

Bed Automation For Hospital Purpose

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Introduction

- The population of India was estimated to be 1.21 billion by April 2012. About 64 millions of people of this population are above the age of 65 and a significant number of them are bedridden due to age related problems. Apart from this, many people are forced to be bedridden because of various reasons like – paralysis, orthopedic problems, vehicle & other accidents, etc. These bedridden people need almost round the clock assistance and care from their relatives, care takers, doctors etc. This problem is compounded as the system of joint family is almost nonexistent now and round the clock assistance is not available in the family, to take care of bedridden patients. Any reduction in the number of people involved and the amount of effort required in managing such patients is going to benefit a large section of the society. Therefore, it is necessary to develop some kind of healthcare system by which such patients can be managed easily. Therefore, an attempt is made to reduce the amount of assistance required in managing these patients by designing a new bed for such patients.

SCOPE OF SURVEY

In this context, a survey was carried out to find the requirements of such a system for bedridden healthcare for the patients, who need management at home / hospital. The patients were of following type.

- Bed-ridden patients having restricted movements due to old age, at home.
- Patients having limbs in plaster at home / hospital due to accidents.
- Patient with backbone (spine) diseases advised rest at home / hospital.
- Patient not allowed sitting for medical reasons.
- Patient advised strict bed rest for various reasons.
- Heart patients.
- Patients with paralysis

Hospital survey





FACILITIES REQUIRED / EXPECTED BY PATIENTS & RELATIVES

- ❖ The design should reduce the amount of work / assistance required.
- ❖ Sitting position by moving backrest up.
- ❖ Chair position by moving leg part downwards.
- ❖ Design of bed should be simple and easy to operate.
- ❖ Movement of patient should be minimum.
- ❖ Mechanisms to be operated by handle / electric motor / both.
- ❖ The positions should be adjustable according to the patient.
- ❖ A multipurpose table in front of patient.
- ❖ Storage rack for needs like medicine, water, towel, tissue paper, toothbrush, toothpaste, glass, spoon, spittoons etc.
- ❖ Cost of such bed should be affordable in general.

