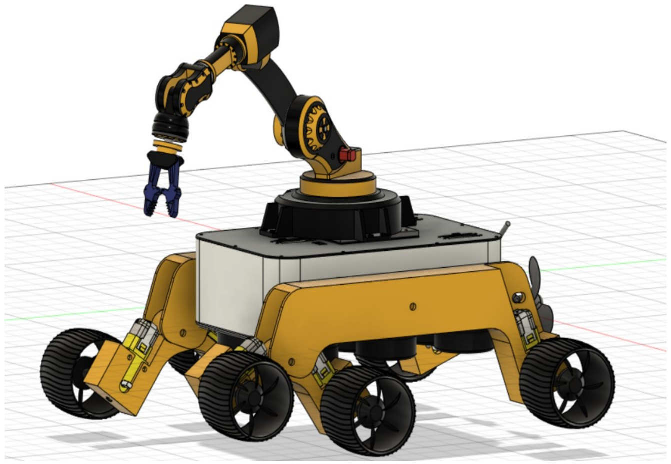
TEAM MEDEXTROUS

SEMI-AUTONOMOUS AMPHIBIOUS ROVER



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OBJECTIVE

Semi-autonomous amphibious rover is a multi-usage rover which can walk on any terrain and the water. Its main objective is that it can go on the water surface to clean any garbage or debris, used as a lifeguard on beaches, in military applications for naval surveillance purposes, for inspection of deep tunnels, sewerage monitoring and in disasters like earthquakes and floods rescue.

EXISTING TECHNOLOGY

Rovers at present are not capable to go on the water and as well as land. The Concept of amphibious vehicles is there but they dont meet up the multipurpose demands which our rover does at a time. They are heavy, with slow speed, and with complex designs. Also, these vehicles cannot walk on every terrain.

Rover in Water

Rover in Land

ABSTRACT

Semi-autonomous amphibious rover is a driver-less land/water transport which can walk on any terrain capable of navigating itself using an intelligent control system with light weight approx 1.5 - 2kg with high speed.
The Rover includes heat sensors, robotic arm for pick and place and cameras for surveillance purpose.
It is made such that it can work on both land using Rocker-bogie mechanism as well as on water by simply providing it with a waterproof hull and propellers.

Semi-autonomous Amphibious Rover

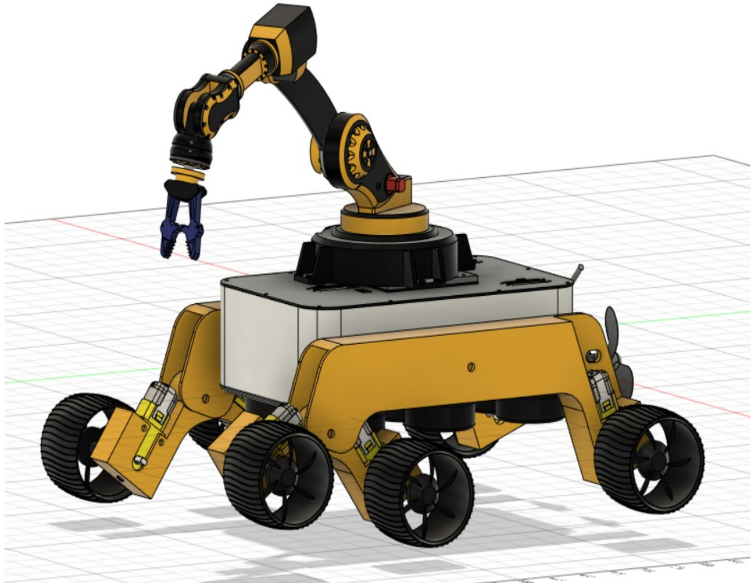
DESIGN/WORKING

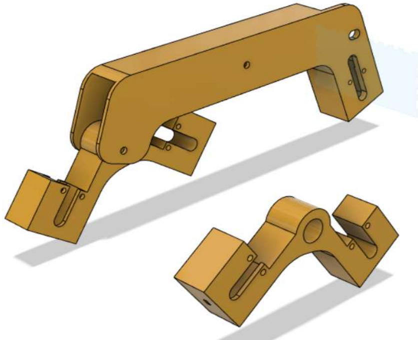
Design is made on Fusion 360 software by using a certain set of parameter such as load to be handled, dimension constraint,speed , etc. Design of each and every component such as main chassis, motor, suspension, wheel, propeller, robotic arm etc. and the analysis of the same are done using ANSYS software. Fabrication of chassis and assembly of various components is done is shown in the subsequent section below and analysis is also done.An Alternative of the hull is that the floating body will be made up of inflatable cylindrical rafts which help the rover to ride in the water. Rover will have two motors which will be controlled semi-autonomously via wireless transmission for manual control using Arduinos. Rocker-bogie mechanism is used here such that rover is suitable for walking on every terrain. A robotic arm is also attached for pick and place and for cleaning purposes using Arduino.

The rover is controlled control semi-autonomously by using GPS. We had to use APM v2.6 microcontroller to fulfill this challenge which has an integrated environment. The Add-ons such as heat Sensors, Cameras, and Robotic arm are also attached.

