



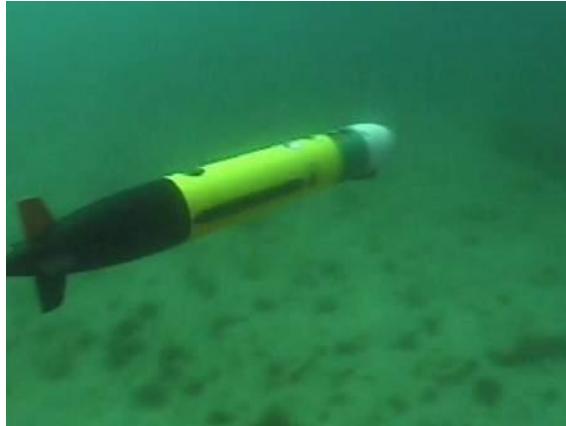
**AUTONOMOUS UNDERWATER VEHICLE**  
*Introductory Session*

January 07, 2017

# Purpose of an AUV



Pluto Plus AUV



Remus AUV



Battlespace Preparation AUV



Cornell AUV: Gemini

## COMMERCIAL

- Maps of Seafloor
- Building subsea infrastructure
- Detecting underwater mines

## RESEARCH

- Studying marine life
- Measuring properties like concentration of elements in ocean floor

## DEFENSE

- Upcoming interest in navy forces
- Finding wreckage of crashed airplanes

## HOBBY

- For robotics enthusiasts
- Participating in competitions held annually

# OUR OBJECTIVE

- To promote robotics, especially underwater robotics as an educational interest.
- To provide facility to interested students and faculties for conducting amateur research and educational experiments in underwater robotics.
- To represent the institute at national and international level competitions held annually, and exhibit the caliber and prestige that the institute carries.



# COMPETITIVE EVENTS



## **Student Autonomous underwater Vehicle (SAVe)**

Organizer: NIOT, Chennai under Ministry of Earth Science

Date: October, 2017

Venue: NIOT, Chennai

## **Singapore AUV Challenge**

Organizer: IEEE & OES

Date: March, 2018

Venue: Singapore Polytechnic, Singapore

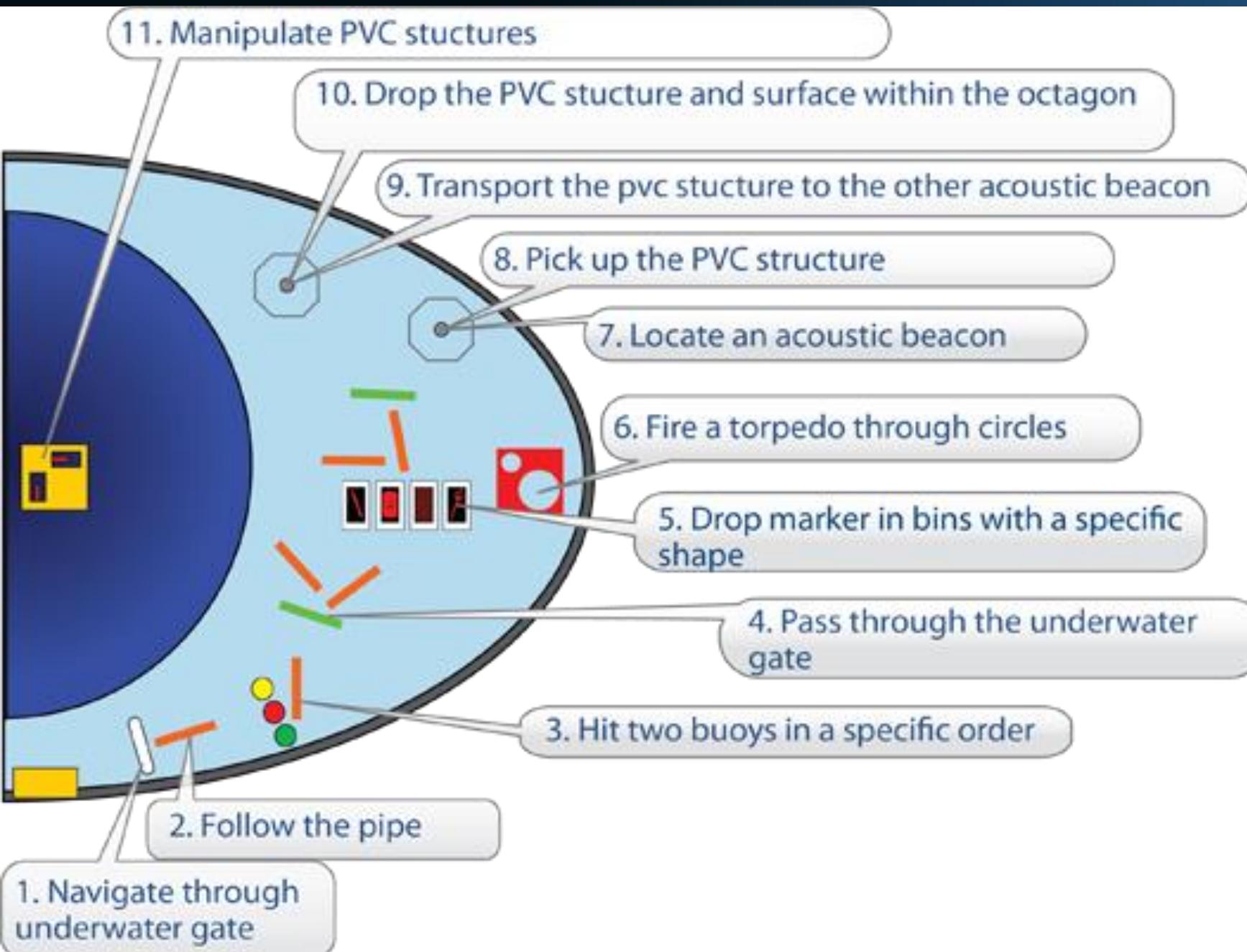
## **International RoboSub Competition**

Organizer: AUVSI Foundation

(Co-sponsored by U.S. Office of Naval Research)

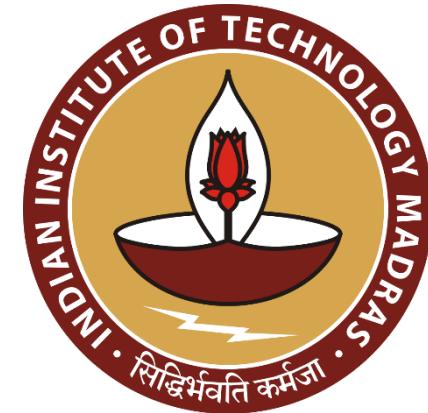
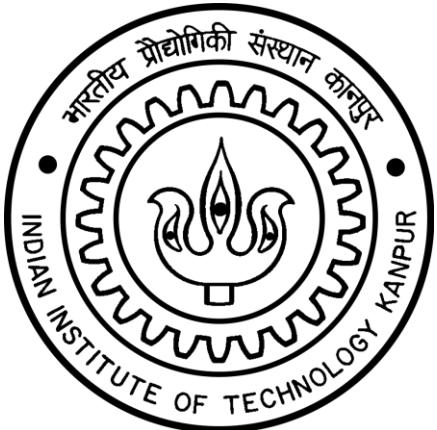
Date: Last week of July, 2018

