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OHMSAT VEHICLE

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ABSTRACT

As the technology is getting updated day by day, the mechanical components which are manufactured are integrated with computer programs and electronic components. This integration of mechanical and electronic components or mechatronics makes it possible to design intelligent, reliable, versatile electromechanical systems such as industrial robots, aircraft simulators, automated assembly and autonomous vehicles.

The OHMSAT vehicle is integrated with computer programs, electronic and mechanical components. It is a spider-shaped vehicle which is flexible to handle. It has 6 links which are actuated mechanically and balances based on the terrain. The center of gravity is well balanced in this vehicle. The DTMF decoder enhances the feature of the vehicle. It provides us to control and regulate the vehicle using the keypad of mobile phones. The control range of the vehicle is very high due to DTMF decoder. It uses satellite communication to control the vehicle. These features help the vehicle to stand out of all other all-terrain vehicles.

***Keywords**: OHMSAT Vehicle, DTMF decoder.*

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1. INTRODUCTION

Mechatronics provides solutions that are efficient and reliable systems. Some **Mechatronic Systems** have microcomputers to ensure smooth functioning and higher dependability. Few examples of Mechatronics System are automated guided vehicles, robots, digitally controlled combust engines and machine tools with self-adaptive tools, aircraft flight control and navigation systems, and smart home appliances (e.g. Washers, dryers etc.).

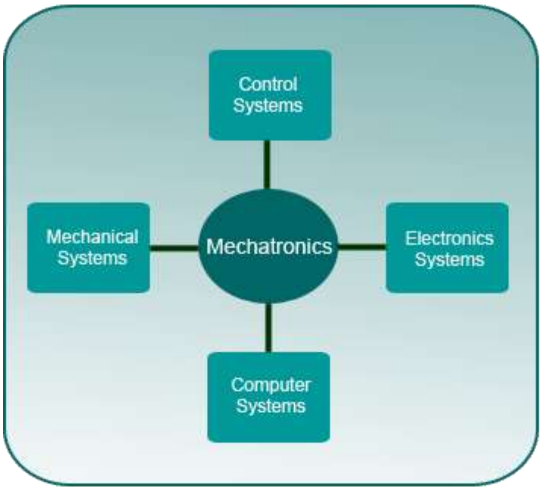

Fig. 1: Block diagram of a Mechatronics System.

1.1 All Terrain Vehicles

- An All-terrain vehicle (ATV), also known as a quad, quad bike, three-wheeler, four-wheeler or quadricycle, as defined by the American National Standard Institute (ANSI) is a vehicle that travels on low-pressure tires, with a seat that is straddled by the operator, along with handlebars for steering control.
- It can also be defined as "A small open motor vehicle with one seat and three or more wheels fitted with large tires, designed for use on rough ground". As the name implies, it is designed to handle a wider variety of terrain than most other vehicles.

OHMSAT Vehicle is a vehicle which is Octagonal shaped, Hexa driven, Mechanically actuated, Spider based, All Terrain Vehicle which can handle a wider variety of terrain (tough terrain, steep slopes, sand, mud, etc.); it is capable of providing high maneuverability and stability on every point of the terrain.

2. METHODOLOGY

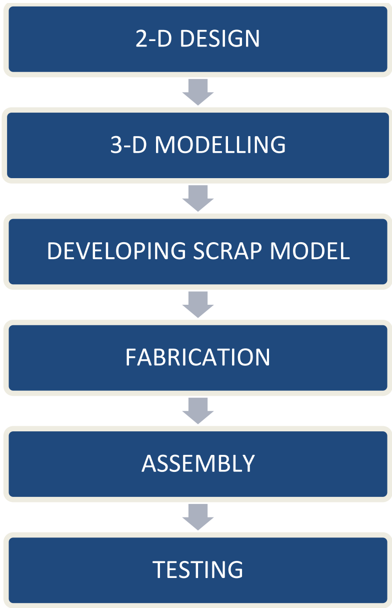

Figure 2. Flow diagram of research

2.1 Calculation

2.1.1 Calculation of an OHMSAT Vehicle:

An OHMSAT vehicle is designed by taking a reference shape of a Spider in which Centre of Gravity point remains within the body itself. Therefore the body will be stable as per the terrain acquired i.e. roll over of a body is not possible due its accurately calculated mechanically actuating links.

