



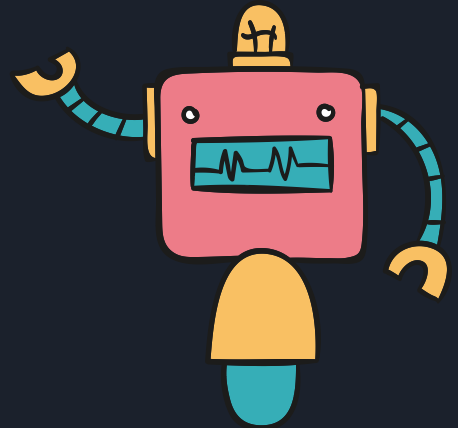
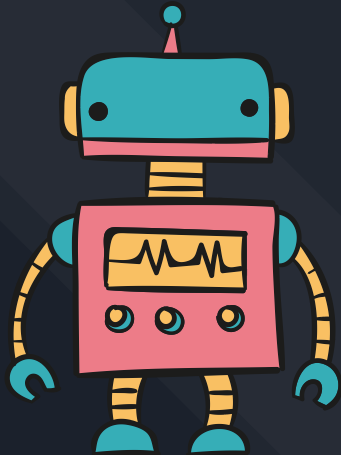
# ***Team British Racing Green***

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# AUTONOMOUS SNOWPLOW



# Objective

## PROBLEM IDENTIFIED



There are hundreds of cardio involved fatal incidents every winter in North America that caused by extensive snow shovelling [1]

## BRAINSTORMED FOR A SOLUTION USING ENGINEERING

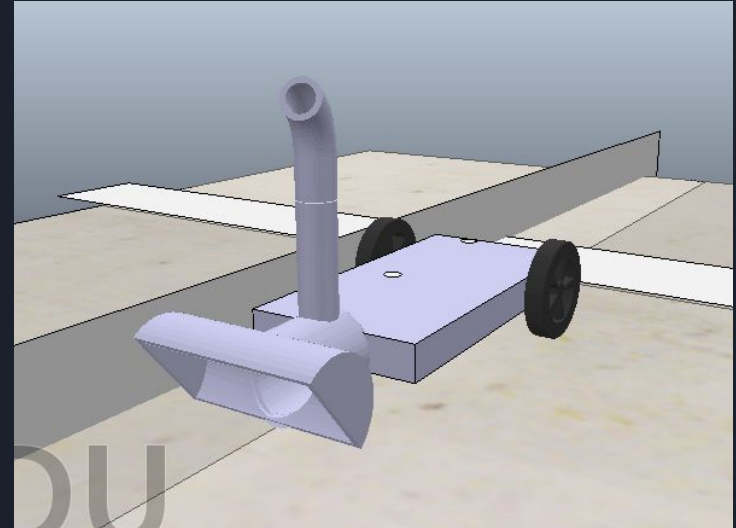
## PRINCIPLES



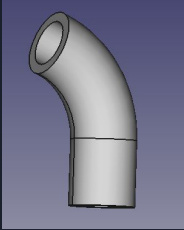
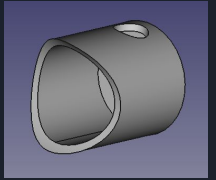
# Our Solution

## Autonomous Snowplow

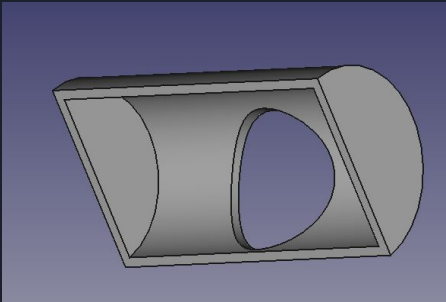
- Server-Client Model using Remote API
- Differential Drive & Maneuvering
- Path defining & Real-time Tracking for Autonomous Navigation
- Obstacle detection & Collision Avoidance
- Snow detection & Plow activation
- Environmental & User safety is paramount



