Asian Journal of Applied Science and Technology (AJAST)
Volume 1, Issue 3, Pages 23-26, April 2017

Arduino Based Smart Staircase Climbing Wheelchair

R.Rajalakshmi[1] and G.Premalatha[2]

[1]*UG Scholar, Department of Electronics and Communication Engineering, IFET College of Engineering, India. Email: rajiravichandran.95@gmail.com*
[2]*Assistant Professor, Department of Electronics and Communication Engineering, IFET College of Engineering, India. Email: pgsmartprem@gmail.com*

Article Received: 21 March 2017 *Article Accepted: 30 March 2017* *Article Published: 02 April 2017*

ABSTRACT

In this project describes the designing of staircase climbing wheelchair. Generally, the physically disabled people and paralyzed patients are to face a more difficulties do their daily activities. In this project is applicable for an ascend or descend the staircase climbing wheelchair locomotion. In this system is used to control the movement of manual operated wheelchair by means of joystick control system. The climbing wheelchair depends on the motor control and drive system, which consists of arguing microcontroller and low speed AC motor (120 rpm).

Keywords: Wheelchair, Staircase climbing system, Disable, Locomotion and Ascend.

1. INTRODUCTION

The main goal of this smart staircase climbing wheelchair project is reduce the cost of powered wheelchair and locomotion of staircase by using of middle class people. The population of people with increase disabilities has significantly during the previous century. As the data come from the National Health Interview Survey (NHIS), two distinct developments have contributed to the increasing generally predominance of disability.as well as rapid increase that is due to health deficiencies and accidents. Persons that are more individual have problem to use a conventional wheelchair.

A current clinical appraisal indicates that 9%-10% of patients who received power wheelchair training found it extremely difficult to use for their activities of daily life style .40% of patients found the maneuvering, directional and steering tasks difficult or impossible. Generally, the physically challenged people and paralyzed patients do their daily activities on wheelchairs. The disabled persons are to face a more difficulties, when they have to locomotion of ascend or descend the staircase. For example, to enter or exit erections, that have no slopes, go up and down in erections that have no lifts or pedestrian bridges, in these state of affairs, several helpers are necessary to carry a disabled person and their wheelchair. This leads to a possibility of injury for both the disabled persons and the helpers. This project was aimed to enhance the quality of life provides for the disabled people by supporting the wheelchair to climbing the staircase.

To reduce number of helpers to carried the wheelchair only one person to handle the wheelchair. This system is used to control the locomotion of a manual operated wheelchair by means of joystick control system wheelchair depends on the motor control and drive system, which consists of arduino microcontroller and low speed AC motor (120 rpm). The motion controller developed uses PWM (pulse wave modulation) technology [1], using a kinematic simulation in Adams. Resolution for a stair-climbing wheelchair that can climb single steps or entire staircase, wheelchair structure is a three-wheel locomotion unit; epicycloid transmission [2].5 spokes wheels was used for climbing system contained of 2 5-spokes wheels and the slot plates [3]. The hybrid leg-wheel resolution is another one type of locomotion that uses two dissimilar devices for moving in multifaceted environments [4], [5], [6] and [7].

To support mobility of disabled persons, some electrical powered wheelchairs are available on the market [8], [9], [10] and [11]. The wheelchair's control module converts positional information from the joystick into power signals to the motors. Control modules are microprocessor based and have many adjustable parameters. The control systems to adjust motor torque so as to sustain near constant speed while the load varies in response to changes in the terrain (slant, bumps) and surface (linoleum, flooring, material, grass, sand) [12],[13] and [14].

2. PROPOSED DESIGN& METHOD OF PROJECT

In this project, the prototype of 5-spokes using staircase climbing wheelchair was design to attach genial unfoldable wheelchair. The main advantage of the wheelchair is more convenient, and reduced more vibration occurs. Any other size wheelchair could apply it because, it consist of a large support base. Why, because selected for a 5-spokes wheel. It was lighter and easier to maintain than a caterpillar track. The spokes wheel was design to climb the stair that had the maximum raiser height of 200mm and minimum tread depth of 220mm .Shows in figure.1

