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A Critical Review of Multiway Adjustable Car Seats for Physically Challenged

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Abstract

Comfort plays a major role while driving a vehicle. Vehicle seat plays one of the major role in this aspect. In addition to sophistication, there is lot of scope for improving comfort in vehicle seat. That too physically challenged people are facing lot of difficulties in it. Nowadays electrical and electronics plays a vital role in the field of automation and actuation control techniques. so, the primary objective is to develop the mechanism for easy accessibility of seats for physically challenged people. The system includes a sliding rail, swivel plate and a dc motor. the sliding rail is used to move the seat forward and backward. the swivel plate is used to turn the seat at about 360º. The seat turns up to a reasonable position towards the direction of the door and moves front. A dc motor is used as an actuator in this system. The dc motor will do all these processes easily that makes no work to passenger. This makes a very comfortable entry and exit of physically challenged people. This mechanism can be fitted in any type of car.

KEYWORDS: Physically challenged people, Automation, Sliding rail, Swivel plate, DC Motor, Car seat.

1. Introduction

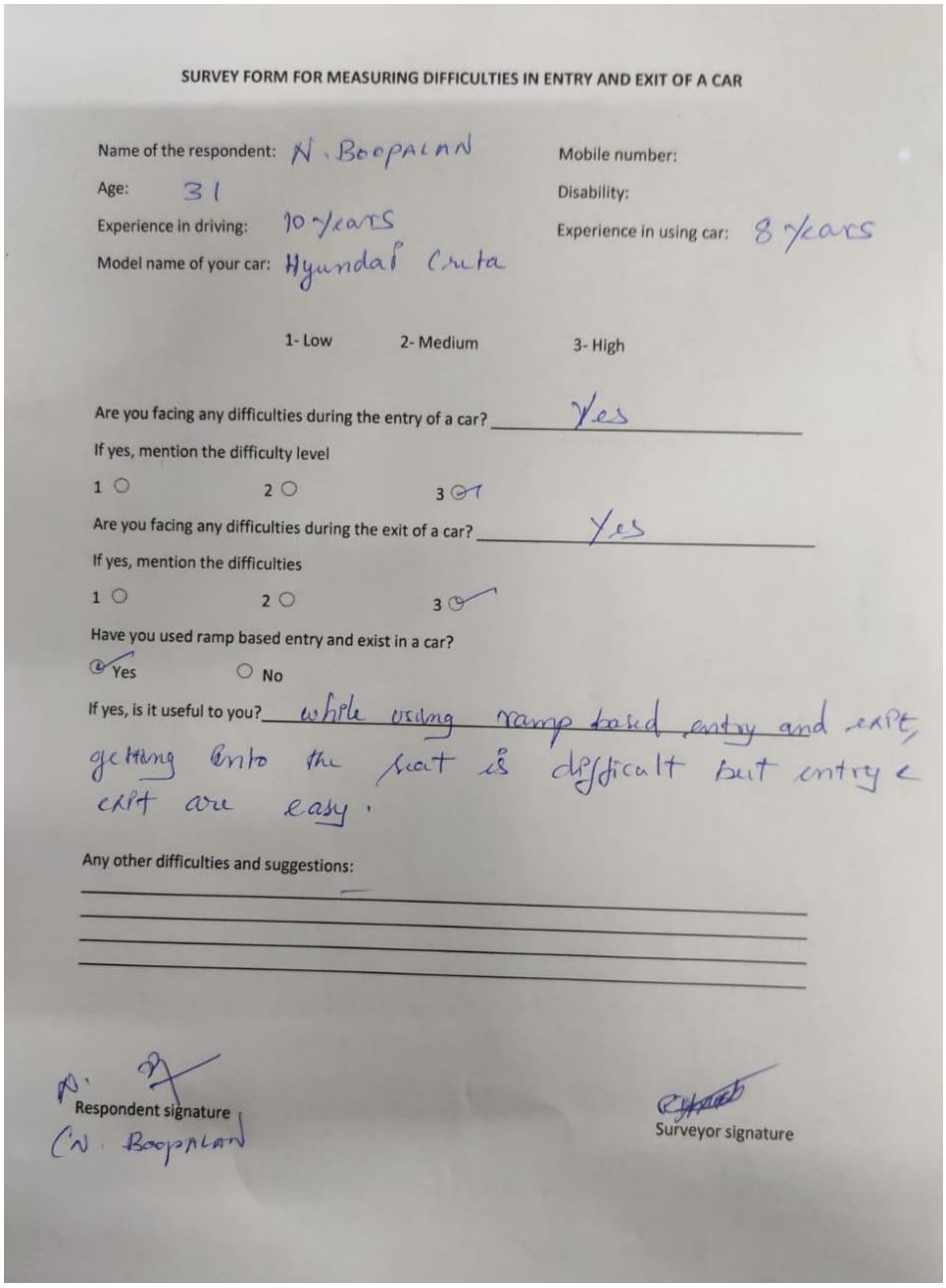
The aim is to design and develop an effortless system on Multiway adjustable seat of a vehicle. This system provides comfort for the physically challenged people. The supreme aim of this system is to make the physically challenged feel ease. By this system, they can travel whenever or wherever needed at any time without the need of others. Many people have done various experiments and models in physically challenged seat design. The most comfortable design is more important one in it. Transportation is an extremely important issue for physically challenged. Over the last two decades, the National Organization on Disability (NOD) has taken three successive polls with people with disabilities, and respondents in each survey have reported that transportation issues are a crucial concern. In the last survey undertaken, it is reported that inadequate transportation facilities was a problem for them of those individuals over half said it was a major problem. Therefore, there are lot of technologies rolling out in market in every day. With the technology being changing every day, facilities for the physically challenged are constantly being studied and improvised. Undoubtedly, either physically challenged people needs an external help or a special equipment is required.

