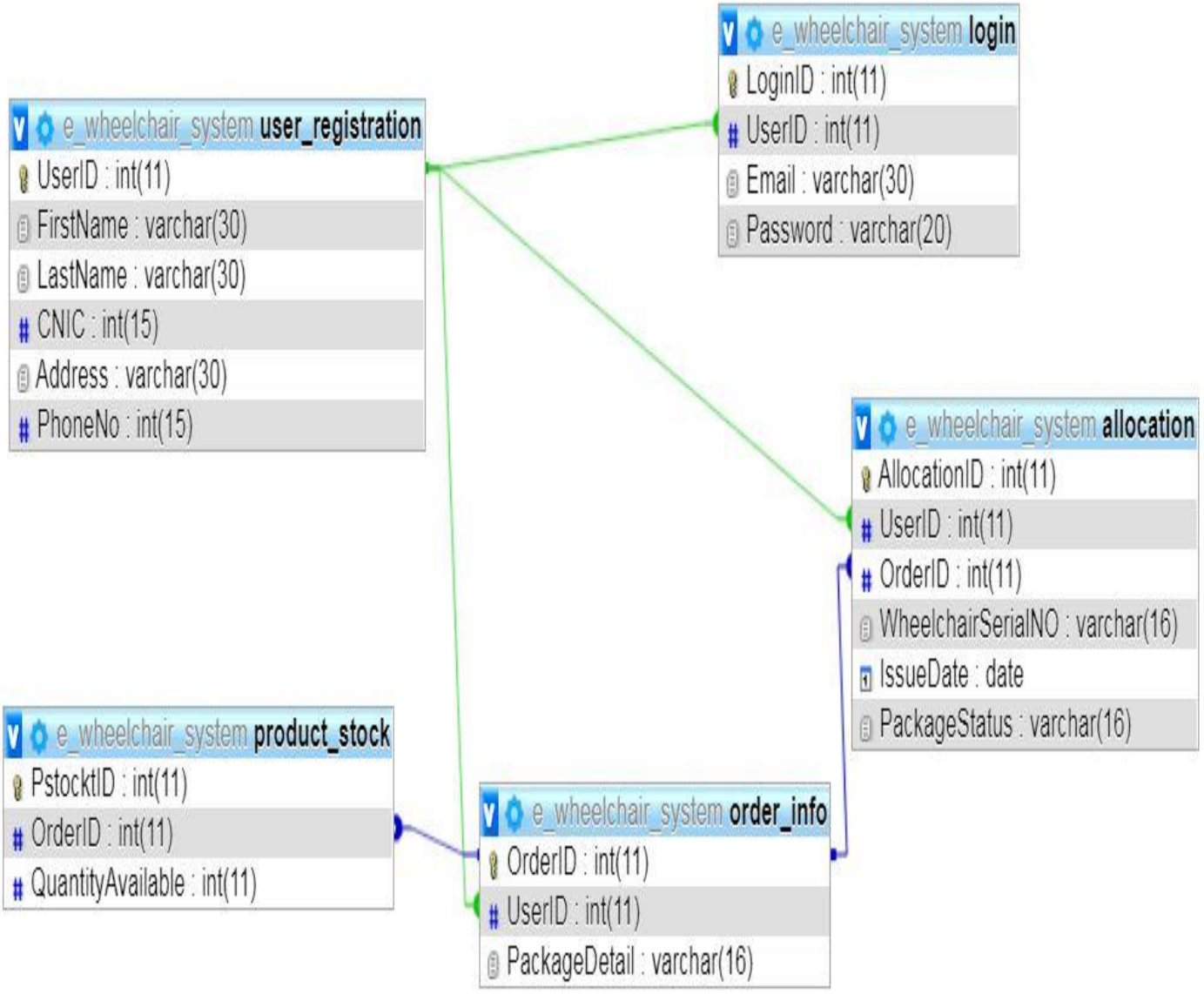

Figure 4: Entity Relationship Diagram of System

3.2. Mechanical Structure of Wheelchair and its Dimensions

The following figure illustrates the important wheelchair terminologies that need to be considered while designing a wheelchair.