Venue: SSC Pacific TRANSDEC, San Diego, CA

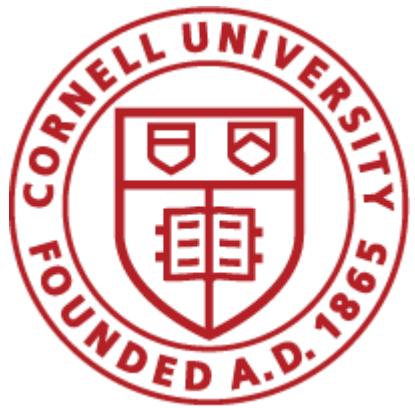


# TASKS IN THE GAME ARENA

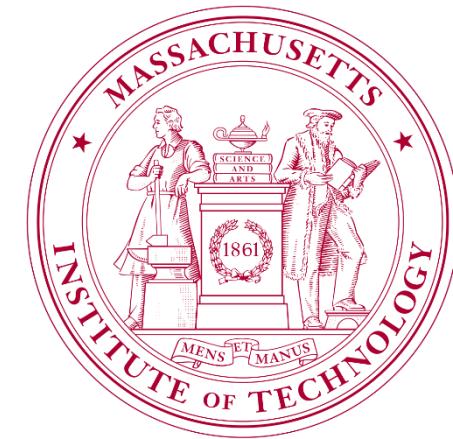
# PARTICIPATING TEAMS FROM INDIA



# MAJOR INTERNATIONAL PARTICIPANTS



**NUS**  
National University  
of Singapore



SAN DIEGO STATE  
UNIVERSITY

*Leadership Starts Here*

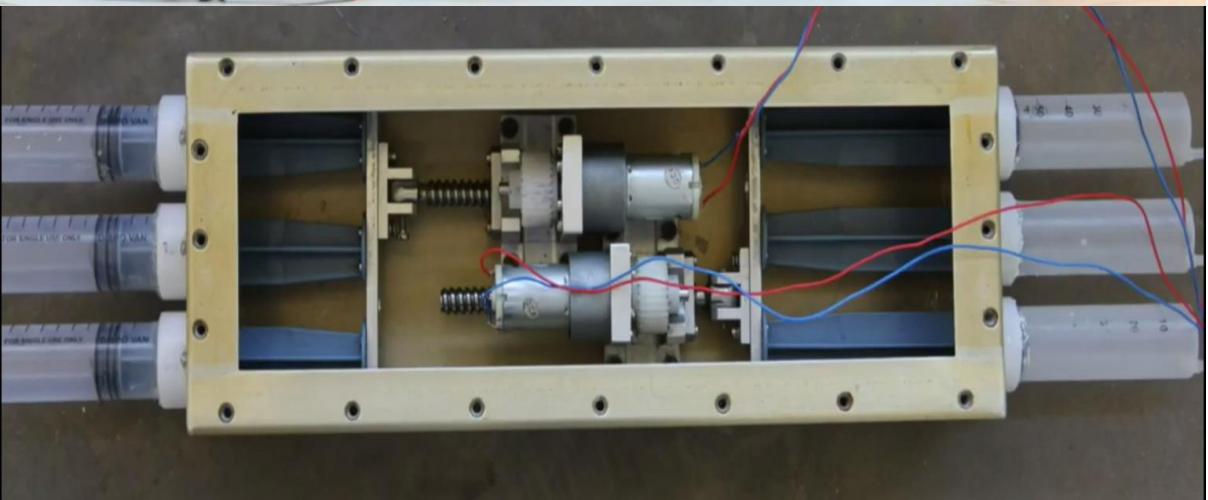
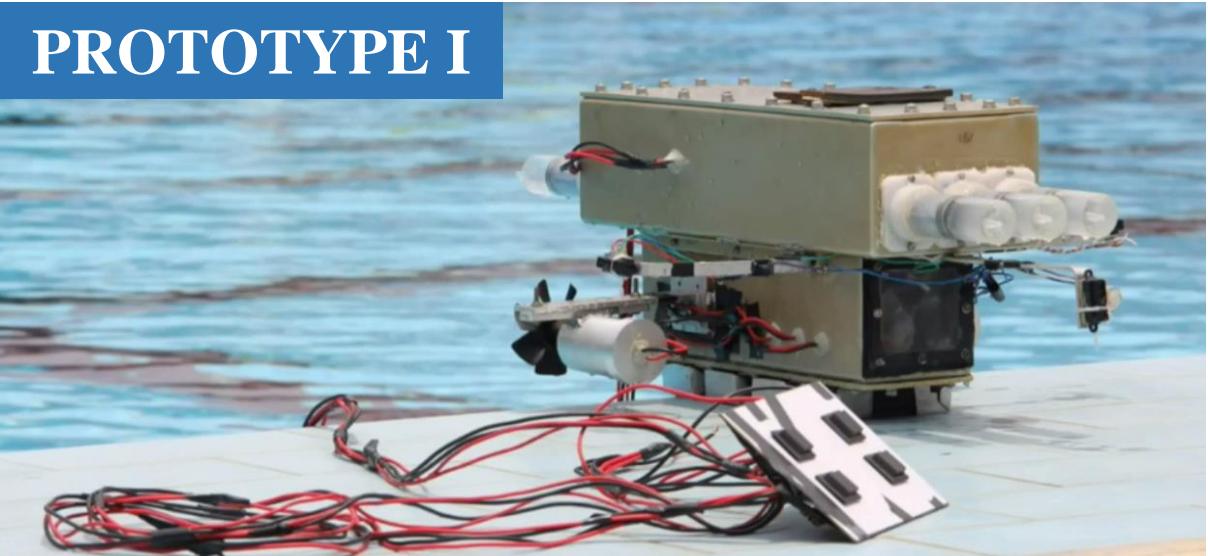


UNIVERSITY OF  
**TORONTO**

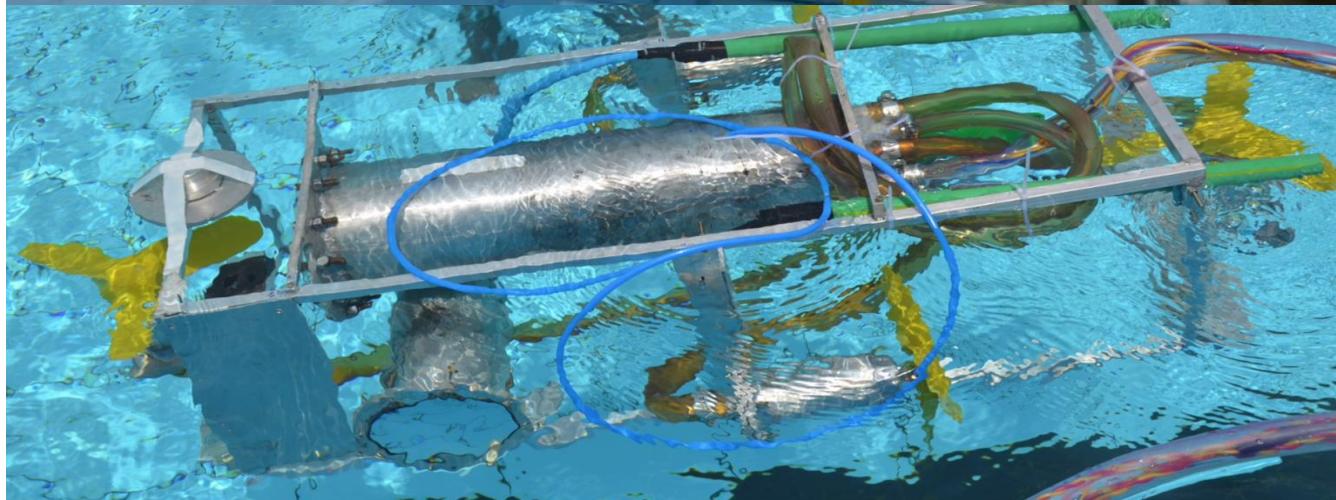


# OUR HISTORY

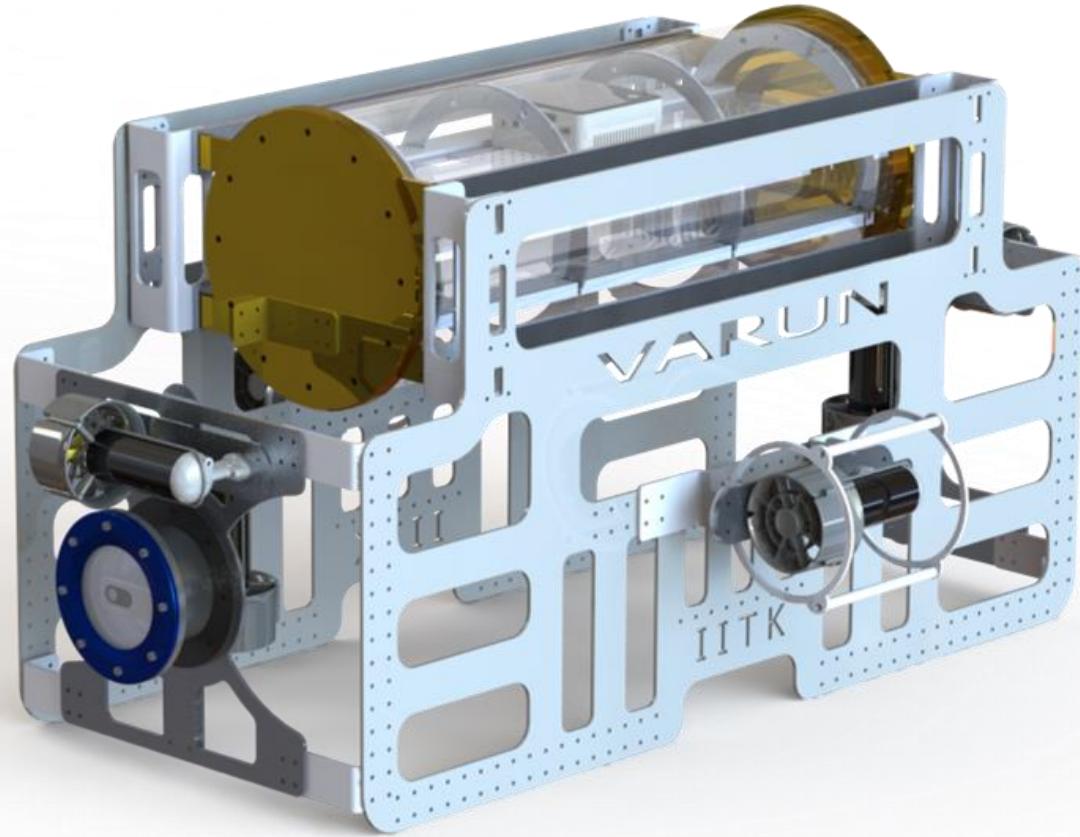
PROTOTYPE I



PROTOTYPE II



# MECHANICAL

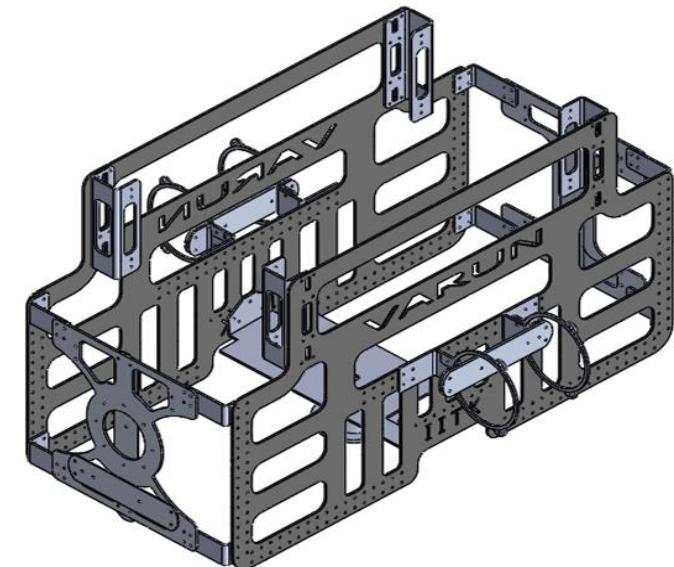
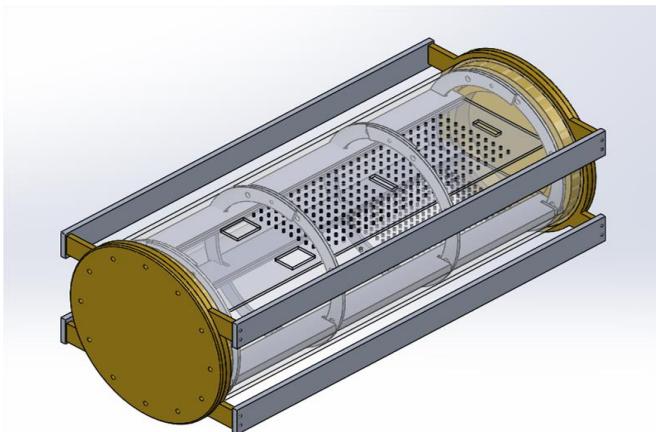


