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Walking Robot Locomotion System

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ABSTRACT: Designing the Robot leg mechanism is one of the challenging tasks in the area of design. More number of links makes robot design complex as well as manufacturing. In this report, we generate the design and manufacturing of walking robot with the use of Klann Leg Mechanism. Moreover, with this mechanism, robot can travel on the flat and uneven surfaces for some distance carrying specific amount of the weight. For reducing complexity of linkage mechanism, we may use gears. This gear mechanism enables the robot to move in forward and backward motion.

KEYWORDS: Klann Leg Mechanism, weight carrying, gears

I. INTRODUCTION

The main purpose of using the Klann leg mechanism is that, we generate the ability of robot to access that places which is not possible for wheel type robots. By copy to the body of legged animals, it should be attainable to enhance performance of mobile robots to provide a great deal of stable and faster walking. Some body and engineers can implement the relevant biological concepts in their vogue. The fore most forceful motivation for learning Klann mechanism robot are, to convey access to places that area unit dirty and to convey access to places those area unit dangerous.

Job that area unit legged robots is utilized in industries wherever material handling is should, in army sectors it will travel on off road wherever army vehicles can't travel , moreover used for rescue work, unsafe places like the within of a reactor, giving biological galvanized autonomous legged robots nice potential. Low power consumption and carry some amount of weight is a lot of advantage of walking robots, so is important to use the minimum type of actuators. Throughout this context, associate objective is concerning throughout this project to develop associate eight legged automaton whose structure depends on the biomechanical of insects. [9]

Form the past so many years there are various research on the robot lagged mechanism to develop their ability for accessing that places not suitable for other types of robots. The design of walking robot relies on the size of boot dimension, height and length. In this project we modified the dimensions of the Klann mechanism as per our design. The projects concentrate on the dimension of legs and supported that dimension the project dynamical the size of boot to eliminate the difficulties in planning of the whole walking robot.

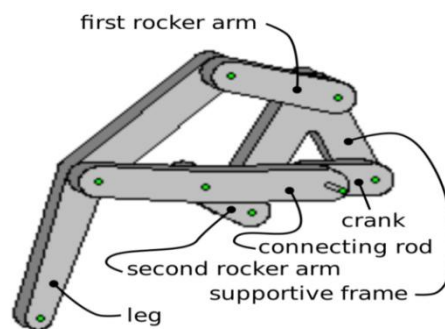
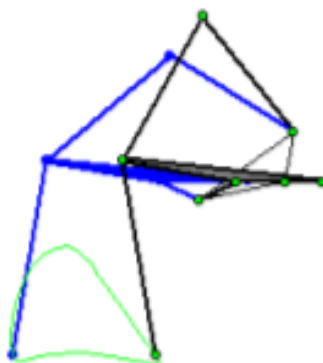


Fig. 1 Klann Mechanism^[9]

An investigation by Yankee Army reports that concerning the earth's surface is unapproachable to wheeled or half-tracked vehicles, whereas this territory is generally exploited by legged animals. Most researchers take concepts from setting to resolve the issues of locomotion. The morphology of multiple legs and their flexibility and coordination square measure the most focus of study for man of science inquisitive about imitating nature living behavior. One in all the foremost acknowledged persons to with success imitate nature is Theo Jansen. He is a Dutch artist who invented "Strandbeest" machines the legs of which are commonly known as the Jansen linkage or mechanism. He postulated a mechanism consisting of rods of different lengths that were linked in conjunction to each other so that it resembled the structure of an insect leg. It has garnered a lot of appreciation for its beautiful simulation of organic walking. This paper introduce the modified gear set combination which give variable output for the constant input speed of DC motor powered by battery.^[17]

Fig.2 Link Mechanism^[17]

The Klann linkage mechanism enhances benefit for more advanced walking robot vehicle with reduction in other robot limitations. It can travel on flat surface, uneven surface, and climb stairs without requirement of microprocessor control or multitudes of inefficient actuator mechanisms. It fits into the technological void between these walking devices and axel-driven wheels.

