

Movable Lower Limb Exerciser

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ABSTRACT

Difficulty walking and Impaired balance are some of the more common challenges for individuals with Parkinson's Disease(PD) and Elder people, They contribute to reduced levels of activity and participation in the community. These impairments are also predictive of future falls and fall related injury. Identifying what types of interventions improve mobility performance in this population is important to guide clinical decision making.

Jogging is a popular exercise. It is known that the jogger's knees suffer from significant impact especially at the moment that the foot hits the ground. The knees could be easily injured after constantly taking the impacts for a period of time. Therefore, many exercisers such as elliptical exercisers, stepper, and air walker are developed to guide the feet Move along one trajectory that is similar to that of real jogging, only that the knees are well protected from being impacted and injured.

MILE will have totally different design compared to elliptical exerciser which has flat surface to climb easily for elder people, Ergonomically designed seat for comfortable seating position, curved foot roller for easy exercise.

KEYWORDS: MILE, Exerciser

I. INTRODUCTION

Jogging is a popular exercise. It is known that the jogger's knees suffer from significant impact especially at the moment that the foot hits the ground. The knees could be easily injured after constantly taking the impacts for a period of time. Therefore, many exercisers such as elliptical exercisers, stepper, and air walker are developed to guide the feet Move along one trajectory that is similar to that of real jogging, only that the knees are well protected from being impacted and injured.

A conventional elliptical exerciser comprises a frame, two handles, a flywheel And two supporting feet members. Both the flywheel and the handles connect with the frame, and the foot support member's one end connects to the flywheel and the other end to the handle. When the handles swing, the foot support members are driven by the flywheel and moved along a pedal trajectory that consists of a supporting travel and a striding travel.

Parkinson's disease (PD) is a progressive nervous system disorder characterized by the main signs of shivering and uprightness, and postural instability. These movement disorders have a significant impact on quality of life and increase the risk of fall-related injuries.

Growing evidence suggests that exercise can have a therapeutic effect on the motor symptoms of PD, however, there has been a lack of well-designed clinical trials with sufficient numbers of patients to draw firm conclusions about the best mode of exercise to optimize physical functioning.

However, This work is to make joints flexible & freeness. it is very friendly to elder people to get workout daily in fresh atmosphere.

1.1. Parkinson's disease

Parkinson's symptoms usually begin gradually and get worse over time. As the disease progresses, the

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person may have difficulty walking and talking. Both Man and woman can have Parkinson's disease. However, the disease affects About 50% more men than women.

mechanical energy into electricity. this is often the foremost used type for generating electricity and relies on Faraday's law.

It is seen through an experiment by rotating a magnet among closed loops of conducting material (e.g., copper wire). the majority industrial electrical generation is finished victimisation magnetic attraction induction, within which energy forces a generator to rotate.

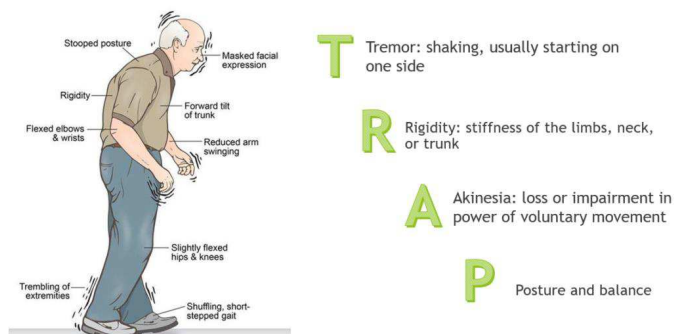


Figure 1.1 Alarming Symptoms of PD

1.1.1. Treatment of Parkinson's Disease

Although no cure for Parkinson's disease. Symptoms can often be relieved with medications, surgery, and other treatments.

1.1.2. Therapies Therapies

That can be used to relieve the symptoms of Parkinson's disease. Other supportive therapies include healthy eating and exercise to strengthen muscles and improve balance.

1.2. Plastic waste management

Plastic is a wonderful material with a wide range of applications, from packaging to engineering and medical equipment, and even aviation. Various life cycle assessment studies have shown that the carbon footprint of plastics is lower than that of alternatives such as paper, jute and even fabrics. It needs to be emphasized that the sustainable option is to properly manage waste plastics to prevent the adverse effects of plastics on the environment.



