DESIGN AND FABRICATION OF ATTACHABLE WHEELCHAIR AUTOMATOR

Vikas Singh[1], Viraj Chaudhary[2], Ravin Kanojiya[3], Deepak Yadav[4] , Jayant Patil[5]

[1,2,3,4] Student of Dept. of Mechanical Engineering, Thakur College of Engineering & Technology, Maharashtra, India.
[5]Associate Professor, Dept. of Mechanical Engineering, Thakur College of Engineering & Technology, Maharashtra, India.

Abstract - *Today,in the twenty-first century, technological advancements have proven to be a boon for all civilian populations and have assisted the globe in becoming independent, but, as with any coin, there are two sides to every coin; similarly, these advancements and progress have left the disabled dependent on others for their mobility, and the same is true for paraplegia patients. According to 2011 surveys, 2.21 percent (2.76 million) of India's population is disabled. The number of people living with paraplegia has surpassed 20,000, and it is growing at a rate of about 10,000 each year. Our initiative intends to provide disabled (paraplegia patients) with an autonomous lifestyle, a clean environment, and an easy form of transportation in order to make their lives easier. Patients with paraplegia have difficulties pushing wheelchairs on uneven surfaces; also, pushing the wheelchair puts effort on their upper body, which can lead to tiredness over time. The typical wheelchair on the market does not make the patient independent, and the electrical version is prohibitively expensive. However, the issue is that it gets caught in minor potholes and does not satisfy the requirements when used on uneven terrain since the front wheel is smaller. Attachments manufactured from a cycle electric conversion kit are used in this project to bring electronics to a wheelchair. Because the trike is three-wheeled, the difficulty of balancing is eliminated because it is a self-balanced vehicle, and the crippled can ride electrically. The addition will lift the smaller front wheels, and the front wheel will be significantly larger in diameter than the front wheel, making it easier to ride on uneven terrain. We have also attached a disc brake and a 4-point safety harness for added safety.The concepts of the wheelchair and the electric conversion kit were thoroughly researched, and the many components that would be employed were created accordingly. The vehicle would next be evaluated and modifications made based on the results in order to optimise it for everyday usage and meet all of the parameters that allow us to have a comfortable and safe ride. We can automate the vehicle and provide the rider with the best comfort by using a hub motor.*

***KeyWords*: Wheelchair, Battery, Motor Hub, 4- Point Safety, paraplegia patients.**

1. INTRODUCTION

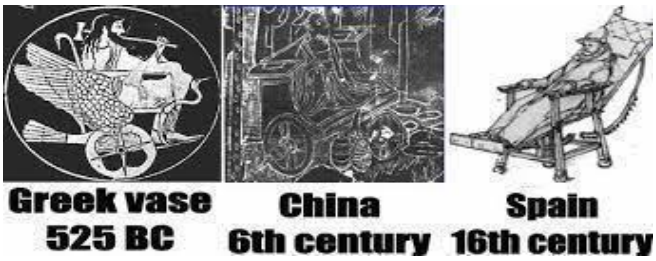
It is well known that, in the twenty-first century, all of the inventions, discoveries, and advances accomplished throughout the centuries have made civilian life nothing short of a paradise. Transportation vehicles have progressed from a single wheel to bicycles to cars to steam engines to ships to aeroplanes, making human travel from one location to another far more convenient than before. These transportation vehicles have made human existence considerably easier and have aided in accelerating progress in order to provide a brighter future for future generations. But, as with every coin, there are two sides to every story, and this road of progress for a brighter future for the majority has left disabled people as a burden on their families. People with lower body disabilities, often known as paraplegia patients, have trouble pushing wheelchairs on uneven and rugged terrain by themselves. Additionally, pushing wheelchairs puts stress on their upper body and can lead to weariness over time. The usage of an electrical wheelchair is the most practicable choice to meet the above-mentioned requirements, but given the economic situation of the majority of the country's civilian population, the electrical wheelchair is too expensive, and the cost increases exponentially with the big brands. The electronic wheelchair is simple to operate and does not place undue strain on the patient's body.

1.1. Background

There has already been far too much research into the electrical wheelchair. Although the traditional electrical wheelchair may be a potential substitute for non-electrical wheelchairs, the high cost and rider comfort make it difficult for the rider to go long distances since the rider's posture places too much stress on the back, shoulder, and neck. This causes the rider to take pauses while riding and makes them reliant on others, which is undesirable because city life is too fast-paced. After doing some study on electrical cycle conversion kits, we discovered that we can turn a regular trike into an electric trike without the requirement for the rider to balance it. Now, in order to provide the highest comfort to the rider, and to ensure that the rider's posture does not cause any stress to the human body when riding the vehicle.

