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Walking Robot By Theo Jansen Mechanism

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ABSTRACT

This paper is to study about the Theo-Jansen four leg walking robot. The objective is built up new mechanical robotic walker using eight bar link mechanism. The system uses a robot which is capable of walking towards the object according to user remote control. The main advantages of Theo-Jansen four leg walking robot is gives the fast response, low power consumption, higher energy efficiency, greater mobility, less environmental damage. We are using a simple mechanism i.e. uses a limiting parts such as bearings, hinges, springs etc. By using a Theo-Jansen four leg walking robot to improve transportation of raw materials from one position to another position and also increased rate of transfer. With improvement and implementation of new technology the cost of expenditure also increased and industries have had to setup roads for smoother movement of these wheel based vehicles. Theo-Jansen mechanism has a capability to extend an adaptive and controllable mechanism on irregular ground. We investigated a new extension mechanism which enables the walking mechanism to transmit between walking and climbing modes.

Keywords-Robot, mechanism, Theo-Jansen.

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I. INTRODUCTION

The advent of new high-speed technology and the growing computer Capacity provided realistic opportunity for new robot controls and realization of new methods of control theory. The objective of this project is to build a new mechanical robotic walker using 8 bar link mechanism. The system uses a Robot which is Capable of walking towards the object according to the user remote control.

An eight-bar linkage is a one degree-of-freedom mechanism that is constructed from eight links and 10 joints. These linkages are rare compared to four-bar and six-bar linkages designed by Theo Jansen for his walking machines. This project makes use of an on-board computer, which is commonly termed as micro controller. It acts as heart of the project. 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.

II. JANSEN MECHANISM

Jansen mechanism consists of 11 links connected in tandem to each other to simulate a walking mechanism which is quite similar to that seen in crabs. It is a result of evolutionary computed models which Theo Jansen started to work upon in 1990. Out of all the links, one particular link acts as the rotational input which results in the walking motion of the entire linkage. The links synchronize together to trace an ecliptic trajectory which gets sharpened at the moment when the leg touches the ground. When two Jansen linkages are connected to each other by a rotating horizontal shaft, both the legs help the machine to move forward or backward depending on the clockwise or anticlockwise rotation of the shaft. This is closely comparable to a

wheeled arrangement in cars where two wheels are connected on both sides of a rotating axle and the shaft rotates by 120 degrees per stride. Interestingly, the relationship of the hind limb with the fore limb is antiphase, thus helping them to move forward cooperatively. The parallel link in the Jansen linkage helps the linkage to attain the required step height by folding during the cycle angling of the leg.

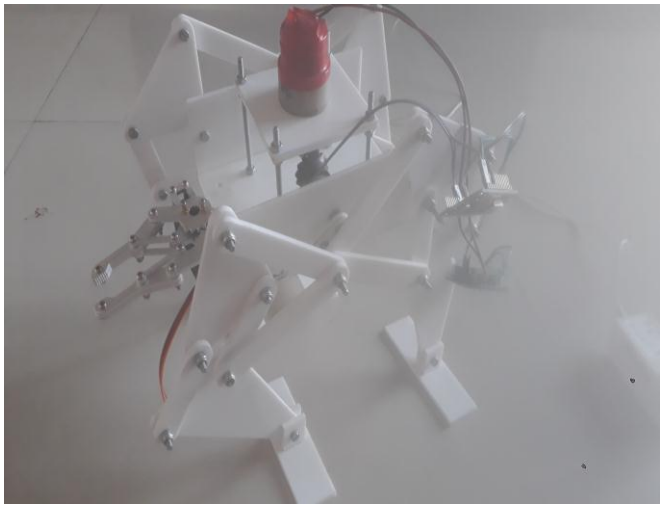

Fig 2. Design mechanism

III. ADVANTAGES OF WALKING ROBOT

Walking machines possess several advantages over wheeled machines in areas of variable terrain. Consider a wheel moving a constant velocity **V**; every point on its perimeter is moving at a constant velocity **V** tangent to the curve of the wheel as shown in fig. 3 A comparable walking mechanism would be one which moves at a constant velocity **V**, and where the "foot" of the walker traces out a similar circular path with a constant velocity **V** at all points on the path (also shown in Fig. 3). The most obvious advantage of the foot over the wheel is that the foot may step over inconsistencies in the terrain. Local maxima and minima may be completely avoided by simply stepping over them. This results in less loss of energy during locomotion and allows the vehicle to maintain a constant velocity and height over variable terrain [2].

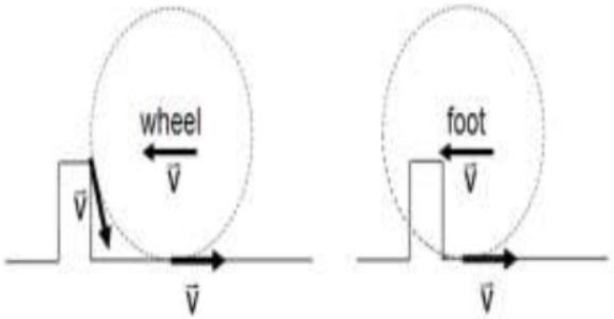

Fig. 3 Overview of Walking.

Fig. 3 Comparison of wheel and foot response to a local maximum in the terrain. The dotted lines indicate the perimeter of the wheel or the path of the foot. The arrows indicate the direction of movement. The foot may step over the obstacle completely, while the wheel must move over the obstacle. Now consider a case where the comparable foot and wheeled systems approach an obstacle that cannot be avoided [2].