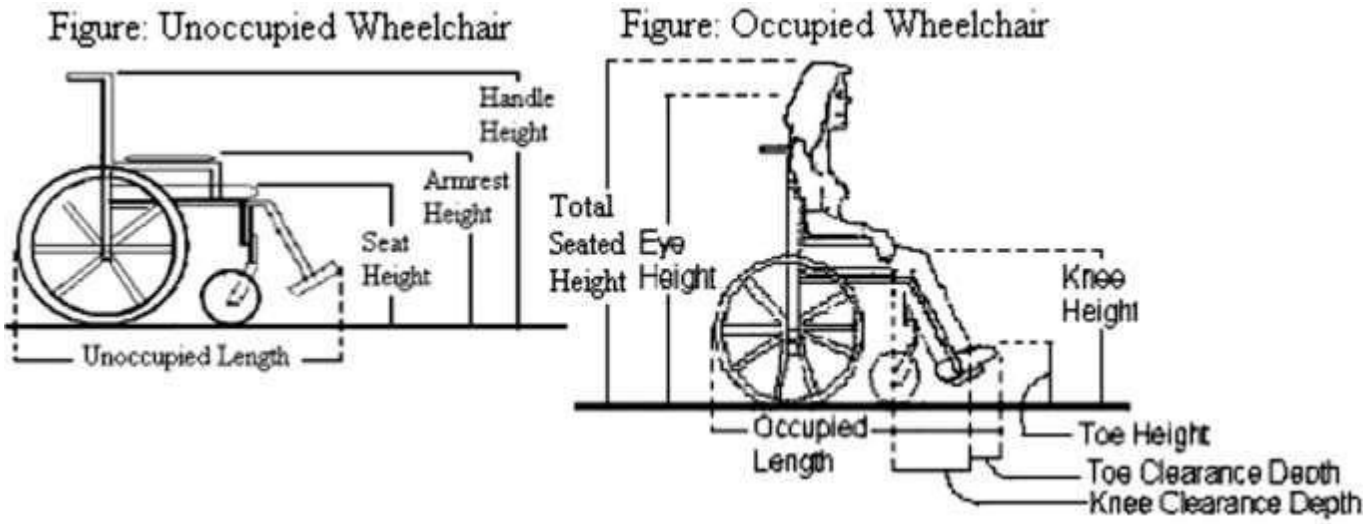

Figure 5: Mechanical Structure of Wheelchair and its Dimensions

All measurements are in millimeters

Unoccupied Width = 650-720

Unoccupied Length = 1000-1100

Handle Height = 910-950 Armrest

Height = 700-740

Seat Height = 480-510

Combined Knee + Toe Clearance Depth = 400-450

For the scaled down model, the dimensions which will be used are as follows:

Unoccupied Width = 325

Unoccupied Length = 500

Handle Height = 455

Armrest Height = 350 Seat

Height = 240

Combined Knee + Toe Clearance Depth = 200

The base plate length = Unoccupied Length - (Combined Knee + Toe Clearance Depth) = 500 - 200 = 300

The Materials to be used are as follows:

A suitable fabric shall be used for covering the seat and back rest that should be non-toxic and non-allergic.

