Design & Development of a Multipurpose Wheelchair For Physically Challenged Persons

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Abstract- Disability can be said as the condition of a person where the human faces many difficulties in their Day to Day life . At present around 650 million people out of world's population facing this problems. Some of them are facing single type of disability or some facing multiple disabilities. Few of them are older people having disabilities due to there weak health. These people are unable to move from one place to another place. Due to disability it is difficult to caretaker to shift and move such peoples. In this project, we focused on the design and fabrication of a pneumatic lift wheelchair equipped with a split seat and opening frame, which enhance accessibility, ease of use, and hygienic for the disabled person . It is user friendly and economical making it useful in home, hospitals, etc. The combination of moving, lifting & shifting offers the effective solutions.

***Keywords*: Pneumatic Lift , Wheelchair Design , Split seat , Patient Transfer , Commode wheelchair , Elder care , Non – electric lifting machine , Opening Frame , Manual Operation , Foot – Operated Mechanism .**

INTRODUCTION

Wheelchairs are designed for an individual Who experienced difficulty in walking due to disability, injury or some sort of medical problems. Common wheelchairs do not satisfy daily needs such as use of washrooms, smooth patient transfer, etc. At homes and hospitals caretakers face many challenges regarding patient transfer from bed to washrooms. This is not only a burden but may also cause an injury to patient due to improper handling. To minimize these limitations the project introduces a Pneumatic Wheelchair equipped with a split seat – opening frame. The Aim of this project is to provide hygiene and comfort instead of using electric devices such as motor etc. The core factor of this project is the pneumatic cylinder which allows the vertical movement through air pressure controlled by foot operated valve. It ensures safe lifting of patients. The chair also consists of caster wheels to ensure stability .The use of material like mild steel gives the chair a long life around 10 years. Some people can't even afford the wheelchair due to their financial conditions, thinking about those people also we have created the chair in the minimum amount of money, so that everyone can get the benefits of wheelchair.

A split seat design with central opening is functionality in the wheelchair. The seat is parted in two different seats which help the user to directly use the washrooms. The Wheelchair is capable of supporting the load of around 250 kg. The design considers Ergonomics, Hygiene and safety. The wheelchair is also equipped with mobile stand to give entertainment to the user and handle the mobile safely within the users reach. It is a cost effective project designed to perform multiple functions. The Vertical movement due to pneumatic cylinder gives a safe way to positioning the body. According to census of India, the below shows the percentage of disability of people –

1] In seeing – 18.8%
2] In hearing – 18.9%
3] In speech – 7.5%
4] In Movement – 20.3%
5] Any other -18.4%

As seen above 20.35% of people are suffering from Movement disability increasing operational efficiency. So to overcome these problems, as a team of engineers we designed & developed a smart wheelchair for paralyzed and disabled person, So that they can also get a taste of freedom. The term 'Smart'

refers to a wheelchair with advancements enhancing safety, Movement, and an independent life to the user.

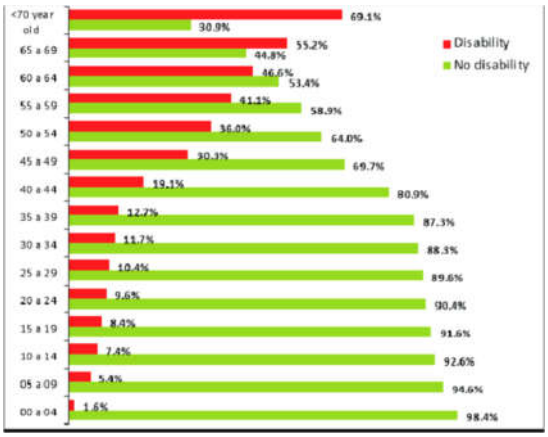


Fig 1: - Chart showing disability of person according to age groups

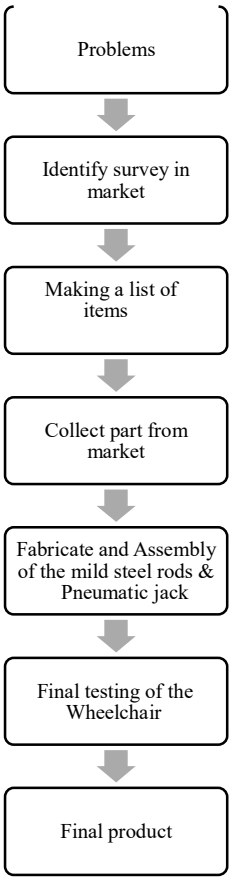
The above chart shows the disability of person with different age groups. Green colour represents person with no disability and the red colour shows the people with Disabilities. It is seen that the disability becomes more frequent with increasing age group.

Fig 2: - Actual working model of pneumatic wheelchair

- Problem Statement: -

On the basis of our survey, it is found that the present wheelchairs are either electric operated or either hand operated. Many elderly or physical disabled person face problem in transferring between washrooms, bed, etc.

Methodology: -



- Objective: -

1.To provide Facilities to the Disabled persons.

2.Make the wheelchair cost effective for everyone.

3.To reduce the burden of helper.

