Convertible Patient Wheelchair with Assist-Free Transfer Support

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LEVEL 1- CEDI-ENTREPRENUERSHIP / INCUBATION PROGRAM

THE CORE TEAM

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Overview and Objective:

The following product's primary objective is to transfer wheelchair users from wheelchair to bed without any external assistance.

Thematic area/Domain area/Sector:

Medical Assistive Devices

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Innovation Proposed:

- Our solution to this issue is to design a modified wheelchair that converts to a horizontal platform along the bed, transfers the patient, and converts back to the wheelchair position.
- This ensures that the patient is transferred in the safest way and overcomes various limitations such as space, cost, and operation without external assistance.
- The proposed solution employs a locomotive four-bar mechanism to convert into a horizontal position and a rack and pinion mechanism to slide the platform along the bed.

Proof of concept/maturity/stage of the idea proposed :

- The proposed product is in TRL-2

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UNIQUE SELLING PROPOSITION

- Providing medical assistive device at affordable price.
- Self-operated, No human intervention required.
- Use of technology for human comfort, alleviates the painful process of external human lifting the patient from wheel-chair to bed.

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SCOPE OF WORK

To design and develop a wheelchair-to-bed transfer device that can operate without external assistance and provide safety and comfort during the operation.

BACKGROUND/MOTIVATION & COMPETENCY *(manufacturing/testing facilities, experience in multi-partner projects, managerial capacity)*

All manufacturing/testing will be done at NIT, Trichy. Sensors and other components will be procured and assembled in-house.

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MARKET SIZE & SEGMENT

The following are the target market segment

- Healthcare Sector
- Social Care Homes & Charity Organizations
- Paraplegia Disparity Patients

Market size: There is a huge market potential for the product

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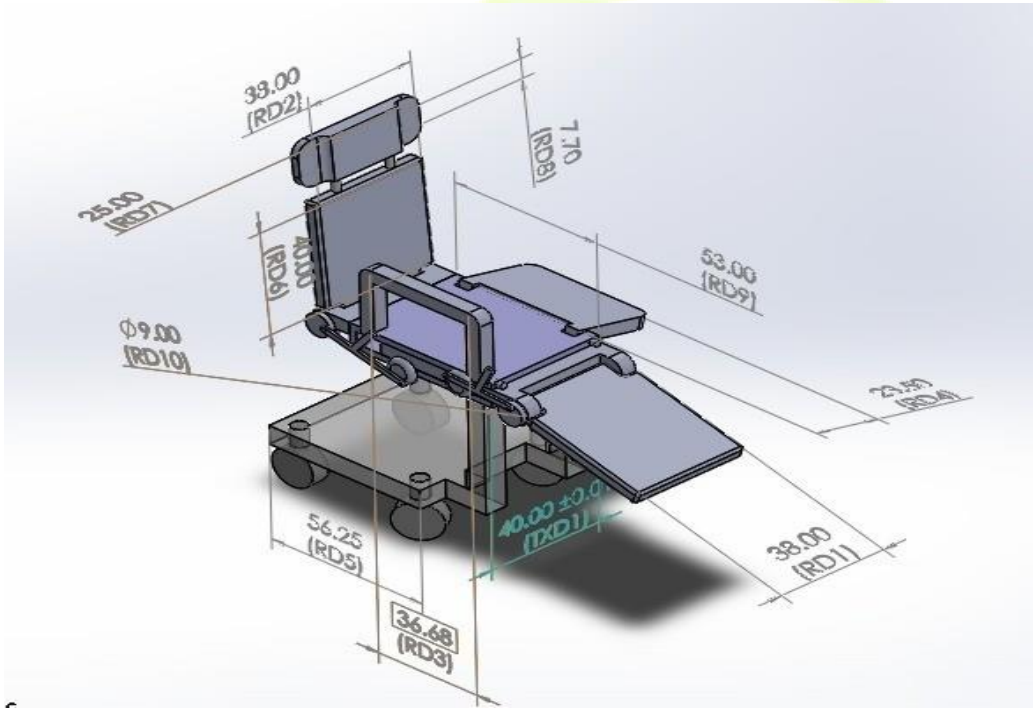
PROJECT/TECHNOLOGY DESCRIPTION

Isometric View of a wheel-chair to bed transferring device



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Description of concepts, theories, and/or approach involved in the proposed solution:

Basic Approach:

The proposed solution aids with patients to make themselves lie down in a bed from their wheelchair without any external assistance from others.

Concept:

The above approach of self transferring the patient from chair to bed is enabled by 3 steps or three simple motions:

STEP 0: (Preliminary Step)

The patient needs to align the wheelchair in such a way that the base of the wheelchair aligns with the mattress of the bed, as well as the length of the base, is made parallel to that of bed's length (In other words, Sidewise aligned).

