POLITEKNIK
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DECEPTICON WHEELCHAIR
FINAL YEAR REPORT

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ACKNOWLEDGEMENT.

Through this acknowledgement, I would like to express my sincere gratitude to all those people who have been associated with this project and have helped me with it and making the journey of doing this project a worthwhile experience.

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Last but not least, my friends from the other team. I am really thankful for having them as my friends as they know that I needed a helping hand and they have really helped me a lot in terms of exchanging ideas and man power in making this project a success.

ABSTRACT

- **Decepticon wheelchair comes with a functionality that combines both a wheelchair and a relaxing chair/Bed.**
- **Decepticon wheelchair will be able to transform to a form of a bed or vice versa with a push of a button.**
- **This wheelchair includes an outer rectangular main frame standing on at least four wheeled legs where the outer frames is being connected to each other by pivots ,hinges and also welding.**
- **The two small tyres at the front makes it easier to change the direction of the chair as they spin around.**
- **This wheelchair can also be converted into bed or any comfortable positions with the help of inner frames.**

CONTENTS

CHAPTER 1

Introduction

A wheelchair is not just a chair for disabled patients, but it is the main mode of support system that is being used to perform their basic daily activities at home or outside. However, the current challenges that the user face are mainly around the process of getting into the wheelchair itself, especially from bed. This task are done with the help of a caretaker, nurse or the user itself with huge difficulty. During this transferring process, lots of safety precaution needs to be taken in order to avoid any serious injuries /complication occurring to both the patients and or the assistant.

There are number of handling and moving devices available in the market, but these devices comes with some limitations and drawbacks. **Decepticon Wheelchair** comes with the functionality that combines both a wheelchair and a Bed. **Decepticon Wheelchair** will also be able to transform to a form of a Bed or vice versa with a push of a button.

Problem Formulation:

- Difficulty in transferring patient to bed from wheel chair.
- Uncomfortness felt by the patients when sitting for a long time.
- Paraplegic patients.
- Requires work force in order shift patients from wheelchair to bed.

Objectives:

- The objective of this project is to analyse and prototype an automated wheel chair cum bed, based on an existing smart wheel chair with extensive fact-findings and research on existing models, technology used, market scenario and customer requirements.
- It improves the balance and postural stability of old age people. Focussing on mobility assistance for bedridden persons
- Specific service to humans in a safe and comfortable manner
- Prevention of incapable of surviving serious injuries
- Gives comfort to the senior adults or paraplegic patients.
- To convert the wheelchair from sitting position to sleeping position in easy ways.

CHAPTER 2

LITERATURE REVIEW

INTRODUCTION

A lot of findings and researches that I have made to make a suitable design for this Decepticon wheelchair. Everything actually started form from a normal chair, bed and finally a wheelchair. Therefore, this Decepticon wheelchair comes with all the three functionality a chair, bed and also a wheelchair.

1.1 Wheel Chair

A wheelchair is a chair with wheels, used when walking is difficult or impossible due to illness, injury, or disability. Wheelchairs come in a wide variety of formats to meet the specific needs of their users. They may include specialized seating adaptions, individualized controls, and may be specific to particular activities, as seen with sports wheelchairs and beach wheelchairs. The most widely recognised distinction is between powered wheelchairs ("powerchairs"), where propulsion is provided by batteries and electric motors, and manually propelled wheelchairs, where the propulsive force is provided either by the wheelchair user/occupant pushing the wheelchair by hand ("self-propelled"), or by an attendant pushing from the rear ("attendant propelled").

Wheelchairs have been around for hundreds of years,but early wheelchairs were intended only to help a disabled individual move from point A to point B. As society progressed and disabled individuals became more integrated, the role of the wheelchair began to change as well. Wheelchairs are now considered not only a means of transportation but also as a way to allow users to express their individuality.

The earliest records of wheeled furniture was an inscription found on a stone slate in China and a child's bed depicted in a frieze on a Greek vase, both dating back to the 6th century. The first records of wheeled seats being used for transporting the disableddate to three centuries later in China.The Chinese used their invented wheelbarrow to move people as well as heavy objects. A distinction between the two functions was not made for another several hundred years until when images of wheeled chairs made specifically to carry people begin to occur in Chinese art. There were many attempts to connect furniture to wheels dating back to the time of Christ.

But perhaps the first wheelchair was invented for King Phillip II of Spain. In 1665 one of the first self-propelled vehicles was invented by Stephan Farfler.

Harry Jennings and his disabled friend Herbert Everest, both mechanical engineers, invented the first lightweight, steel, collapsible wheelchair in 1933. Mr. Everest had broken his back in a mining accident. The two saw the business potential of the invention and went on to become the first mass-manufacturers of wheelchairs: Everest and Jennings. Their "x-brace" design is still in common use, albeit with updated materials and other improvements.