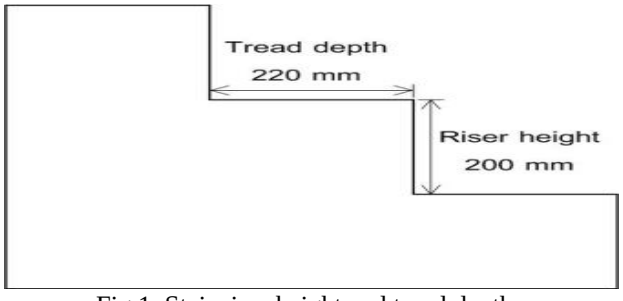

Fig.1. Stair riser height and tread depth

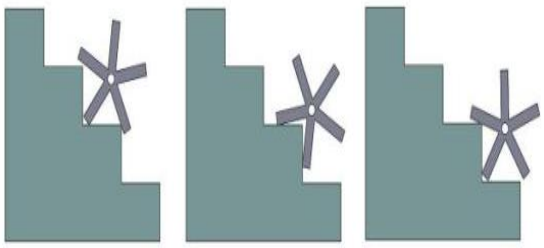

Fig.2. Motion of spoke wheels

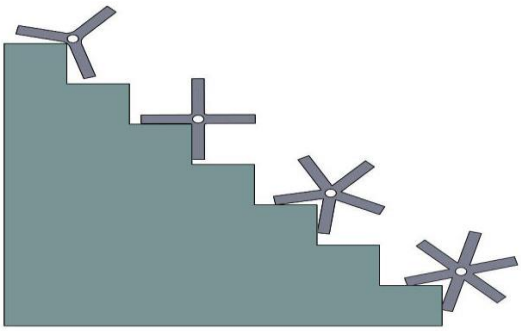

Fig.3. Comparison for number of wheel spokes

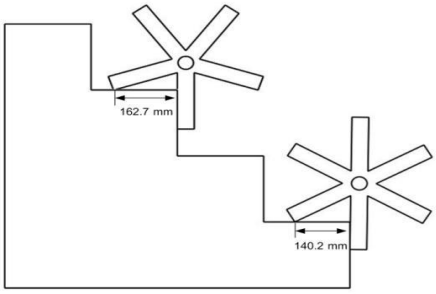

Fig.4. Comparison of contact depth

From figure 2, for the staircase climbing wheelchair increased when number of spokes increased. However, more number of spokes will increase the weight of the wheel. IN figure 4, the 3-spokes and 4-spokes wheels had the possibility of strikes the staircase, while 5-spokes and 6-spokes had no possibility. Thus, the 3-spokes and 4-spokes wheels are not appropriate for the stair-climbing system. Figure.4 that could be observed that the 5-spokes wheel was more stable than 6-spokes wheels because, the 5-spokes wheel had a longer tread depth and riser height higher than the 6-spokes wheel. Therefore, 5-spokeswheel was the most appropriate for the staircase climbing system. The 5-spokes are inclined to each other 72%. In this project, describe a new mechanism that is able to climbing stairs. This mechanism has been designed to enforce mechanical stability while wheelchair on the staircase

This type of wheelchair is also transferred the weight at all times to horizontal surface, and it is making unnecessary to rely on friction to ensure safety. This is one of the main property makes the wheelchair extremely safe and secure. The wheelchair locomotion on the staircase is more convenient. While; it had a large support base. The most important feature of that is more convenient and comfort to feel disabled person .to reduce a vibration locomotion of staircase, the structures rigid and light, flexible. The design solution of the staircase-climbing wheelchair is developer by in solid works, based on wheelchair dynamic calculation and parameters are established the necessary torque and speed of gear motor.

3. BLOCK DIAGRAM

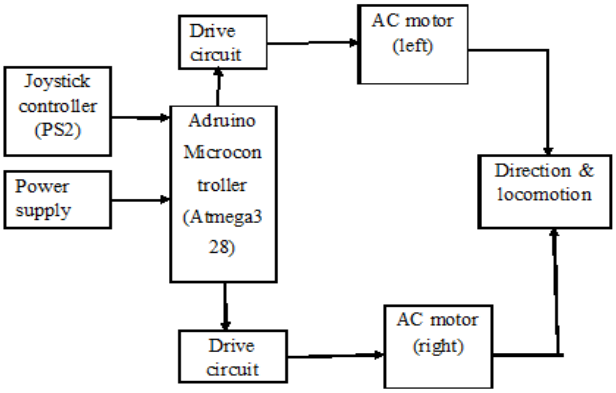

Fig.5. Block diagram

A joystick is an input device, consisting of a stick that pivots on a base and reports its angle direction to the device to move the forward, backward direction and right and left. AC motor is specific type of electric motor that is design to produce high torque while maintaining a low horsepower or low speed motor output. Finally, it provides the locomotion of wheelchair direction.