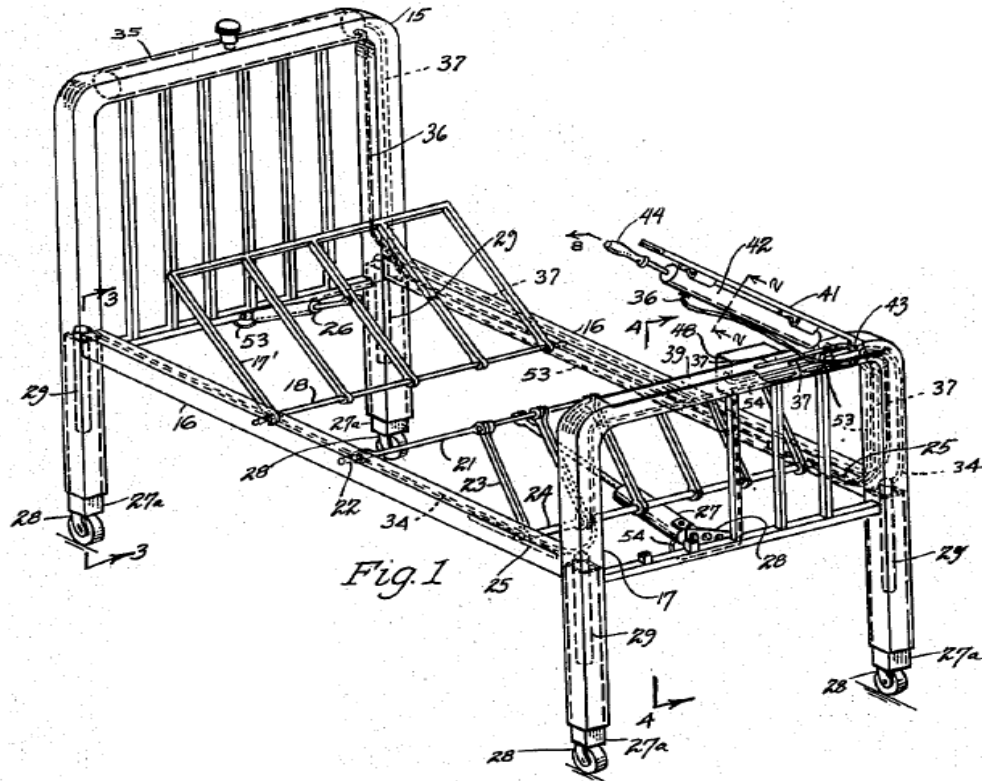
OBJECTIVE OF WORK

The objective of work is to design and develop a bed with above facilities at minimum initial cost and low maintenance cost in order to benefit a large section of society. In view of above objective it is necessary to study various attempts made earlier in this direction.