II. METHODOLOGY

Kalnn mechanisms with eight legs are attached with driven gear and it is balanced so that it can generate motion in both the forward as well as in backward direction. There are two plates used, four legs is attached with one plate and another plate have reaming, which is fixed with bolts moreover each plate consists of three gears in which two gear work as driven and one gear is driver which are coupled with motor which supplies mechanical power by the rotation of motor thangear rotates and we get the motion of link mechanism. The weight carrying cabin structure is generated on it.

It is almost like the primary fig one however here the robot cannot observe the motion of the most leg linkages. If we have a tendency to see the motion of the most leg linkages, there is a distinction between the motion rates. Similarly, if changes the size of the higher valve rocker and lowers valve rocker then the robot will observe a similar development within the motion rate.

The power transmission for every individual leg up to the mark gear quantitative relation. This can be achieve by the sensors and actuators. Actually, this type of robots referred to as mechanical spiders which were introduced by the Klann. But they are coming up with legged robots consisting of 4 legs.

That could be a lot of advantageous than six-legged owing to less variety of joints and links can lead to less friction.



Fig. 3 walking robot

In this present leg mechanism there is an individual motors for the individual cam, one motor for backward three legs and a second motor for forward three legs. But the motors ought to follow a similar gear quantitative relation. Otherwise, the robot cannot get the walk for the automation. This will helps to require turnings once the 2 motors rotating during a reversed direction and within the same direction can lead to forward or backward moment.

With this study, the robot will able to build the specified by speed and cargo capability supported as per the demand. Whether the automaton accustomed carry the hundreds or its accustomed transport from one place to another through the uneven land areas which is shown in the fig no. 4, wherever the wheeled robots is much difficult to move on it.



Fig. 4 weight lifting robot

The design of walking robot relies on our size of larva dimension, height and length which is ex gratia for selecting the dimension of the boot whether or not the boot is greater in size or smaller. It can be used in industries where weight carrying is necessary, it can travel on off road where other army vehicles travel is difficult, also in the hospital where infected patients are there and there's possibility of getting infected from patient these robots can go near them and ensure his safety etc.

III. DESIGN AND CALCULATION

Here robot assembly in fig. 5 and its details parts like linkage mechanism, frame, and weight carrying box, gear and nut bolt with its supporting shaft are shown in fig 6 to fig 10 respectively.

