

Improvement in Mobility of Mechanical Spider

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Abstract— As a different types of mechanical spider has been developed in past few years, that can walk on rough plane but only in forward and backward direction, according to the recent study on mechanical spider which moves in left or right direction, but this is the major disadvantage of mechanical spider .So this research study is mainly focused on improving the mobility of mechanical spider.

Key words: Mechanical Spider, Gear and Pinion, Arduino

I. INTRODUCTION

This research is useful in hazardous material handling, clearing minefields, or secures an area without putting anyone at risk .The military, Explosive Ordinance Disposal units, and security system could also benefit from applications of mechanical spider. It would perform very well as a platform with the ability to handle stairs and other obstacles^{[1][14]}. This research relates to a mechanism that involves enabling the arms of a rover to traverse up steps / rocks and still be able to take the shocks of uneven or rough terrain. The primary use of the mechanism discussed in this paper is to allow extraterrestrial rovers to climb high stepped terrain and have a suspension system in place to provide restoring force for the arms to come down and provide traction for the wheels over the ground. Such a mechanism allows the rover to travel uncharted and unexplored terrain^{[18][14]}.

II. CONSTRUCTIONS

A single leg is a six-bar linkage that consists of the plate, pinions, electric motor, crank, connecting plate, lower arm, leg and an upper arm. The ground points for the upper and lower rocker in this configuration are vertically in line to allow a coupled pair of legs to articulate like the front wheels of a typical car for steering.

The body is made of aluminum because aluminum is light in weight and it is very important to reduce the weight of device as much as it is possible. Also other parts i.e. links are made of aluminum. Four gears and two pinions made of aluminium material are used.

Electric motor is mounted on frame and pinion is connected at the shaft of electric motor. Two gears are in mesh with pinion on both side with the help of shaft and crank. The leg has a pin joint axially connected to the upper arm in order to limit pin motion and a knee joint axially connected to connecting plate. All links and final assembly is modeled in Creo parametric 3.0 and autodesk 2k16 as shown in figure.