In the 1950's the first powered wheelchair was developed. It used a motor to power the wheelchair. It was around the same time that wheelchair sports were first started. In the year 1964 the first Paralympics games were held in Tokyo, Japan. Modern day wheel chairs contain light materials, microprocessor controlled and many more sophisticated systems. There is a revolution of wheelchairs available today driven by needs and desire or man today. The future expects a better range of wheelchairs that could suit the imagination of the human mind and serve the needy. The basic structure of the wheelchair contains various parts.

In simple words its nothing but a set of wheels attached to a chair. There are some important things a wheelchair must contain. A seat must be comfortable, so that the person does not get tired sitting on it for a long time. It must contain a backrest that provides a good lumbar support. It must have an arm rest at an optimum height and a also a foot rest. The most important think is it must have brakes for the wheels.

1.2 Stretcher

A stretcher, litter, or pram is an apparatus used for moving patients who require medical care. A basic type (cot or litter) must be carried by two or more people. A wheeled stretcher (known as a gurney, trolley, bed or cart) is often equipped with variable height frames, wheels, tracks, or skids. In American English, a wheeled stretcher is referred to as a gurney.

A stretcher/bed is a medical device to carry patients for a short duration of time. A stretcher contains a surface which support for carrying patients, and has handles on either side along its length to help carry it.

Stretchers have been used since antiquity, on battlefields and in emergency situations, where wheeled vehicles are hindered by rough terrain. In their simplest form, they generally consisted of a canvas sling with long edges sewn to themselves to form pockets through with wooden poles could be slid. Today there are a wide variety of stretchers available, involving light weight materials, attachments so that it can be fitted to other contraptions.

Stretchers are primarily used in acute out-of-hospital care situations by emergency medical services (EMS), military, and search and rescue personnel. In medical forensics the right arm of a corpse is left hanging off the stretcher to let paramedics know it is not a wounded patient. They are also used to hold prisoners during lethal injections in the United States

Meng-Hui Hsu, Hsueh-Yu Chen, Jen-Yu Liu and Chien-Liang Chen (2009) in there paper "Dualpurpose wheelchair mechanism designs" has stated that a wheelchair with dual-function of sitting and lying is usable to the users no matter what he sits or lies. In addition, if the rear wheels of the dual-purpose wheelchair are designed as movable ones, the whole mass-center of the wheelchair can move between the rear and front wheels of the chair.

Sreerag C S, Gopinath C, Manas Ranjan Mishra (2011) in their paper "Design and development of conceptual wheelchair cum stretcher" has stated that

mobility aids are useful for patients for transportation and a replacement for walking especially in indoor and outdoor environment. Their study shows that it is possible to save 50% space by the wheelchair- cumstretcher design.

The product will thus likely be an efficient mobility aid in hospitals. They generated some concepts compared and studied using Pugh method with the bench marked product And finally one concept was selected as the final concept and it was verified with user opinion.

U. D. Gulhane, R. J. Dahake, O.M.Sharma (2005) In their paper titled "Wheel Chair cum Stretcher/Bed, n innovative product for small hospitals and patients" , the authors has design and fabricated a new modified wheelchair cum stretcher. The develop wheelchair can very easily be converted into stretcher as well as operation table depending on the need. Simple parallelogram mechanism has been synthesized for lifting. The mechanism is driven hydraulically. The hydraulic piston can be operated manually as well as automatically. The chair gets converted in stretcher while lifting automatically. Inverted slider crank mechanism are applied for the purpose. Five legged support provides required stability to stretcher. The developed model is economical as compared to the available modern automatic wheelchairs.

Hsin-yi Liu, Rory A. Cooper, Jonathan Pearlman, Rosemarie Cooper, Samuel Connor (2008) In their paper titled "Evaluation of titanium ultra light manual wheelchairs using ANSI/RESNA standards" stated that Comfortable propulsion and support, light weight, and small dimensions are important features that help preserve upper-limb integrity of manual wheelchair users and improve accessibility. The titanium wheelchair is a product developed in response to these goals, but none of the test results of titanium wheelchairs had been disclosed before this study was performed. They hypothesized that these titanium wheelchairs would be in compliance with American National Standards Institute (ANSI)/Rehabilitation Engineering and Assistive Technology Society of North America (RESNA) standards. They tested 12 ultralight titanium rigid-frame wheelchairs (4 models) using ANSI/RESNA testing procedures and compared the test results with previously tested ultralight and lightweight aluminium wheelchairs.

1.3 Bed

A hospital bed or hospital cot is a bed specially designed for hospitalized patients or others in need of some form of health care. These beds have special features both for the comfort and well-being of the patient and for the convenience of health care workers. Common features include adjustable height for the entire bed, the head, and the feet, adjustable side rails, and electronic buttons to operate both the bed and other nearby electronic devices.

Hospital beds and other similar types of beds such as nursing care beds are used not only in hospitals, but in other health care facilities and settings, such as nursing homes, assisted living facilities, outpatient clinics, and in home health care.While the term "hospital bed" can refer to the actual bed, the term "bed" is also used to describe the amount of space in a health care facility, as the capacity for the number of patients at the facility is measured in available "beds."