1.2. HISTORY OF WHEELCHAIRS:

In the 6th and 5th centuries BCE, an engraving unearthed on a stone tablet in China and a child's bed depicted in an ornament on a Greek decorative handleless container are the first documented examples of wheeled furniture chairs. (Ability Tools, 2013; Koerth-Baker et al., 2017; Joseph Flaherty, 2012; Maggie et al., 2012; Joseph Flaherty, 2012; Maggie et al., 2012). The earliest evidence of wheelchairs being used to transport crippled people can be found in China three centuries later. As depicted in Figure 1, the Chinese used wheelbarrows to transport people and large things. A distinction between the two purposes was not made for another many years, until around 525 CE, when Chinese art began to depict wheeled chairs constructed explicitly and categorically to carry people. For a long time, wheelchairs have been used to carry physically weak patients in hospitals, as well as the elderly, crippled, and physically challenged. Wheelchairs are driven by manual efforts, and the crippled operate and control them with their hands while someone else pushes the patient's wheelchair. This study offers a simple automaton that may be attached to or connected to a traditional hand-operated wheelchair to convert it into an E-wheelchair. This does not necessitate any human effort on the part of the user (self-propelled) or an attendant pushing from behind (attendant propelled).



2. Problem Definition

According to 2011 polls, 2.21 percent (2.76 million) of India's population has a disability, and the number of paraplegia (those with a lower body handicap) is over 20,00,000, with an annual increase of about 10,000.Patients with paraplegia have difficulties pushing wheelchairs on uneven surfaces; also, pushing the wheelchair puts effort on their upper body, which can lead to tiredness over time. The standard wheelchair on the market does not make the patient independent, and the electrical version is prohibitively expensive. However, the issue is that it gets caught in minor potholes and does not satisfy the requirements when used on uneven terrain because the front wheel is too narrow. The majority of electric wheelchairs on the market today use Lithium-ion rechargeable batteries, which are both damaging to the environment and expensive. To address the aforementioned issues, we reasoned that why not create an alternative that best matches the basic parameters of an electrical wheelchair while also being cost-effective, non-hazardous to the environment (specifically in terms of batteries, as lithium ion batteries have disposal issues) and keeping the factor of ergonomics as a primary consideration. In addition, we kept people who already have wheel chairs and hoists in mind.

2.1.Objective

2.1.1. Design Objective

Disabled individuals should have access to a sustainable mode of transportation that does not jeopardize their safety, allowing them to travel independently, in an environmentally responsible, socially acceptable, and economically viable manner. The transportation system should be built and operated in such a way that it protects people's health, ensures everyone's safety, and improves community quality of life. The rich and the poor have different interpretations of the term "sustainability." For the wealthy, sustainability can be achieved by technological fixes such as cleaner engines and fuels, but for the poor, it is a way of life and they are limited to using public transportation. The goal should be to provide accessible, cost-effective, and environmentally responsible transportation for disabled individuals. The electrical tricycle attachment is the ideal answer for this. The objectives due to which electrical tricycle attachment are preferred over traditional wheelchair are as follows:

1. To virtually design a wheelchair according to the anthropometric data, ensuring maximum comfort, safety and efficiency keeping Design for Manufacturing and Assembly [DFMA] guidelines in consideration and making it a success model when it comes to actual implementation of concept on the shop floor.

2. The clamps would be in such a way that it can be fitted in any of the traditional pre- existing wheelchairs.

3. Develop an aesthetically appealing wheel chair which is economically affordable at the same time to render it marketable.

4. It can also manage on rough terrain as it has the larger front wheel which won't get stuck in rough and uneven terrain.

5. As the rider (patient) do not have to push it manually so there is no stress generation in the body.

6. The disc brakes and 3-point safety harness with a proper head support add on features which make it more safe and Ergonomic.

7. To create a revolutionary and sustainable model to pilot a change in the wheelchair industry.

8. To adhere to COVID - 19 precautions and guidelines issued by Governments for the safety of every Team member in every phase.

2.1.2. Design Specification

TEAMS DESIGN CONSTRAINT	TEAMS PERSPECTIVE
Factor of safety (Minimum 1.5)	Greater the factor of safety lesser would be the chances of failure of the wheelchair ensuring the safety.
Weight	Lesser the weight less would be the effort taken by the patient.