# PROJECT PROGRESS FLOW



- DESIGN SKETCH
- INDIVIDUAL DEVELOPMENT OF SOFTWARE MODULES
- INTEGRATE MODULES
- ITERATIVE TESTING & CALIBRATION



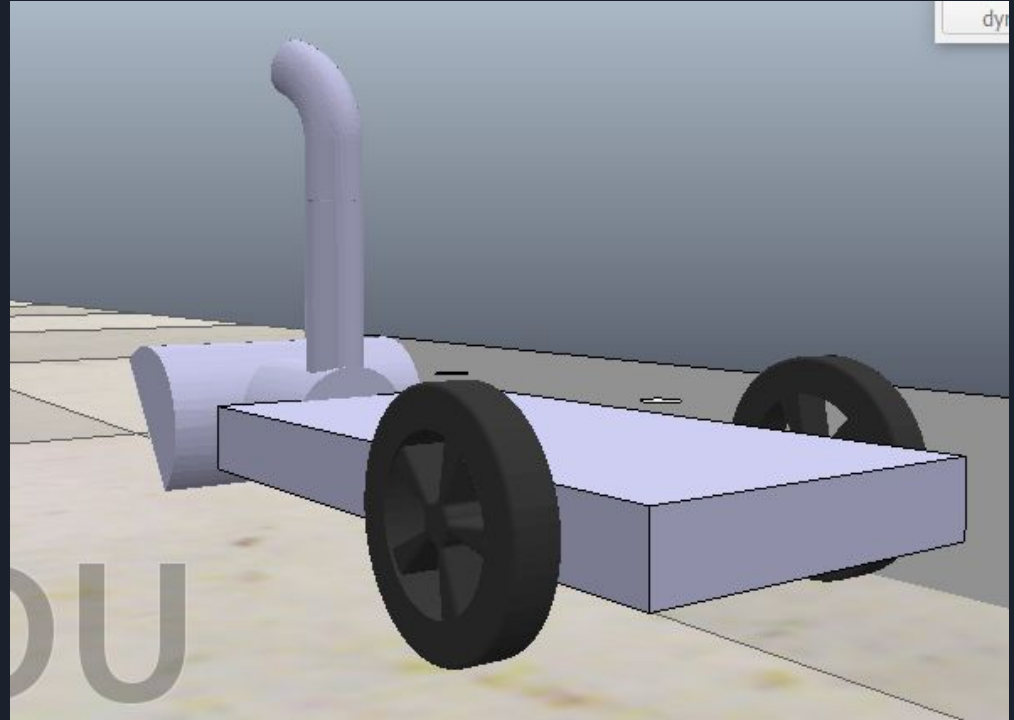
# Differential Drive & Maneuvering

2 revolute joints

Reference points

