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Design and Fabrication of Wheelchair into Foldable Bed

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Abstract: ***In this paper lead screw mechanism is used to convert a wheelchair into bed and vice versa. When lead screw mechanism is operated, the foot rest which is downward goes till the level of seat of wheelchair and simultaneously the back support goes down to the same level making, its stretcher and vice versa, when it is converted into wheelchair from stretcher. Below the seat, a defecation system has been provided which is detachable and is operated by sliding mechanism. It is designed and fabricated in such a way that it can be used in hospitals as well as for personal use at home. Below the seat, a defecation system has been provided which is detachable and is operated by sliding mechanism. Also, obstacle avoiding sensor i.e., ultrasonic sensor is used to know if any obstacle will come in front of wheelchair, siren bell will ring.***
Keywords: Fabrication, Hospital, Mobility Aid, Lead Screw, Design, Wiper Motor, Wheelchair, Battery.

I. INTRODUCTION

Design an automatic wheelchair is the important things present day. In this generation, for the disabled people where the care requires a lot of money, labour and time. This report is the example of a design of an automated wheelchair into a foldable bed that will be able to perform all the functions in these modern wheelchairs (Wheelchair with the adjustable portion of the backrest and also footrest). Physically disabled people are affected millions of families in the world. In the present century, million people are suffering from physical challenged.

The disabilities of people are often in the empowered and enable them to measure a traditional life a normal and independent life with the assistance of wheelchair. Latest and modified wheelchairs can give the comfort and ease to disable people instead of the old peoples. It will help the disabled people in various design changes are to be done. It is expected that these new automatic wheelchair into foldable bed, sections (legs positions will be adjusted). It is expected that the new type of automatic wheelchair may enable people's better in the medical care of the patient, and would greatly decrease time and labours to the old-age home staff and also help for physical disabled people. It gives easy and comport to the patients and the medically staffs.

II. LITERATURE SURVEY

The paper titled "Design and fabrication of the multiutility wheel-chair". In this paper, wheel-chair that can prevail over this conventional wheel-chair. By adopting different research, papers aided to spark the varied problems with objects regarding the solutions, precautions and general advancements and propelled of different materials for the development of wheel chair and ideas of manufacture regarding the advancement of power chairs. Generally, the project focuses on cost effectiveness and easily acceptance.

This Designed of Wheel-Chair Stretcher enables the easy to transferring and handling of patients in hospitals without producing any damage to patient's body externally and internally. Thus, the time and effort required for moving the patient may be reduced. Modelling software such as cad has helped in visualizing the product.

III.METHODOLOGY

The model works on lead screw mechanism. A lead screw or power screw or translation screw is a screw used as a linkage in a machine to translate turning motion into linear motion. Because of the large area of sliding contact between their male and female members, screw threads have larger frictional energy losses compared to other linkages. They are not typically used to carry high power, but more for intermittent use in low power actuator and positioned mechanisms.

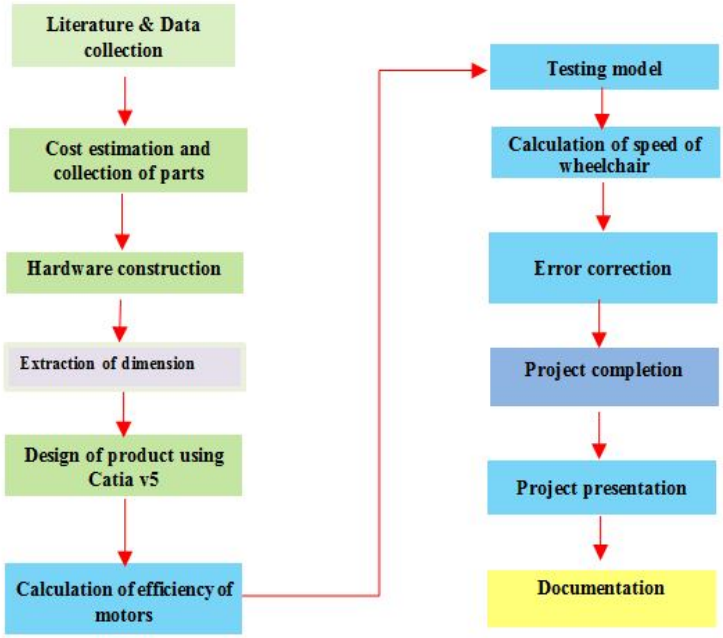

Fig.1: flowchart of methodolog

IV. COMPONENT USED IN FABRICATION

Actually, wiper motors are generally design for the 2-speed operation process. The wiper motor mainly consists of three brushes namely; common, low and high-Speed motors. These two types of the brushes may supply for vary mode of operation process.
12v high torque low rpm electric motor.