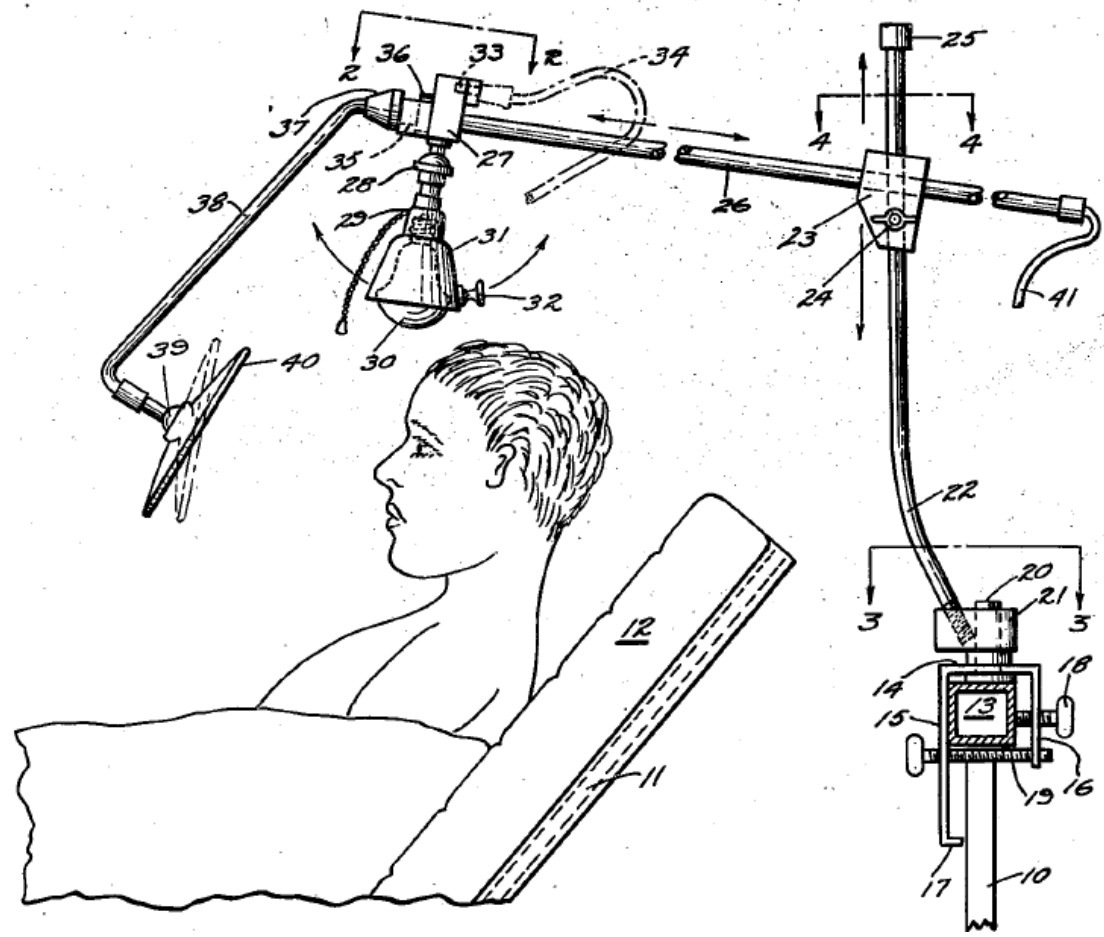
Literature Review

In view of product requirements based on survey the various attempts to solve the problem were studied. In the area of equipment or system design for bedridden healthcare, few published works are available. As bed is the most important unit in this healthcare system, major focus is on the design of beds or related systems so that the patients can be managed without much assistance. Various researchers have tried different approaches for designs of such healthcare systems.

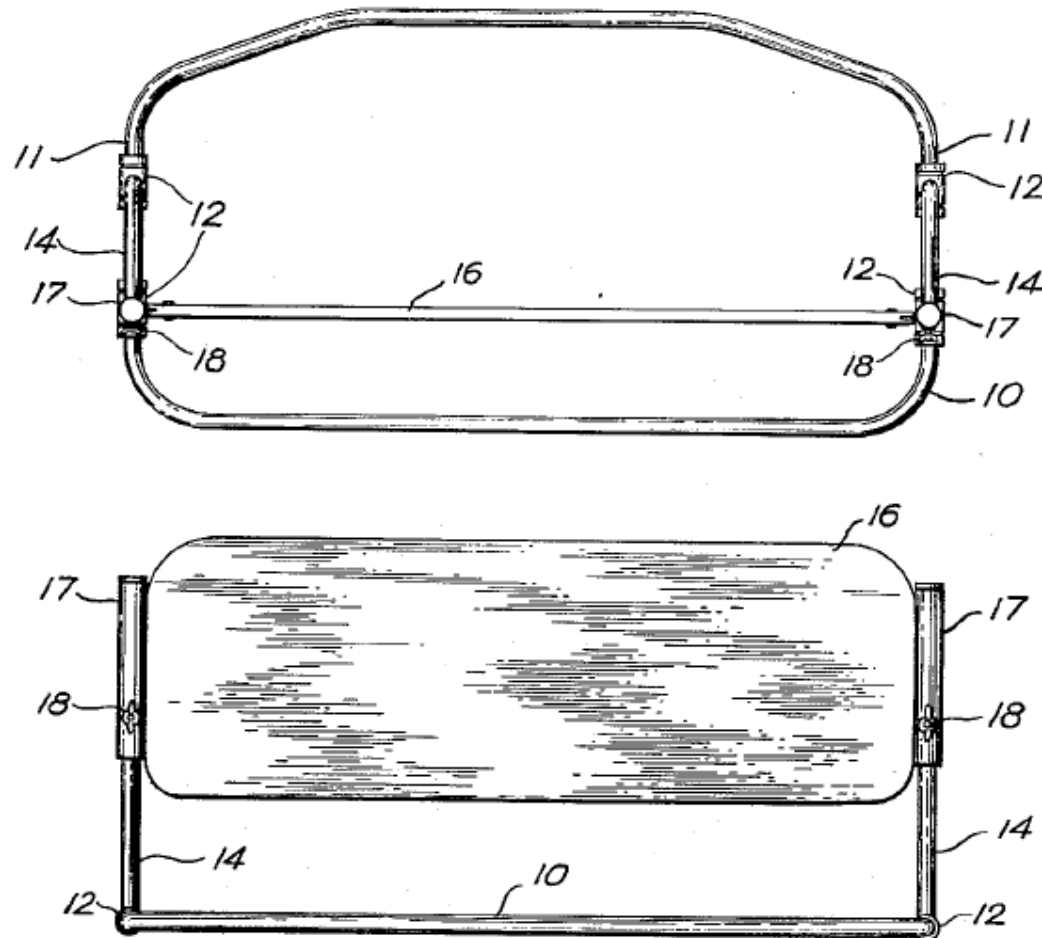
- ❖ Roy G. Miller had US patent no. US2540133 [Fig. 2.2] with a perspective view of an adjustable hospital bed with the pump device for raised operation and wherein the top and bottom portions of the bed have been raised.