- Various Attachments: -

1.Anti- locking Wheels-

The wheels are connected at the bottom of the chair. It is useful for making movement on the floor. Wheels that we used in our project is made up of Nylon Material. It is also but a plastic like material which is used for the replacement of bearings and bushes. This Nylon posses a good properties like friction resistance, Good elasticity that make it an ideal material for wheels. Another advantage of this wheels is the can absorb the surface shock and surface irregularities without breaking and give the user a comfortable Ride. The Foot Operated lock system in wheels helps to keep the chair stable without Tilting, etc.

Fig 3: - Anti locking wheels

2. Pneumatic Air Jack -

It works on Medium that is air. As we push down the cylinder the air compresses inside the tube, the chamber is completely sealed. As we push down the pump with the help of footrest it compresses the air inside the chamber, it offers a several advantage over battery models. This pneumatic air jack makes the wheelchair light weighted because there is absence of heavy battery . It can be used for lifting and lowering of wheelchair. This component makes the project more attractive & affordable.

Fig 4: - Pneumatic air jack

3. Matting -

It a thick material used for covering made up of ropes, plastic, natural fibre (coir), rubber etc. This gives comfort, safety, cleanliness. This matting prevents fatigue, slipping, Insulating against electricity, and can be also used for good appearance. In our project we use it for purpose of covering the seats.

Fig 5: - Mattings

4. Cushion -

The below figure shows cushion, It is Soft And is typically used to enhance comfort while sitting, They are often made up from foam, sponge or any other soft materials, And is later covered with Fabric. This matting is often used in chairs, wheelchairs, beds, sofa, etc. To prevent body pain and discomfort to the user, This cushion provide pressure relief and also gives support, making them beneficial for the person who remains seated at a one position for a long time.

Fig 6: - Cushion

Testing And Result: -

Fig 7: - ready Model

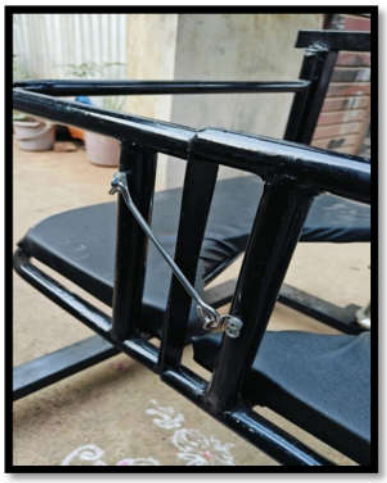


Fig 9: - Locking system of Opening frame

Benefits for Smart wheelchair -

1. Affordable & Cost-Effective – smart wheelchair for paralyzed persons are much cheaper than other wheelchairs available in market, so that everyone can afford this wheelchair, and get a safety and comfortable life.
2. Multi-Functional – They can be used for Safely transferring from one position to another For example -transferring a patient from bed to washroom and vice versa.
3. Hygiene Support – The cut in hole on seat make it easier for using the toilet for the patient instead of lifting him / her again & again, also Reduces the manual effort required.
4. Easy to Operate – Lightweight and simple in controls make it user-friendly for everyone.
5. Enhance safety & stability – The locking wheel keeps the wheelchair stationary at one position Providing stability and safety.
6. Easy to handle – As this wheelchair is foldable it is easy to carry at any place while travelling.
7. Low maintenance – The material used in project is usually mild steel which is long time usable material. Once fabricated can be use for 9 to 10 years.
8. Enhance weight capacity – Can handle a body weight up to 200- 250kg at a time, and supports a range of different body types.

Future Scope -

1. AI assistance -
   - Use of AI to monitor the health , Voice commands, etc
   - Implementation of Smart assistance system.
2. Compact and Light weight -
   - Use of material like carbon fibre to make it more light i.e. reduce the weight .
   - Improved safety and user-friendly ergonomics .
3. Cost Optimization and Mass Production -
   - Exploring low-cost manufacturing techniques and materials.
   - Government partnerships for mass production and distribution to Hospitals, care centres, etc.
4. Hybrid Mechanism -
   - Using of electric hydraulic or pneumatic system for energy efficiency/ energy saving.
   - Making it more multifunctional.
5. Self –cleaning & more hygienic -
   - Addition of antibacterial material and automatic cleaning option.
6. Advance comfort &suspension -
   - Implementation of suspension system to absorb road shocks and road irregularities.
7. Use of sensors -
   - Include sensors to monitor posture, heart rate , all connected to mobile phone.

- Use of joystick, Remote control or Smartphone app-based control systems for control of wheelchair.

ACKNOWLEDGMENTS

It is with great pleasure that we present this project report on “Design & development of a multipurpose wheelchair for physically challenged purpose.”

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CONCLUSION

The on multipurpose wheelchair for physically challenged purpose offers a practical, low-cost, and efficient solution to Disabled person and also for hospitals & care centres, by combining multiple essential functions —such as shifting, lifting, and transferring, into a single compact wheelchair. Powered by Pneumatic air jack, the wheelchair ensures Safe transferring, ease of operation, and adaptable to different body range Conditions. The modular design and lightweight construction enhance portability and usability to paralyzed persons.

Experimental testing and performance analysis confirm that the Design significantly reduces manual effort, operational time, and overall costs. Its multi-functionality, and cost effectiveness make it an ideal wheelchair. This innovation addresses the financial and operational challenges faced by patients and nurse/sisters in hospitals, care centres during operations, providing a helpful solution and impactful contribution to medical sector .

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