4. COMPONENTS AND MATERIALS

4.1 Arduino Microcontroller: The microcontroller based on Arduino/Genuino UNO ATmega328.It has 14 digital input/output pins(of which 6 can be used as PWM output),6 analog inputs, a 16 MHZ quartz crystal, a USB connection, a power jack an ICSP header and a reset button. Figure 6.

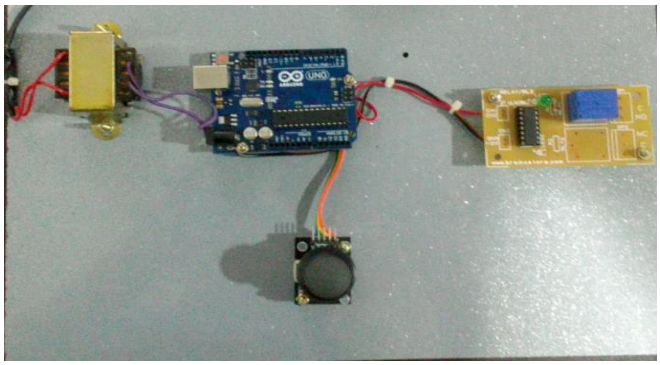

Fig.6. Interface Circuit of Joystick

4.2 Joystick Controller: A joystick is an input device consisting of a stick that pivots on a base and reports its angle or direction to the device it is controlling. A joystick also known as the control column. It is used the principle of control device in the cockpit of many civilian and military aircrafts either as a center stick or side stick .Figure.6

4.3 AC Motor (120 rpm): It is a specific type of electrical motor that is designed to produce high torque while maintaining a low horsepower, or low speed motor output. They reduce speed in a series of gear and in turn create more

torque. Therefore, it is space saving, reliable and durable, consumes low energy and has small vibrations.

4.4 Spokes Wheels: spokes wheels are made by nylon .nylon wheels are widely used in any industry; it is strong, durable and keenly priced. The nylon wheels size are 50mm thus the load capacities from 70kg. A pulley is a wheel on an axle or shaft that is design to support movement and change of direction of a taut cable, rope or belt along its circumference. Pulleys are using in a variety of ways to lift loads, apply forces, and to transmit power. In nautical contexts, the assembly of wheel, axle, and supporting shell is referred to as a "block. "Gallium ionic material is used to design a shaft (2inch).The distance between two spokes wheel is 2 feet.

4.5 Power Supply Unit

1. Transformer – step down high voltage AC mains to low voltage AC.
2. Rectifier – converts AC to DC, but the DC output is varying.
3. Smoothing – smooth the DC from varying greatly to a small ripple
4. Regulator – eliminates ripple by setting DC output to a fixed voltage.

Fig.7. Spokes wheel design

5. WORKING PRINCIPLE

In this design, AC motor is connected to belt dive pulley mechanism. Through this belt drive the rear wheel start to rotate. The dc motor controlled by joystick. There are three position in joystick to move forward, backward and remain neutral. While neutral there is no power connection to AC motor. When in forward position battery power is connected to motor, hence it move forward. When it is in backward position terminals are reversed make the motor to rotate reverse direction.

