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Six Leg Walking Robot

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***Abstract*: A legged vehicle includes a body, wherein the body includes a major axis corresponding to a primary direction of travel; a plurality of leg mechanisms attached to the body, wherein each leg is attached at its proximal end at one or more discrete attachment points, wherein the attachment points are arranged in-line, one behind the other, with respect to the body, each of the legs including actuators attached between the legs and the body and between adjacent leg members, said legs being actuated for movement of a distal end in three dimensions; a control system in communication with the leg mechanisms to coordinate movements of the leg mechanisms according to approximately single track foot placement, and movement of the legged vehicle in three dimensions over the ground; and a power source connected to and driving the control system components and the plurality of actuators and joints which drive the legs.**

***Keywords*: Robot, Leg Mechanisms**

1. Introduction

The study of our project gives the introduction of a six-legged walking machine with some different kind of leg structure or we can say that with some new leg structure. Walking machines are one kind of robots. This robot is mainly used for the motion and translocation of the legs which is quite easy and simple. The structure design of this kind of robots puts a great contribution to the environment. Walking stability of this robots on complex and nasty non-structure environment is superb. Here, the human activities are need to be replaced by these kind of walking machines. This design shows a valuable way in walking machines and walking mechanism. There are broad applications of these walking devices. The application prospects are wider in many fields such as mountain transport, mineral exploitation and many other military purposes and they can be even used in war and serious conditions like surgical strike where human life is more concerned.

We can achieve locomotion in robots widely using wheels. But as a coin has two sides similarly wheel robots along with many advantages have several disadvantages. Wheel robots have deficiencies in moving in a complex terrain or we can say some kind of rough terrain where we can’t find smooth ways so there arises a problem in the movement or motion of the wheeled robots. Now, here comes the advantages of legged robots. The benefit of the legged robots is that they have discrete contacts with the ground that are good for walking over the obstacles and they are also good for navigating complex terrains. Legged robots can be protected from failure due to mechanical redundancy of legs. The main advantage of wheeled locomotion is the ease with which it can be maneuvered. It is highly efficient and can reach high speed with the help of wheels. But it has some disadvantages, one being that it demands cluttered terrain, which means that more than the 50% of earth’s terrain is inaccessible to the wheel robots. The wheel robots will not be able to move over large vertical steps. The wheel robots can be rectified by increasing the diameter of the wheel. But this may not be possible every time because there are certain factors which limits the change in wheel diameter. In a very extreme case, the wheel may get stuck and the vehicle stops permanently. This kind of things results in the wastage of power. Whereas, the legged locomotion on the other hand does not demand any special terrain. Thus, we can say that the legged robot does not ask for the smooth terrain.

It also causes less damage to the natural terrain as it leaves behind footprints of discrete steps. There are many advantages of legged locomotive robot over wheeled locomotive robots. In legged robots one can step over obstacles and can go up and down on the stairs. Legged locomotive robots can even carry a vehicle over wide chasms or extremely broken ground. One can achieve a smooth ride on rough ground by varying the effective length of its legs to overcome the undulation of the ground. It can work very efficiently on soft grounds where the wheeled locomotive fails. A multi-legged robot possesses tremendous potential for maneuverability over the rough terrain, particularly in comparison to conventional wheeled or tracked mobile robot. A multi-legged robot introduces more flexibility and terrain adaptability at the cost of low speed and increased control complexity in order to develop dynamic model. It is important to have good models describing the kinematic behavior of the complex multi-legged robot.

Different types of walking robots

- *Two-legged walker:* A two-legged walker is, by far, the hardest to create. Since at the point of stride only one foot will be in contact with the ground and the center of gravity must dynamically shift in the order to keep the robot from falling over. It is neither as efficient nor as simple as the wheeled or a tracked vehicle. The potential for crossing more difficult terrain is paramount. An obstruction can merely be stepped over, pass between the legs. However, there is no redundancy in the legs. If one leg fails, the other cannot work at all.

- *Four-legged walker:* A four-legged walker is fairly common. An example of a commercially available quadruped is the Sony Ambo. A quadruped is simple to control than a bipedal robot and so long as only one leg is ever off the ground. No sophisticated balance is required. However, a four-legged robot does not offer any redundancy in the legs. If a leg fails the robot loses the ability to walk.
- *Six-legged walker:* A six-legged walker is very stable. A designer can design a gait that can take three legs off the floor at any one time leaving a stable tripod. A hexapod is very good for complex terrain and along with the quadrupeds it is the most common legged form robot. This form of robot offers excellent stability and redundancy in the mechanisms. The main problem with this six-legged walker is that the extra cost incurred from implementing the additional legs.