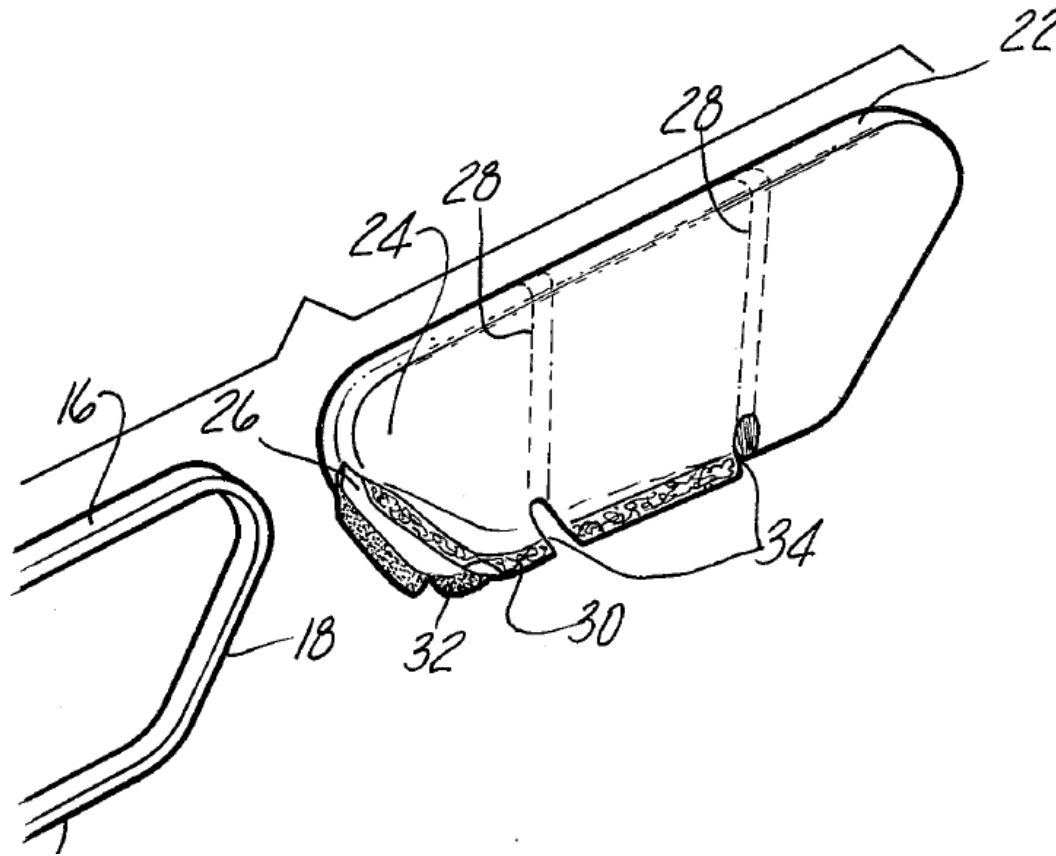
❖ John M. Anderson had US patent no. US2607881 [Fig. 2.3] with the provision of a bed light and mirror combination on an adjustable mounting stand which in turn is attachable to the headboard of a hospital bed.