1.1. Problem Identification

Even though there are many equipment and transfer, aids are available in the market still people find difficult in getting in and out of a car. The car does not have a seat that helps the physically challenged to access

easily. A field survey is taken to find out the real problem of physically challenged people's discomfort during the entry and exit. A survey form is designed for this purpose. The survey form contains different questionnaires to find their difficulties.

The surveyed person is asked if he experiences difficulties during the entry and exit. If so, the subject is asked to mention all discomfort levels, in three scale format. Other parameters like age also grouped to find the elderly people's difficulties. Collected forms are analyzed and the problem statement is framed as entry and exit is not comfortable for physically challenged people when they approach a car. They also need lot of efforts to get in and out.



SURVEY FORM FOR MEASURING DIFFICULTIES IN ENTRY AND EXIT OF A CAR

Name of the respondent: N. Boopalan
Mobile number:
Age: 31
Disability:
Experience in driving: 10 years
Experience in using car: 8 years
Model name of your car: Hyundai Creta

1- Low 2- Medium 3- High

Are you facing any difficulties during the entry of a car? Yes
If yes, mention the difficulty level
1 ○ 2 ○ 3 ✓
Are you facing any difficulties during the exit of a car? Yes
If yes, mention the difficulties
1 ○ 2 ○ 3 ✓
Have you used ramp based entry and exist in a car?
✓ Yes ○ No
If yes, is it useful to you? while using ramp based entry and exit, getting into the seat is difficult but entry & exit are easy.

Any other difficulties and suggestions:

Respondent signature
(N. Boopalan)
Surveyor signature

Fig 1 Survey form

Therefore, a Multiway adjustable car seat will help the people to get in and out of a car. This seat will be very comfortable for them and helps them to a greater extend. This system has a rotating plate that will help them to rotate towards the door and get out of the seat. It is very useful for physically challenged as it is reducing their effort. Having these system enables them to travel anywhere without any restrictions and it is economical when compared to other techniques. In our country, implementation of this idea is easy and safe.

1.2. Methodology

Our project works based on electrical system that will transfer disabled person from wheel chair into a passenger car. Our system consists of three plates each mounted with a motor. First motor is to perform front and back movement in the default position. Second motor is used to perform turning motion (i.e.) 360° movement from default seat position. Third motor is used to move front and back in the turned position. We fixed a swivel plate between two sliding rail, one will be in default position and another will turn 360° along with swivel plate. It performs three tasks to complete one cycle (i.e.) first sliding rail moves front then swivel plate turns 90°-135º and another sliding plate moves through outwards and vice versa. Each task has an individual control switch connected to individual motor.

