LEVER FOUR-BAR MECHANISM DESIGN

FOR ALL-TERRAIN WHEELCHAIR

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LEVER FOUR-BAR MECHANISM FOR ALL-TERRAIN WHEELCHAIR

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DECLARATION

I declare that this project report entitled “Lever four-bar mechanism for all-terrain wheelchair” is the result of my own work except as cited in the references

Signature : …….

Name : ……..……

Date : ……..……

APPROVAL

I hereby declare that I have read this project report and in my opinion this report is sufficient in term of scope and quality for the award of the degree of Bachelor of Mechanical Engineering.

Signature :…..…….……

Supervisor`s Name : ……..……..……

Date : ……..…….

DEDICATION

To my beloved parents:

Zainuddin bin Hashim, Normah binti Said

ABSTRACT

Four-bar mechanism is a simplest movable mechanism which is closed chain linkage mechanism. Even since centuries, this mechanism is widely used because of the movement and also the performance of the linkages. Thus, this linkage is presume to be fits as a moving mechanism in a leverage wheelchair. In market, there already has a chain mechanism leverage wheelchair which also has been commercialize due to time being. However, due to the living cost that has been rapidly increase lately has forced someone who are having disability cannot afford it. According to statistics by World Health Organization, 2011; most of disabilities people are come from the rural area. And the only way to them to make connection in community, to get education, and also to work is by using wheelchair. This study are aims to design a moving mechanism to use in all-terrain wheelchair by using a lever four-bar structure. The paper will calculate the performance of wheelchair in term of velocity and acceleration. There are two method used to get a result which is theoretical analysis by referring to machine and mechanics book written by Myzska and also by using SolidWorks.

ABSTRACT

Mekanisme empat bar adalah mekanisme mudah alih yang mudah dan seakan-akan mekanisme hubungan rantaian tertutup. Walaupun sudah berabad lamanya, mekanisme ini masih digunakan secara meluas kerana pergerakan dan juga prestasi pergerakan mekanisme. Oleh itu, mekanisme ini dianggap bersesuaian untuk digunapakai untuk mekanisme bergerak dalam kerusi roda. Di pasaran kini, sudah ada mekanisme rantai kerusi roda yang juga telah dikomersialkan dari semasa ke semasa. Walau bagaimanapun, disebabkan kos hidup yang telah meningkat pesat kebelakangan ini telah memaksa seseorang yang mengalami kecacatan tidak mampu membelinya. Menurut statistik oleh Pertubuhan Kesihatan Sedunia, 2011; kebanyakan orang kurang upaya datang dari kawasan luar banda dan satu-satunya cara mereka untuk membuat sambungan dalam komuniti, mendapat pendidikan, dan juga bekerja adalah dengan menggunakan kerusi roda. Kajian ini bertujuan untuk mereka bentuk mekanisme bergerak untuk digunakan dalam kerusi roda yang bergerak diatas laluan tidak rata dengan menggunakan struktur empat bar. Kertas ini akan mengira prestasi kerusi roda dari segi halaju dan pecutan. Terdapat dua cara yang digunakan untuk mendapatkan keputusan yang merupakan analisis teoritis dengan merujuk kepada buku mesin dan mekanik yang ditulis oleh Myzska dan juga dengan menggunakan applikasi SolidWorks.

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At – tangential acceleration, [rad/s2]

$L1$,2 ,$L3$,$L4$ – links, [mm]

$\theta 2$ – certain crank angle, [deg]

$\theta 3$ – interior joint angles, [deg]

$\theta 4$ – interior joint angle, [deg]

A – linear acceleration [m/s2]

V- linear velocity of a point [m/s]

r - distance from the center of rotation to the point, [mm]

v - magnitude of the linear velocity of the point, [mm]

ΔR – linear displacement, [mm]

$\Delta\theta$ – angular distance, [deg]

α – angular acceleration, [deg/s2]

γ – interior joint angle [deg]

ω – angular velocity [deg/s

CHAPTER 1

INTRODUCTION

1.0 BACKGROUND

According to the world Health Organization, there are presently 1 billion folks within the world living with disabilities, several of whom do not have equal access to treatment, education, and employment. This can be significantly true for those living in low and middle financial gain countries. Lack of resources in developing countries fully prohibits the disabled from taking part in society. (World Health Organization, 2011).

