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Design and manufacturing of a Human Essential Need biped Robot Skater

Ananda Mohan Vemula[1]
Associate Professor
Mechanical Engineering Department
Guru Nanak Institutions Technical Campus
Ibrahimpatnam, Hyderabad, Telangana State, India

T.V Seshi Reddy[2]
Assistant Professor
Mechanical Engineering Department,
Guru Nanak Institutions Technical Campus
Ibrahimpatnam, Hyderabad, Telangana State, India

Dr. P. Manoj Kumar[3]
Professor
Mechanical Engineering Department
Guru Nanak Institutions Technical Campus
Ibrahimpatnam, Hyderabad, Telangana State, India

Prof. R. V. Prasad[4]
Professor
Mechanical Engineering Department
Methodist College of engineering and Technology
Abids, Hyderabad, Telangana State, India

Abstract: The concept of this article is presenting of design and construction of a biped robot based on walking. The main objective of this project is of technology in the field of walking robots; therefore, the reason for performing this project is to have a starting point in the development of bipedal robots and human prostheses. The robot was built under a mechatronic approach, i.e. with a relationship between the mechanical, electronics and programming constituent parts. The prototype performs walking to the locomotion of humans. It was concluded that these technologies could be used for the design, simulation and construction of biped robots.

Index Terms: biped, human prostheses, locomotion, simulation, and hen.

I. INTRODUCTION

The main aim of this article is to design and fabrication a biped skater with which a paralyzed person can do daily activities like a normal individual. The biped skater can be operated through different inputs i.e., through voice commands of the user and through control buttons. This project makes use of a control buttons system to operation given by the user for the movements. In addition, we use limit switches which gives the input of the maximum extent the biped skater could be moved. This biped skater is designed by high rated efficient DC Motors, which are driven by DC Motor driver. The led movement can also be done in angle wise through servomotor. The project makes use of a microcontroller, which acts as a central controlling unit. This module is capable of communicating with the input and the output modules. The motors used for controlling the direction of the biped skater form the output module. The input and output modules of this project are, Control Buttons, motor drive, a microcontroller, DC motors for the biped skater. [2]

II. PROCESS FLOWCHART DESCRIPTION:

At the first step of the flow chart, biped skater is connected high torque Dc motor and the dc motor is connect to batteries because of power supply to dc Motors. This process is quite significant because the motors worked at same power the otherwise the disturbance occurs due lack of power. The power is maintain to Five Dc motor is 1.16 mW. If dc motor is not worked then it goes to check microcontroller.

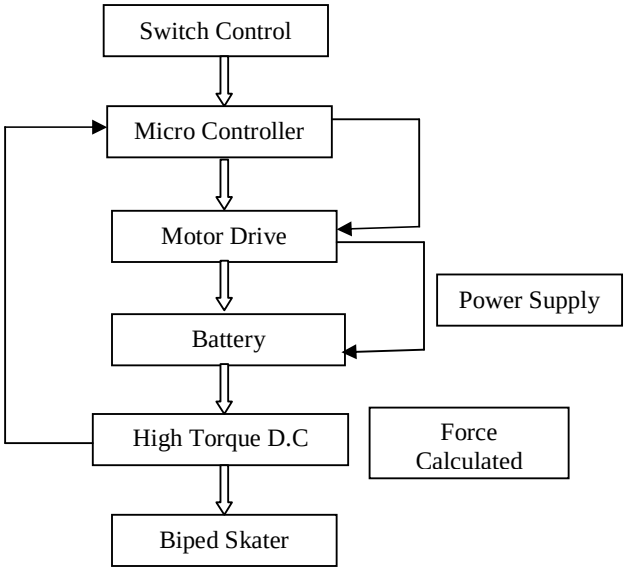

Fig 2.1 Flow chart of a biped skater

III.