Figure 1.2 Recycling of Waste Plastics

The Plastic Waste Management Rules, 2016 clearly stipulate that urban local bodies (ULBs) should ban less than 50 micron thick plastic bags and not allow usage of recycled plastics for packing food, beverage or any other eatables. The Rules also require that local bodies should provide separate collection, storage and processing of plastic waste in their areas.

1.3. Mobility of joints

Joint mobility is important to allow these joints to work more efficiently so that their movements are not compromised, and the joints must be strong so that they move better and stay in place. They must be mobile enough to allow the muscles to do their job properly.

When the joint is stiff, the muscle's ability to move the joint in normal motion is reduced.

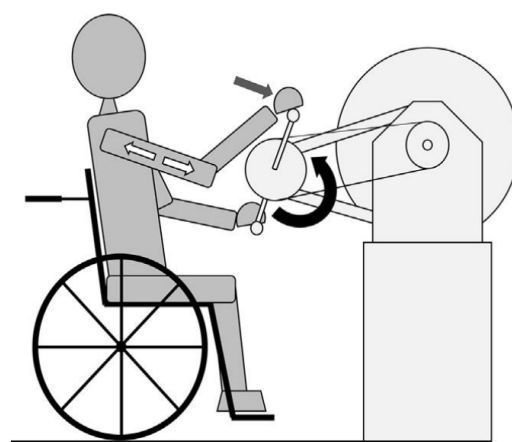


Figure 1.3 Mobility of Joints

1.4. Mechanisms used in the work

1.4.1. Gear Mechanism

In this work, the Foot roller works with the help of bearing and shaft rod, which is connected to the multiple gears. the Gear mechanism acts as torque converter to reduce stress for easy operation.

1.4.2. Pneumatic Powered Chair Mechanism

In this work, when the chair is at normal position, we can adjust as up & down & recline the chair as per our comfortable, using pneumatic powered kinematic mechanism. and can adjust as per ergonomics to our comfort level.

1.4.3. Roller Mechanism

A multiple Foot pad which is attached to a belt and driven by small wheel and it is guided by many bearings to hold curved shape. The whole system is connected to a shaft rod and gear system to rotate the wheel.

1.5. Benefits of the work

Some of the benefits of work are :

- Main focused for elder people.
- To prevent from PD disease

- To get rid of joints related pain
- Cost saving in therapy treatment
- To get more flexible & mobility in lower limb joints.
- self-balanced exerciser
- Can be implemented in metro parks, community centres
- Adjustable seat for comfortable seating position.
- Partially made from plastic waste.
- Cost reduction plan for poor people
- Flat & lower surface for easy climbing
- To gain same workout like physiotherapy
- Benefits of fresh air & Sun light for elder people
- Steering wheel for easy turn & hand joints mobility
- Day to day relaxation on outer atmosphere

II. LITERATURE REVIEW

2.1. Review of literature

Daniel G. Miner et al [1] (2020) said that There is currently no treatment for Parkinson's disease (PD)-associated progressive movement disorder. Pharmacological management of dyskinesia in PD has been associated with serious negative side effects.

Exercise improves the effectiveness of anti-Parkinson's drugs, but not the side effects. There is a lack of consensus on the optimal mode of exercise education or medications to improve motor function in PD patients. A novel concept of forced exercise is attracting attention in the literature as an exercise mode that can improve motor function in PD patients.

Fujiwara T et al [2] (2003) described about Ambulatory ability in patients with hemiplegic stroke is often limited by muscle weakness, inability to achieve super flexion support in the stance phase, or spasticity and strong synergistic effects that inhibit selective compatibility activation of muscles during the gait cycle. Restoring motor control in this paralyzed limb requires facilitation of weak muscles and selective activation of compatibilizing muscles, in order to synergize and prevent exacerbation of spasticity.

Fu-Chen Chen et al [3] (2018) said that Jogging is a popular exercise. It is known that the jogger's knees suffer from significant impact especially at the moment that the foot hits the ground. The knees could be easily injured after constantly taking the impacts for a period of time. Therefore, many exercisers such as elliptical exercisers, stepper, and air walker are developed to guide the feet to move along a trajectory that is similar to that of real jogging, only that the

knees are well protected from being impacted and injured.