Structure: synchronous motor
Shape: tabular
Phase: single-phase
Speed: High speed
Function: control

Power output: 25-30 W
Current: 10-13 Amps
Torque: 18.5 N-m
Load speed: 85 ± 15 rpm
Current (No load): < 5 A

V. COMPONENTS DESIGNED IN CATIA V5

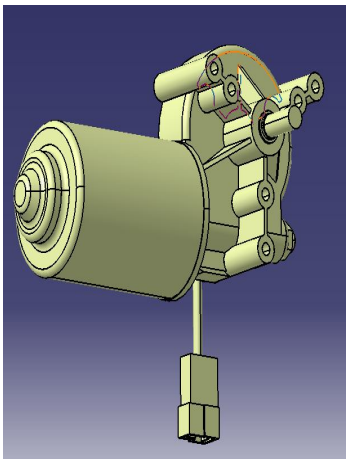

Fig. 2 Wiper Motor

Fig. 3 Rear Wheel

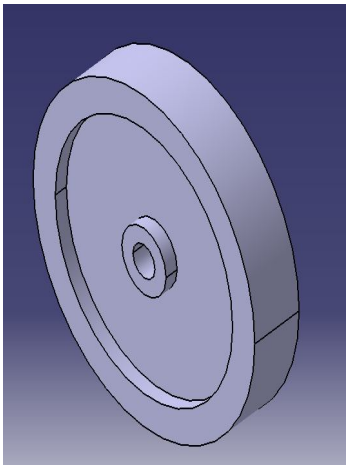

Fig.4 cater

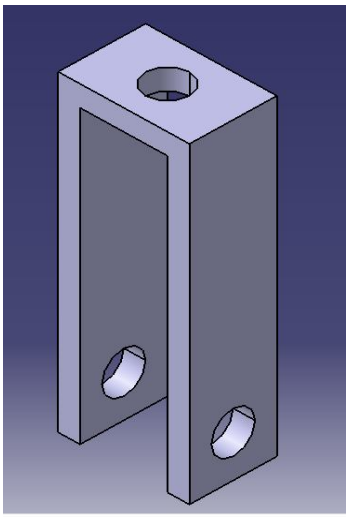

Fig.5 Caster Frame

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VI. ASSEMBLED DESIGN AND IT'S DRAFTING

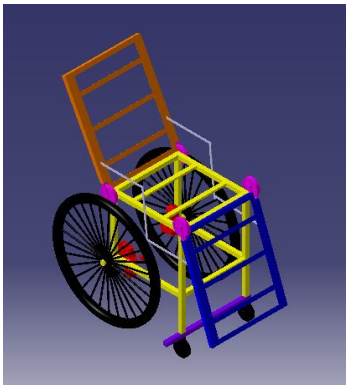

Fig.6 3D Design

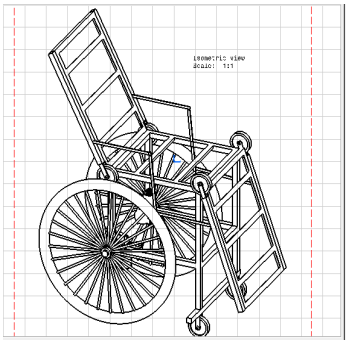

Fig.7 Isometric View

TABLE I
Dimensions of Wheel Chair

Dimensions	Centimetre (cm)
Overall length	198 cm
Overall height	135 cm
Height from bottom to seat	76 cm
Overall width	69 cm

VII. DESIGN CALCULATION

A. Calculation of Input Power

We will use International Standard of units. By the definition of Ohm's Law. Ohms' law states that the generated current passing through the conductor is directly proportional to applied voltage, which can be expressed in the form of current, and voltage

Current (I) = Voltage (V) /Resistance(R)

Current (I) = 12 / Resistance(R)

Resistance(R) = 12/1.2

Resistance(R) = 10 Ohms

The electrical power can be calculated by using these formulae:

Pin =current(I) * Voltage(V)

Pin =12 * 12

Pin = 144 W

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B. Calculation Of Output Power And Angular Speed

Input power (Pin) is measured in Watts
Current (I) is measured in Amperes
Applied voltage (V) is measured in Volts
Mechanical Power Output for the motor can be calculated by using the formulae:
Pout = Torque(τ) *Angular speed(ω)
Pout = 18.5 * Angular speed (ω)
Angular speed (ω) =?
Where;
Pout – power output in Watts
Torque (τ) in Newton meters
Angular speed (ω) in radian per second
Angular speed (ω) = rotational speed * 2*π / 60
Angular speed (ω) = 63 * 2*π / 60
Angular speed (ω) = 6.5973 rad/sec
Pout = 18.5 *6.5973
Pout = 122 W

Where;
π -Mathematically constant pi (3.14)
60 seconds in a minute
By using mathematical formula to get efficiency
Efficiency (E) = Power out (Pout) / Power in (pin)
After substitution we get
E = Pout / Pin
E = 122 / 144
E = 0.847 * 100
Efficiency = 84%

C. Load Calculations

1) Front Caster

Weight of the wheel chair = 24.45 Kg
Weight of the body = 80 Kg
Vertical force = (239.61 + 784) Kg
Load of each caster= (1023.61)/2 Kg
Force on each caster= (909.5)/2 Kg

2) Back Rest

Human back weight =310.91 N
Incline = 25degree
Back rest weight = 58.8 N

3) Leg Rest

Inclination = 55 degree
Weight of the leg = 4 kg
Entire force = 39.2+39.2
=78.4 Newton
Actual force = 78.4* sin (50) = 64.22 Newton

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D. Calculation of Lead screw

Linear velocity of the lead screw = Number of rotations*pitch diameter
= 50*10 millimetres(mm)/minutes(min)
= 500 millimetres (mm)/minutes (min)
= 8.33 millimetres (mm)/seconds(sec)

Angular velocity of lead screw = (2*π*N)/60
= (2*π*50)/60
= 5.326 radians/seconds

Pitch diameter (D) = (d1 + d2)/2
= (14 + 18)/2
= 16 mm

Halix angle (α) = Tan (α)
= [1/ (π*d)]
= (1/π*16)
= 11.25 degree

To lift the load, torque (T) = W*(D/2) *Tan (β+α)
= 784.8 *2* tan (12.95 + 11.23)
= 268.42 N-mm

Power of the lead screw =T*[2*π*N)/60]
= 0.268*[2*π*50/60]
= 1.4 Watts

Torsional moments (MT) = W*(d_2/2) *Tan (β+α)
= 80*9.81*9*tan (11.25+12.95)
= 3174.32 N-mm

Torsional shear stress (τ) = (16* 3.174)/ (π* 143)
= 5.89*10.3 N/mm^2

Principle shear stress (τ_{max}) = 2.549 N/mm^2

Principle normal stress (σ_{max}) = 5.098 N/mm^2

Transverse shear stress (τ_s) = W/ (π* d_1* t* i)
= (80*9.81)/ (π * 14* 4* 43)
= 0.103 N/mm^2

Efficiency (E) = tan (α)/ tan (ϕ + α)
= tan (11.25)/ tan (12.95 + 11.25)
= 0.44
= 44%

If efficiency of screw < 50 %
Then it will be self -locked to the system.

1.5. SPEED CALCULATION OF WHEELCHAIR

Radius of rear wheel (R) = 355.6 mm
Perimeter (P) = 2*π*R
= 2234.30 mm
N_1 = 85rpm
V_1 = P*N_1
= (2234.30 *85)/ (60*1000)
= 3.16 mm/sec

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VIII. TESTING

After the fabrication, we have performed the various test like speed of the wheelchair without load and the speed of the wheelchair with the load (person) of different weight and found that the speed was without load and with load. Also, the transformation of wheelchair into bed and vice versa was successful without load and with load. We have successfully installed the Ultra-Sonic sensor which detect obstacle on the path and alert. The wheelchair was comfortable and easy to handle. The battery backup was also good.