WORKING PRINCIPLE:
The minimum number of wheels required for static stability is two. These are some special cases; under normal circumstances a wheeled robot needs at least three wheels with ground contact to achieve static stability, additionally the centre of gravity has to be completely within the support polygon, formed by the three wheels with ground contact.[1]

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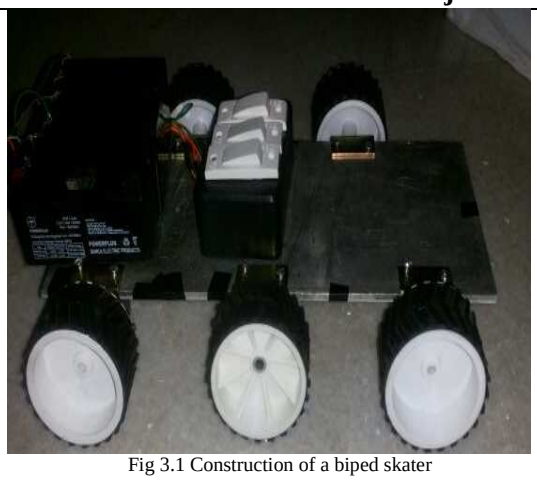
Fig 3.1 Construction of a biped skater

Maneuverability is a very important issue for a wheeled robot to solve its tasks. When a robot is able to move in any direction of the ground plane (x, y) it is omnidirectional. This level of movement requires usually actively powered wheels that can move in more than one direction like spherical wheels. Vehicles using this configuration have usually turning radius which are larger than the vehicle itself, furthermore it is not able to move sideways (that means in axis direction). [1]

The advantage of omnidirectional designs is the high maneuverability of the robot, but this advantage makes it more difficult to control the robot. Driving straight forward means just locking the steerable wheels and driving the motorized wheels.

After these considerations, it can be said that there is in general an inverse correlation between controllability and maneuverability. If the vehicle is easy to control then it is less maneuverable; if it is high, maneuverable, controlling is more difficult. [4]

IV. DESIGN ANALYSIS:

Acceleration in linear direction

Testing torque for motor:

T1 = 9.81 * s * r

= 9.81 * 50 * 0.03

= 14.715 N-m for one motor

Total torque for motor:

T = t1* 5

= 73.575 N-m

Force applied:

Force = torque / distance

= 73.575 / 0.5

= 147.17 N

Force at 1m distance

F= t/d =73.575 N

Force at 1.5 m distance

F=t/d= 49.05 N

The average force = 89.93 N

Acceleration:

F= ma

a= f/m

= 89.93/50

= 1.798 m/s^2

Velocity of total body:

$V^2-u^2=2as$

$V^2-0=2*1.798*1$

=1.715 m/s

The Acceleration of body in inclined direction

Sliding up:

Vertical forces:

R-w cosθ = 0

R=50*9.81*cos 5

= 488.63 N

Horizontal forces:

=147.17-0.2*488.63-(50*9.81*sin5)

F=6.69N

Acceleration

a= f/m

= 6.69/50

=0.1336 m/s^2


source:[2012-12, dizajnérka Paulína, robot Biped]: Skater – bez skateboardu.

Fig: 4.1 The Acceleration of body in upward direction.

Acceleration of body in downwards direction:

Horizontal forces:

R=w cos θ

= 50*9.81*5

=139.136 n

Vertical forces

=147.17-0.2*139.136-(50*9.81*sin5)

F = -92.193N

A = f/m

= -92.192 /50

= -1.82 m/s^2

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source:[2012-12, dizajnérka Paulína, robot Biped]: Skater – bez skateboardu.

Fig: 4.2 The Acceleration of body in downward direction.

V. MANUFACTURING OF THE BIPED SKATER:

The components mainly used for the construction of the desired Biped skater are Aluminum sheet, DC shunt motor, micro controller, battery etc.

Aluminum is a very light metal with a specific weight of 2.7 g/cm^3, about a third that of steel. For example, the use of aluminum in vehicles reduces dead-weight and energy consumption while increasing load capacity. Its strength can be adapted to the application required by modifying the composition of its alloys

Fig: 5.1 Diagram of Al Sheet as used as base.