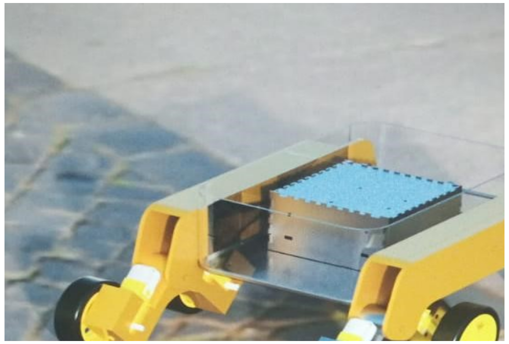
At the first design of various parts like motor assembly, gearbox assembly, suspension assembly are to be done on Fusion 360 software. After modelling, all the components is assembled to get the final assembly. After Getting the basics design parameters of the hull theoretically further design of a 3D hull is done. After designing all the parts and assembling all them, it is necessary to analyze the design for stress and strain. Wiring and circuit are shown separately by another model.

Calculation is done for finding the torque at output shaft of the gearbox for a given motor and dimension of raft skirt.

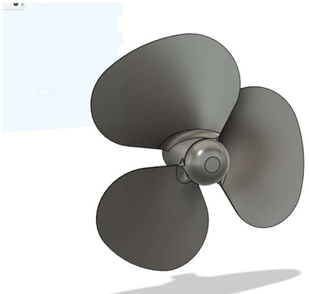




Rocker-Bogie



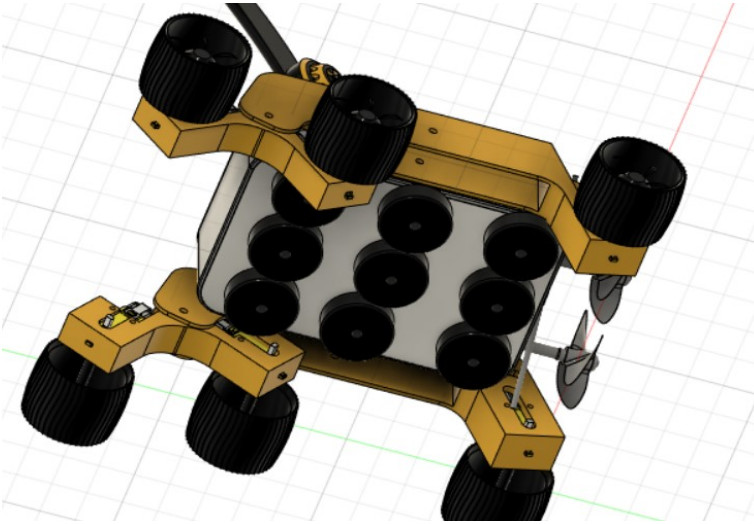
Hull with chassis and motor box

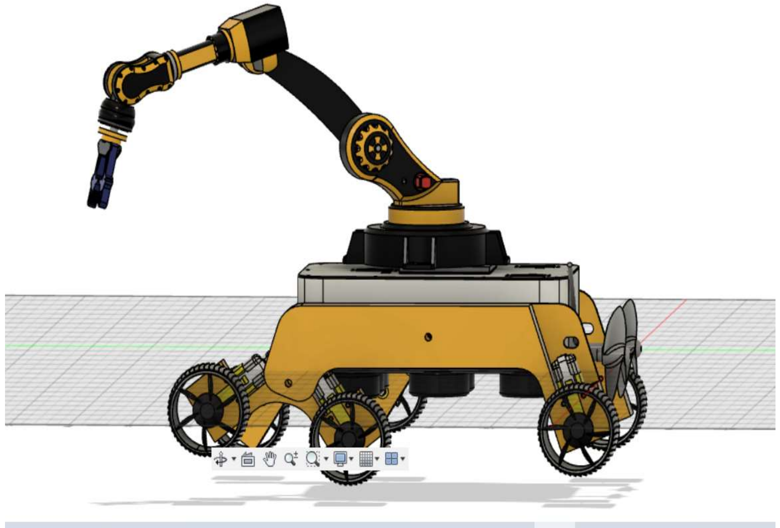


Propellers

Wheels

To see formation of semi-autonomous rover please refer to this link:
https://drive.google.com/file/d/17jvnVhYt1G8Twe9zk6R9BhTGetiUEWGQ/view?usp=drivesdk





Floaters

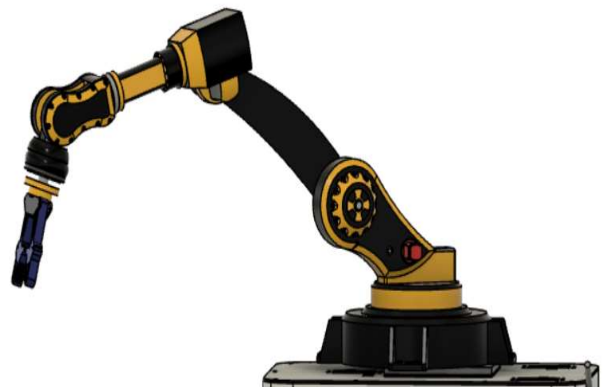
Side view

To see the motion of rover please refer to this link

https://drive.google.com/file/d/19GH9Ch6EePMG43luXUyQJ5IhQW-0QIMV/view?usp=drivesdk

