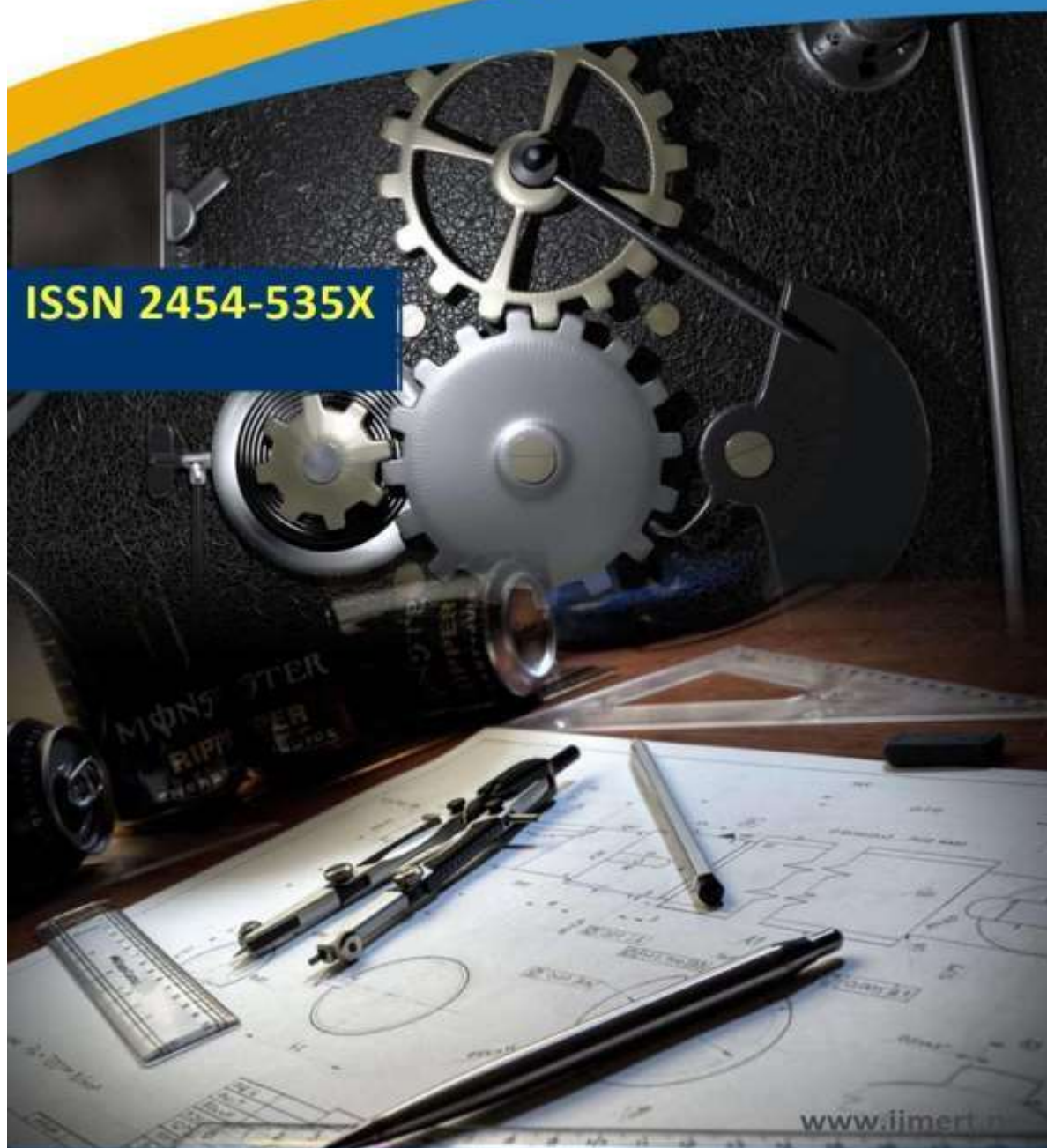




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Design and Fabrication of Recliner Wheelchair for Physiotherapy

