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BACK CLIMBING WHEELCHAIR FOR PHYSICALLY HANDICAPPED

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Abstract:

The design and analysis of an affordable automatic step climbing wheel-chair for physically disabled is presented. The motivation is to cater the needs of disabled people who are at economically disadvantage position. Global statistics of the disabled persons report shows that the number of disabled people is increasing with the increase in world population. It may be noted that the electrically operating lifts are not common in two or three store buildings. Therefore, step climbing wheel-chair can make life easy for disabled people in terms of accessing any location in a building without help of others. Advanced wheel-chairs that are available in the market are having high cost, i.e., approximately ten lakh rupees. So in this thesis a cost effective automatic wheel-chair is designed which can be made available for the masses. It helps physically disabled and elderly people to move across stair cases easily. Electric-powered wheelchairs with stairclimbing ability have attracted great attention in the pasttwo decades. By using the developed electric-poweredwheelchairs with stair-climbing, many patients with walking difficulties are able to descend the stairs conveniently to participate in outdoor activities, which are beneficial to both their physical rehabilitation and mental health. The development history is reviewed and wheelchairs with stair-climbing are compared based on a control method, cost of manufacturing and adaption to different stairs. There are many models available in market but the cost is major factor due to which it cannot be used commonly by hospitals and differently abled person. Thus, the aim is to reduce the cost of the wheelchair without compromising the quality. The main factor which will reduce the cost is partial automation of chair. Most of the wheelchair which are available in a market have automatic controlwhilemoving on ground as well as while climbing on staircase. We are using automated drive only during climbing the stairs and the operation of wheelchair on ground is manual.

1. 1.INTRODUCTION

Over a few decades there is no great change in the availability of sophisticated wheelchairs to the common people. The economic or below economic classes of India are suffering with the exorbitant prices for sophisticated or the reliable models of wheelchairs. The basic issue, which is found these days is the inability of the wheelchairs to pass through different terrains. Furthermore, the common wheelchairs are not manufactured with purposes of climbing the stairs. The evolution of wheelchair has been governed by a notion of comforting diversified users and their accessibility. Many numbers of organizations have ventured into the transmissible systems. The drawbacks for such insolvencies are complexity in building theSystems, less standard buildings and uncertain problems those which are faced by a wheelchair user. To deal with all such aspects the deep study of pre-existing models and their disadvantages have been studied. Extensive literature survey is carried out to study the pre-existing models of different types, it is observed that, Intermittent stair-climbing wheelchair models, developed, by various organisations have been searched and their limitations are found to be low transmission efficiency with difficulty in balancing. Auxiliary stair-climbing wheelchair models have huge occupancies and requirement of human assistance as limitations. The study carried out over tracked mechanism shows that there are slight issues such as exertion of pressure on the heads of stairs. Out of the three major mechanisms tracked mechanism is most adaptable mechanism for stair climbing and all terrain wheelchairs. Hence in the present paper wheelchairs is developed with tracked mechanism, with following objectives: To furnish an efficient, rugged and economical mechanism. Implement ergonomic aspects of the wheelchair user. Material identification and concluding over the shape of the structural unit member. Designing the wheelchair with respect to adapted mechanism. Theoretical analysis on dynamic aspects of the wheelchair.

Development of stair climbing and all terrain wheelchair:
The development proposed for all terrain wheelchair is initially carried out with a conceptual solid model using solid modeling software. Conceptual model is further modified considering the dynamic stability of tracked mechanism for all-terrain wheelchair. Elaborate analysis is carried out, considering the following.
1. Most importantly, the tracked mechanism not only helps in climbing stairs, but also most suitable for all the different terrains.
2. The mechanism must maintain the stability while climbing any gradient.
3. Climbing stairs comfortably without any possibility of toppling.

OVERVIEW:

Day to day the patients with disabilities go on increasing, nearly 15% of the world population are disabled according to "the globally disabled report". The physically disabled people have less living space and the life is seriously affected and faces difficulty problems with their family. Stair-climbing wheelchair plays an important role in the life of disabled people. The society nowadays concentrating on physical disabled and old people developing and constructing elevators, but it is not possible everywhere we go. The disabled people feel difficult to travel from one place to another due to inconvenient for them by using an ordinary wheelchair even though they have help from others. So most of the times the physically disabled people will remain in homes due to lack of facilities like elevators and uneven roads. Due to the above activities, it may influence their physiology and psychology. Limb disability is one of the disabilities which are caused due to various reasons such as deformation by birth, war, disorders such as diabetes. Lower limb of sports person also suffers huge blows while playing and are always at the risk of suffering severe injuries. These injures sometimes may be a permanent disability. The invention of wheelchair is one of the contributions for such physically challenged people. It is a boon for them. Since from the