Arm Jaws

Arm



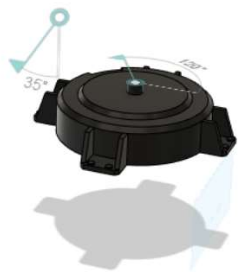
Robotic Arm

Gripper

Connector

Wrist

Forearm

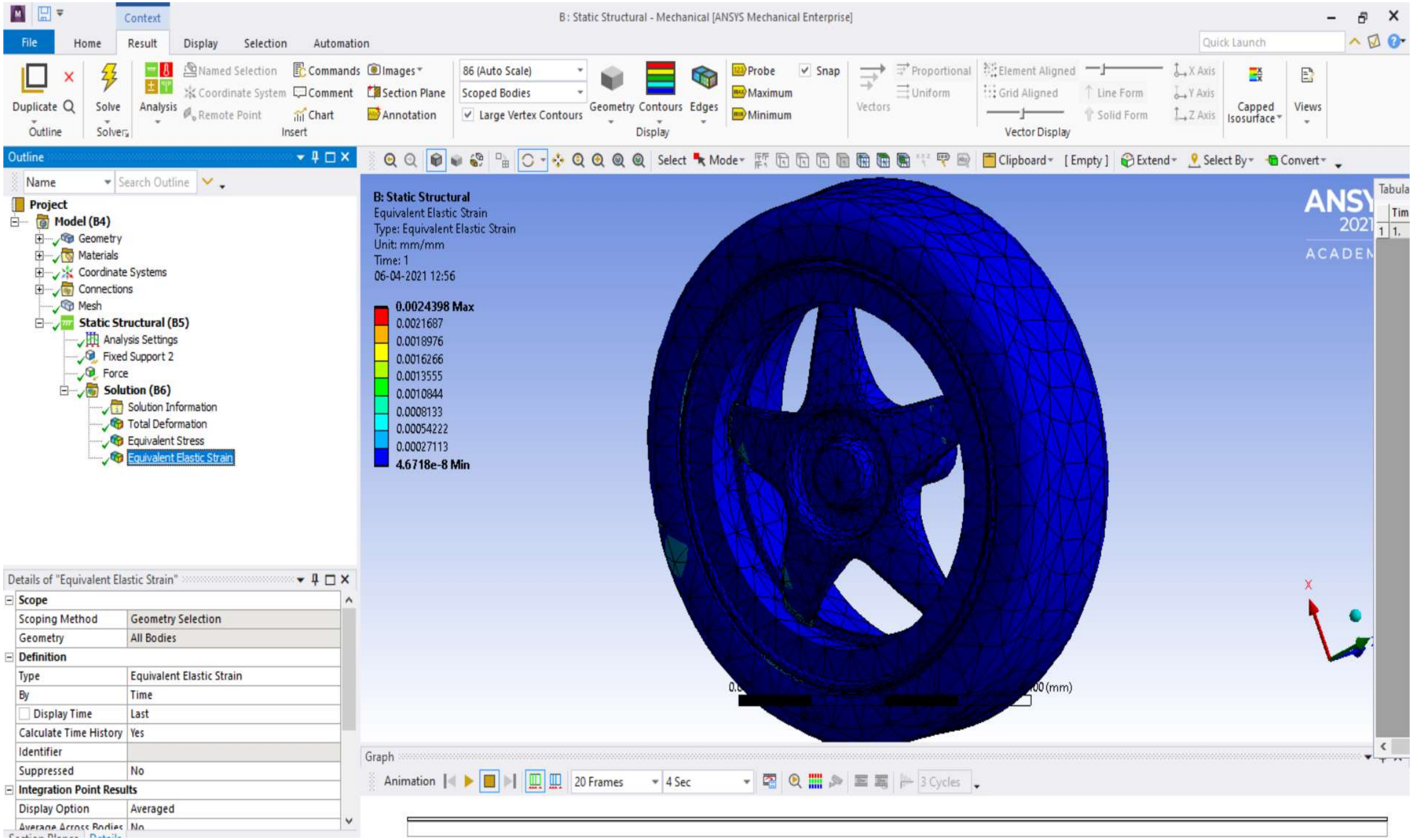