V. R. Rao¹, Md Azhar Uddin Parveez², Tanguturi Bharath², Rahul Vemula², P. Saikumar², Udayakiran², Srikanth Ghodke²

Abstract

Wheelchairs are essential mobility aids for individuals with disabilities or limited mobility. However, traditional wheelchairs often lack features that provide optimal comfort and functionality. One such feature is a reclining mechanism, which allows users to adjust their sitting position for enhanced comfort, relaxation, and pressure relief. This project presents the design and production of a recliner wheelchair specially developed for physiotherapy applications. The wheelchair is equipped with two linear actuators, positioned on the left and right sides respectively, which enable the reclining feature. Additionally, the design incorporates a 4-channel relay module powered by a 12V supply, as well as two single-pole, double-throw (SPDT) switches. The primary goal of this project is to create a wheelchair that offers adjustable reclining positions to aid physiotherapy patients. The key mechanism for achieving the reclining functionality is the implementation of two linear actuators, strategically positioned on each side of the wheelchair. This configuration ensures proper balance and stability while accommodating the user's desired recline angle. To effectively control the linear actuators, a 4-channel relay module is employed. This relay module serves as an intermediary component between the actuators and the control switches, ensuring convenient and safe operation. The module operates using a 12V power supply, delivering the necessary electrical power to both the actuators and the relay module. To facilitate user interaction, the wheelchair's control system integrates two SPDT switches. These switches offer multiple positions, allowing the user to exert control over the direction and degree of recline. By utilizing the switches, the user can effortlessly adjust the wheelchair to their preferred reclining angle, enhancing overall comfort and assisting in performing physiotherapy exercises.

Keywords: Recliner Wheelchair, Physiotherapy, Linear Actuators.

1. INTRODUCTION

The development of recliner wheelchairs for physiotherapy has a rich history and stems from the evolving needs of individuals with mobility impairments. Over the centuries, wheelchairs have undergone significant transformations, progressing from basic wooden platforms to advanced designs tailored to diverse requirements. Physiotherapy, a field dedicated to rehabilitating physical function and mobility in individuals with disabilities or injuries, necessitates the design and fabrication of recliner wheelchairs. These specialized

wheelchairs offer adjustable seating positions, allowing therapists to position patients comfortably during specific exercises and treatments. The significance of recliner wheelchairs for physiotherapy cannot be overstated. They provide numerous benefits, including enhanced patient comfort. Physiotherapy sessions often demand prolonged periods of sitting, and a recliner wheelchair allows patients to adjust their positions, minimizing discomfort and

¹Assistant Professor, ²UG Student, ^{1,2}Department of Mechanical Engineering

^{1,2}Malla Reddy Engineering College and Management Sciences, Kistapur, Medchal, 501401, Telangana

the risk of pressure sores. Furthermore, these wheelchairs offer improved therapeutic support. By enabling therapists to recline patients, they can optimize positioning for various exercises and therapies. This flexibility facilitates the effective application of techniques like range of motion exercises, stretching, and strengthening exercises. Safety and stability are also key advantages of recliner wheelchairs. Equipped with locking mechanisms, these wheelchairs ensure stability in different reclined positions, reducing the likelihood of accidents or falls during physiotherapy sessions and providing a secure environment for patients. Customizability is another significant aspect. Each patient undergoing physiotherapy has unique requirements, and recliner wheelchairs can be tailored to accommodate these needs. Adjustable seat height, backrest angle, and leg rest positions ensure optimal support and comfort, promoting individualized care. The need for recliner wheelchairs in physiotherapy arises due to several factors. First, they enhance therapeutic efficiency by facilitating precise positioning, leading to targeted and effective treatment, faster recovery, and improved outcomes. Second, these wheelchairs promote patient compliance by offering a comfortable and supportive seating position, encouraging active participation in therapy sessions and adherence to treatment plans. Finally, recliner wheelchairs cater to the long-term care needs of individuals undergoing physiotherapy. As patients may require extended rehabilitation and support, these wheelchairs accommodate their ongoing requirements, providing adjustable positions that ensure comfort during extended periods of wheelchair use. The problem addressed by the real-time wheelchair with a recliner system is the limited availability of wheelchairs that offer real-time adjustment of the reclining position. Many existing reclining wheelchairs require manual adjustment or rely on pre-set positions, which can be inconvenient and time-consuming for users. Additionally, caregivers or attendants often need to assist individuals in