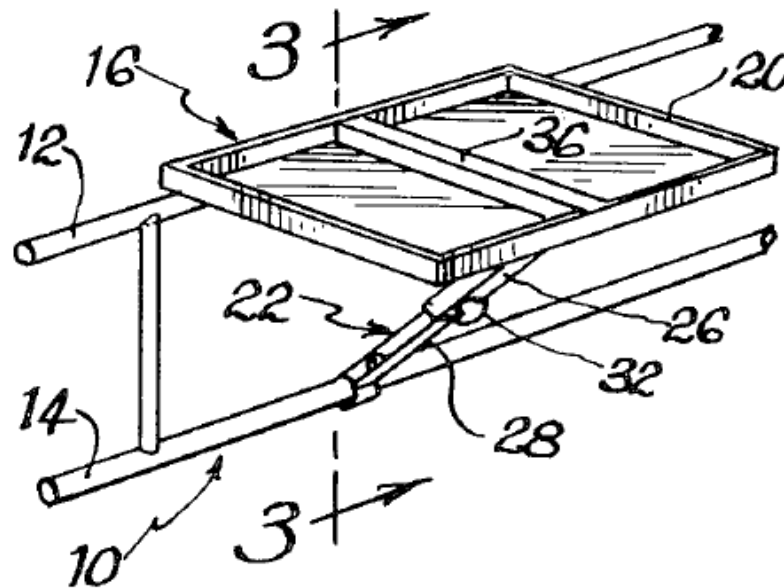
- ❖ Rudolph J. Zuti [US patent no. US2952855] [Fig. 2.4] had found a foot rest that may be installed on a hospital bed so that a person on the bed may rest his feet there against.



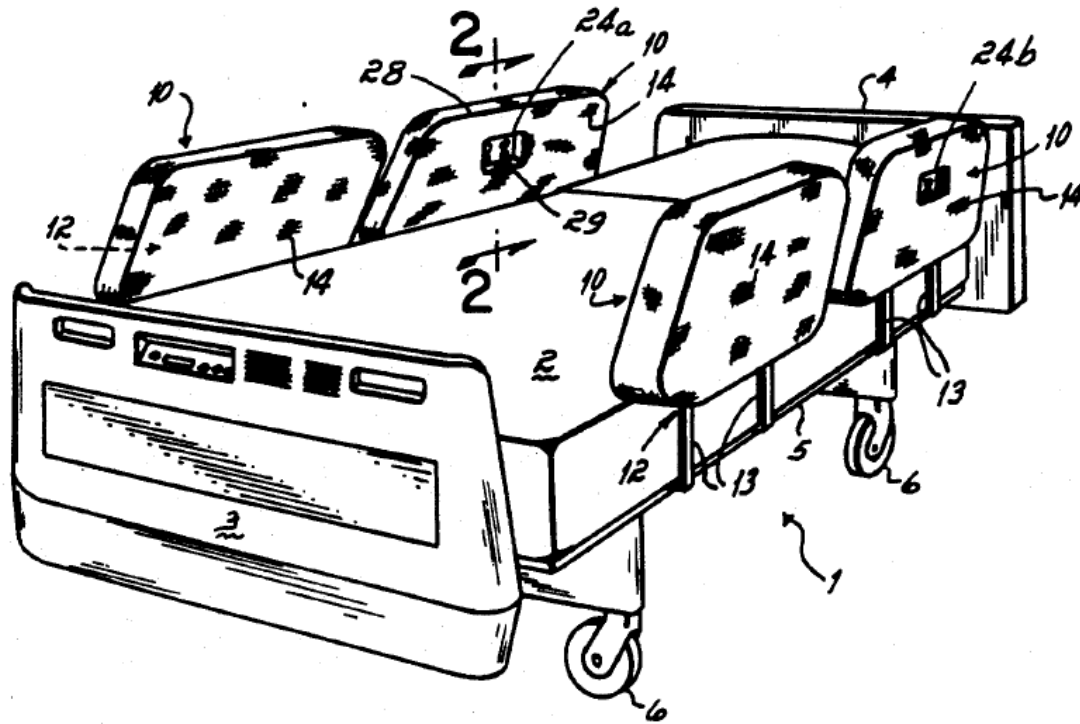
- ❖ Patsie Mahoney had US patent no. US4215446 [Fig. 2.6] which is related to a padded cover used to enclose the standard hospital bed side rail. The standard hospital bed rail has a hard metal upper frame and is not padded. It is therefore necessary to provide some kind of padding on the rail to prevent the injury of patients who may thrash about.