Small velocity delta  $\rightarrow$  finer steering angle

Larger velocity delta  $\rightarrow$  larger steering angle



# Server-Client Model using Python

## Remote API

6 Main States

Stop

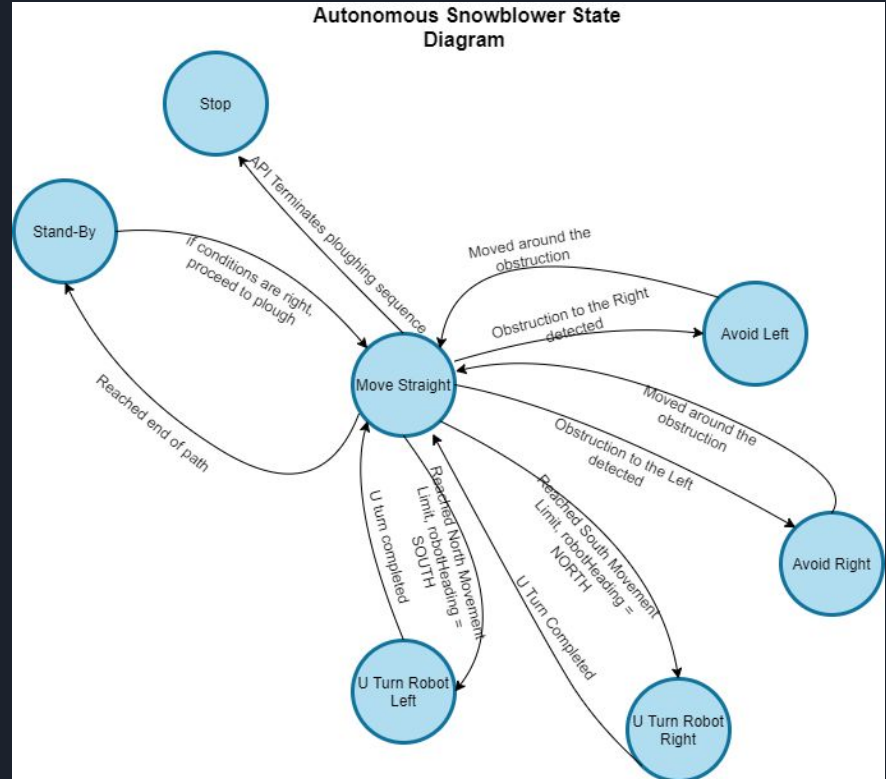
Move Straight