3.2.1. Mechanical Design

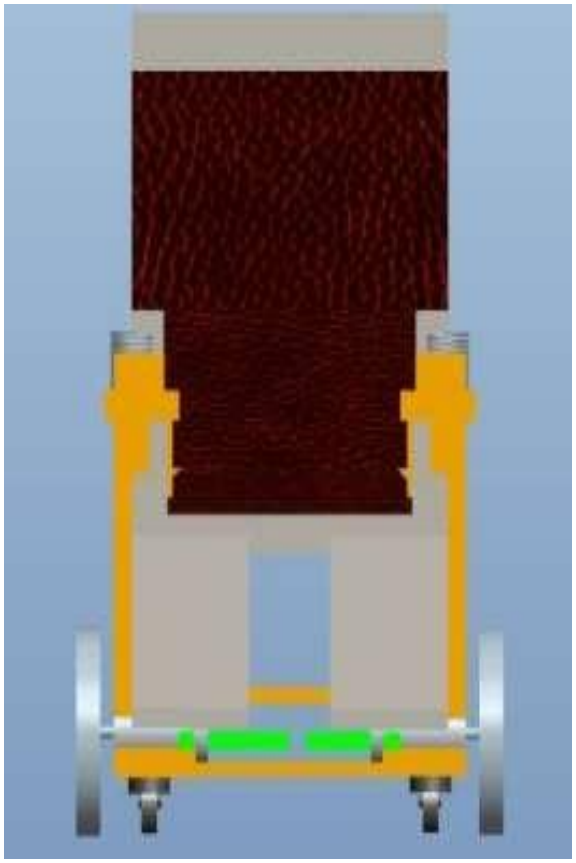

Figure 6(a): Front view

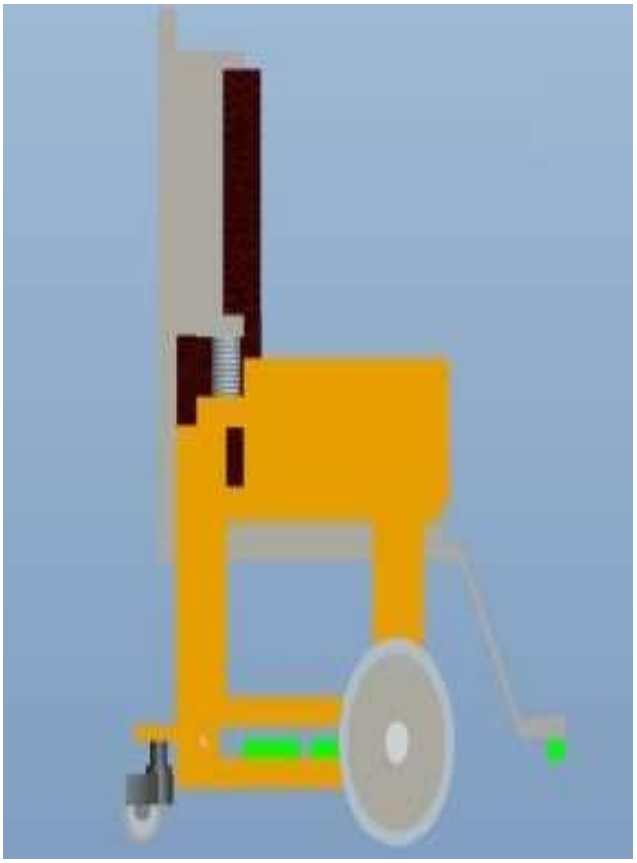

Figure 7(b): Side View

Figure 7(c) Top view

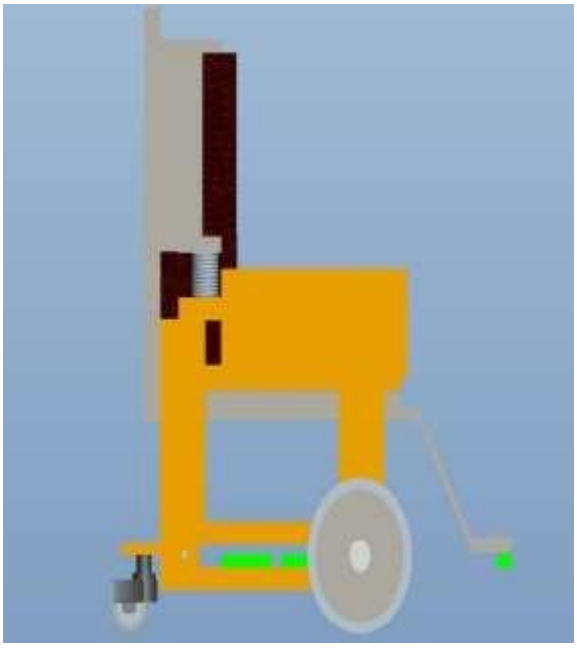

Figure 7(d) Right view

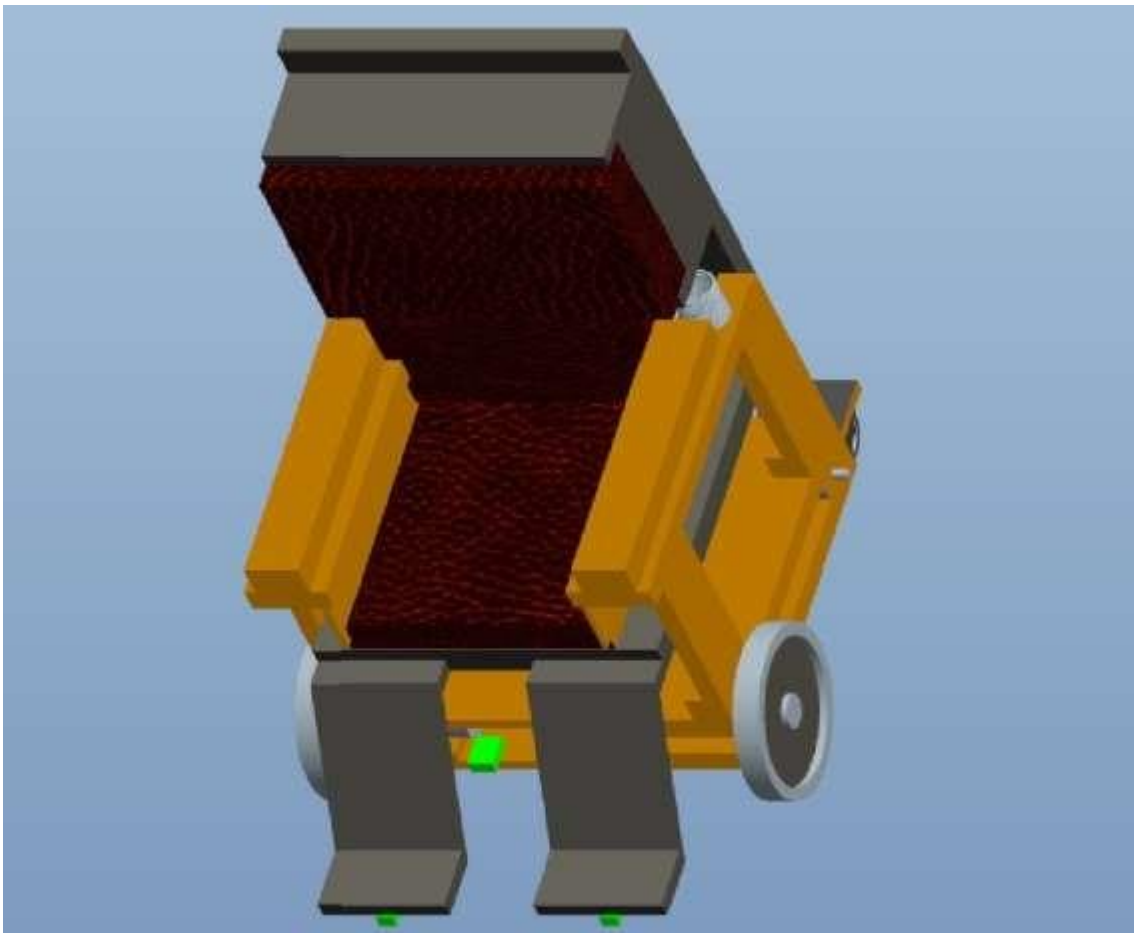

Figure 7(e) Isometric views

3.2.2. Caster Design

Caster stems must be kept as vertical as possible. Caster stems that are not vertical cause a number of problems. If the stem leans forwards at the top the chair is difficult to turn and the knees are lower wheeling forwards than when wheeling backwards. If the stem is leaning backwards at the top, the chair is difficult to keep in a straight line and the knees raise up higher when rolling forwards. Also whenever the wheeler stops the chair will roll backwards a little.