Thomas Edwards et al [4] (2018) described about Multiple sclerosis (MS) is an immune-mediated central nervous system disease characterized by the accumulation of progressive nerve damage. This damage usually manifests as movement discomfort, which is one of the most common and mismanaged consequences of MS. Mobility impairment increases with disease progression and has negative consequences for employment, participation in everyday activities, and overall quality of life (QOL).

Lydia L. Lytle et al [5] (2019) said that they used a single-group repeated measures design and Physiological responses were compared with eccentric and concentric arm cycling executed at iso-metabolic rate and iso-output. In the experimental arm circulation scheme, participants circulated eccentric and concentric arms at 35% of the maximum oxygen consumption, and compared the possible differences in power output.

Kenneth J. Hunt et al [6] (2019) described about to develop a unified heart rate (HR) control approach for cycle ergometer (CE) and treadmill(TM) exercise, and to empirically compare the common controller's performance between the CE and TM. Methods.

Patrick Kangas et al [7] (2018) described about E-waste recycling is only an introduction to the complex labor, technology, and economic market loops that need to interact in order to recycle human products into basic raw materials that can be reused in the production process. The raw materials may not return to the same type of product, but the goal is to find some productive uses for the recycled materials. This involves networking with a diversity of production processes to find best fits.

2.2. Summary of the Literature

Based on the above literature surveys, the mechanism of various cycling methods, types of disease affected to the elder people and waste recycling process are studied. In this way, the exercise machine can be made using a new method besides the traditional approach. By this, various disease can be controlled and waste management can be obtained.

2.3. Problem identification

Based on literature review collected, the main problems identified are

- Movable exerciser are not self balanced.
- Mostly designed for standing posture.
- Chair or seat was not comfortable for elder people
- Surface of exerciser was not suitable for elder people

- Foot roller doesn't meet ergonomic formula.
- Exercise equipments are mostly indoor purpose only

2.4. Objective of the Project

The objective of the work is to

- To get more flexible & freeness in lower limb joints.
- Ergonomically designed seat for comfortable seating position.
- Flat & lower surface for easy climbing for elder people
- Curved foot roller designed ergonomically for less stress.
- Steering wheel for easy turn & hand joints freeness
- Adjustable seat for elder people.

III. METHOLOGY

Figure 3.1 shows flowchart of methodology used in this work.

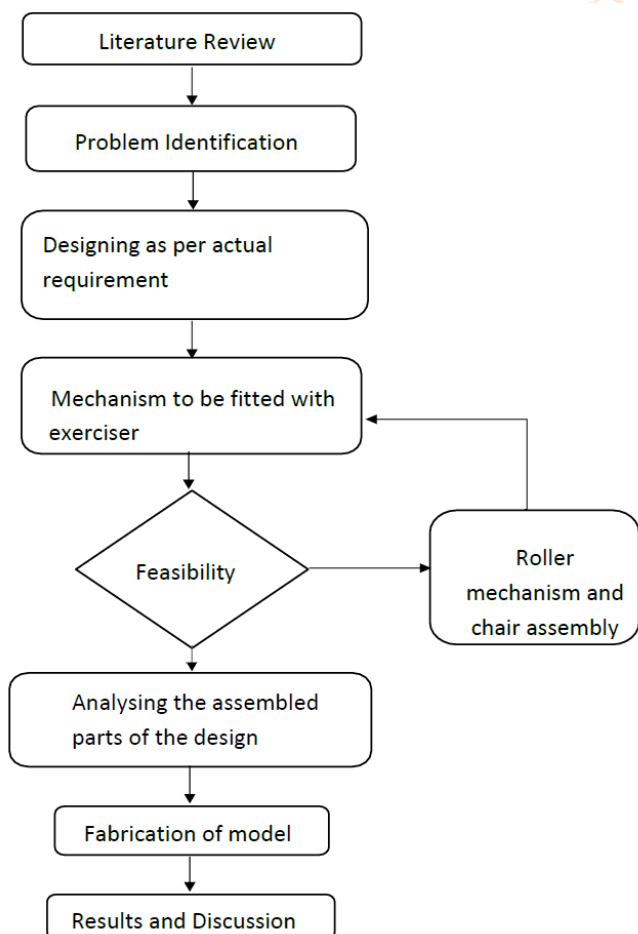


Figure 3.1 Methodology

3.1. Description of methodology

Based on the review of literature, the new form of exerciser is formulated, as followed Flat surface is to climb easily onboard. then Seats are adjustable depends on human comfortability using pneumatic and kinamatic system. The Foot roller is related to conveyor belt method, which will rotate by external force with less stress and is connected to a shaft rod