A dc motor uses electrical energy to produce mechanical energy, very typically through the interaction of magnetic fields and current-carrying conductors. An alternator, generator or dynamo accomplishes the reverse process, producing electrical energy from mechanical energy. Many types of electric motors can be run as generators, and vice versa. The input of a DC motor is current/voltage and its output is torque (speed). [3]

Fig: 5.2 Diagram of DC motor

VI. RESULT

Power supply is a supply of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others. [8]

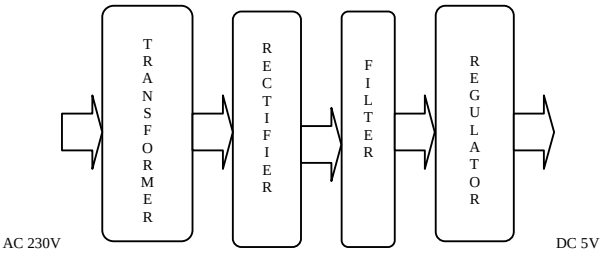

Fig: 5.3 Regulated power supply

Generally, an armature has resistance of less than 1 Ohm, and powering it with heavy voltages of Direct Current could result in immediate short circuits. This back emf helps us there. When an armature is loaded on a DC Shunt Motor, the speed naturally reduces, and therefore the back emf reduces, which allows more armatures current to flow. This results in more armature field, and therefore it results in torque. When a DC Shunt Motor is overloaded, if the armature becomes too slow, the reduction of the back emf could cause the motor to burn due to heavy current flow thru the armature. The poles and armature are excited separately, and parallel, therefore it is called a Shunt Motor. [7]

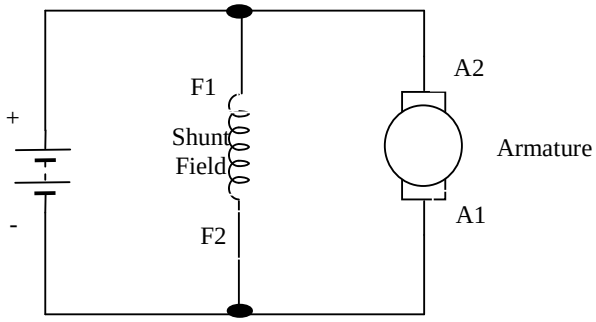

Fig: 5.4 Diagram of DC shunt motor

Fig: 5.5 Micro Controllers

The *HUMAN ESSENTIAL NEED(HEN) BIPED SKATER* has advantage of it will go without support of other and move smoothly in linear direction as well as in inclination plane

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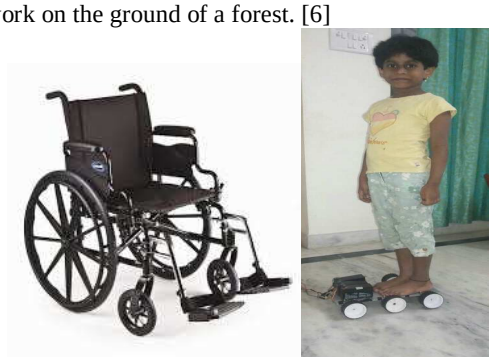
It is implemented from wheel chair that as motor wheels. The wheel chair moves freely in linear direction and but not in inclination plane. It will take support in upward direction.

Finally the analysis part is taken from work energy method in engineering mechanics. When force is acting positive value then it is in upward direction and friction value is negative value then it is in downward direction then both are true. [5]

VII. CONCLUSION

After considering legged and wheeled locomotion in detail, within several different leg and wheel configurations and their advantages and disadvantages, it can be said that there is no superior locomotion mechanism,

Which is the best and the most useable in any situation. When developing a robot it is the designer's task to analyze the terrain in which the robot will travel and what the robot has to do there. According to this analysis the robots locomotion mechanism can be chosen. Due to this the application area of most robots is very specialized. For example a robot which is designed to serve in a hospital wouldn't work on the ground of a forest. [6]



With this technology a paralyzed person who needs help of another person even though sitting in the wheel chair, can be able to do house hold activities without taking another's help by using this HEN biped robot.

Furthermore there is, especially in legged locomotion, a large requirement of research, to make robots faster, more energy efficient, stable and maneuverable. As seen, there are a lot of commercial (like Sony and Honda) and non commercial (like several universities) research labs which spend lots of research energy in this thematic. So it will surely be interesting to consider the developments which are made in the next years.

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