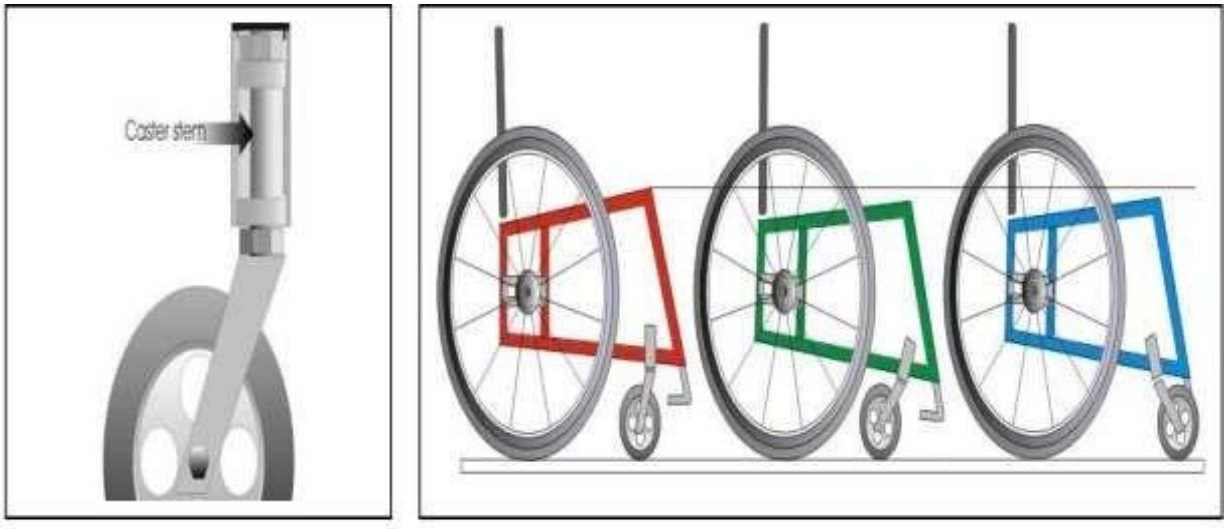

Figure 8: Caster Design

3.3. Transmitting Section

3.3.1. SMARTPHONE

A Smartphone is a mobile phone built on a mobile OS; it has more advanced computing capability and connectivity than an ordinary phone. Most smart phones have Bluetooth Wireless Technology built in the device for various small range wireless applications like headset, file transfer, wireless input devices etc. the following project uses above features of the Smartphone to use it as a transmitter and control device and completely eliminating the need for a separate transmitter block.

3.3.2. ACCELEROMETER

An accelerometer is a device that measures proper acceleration ("g"). Proper acceleration is different from the acceleration (i.e. Rate of change of velocity), e.g. an accelerometer at rest on the surface of the Earth will measure an acceleration g= 9.81 m/s2 straight upwards whereas, accelerometers in free fall orbiting and accelerating due to the gravity of Earth will measure zero.

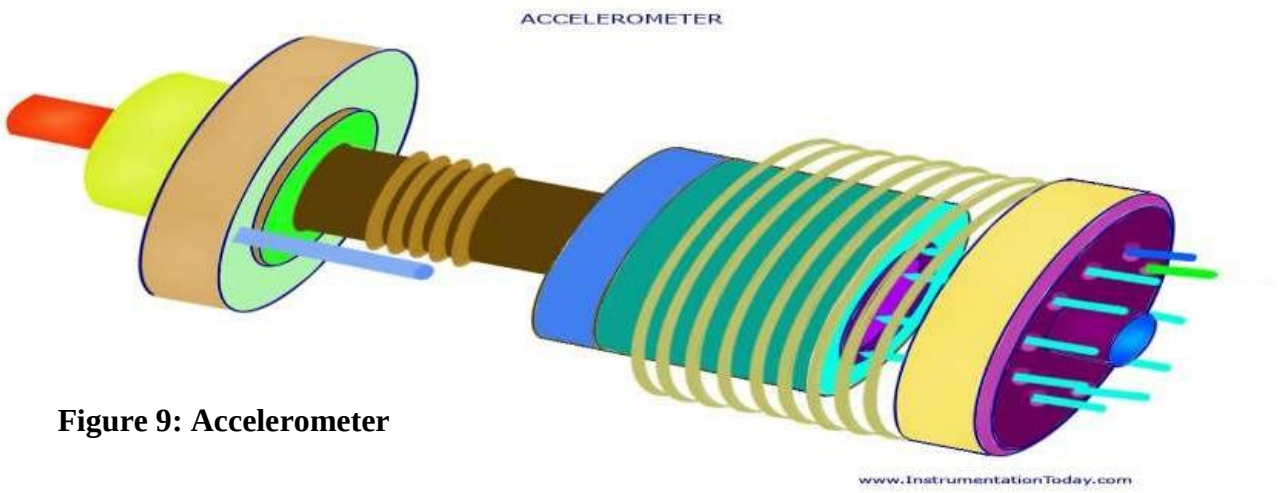

Figure 9: Accelerometer

An accelerometer is an electromechanical device that will measure acceleration forces. These forces may be static, like the constant force of gravity pulling at your feet, or they could be dynamically caused by moving or vibrating the accelerometer. The Smartphone Accelerometer is a semiconductor IC that measures motion and its intensity in all 3 axes and directly can provide values to suitably designed application.

3.3.3. BLUETOOTH

- Bluetooth present in the Smartphone can be tapped using protocol stacks in the app design environment of the mobile operating system.
- Command to wheelchair can be given using Bluetooth module

3.4. Receiving Section

3.4.1. MICROCONTROLLER

- Its need involves the reception of data signals that are transmitted by the Smartphone via Bluetooth module and control the working of DC motors. e.g. Arduino (an open source single boardmicrocontroller).
- The wheelchair interacts with the Smartphone app by means of this Arduino microcontroller via Bluetooth. The Bluetooth receiver that can be interfaced with the Arduino board is EGBT – 045MS Bluetooth module.