# Robot Designing



Used for designing the robot before fabrication to ensure that everything is picture perfect

- 3-D view of the robot
- Orthographic and isometric views of parts
- Selecting the material required

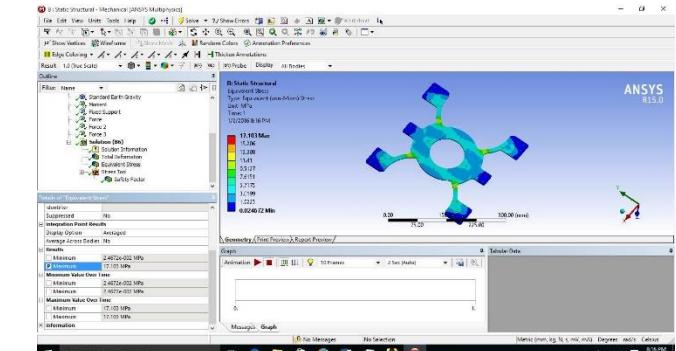
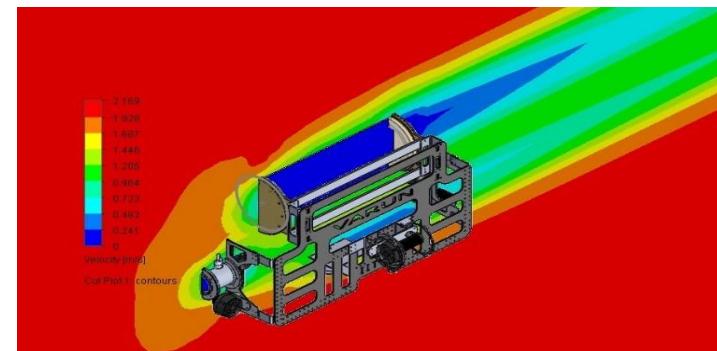
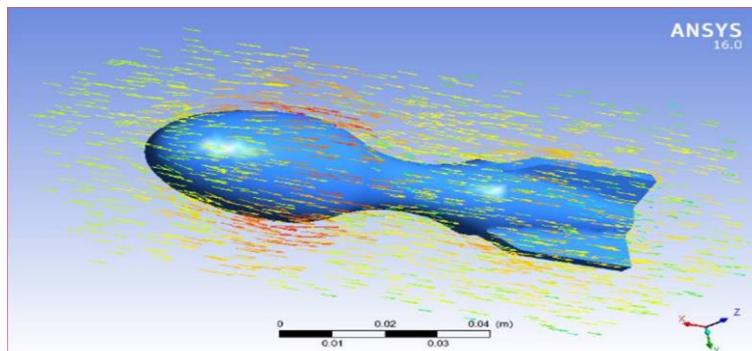


# Design Analysis

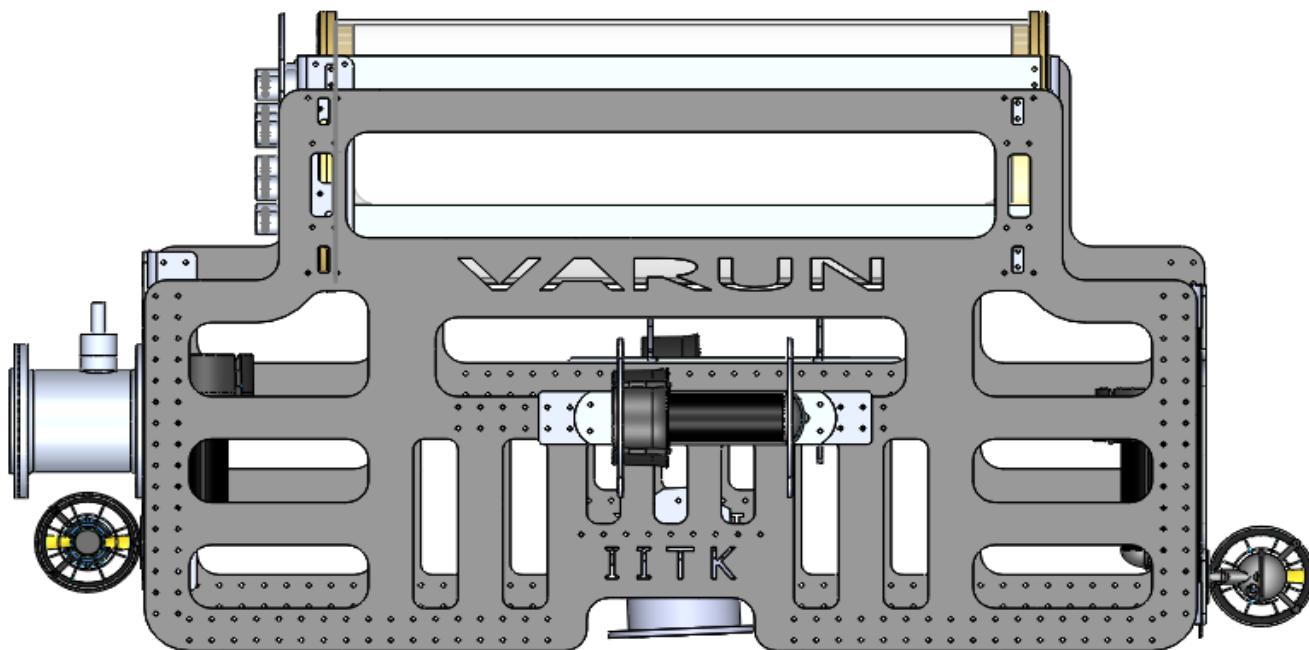


Used for analyzing the design for optimizing it's performance in terms of:

- Coefficient of Drag
- Centre of Mass
- Center of Buoyancy
- Vehicle Speed
- Weight



# Varun's Design Specification



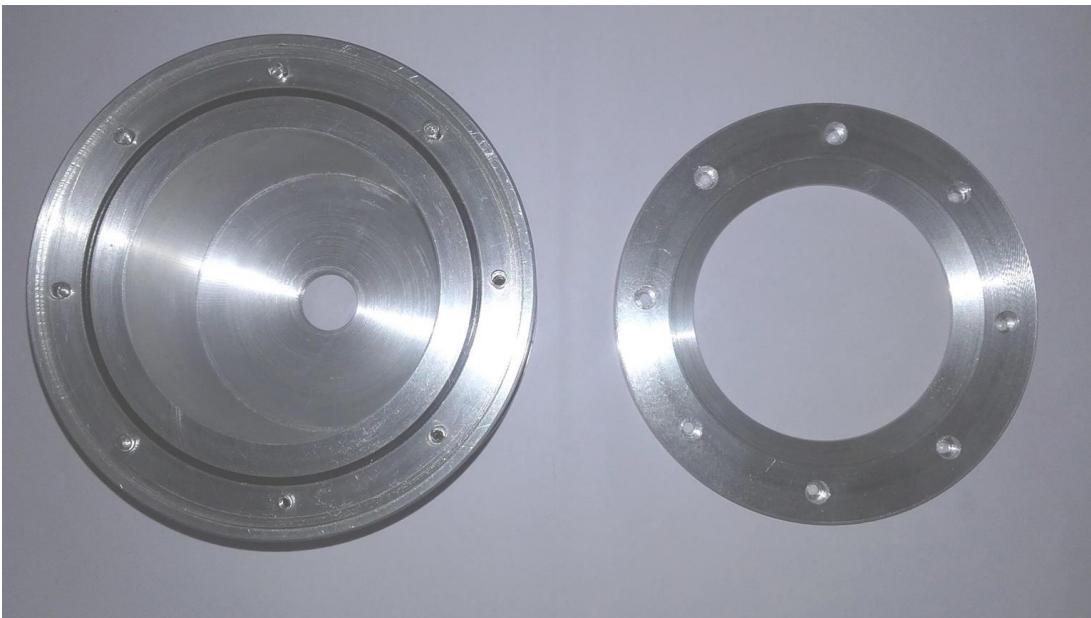
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Name:	Varun
Degree of Freedom:	5
Number of thrusters:	6
Weight:	41.550 kg
Buoyancy:	+1%
Dimensions (in mm):	1081*434*530

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# Custom- Made Waterproof Casings

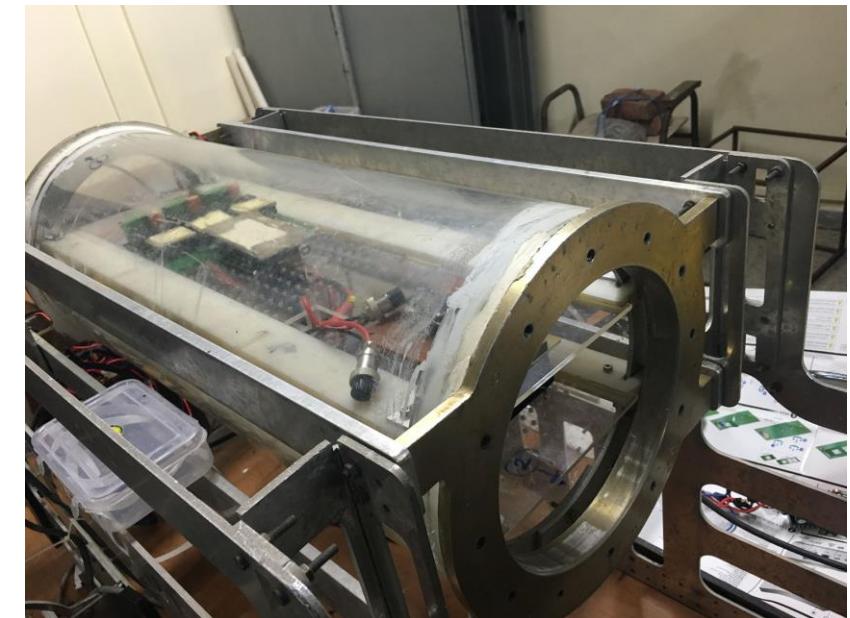
Manufactured using in-house facilities available at Tinkering Lab and 4-i Laboratory under Mechatronics Lab