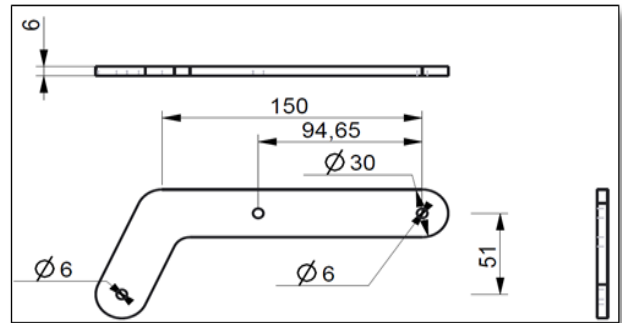


Fig. 1: Link 1 - Connecting plate

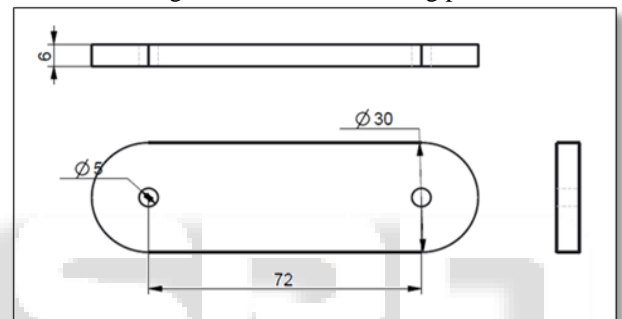


Fig. 2: Link 2 - Lower Arm

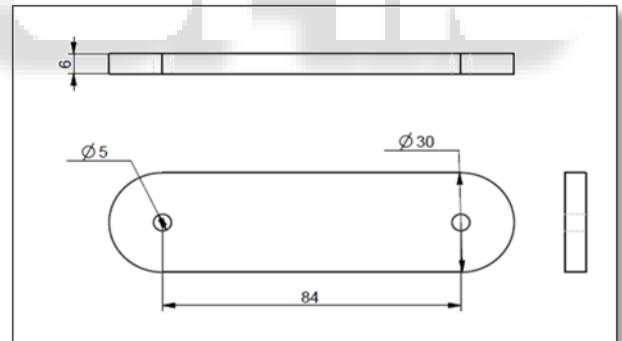


Fig. 3: Link 3 - Upper Arm

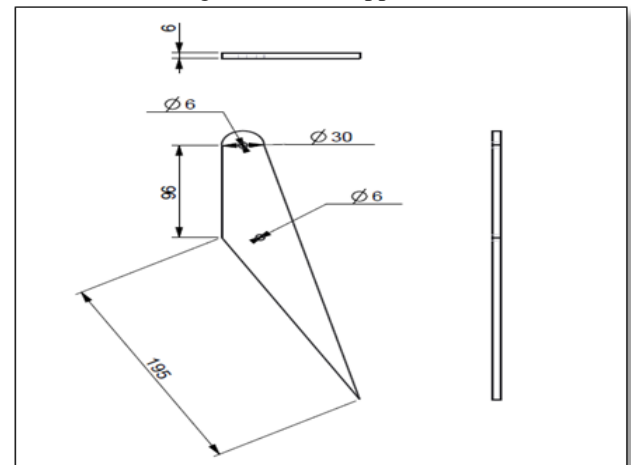


Fig. 4: Link 4 - Leg

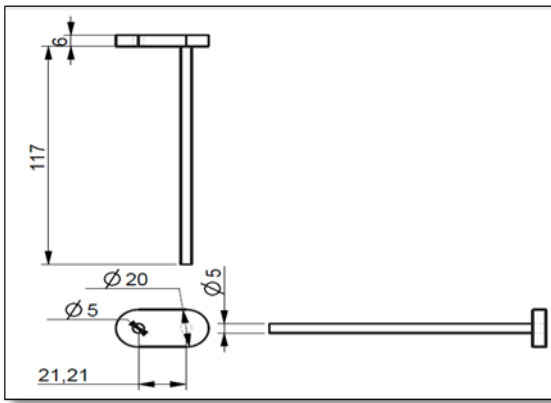


Fig. 5: Link 5- Crank

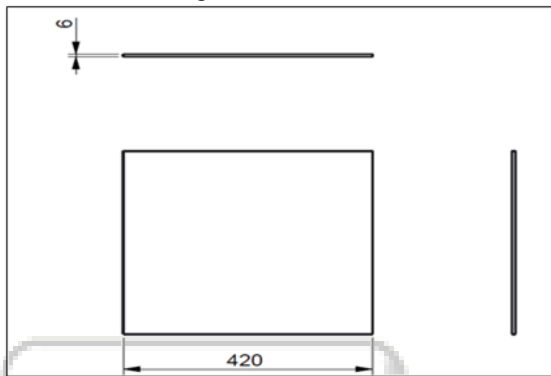


Fig. 6: Base plate

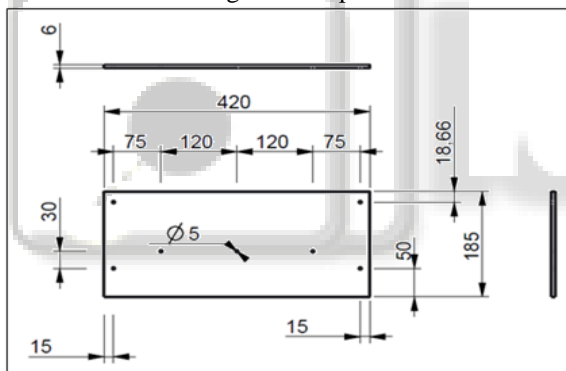


Fig. 7: Vertical plate (Joint this with base plate)

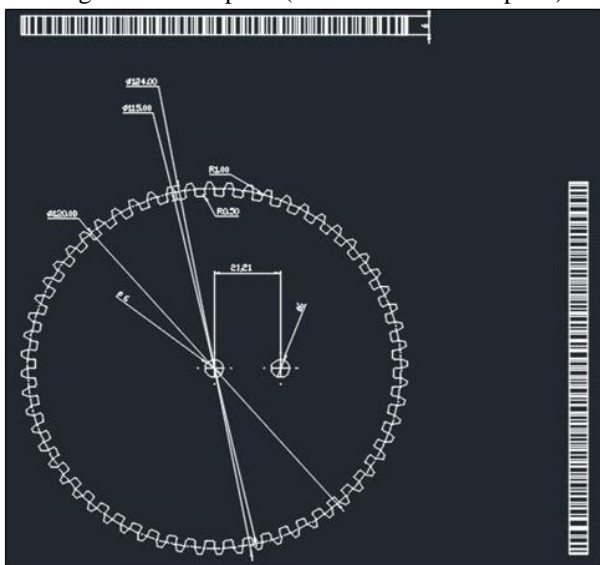


Fig. 8: Gear and Pinion

Gear Calculation:

No. of teeth

$$Z1 = Z2 = 60$$

Module(m) = 2

Outside diameter (OD) = 124mm

$$\text{Pitch circle diameter (PCD)} = m \times Z1 \\ = 120\text{mm}$$

Pressure angle = 20°

Tooth thickness = 3.14159mm

Addendum (h_a) = 2mm

Deddendum (h_d) = 2.5mm

Depth of tooth(h) = 4.6mm

Bore diameter = 6mm

III. WORK METHODOLOGY ADOPTED

- 1) So purpose of this research is to design a mechanical robot that can steer or turn in desired direction or a particular angle.
- 2) The material used in this research is aluminium.
- 3) The whole structure of spider has been designed on creo parametric or autodesk
- 4) The motor, which is used in this research is 20kg-cm (200 rpm) Gear motor.
- 5) The steering action takes place by changing the polarity of two motor.
- 6) The movement of spider will be perform by following methods:

MOTOR 1	MOTOR 2	MOVEMENT
Clockwise	Clockwise	Forward
Anti-clockwise	Anti-clockwise	Reverse
Clockwise	Anti-clockwise	Right or left
Anti-clockwise	Clockwise	Left or right

- 7) The further improvement in this research, where spider is controlled by Arduino by interfacing it with a mobile application.
- 8) That mobile application has developed at android studio.

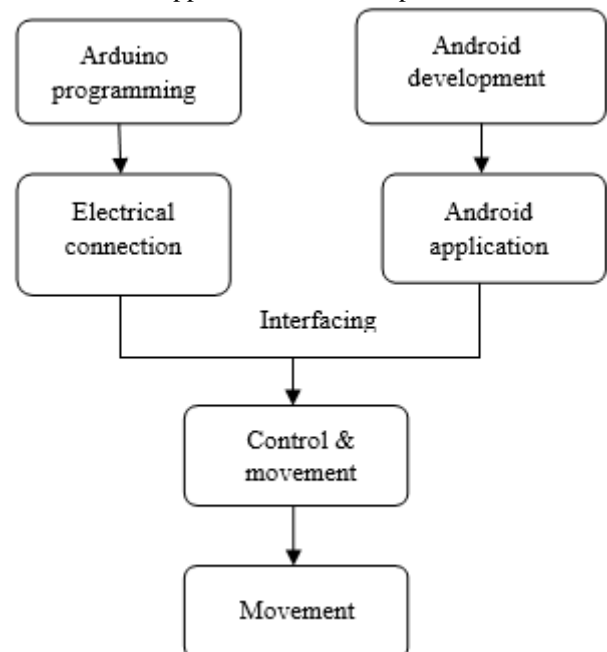


Fig. 9:



Fig. 10: Actual Model

IV. ADVANTAGES

- 1) Highly efficient as replacement of wheels.
- 2) Constructing cost is low.
- 3) Require less maintenance.
- 4) Capable of carrying heavy loads.
- 5) Easy to operate.

V. DISADVANTAGES

- 1) More power consumption.
- 2) Speed range is limited.
- 3) Running is not smooth.

VI. APPLICATIONS

- 1) It is useful on uneven surface.
- 2) It is useful in army for bomb detection and carry weapons.
- 3) It is useful in industries in place of different conveyors.
- 4) It is useful in carrying heavy weights.
- 5) It is useful for carrying objects through the river where using boats become costly.

VII. CONCLUSION

- 1) Thus in this research we have developed a method to substitute the function of wheel in order to overcome the difficulty of travelling on uneven surface.
- 2) This research has developed a mechanical spider that can steer in all direction along y-axis.

VIII. FUTURE SCOPE

- 1) Mechanical spider can be applicable for making robots.
- 2) A large version could use existing surveillance technology.
- 3) By placing bomb detectors in the machines we can easily detect the bomb without harming the humans.
- 4) Further improvement can be done by adding GPS locator into the machine to store the locations, where humans can't easily travel.
- 5) A spy camera would be useful for capture the images and store it, for future access.

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