1.3. Concept

The Multiway adjustable car seats for physically challenged is design and developed using "Idea development method". Idea generation is a process by introducing new concepts based on inputs and feedback given by experts and customers. The important components are,

SEAT RAIL – Used for front and back movement of seats
SWIVEL PLATE – Used for 360º rotation of seats
DC MOTOR – Used for electrically adjusting seats
DPDT SWITCH – Used as a two way switch for adjusting seats

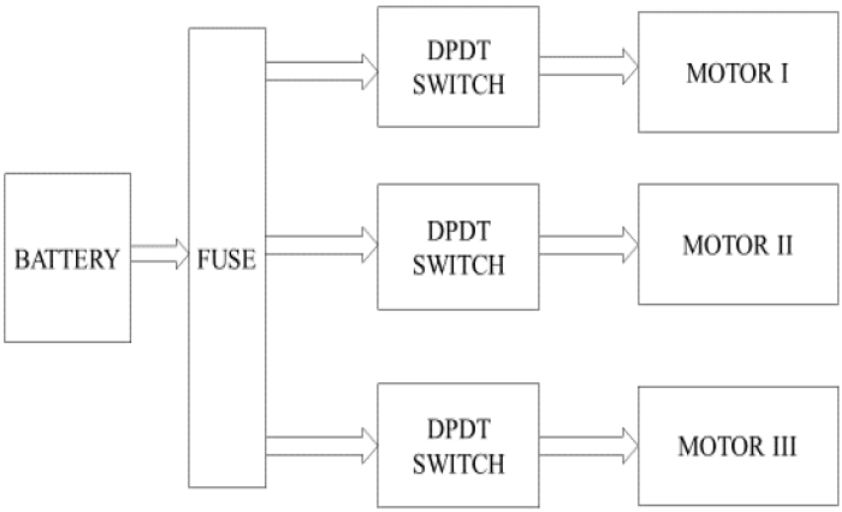


Fig 2 Conceptual diagram

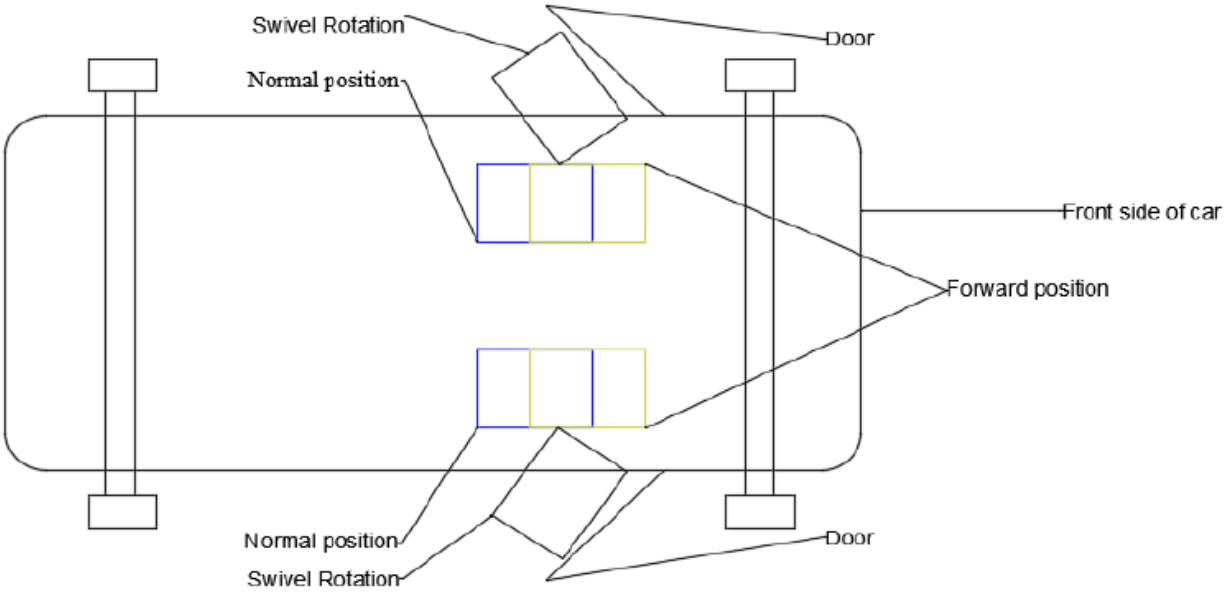


Fig 3 Functional diagram

Three concepts such as Hydraulic, Pneumatic and Electric motor were compared and analyzed based on these criteria and Electric motor was selected to use in this project.