day chair was fabricated, it has been continuously improving to raise its comfort level and with as many features as possible. We have come upon many sorts of wheelchairs with completely different shapes, sizes, mechanisms, sources, materials etc. For many individuals, associate acceptable, well-designed and well fitted chair may be the primary step towards inclusion and participation in society. Though the wheelchair is helping the physically challenged & disabled people for their mobility, it is not equivalent to the motion by normal people. They can't run, jump and reach all places where ever they wish to go. These suppress the mental level of these individuals and that they begin feeling themselves as „burden" to others. To overcome this psychological depression, the comfort level ought to be raised up to the „peak", where they can do all those things that a normal man can do. This is the responsibility of the engineers. We have the responsibility of satisfying the needs of people. When the need is not met, people with disabilities are isolated and do not have access to the same opportunities as others within their own communities. Providing wheelchairs that are fit I'm not solely enhances quality however begins a method of gap up a world of education, work and social life. So this can be our tiny step or plan to reach that „peak". We want that this work can become a contribution for the society serving to sizable amount of disabled. Keeping all the on top of things in mind, focusing the doable enhancements in wheelchairs, we got an idea of a stair climbing wheelchair.

2. LITERATURE SURVEY

After conducting an intensive literature review, it was found that wheelchairs with stair climbing capacities can be categorized into two types; the battery powered and the manual powered. Although there are plenty of powered wheelchairs available in the market place, there are limited scholarly reviews published on manual or battery powered wheelchairs. Instead, patent certificates, wheelchair descriptions, and operation manuals are available. Indeed, no peer reviewed literature was found for manual wheelchairs. Some researchers have built scale models or full size prototypes of their designs but little documentation has been published on this type of wheelchairs.

In 1962, Ernesto Blanco, while working at Massachusetts Institute of Technology (MIT), designed a self-propelled stair-climbing wheelchair, but a full scale prototype was never built. However, a small model of Blanco's design was built to showcase how his wheelchair would perform rolling in flat ground as well as how it would climb and descend stairs. Although no peer reviewed literature was published on Blanco's wheelchair, the mechanism can be examined from the description given in MIT's website and picture of the model.

The spokes that extend outward away from the drive wheels are loaded with springs. The spokes are spaced in such a way that, as the wheelchair rolls on flat terrain; they are completely compressed inward, allowing the wheelchair to roll entirely on its drive wheels. While climbing or descending a staircase, the spokes project outward away from the drive wheels to engage the top edges of the steps. The contact points act as pivot points and allow the user to climb or descend softly. As the drive wheels roll on top of the spokes, these are compressed inward allowing the drive wheels to rest on the top flat surface of the step. Not much else can accurately be said of Blanco's wheelchair as no other literature was found.

A second manual stair-climbing wheelchair found through an internet search is Vardaan. Figure 2 is a wheelchair designed by a group of four engineering students at the Indian Institute of Technology (IIT). Vardaan is capable of climbing a wing of stairs by pulling on handle bars connected to sets of "Y" shaped wheels. The power arms are connected to ratchets and braking systems making a safe and stable climb and descend. As with the previous wheelchairs, there exists very little published documentation that further explains how Vardaan climbs. Lola Nayar describes the project and its innovative climbing procedure conducted by Shanu Sharma, and mentored by Prof. Kanpur. Currently, the wheelchair designed by Shanu Sharma has been approved by the IIT science and technology departments for further research and possible mass production. The wheel frame is designed to hold the tri -wheels comfortable on each side of the shaft. The wheel frame, first it is made of straight wheel frame and became more complicated while climbing so it is modified to quasiplanetary wheel frame to create more frictional force and provide smooth power transmission for climbing stairs. This quasi-planetary wheel frame is suitable to transmit exact velocity ratio. The wheel frame setup is designed to provide higher efficiency. The maintenance is less because of simple design parts and failure occurs in the bolt, washer, nuts, etc.

3. PROPOSED METHODOLOGY

The standing posture model is available but, it is not automated and hence needs man power to operate it. Patients involved in physical injuries and disabilities with good mental strength struggle to get through places using the conventional hand powered wheelchair. The proposed project enables an economic assembly in any existing wheelchair that enables a smart system for automated motion which can be controlled by any Smartphone, which in turn reduces the need of man power. In the existing systems this prospect is not met. The conventional manual wheelchair is not always useful as it is not powered and does not meet the necessary need to shift to different positions. Even after the evolution of powered wheelchairs the systems with voice recognition defy proper use because of voice traffic. Voice traffic is a major disadvantage of these existing systems.