STEP 1: (Leg rise)

The patient should then lift the lever on the right side of the base, situated near to his knees. Once, he pulls it up the locomotive mechanism, (derived from the basic four-bar mechanism, excepting the crank link, and the rocker link being a rotating disc).

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Description of concepts, theories, and/or approach involved in the proposed solution:

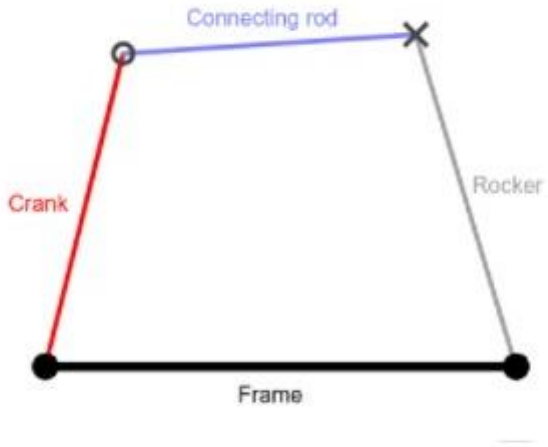

Figure A: Four bar mechanism terminology.

Figure B: Mechanism incorporated for Leg rise

Correlation between Figure A and Figure B:

- Frame: Fixed Base of the chair
- Crank: Left side disc
- Connecting Rod: Lever
- Rocker: Right side disc

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Description of concepts, theories, and/or approach involved in the proposed solution:

STEP 2: (Base Slide)

The patient has to crank the gear (pinion) on the left side of the base. This will propel him to move further into the bed. Rack and Pinion Mechanism was deployed for this action. The rack is attached with the slider, which is fitted into the base. The pinion is the gear that is mounted on an axis normal to the sidewalls of the base.

STEP 3: (Upper Member tilt)

The patient has to perform the same activity as described in Step 1, but this time he/she should lift the lever closer to the upper member. This will tilt his upper body down. The locomotive mechanism was deployed (as described in Step 1) to achieve this action. At the end of this step, his whole body gets aligned horizontally with the bed.

STEP 4: (Armrest tilt)

Finally, the patient should push his left arm/hand rest downwards such that the revolute joint between the base and the armrest tilts the armrest towards the bed. Once, it has been fully tilted, it establishes a connection between chair and bed such that the patient can move towards the bed.

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Description of concepts, theories, and/or approach involved in the proposed solution:

Technical Aspects of the solution:

Rack and Pinion Mechanism:

The rack and pinion mechanism is a gear mechanism that converts rotary motion into translation. It consists of gear with a small pitch radius, called pinion, and a linear gear, with an infinite pitch radius. The rack and pinion mechanism is deployed for sliding the bed along the length of the bed. The rack and pinion are situated at the middle seat.

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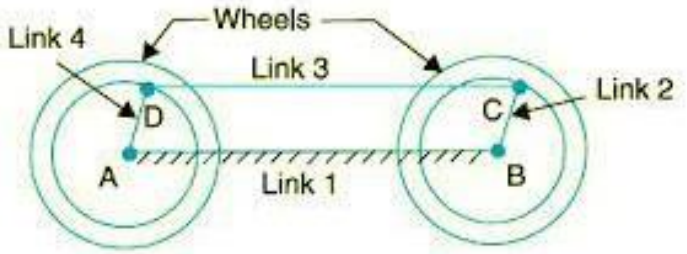
Description of concepts, theories, and/or approach involved in the proposed solution:

Locomotive Mechanism:

The parallelogram mechanism is an inversion of the four-bar mechanism where linkages of equal lengths are positioned opposite to each other. Here, the sum of the largest and smallest links is equal to the sum of adjacent links, giving a double crank motion. The locomotive mechanism is a type of parallelogram mechanism where the largest link is grounded.



Coupling rod of a locomotive.

The locomotive mechanism is used to turn leg-rest and head-rest seats by 90 degrees to achieve conversion of the seat to the horizontal platform. The locomotive mechanism is situated at the joints of the middle seat and leg/head-rest seats.