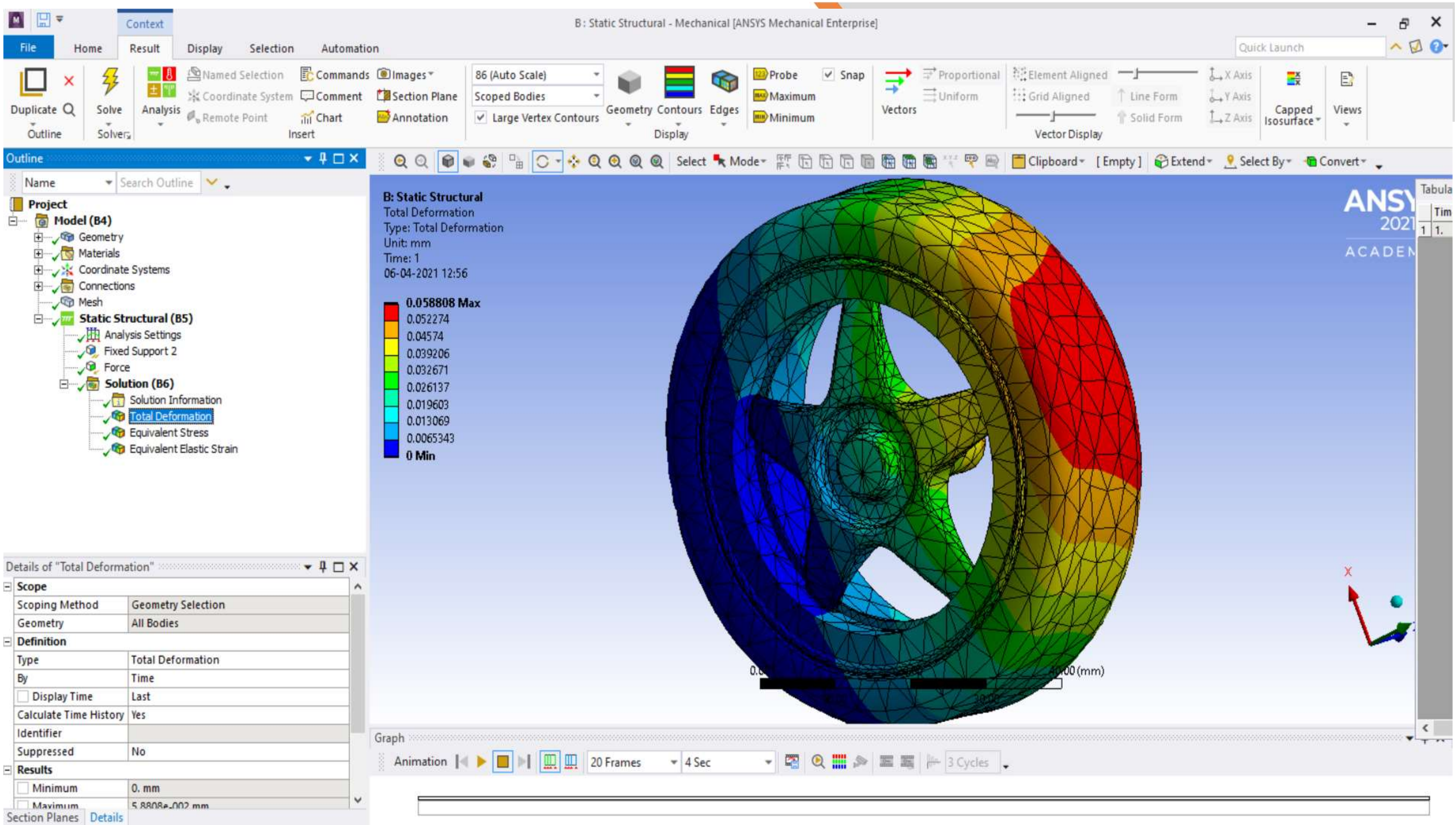
Base

Shoulder

SIMULATION

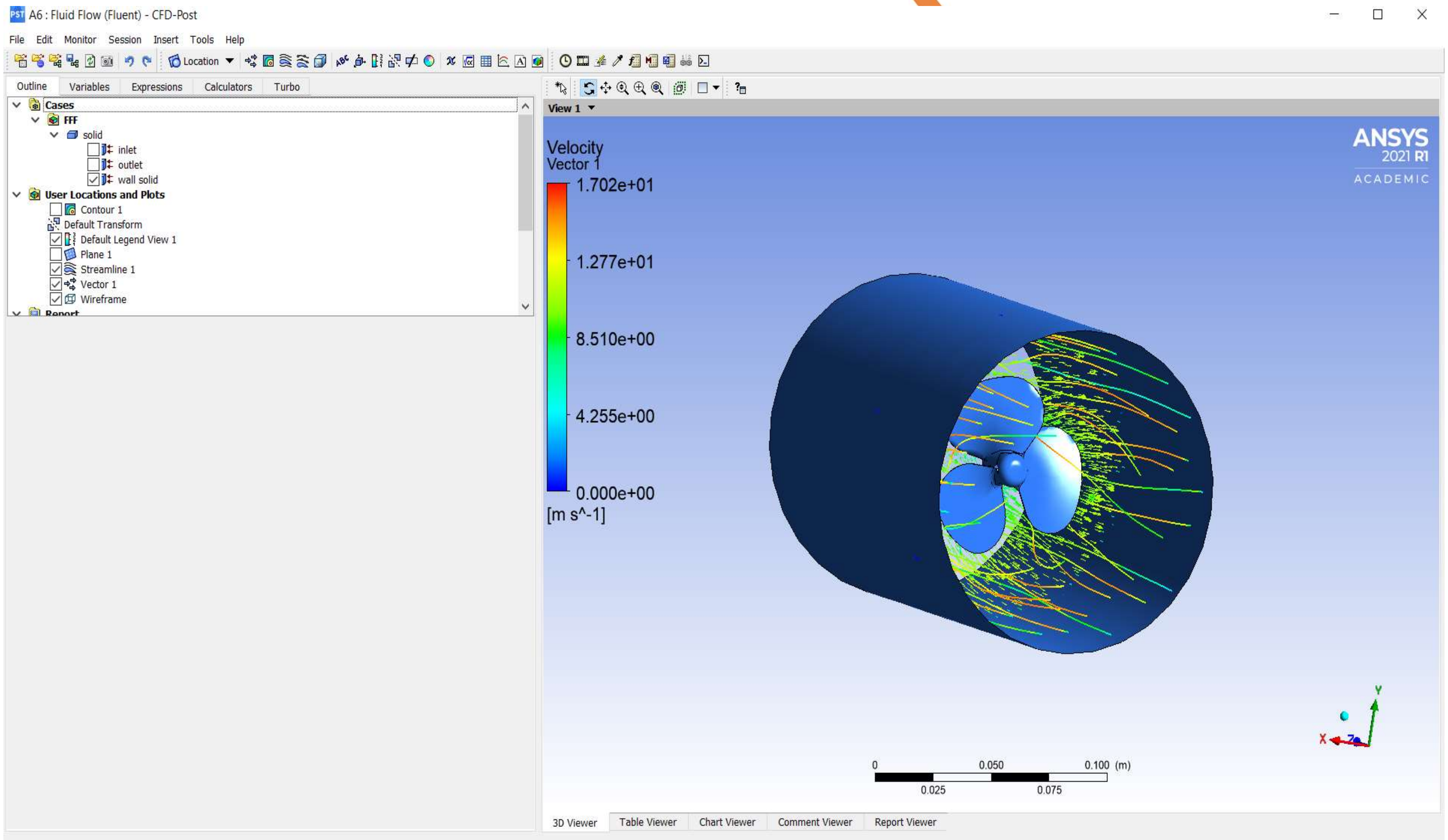
STRUCTURAL STRESS ANALYSIS OF WHEELS





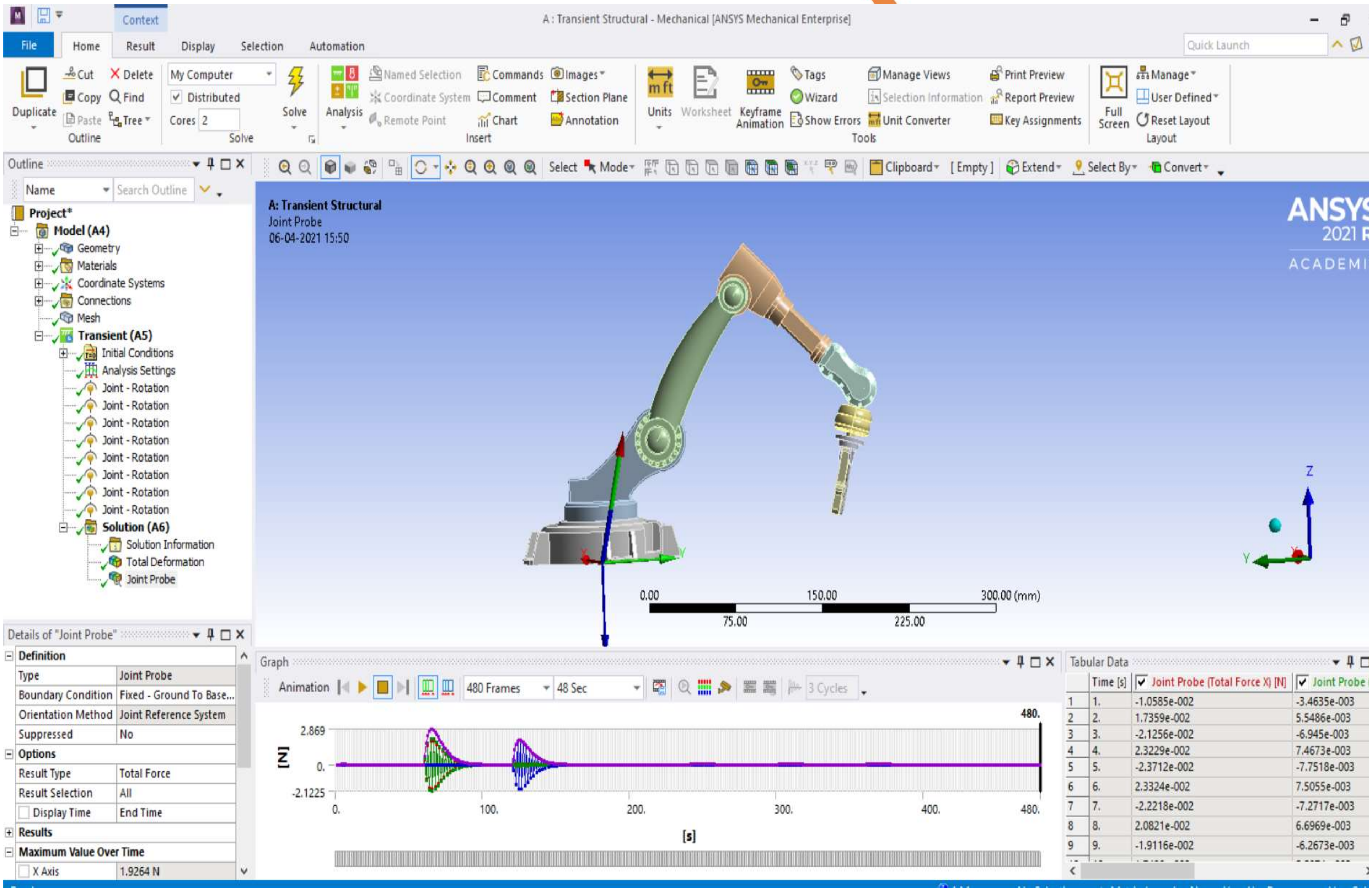
To see structural stress analysis of wheels please refer to the link given below:
https://drive.google.com/file/d/170SKWviaa5eKNV0bdavDgBF4D9ldXPTh/view?usp=drivesdk