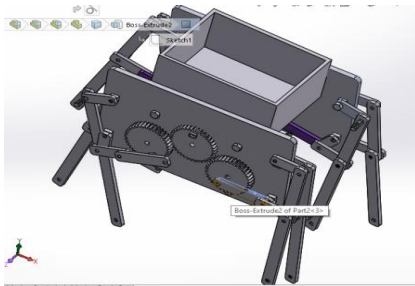


Fig. 5 Assembly

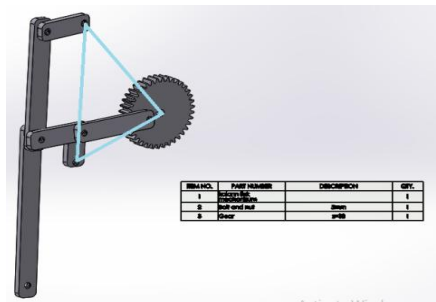


Fig. 6 Linkage mechanism

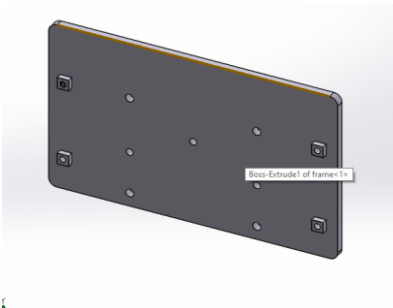


Fig.7 Frame

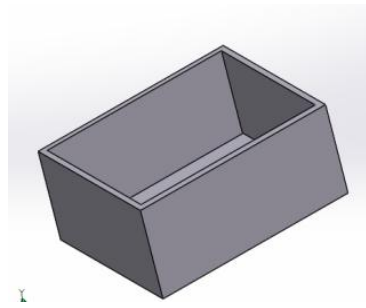


Fig. 8 Weight carrying box

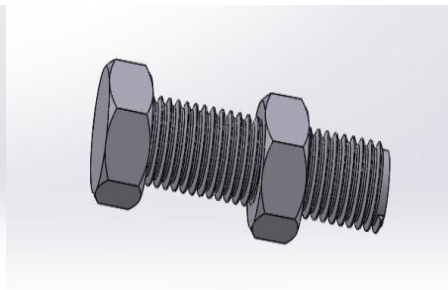
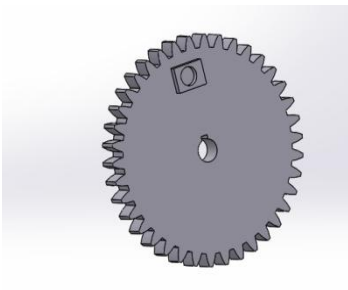


Fig.9 Gear and Nut bolt



Fig.10 Supporting shaft

After solving modelling of parts the calculation parts has be done.

➤ **CALCULATION**

The equation is named “Kutzbach criterion” for the linkage motion of a mechanism having plane motion. If ‘n’ is equal one than the motion of link is possible.

Number of D.O.F of mechanism is given by,

$$n = 3(i-1) - 2*j$$

Where, n= degree of freedom,

i = number of links,

j = number of binary joint

We have, D.O.F, $n = 3(6-1) - 2*7$

$$n = 1$$



The gear nomenclature is much important to find out the dimension of gear, in this design the gear is used is directly purchased from the market with the number of teeth in gear $Z=38$ and gear ratio $i=1$ with gear diameter =60mm.

Determined dimension of frame and weight carrying box,

As per the gear and link data calculate the frame and weight carrying box dimensions which was shown in below table 1.

Table 1. Weight caring capacity

| | Frame (mm) | weight carrying box (mm) |
|------------------------------|------------|--------------------------|
| Length | 250 | 160 |
| Width | 150 | 130 |
| Thickness | 5 | 5 |
| Length of supporting shaft | 150 | - |
| Diameter of supporting shaft | 8 | - |
| Height | - | 50 |

Theoretical calculations for Dynamic Analysis

In this robot leg mechanism, we fixed the rpm of motor and the distance which was travel by the robot without carrying the weight and with carrying the weight which was increased on every trail done by robot.

For the,

Angular velocity of crank (ω) = $2\pi n/60$ with the higher than formula the angular speed of the crank speed $n= 30$ rpm.

Angular velocity (ω) = $2\pi n/60$

$$= \frac{2 * 3.14 * 30}{60}$$

$$= 3.14 \text{ rad/sec}$$

Linear velocity (v) = ωr m/sec

$$= 3.14 * 0.110$$

$$= 0.3454 \text{ m/sec}$$

Form the above calculation data, manufacturing the robot leg mechanism with the use of wooden material, one battery and wire connection mechanism which was shown in the below result table 2.

IV. RESULT

In this robot leg mechanism we fixed the two measurement, one is rpm of the battery that is 30 rpm and second one is distance which are travel by the robot with carrying increasing weight at every trial.

Table 2. Weight caring capacity

| TIME(sec) | WEIGHT(gm) |
|-----------|------------|
| 23 | 250 |
| 24 | 500 |
| 23 | 700 |
| 25 | 1000 |
| 26 | 1200 |
| 26 | 1250 |
| 30 | 1500 |
| 37 | 1700 |
| 38 | 1750 |

V. CONCLUSION

In this current concept we used wooden as material for making legs and other structures and the motor is fixed at 30 rpm on the basics of robot material. This robot will carry nearer to 2 kg weight and travel. After considering all the practical trial done by robot, we have conclude that as the weight increases the travel time was cover by the robot is increases. It can easily travel up to 10° to 20° of slope. Other tires robots have high possibility of getting slip, this concept will move forward on legs with power. Even if one mechanism of one leg fails or get cracks it keeps on moving with support of other legs.

But this can be increased much by changing the material of suitable type and fitting bearing in every leg of robot and using other equipment there will increase in the efficiency of distance travel by robot with weight carrying capacity.

VI. FUTURE SCOPE

It is difficult to take turn quickly while moving at high speed in this robot also maintaining CG is quite difficult in this mechanism. Moreover, it cannot climb at a slope of 45° or more. With the changing in the material and attached the required equipment and mechanism get to fulfill this scope.

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