adjusting the reclining position, further limiting the independence and autonomy of wheelchair users. The real-time wheelchair with a recliner system aims to address these challenges by introducing an innovative solution that enables wheelchair users to adjust their reclining position in real time, without relying on external assistance. The system incorporates advanced technologies such as motors, sensors, and control mechanisms to provide seamless and effortless adjustments, enhancing user comfort and independence.

2. LITERATURE SURVEY

Lee, S., Lee, J., & Kim, C. (2019) focused on the development of a reclining wheelchair with an adjustable seat depth specifically designed for individuals with spinal cord injury. The study explores the features and benefits of the wheelchair design. Ng, Y. S., & Wong, A. K. (2017) discussed the design and development of a manual reclining wheelchair. It explores the manufacturing process and presents the specifications and features of the wheelchair. Park, J., & Lee, S. (2017) presented a design of a reclining wheelchair that incorporates a tilting and elevating legrest. The study highlights the mechanical aspects and technology used in the wheelchair's design.

Tanaka, H., Hirakawa, K., & Kamijo, S. (2016) focused on the development of an electric reclining wheelchair specifically designed for elderly people. The article discusses the considerations and challenges in designing a wheelchair suitable for the elderly population. Desroches, G., Aissaoui, R., & Bourbonnais, D. (2012) discussed the design and development of an adjustable reclining backrest for a manual wheelchair. The study emphasizes the importance of customization and ergonomic considerations in wheelchair design. Ghobakhloo, M., Hong, T. S., & Sabouri, M. S. (2015) presented a fuzzy expert system used to evaluate different design alternatives for reclining wheelchairs. The study demonstrates how a fuzzy logic

approach can be applied to wheelchair design decision-making.

Moussavi, A., & Cao, J. (2018) introduced a novel adjustable and tiltable backrest for wheelchairs. The article describes the design, development, and evaluation process of the backrest, highlighting its functionality and benefits. Alhaj, F., Zhou, J., & Zhou, L. (2019) focused on the design and optimization of a reclining wheelchair frame using topology optimization. The study explores how optimization techniques can improve the structural design and performance of the wheelchair frame. Lin, M., Ma, Q., & Li, P. (2019) presented the design and analysis of a reclining wheelchair with additional features such as vibration and heating functions. The study discusses the benefits of incorporating these functions into the wheelchair design. Alayli, Y. A. (2019) described the design of a novel manual reclining wheelchair with adjustable seat depth and tilt angle. The article emphasizes the importance of customizable features for optimal user comfort and functionality.

3. PROPOSED METHODOLOGY

This project focuses on the design and production of a recliner wheelchair specifically intended for physiotherapy applications. The primary objective is to create a wheelchair that offers adjustable reclining positions to aid physiotherapy patients.

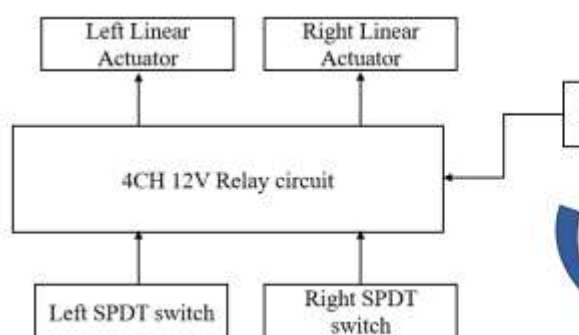


Figure. 1: Proposed block diagram of recliner wheelchair with linear actuators.