The World Health Organization, along with the North American nation Agency for International Development, the International Society for medical specialty and Orthotics, and Disabled Peoples International have made a manual entitled tips on the availability of manual wheelchairs in less resourced settings. This manual summarizes the rights of the disabled to a quality device. It underscores the downward spiral leading to the lives of these UN agency are denied this right and are so unable to raised themselves. (World Health Organisation, 2011).

This report will discuss about the innovations that will be made on the wheelchair, which is generally, wheelchair is only could be used in a flat area but is given a new breath for use in areas of all terrain. This report will focus on the moving mechanism required for wheelchair use in all terrain.

The concept of movement for this wheelchair is taken from the hydraulic system of a front- end lifter, mountain bike suspension and traditional tool box designs. Discuss about all terrain wheelchair there is a lot of innovation that has been made from time to time. However, the question is whether it is appropriate for developing countries. Instantly of study about the wheelchair, this research is also looking for an appropriate solution that is suit for developing countries.

1.1 PROBLEM STATEMENT

Manual Wheelchairs are the kind of device that someone should move themselves while not the help of battery. The choice can made from self-propel, which needs the employment to propel with the use of their limbs, and companion propelled, which implies that can simply to have someone to push user.

The major disadvantages of the manual wheelchairs have to be compelled to do with ones- higher body. Though the exercise could also be sensible for the folks that push themselves over a amount of time an equivalent motion regularly will eventually cause injury. Another disadvantage of a manual chair is that the tires can got to be inflated frequently. A spread of things should be properly considered before someone selecting between a power chair and a manual version.

The manual chairs might not go with all the flowery accessories that the power wheelchairs tend to supply for the incapacitated people, but it will be cheaper and a touch a lot of economical than their large power wheelchairs alternatives. Some insurance suppliers might not cover the motorized chair and if that's the case it makes the choice all the easier.

Wheelchairs have attended move toward larger machines when put next with the initial 3 wheelers of past years and because the selections broaden such a lot for the higher. To select the right wheelchair, user need to decide which category, model, and price point is suited the lifestyle and condition.

For example, in East African, people in Samburu, Kenya who is suffer from malnutrition tend to have several disabilities such as not be able to walk. According to current statistic, there is 1 in 200 disabled people lives in need of a wheelchair and 98% of disabled adolescents in developing countries do not go to school (UNESCO, 2015). This made it clear that people in Kenya need the wheelchair to be able lives their life like normal people.

However, the existing wheelchairs which have been distribute in FMW are difficult to repair and impractical on rough terrain. Significant increases were found within the range of participants reportage repairs (7.8%) and adverse consequences (23.5%) in an exceedingly 6-mo amount (2006Y2011) compared with historical information (2004Y2006) (P G 0.001). once examining current information, minorities experienced a bigger frequency and better range of reportable consequences (P = 0.03). Power chair users reportable a better range of repairs and consequences than did manual chair users (P G 0.001). Wheelchairs equipped with seat functions were related to a bigger frequency of adverse consequences (P = 0.01). Repairs did not vary across funding supply, however people with wheelchairs provided by Medicare and Medicaid reportable a better frequency of consequences than did the combined cluster of the Department of rehabilitation, Worker's Compensation, and therefore the Veterans Administration (P = 0.034 and P = 0.013, respectively).(Am J Phys Med Rehabil. 2012 Jun; 91(6): 463–469.)

