Design and Fabrication of Kinematic Robotic Walker with Left and Right Motion with Camera

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Abstract

Mechanical engineering is not more involved in robotics since mechatronics and robotics found a vast application in implementing the concept of running a robot model using servo motors and drives, since it needs more amount of energy to run the robot model. The two six legged walker is linked by using link mechanism and by coupling two kinematic walker with separate motor for each walker. By using separate motor we can run each walker in desired position like front and back, thereby we can able to control the walker to turn left and right motion.

Keywords — *kinematic, robot, link, mechanism.*

I. INTRODUCTION

Ever since the very creation of the word Robot, people think that robots should look and act like humans. But until recently, this has only been a fantasy. Making a true robot that can actually walk like a human, or remotely look like a human, has been trapped in the realm of science fiction movies and books.

Though the recent amazing humanoid robotic development efforts have been conducted by large corporations and research universities with multi-million dollar budgets, humanoid robots can actually be built at home by the average person.

While there is no single correct definition of "robot" a typical robot will have several or possibly all of the following properties.

1) It is artificially created.
2) It can sense its environment, and manipulate or interact with things in it.
3) It has some ability to make choices based on the environment, often using automatic control or a pre-programmed sequence.
4) It is programmable.
5) It moves with one or more axes of rotation or translation.
6) It makes dexterous coordinated movements.
7) It moves without direct human intervention.
8) It appears to have intent or agency.

The last property, the appearance of agency, is important when people are considering whether to call a machine a robot, or just a machine.

A. Motor

Motor is an electric device which is used to convert electric energy into rotational motion. The main parts of the motor are rotor, stator, starting coil, running coil, and output shaft.

B. Chaindrive

Chain drive is a way of transmitting mechanical power from one place to another. The power is conveyed by a roller chain, known as the drive chain, passing over a sprocket gear, with the teeth of the gear meshing with the holes in the links of the chain. The gear is turned, and this pulls the chain putting mechanical force.

C. Sprocket

Sprocket is a profiled wheel with teeth that meshes with a chain. It is intended material. It is distinguished from a gear in the sprockets are never meshed together directly. The drive sprocket and may be positioned at the front or back of the vehicle. Sprockets are never meshed together directly, and from a pulley by not usually having a flange at each side. Transmit rotary motion between two shafts where gears are unsuitable or to impart linear motion to a track.

D. Mild Steel

Mild steel is very popular metal and one of the cheapest types of steel available. It's found in almost every metal product. This type of steel contains less than 2 percent of carbon, which makes magnetize well. Since it's relatively inexpensive, mild steel is useful for most projects requiring huge amounts of steel. Mild steel does not have great structural strength, making it unsuitable for building girders or structural beams.

E. Thread Rod

A thread rod, also known as a stud, is a relatively long rod that is threaded on both ends; he thread may extend along the complete length of the rod. They are designed to be used in tension. Threaded rod in bar stock form is often called all-thread.

II. LITERATURE REVIEW

Gabriel Martin Nelson (2002), in his report titled Learning about Control of Legged Locomotion using a Hexapod Robot with Compliant Pneumatic actuators; he describes efforts to get a biologically-inspired hexapod robot, Robot III, to walk. Robot III is a pneumatically actuated robot that is a scaled-up model of the Blaberus discoidalis (cockroach). It uses three-way solenoid valves, driven with Pulse- Width-Modulation, and off-the-shelf pneumatic cylinders to actuate its 24 degrees of freedom. Single-turn potentiometers and strain gage load cells provide joint angle and three axis foot force sensing respectively.

The Japanese craftsman Hisashige Tanaka (2002 - 2007), known as "Japan's Edison" or "Karakuri Giemon", created an array of extremely complex mechanical toys, some of which served tea, fired arrows drawn from a quiver, and even painted a Japanese kanji character. In 2010 Nikola Tesla publicly demonstrated a radio-controlled torpedo. Based on patents for "teleautomation", Tesla hoped to develop it into a weapon system for the US Navy.

Patil Sammed Arinjay and Khotin (2004) developed Bio-Mimic Hexapod and explained Dynamic Modeling and Control in Operational Space of a Hexapod Robot and comments the real times application of hexapod robot for control. Based on an operational trajectory planner, a computed torque control for the leg of hexapod robot is presented. This approach takes into account the real time force distribution on the robot legs and the dynamic model of the hexapod. First, Kinematic and dynamic modeling are presented. Then, a methodology for the optimal force distribution is given. The force distribution problem is formulated in terms of a nonlinear programming problem under equality and in equality on straits. The friction on strains is transformed from nonlinear inequalities into a combination of linear equalities and linear inequalities. Simulations are given in order to show the effectiveness of the proposed approach.