to a gear mechanism. the mechanism of the gear will acts as torque converter to reduce the stress. then it is connected to a wheel shaft which will rotate the wheel forward. Steering wheel mechanism helps to mobilize hand joints from stiffness.

In future, the main mechanism of the whole work to be created then, Assembling of designed parts has to be done. then, Analysing of the modelled exerciser. Finally Fabrication of the model and Testing of the model takes place.

IV. Design of LOWER LIMB EXERCISER MODEL

4.1. Introduction

The frame of the movable lower limb exerciser model. The main purpose of the work is to

- Ergonomically designed seat for comfortable seating position.
- Flat & lower surface for easy climbing for elder people
- Curved foot roller designed ergonomically for less stress.
- Steering wheel for easy turn & hand joints freeness
- Adjustable seat for elder people

4.2. Main Frame

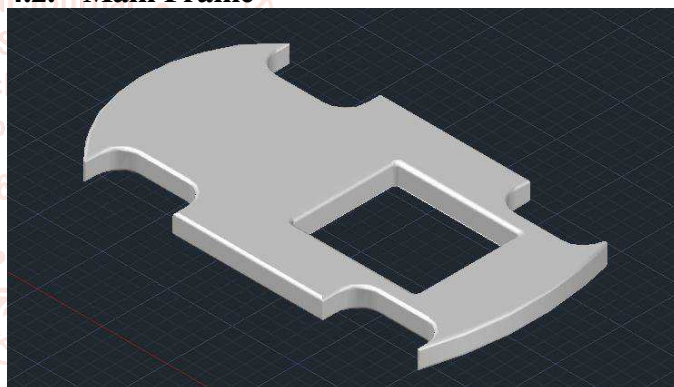


Figure 4.1 Frame of The Model 3d

The above Frame (Figure 4.1) designed based on safety measures & Rigidity. Front and Rear was arch shaped and it will work as bumper. Centre pocket is to place foot roller where it will be seated below of the mid-frame. wheel arch at four corner is to place wheels for its self balance.

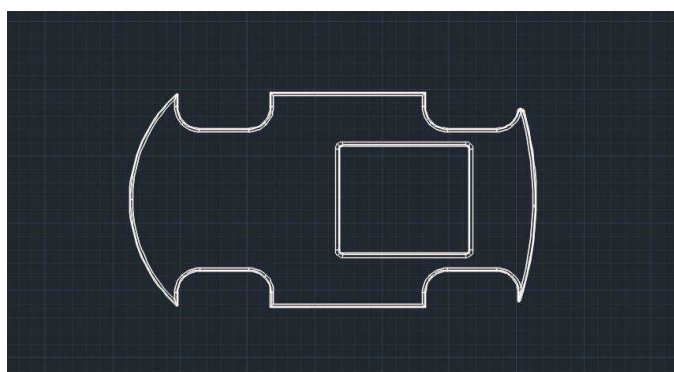


Figure 4.2 Frame 2d Sketch

4.3. Foot Roller

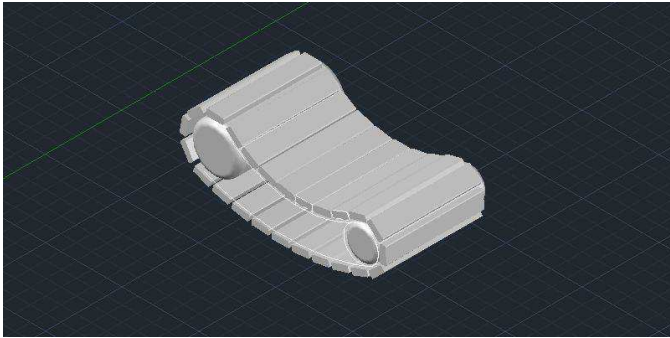


Figure 4.3 Foot Roller 3d Model

The above figure (4.3) shows the actual design of foot roller. the curved design is taken with the reference of leg movement angle as per ergonomics. the flat pad(chain like structure) was designed to follow accurate angle of roller instead of belt. and gap between two pads is kept for not to contact each other. bigger shaft at front is kept for connecting to a gear mechanism. and rear shaft is for support of the foot roller.