Avoid Left

Avoid Right

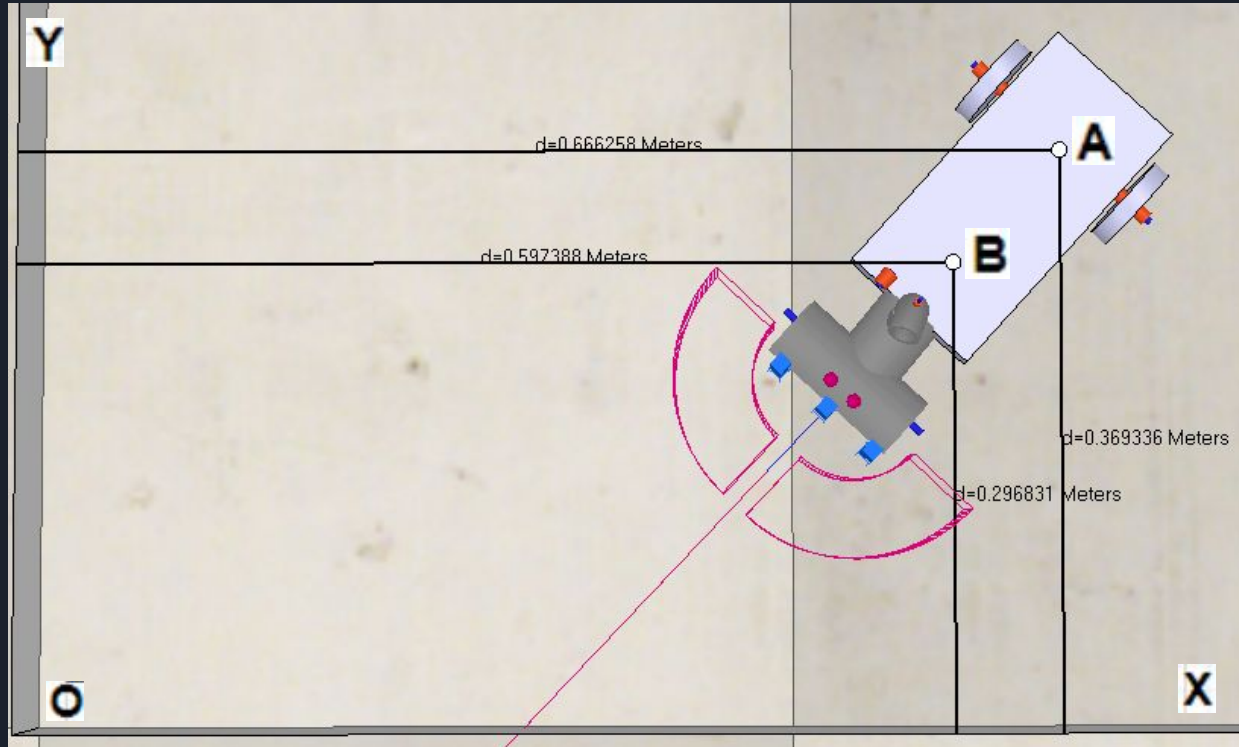
U-turn Left

U-turn Right



# Path Defining & Real-time Tracking for Autonomous Navigation

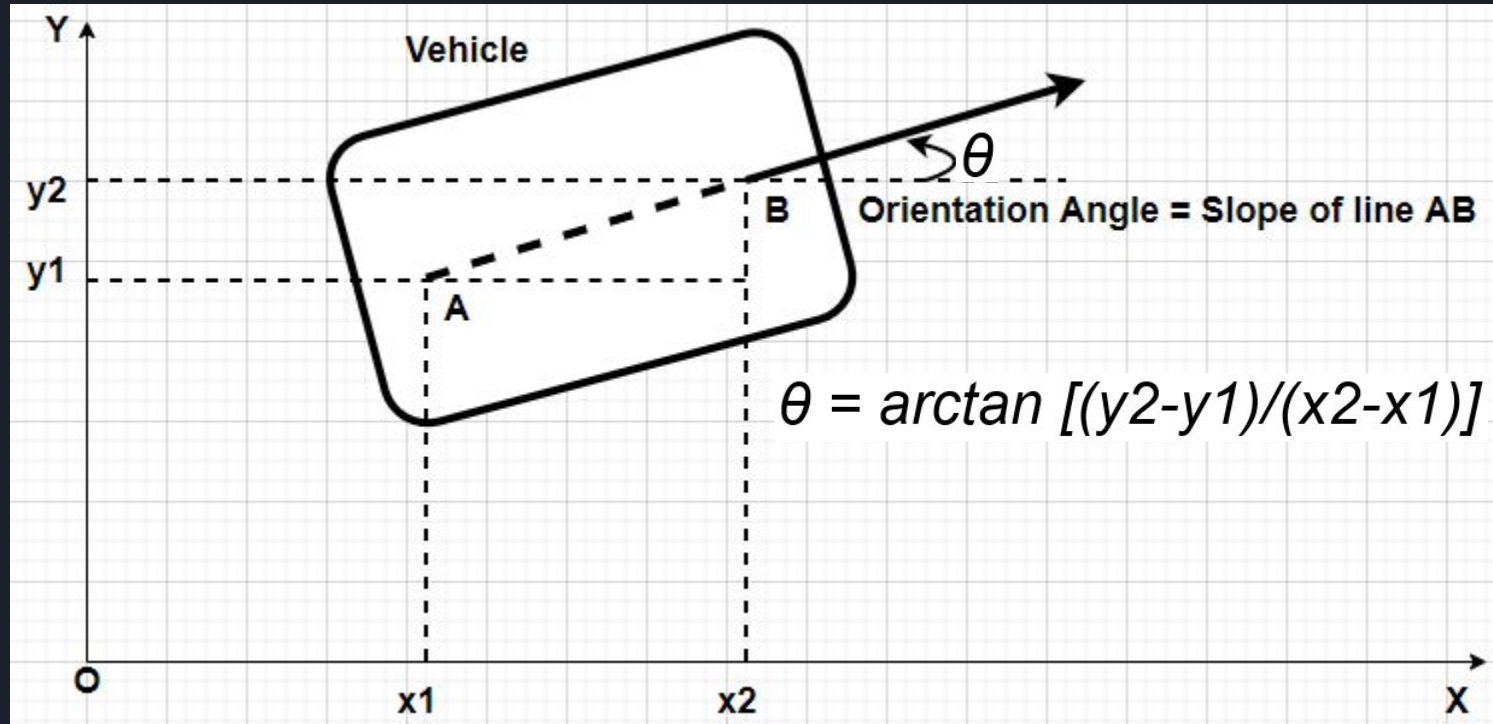
## Establishing a Coordinate System without GPS