Beds with adjustable side rails first appeared in Britain some time between 1815 and 1825.In 1874 the mattress company Andrew Wuest and Son, Cincinnati, Ohio, registered a patent for a type of mattress frame with a hinged head that could be elevated, a predecessor of the modern day hospital bed.

The modern 3-segment adjustable hospital bed was invented by Willis Dew Gatch, chair of the Department of Surgery at the Indiana University School of Medicine, in the early 20th century. This type of bed is sometimes referred to as the Gatch Bed.The modern push-button hospital bed was invented in 1945, and it originally included a built-in toilet in hopes of eliminating the bedpan.

The literature review indicates that the patient handling method and equipment, wheelchair and stretcher/Bed is used presently cannot prevents the manual handling of patient from hospital bed to wheelchair/stretcher and vice-versa. Though above authors developed different systems were proposed to transfer the patient from hospital bed to stretcher or vice versa. The proposed system is very complicated and costly and hence not suitable for use in hospital environments present in our country.

CHAPTER 3

METHODOLOGY

PROJECT DESIGN

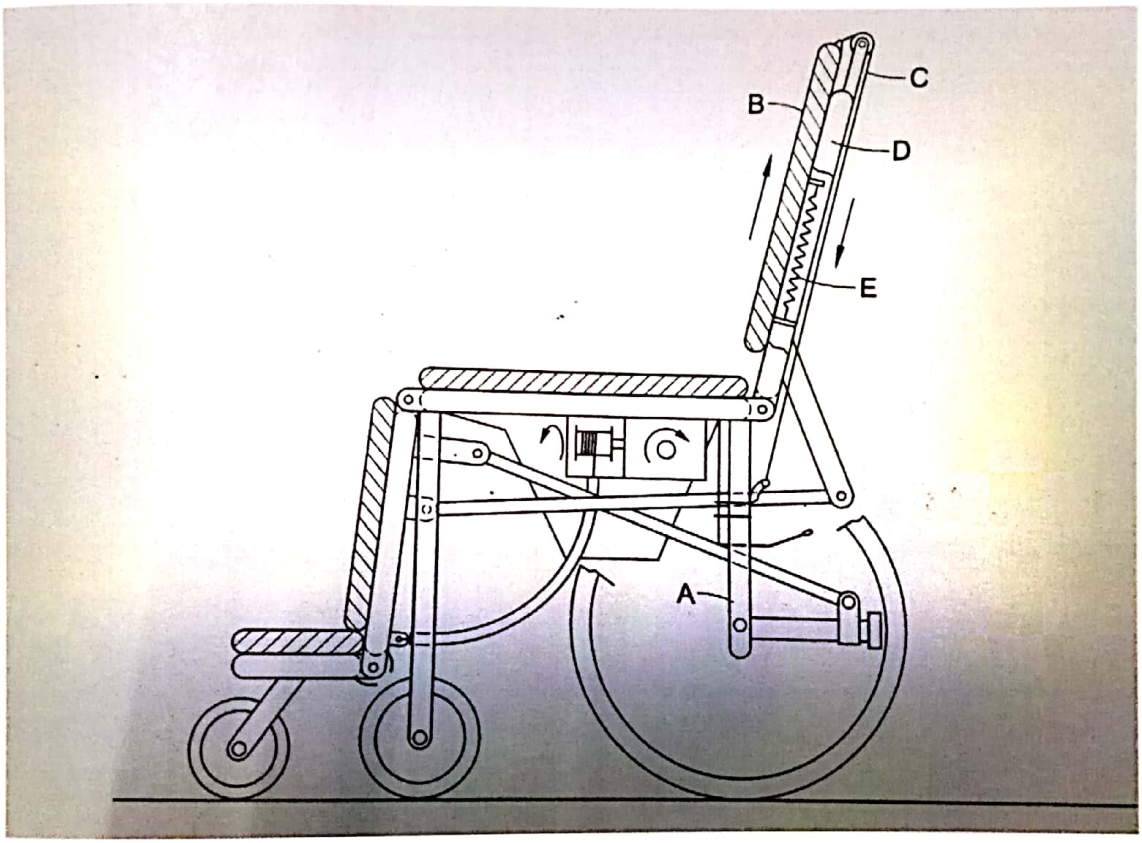


FIGURE 1: THE WHEELCHAIR IS IN A SITTING POSITON

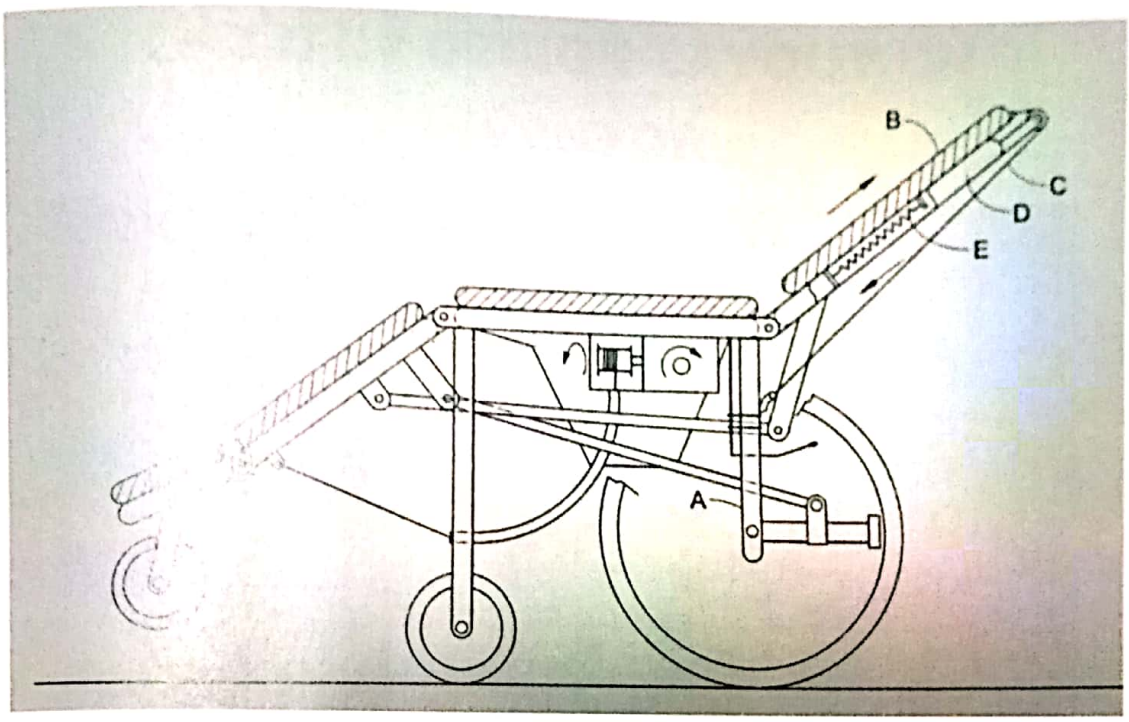


FIGURE 2: THE WHEELCHAIR IS IN A RELAXATION POSITON

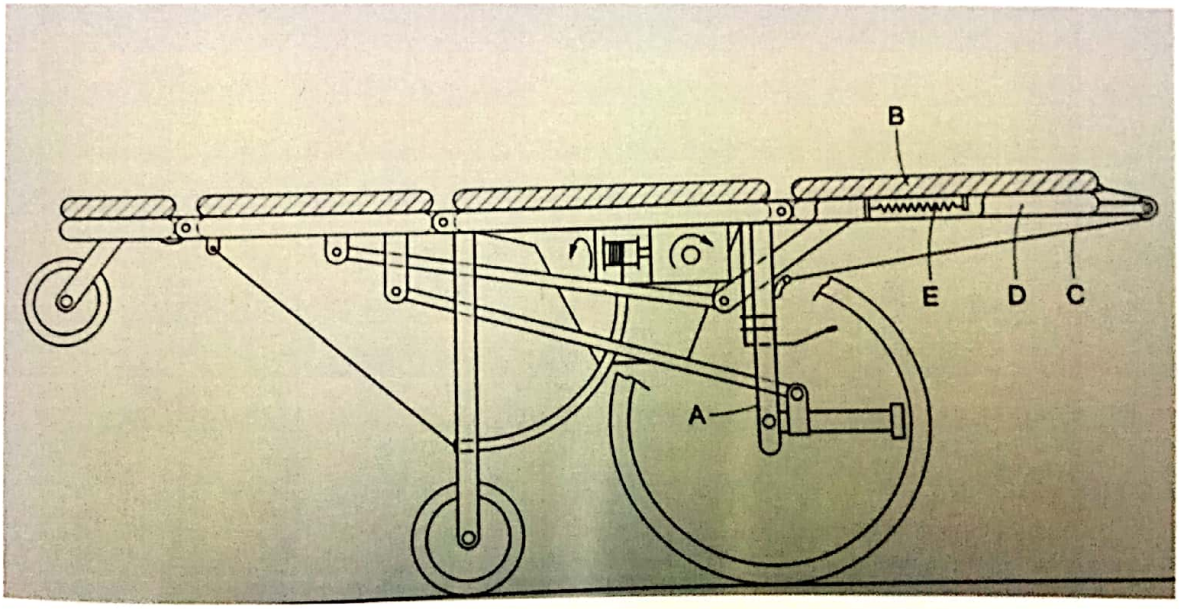
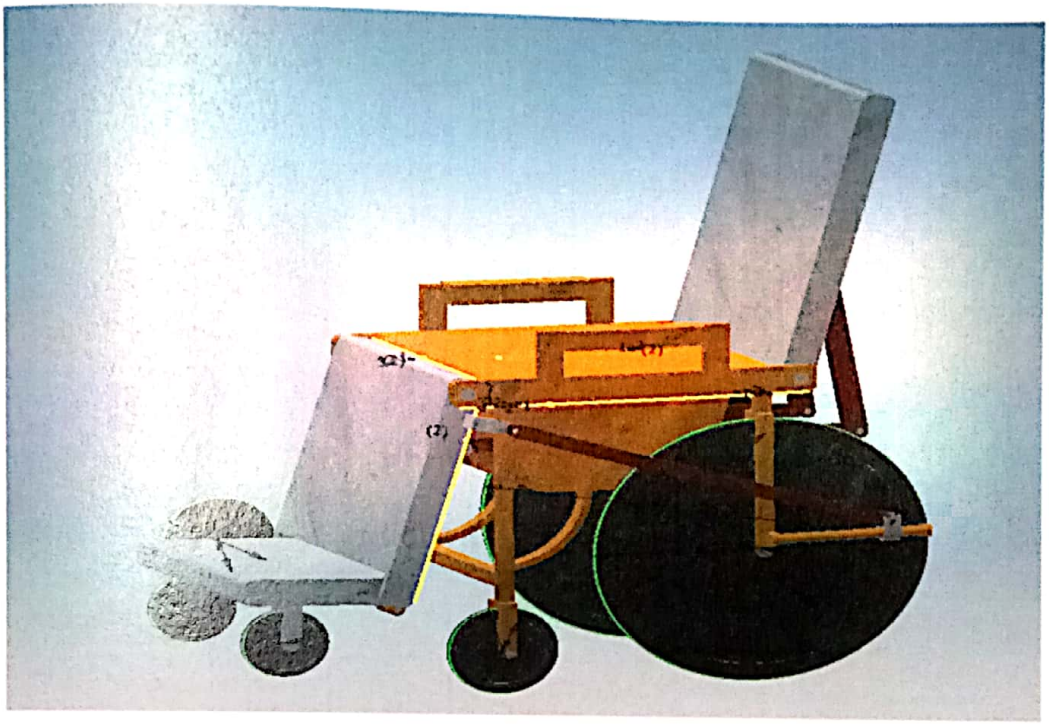
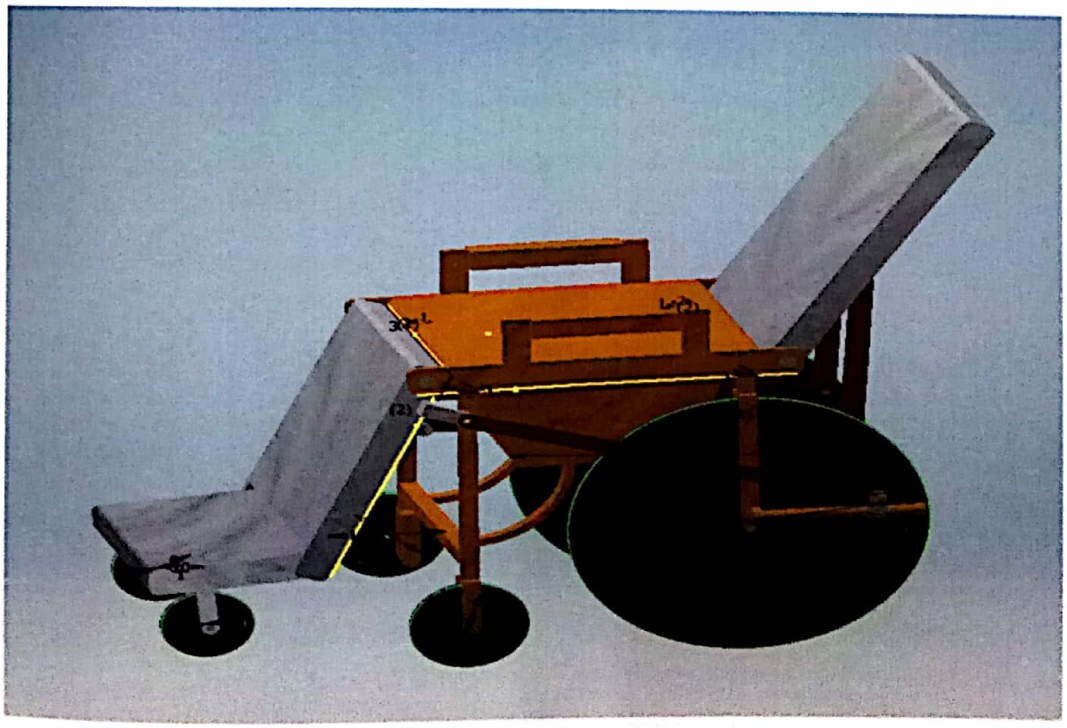
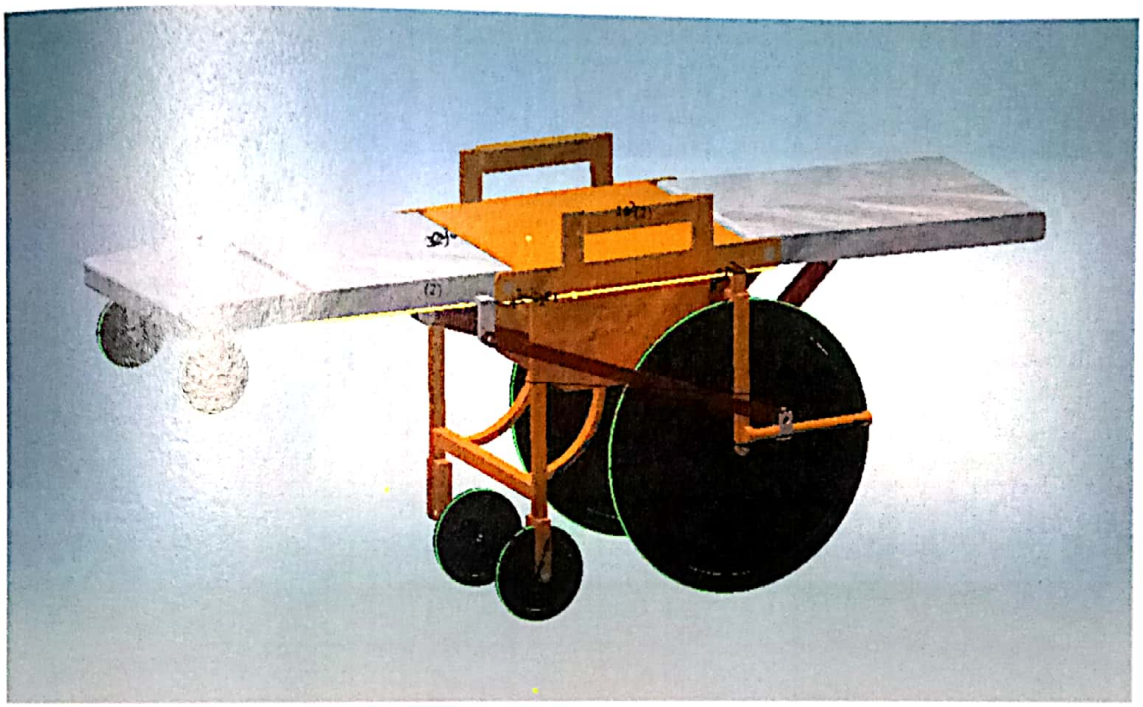