The key components and methodology involved in achieving this functionality are as follows:

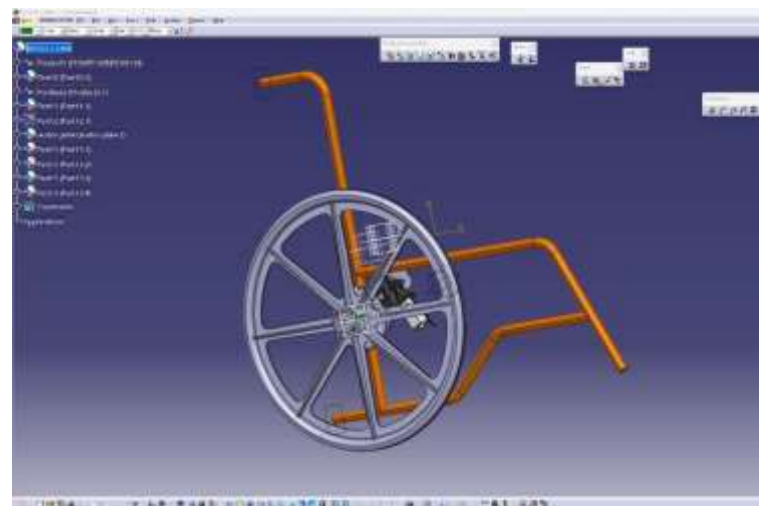
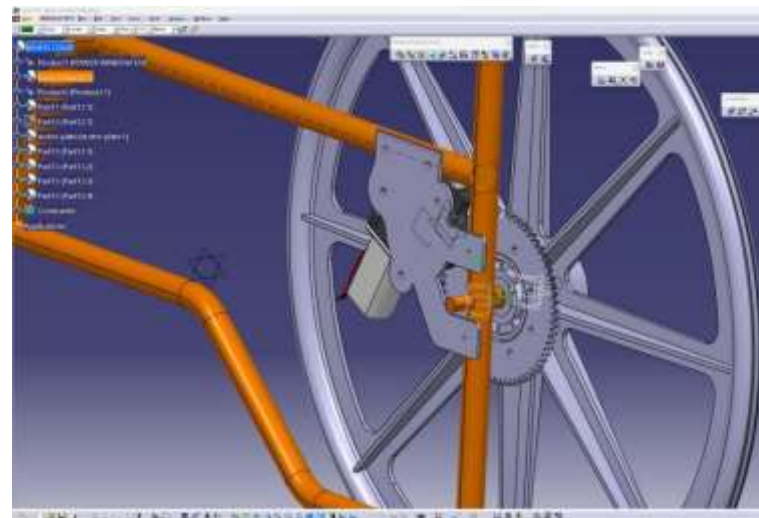
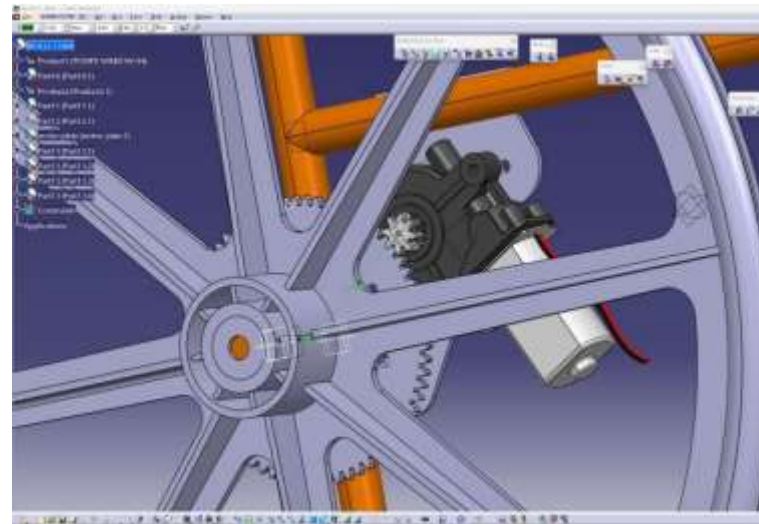
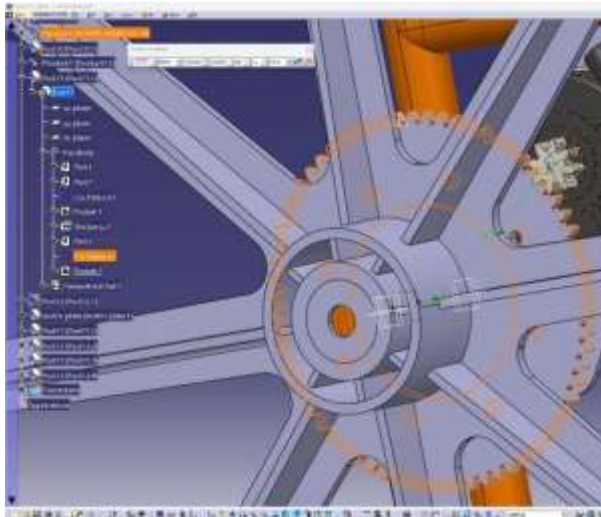
- Reclining Mechanism: The wheelchair is equipped with two linear actuators positioned on the left and right sides, respectively. These linear actuators are responsible for providing the necessary motion to enable the reclining feature. By extending or retracting the actuators, the wheelchair can adjust the user's sitting position.
- Balance and Stability: The placement of the linear actuators on each side of the wheelchair ensures proper balance and stability while accommodating the user's desired recline angle. This configuration helps maintain the overall stability and safety of the wheelchair during reclining.
- 4-channel Relay Module: A 4-channel relay module is used to effectively control the linear actuators. The relay module acts as an intermediary component between the actuators and the control switches. It facilitates convenient and safe operation by managing the flow of electrical power to the actuators based on the input from the control switches.
- Power Supply: The 4-channel relay module and the linear actuators are powered by a 12V supply. This power supply delivers the necessary electrical power to both the actuators and the relay module to ensure their proper functioning.
- SPDT Switches: The wheelchair's control system incorporates two single-pole, double-throw (SPDT) switches. These switches offer multiple positions, allowing the user