The cost of a manual chair may depend on the user condition and daily personal

needs. Some users need more features than conventional chairs provide, this is a point where researcher must add additional features or think about buying a different type of wheelchair. A low price point for a chair means that the quality and weight of the chair will suffer. Low priced wheelchairs are usually heavier and do not last as long as higher end chairs. Medium price points for a wheelchair are defined in the mid to high hundreds ($300-$600). These types of wheelchairs are usually of higher quality and price than low level priced chairs. This type of chair is usually lighter in weight than conventional chairs and may have more features than cheaper wheelchairs. The cost of a manual wheelchair is a factor when looking around for a wheelchair. Understandably, some potential users in such a developing country will factor in the price of a chair before thinking about anything else.

The manual wheelchair are makes it difficult to users to roll over grass, mud, rocks and even lightly packed sand. Even it cannot eliminate inflates and cannot absorb shock. The back tires are given the puncture resistant to user by not allowing to travel over rough ground, perfect for off road adventures.

1.2 STATEMENT OF PURPOSE

To design a moving mechanism to use in all-terrain wheelchair by using a lever four-bar structure.

1.3 SCOPE OF STUDY

i. To study the mechanism involved in All-terrain Wheelchair.

ii. To design an all-terrain wheelchair to use in rural area,

iii. To design a cost-effective wheelchair for rural area residential.

iv. To design a wheelchair that easy to maintain.

CHAPTER 2

LITERATURE REVIEW

2.0 TYPE OF WHEELCHAIR

There are many types of wheelchairs available in the market like manual or powered wheelchair and the choice of wheelchair depends upon the physical and mental ability of the user. General types of wheelchairs are,

I. All terrain wheelchair

Figure 2.1: All terrain wheel chair (Source: Numotion, 2018)

One of the foremost uncommon kinds of power wheelchairs, these are niche merchandise, however, well value a mention. All terrain features large inflated tires and generally tank tracks with deep treads that modify them to travel over regarding any tract. Several models are additional like quality scooters than wheelchairs, however they are doing build all-terrain wheelchairs in additional ancient forms moreover, together with manual models. They are excellent for the soul World Health Organization has lost quality,

however not a way of adventure.

II. Manual Wheelchairs

Figure 2.2: Manual wheel chair (Source: Numotion, 2018)

`These are what most typically seen in hospitals and nursing homes, they are the foremost economical alternative for many folks. Having that, of all the kinds of wheelchairs for aged, there are available; this is often in all probability a sub-optimal alternative as a result of several older folks lack the higher body strength to propel themselves, requiring Associate in nursing assistant to urge them wherever they require to travel.

III. Electric Wheelchairs

Figure 2.3: Electric wheelchair (Source: Gov.uk. 2018)

Electric wheelchairs are way and away the foremost fashionable selection as a result of, as permitted to those who use them larger flexibility of quality while not having to have confidence a nurse or different assistant, except maybe for moving into the chair. However, once in position, even individuals with serious quality problems will get around quite simply. These are one in every of the simplest kinds of wheelchairs for encephalopathy sufferers, and folks with similar mobility- restricting conditions. They're considerably dearer than their manual counterparts however well worth the additional expense. These also can have multiple variations, just like the folding electrical wheelchair, furthermore, as be bespoke and tailored to desires.

2.1 TYPE OF MECHANISM FOR ALL TERRAIN WHEELCHAIR

As for the time being, there is a lot of innovation that has been create and has been invented through the design of mechanism study. There are a few findings about mechanism which has been used to wheelchair which is gear and chain mechanism, clutch mechanism and four bar mechanism.

I. Gear and Chain Mechanism

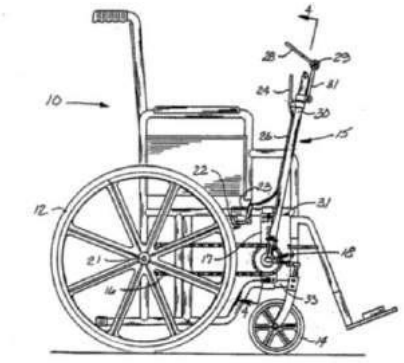

Figure 2.4: Gear and chain mechanism (Source: Theory, M., 2018)

A bicycle type multi linked gear and chain connects the ratchet to the rear driving wheels of the chair. Movement of the push rod in its vertical position changes gears and a handle attached to the top of the push rod assembly permits movement of the chair by direct drive to the bicycle chain. A linkage connecting the push rod housing to the front mounted caster wheel allows the patient to move the caster wheels by turning the push rod handle connected to its housing.