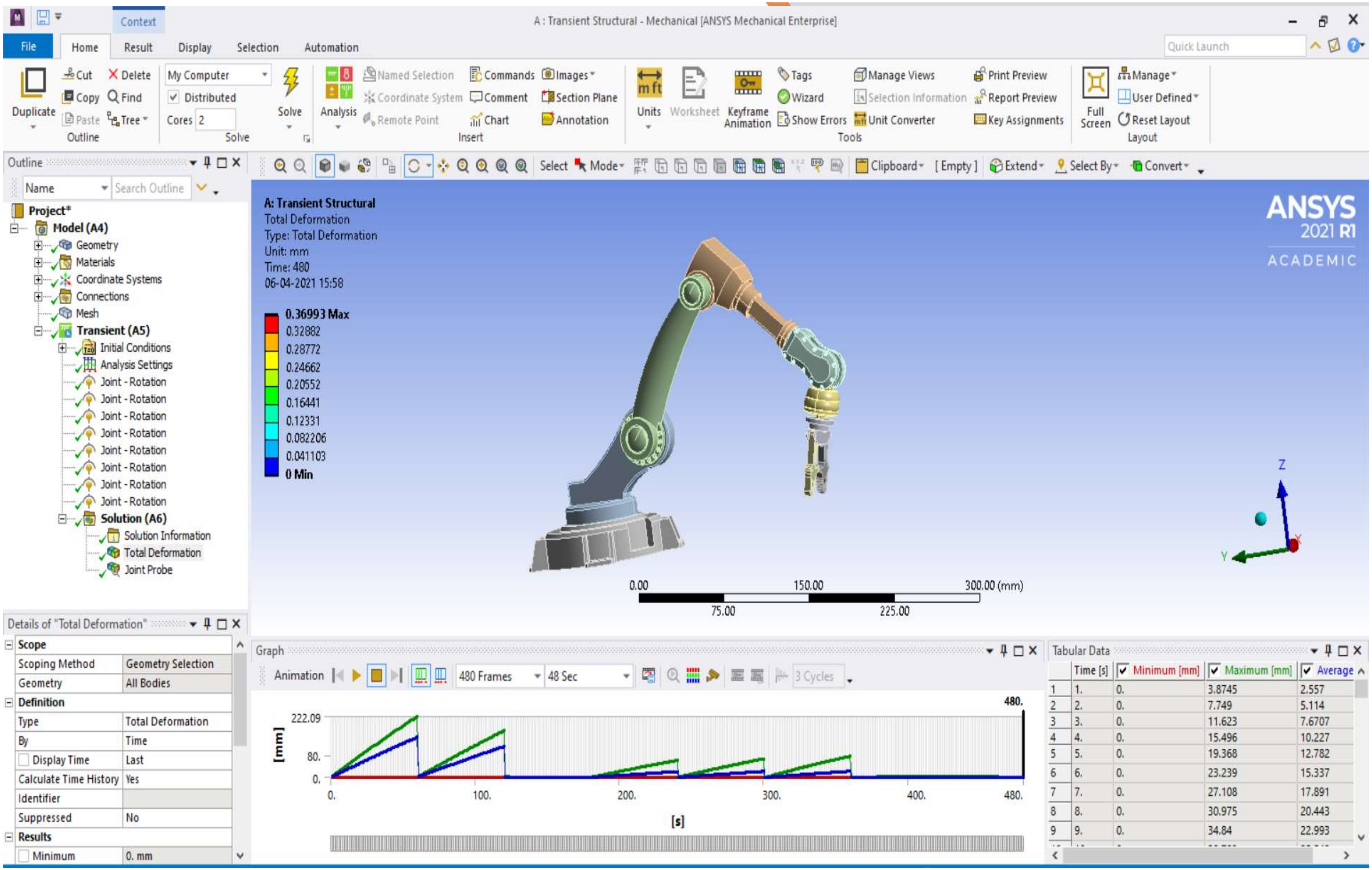
CFD OF PROPELLERS



To see the CFD of propellers please refer to the link given below:
https://drive.google.com/file/d/172QbAtNzdxsZderMXeIatil1mMNfg4fN/view?usp=drivesdk