The centre of gravity plays an important role, as it is geometric property of any object. The center of gravity is the point at which the entire weight of the body is considered so that if supported at this point, the body would remain in equilibrium at any position. The stability of an object is extremely dependent upon its centre of gravity. To improvise the stability, the center of gravity point should remain stable or within the limited area.

As in case of OHMSAT Vehicle, the links are connected to the body such that the center of gravity concentrates on center point of the body as shown in the Fig. During the motion on rough terrains the center of gravity will remain stable inside the body as the links itself cover and constrain the motion of a vehicle in all possible terrain.

Using this geometric structure, we have assumed the reference outer circle radius as 370mm. In order to accommodate all the electronic components in the body, we have assumed the side of the octagon as 100mm. Therefore the distance between the body and reference circle is 250mm.

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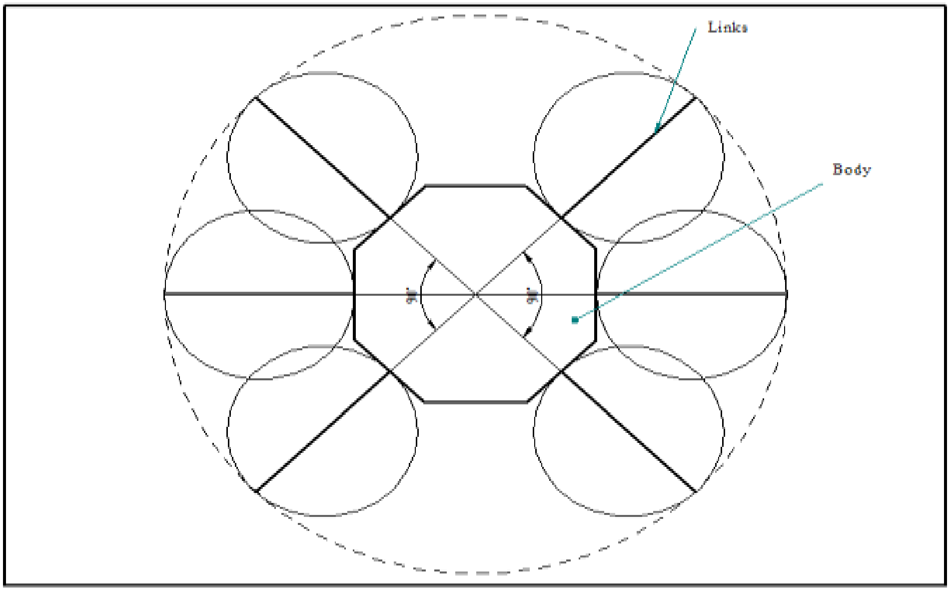

Fig.2.1.1 (a): Geometric structure of OHMSAT Vehicle

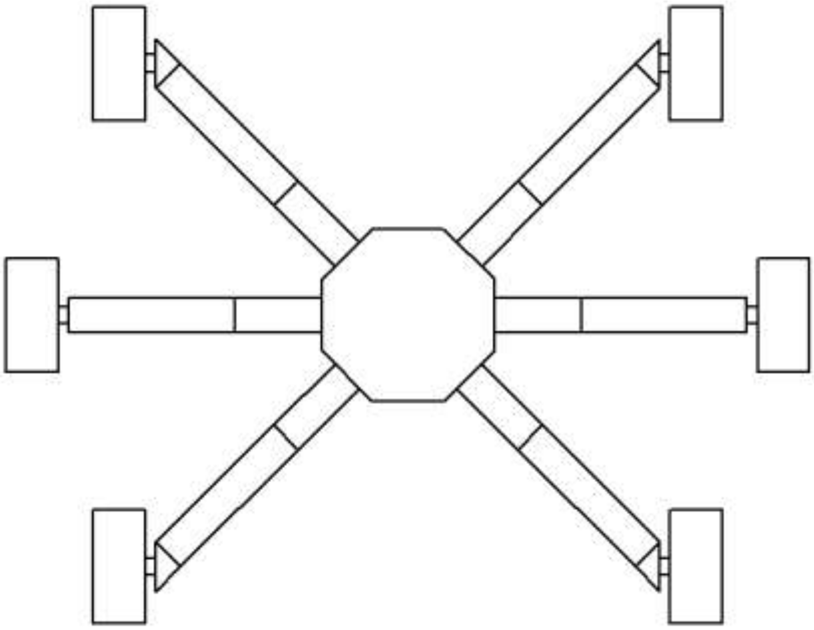

Fig. 2.1.1(b): Top View of an OHMSAT Vehicle with Links.