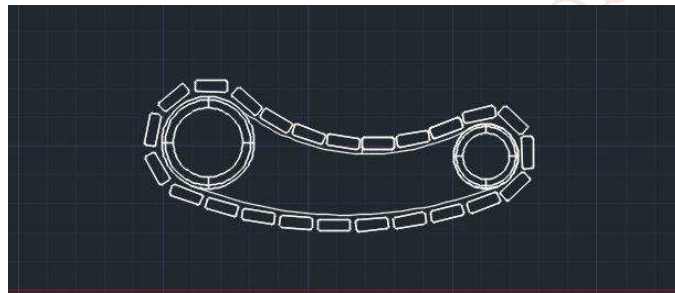


Figure 4.4 Foot Roller 2d Sketch

4.4. Ergonomically Designed Chair

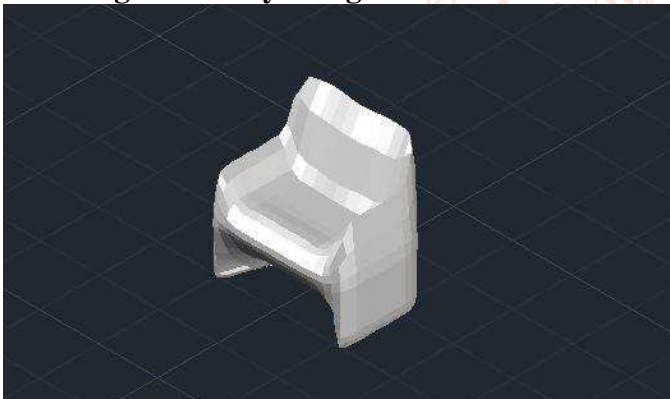


Figure 4.5 Ergonomically Designed Chair 3d Model

The chair is designed based on ergonomics. and the seating comfortable has attained at high level for elder people. and planning to keep lever operated adjustment to sit as per their convenience.

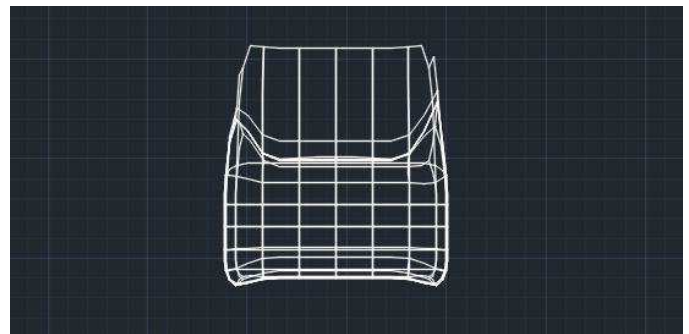


Figure 4.6 Ergonomically Designed Chair 2d Sketch

4.5. Balancing Wheel

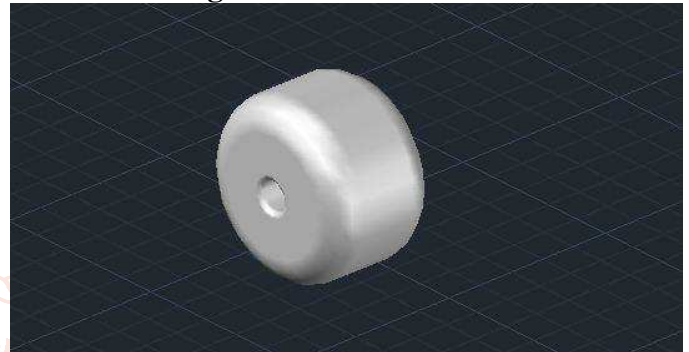


Figure 4.7 Balancing Wheel 3d Model

The four wheel mechanism is known for self balancing technology. where, here it will be useful for elder people and locomotor disorder.