TRANSIENT STRUCTURAL ANALYSIS OF ARM

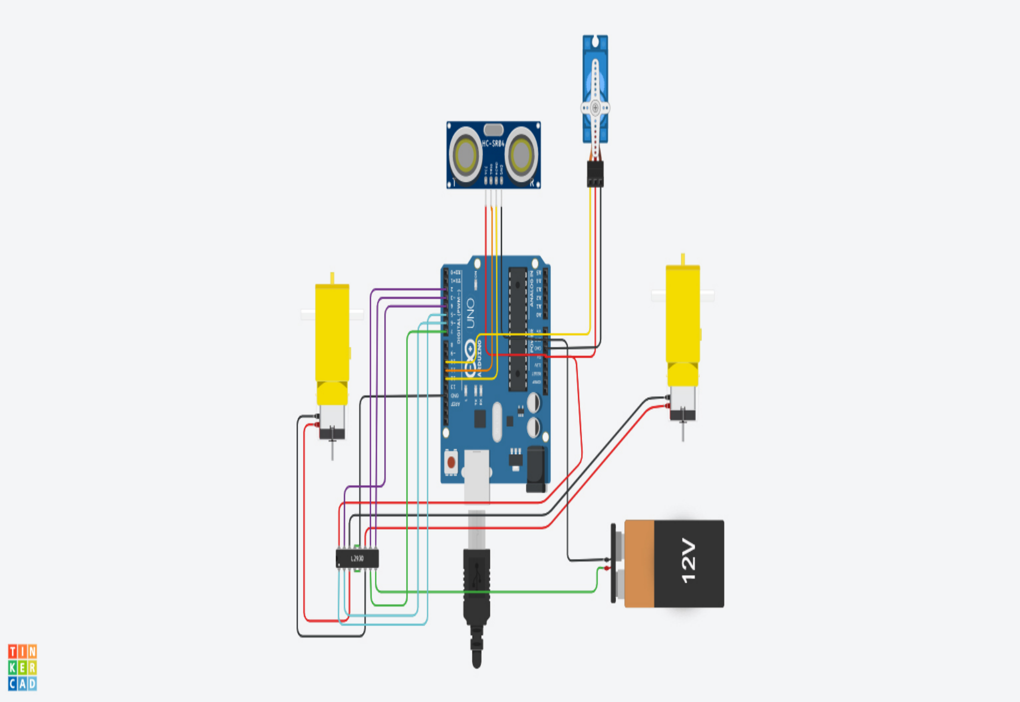




To see the the transient structural analysis of arm please refer to the link given below:
https://drive.google.com/file/d/19FXmAsYaeDBSEXENspf1tH4T-FD_bQMo/view?usp=drivesdk

CIRCUIT DESIGN

MAIN CIRCUIT SHOWING UP THE CONNECTION OF ROVER-WHEELS AND PROPELLERS



SAMPLE CIRCUIT

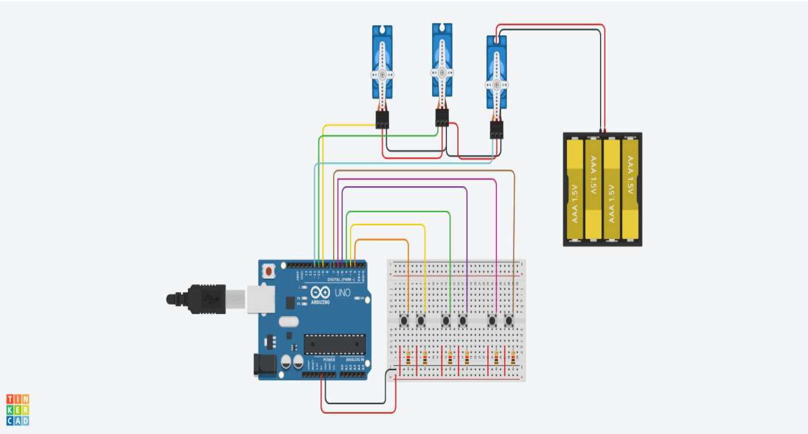
CIRCUIT ELEMENTS

Gear Motors - 2
Arduino Uno R3- 1
Ultrasonic distance- 1 Sensor
Micro Servo - 1
12 V battery- 1
Wires

MOTOR SPECIFICATIONS

Operating Voltage- 3V-12VDC
Maximum Torque- 800g/cm
Gear Ratio- 1:48
Load Current- 70mA
(250mA max.)
Weight- 29g