Braking Safety Requirement	Disc brakes have been used to ensure greater efficiency and low maintenance.
Safety Harness (Seat belt)	Use of 4- or 5-point safety harness to ensure the safety.
Material (M.S. Pipe, GRADE:-ANSI 1020)	M.S. has high machinability, high strength,high ductility and good weldability.
Braking distance (Less than 6m at the speed of 25km/h)	The braking distance is laid down by theASME and we decided to stick with it.
Battery (Lithium sulphur battery)	We decided to opt for the battery which is cheap and eco friendly
Minimum product Weight	Maintaining minimum weight of the entire assembly in order to achieve maximum speed and proper vehicle stability.
Manufacture the attachment within a budget of ₹20,000	To make the vehicle an affordable alternative for the consumer
Type of handlebar	This type of handlebar possesses greater

3. Methodology

3.1. Planning & Flow of Working

The production of these vehicles is divided into following phases:

1. Phase of design: - The attachment was designed by amassing anthropometric data and using that data to compute measurements for the attachment, which were then calculated and designed in Solidworks software, where all of the pieces were created and assembled. It is a chassis with a single frame. We iterated our car frame after collecting all of the data.

2. Market research phase: - All of the parts and tools needed to make the attachment were researched in order to get the greatest quality products at the best pricing. During the procedure, the optimal materials, pipe shape, pipe size, and parts for the job were discovered. More attention was placed on the usage of more conventional products, ensuring that the product's availability and maintainability are optimal for the general public. Despite the fact that production is not viable owing to the COVID-19 pandemic.

3.Testing and modification phase: - We will test all of the components on the software during the testing phase because actual fabrication of the prototype is not possible due to the lockdown, so we will only do analysis on ANSYS Software. Based on the results of the analysis, we will surely modify our design and make it more competitive when it enters the world market.

4. Literature Survey

1. Design and Fabrication of Drivable Wheelchair Attachment International Journal of Innovative

We all know that wheelchairs are used to transport patients or persons who are disabled. Handicapped people can maneuver their wheelchairs using their upper limbs or with the assistance of others. So, here we are building a detachable handle that is connected to the wheelchair so that a person may simply operate their wheelchair without the assistance of others and without experiencing any stress while doing so. So we're employing a battery in that handle, which can be simply recharged or removed. We intend to use a 300W, 12V brushless motor and 48V, 24Ah batteries in our project, which can be charged in 4-5 hours and have a range of 30km at a speed of 25 km/hr.

2. Prototype of Wheel chair attachable E hand bike International Journal of Advance In Science And Engineering (IJITEE) .

In this work, the focus is on building a wheelchair-attached hand bike that may be operated manually for

improved road mobility. To control it, a hand bike has a battery as well as mechanical brakes. They are made in such a way that they are inexpensive to those in the middle class. Hand bikes are designed to be safe, light, and attractive. Recycled aluminium and steel bicycle parts are used to make hand bikes. The initial intention was to build a composite wheelchair that could be converted into an electric wheelchair attachment. Ability to adapt a high-performance tricycle for disabled people without having to leave the chair. It's simple to convert to a tricycle. It's simple to engage and withdraw. We chose the subject of wheel chair attachment E hand bike because it is necessary for disabled persons who are unable to go long distances and require an additional person to push the wheel chair.

3. Design and Implementation of electric wheelchair

A smart wheelchair is made up of a regular power wheelchair with a computer and a collection of sensors attached, or a mobile robot base with a seat attached. Geared hub motors make up the majority of 250 watt motors. Planetary gears are used to boost efficiency and speed.This allows us to lower both the weight of the engine and the overall weight of the wheelchair.

4. Study on smart wheelchair systems 2016

Accidents lead people to suffer from lower impairments. They benefit from the use of an electrical wheelchair because it allows them to meet their needs for independence and mobility. Air pressure is employed when sipping (inhaling) and puffing (exhaling) on a straw tube that delivers a signal to a wheelchair. Another strategy is to use the direction in which the impaired person is gazing or turning his or her head. In such technology, a camera is employed, and the user must stare in the direction in which he wishes to move.

5. Solar Powered Wheelchair Mobility for Physically Challenged'

People who are physically challenged have limited mobility. The project intends to improve the mobility of physically challenged people. With the help of a mobile application, power is provided by rechargeable lead batteries, which are combined with a GPS and GMS system for position. For indirect drive transfer, the motor is attached to the drive wheel shaft. When the drive wheels are struck or under a severe load, this reduces torque and also acts as a shock absorber.

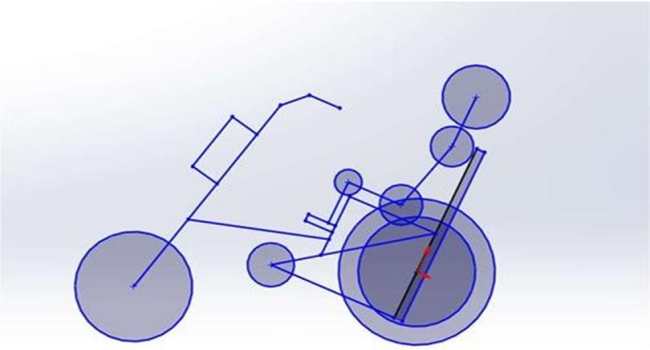
6. Electrical Attachment of Wheelchair for Handicapped Person National Conference on Information, Communication and Energy Systems and Technologies.