The proposed system has major components like ARDUINO microcontroller, two DC motors relay motor driver circuit, crystal oscillator, LCD display and power supply as shown in Fig-1. The programmed microcontroller produces PWM signals. The PWM signals drive the two DC motors and moves the wheel chair with the help of relay circuit. Embedded C is used for programming the microcontroller. The controller is interfaced with DC motors through relay circuits. It is capable of communicating with both input and output modules.

This system operated with taking head movement as input signal to control the motion of wheel chair in any direction. The variations produced by the remotely according to requirement are trapped and fed as input to the microcontroller. The microcontroller takes decision based on the inputs provided and controls the wheel chair. The decisions made by microcontroller

4. EXPERIMENTAL ANALYSIS

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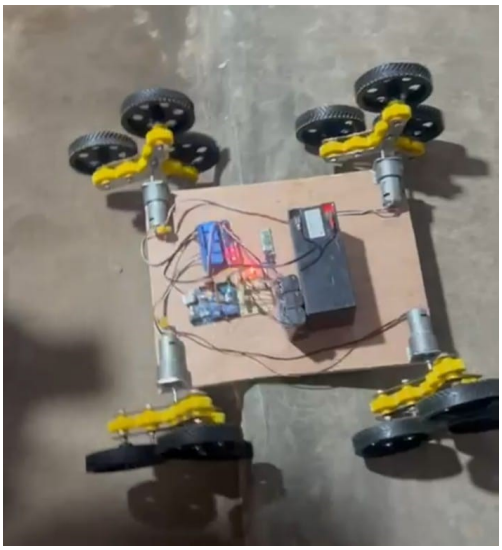


The working of the proximity sensor is in the chair that if any obstacle or any unwanted thing comes suddenly in front of the wheelchair, then it will sense that and then our chair will stop at that place only using braking system implemented in it, and it will give beep sound using buzzer also. The chair will not take that movement until the object is clear from there, but it will take all other movements other than that. Other work of buzzer is that, when user switches on the circuit then it will make to user that the circuit is on by its beep sound.

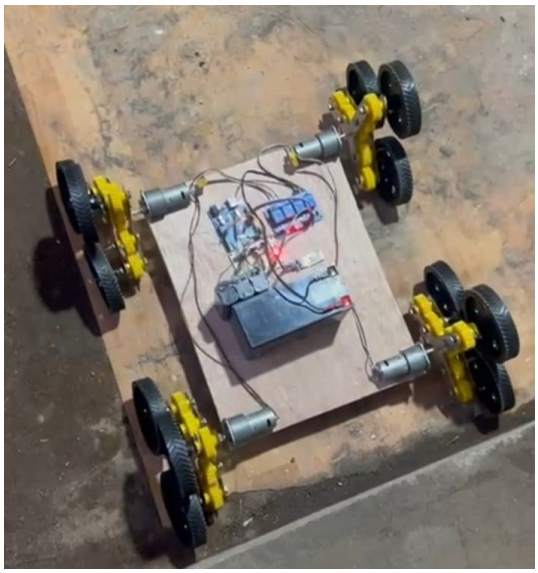
ADVANTAGES:

1. Accessibility to Difficult Areas
Can climb vertical or inclined surfaces where humans or wheeled robots cannot reach.
Useful for inspecting skyscrapers, bridges, tunnels, and industrial structures.
2. Safety Enhancement
Reduces the need for human workers to climb dangerous heights.
Minimizes the risk of falls and accidents in hazardous environments.
3. Versatility in Applications
Can be used in industries like oil & gas, construction, and power plants for maintenance.
Suitable for disaster response, such as inspecting collapsed buildings.
4. Improved Efficiency
Automates inspection and maintenance tasks, reducing time and labour costs.
Can work continuously without fatigue, unlike human workers.

5. Advanced Mobility & Adaptability

Some designs feature magnetic, suction, or bio-inspired gripping mechanisms to adhere to surfaces.
Can navigate complex surfaces, including pipes, beams, and rough textures.
6. Data Collection & Monitoring
Equipped with cameras, sensors, and AI for real-time inspection and analysis.
Helps in detecting cracks, corrosion, leaks, and structural weaknesses.
7. Remote Operation
Can be controlled remotely, making it suitable for hazardous or high-radiation environments.

1. The wheelchair is ergonomically sound.
2. It is user friendly and cost effective.
3. One can take wheelchair from one place to another place without dismantling the circuits.
4. If user is unable to operate the wheelchair, in that case his/her companion can operate it within a certain range.
5. Aesthetically the design of the original Wheelchair is not changed, so that the user can use it manually also.



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5. CONCLUSION

The wheelchair will provide more mobility in future and it will make people familiar with the machine. We can further improve wheelchair by making it with high accuracy. The safety measures can be included into the wheelchair like implementation of high-power sensor like Ultrasonic sensor for object detection. Artificial Intelligence can also be included to make wheelchair more technically advance.

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