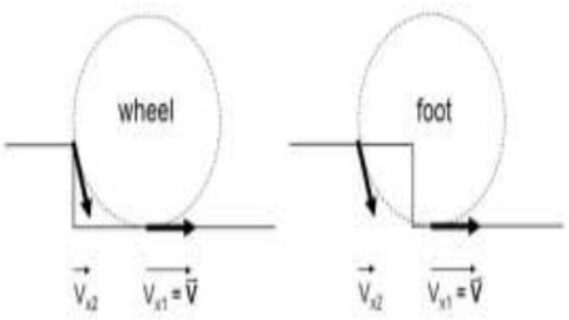

Fig. 4 Overview of walking robot

When the edge of the wheel makes contact with the higher ground, it forces the velocity of the vehicle to immediately slow. This edge has a total velocity V, but only a fraction of that velocity is in the direction, so the vehicle quickly slows from V to Vx2. The foot encounters a similar change in velocity, but it has the advantage of being able to slide along the ground. Although this scenario is not ideal, dragging the front foot across the raised terrain reduces change of velocity in the x direction. Both models must still overcome the potential energy barrier posed by the increased height of the terrain [2].

Fig. 4: A comparison of a wheel and a foot (moving in a wheel-like path) approaching an inconsistency in the terrain. The x component of the velocity of the edge of the wheel and the foot's path are indicated. Furthermore, the wheel causes a great deal of environmental harm3. Its inability to avoid obstacles means that it erodes more terrain than a foot when moving comparable vehicles. Additionally, wheeled vehicles work best on terrain with no inconsistencies; this has led to paving of many permanent roadways, another form of environmental degradation [2].

IV. SELECTION OF DEGREE OF FREEDOM

The number of joints in a robot roughly translates to the degrees of freedom. In the design process three different possibilities were considered.

The foot of the leg is constrained to a spherical surface. However the up-down and forward-back motion is approximately linear and provides a method to propel forward or backward while adjusting to some uneven terrain. A two degree of freedom leg offers very limited capabilities and produces legs which act similar to uneven wheels. Legs with two degree of freedom also prevent the robot from adjusting its step sizes to compensate for the environment rendering one degree of freedom inadequate. A three degree of freedom design offers superb manoeuvrability allowing the robot to adjust too many situations.

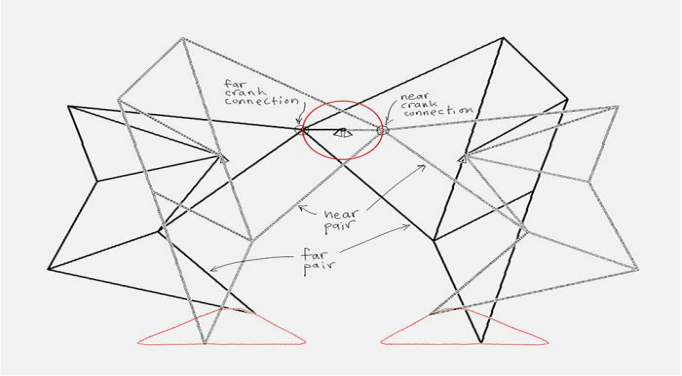

Fig. 5 Motion of the tip of the leg

V. COMPONENTS

A. *DC MOTOR-*:

DC motors are commonly found in wheeled robots. DC motors rotate as long as power is applied and stops when power is removed. A continuous rotation at a constant speed can be achieved by applying a constant voltage. However, extra support circuitry including a sensor for feedback is needed for position control.

B. *SERVO MOTOR-:*

A **servo motor** is an electrical device which can push or rotate an object with great precision. It is a closed loop system where it uses positive feedback system to control motion and final position of the shaft. Here the device is controlled by a feedback signal generated by comparing output signal and reference input signal.

C. *WIFI MODULE*

The Arduino Uno WiFi is an Arduino Uno with an integrated WiFi module. One useful feature of Uno WiFi is support for OTA (over-the-air) programming, either for transfer of Arduino sketches or WiFi firmware.

D. *ROBOTIC ARMS*

A robotic arm is a type of mechanical arm, usually programmable, with similar functions to a human arm; the arm may be the sum total of the mechanism or may be part of a more complex robot. The links of such a manipulator are connected by joints allowing either rotational motion (such as in an articulated robot) or translational (linear) displacement. The links of the manipulator can be considered to form a kinematic chain. The terminus of the kinematic chain of the manipulator is called the end effector and it is analogous to the human hand.

E. *APPLICATIONS*

I. TO PICK AND PLACE ROBOTIC ARMS

Pick and place robotic arm is a system which can be designed in many different ways according to its applications. Further they heavily depend on joints, which are used to join the two consecutive rigid bodies in the robot and can be rotary joint or linear joint. Joints principally define the movement of the arm as they decide the degree of freedom of the components.

II. LOAD-CARRYING TIPPER AND TRUCKS FOR MINING INTEGRATED WITH JANSEN LINKAGE

A detailed study of this robot has been done by Patnaik [5]. He explores and analyses the Jansen linkage as a permanent replacement for the wheels of load carrying tippers and trucks used in mining. The main aim of his research is to remove the problems associated with the smooth movement of vehicles at mining sites, which is commonly dealt with by making roads separately for it, a time consuming and costly process. Patnaik has chosen Jansen linkage over other mechanisms since it has the ability to bear huge loads while keeping its body steady.

VI. CONCLUSION

Our study demonstrated that various elliptic orbits for walking, climbing, stepping in a place and rolling back by using the cyclic motion of the linkage center. This paper is to study about the Theo-Jansen four leg walking robot. The objective is built up new mechanical robotic walker using eight bar link mechanism. In future we have to use this robot to perform different type of operations automatically by using sensors. When we are making this robot in high heat resisting material then we are using this robot in nuclear power plant or in place with high radiation level.

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