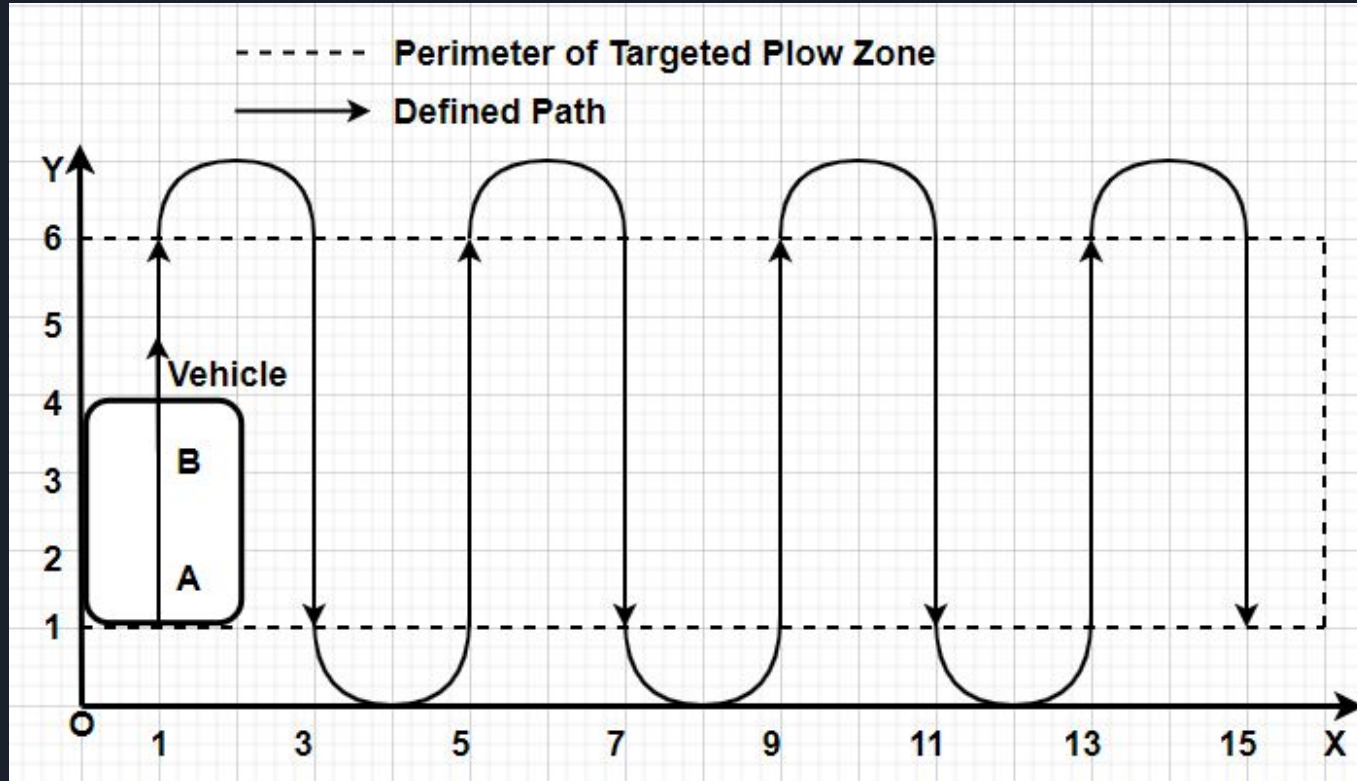
# Path Defining & Real-time Tracking for Autonomous Navigation