II. Clutch Mechanisms

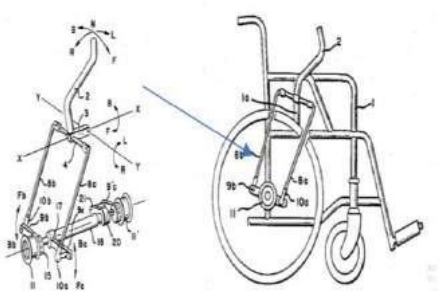

Figure 2.5: Clutch mechanism (Source: Theory, M., 2018)

A lever-operating type wheelchair includes a differential link mechanism connected to an operational lever, a pair of forward/backward clutch mechanisms driven to interlock with the link system, and an expansion joint mechanism provided between the link mechanism and one of the clutch mechanisms. The lever-operated type wheelchair of this invention has better operational capability in use for one-handed operation due to a fulcrum and a knob of the operational lever arranged so as to make the operation thereof easier.

III. Lever four-bar Mechanism

Figure 2.6: Lever-four bar mechanism (Source: Kickstarter., 2018)

A folding wheel chair with swing-able chassis and leg rests driven by the inhabitant with the assistance of a lever system is disclosed. The system consists of the tunable handle that with the, coupling and also the chain drive turns the steering wheel mounted within the tunable fork.

Throughout driving, it's enough to steer one wheel solely, since the opposite follows mechanically. The swing-able leg rest consists of the arm swinging within the suspension which has a pivot. To the arm, there's connected the bar in conjunction with the swing-able section. By releasing the section from the pin, the pull of the spring is discharged, the bar falls by its own burden and is engaged by its slot with the pin on the arm, and also the arm is connected firmly with the arm and starts to form a swinging movement.

2.2 ANALYSIS AND SYNTHESIS MECHANISM

The design of mechanisms has two aspects, analysis and synthesis of mechanisms. Analysis mechanism is consisted of techniques of determining the positions, velocities and accelerations of certain points on the members of mechanisms. The angular positions,

velocities and accelerations of the members of mechanisms are also determined during analysis of mechanisms. By analysis of mechanisms the trajectory of particular points and the orientation of the members at particular points of time are obtained. (L. Roy, 2008)

Meanwhile, the synthesis of mechanism is the desired set of positions/angular positions, velocities/angular velocities and acceleration/angular acceleration at definite points of time are stipulated. Then the synthesis of mechanisms comprises of mathematically determining the geometry of members of mechanisms such as to produce the desired results. When that mechanism is operated it will pass through the stipulated points with the required velocity and acceleration, and the members will have the desired orientation.

Synthesis of mechanisms as per the requirement can be achieved through two ways. First, Rational Synthesis, which consists of standard synthesis techniques developed by "Kineticists". Being systematic these techniques can be automated using computer programs. Limitation of rational synthesis technique is that it is applicable only to some specific types of mechanisms. Second technique commonly used by design engineers is Informal Synthesis. This design procedure involves first a guess of dimensions of members of mechanisms and then checking the resultant performance by analysis. The dimensions are modified based on previous performance and adjusted such that to obtain results close to desired. In this way the process of iterative synthesis and analysis is repeated to obtain acceptable design. (Arun K. Natesan,1994)

After conduction an intensive literature review, it was found that all-terrain wheelchairs which is using leverage mechanisms can be categorized into two types, which is using chain and gear or using Four-lever bar mechanism. However, there is still a long way to go for Four-Lever bar mechanism because this mechanism is quite new for this field.