This length is shared between the two links i.e. Link1 and Link2 with the ratio of 1:4 respectively and also with respect to the angles to safeguard the Centre of gravity within the body.

Link1 is connected to the body by 45 degree and link2 is connected to the Link1 by 90 degree to attain stable arrangement of the vehicle.

Thus by sine and cosine function, we get Link1= 10cm and Link2= 26cm. Using this arrangement, we got the ground clearance as 160mm.

2.1.2 BODY:

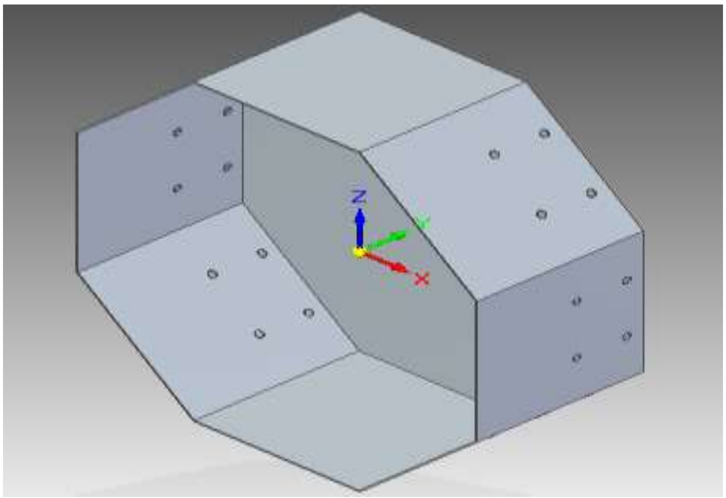

Fig. 2.1.2: Isometric view of the body.

- The body of an OHMSAT Vehicle is octagonal shaped with the length of 10cm of a side.
- The weight of the body is 1 kg.

2.1.3 LINK 1:

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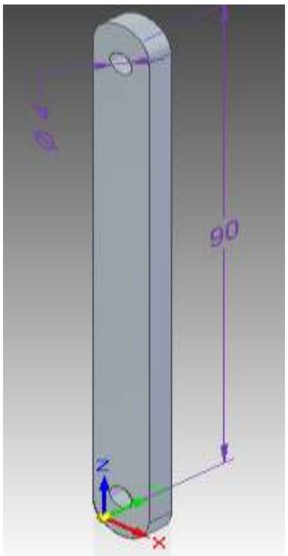

Fig. 2.1.3: Isometric view of Link 1 with the dimensions

- The material used for Link 1 is Aluminium which is of length 10cm, width of 1cm and thickness of 3mm.
- The mass of this Link is calculated while fabrication.
  We know that, density ∫ = mass/volume.
  Where,
  Density of Aluminum ∫ = 2700 kg /m^3.
  Volume= Length* Width* Height = (0.10* 0.01* 0.003) = 0.000003 m^3.
  Therefore,
  Mass of Link2= Density of Aluminum* Volume of Link 1.
  For 1 Link, M = (2700* 0.000003) = 8.1 grams.
  For 24 Links, M = (24*8.1) = 195 grams.

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2.1.4 LINK 2:

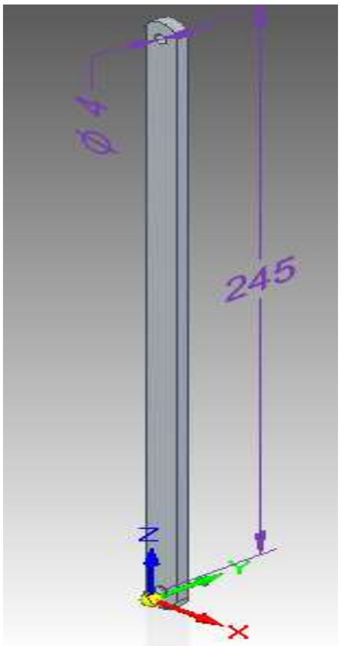

Fig. 2.1.4: Isometric view of Link 2 with the dimensions.