Estimating Vehicle's Orientation without a compass

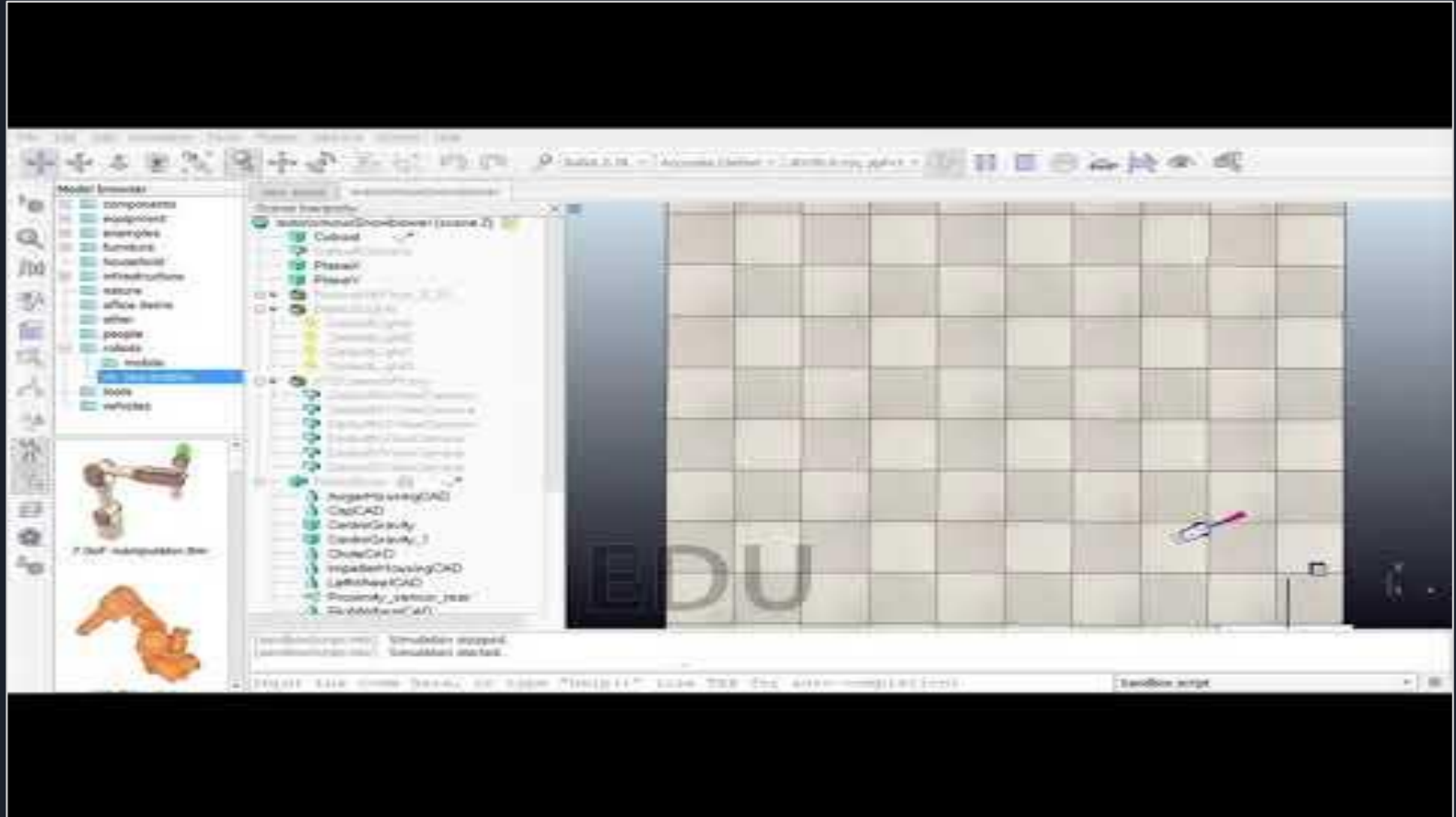


# Path Defining & Real-time Tracking for Autonomous Navigation

## 2D Coordinate System & Path Traversal

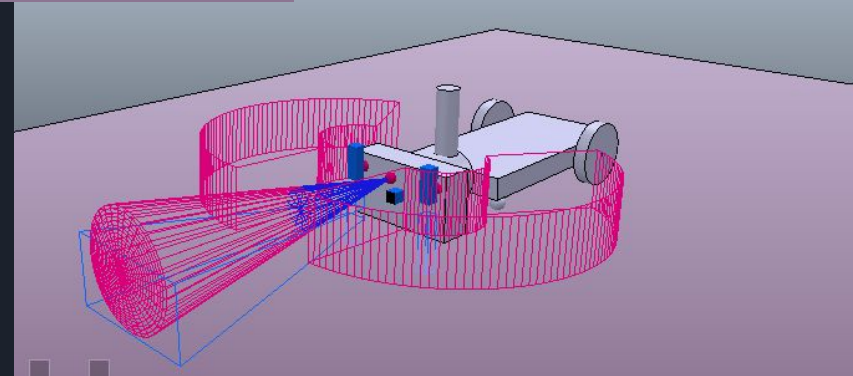
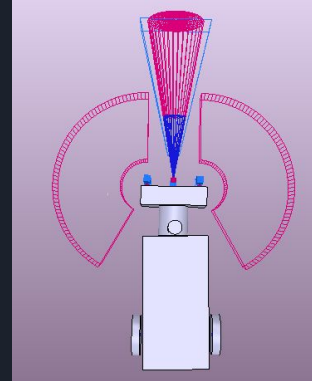


