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Walking Mechanism For Uneven Road Surface

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Abstract:

Theo Jansen mechanism is beneficial for advanced walking vehicles. It can travel areas that are currently not accessible with wheels. In this mechanism links are connected by pivot joints and convert the rotating motion of the crank into the movement of foot similar to that of animal walking. The proportions of each of the links in the mechanism are defined to optimize the linearity of the foot for one-half of the rotation of the crank. The remaining rotation of the crank allows the foot to be raised to a predetermined height before returning to the starting position and repeating the cycle. Two of these linkages coupled together at the crank and one-half cycle out of phase with each other will allow the frame of a vehicle to travel parallel to the ground. The system uses a robot that is capable of walking towards the object according to the remote-control input. This project is useful in hazardous material handling, clearing minefields, or secures an area without putting anyone at risk. It would perform very well as a platform with the ability to handle stairs and other obstacles to wheeled or tracked vehicles.

Keywords: *Walking Robots, Artificial Legged Locomotion, Locomotion Gaits, Optimization, Genetic Algorithms.*

INTRODUCTION

This mechanism has generated a lot of interest and enthusiasm among researchers, especially in finding useful applications based upon its core concept. Some researchers also proposed some modifications and improvements to increase its usability for different applications.

In the field of motion planning for legged robots, a large body of research work is inspired from insects due to the fact that they are responsive, adaptive and possess sensory systems to generate reactive walking patterns . In the field of biomimetic robots, a large volume of work exists which deals with their modeling and design inspired from legged creatures found in nature. It has been well understood through various research studies that mammals and walking insects posses inherent capabilities to choose stable and secure walking patterns in response to external disturbances when the terrain becomes uneven to keep up a continuous gait. This walking pattern is characterized by the sequential motion of legs and coordinated advancement of the body which makes them appropriate and suitable for replicating in walking robots for the real world.

As mentioned above nature has always chosen legs as the best mode of locomotion so using linkages we tried to mimic nature and come up with certain walking mechanism which will suite all terrain. After studying a few research papers and articles suggested by our guide we came across Theo Jansen Mechanism which proved to be very efficient to accomplish our objective. We seemed help from a technical expert at who assisted us throughout the process of designing, constructing, fabricating and testing our project. After searching through the market we procured all the raw materials, fittings and equipment's that were required to construct the walking bot. In this project we use micro controller, which is programmed to control the input and output modules interfaced to it. The controller makes use of a remote, which is used to control the robot. The project consists of micro controller based motherboard is present with the Robot itself. It is interfaced with some DC motors for moving the robot, and a RF for receiving the instructions from the remote.

LITERATURE SURVEY

According to Webster and Warson, a good literature review acts as a foundation for knowledge enhancement and new theory formulation. For extensive literature review two majorly known databases have been referred to, that is, Research Gate and Online Journal. The various literature surveys are as below:

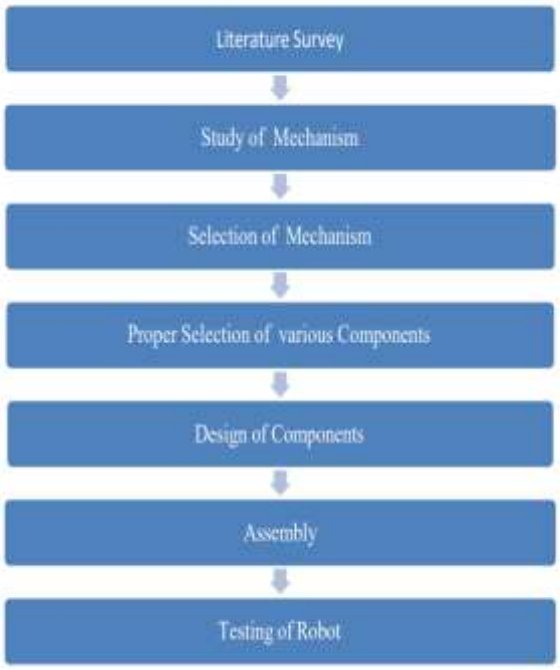
Swadhin Patnaik:conducted research on four legged walking machines. After researching about mining and excavation industries I came across with these data. The statistics suggests that about 50% of mining cost is spent on roadway and rail transports in the vicinity of the mines (haul roads & side rails). Haul roads cause a great damage to tires of transporting vehicle requiring frequent and regular replacement. Maintenance cost of haul roads is also high and it needs a separate wing. Weight distribution is uneven in haul roads causing higher stress problems in transport vehicles. On a rough terrain legs have advantage over tires so I came on Klann Mechanism. After researching through this mechanism on internet and going though few reports and watching its motion in the YouTube videos I found that Klann Mechanism has its own demerits which include steering and stability. After crossing out the Klann Mechanism from the list I stumbled on Theo Jansen Mechanism. This mechanism gave me the smoothest motion and is able to carry loads without much high forces applied to it. With the inspiration from Jansen‘s walking mechanisms, I began searching for various applications of the Jansen leg mechanism.