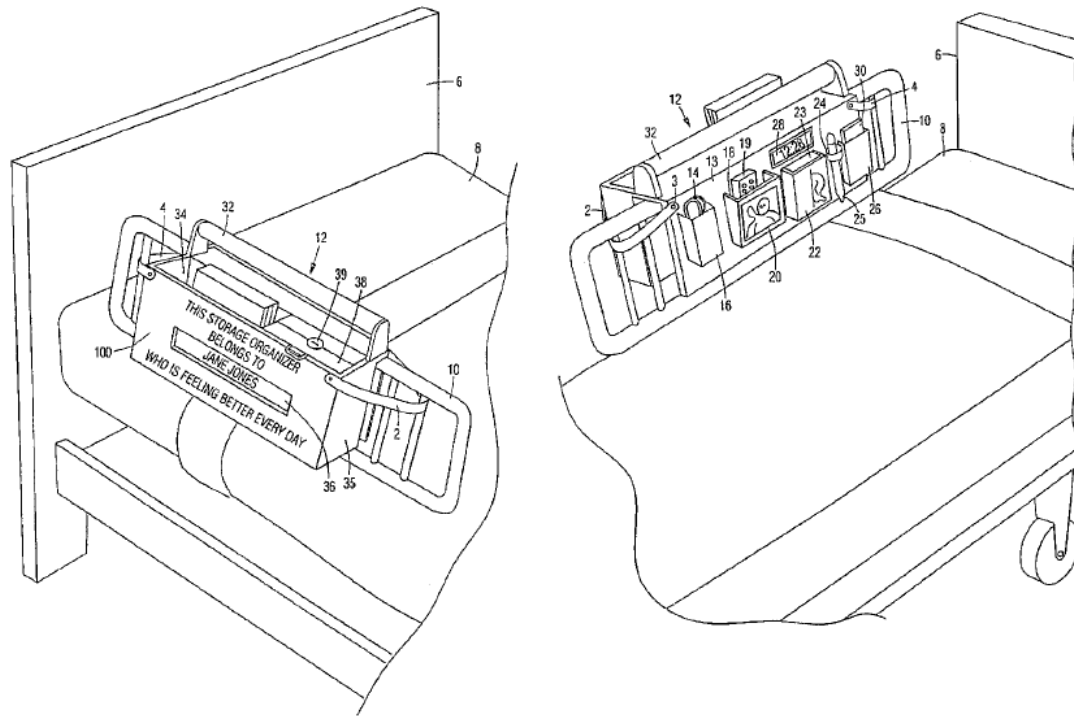
- ❖ Harold D. DeLong [US patent no. US4357881] [Fig. 2.7] had provided a tray which is conveniently attached to the rungs of the side rail of a hospital bed. The unit is designed to easily snap into place over the upper rung of the side rail, with a pivotal brace which clamps into a lower rung.



- ❖ Fredenck J. Holder [US patent no. US5191633] [Fig. 2.8] had included sideguards which are on either side of the bed for preventing a patient lying atop the hospital bed from rolling off the bed and becoming injured. These sideguards are normally fabricated of a hard material such as a rigid plastic.