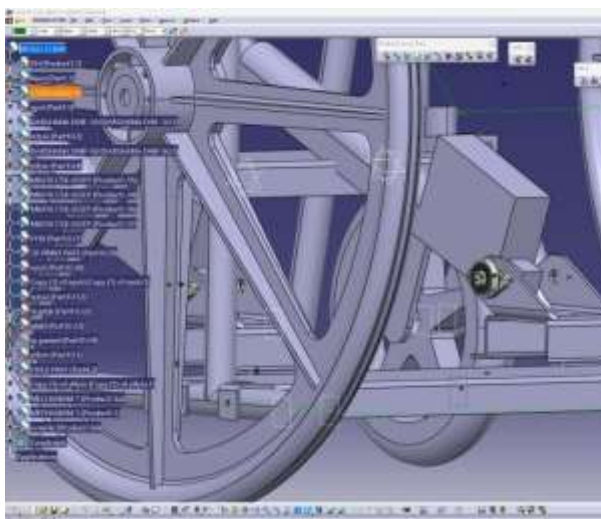
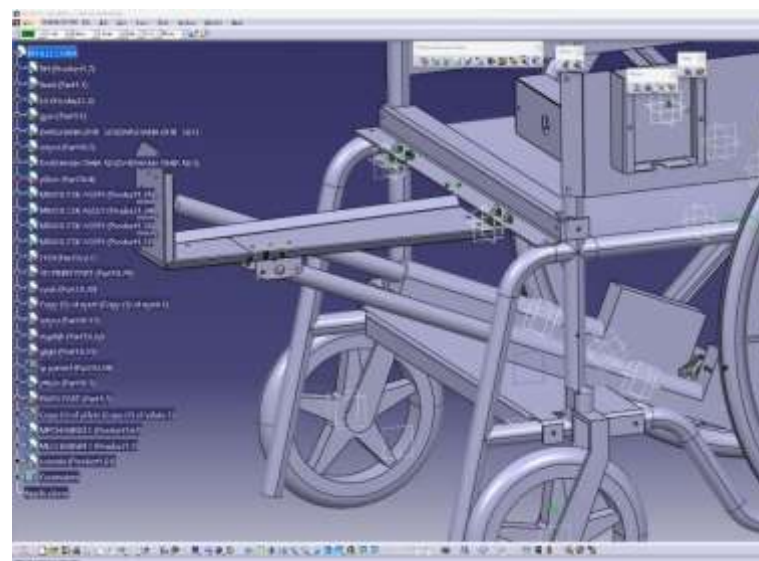
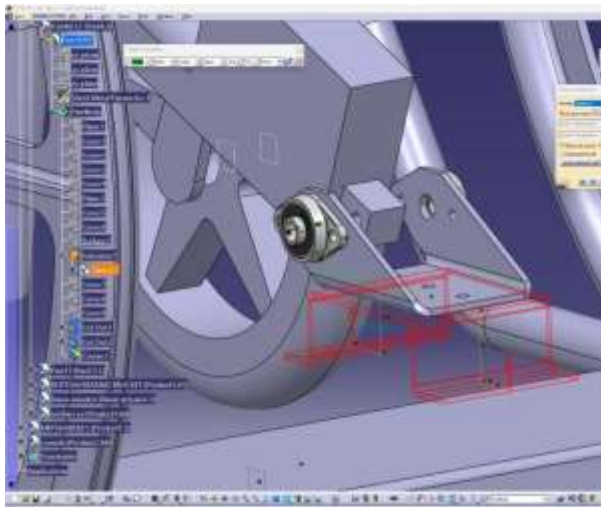
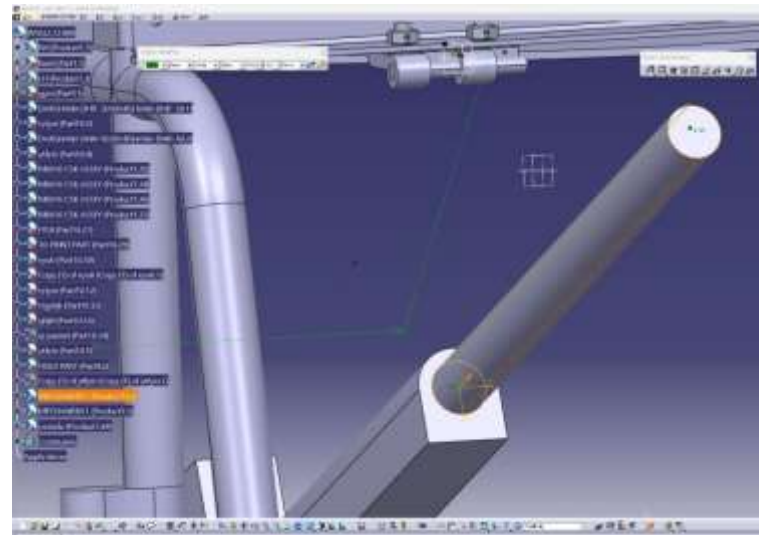
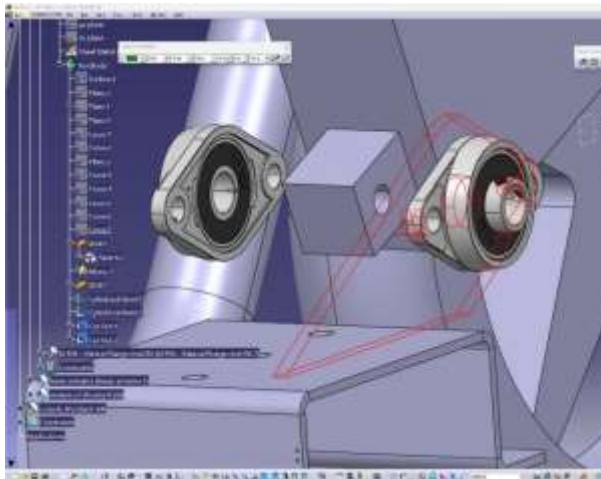
to exert control over the direction and degree of recline. The user can interact with the switches to effortlessly adjust the wheelchair to their preferred reclining angle.

