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Design and Manufacturing of Six Leg Moving Support Mechanism

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Abstract- *In some circumstances it is mandatory to carry a heavy load, reach remote places where human access is not viable. In such cases a device can be designed with the help of electro-mechanical system which will prevail over above problem. The literature observes that as the number of legs increases, possibility of stability and operation also increases. The intent of this project work is to design a six-leg support mechanism fully mechanical designed and operated. Concept designing and 3D Modelling is done using Solidworks 3D designing Software and Finite Element Analysis software ANSYS Workbench 15.0 is used to find the stability of the device for load carrying capacity. Fabrication of Six leg support mechanism will be done using Steel plates and Laser cutting operation. These variety of support mechanism will be helpful in rescue operations, reaching in compact places, carrying load on uneven surfaces. Such systems can be optimized by placing sensors and camera to find the obstacles in the travel path.*

Key Words: Load Lift, Solidworks CAD, Cost Optimise

1. INTRODUCTION

The invention provides a walking device which stimulates in manner of a legged animal. The device includes a frame with spaced axial mounts, a leg, axially connected upper and lower rocker arms which limit reciprocating leg motion. The leg is driven by a connecting arm powered by a rotating crank. The position and configuration of the axial connecting sites establish a prescribed orbital path that the foot undertakes with each revolution of the crank. Both rocker arms and the crank are axially mounted to the frame. The leg has a hip joint axially connected to the upper rocker arm for limiting hip motion, a foot and a knee joint axially connected to the connecting arm. The connecting arm has three axial connecting sites, one for connecting to the knee, another to the crank, and a third connecting site defined as a centrally disposed elbow joint connecting site which connects onto the lower rocker arm and limits knee joint motion. Under power, crank rotation is transferred to the connecting arm causing the leg to move in an accurate reciprocating movement of a restricted actual pathway which stimulates the gait of the legged animal.

1.1 Legged Mechanism

The main advantage of legged robots is their ability to access places impossible for wheeled robots. By copying to the physical structure of legged animals, it may be possible to improve the performance of mobile robots. To provide more stable and faster walking, scientists and engineers can implement the relevant biological concepts in their design. The most forceful motivation for studying legged robots is

- To give access to places which are dirty
- To give access to places those are dangerous
- Job which are highly difficult

Legged robots can be used for rescue work after earthquakes and in hazardous places such as the inside of a nuclear reactor, giving biologically inspired autonomous legged robots' great potential. Low power consumption and weight are further advantages of walking robots, so it is important to use the minimum number of actuators. In this context, an objective is set in this project to develop a six- legged mobile robot whose structure is based on the biomechanics of insects.

1.2 Application

It would be difficult to compete with the efficiency of a wheel on smooth hard surfaces but as condition increases rolling friction, this linkage becomes more viable and wheels of similar size cannot handle obstacles that this linkage is capable of. Toys could be developed that would fit in the palm of your hand and just large enough to carry a battery and a small motor. Six leg mechanical spiders can be applicable for the making of robots. It has a wide range of application in the manufacturing of robots. A large version could use existing surveillance technology to convert your television into a real-time look at the world within transmitting range. It would also relay commands from the remote to the spider bike additional frequencies could be used to operate manipulators for retrieving the mail during unfavorable weather or taking the dog out. In toy industries for making robotic toys it has got many applications. It can also be used for military purpose. By placing bomb detectors in the machines we can easily detect the bomb without harmful to humans. It can be used as heavy tanker machines for carrying bombs as well as carrying other military goods.

1.3 Objective

- To design a six-leg moving support mechanism which can be used where humans are not able to access due to compact regions.
- To design a six-leg moving support mechanism which can be used with additional attachments such as screw jack (i.e. for lifting of vehicles) etc.

- To design a six-leg moving support mechanism with high strength and simple mechanism.

1.4 Problem Definition

It is difficult for humans to reach in compact places, or during search and rescue operations in disaster areas where electricity is not available. So there is a need to design a six leg moving support mechanism with low cost and simple mechanism which can carry out the operations. Which can be easy to operate and effective for carrying out the operations.