FIGURE 3: THE WHEELCHAIR IN A SLEEPING POSITION.

PROJECT DESIGN LAYOUT ON INVENTOR

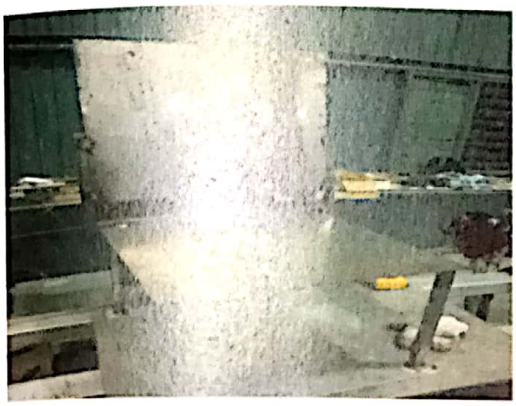






SAMPLING TECHNICQUES.

PROJECT PROGRESS



FINAL PROJECT VIEW

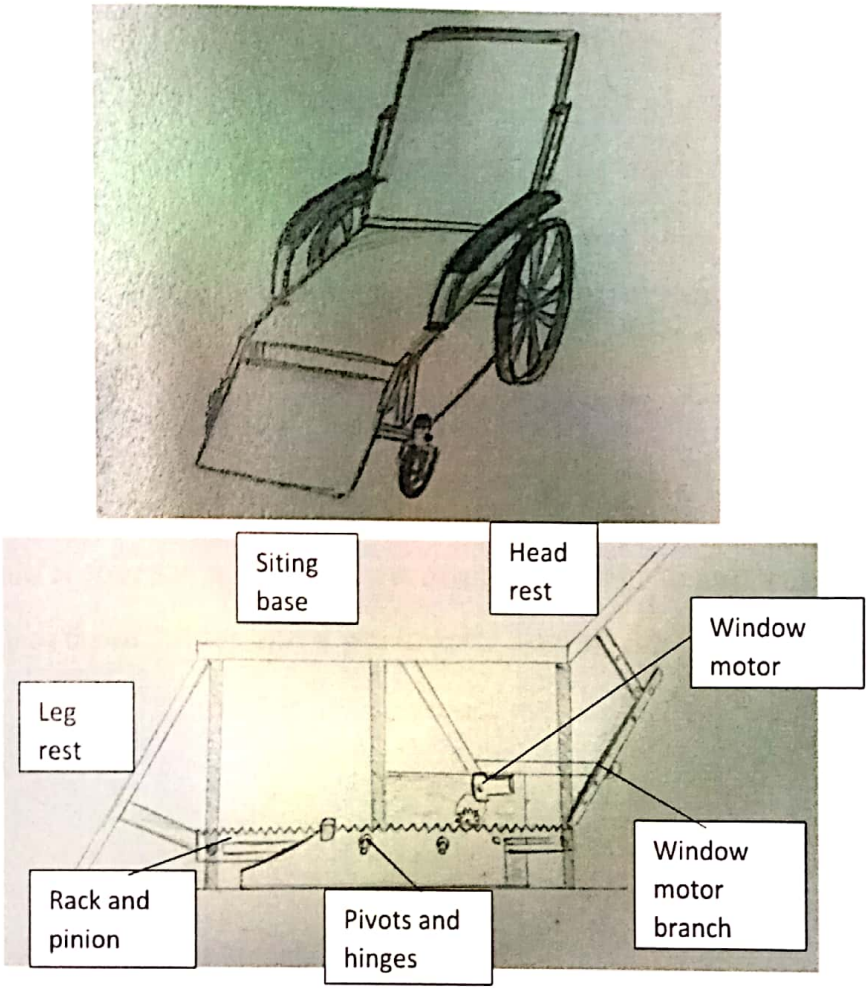
MATERIALS AND EQUIPMENTS

- STEEL BARS(6m)(2cm diameter) (for the frames)
- MOTOR &GEARS (rack and pinion)
- PIVOTS & HINGES
- WIRE CABLES(3m)
- WHEELS
- AXELS (metal rod)
- STEEL PLATE(46cmX46cm)x4
- CUSHIONING

MATERIALS	COSTING
STEEL BARS	RM20
RACK AND PINION GEAR	RM340
STEEL PLATE	RM100
AXELS	RM30
BANNER	RM20
BROCHURE	RM20

TOTAL:RM530

DATA ANALYSIS,



Since this wheelchair is only a prototype, i put my focus mainly on the mechanism of the wheelchair. The base of the wheelchair is a rectangular steel plate with the thickness of 5mm.This plate is used to withstand the weight of the wheelchair and also other equipment such as battery, motor and gears. Testing has been carried out and at least 65kg of weight can be put on this wheelchair. The 2 big wheelchair tyres is to balance and support the weight of the human when the wheelchair is being used. There are about 8 steel bars under the sitting plate as it acts as the main frame of this

wheelchair. So when there is weight applied the main frames carries some weight support to prevent all weight from going to the main base plate.