Front Camera Casing



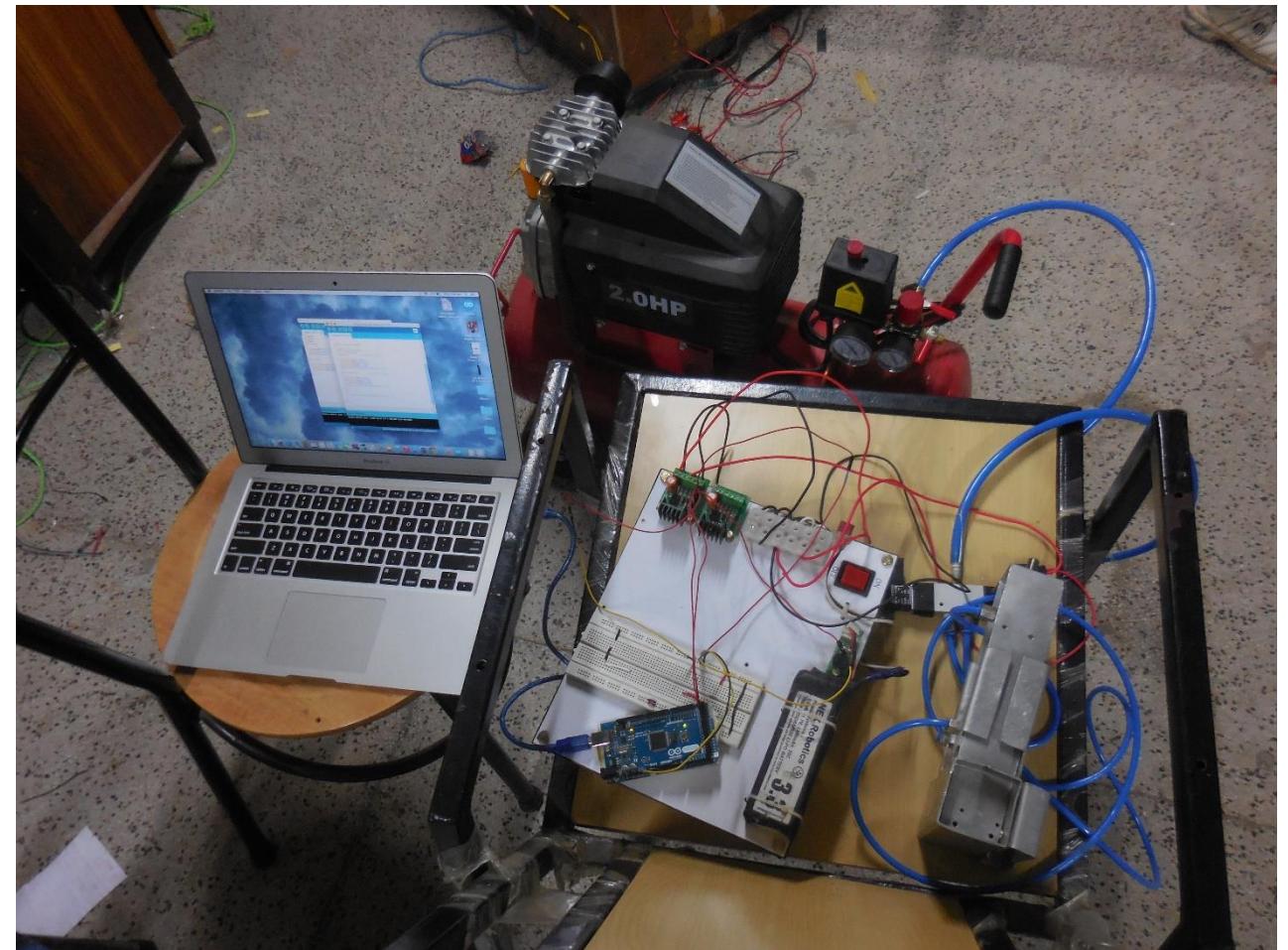
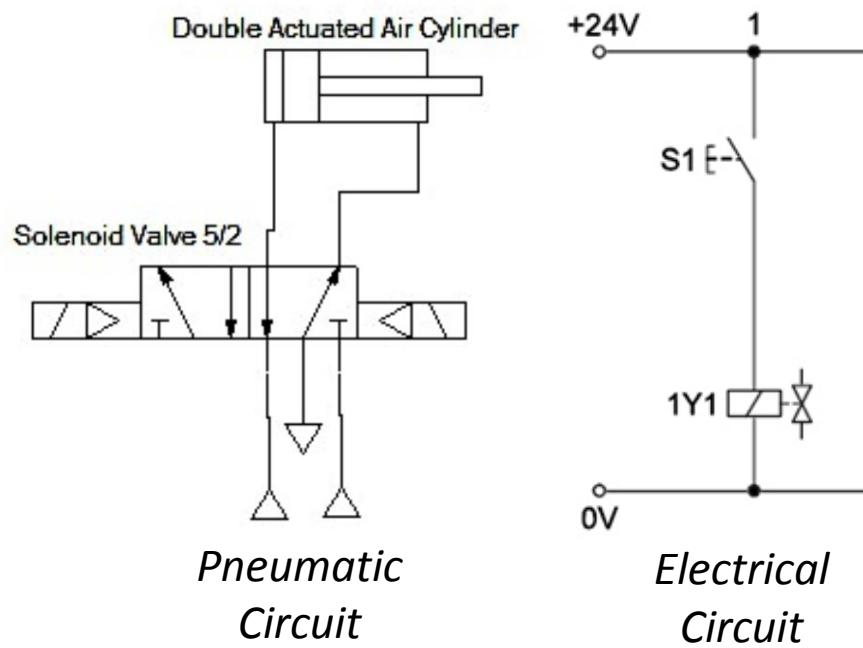
Hull Cap with Connectors



Main Pressure Hull

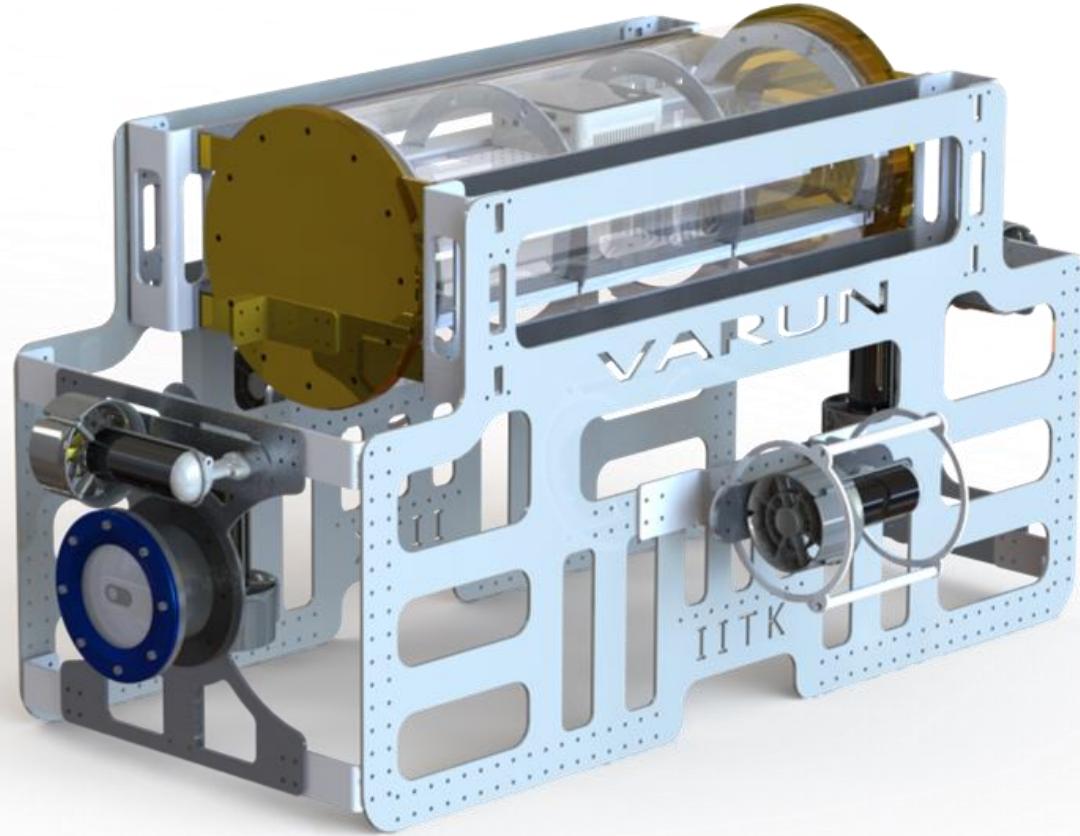
# Pneumatic System

- For grabbing and dropping manipulator
- For torpedo shooting
- For marker dropping