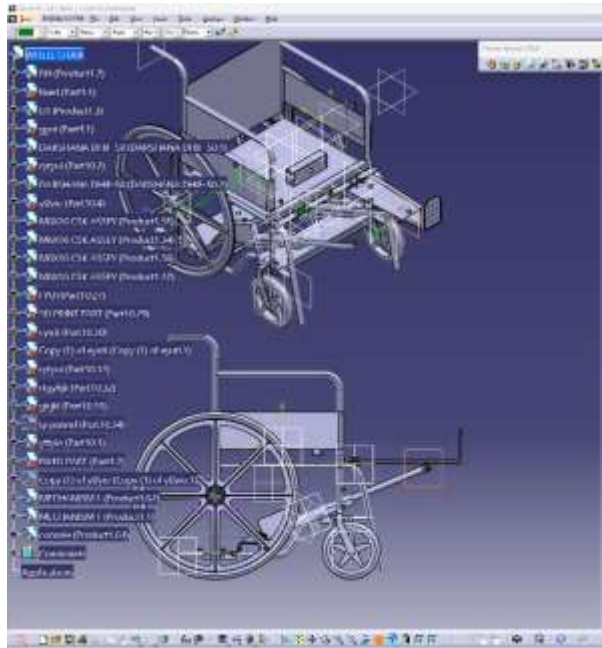
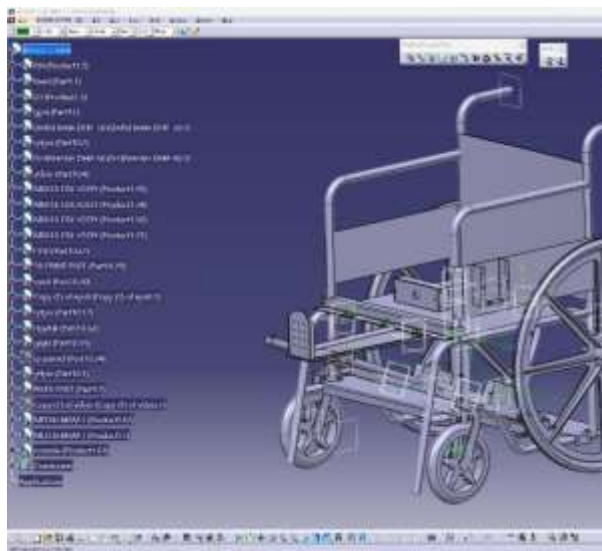
- User Comfort and Physiotherapy Assistance: By utilizing the reclining feature and control switches, the wheelchair enables the user to adjust their sitting position according to their desired recline angle. This enhances overall comfort and facilitates performing physiotherapy exercises by providing optimal support and positioning.

4. RESULTS AND DISCUSSION

4.1 3D modelling







5. CONCLUSION AND FUTURE SCOPE

The utilization of wheelchairs plays a vital role in assisting individuals with disabilities or limited mobility. However, traditional wheelchairs often lack certain features that could offer optimal comfort and functionality. One such feature is a reclining mechanism, which enables users to adjust their sitting position, leading to enhanced relaxation, comfort, and pressure relief. This project aimed to address this issue by presenting the design and production of a recliner wheelchair specifically tailored for physiotherapy

applications. To achieve the reclining functionality, the wheelchair incorporates two strategically positioned linear actuators, one on each side. These actuators serve as the primary mechanism responsible for enabling the adjustable reclining positions. In addition, a 4-channel relay module, powered by a 12V supply, has been integrated into the design. This relay module acts as an intermediary component, facilitating the safe and convenient operation of the actuators. By delivering the necessary electrical power, it ensures the seamless control of the reclining feature.

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