- The material used for Link 1 is Aluminum which is of length 26cm, width of 1cm and thickness of 3mm.
- The mass of this Link is calculated while fabrication.
  We know that, density ʃ = mass/volume.
  Where,
  Density of Aluminum ʃ = 2700 kg /m^3.
  Volume= Length × Width × Height = (0.26 × 0.01 × 0.003) = 0.0000078 m^3.
  Therefore,
  Mass of Link2 M= Density of Aluminum × Volume of Link 1.
  For 1 Link, M = (2700×0.0000078) = 21.06 grams.
  For 24 Links, M = (24×21.06) = 506 grams.

2.1.5 BODY CLAMP:

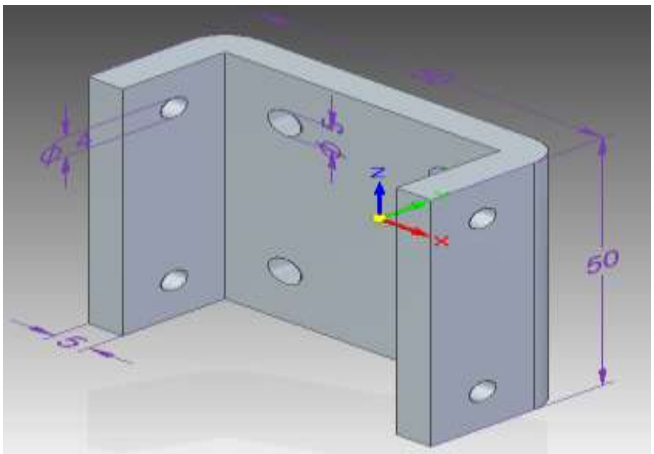

Fig.2.1.5: Isometric View of Body Clamp.

- The Material used for body clamp is aluminium with the length of 5cm, width of 5cm, and thickness of 4 cm. The body is extended for 1.5cm on either side with the thickness of 4cm.
- The mass of this clamp is calculated while fabrication.
  We know that, density ʃ = mass/volume.

Where,
Density of Aluminium ∫ = 2700 kg /m^3.
Volume of clamp, V1 = Length×Width×Thickness = (0.05×0.05×0.004) = 0.00001 m^3.
Volume of extended clamp, V2 = Length×Width×Thickness,
V2 = (0.05× 0.015×0.004) = 0.000003 m^3.
Volume of hole 1, V3 = (π/4) × (d^2) ×t = (π/4) × (0.004^2) ×0.004 = 5.0265×10^-8 m^3
Volume of hole 2, V4 = (π/4) × (d/2) ×t = (π/4) × (0.005^2) ×0.004 = 7.854×10^-8 m^-3.
Therefore, Total Volume V = V1 + 2V2 - 4V3 - 4V4.
V= (0.00001)+(2×0.000003)-(4×5.0265×10^-8)-(4×7.854×10^-8) = 1.548×10^-5 m^3
Mass of 1 Body clamp, M= Density×Volume = 2700×1.548×10^-5 = 41.809 Grams.
Mass of 6 Body clamps, M= 6×41.809= 251 Grams.

2.1.6 INTERMEDIATE CLAMP:

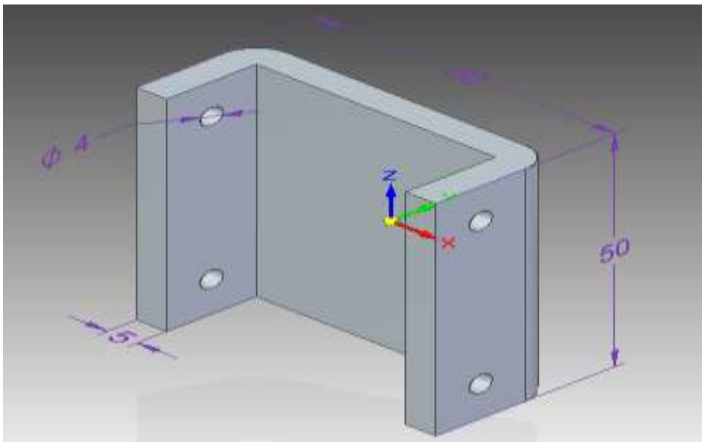

Fig.2.1.6: Isometric view of Intermediate clamp.