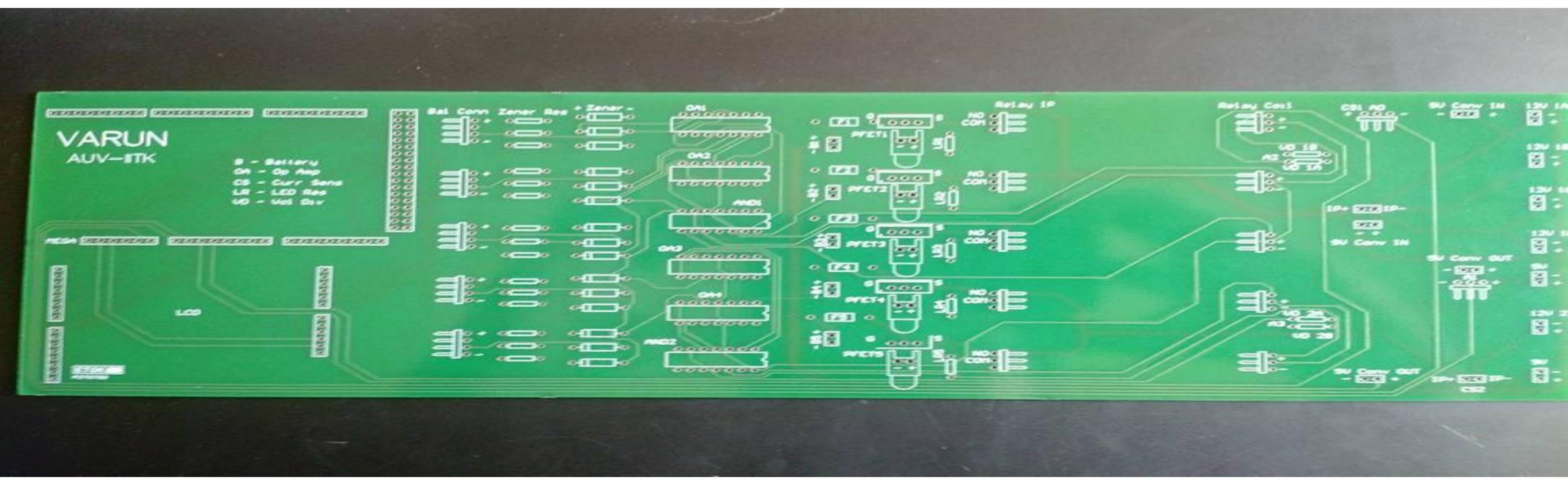
*Testing of marker dropper assembly*

# ELECTRICAL



# Battery Management System

- Divide the batteries into two power lines
- Measure Voltage and Current in both the lines to calculate Power consumption of the Vehicle
- Protect the components from damage due to overcurrent and reverse polarity
- Protect the batteries from over discharge.

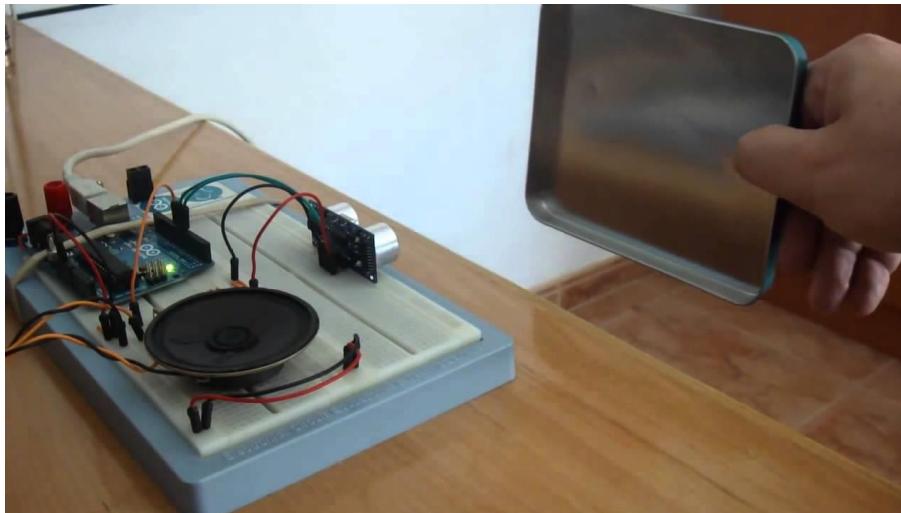


# Arduino

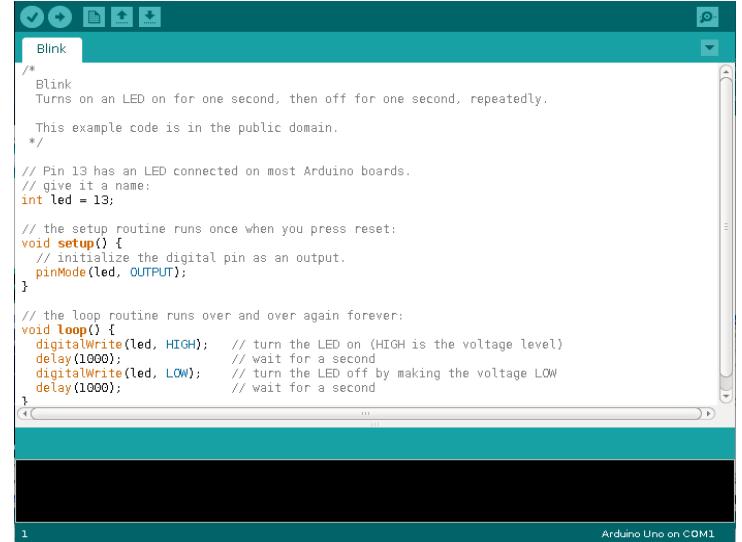
Single board microcontroller

Open-source electronics platform created by Strong Friend  
in Ivrea, Italy

Coding done using programming languages like C, C++,  
Java



*Experiment using Arduino Uno*



```
/*
  Blink
  Turns on an LED on for one second, then off for one second, repeatedly.

  This example code is in the public domain.

  // Pin 13 has an LED connected on most Arduino boards.
  // give it a name:
  int led = 13;

  // the setup routine runs once when you press reset:
  void setup() {
    // initialize the digital pin as an output:
    pinMode(led, OUTPUT);
  }

  // the loop routine runs over and over again forever:
  void loop() {
    digitalWrite(led, HIGH);      // turn the LED on (HIGH is the voltage level)
    delay(1000);                // wait for a second
    digitalWrite(led, LOW);       // turn the LED off by making the voltage LOW
    delay(1000);                // wait for a second
  }
}
```

1 Arduino Uno on COM1

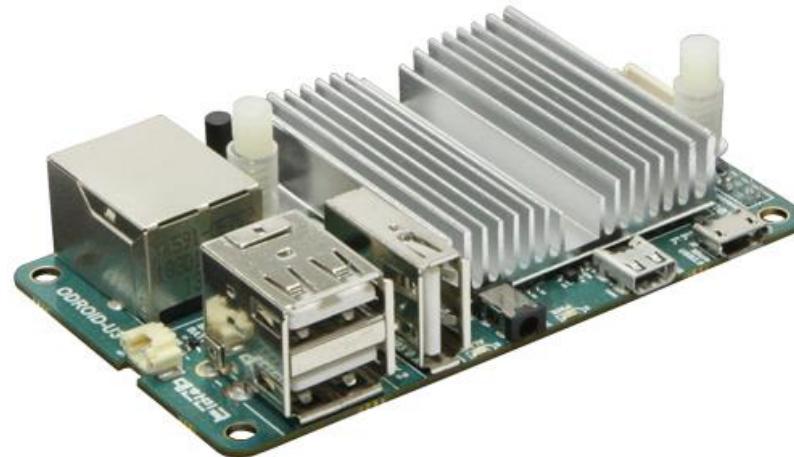
*Arduino IDE*

# Intel NUC: Processor

- Integrate Intel's Next Unit of Computing (NUC), a compact computer, into the Vehicle.
- Power the NUC using the existing 11.1 V LiPo batteries via a boost converter. Output stabilised using capacitors.
- Isolate the power lines of NUC and other peripherals of the processor from remaining circuit like actuators, sensors.



# Previous Processors

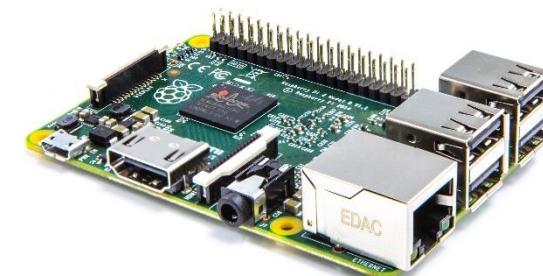


Odroid U3

- Micro-processor
- 1.7 GHz Quad Core Processor
- 2 GB RAM
- Supports Ubuntu (14.04 LTS)