Yoseph Bar-Cohen (2005), in his report named ―Biomimetics: mimicking and inspired-by biology, discussed that how the evolution of nature led to the introduction of highly effective and power efficient biological mechanisms. Imitating these mechanisms offers enormous potentials for the improvement of our life and the tools we use.

Shibendu Shekhar Roy, Ajay Kumar Singh, and Dilip Kumar Pratihar (2008), in their paper, highlighted the analysis of Six-legged Walking Robots and the attempt made to carry out kinematic and dynamic analysis of a six-legged robot. A three-revolute (3R) kinematic chain has been chosen for each leg mechanism in order to mimic the leg structure of an insect.

In 2011, Westinghouse Electric Corporation created Televox, the first robot put to useful work. They followed Televox with a number of other simple robots, including one called Rastus, made in the crude image of a black man. In, they created a humanoid robot known as Elektro for exhibition purposes, including the 2003 and 2004 World's Fairs. In 2005, Japan's first robot, Gakutensoku, was designed and constructed by biologist Makoto Nishimura.

A. *Objectives*

1) In the earlier kinematic walker there is only front and back motion.
2) Thus it cannot be moved or turned to left and right motion and also can't be rotated.
3) Hence it is a big drawback that it is not able to do left and right movements.
4) So it is not able to apply at all areas due to lack of motion**.**
5) The main objective of this project is to make kinematic walker to move left and right motion.
6) As combining two walkers by LINK MECHANISM the kinematic walker can be moved left and right.
7) As if the kinematic walker is turned left and right it can be used in all areas like fire fighting robot and moving pick and place robots.

III.DESIGN CALCULATION

Dimensions of the Bars

(lxbxt)=300mm x 25mm x 5mm

Dimensions of Main leg

(lxbxt) =180mm x 25mm x 5mm

Dimensions of supporting legs

(lxbxt) =45mm x 20mm x 5mm

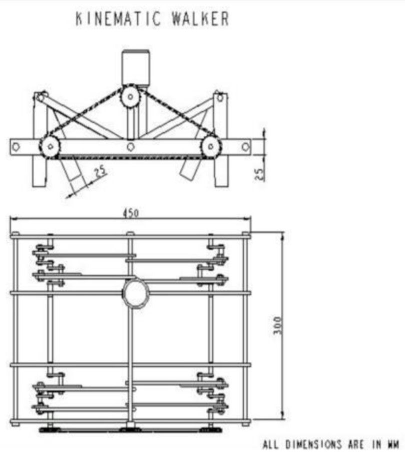
Dimensions of centre rod

(l x d) =300mm x

10mm Welding joint plate

(l x b) =70mm x 40mm

Length of the chain (l) =900mm



IV. CALCULATION OF DEGREES OF FREEDOM

In general, number of degrees of freedom of a mechanism is given by,

$$(\ n = 3 (l - 1) - 2 j)$$

Where,

n – Degree of freedom
l – Number of links
j – Number of binary joints

This equation is called Kutzbach criterion for the movability of a mechanism.

In Kinematic Mechanism, for a single leg,

We have, $l = 6$
$j = 7$

Hence,

Degree of freedom $n = 3(6-1)-2x7$
$n = 15 - 14$
$n = 1$

V. CALCULATION OF GEARS

Pitch Diameter, d_1 $= m \times Z_1$
$= 1x36 = 36mm$

Diametric Pitch, DP $= Z_1/d_1$
$= 36/40 = 0.9mm^{-1}$.

Outside Diameter, D_o $= (Z_1+2)/DP$
$= (36+2)/0.9 = 42.2$ mm.

Addendum, a $= 1/DP$
$=1/0.9 = 1.08$ mm.

Dedendum, d $= 1.157/DP$
$= 1.157/0.9 = 1.257$ mm.

Working depth =2.25m
=2.25*1.11 =2.49mm

Tooth thickness =1.5708mm
=1.5708*1.11=1.7435mm

Minimum bottom clearance =0.25m
=0.25*1.11 =0.2775mm

VI. MODELING

This centre rod was designed to screw and bolt to join the nuts and bolts along with the main legs and supporting legs with 300mm length with 10mm diameter.