For the converting to bed mechanism, a gear concept of rack and pinion is being used. This concept is used because it suits the working mechanism so when the head rest comes down ,the leg rest goes up. The rack is attached to a window motor for its movement. In researches, in this type of mechanism a motor with high torque and low rpm needs to be used so that's the purpose window motor is used.

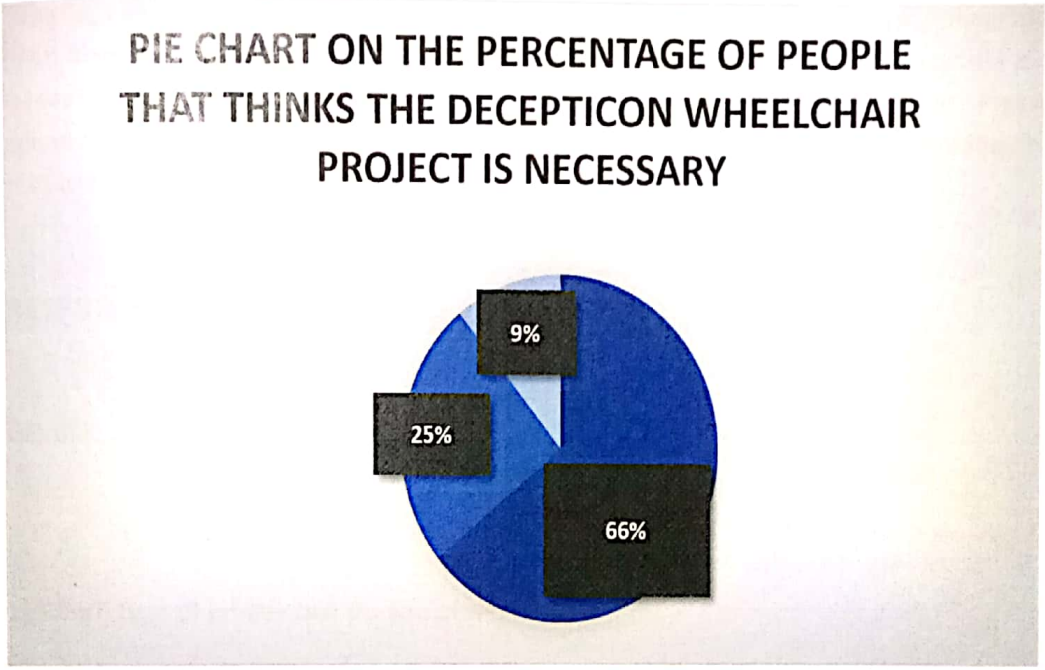
In summary, the mechnasim of the wheelchair worked well without any problems and if there is more fund eventually the wheelchair can be upgraded to around 100kg and a pneumatic system concept can be used.

CHAPTER 4

FINDINGS

The pie chart below shows the survey response from the patients itself.

The response are mainly from disabled patients.



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INTRODUCTION

Greetings everyone, we the Diploma in Mechanical Engineering students from Polytechnic Shah Alam would like to conduct a survey on our mechanical project. Our project title is **Decepticon Wheelchair**. Our project is basically a convertible wheelchair to a bed. Please spend a few minutes of your time to answer these few simple questions for our research purposes. Thank you in advance.