Asalam Eh shamsudin: studied on the movement of robots in surfaces. In this paper the emphasis is given towards the mechanical structure of a quadruped robot able to walk on ground, climb on vertical walls, and perform the ground wall-movement automatically. The overview of the robot is shown, the configuration, number of DOFs, and the actuation system of the leg is analyzed. Biologically inspired gaits of the robot are discussed. The movement of the leg from the ground to the wall is analyzed. The integrated leg movement-trunk regulation sequences are simulated. And the trajectories of specific points on the trunk are traced, showing the limits for safe movement inside meandrous chimneys or zigzag tubing.

Kazuma Komoda: studied on linkage mechanism of robots and proposed an extension mechanism of the Theo Jansen linkage for climbing over bumps. The linkage is useful to mimic animal locomotion, we hypothesized that an additional up-and-down motion in the linkage center provides different motion patterns from the original internal cycle. Our results demonstrated that the lifting up of the linkage center alters the leg's orbit upward and the combination of a cycle and updown motion provides a new elliptic orbit to climb bumps with about 10 times height of the original. This analysis may shed light on the future expandability of the linkage mechanism in bio-inspired robots.

M.F. Silva: investigated on the optimization of legged robots. During the last two decades the research and development of legged locomotion robots has grown steadily. Legged systems present major advantages when compared with ―traditionall vehicles, because they allow locomotion in inaccessible terrain to vehicles with wheels and tracks. However, the robustness of legged robots, and specially its energy consumption, among other aspects, still lag being mechanisms that use wheels and tracks. Therefore, in the present state of development, there are several aspects that need to be improved and optimized. Keeping these ideas in mind, this paper presents the review of the literature of different methods adopted for the optimization of the structure and locomotion gaits of walking robots. Among the distinct possible strategies often used for these tasks are referred approaches such as the mimic of biological animals, the use of evolutionary schemes to find the optimal parameters and structures, the adoption of sound mechanical design rules, and the optimization of power-based indexes.

METHODOLOGY



DESIGN

Design parts :

Gear: A gear is a rotating machine part having cut teeth, or in the case of a cogwheel, inserted teeth (called cogs), which mesh with another toothed part to transmit torque. Geared devices can change the speed, torque, and direction of a power source. Gears almost always produce a change in torque, creating a mechanical advantage, through their gear ratio, and thus may be considered a simple machine. The teeth on the two meshing gears all have the same shape. Two or more meshing gears, working in a sequence, are called a gear train or a transmission.

Motor: A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have similar internal mechanism, either electromechanical or electronic; to periodically change the direction of current flow in part of the motor.

Remote: Remote was the medium to transmit the signals to the circuit so as to drive the walker mechanism.

ADVANTAGES OF PROPOSED SYSTEM

- Higher energy efficiency, better fuel economy.
- Greater mobility.
- Improved isolation from terrain inconsistencies.
- Less environmental damage (both from paving and erosion).
- Simple in design and simple mechanism.
- Only point contact is there and thus less loss of energy.

DISADVANTAGES

1. Lower speed as compared to the vehicle

2. Cannot be used commercial purpose.

3. Need high accuracy in Manufacturing.

APPLICATIONS

1. It can be used in the military operations.
2. It can be used in geological research operations.
3. Transportation across rough terrain.

CONCLUSION

From the above results it can be seen the objective are achieved which are required for the smooth running of the walking mechanism. The following conclusions can be drawn from the mechanism:

1. Ability to avoid obstacles by stepping over them because of the path followed by the leg toe and heel.
2. To demonstrate the proposed design is feasible, the leg mechanism based on the optimal design.
3. To design and construct a mechanism such that it will give a smooth leg like motion.
4. Because of the more taking time in support phase and there will be eight legs will be in contact with ground it can be statically stable during entire locomotive cycle.
5. Durable joints/hinges/moving parts which will not become blocked by debris over time.
6. It can make with inexpensive materials like plastic components.
7. It utilizes less power for movement of legs compared to traditional system i.e. wheels on the uneven surfaces, steps climbing, rock or hill areas therefore it is energy efficient.

No control mechanism necessary for movement like hydraulic systems and control systems etc. The robot presented here is a hexapod to walk using a biologically inspired leg control system over an uneven terrain using a sensor-based traction control. Sensory network in a leg is responsible for influencing the direction and motion of each joint such that an evolving, adaptive, and reactive stepping pattern is realized through leg-environment interaction. Simulation tests that evaluated this gait model showed that the robot could clear raised and lowered obstructions over uneven surface which were within and beyond the nominal gait control variables (leg-lift and leg-stroke), as shown by the obstacle crossing testing results.

FUTURE SCOPE

1.This mechanism can be made more flexible by using different link lengths for front, middle and hinge legs.

2. There is high potential for development of other applications like bomb disposal, security surveillance, spy operations, stair climbing, moving furniture, etc. based on this mechanism in future.

3. In future by connecting wireless camera to the robot, then we can see the outer world from our personal computer only by using GPRS and GPS.

4. By connecting temperature sensor to the robot we can get the temperature of dangerous zones in personal computer itself instead of sending human to there and facing problems at field we can send robot to there and sensor will detect the temperature and it gives information to the micro controller and micro controller gives the information to the transceiver from that we can get the data at pc side. By connecting smoke sensor to the robot we can get the information related concentration of smoke or gases in respective fields.

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