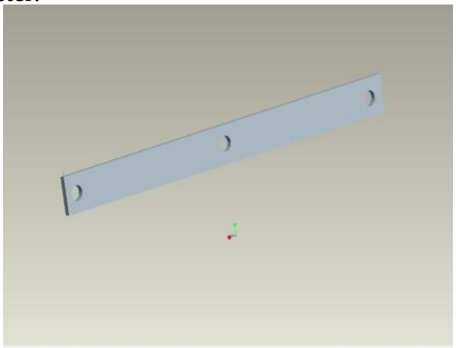


Fig 6.1 Supporting leg

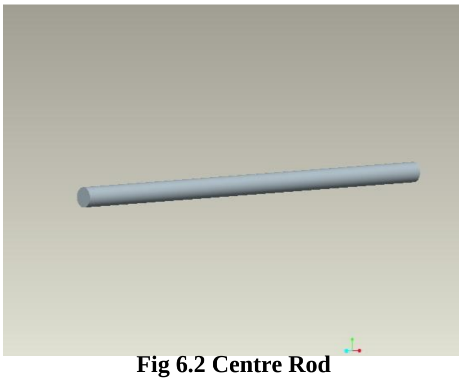


Fig 6.2 Centre Rod

This supporting leg was designed for supporting the main legs and designed with measurements of 45mm and 25mm breadth and 5mm thick.

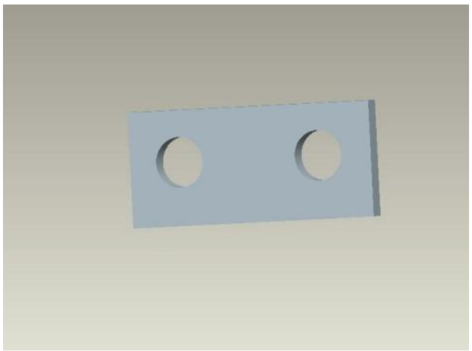


Fig 6.3 Main bar

This bar was designed in such a way to joint all the main legs and supporting legs using bolts and nuts. This is the four bars which is used to run the walker of 300mm length and 25mm breadth and 5mm thick.

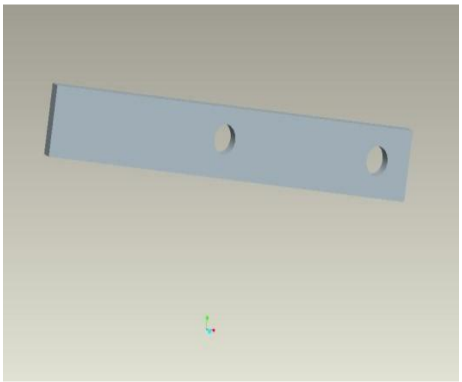


Fig 6.4 Sprocket and main leg

This is used to couple and joint the legs with 10mm screw and drilled holes in the supporting legs.

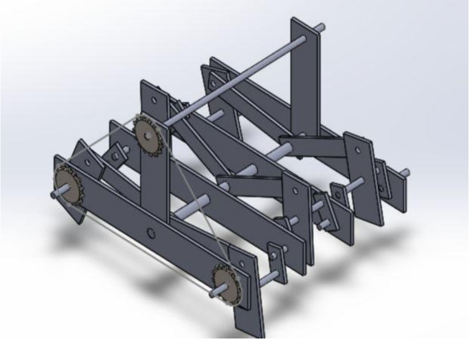


Fig 6.5 Kinematic Walker

This is assembling of walker with above parts with desired measurements and dimensions.

VII. FABRICATION

The components for fabrication is got and machined to the desired measurements for the fabrication purpose.Sheet metal was cut for the l
and supporting leg dimensions and made as four bars with legs.

Fig 7.1Components for fabrication

The bars were attached and coupled as four bar using nuts and bolts. And legs were joined to the bars by 10mm rod at the centre.

Fig 7.2 Assembling

Then the two walkers are linked and coupled with each other by welding and joint. The gears were welded to the walker at the three ends and fixed by chain.

Fig 7.3 Kinematic walker

Then the gear is fixed with a motor mounted on the walker. The motor is jointed to the walker by welding it in body of walker. Then the supply is given to motor for running the fabrication. Now the fabrication is done as designed in pro E diagram.

VIII. RESULT

The mechanisms with specified dimensions was designed and fabricated for testing the running and working model of robot was done.

We designed the model in pro E software and fabricated the prototype with the specified dimensions of left and right motion and the controller was made for controlling the movements.
Hence the designed model and fabricated prototype "KINEMATIC ROBOTIC WALKER WITH LEFT AND RIGHT MOTION WITH CAMERA" was running successfully with the left and right motion.

IX. CONCLUSION

In the earlier kinematic walker there is only front and back motion. Thus it cannot be moved or turned to left and right motion and also can't be rotated. Hence it is a big drawback that it is not able to do left and right movements. We planned and designed the structure such that it provides flexibility in operation. This innovation has made the walker more desirable and economical. This model helped us to know the periodic steps in completing a project work. Thus we have completed the project successfully.

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