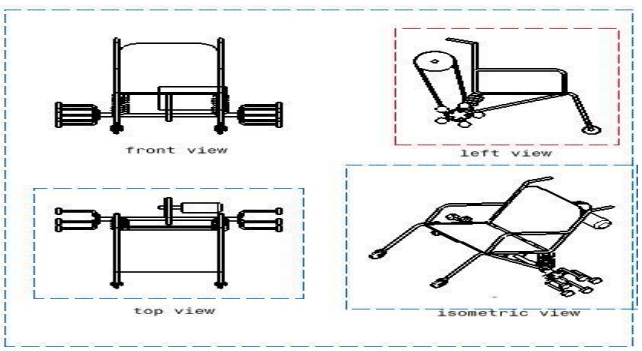

Fig.8. Views of wheelchair

6. RESULT

The stair-climbing system was tested with the building stairs and pedestrian bridge stair. The size of the stair was (riser height 150mm, tread depth 450mm). the pay load tested was from 50 to 70kg .The motor did not have enough torque to drive the 5-spokes wheels for ascending the stairs. However, it still could descend the stairs. A moving of the stair-climbing system on the floor was also tested. The test was conducted with and without an assistant. When the payload was over 75kg, the rear wheels could not be rotated. This was due to the alignment of the rear wheels changed.

7. CONCLUSION

In this project, the prototype of a stair-climbing system for a wheelchair was designed based on simplicity and easy maintenance. The 5-spokes wheels were used for the stair-climbing system. From the results, the system could ascend and descend the stairs with the maximum riser height of 200 mm. Only one assistant was required to control the wheelchair. It could also move on the floor as a general wheelchair. The maximum payload was 70kg. The sliding of the rear wheels of the wheelchair will be improved to enable the assistant to slide both rear wheels simultaneously. This will reduce the time required for sliding the rear wheels.

Fig.9. Wheelchair setup

REFERENCES

[1] Ionut danielgeonea, Nicolae Dumitru, Alexandru Margine, "Motion study of a wheelchair prototype for disabled people". May 2015.

[2] G.Quaglia, W.Franco, M.Nisi, "Evoluation of wheelchair.q,a stair-climbing wheelchair", Oct.2015.

[3] Ekachi Chaichanasiri, Teerapol Puangumpan, "A prototype of a stair-climbing for a wheelchair", *The second TSME International Conference on Mechanical Engineering*, Oct.2011.

[4] Morales R, Feliu, Gonzalez A, "Coordinated Motion of a new staircase climbing wheelchair with increased passenger comfort", *International Conference on Intelligent Robotics and Automotion*,2006.

[5] Sugahara Y, Yonezawa N and Kosuge K, "A Novel stair-climbing wheelchair with transformable wheeled

four-bar linkages", *International Conference on Robots and Systems*, 2010.

[6] Murry J. Lawn, Ishimatsu T, "Modeling of a stair-climbing wheelchair mechanism with high single-step capability" *Transactions on neural system and rehabilitation engineering*, 2003.

[7] Yuan J and Hirose S., "Research on leg-wheel hybrid stir-climbing robot, Zero carrier", *International Conference on Robotics and Biomimetics*, Shenyag, 2004.

[8] Gonzalez-Rodrigue Antonio, "Mechanical synthesis for Easy and Fast Operation in climbing and Walking Robots, climbing and walking Robots", *Intech Viena*, 2010.

[9] Gurpude R., "Design, Synthesis & simulation of Four Bar Mechanism for guiding wheel for climbing*", International Journal of Engineering Research and Applications*, 2012.

[10] Hassan Abdulkadir, "Design and Fabrication of a Motorized prototype Tricycle for the Disable persons", *IOSR Journal of Engineering*, May 2012.

[11] Kumar Vijay, "Assistive Devices for people with Motor Disabilities", Wiley Encyclopedia of Electrical and Electronics Engineering. *Assistive Devices for people with Motor Disabilities*, 1997.

[12] Modak G.S, "Evolution of a stair-climbing power wheelchair", *ISOR Journal of Mechanical and Civil Engineering*, 2009.

[13] Shanu Sharma, "User Centric Designed Mechanism For stairs-climbing Wheelchair", *15th National Conference on Machines and Mechanisms NaC0MM*, 2011.

[14] Rajasekar R., "Design and fabrication of staircase climbing wheelchair", *Int. J. Mech. Eng. & Rob. Res.*, 2013.

AUTHOR BIOGRAPHIES

R.Rajalakshmi is pursuing her Bachelor of Engineering in the stream of Electronics and Communication Engineering at IFET College of Engineering, Villupuram, Tamilnadu, India. Her areas of interest are Microprocessor and Microcontroller, Computer Networks.