



# Models And Robotics Section

Dum-E

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# Acknowledgement

- ▶ We would like to thank the **Indian Institute of Technology Roorkee** administration for providing us an opportunity to do this project and show our skills. We would also like to thank the **Models and Robotics Section, IIT Roorkee** for mentoring us and providing the assistance for the project.

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# Abstract

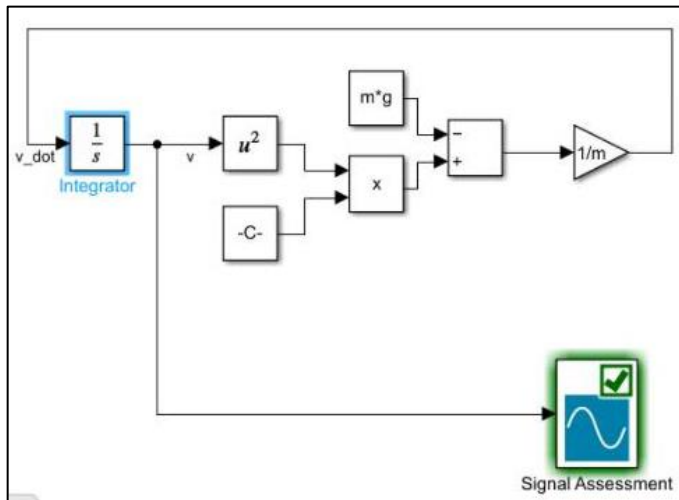
- ▶ DumE is basically designed to perform Pick and Place functions. For now, we have successfully created the pick and place function in predefined static environment.
- ▶ Also, with the help of Haar Cascade from Computer vision toolbox, we have trained it to detect objects like ball in real environment.

# Motivation

- ▶ Dum-E was a robotic arm which repeatedly appears in the movie, Iron Man I. Though the robotic arm keeps creating mess for Tony, it had saved his life too.
- ▶ To make a model such as DumE, it looked helpful and made us explore various aspects of robotics. Since robotic arm is basic model of robotics, we were highly motivated to start with it. Also, we were going to learn various software to run our model and provide insight about robotics.

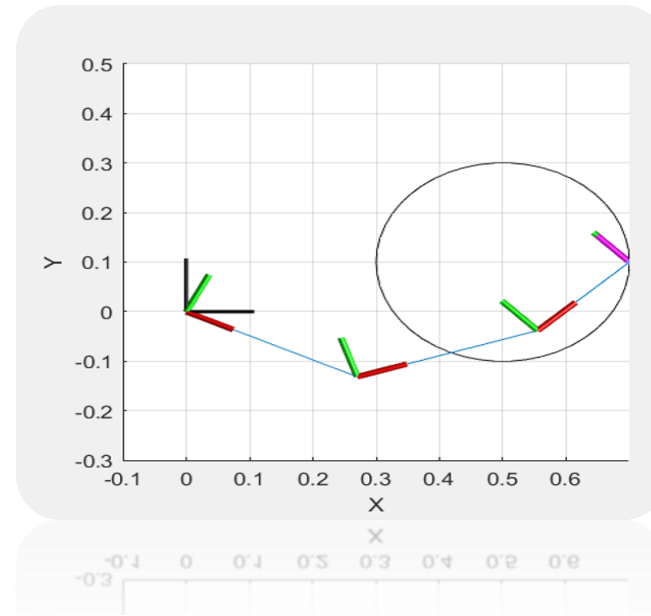
# What all we have used

- ▶ Matlab
- ▶ Simulink

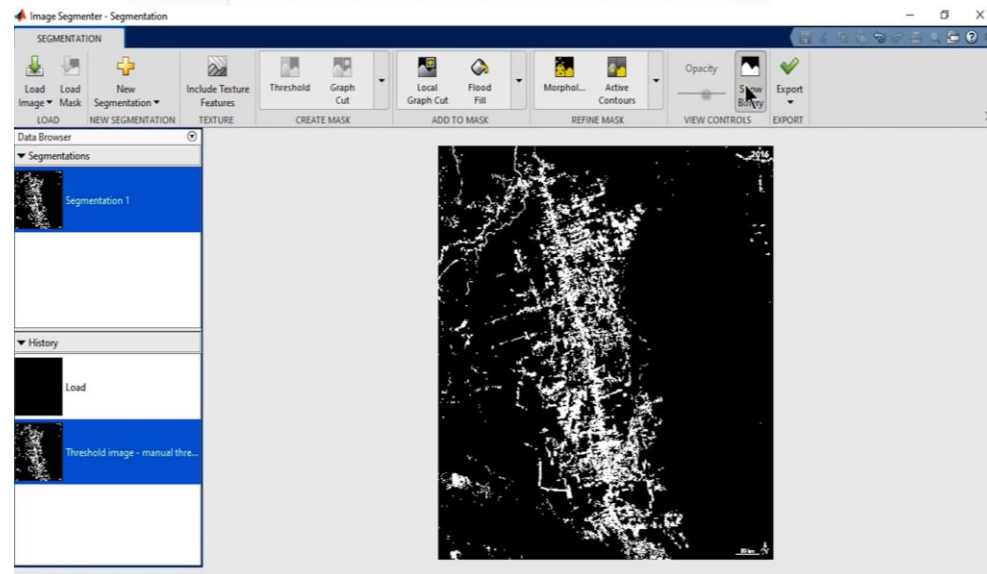


- ▶ Simscape
- ▶ Different Toolbox: Robotic System Toolbox Model Predictive Toolbox & Optimization Toolbox, Computer Vision Toolbox.