1.5 Methodology

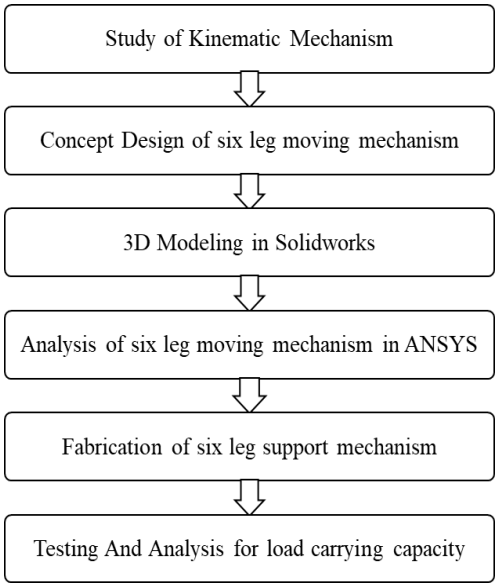
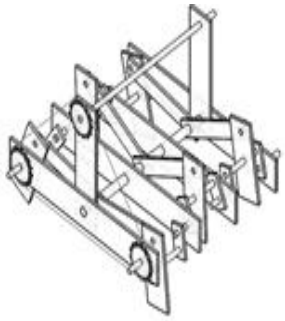


Fig -1: Methodology

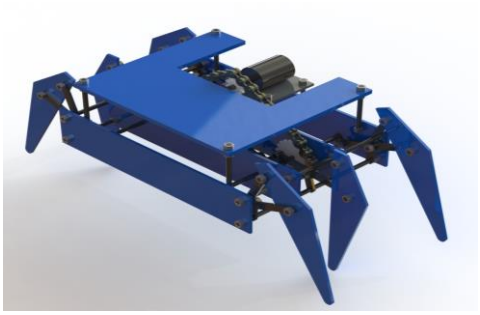
2. CONCEPT DESIGN & CAD MODELING

Concept design is the very first phase of design, in which drawings or solid models are the dominant tools and products. The concept design phase provides a description of the proposed system in terms of a set of integrated ideas and concepts about what it should do, how it should behave, and what it should look. It includes the design of interactions, experiences, processes and strategies. It helps to create a user interface which is easy to understand and interpret.



(a) Concept Design 1

(b) Concept Design 2



(b) Concept Design 3

Fig -2: Options Concept Design of Six Leg Mechanism

Concept Design 3 selected for design of six leg Mechanism This mechanism is derived from concept design 1. Simple Klann linkages are used in this mechanism. Gears and sprocket are on the inner side of the mechanism. Platform is present where additional attachments can be placed. This mechanism has good strength to handle heavy loads. Mechanism can work on battery. Additional attachments such as camera and sensors can be placed.

2.1 CAD- Solidworks Design

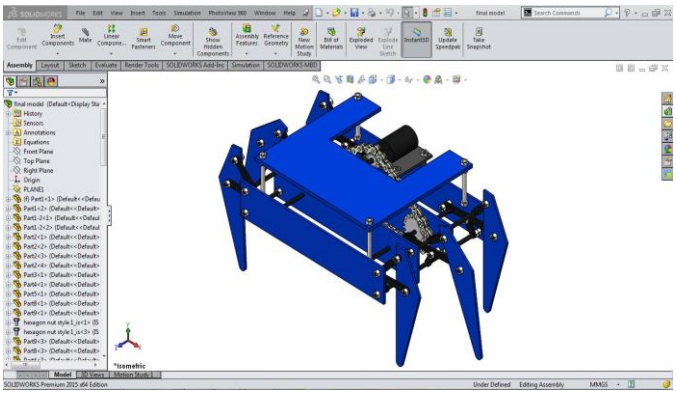


Fig -3: Solid Model Design in CAD

Part List

Table -01: Part List

ITEM NO.	PART NUMBER	QTY.
1	Part no 1	2
2	Part no 2	2
3	Rod of length 188mm Ø6mm	4
4	Link 4	8
5	Link 1	6
6	Link 2	6
7	Link 3	6
8	Leg	6
9	Hexagonal Nut	66
10	Rod of Length 77mm Ø 6mm	4
11	Part no 3	1
12	Rod of length 40mm Ø 6mm	4
13	Top Plate	1
14	62mmRod	4

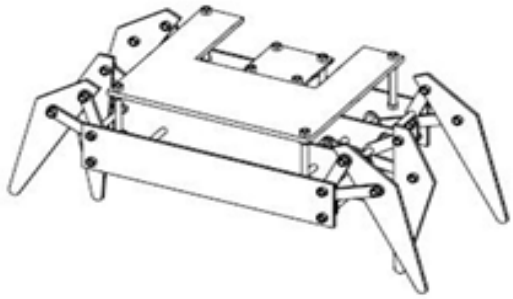


Fig -4: Part List of Model

3. FEA ANALYSIS & SIMULATION

Finite element analysis helps predict the behavior of products affected by many physical effects.