CIRCUIT OF ROBOTIC ARM

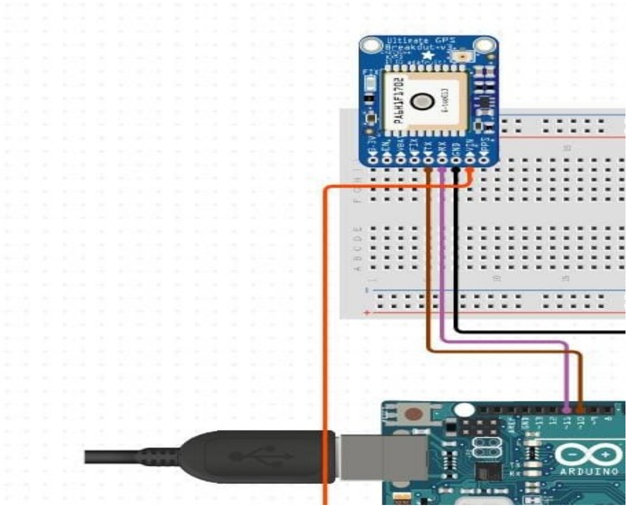


Sample Circuit

CIRCUIT ELEMENTS

Arduino Uno R3- 1
Micro Servo - 3
Bread Board- 1.5V AAA
Battery- 4
Wires

GPS CIRCUIT



Sample circuit

CIRCUIT ELEMENTS

Arduino Uno R3- 1
Bread Board- 1
GPS Module- 1
Wires

CALCULATIONS

Dimensions of HULL

Length = 180mm = 18 cm

Breadth = 105 mm = 10.5 cm

Height = 50 mm = 5 cm

Thickness = 1.5 mm = 0.15cm

2. Side

Volume = 10.5× 5×0.15

= 7.875 cm³

Volume of two sides = 15.75 cm³

Mass = density × volume

= 1.18 × 15.75

= 18.585 g

Calculation of mass of HULL

1. Base and Top

Volume of base = 18×10.5×0.15

= 28.35cm³

Volume of base & Top = 56.7 cm³

Now, Density of Acrylic sheet = 1.18 g/cm³

Mass = density × volume

= 66.906 g

3. Other side

Volume = 18× 5 × 0.15

= 13.5 cm³

Volume of two sides = 27

Density = 1.18 × 27

= 31.86g

Total mass of HULL made of acrylic sheet = 117.351 g

Top and bottom layer (Steel)

Volume = 56.7 cm^3

Density of steel = 8.05 g/cm^3

Mass = 56.7×8.05
= 456.435g

Now, Motor weight = 30 g
Weight of two motor = 60g
Weight of Arduino = 25 g

Total mass = 117.351 + 456.435 + 60 + 25
= 658.786 g

Volume of HULL= $18 \times 10.5 \times 5.3$
= 1001.7 cm^3

Weight of box in air
$658.786 \times 10^{-3} \times 9.8 = 6.456N$

In order to make rover float we need to displace amount of water equal to its weight, according to Archimedes principle
Buoyancy = weight of displaced fluid.
We can write this principle in equation form as:
$FB = \rho \times V \times g$.
Where FB is the buoyant force, ρ is the density of the displaced fluid, V is the volume of the displaced fluid, and g is the acceleration due to gravity.

If the weight of the object is more than 9.8 N, then the object will sink. If it is less than 9.8 N, the object will float. If it is equal to 9.8N then it will neither float nor sink.

Buoyancy = weight of displaced fluid
= density × volume of displaced fluid
= 1000 × 1001.7 × 10^-6 × 9.8
= 9.816N

Since, upthrust is equal to 9.8 hence the rover will float

BENEFITS

- □ It can be used as a lifeguard on beaches.
- □ It can be used for naval surveillance purposes.
- □ It can be used to clean garbage from rivers.
- □ It can detect the human body using warmth sensors such that it can be used during floods and earthquakes to detect the human body for a rescue operation.
- □ Rocker-bogie mechanism is used here such that it can walk on any terrain.
- □ The rover is controlled semi-autonomously.
- □ It can be used in sewerage monitoring in deep tunnels.
- □ Very small which enhances its stability, mobility, and accessibility.

CONCLUSION

Since this Semi-autonomous rover is multipurpose so it is very helpfulfor humans to accept various challenges such as saving people during natural disasters like earthquakes, floods save and rescue operation, sewerage monitoring for their proper maintenance in the military, for naval surveillance purposes, cleaning garbage, etc.

Since existing rovers are single usage rovers like they are made to perform a single task, also they are very heavy and large with complex designs and with low speed.
But, The Semi-Autonomous Amphibious Rover is a multiusage rover that is made to perform several tasks at a time. It is small in size and lightweight with good speed and cheaper than existing rovers

To see working of the rover please refer to this link:
https://drive.google.com/file/d/17xAI2exfgpuQ69uZ4b09cgoM6im6qqUj/view?usp=drivesdk

thanks you