Odroid X2



Raspberry Pi2

# Sensors and Systems

**Currently sensors being used:**



**Pressure Sensor**



**Camera**

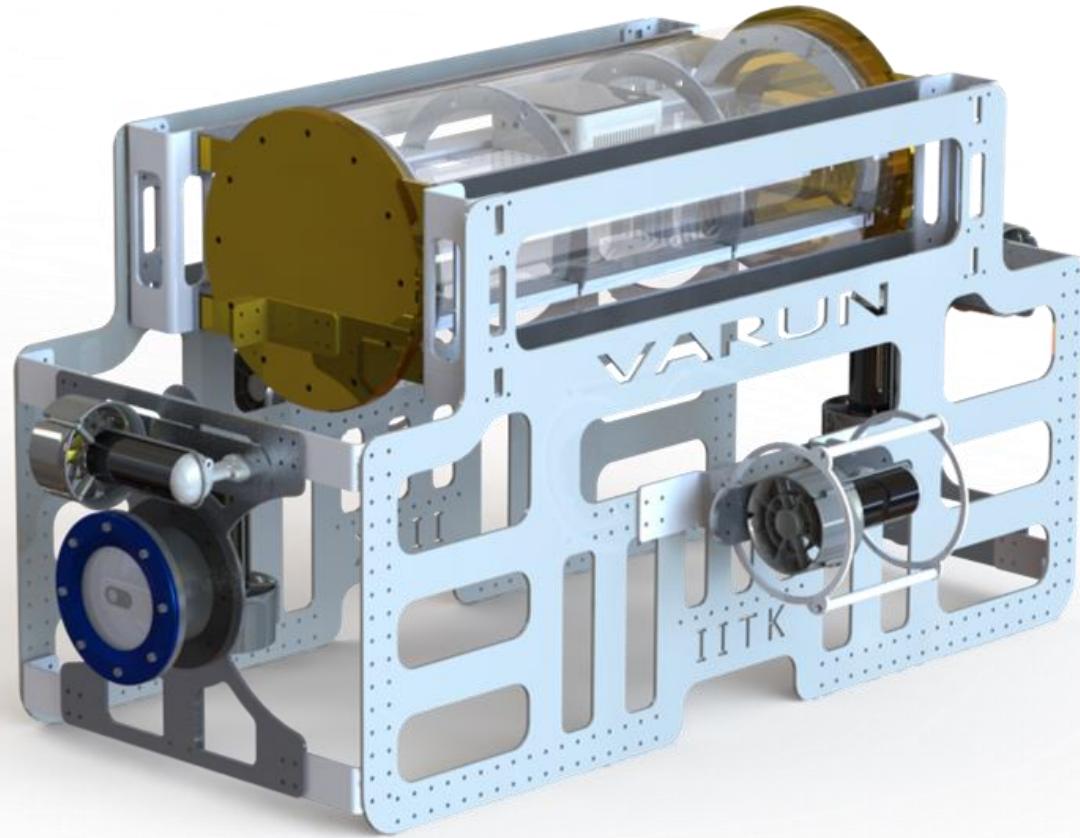


**IMU**

**Future Additions:**

Water Detection Unit  
Acoustic localization system  
Doppler Velocity Log

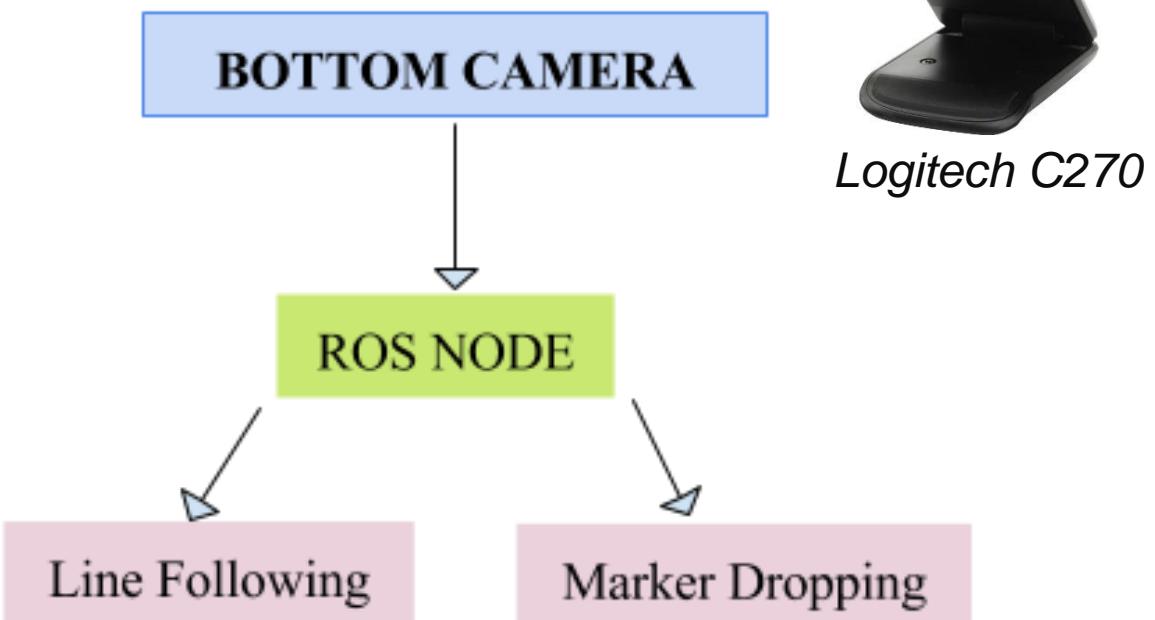
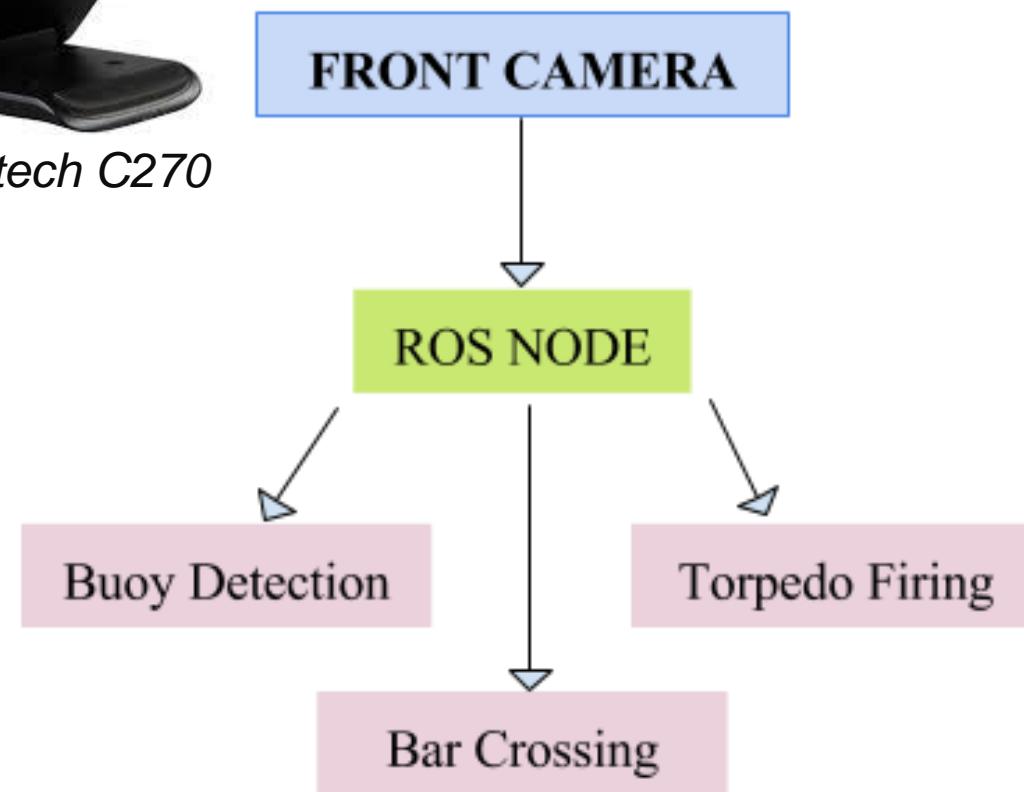
# SOFTWARE



# Vision



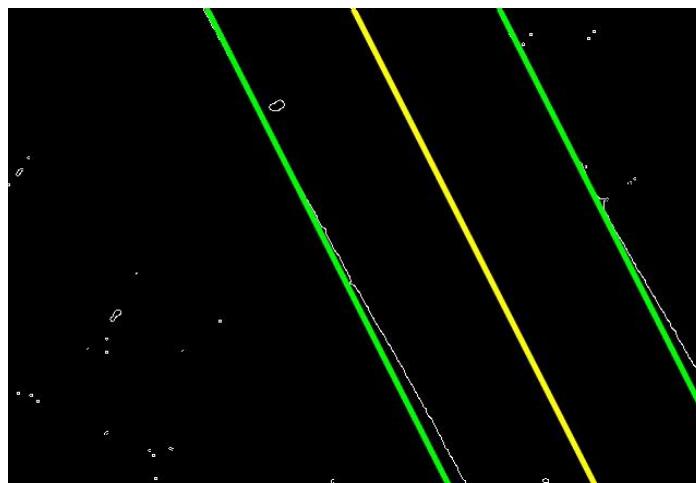
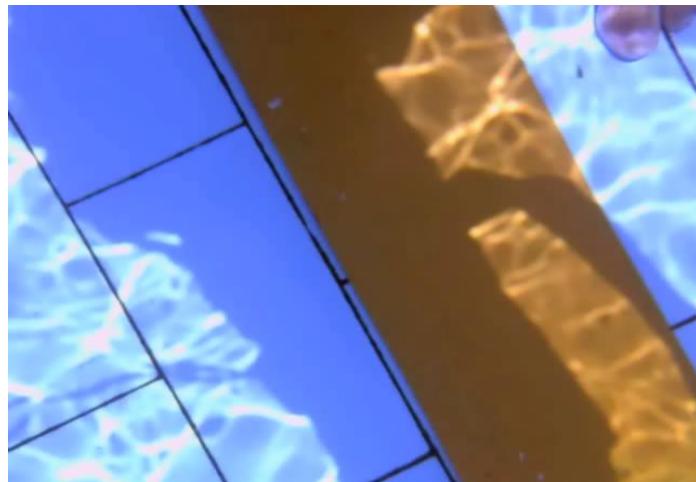
Logitech C270