A. Six-legged walker design

1) Design of leg

The leg of a walking machine serves to provide a desired working volume, which is the three-dimensional reachable work space of the foot reference point. The second is to carry the weight of the vehicle. Also, interference between links and among legs should be avoided. Considering these three aspects, the design specification of the four-bar leg is determined.

2) Leg strokes

The stroke pitch was selected to be 120mm since the predetermined maximum length of the vehicle was 500mm. Hence, the leg stroke was selected to be 80mm in ordered to avoid any interference between the feet. The vertical stroke is originally used to lift the foot in transfer phase only. Hence, a small amount of vertical stroke, such as 14mm, was sufficient. This was suitable for walking on smooth terrain only. Later, the vertical stroke was increased to 40mm in ordered to be able to walk in rough terrain. After the mobility requirement was finally determined, the vertical stroke was increased to 80mm to satisfy the requirement of vertical step crossing ability. While the vehicle is walking in a tripod wave gait, a four-foot stroke results in less than one Hertz cycling frequency at cruise speed, which is 170mm/seconds. If the feet contact the ground at different times, the height of each supporting leg will be different due to this vertical variation. This different leg height will contribute to undesired pitching and rolling of the vehicle and will result in energy losses. Therefore, the vertical variation should be as small as possible.

3) Loads

When the center of gravity is kept in the center line of the support pattern, the supporting legs on each side bear half the vehicle weight. In an alternating tripod gait at any time, one side of the robot is supported by only one leg. In this case, the maximum vertical load on that leg is half the vehicle weight. Hence, the leg has to be able to take a vertical load of 1/3 in its working volume. The maximum horizontal load was taken to be the longitudinal components of half the weight when the vehicle is walking on a 5% slope. The leg bears lateral load when it is abducted or adducted.

4) Leg size

The dimension of the leg was determined according to stroke pitch; the maximum width in the longitudinal direction for one leg to move between its two extreme positions is about 99mm in order to avoid interference between legs. The maximal leg height is determined to be 168mm. Since the foot radius is about 10mm, a leg height of 155mm is used for the linkage synthesis. The leg thickness should be as small as possible and the maximum thickness is temporarily determined to be 20mm.

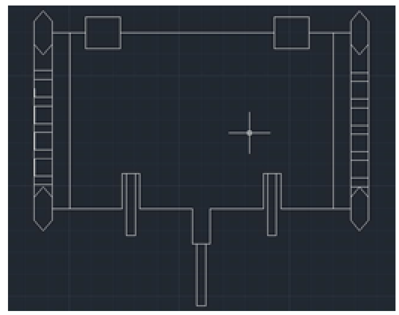

Fig. 1. Front view

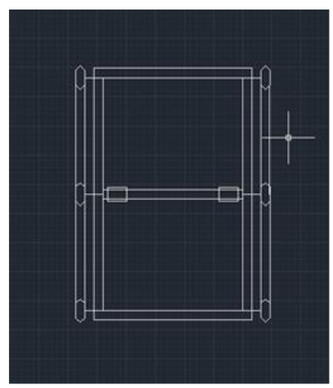

Fig. 2. Top view

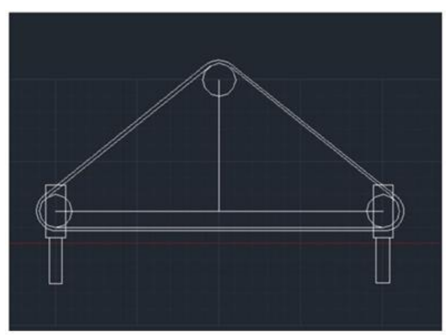

Fig. 3. Side view

5) Description of components

1. Frame:
Length=500mm.
Width=340mm.
Height=200mm.
2. Gear:

Type of Gear=Spur Gear.
No. Of Gears=6
Gear Diameter=50mm.
Pitch circle=157mm.
Pitch circle Diameter=9.235mm.
No. Of Teeth=17

3. Chain Drive:
Length of Chain=1140mm.
Type of Chain=Bush Chain
No. Of Links=80.
4. Shaft:
Shaft Diameter=15mm.
Length of Shaft=40mm.

5. Leg:
Height of Leg=80mm.

2. Conclusion

This paper presented implementation of six leg walking robot.

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