RESPONDENT INFORMATION

GENDER ☐ **AGE** ☐

1) Which type of wheelchair do you prefer?

Manually operated ◯

Automatically operated ◯

2) Does any of your family members / friends uses a wheelchair?

YES ☐

NO ☐

3) What type of illness/sickness are they facing?

_____

4) Are they having difficulties in transferring from a wheelchair to a bed?

YES ☐

NO ☐

5) Do they need any assistant in order for them to transfer from the wheelchair to a bed?

YES ☐

NO ☐

6) How long do they usually take for the transferring process?

A few seconds ◯

1-4 MINUTES ◯

MORE THAN 5 MINUTES ◯

7) Do you think that a convertible wheelchair to bed is necessary for them to make this transferring process?

YES ☐

NO ☐

In conclusion, about 20 patients have given their responses towards our project and majority of them thinks that this decepticon wheelchair is necessary mainly in hospitals and believe that it would better their medical. There are patients whom disagree because this type of patients are used to moving without their disabled legs and hands and believe without their one hand or leg they can still able to climb on the bed and move.

ADVANTAGES & BENEFITS

- Increases the comfort level of patient handling staff.
- Prevents damages to patient while transferring from wheelchair to bed.
- Occupy less space
- Easily converts from wheelchair to bed
- Emergency and serious who should not be moved or disturbed from their position can be shifted
- Shifting of patient is reduced when this type of wheelchair is being used.
- Position of patients can be easily adjusted as per doctors use
- No special training is required to operate it.

LIMITATIONS

- Increases system weight slightly
- Increases system cost slightly
- This automatic system is only for changing from sitting position to bed positions.
- Only supports 70 kg of weight

Problems faced while doing this project.

- COST

The main problem faced is the rack and pinion gear concept,The only reason the bed didn't turn out 180 degrees is because of the length of the rack.The rack that I customised is 40cm and its price is rm340 which is costly for me as I was all alone.If at all I have more fund in my hands eventually I will be customising a longer rack and will be turning the wheelchair to full bed postion.

- Exchange of ideas.

  During the installation of project,there a lot of troubleshooting problems faced which lengthens the time and makes the project to be finished in a rushing way.So I felt that there was lack of exchanging ideas as I was the only one sorting out the problems faced as my friends from other team also had their project to be settled.

CHAPTER 5

Discussion&Conclusion.

Discussion

As per the above discussion, we concluded that now day in hospitals fully atomized beds, wheelchairs and stretchers are used for the patient handling purpose. However, they are very costly and cannot be afford to all the hospital. The stresses developed during the handling of patient in both, i.e., patient and staffs are same for all the hospital. Our aim to provide a better solution for patient handling to these hospitals whose having limitations for the use fully automated beds/stretchers and wheelchair.

Conclusion

As a conclusion, we propose a new design of wheelchair called **Decepticon Wheelchair** for patient handling. Cost of such type of wheelchair will be affordable for all type of hospitals and it will be beneficial for patient handling.It is expected that this automatic based **Decepticon Wheelchair** would enable people's better medical and with the future recommendations of this project it would greatly reduce time and man-power to the old age home staff.

PROJECT RECOMMENDATIONS.

- The bed of the wheelchair can be widen.
- All the steel bars and plates can be changed into aluminum to reduce the weight of the wheelchair.
- A pneumatic system concept can be used to make the mechanism work more efficiently.
- The design of the wheelchair can be change by using bending frames as the base to prevent it from looking bulky.
- A wheelchair that can be adjust according to the height of patient will be useful. This can be done using actuators with the help of pneumatic system.
- A joystick controller can be used to make the wheelchair move from one place to another.

REFFERENCES

- ✓ https://patents.google.com/patent/US20100199422A1/en?q=WHEELCHAIR+WITH+A+COMMODE+THAT+CONVERTS+TO+BED&oq=WHEELCHAIR+WITH+A+COMMODE+THAT+CONVERTS+TO++BED
- ✓ https://www.seminarsonly.com/Engineering-Projects/Mechanical/automatic-wheel-chair-cum-bed.php
- ✓ http://mechanical.srpec.org.in/files/Project/2015/15.pdf
- ✓ https://journalnx.com/papers/20150291-convertible-stretcher.PDF

Table 2: Gantt chart Designing & Implementation of Project

Month / Week	JULY		AUGUST				SEPTEMBER				OCTOBER		
	3	4	1	2	3	4	1	2	3	4	1	2	3
The design of wheelchair chair is sketched based on the researches.													
Listing the materials and equipments needed and buying them.													
The installation of the project is carried out. The main base frame is constructed at first.													
The headrest and leg rest is being done with the suitable plate and metal rod connected by pivots and hinges.													
The motor and the rack is installed for the moving mechanism of the head rest and leg rest													
The wheelchair tyres is installed and testing is carried out.													

Indicator :

	Implementation
	Execution