- Cost
- Weight
- Space compatibility
- Performance

Criteria	Hydraulic	Pneumatic	Electric motor
Cost	Moderate	High	Low
Space compatibility	More	Moderate	Less
Weight	More	Average	Less
Performance	High	Average	Average
Preferable	Preferable	Less preferable	Highly preferable

Table 1 Scoring matrix

1.4. Dimensions

The dimensions and the material selected for Sliding rail and Swivel plate are presented below

1.4.1. Sliding Rail

Material	Mild Steel
Inner Slide Rail length	400mm
Outer Slide Rail length	355mm
Travel length forward	180mm
Travel length backward	110mm

Table 2 Sliding Rail Specifications

1.4.2. Swivel Plate

Material	Mild Steel
Length	390mm
Breadth	360mm
Thickness	20mm
Rotation	360º

Table 3 Swivel Plate specifications

1.5. Load Acting on the Seat Frame

As more load will act on the frame material while vehicle is in movement, let us consider load acting on the frame as approximately two times of average human being weight. Weight of an average human being is 60kg therefore let us consider 105kg of load acting on frame.

Calculation for load carrying capacity of a motor

$$P = W*g*D/t$$

$$15.4 = W*9.81*60*10^{-3} / 4$$

$$W = (15.4*4) / (9.81*60*10^{-3})$$

$$W = 104.65 \text{ kg}$$

2. Seat Design

The design of seat mechanism is completed. The sliding rail and swivel plate are designed for forward, backward and rotation movement of the seat. The length of the sliding rail used was 400mm. The thickness was around 10mm. The dimension of swivel plate was 390*360mm and the thickness was around 20mm. The Seat mechanism is modelled using SOLIDWORKS software.