# Autonomous Navigation - Demo

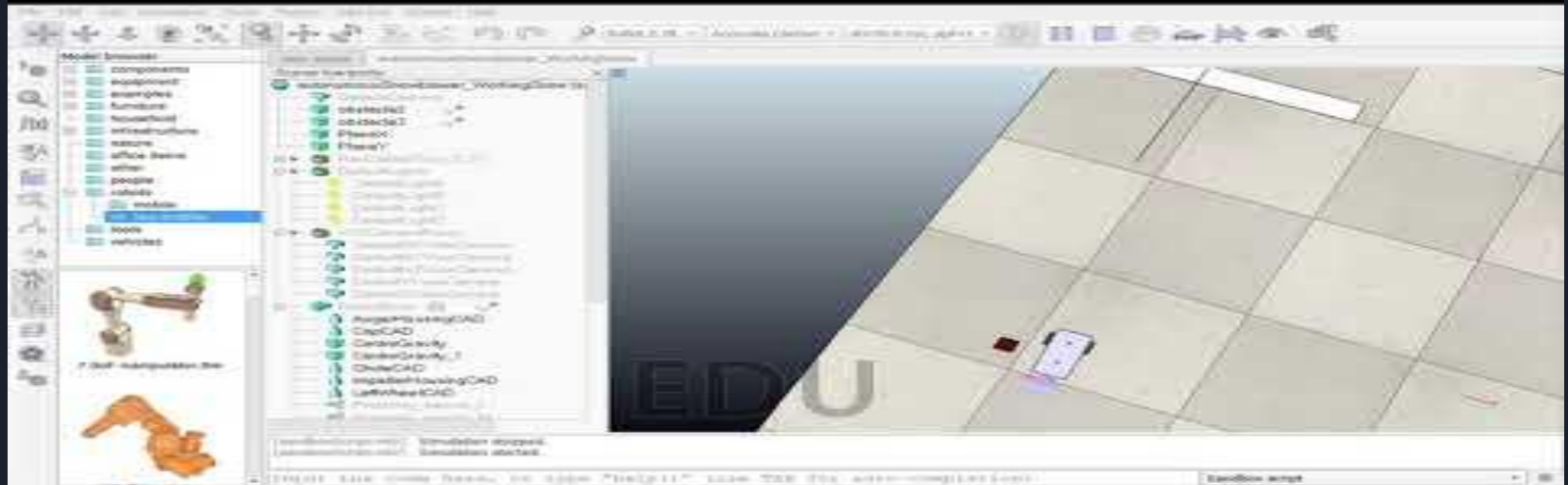


# Obstacle Detection & Collision Avoidance

- **Wide Angle Proximity Sensors**
  - Detection enhanced with disc faced design
- **Iterative checking for continuous obstacle detection**



