"Design and fabrication of kinematic legged robot"

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***Abstract*—** *The first kinematic walking model is appeared in 1870,which is invented by the famous Russian mathematician Chebyshev with the help of the kinematic linkages and as the years passed there are many inventions are happened in kinematic walking robot .Now the use of wheeled robot is not always the best in some cases. In general, wheels are not used in drive over obstacle situation. Depending on the terrain, a robot needs to pass small or large obstacles. For a wheel to get over a vertical obstacle, it has to be at least twice as tall as the vertical obstacle. The Kinematic Legged Robot is the robot which is walk on any Surfaces with a stiff gait slow and carries a limited load. It could be used for surveillance in sewer maintenance. This project involves the design and fabrication of a kinematic walker. This kinematic walker is six-legged machine did can walk on any surface. It is an arrangement of six linkages did together are powered by a single engine. The motor can be powered by mains either or a battery. The kinematic legged robot comprises six legs that move simultaneously to provide motion.*

Keywords*— *Kinematic, Robot, Chebyshew.

I. INTRODUCTION

The Modern researchers are continuously upgrading the idea of legged machines. It has become very popular as well as necessary field of robotics for upcoming explorations. Taking together all the development of computer-controlled machines, have provided strong base and technical feasibility to make walking machine possible. The idea of walking robots originated from nature of insect movement. These legged machines have been used for at least a hundred years and are superior to wheeled machines. They can be operated on various soil conditions, smooth as well as rough surface and are capable of crossing obstacles.

Thus we have to design and fabricate a small, robust and highly maneuverable walking robot which has good stability, speed as well as load carrying capacity. It will be design for walking and carrying loads with it on the different platforms overcoming obstacles in its path.

1.1 The Mechanics of Legged Robots

1.1.1 Number and Arrangement

The number of legs provided plays a major factor in its performance. Machines equipped with higher number of legs are suitable for heavy loaded slow moving robot, whereas bipeds and quadrupeds seem to be fastest and most agile. Some of the properties affected by the number of legs are:

- Stability.
- Energetic Efficiency.
- Redundancy: the ability to use fewer legs if some are damaged.
- Quality of joint control required
- Cost.
- Weight.
- Complexity of sensing needed.
- Possible gait.

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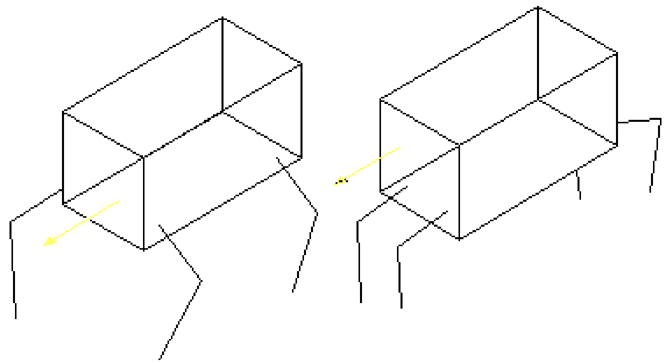
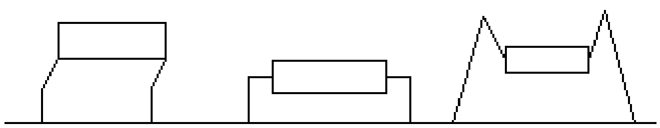
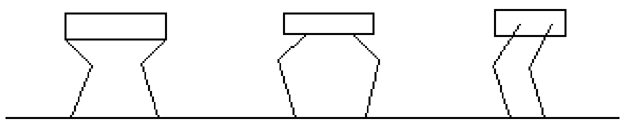


a) Frontal b) Sagittal

Fig 1.1.1.1: Frontal and sagittal plane leg arrangements



a) mammalian b) reptilian c) insect leg disposition



(a) (b) (c)

Fig 1.1.1.1.2: Effect on stability and foot placement of relative orientation of the legs