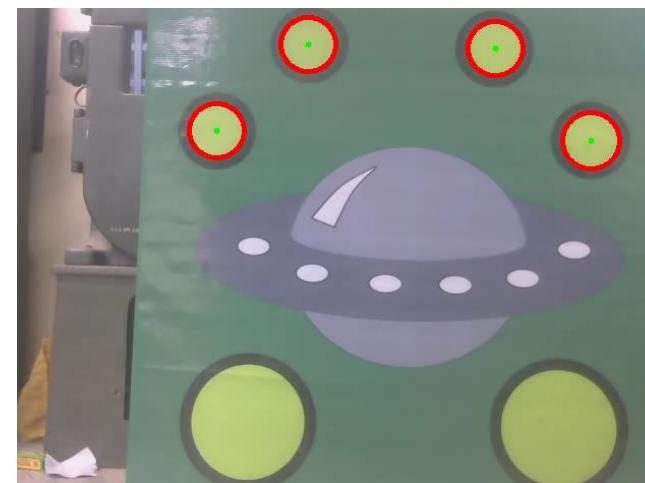
Logitech C270

# Samples

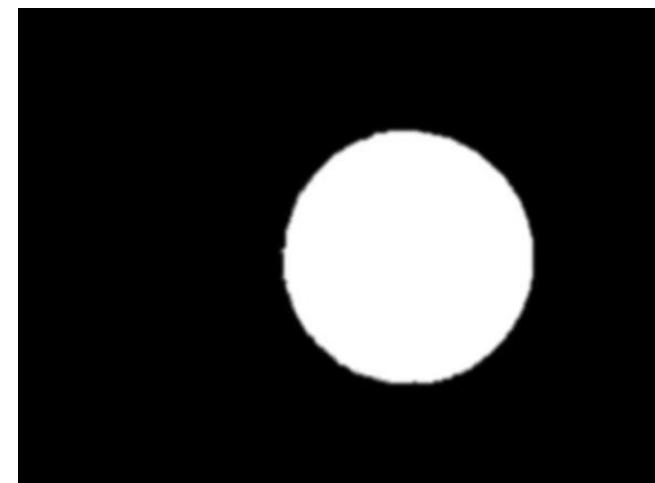
Line Detection



Circle Detection



Buoy Detection



# ROBOT OPERATING SYSTEM

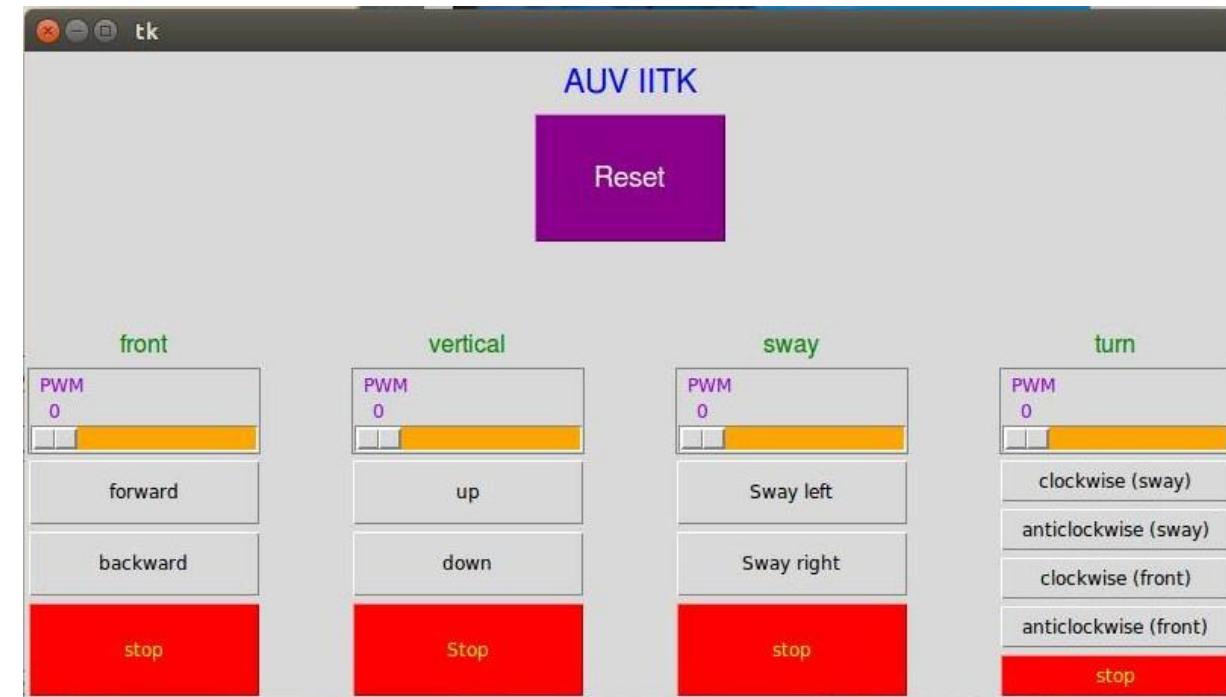
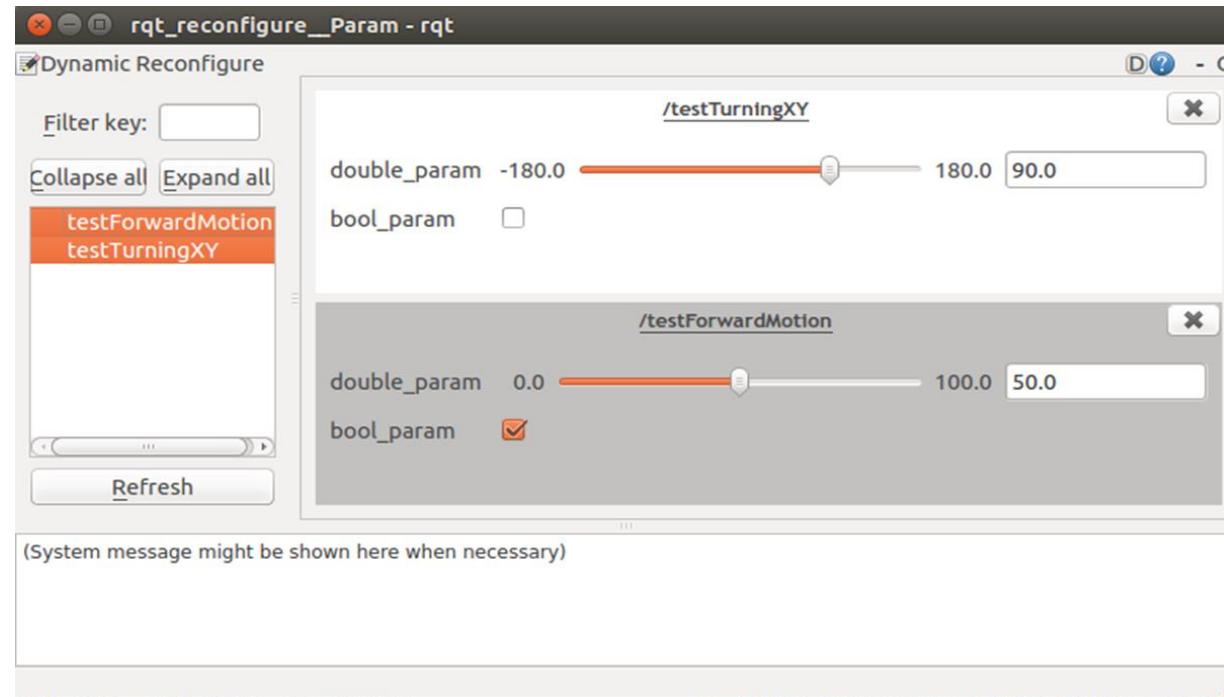


- Flexible framework for writing robot software
- Collection of tools, libraries, and conventions that aim to simplify the task of creating complex and robust robot behavior.
- Has built-in messaging system that manages details of communication between distributed nodes via anonymous publish/subscribe mechanism
- Easier to capture data published by some task (node) to a file, and then republish that data from the file at a later time.

# Graphical User Interface(GUI)

ROS

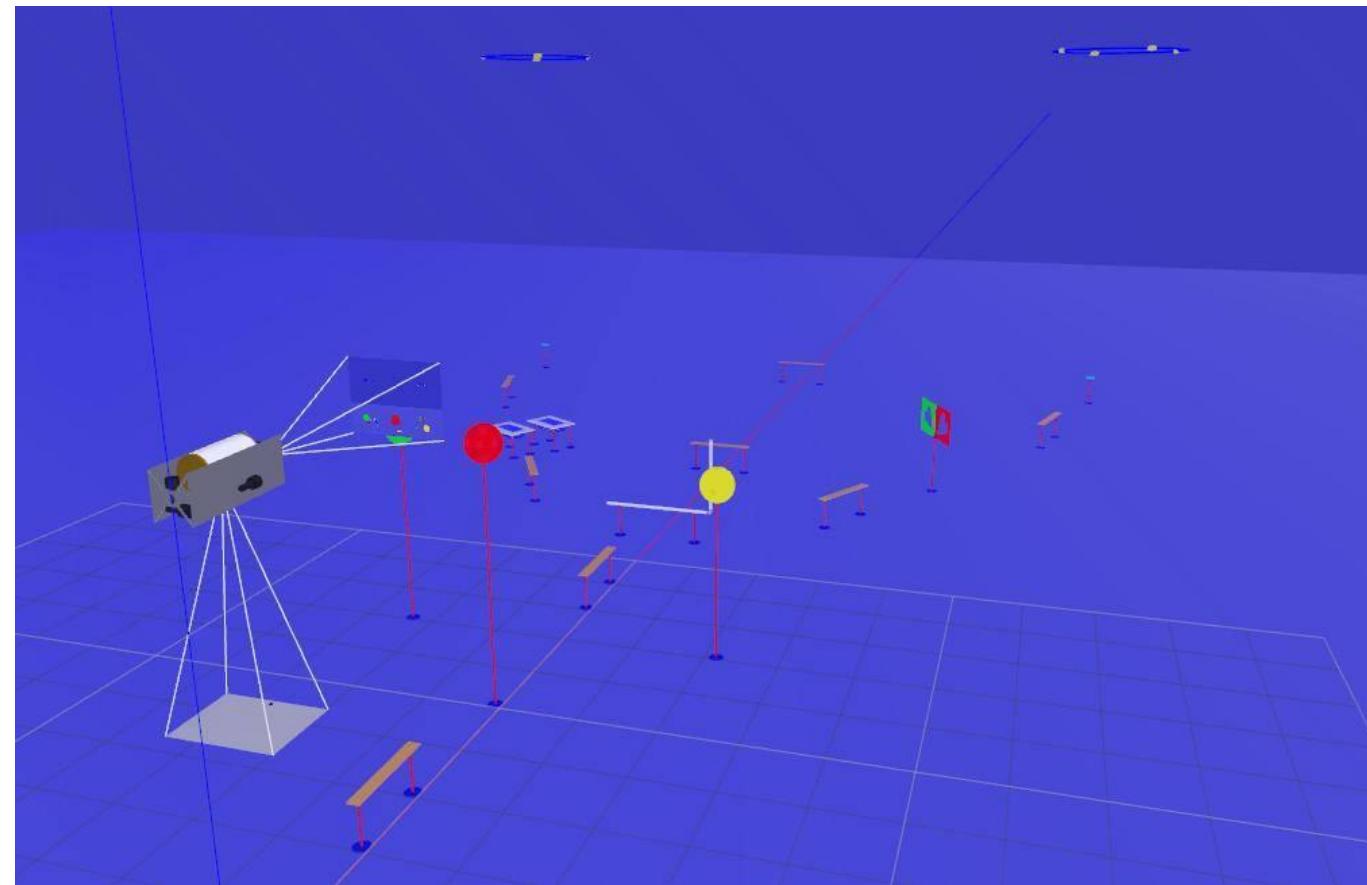
We use this GUI for testing our Bot's Motion.