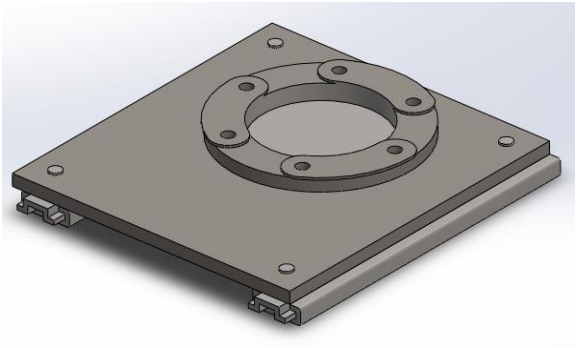


Fig 4 Top plate 3D View

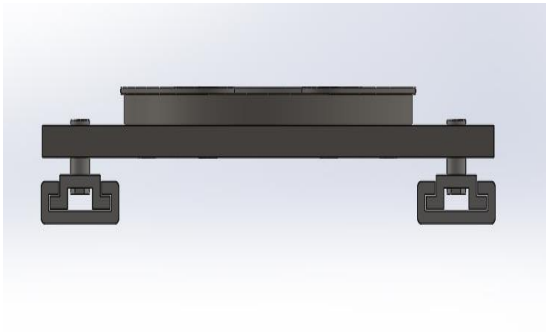


Fig 5 Top plate front view

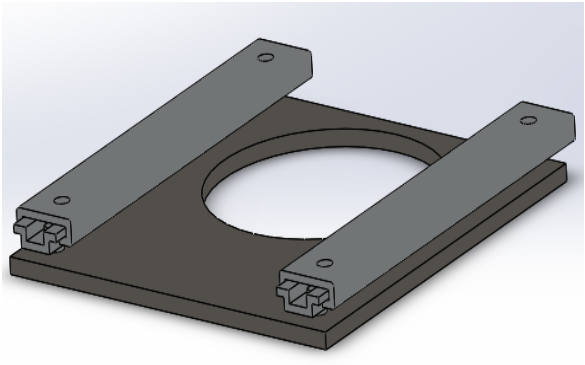


Fig 6 Bottom plate 3D View

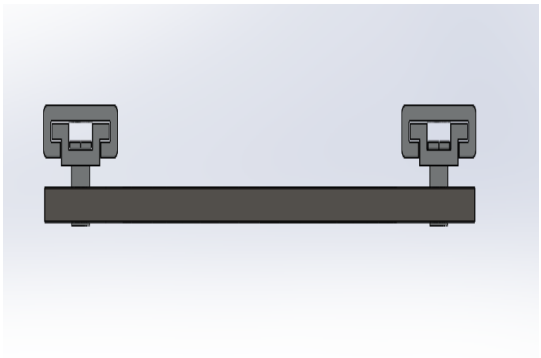


Fig 7 Bottom plate front view

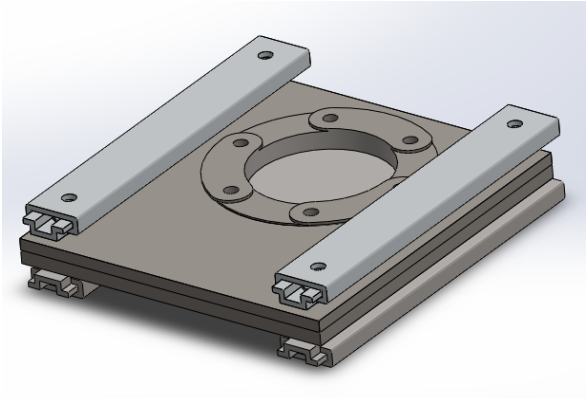


Fig 8 Complete Frame setup 3D View

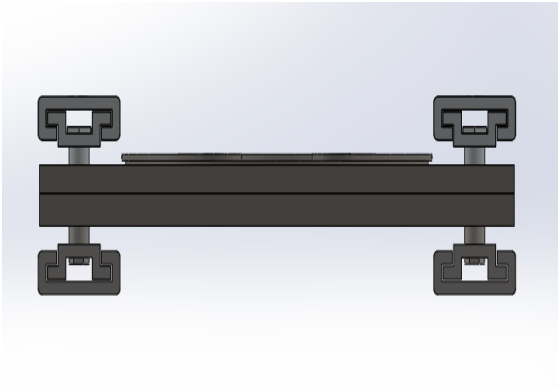


Fig 9 Complete Frame setup front view

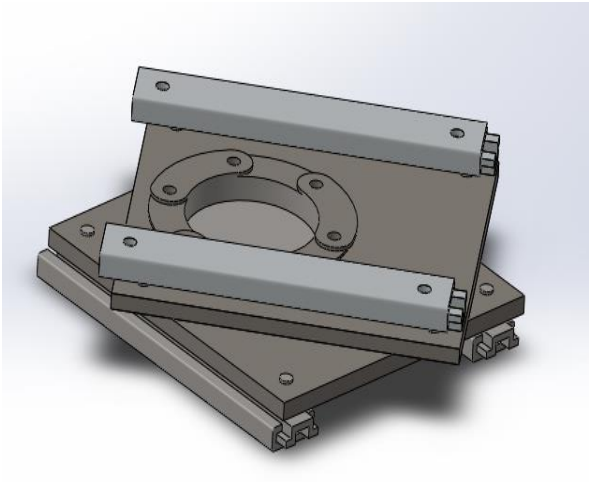


Fig 10 Complete Frame setup 3D View

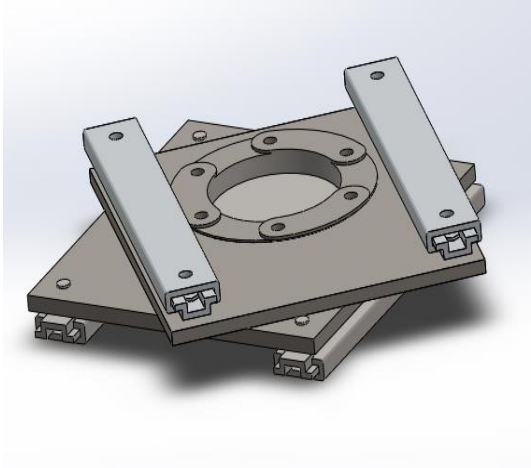


Fig 11 Complete Frame setup front view

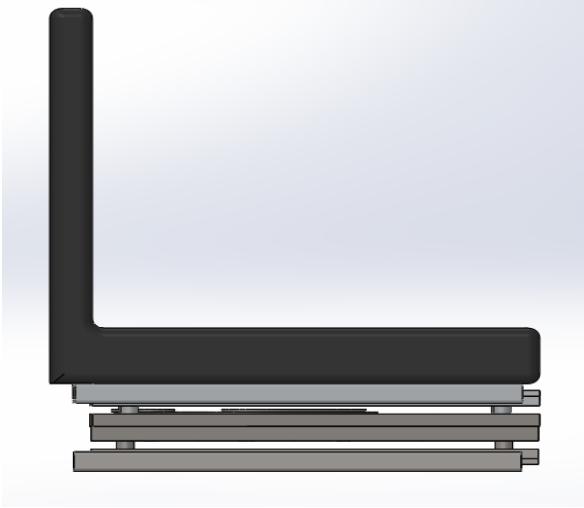


Fig 12 Complete seat setup side view

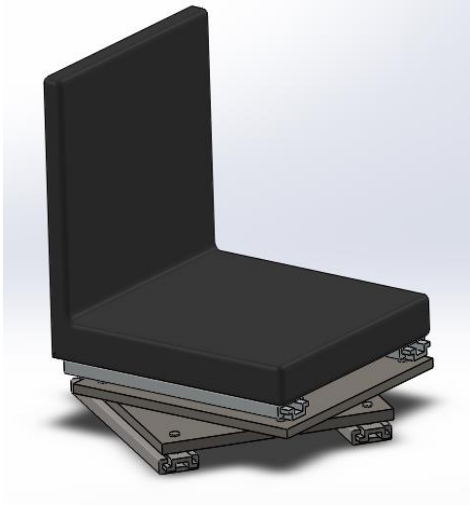


Fig 13 Complete seat setup 3D view

Simulation

A simulation was carried out of the designed circuit for DC motor with the Proteus Software. The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation.

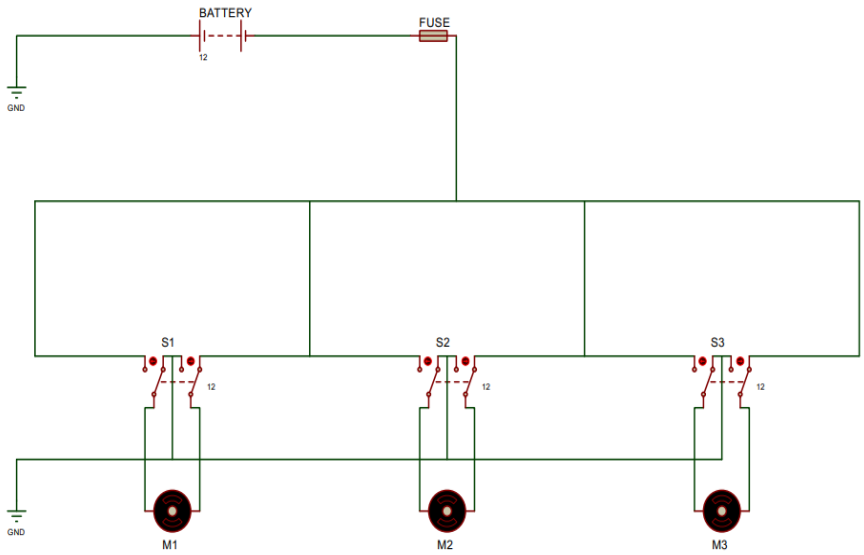


Fig 14 Circuit Simulation

Components			
Motor	M1	Slider motor	Forward and Backward movement
	M2	Swivel motor	90º-135º rotation
	M3	Slider motor	Forward and Backward movement
Switch	S1	Slider switch	
	S2	Swivel switch	
	S3	Slider switch	

Table 4 Circuit components

Result and Discussion

Thus the new seating arrangements were made to the physically challenged and elder people's to get in and get out from a car by considering various parameters. The designed Multiway adjustable seats for physically challenged people is makes them the access of entry and exit easier. As the seat nearly comes out of the car, it is much easier for them to occupy the seat without much help from others. Thus the developed a Multiway adjustable car seat is low cost with more comfort. Also occupant memory seat can be designed further to improve their comfort in the car.

Conclusion

The design and fabrication of Multiway adjustable electric seat that will turn about 135º and move towards outside towards the door will be very comfortable for the physically challenged people to get in and out of a car. They will not have any difficulty to access the seat and they can travel anywhere whenever needed without any assistant of another person. S they can be independent.

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