In this project, we are using a pre-made wheelchair and converting it into a tricycle with an electric bike hand using an electric conversion cycle kit. We're putting the battery in the hand so that it can charge quickly and be used for a long time. This hand bike is simple to disassemble. It is simple to use for patients with mobility issues.

7. Lithium-Sulfur Battery Technology Readiness and Applications.

We are using LiS battery instead of Li-ion because all we know is that it is better as compared to it. Although LiS batteries have tremendous advantages over Li-ion batteries, Performance and capacity of the batteries are best. The major disadvantage of the Li-ion batteries is that they are not as robust as other rechargeable technologies. It requires protection to be overcharged and discharged too. Also it suffers from aging which is not good for the electronic consumers. For air travelers, lithium ion batteries need to be carry in luggage so that we require security position, this may change from time to time .We have to take it with the cover and with protection. Li-S batteries offer a number of advantages in comparison to current battery technology including (1) an improved gravimetric energy density, (2) a significantly reduced raw materials cost, (3) improved safety characteristics and (4) a reduced environmental burden associated with the cell materials. Lithium-sulphur technology has the potential to offer cheaper, lighter-weight batteries that also offer safety advantages. After initially finding use in niche markets such as satellites, drones and military vehicles, the technology has the potential to transform aviation in the long-term.

5. CAD Models



6. Results and Discussion

1. A wheelchair attachment is being developed to address a dependability and safety issue for a disabled person's movement (paraplegia patient).

2. The electric Tricycle attachment is designed to eliminate the strains that the paraplegia patient's upper body has been subjected to.

3. Furthermore, having a mode of transportation provides individuals a sense of freedom.

4. The existing system is substantially more expensive and has some shortcomings, which our project has addressed.

5. The project's price, as well as its modular nature, making it a viable option for disabled people who cannot afford conventional alternatives.

6. Front wheel drive and a low centre of gravity Driving and braking make it easier to navigate uneven terrain while maintaining stability.

7. Conclusion

1. We leveraged current technologies to produce a cost-effective and efficient solution to a problem that has plagued disabled persons who cannot afford pricey mobility solutions.

2. The expected mass manufacturing cost is roughly $15,000/-, which is around a fourth of the least expensive electric wheelchairs with good safety and quality ratings.

3. This document details the whole design of an electric trike attachment for wheelchairs. The usage of solid modelling aided in the production of high-quality designs. Finally, the trike's chassis was examined to determine its capabilities and endurance, with the results being tracked for future improvement. To make driving an electric trike as safe as possible, extraordinary procedures were taken.

4. A near-perfect safety record and driver trust have resulted from experience and smart engineering. This electric trike concept can be considered for mass manufacturing by industries in order to replace conventional electric wheelchairs and contribute to environmental sustainability.

8. Reference

[1] S.D. Kumar, Avinash Jangir, Nishant Saraswat, Anadi Nema, Bhargav Patel "Design and Fabrication of Drivable Wheelchair Attachment" International Journal of Innovative Technology and Exploring Engineering(IJITEE)ISSN:2278-3075, Volume-8 Issue-8, June, 2019.

[2]Anupam S. Bhojkar, Hrishikes D.Gaikwad, Shubham A. Jankar, Akash P. Salokhe, Vishwajeet R. Salokhe "Prototype of Wheel chair attachable E hand bike" International Journal of Advance In Science And Engineering (IJITEE) ISSN: 2319-8354, , Volume-7 Issue-1, March, 2018.

[3] Prof. S. S. Kumbar, , Mr Sandeep Mudakannavar, Mr Vinayak patil, "Design and Implementation of electric wheelchair with Controlling the speed & movement of wheelchair".

[4] Electrical Departmant, SGI-Antigre, Shivaji University "Study on smart wheelchair systems 2016".

[5] P. Swapna , Dr. B. Sharmila, Y. Dharshan Arun Manohar Gurram, P.S,V Ramana Rao , Raghuveer Dontikurti "Solar Powered Wheelchair Mobility for Physically Challenged" International Journal of Current Volume - 3, Issue – 5 May – 2016.

[6] Robotics and Autonomous Systems. Volume 58, pp. 1148-1158 Lockton D., (2004) Wheelchair, Drive 241 (1) 5-68 Lucas, H.V., Woude V., DeGroot, S. and Janssen, T.W.J., (2005). Manual wheelchairs: Research and innovation in rehabilitation, sports, daily life with health, Medical Engineering & Physics, volume 28, pp. 905–915.

[7] Murray, John Lawn (2003) "Study of Stair Climbing Assistive Mechanisms for the Disabled", IEEE Transactions on Neural Systems and Rehabilitation Engineering, Volume 11, No.3, pp. 323-332.