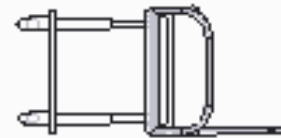
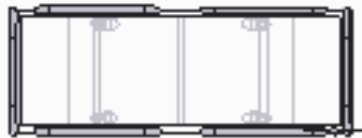
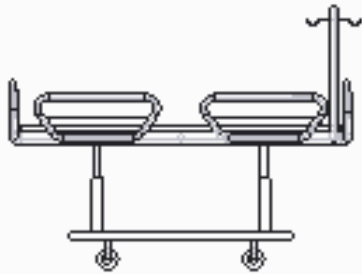
- ❖ Jane E. Ritchie [US patent no. US5651152] [Fig. 2.9] had attached a storage device to a standard hospital bed side rail. When a person has a medical problem which requires them to spend time in a hospital, they frequently bring personal items with them such as eyeglasses, dentures, magazines, tissues, mobile phones, etc. There are very few convenient places to put such items in a hospital room environment. If a small table next to the bed is provided, it is often cluttered with hospital food trays or other hospital related items. Therefore, a storage organizer which is removably attached to the side rail of a hospital bed which is capable of holding a variety of personal items as described above.

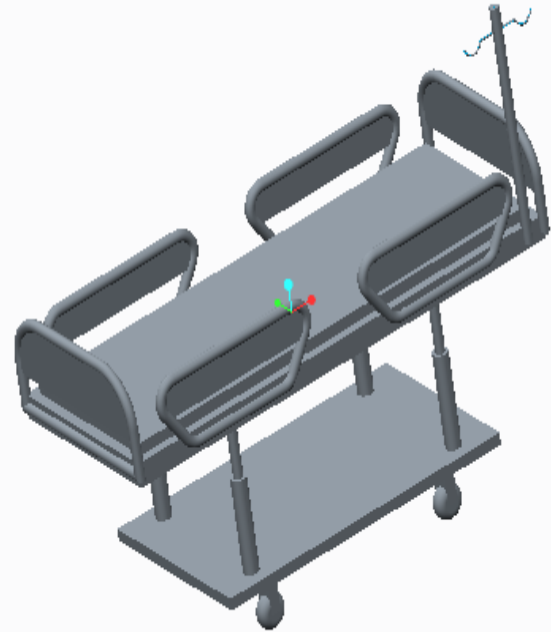
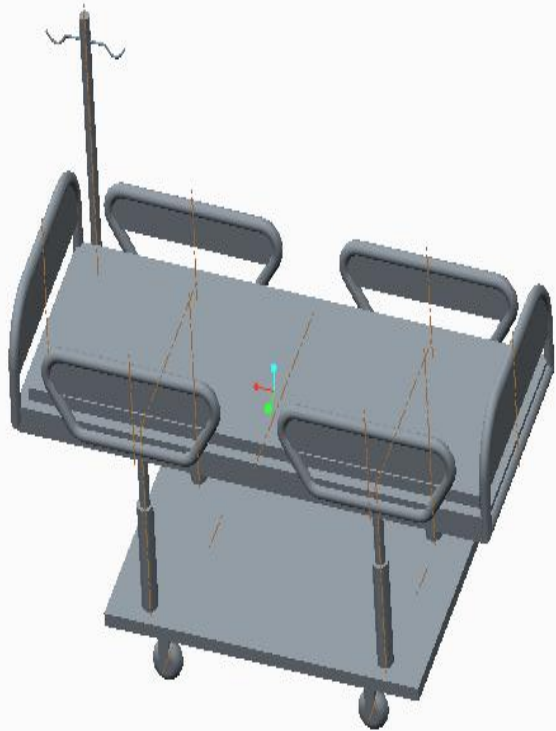