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ALL ABOUT THE PRODUCT/TECHNOLOGY

- Step 1: Leg rise – Locomotive Mechanism
- Step 2: Base slide – Rack and Pinion Mechanism
- Step 3: Upper Member tilt – Locomotive Mechanism
- Step 4: Armrest tilt – Rotation through revolute joint

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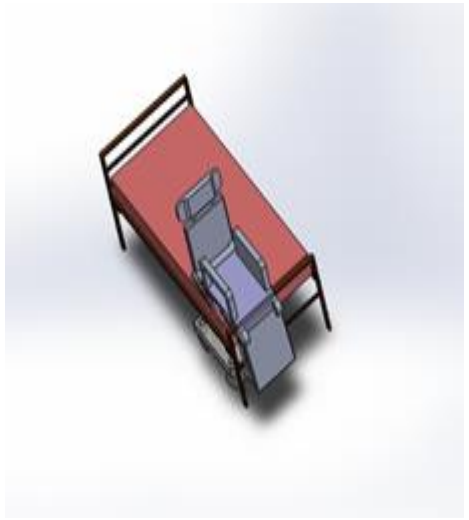
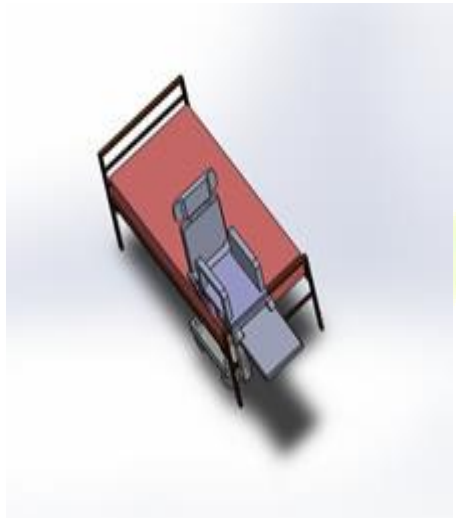
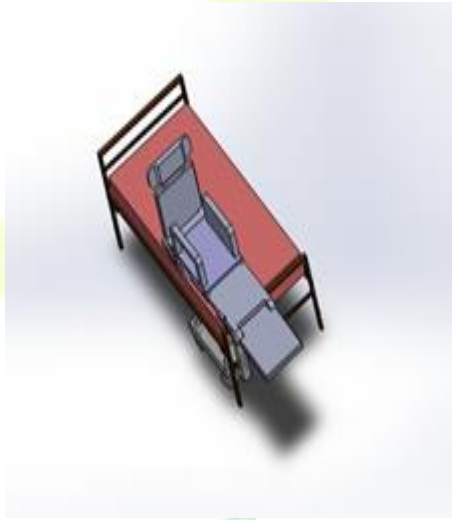
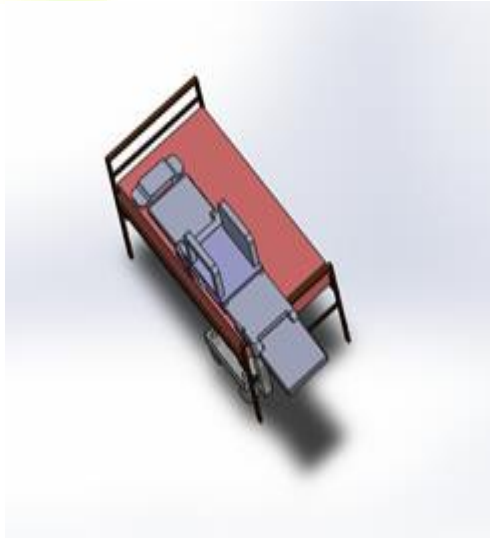
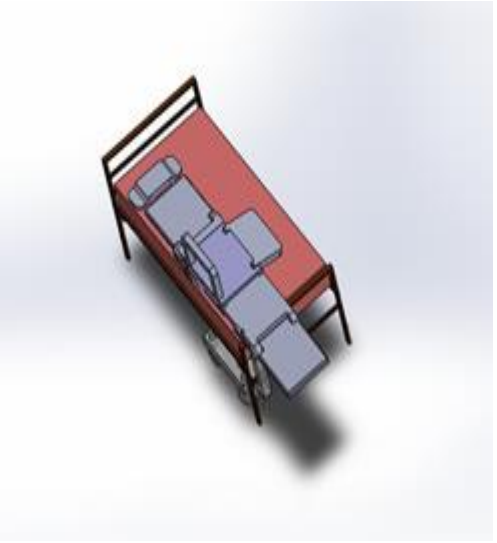
Description of the flow of operations with pictures:

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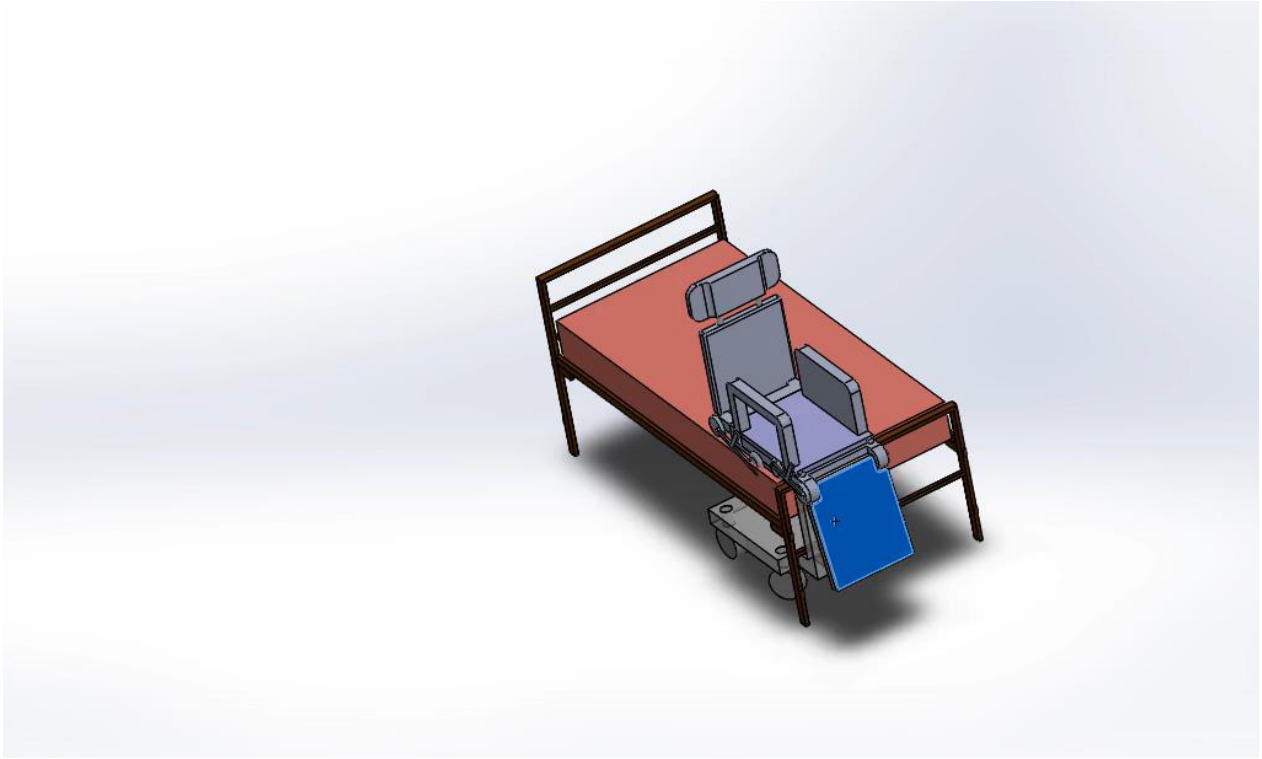
Working Video:



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MEASURABLE OUTCOMES AND RELATED BENEFITS, IMPACT

Commercial benefits: Have potential to earn good profit

Societal benefits: Providing sense of freedom and mobility to users; Improve assistive healthcare systems

Technology benefits: Integrating new innovations in healthcare

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COST ESTIMATION

Castor Wheel (4) – Rs.180
Chromoly Steel rod (20mm, 25mm) – Rs.500
Mild steel rack gear – Rs.700
Spur gear – Rs.1500
Wheelchair seat, frame and handle – Rs.12000
Chromoly Material – Rs.800
Manufacturing cost – Rs.500
Total cost – Rs.16680

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COMPETITION and its RISK

There are many convertible wheelchairs that can convert to bed. However, space constraints might hinder their function.

Also, patient hoist are used to carry wheelchair users from wheelchair to bed. However, it requires external assistance, and any malfunction/improper use could lead to injury/fall for the user.

There are patient transfer devices from one bed to another bed, however they are not compatible for wheelchair-to-bed transfer due to its method of transfer.

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COMMERCIALIZATION PLAN

Techno-financial USP: Hospitals/Assistive healthcare units, Ambulance/emergency services, Personal use (Temporary/Permanent), NGOs

Basic Modalities/Approach for acquiring the estimated market and its plan: Targeted Marketing (Social Media, MoU with Hospitals/NGOs)

The main strategy to stay in the competitive market is to highlight the distinguishable features of the product and the sense of freedom and mobility it provides to consumer.

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WHY INCUBATE AT CEDI?

The Centre for Entrepreneurship Development and Incubation (CEDI) provides a pathway for entrepreneurs to seamlessly deploy their product to market. There is a lot of success stories who graduated from CEDI and excel in the business. Being a faculty with strong R&D potential, I believe CEDI could help to transform the prototype into marketable product.

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