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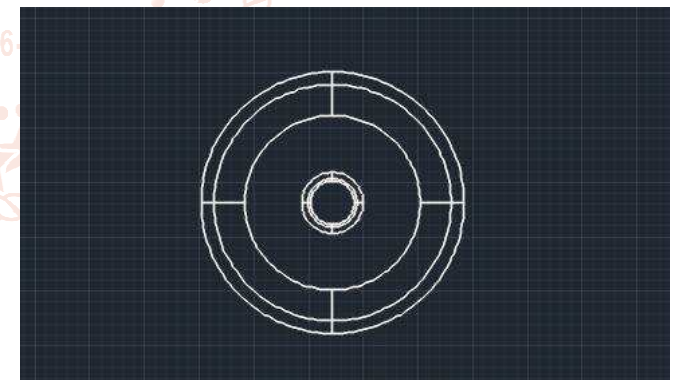


Figure 4.8 Balancing Wheel 2d Sketch

4.6. Mud Guard

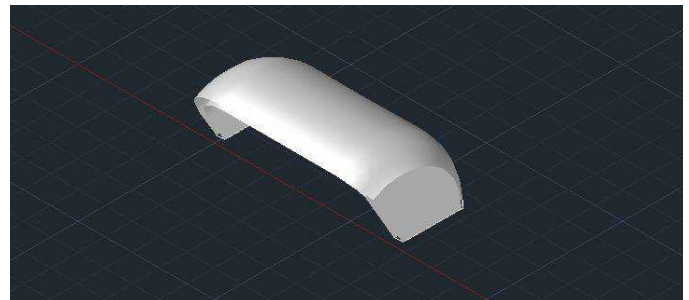


Fig 4.9 Mud Guard in 3d Model

The mud guard will work as safety protection while climbing the vehicle and as well as mud guard purpose.

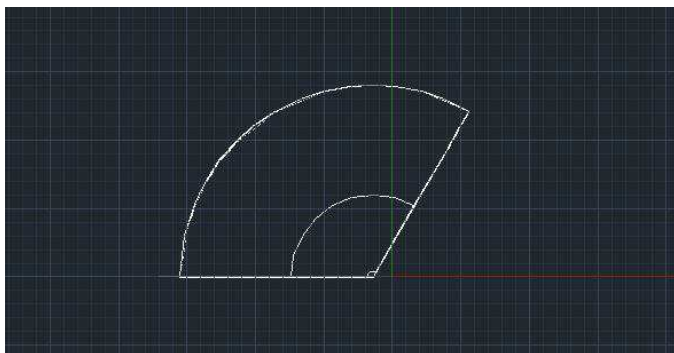


Figure 4.10 Mud Guard in 2d Sketch

4.7. Working Simulation of the Model.

The process of working operation is based on exerciser cum vehicle. Flat surface is to climb easily onboard. then Seats are adjustable depends on human comfortability using pneumatic and kinematic system. The Foot roller is related to conveyor belt method, which will rotate by external force with less stress and is connected to a shaft rod to a gear mechanism. the mechanism of the gear will acts as torque converter to reduce the stress. then it is connected to a wheel shaft which will rotate the wheel forward. Steering wheel mechanism helps to mobilize hand joints from stiffness.

Conclusion And Future works

This work is specially designed for elder people. To prevent them from various joints related disease & stiffness. Thus, the work is based on people's ergonomics and comfortability. and cost reduction plan as from recycled waste plastics directly contribute to poor people who can't able to afford therapy treatment. Movable car which provide best in capable for outdoor purpose.

Self balancing will achieved using 4 wheel mechanism which provide much safety and confidence for elder people. Less strain foot roller is much easier for mobility of joints compared to elliptical exerciser. The Foot roller is related to conveyor belt method, which will rotate by external force with less stress and is connected to a shaft rod to a gear mechanism. the mechanism of the gear will acts as torque converter to reduce the stress. then it is connected to a wheel shaft which will rotate the wheel forward. Steering wheel mechanism helps to mobilize hand joints from stiffness.

5.1. Future Works

- In future, the main mechanism of the whole work to be created ,
- Assembling of designed parts will be done
- Analysing of the modelled exerciser

- Fabrication of the model
- Testing of the model

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