Fig.8 Front View

Fig. 9 Side View

Fig.10 Wheelchair into Bed

IX. CONCLUSION

This wheel chair has been designed in order to reduce the pain for patients and pregnant woman too. This wheel chair can be easily afforded new design. This can be generally helpful in hospital, health-post, old age home and also for disabled societies. Mostly, this wheel chair will be most helpful to prenatal and postnatal too. This wheel chair will be more advanced technologies. we have come to that the analysis of patients in the hospitals, health-post, old-age home and the analysis of medical market. To overcome these problems regarding the patients, we have designed and fabricated a wheel chair into foldable bed. Make sure this wheel chair into foldable bed may help the victims for relaxing and relief over the pain and problems.

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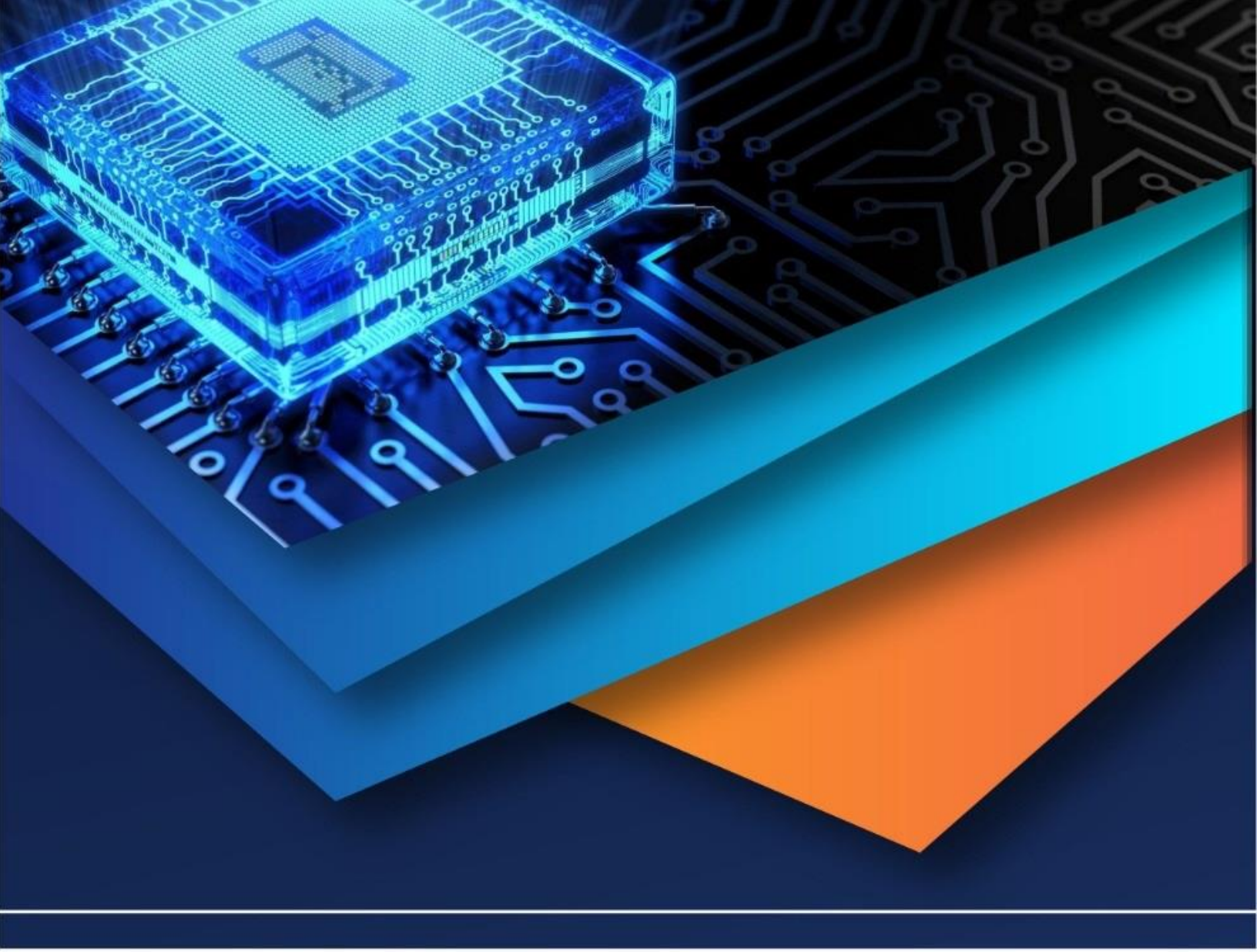

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