1.2 Pantograph Mechanism

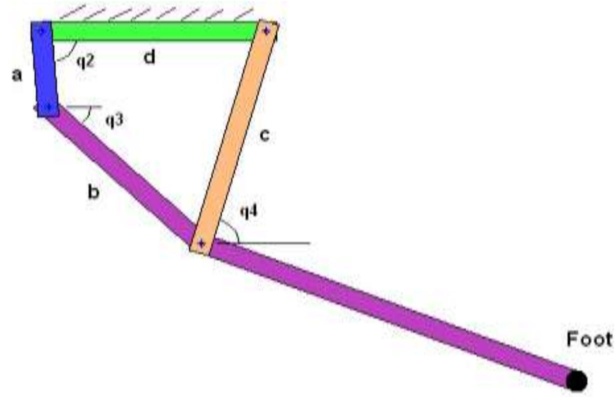


Fig 1.2.1 Pantograph Mechanism

A simple solution regarding this problem can be provided by decoupling the thrust and support mechanism using leg geometry. Here energy is consumed only in positive work made by keeping one actuator located and other moving. This type of actuator is

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also known as gravitational actuator. A leg designing exhibiting the geometrical decoupling represents the pantograph mechanism. This mechanism shows the horizontal and the vertical motion of its linear actuators. The horizontal actuator controls the extension of the leg and vertical actuator controls the height of the body above the foot. Furthermore, the pantograph mechanism permits a wide area of reach with the lightweight leg structure desirable for walking. In order to achieve a flexible gait, a third degree of freedom is introduced by allowing the whole mechanism to rotate about a vertical axis through the height actuator. If a rotary actuator is used, the foot moves in circle centered on the height actuator. However, if a linear traversal actuator is connected to the same point as the extension actuator.

As the basic motion of walking is more easily described in Cartesian coordinates than in cylindrical coordinates, this design is more desirable from the standpoint of controllability.

1.3 Degree of Freedom

We can estimate the number of D.O.F. which ought to be necessary by just observing its locomotion. Ideally it must be possible to control the body with 6 D.O.F. when it is supported by each of two alternating leg set. So we might be expecting minimum 12 number of D.O.F. for a walking machine expecting the leg sets may share some legs.

If we want 3 D.O.F. for each legs for a 4 legged robot it would total give the 12 D.O.F.to the body. The most uniform mathematically are a Cartesian system of three sliding joints at right angles and a polar system in which a telescopic leg pivots about a two axis rotary joint.

II. PROPOSED METHODOLOGY

2.1 Mechanical, Software and Hardware Aspects

2.1.1 Mechanical Aspects

- To study the general principals involved in legged locomotion and mechanics of legged vehicle.
- Selection of number of leg for the robot depending upon the requirement of speed and stability.
- By taking into consideration all the factors deciding upon the number of D.O.F. for each leg.
- Selection and design of leg mechanism.
- Study of ‘Forward and Inverse Kinematics for the leg mechanism.
- Design of entire mechanical structure of the robot.
- Analysis of possible control strategies, ranging from purely feed forward to purely feedback and selection of suitable control strategy.

2.1.2 Software Aspects

- Building appropriate algorithm to implement the control strategy including teaching and control of several gaits and different behaviors to adapt to the surrounding environments
- Verification by simulation of control strategy and study of simulation results to improve performance
- Study of Interfacing Techniques.

2.1.3 Hardware Aspects

- Use of microcontrollers and their programming.
- Building a remote link between robot and control station.
- Use of various sensors.

2.2 Drawing of Kinematic Legged Robot :-

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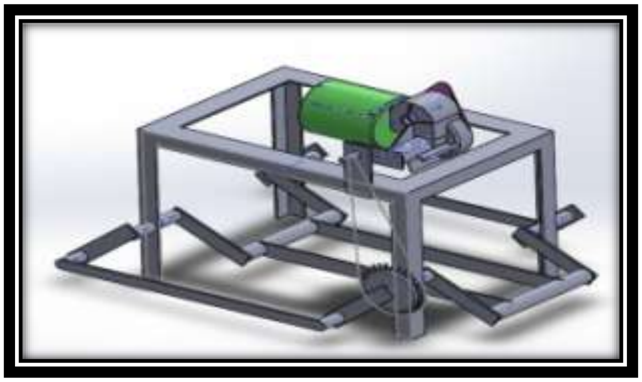

Fig 2.2.1 3D Drawing of Model

III. ONCLUSION

The design and fabrication of kinematic legged robot has been done by taking the quality into consideration. To improve its performance, have tried to overcome its disadvantage to maximum extent. The quality of legged robot is like load carrying capacity, which can cross or overcome any obstacles coming in its way. Its performance shows the overcoming the disadvantages caused the reduction in speed of robot. We can conclude our report by comparing advantages and disadvantages of kinematic legged robot and giving the output motion as well as load carrying capacity.

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