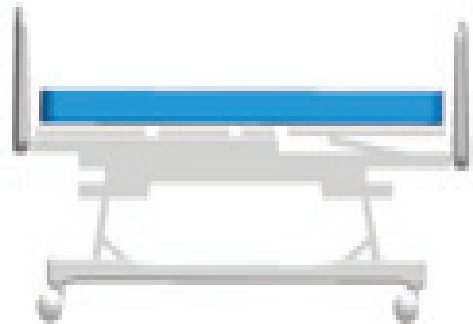
METHODOLOGY

- ❖ To conduct a survey of patients to crystallize the problem.
- ❖ To conduct literature survey and study the various solutions suggested for managing the said problem. To study their merits and demerits.
- ❖ To decide the requirement of the product along with size and arrangement of components based on above literature survey and actual need of patients.
- ❖ Identify possible mechanisms and selection of mechanism.
- ❖ Analysis, synthesis and selection of mechanisms for the product.
- ❖ Decide the design requirement.
- ❖ Decide the sizes of important components based on design calculations.
- ❖ To prepare model and check the motions needed with arrangements.
- ❖ Fabrication of model and testing for load, motions and positions desired.

Design of Project







Auxiliaries

- Wheel and Castors
- Storage Rack
- Lamp Holder
- Bottle Holder
- Foot rest
- Side Rail
- Control Panel



Design Calculation

❖ Load on casters

Weight of body of bed in kg = 50 kg

Weight of body of bed in newton = 490.5 N

Weight of human body in kg = 100 kg

Weight of human body in newton = 981 N

Force on castors = $490.5 + 981 = 1471.5$ N

Force on each castor = $1471.5 / 4 = 367.875$ N

❖ **Load on back rest**

Weight of human body (back) in kg = 50 kg

Weight of human body (back) in newton = 490 N

Weight of frame (back) in kg = 18 kg

Weight of frame (back) in newton = 176.58 N

Force on back rest = $490 + 176.58 = 666.58$ N

❖ **Load on leg rest**

Weight of human body (leg) in kg = 20 kg

Weight of human body (leg) in newton = 196 N

Weight of frame (back) in kg = 18 kg

Weight of frame (back) in newton = 176.58 N

Force on back rest = $196 + 176.58 = 372.58$ N

❖ Stress on castors

Dia. of castor $d = 10 \text{ mm}$

Bending stress $\sigma_b = M * y / I$

Where, $M = F * (L / 2) = 294 * (50 / 2) = 7350 \text{ N.mm}$

$$y = d / 2 = 10 / 2 = 5 \text{ mm}$$

$$I = \pi * d^4 / 64 = \pi * 10^4 / 64 = 490.87 \text{ mm}^4$$

$$\sigma_b = 7350 * 5 / 490.87 = 74.877 \text{ N / mm}^2$$

Shear stress $\tau = T * R / J$

Where, $T = F * (L / 2) = 294 * (50 / 2) = 7350 \text{ N.mm}$

$$R = d / 2 = 10 / 2 = 5 \text{ mm}$$

$$J = \pi * d^4 / 32 = \pi * 10^4 / 32 = 981.74 \text{ mm}^4$$

$$\tau = 7350 * 5 / 981.74 = 37.433 \text{ N / mm}^2$$

❖ Factor of safety

F.O.S. = Ultimate tensile stress of material / Maximum stress generated in material

$$= 450 / 74.877$$

$$= 6$$

Material	Mild Steel
Density	7200 kg/m ³
Thermal expansion	10.1 - 16.6*10 ⁻⁶ (mm/°c)
Young's modulus	68.9-207 Gpa
Poisson ratio	0.23-0.3
Melting point	1230-1530 (°c)
Ultimate tensile strength	450-500 Mpa

➤ Metal Joining

Permanent Joining

Temporary Joining

- Permanent Joining:-

Permanent fastening can be done by welding.

- Temporary Joining:-

Temporary fastening can be done by bolt and nut.

➤ Equipment used

PMDC Motor

Voltage- 24 volt

Ampere- 3 amp

Power- 0.25 hp

Motor shaft dia. - 10mm

Screw motor

Voltage - 24 volt

Ampere - 2.5 amp

Power - 60 watt

stroke length - 17 cm

shaft dia. - 25mm

Output - 5mm/sec as per above input

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Thank You!