- The Material used for body clamp is aluminium with the length of 5cm, width of 5cm, and thickness of 4 cm. The body is extended for 1.5cm on either side with the thickness of 4cm.
- The mass of this clamp is calculated while fabrication.
  We know that, density ∫ = mass/volume.
  Where,
  Density of Aluminium ∫ = 2700 kg /m^3.
  Volume of clamp V1 = Length×Width×Thickness = (0.05×0.05×0.004) = 0.00001 m^3.
  Volume of extended clamp V2 = Length×Width×Thickness,
  V2 = (0.05×0.015×0.004) = 0.000003 m^3.
  Volume of hole, V3 = (π/4) × (d^2) ×t = (π/4) × (0.004^2) ×0.004 = 5.0265×10^-8 m^3
  Therefore, Total Volume V = V1 + 2V2 - 4v3.
  V= (0.00001) + (2×0.000003) - (4×5.0265×10^-8) = 1.58×10^-5 m^3.
  Mass of 1 Clamp, M = Density×Volume = 2700×1.58×10^-5 = 42.66 Grams.
  Mass of 6 Clamp, M = 6×42.66 = 256 Grams

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2.1.17 CLAMP TO WHEEL:

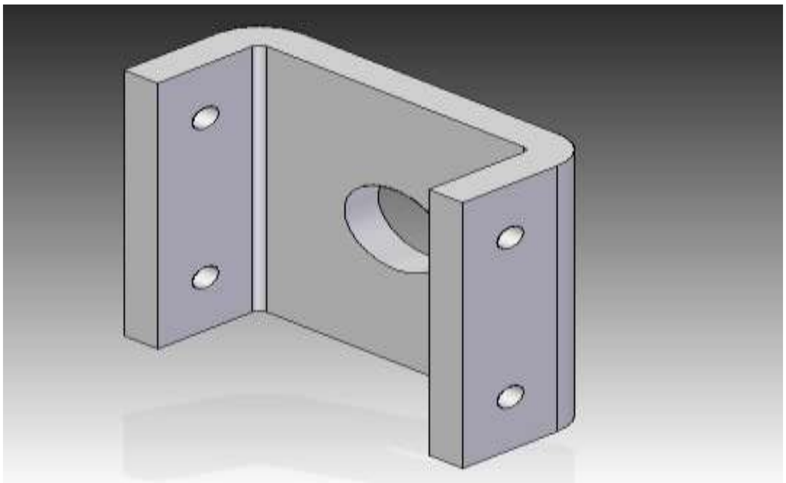

Fig.2.1.7: Isometric View of wheel Clamp

- The Material used for body clamp is aluminium with the length of 5cm, width of 5cm, and thickness of 4 cm. The body is extended for 1.5cm on either side with the thickness of 4cm.
- The mass of this clamp is calculated while fabrication.
  We know that, density ∫ = mass/volume.
  Where,
  Density of Aluminium ∫ = 2700 kg /m^3.
  Volume of clamp V1 = Length× Width× Thickness = $(0.05\times0.05\times0.004) = 0.00001\ m^3$.
  Volume of extended clamp V2 = Length×Width×Thickness,
  $V2 = (0.05\times0.015\times 0.004) = 0.000003\ m^3$.
  Volume of hole, $V3 = (\pi/4) \times (d^2) \times t = (\pi/4) \times (0.004^2) \times 0.004 = 5.0265\times10^{-8}\ m^3$
  Therefore, Total Volume V = V1+2V2-4v3.
  $V = (0.00001) + (2\times0.000003) - (4\times5.0265\times10^{-8}) = 1.58\times10^{-5}\ m^3$.
  Mass of 1 Clamp, M = Density×Volume = $2700\times1.58\times10^{-5}$ = 42.66 Grams.
  Mass of 6 Clamps, M = 6×42.66 = 256 Grams.