Step of FEA Analysis

Step 1: Working window of FEA software will open.

Step 2: Open Static Structural from Analysis system which is present on left side of window.

Step 3: Double click on Engineering Data for selection of material. Click on Engineering Data Sources. To assign material to component which is not present in general materials for that add material to library by giving their properties. Write name of material at bottom of Engineering Data Sources. Give location to material then add desirable properties by click on properties from left window

Step 4: Now right click on the geometry and select replace geometry, then browse the step format file of six leg moving mechanism.

Step 5: Double click on model and assign material to the geometry.

Step 6: Now mesh the geometry with course mesh size of 5 mm as shown below.

Step 7: Now give the boundary conditions to the geometry of six leg moving mechanism as shown below.

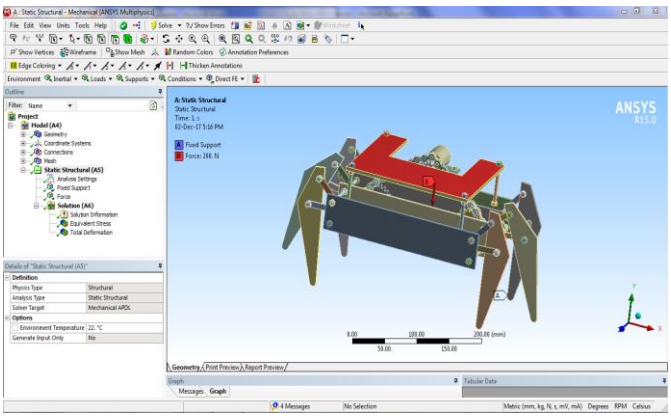


Fig -5: Boundary conditions assigned to the geometry of six leg moving mechanism

3.1 Simulation of Load lifting mechanism

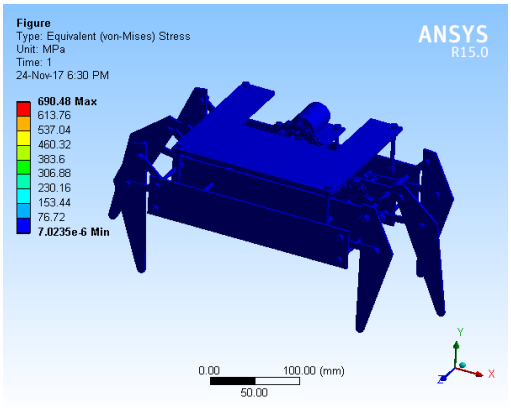


Fig -6: Von misses stress in geometry of six leg moving mechanism

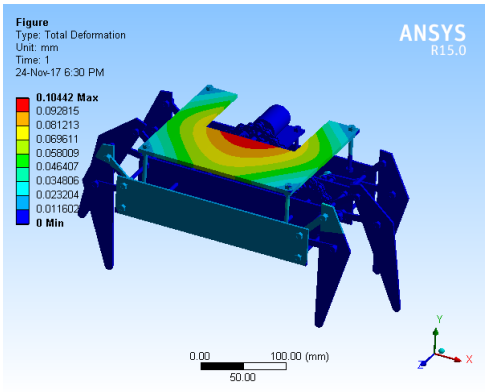


Fig -7: Displacement in Six leg moving mechanism

4. RESULTS

Table -02: Results

Sr.no.	Load	Stress	Displacement
1	200	7.02×10^{-6}	0.104

FEA results shows the stress and Displacement in the six-leg walking support mechanism when a load of 200 N is applied on it.

3. CONCLUSION

Six-leg moving support mechanism is developed using simple Klann's linkage mechanism. It is electro-mechanical mechanism which can also run on batteries. Six leg walker can be operated on uneven or rough surfaces. It can access compact places were humans cannot access. Strength of six leg walker is high so it can also be used for carrying loads on uneven surfaces. Adding night vision cameras and obstacles detecting sensors to the six-leg walker it can be used for surveillance at night.

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