# Obstacle Detection & Collision Avoidance – Demo

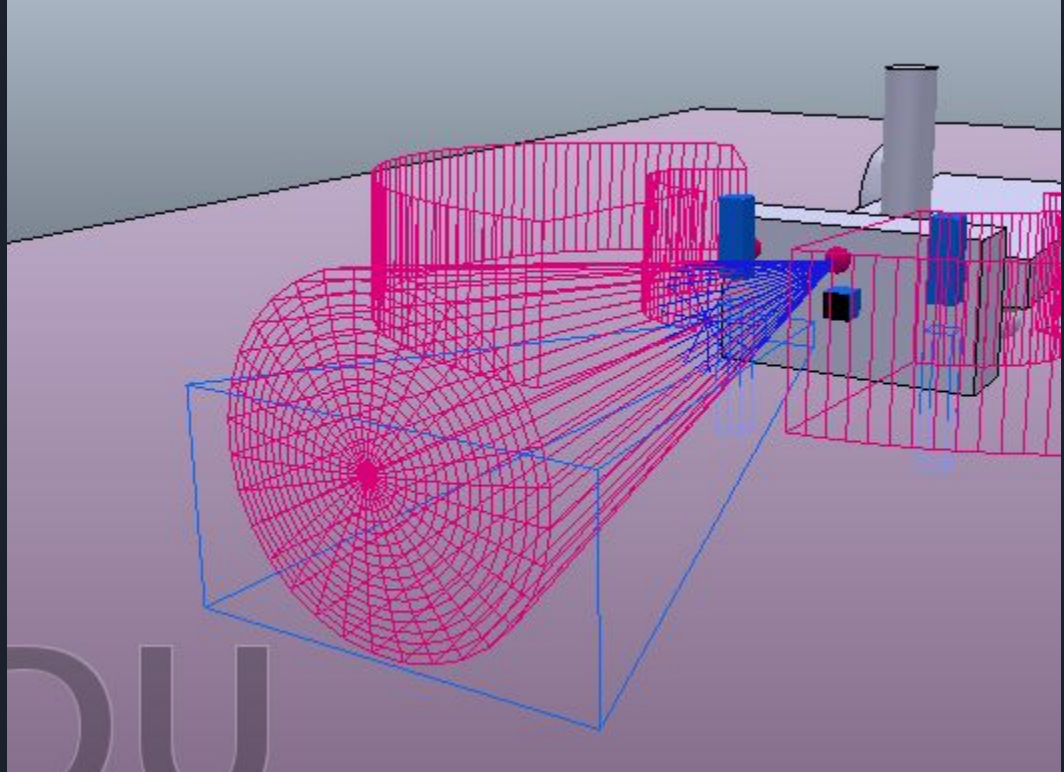


# Snow Detection & Plow Activation ❄️

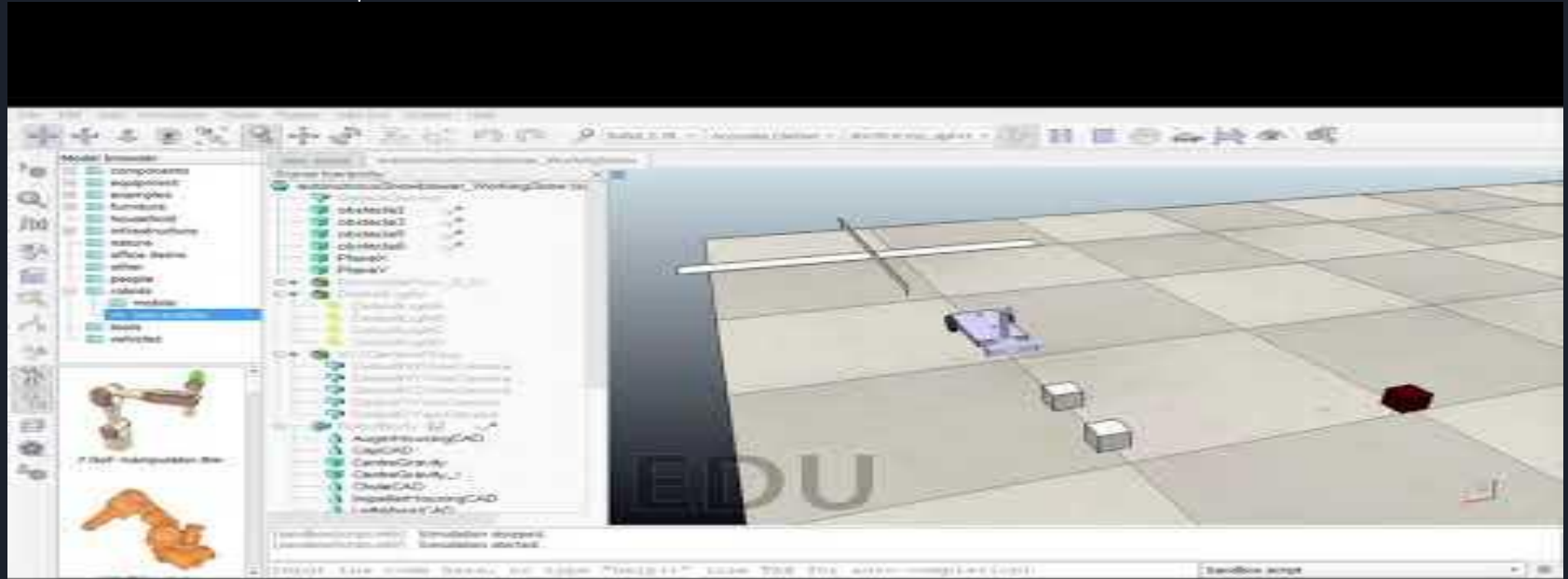
Vision Sensor in Perspective Style

Proximity sensor simulates Snow removal process

Snow is not an obstacle



# Snow Detection & Plow Activation - Demo ❄️



# Environmental & User Safety of Final Design

- Fully Electric means Zero Emissions
- Sensor Redundancy for Enhanced Safety
- Fail Safe Mode
- Manual Override Option







# Challenges Encountered

- Virtual collaborations only due to the Pandemic
- Differentiating obstacles from snow bank & vice versa
- Snow Blower idea turned into Snowplow
- Implementing coordinate system without a GPS
- Determining vehicle's orientation without a compass



# References

[1] <https://www.sciencedirect.com/science/article/abs/pii/S0002914997891813>



# Questions?



**Thank you!**