2.2 ELECTRONIC COMPONENTS:

2.2.1 Cell Phone Controlled Robotic Vehicle using DTMF Technology:

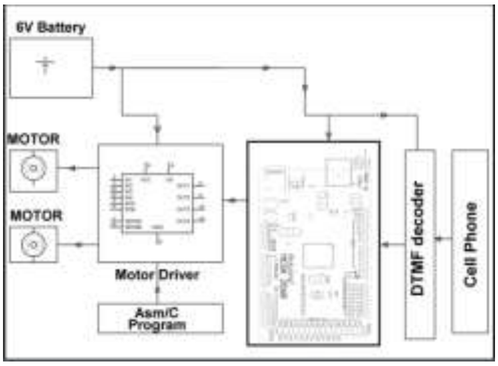

Fig.2.2.1: Circuit of Cell Phone Controlled Robotic Vehicle.

This technology helps in controlling the robot movement over long distance with a mobile phone. The proposed system uses a microcontroller of 8051 family to control the whole application. If a button is pressed to generate a corresponding tone in the user phone, the same tone can be heard at the receiver end of the cell attached to the robot, to operate the robot. This tone is called 'Dual Tone Multi Frequency' (DTMF) tone. The received tone is processed by the 8051 microcontroller with the help of the DTMF decoder. The microcontroller is preprogrammed to take the decision for any given input and output, wherein the motor drives the robot in forward and backward direction.

2.2.2 ARDUINO MEGA 2560:

Fig.2.2.2: ARDUINO MEGA 2560.

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins, 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC to DC adapter or battery to get started. The Mega 2560 board is compatible with most shields designed for the Uno and the former boards Duemilanove or Diecimila. The Mega 2560 board can be programmed with the Arduino Software (IDE).2.2.3 Controlling the vehicle mobility using DTMF Technology.

DTMF technology embedded in the vehicle will help to control the vehicle's mobility by pressing the keypad in the transmitter phone fed through a program.

The following are the numbers in the keypad used to navigate the vehicle:

NUMBERS	DIRECTIONS
1	FORWARD (SLOW)
2	FORWARD
3	FORWARD(FAST)
4	LEFT
5	STOP
6	RIGHT
8	REVERSE

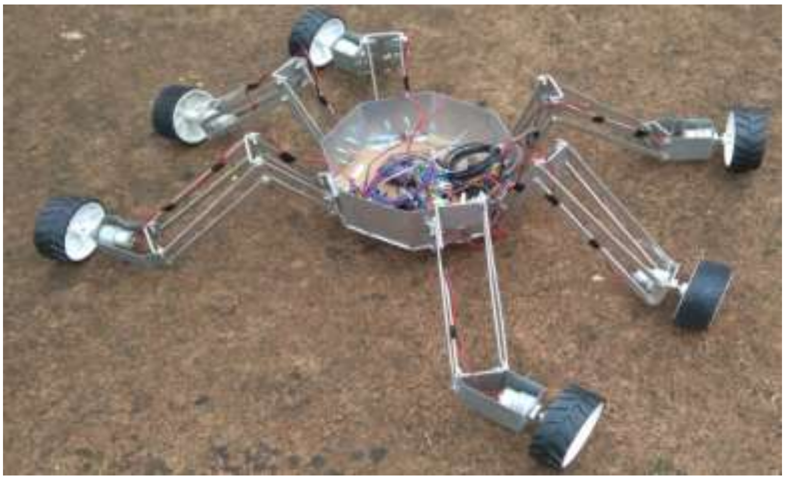

Fig.2.2.3: Assembled image of an OHMSAT Vehicle

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3. RESULTS AND CONCLUSIONS

- Since we have taken the spider shape as reference, we are successfully achieved in building the model in the shape of a spider.
- We used 6 arms round the body, thus provides stability. Due to the action of links and springs provided, vehicle will self balance and prevent rollover of vehicle.
- The control range of the vehicle is very high, thus it can be used in hazardous areas, hilly areas etc.

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