**Actually testing our code rather than praying that it'll work!**

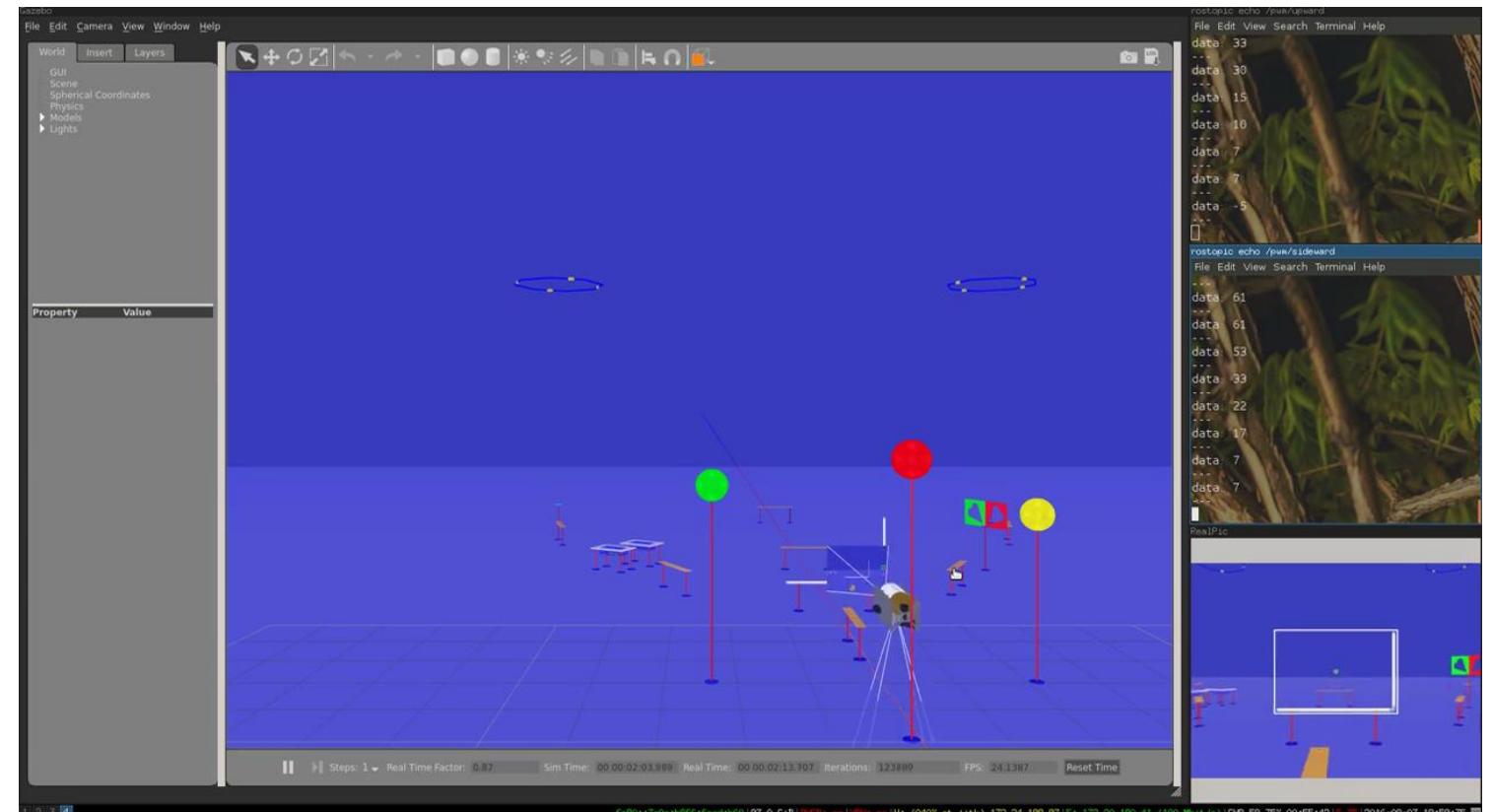


GAZEBO

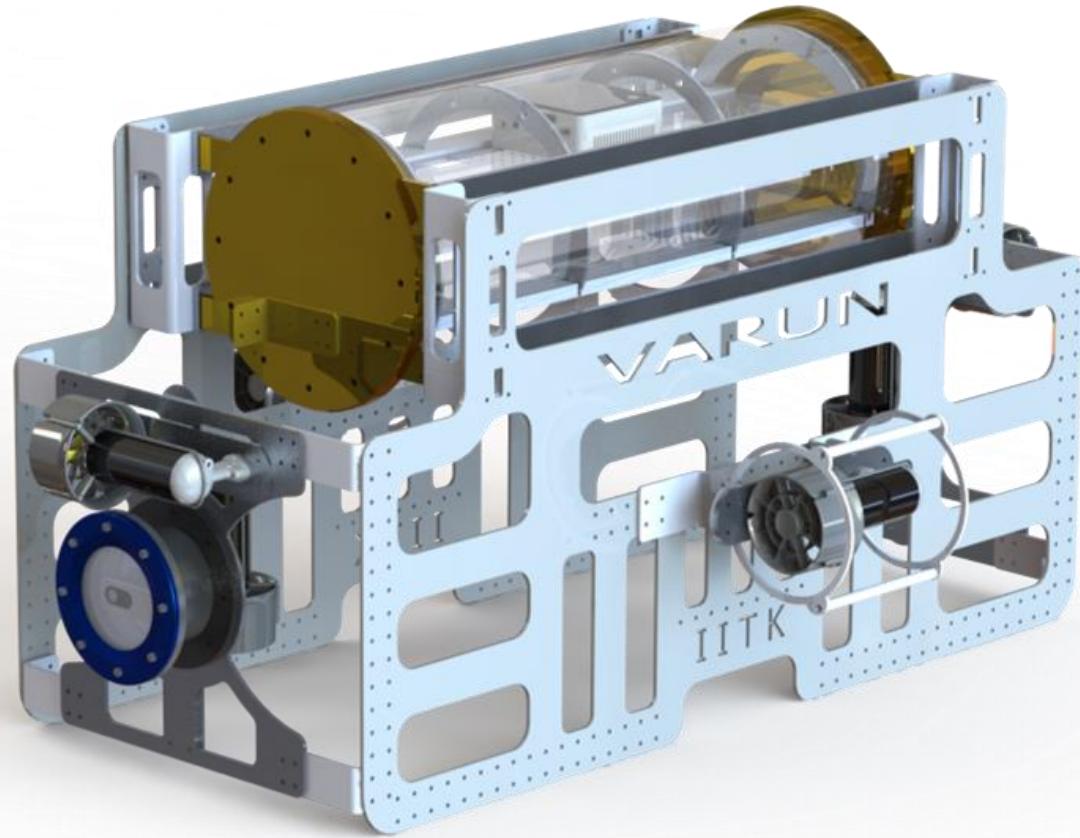


# Tasks

- Task\_gate
- Task\_line
  - line\_detection
  - line\_centralize
  - Line\_align
- Task\_buoy
- Task\_torpedo
- Task\_octagon



# BUSINESS



# Face of the Team

- Represent team in various exhibitions and conferences held across the country
- Ensures interests of campus community and professors
- Opportunity to connect with industrial professionals and experts
- Publishes papers and newsletters for the team



# Marketing and Sponsorships

- Establish tie-ups of the team with various goods and services providing companies
- Learn marketing strategies through market analysis along with understanding methods of influencing companies and alumni to fund the project
- Learn how to advertise and brand the team



Doppler Velocity Log



CNC Milling

Sponsorships required to purchase better sensors and have availability of better services to build the robot

Example: A new sensor we want to purchase called Doppler Velocity Log is worth INR 13 lakhs!

# Online Footprint and Graphic Designing



# Expectations from the Team

- Members in each sub-systems would further be given projects relevant to a particular topic/product idea in groups of 2-3
- There would be **strict deadlines to the work** assigned and any form of negligence may lead to unpleasant consequences
- Past experience: *People don't work from their room a lot*, so on an **average estimate around 20-30 hours per week** as time spent together doing work together
- Documentation of work is important and would be done after completion of each project
- Since next competition is in less than a year, every member of the team **have to stay in the mid-sem breaks and summer vacations** (exceptions only in case of valid reasons)
- Leaving in-between from the team would lead to no recognition of your work
- Free to join other activities, however, if **any form of slackness observed** and if team is being affected by that, you **won't be allowed to further work on this project**

# Any Questions?



For more information, visit: [auviitk.com](http://auviitk.com), or contact:  
Mayank Mittal +91-7755-057-609  
Shibhansh Dohare +91-7755-057-787