## ► Forward And Inverse Kinematic



## ► Image Processing

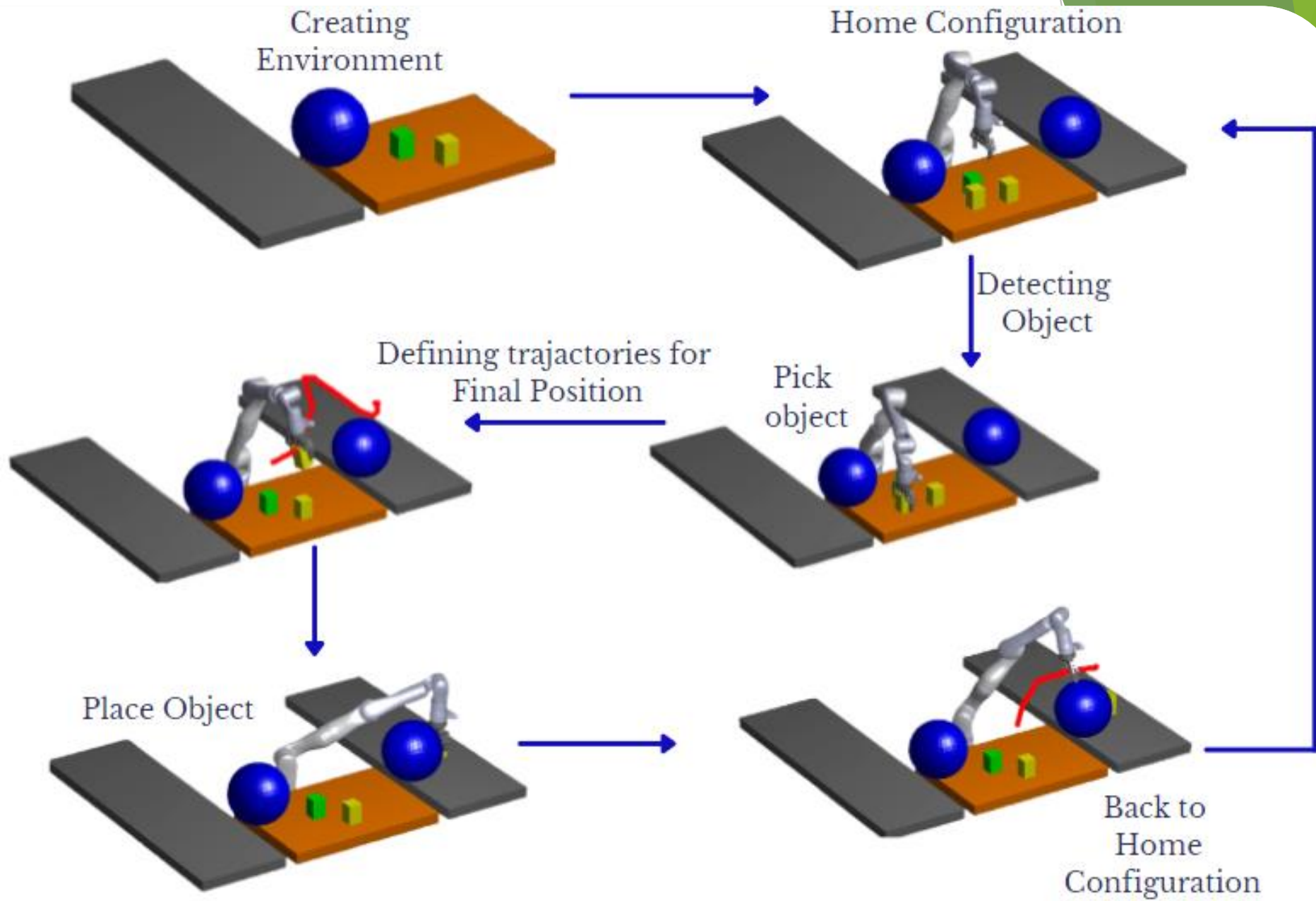


## ► Haar Cascade





# Workflow



# Mechanical Aspect

## Kinova Gen 3

- ▶ 7 DOF
- ▶ Embedded Controller in each actuator
- ▶ Torque sensor in each joint
- ▶ Unlimited joint rotation

# Cost

Software Used	Cost (in INR)
MATLAB	<u>62,000</u>
Simulink	<u>94,000</u>
Model Predictive Control Toolbox	<u>62,000</u>
Simscape	<u>62,000</u>
Robotic System Toolbox	<u>54,000</u>
Computer Vision Toolbox	<u>39,000</u>
Optimization Toolbox	<u>36,400</u>
Total Cost	4,09,400

# Application

- ▶ It can be used in automated Industries
- ▶ It can be used in space missions where human hands are ineffective
- ▶ It can be used in bio-technology.

# Limitations

- ▶ It can't work in real time environment.
- ▶ It is highly costly( Software) to build.

# Future Improvement

1. To integrate a path planning algorithm, which lets the robotic arm as a whole to move in a static environment,
2. To make it function in a dynamic environment using computer vision and statistical and machine learning toolbox,
3. To make both the end-effector as well as the robotic arm as a whole to move in a dynamic environment.

# Reference

- ▶ [Importing CAD model in Matlab](#)
- ▶ [Creating predefined Simulink environment](#)
- ▶ [Inverse Kinematics](#)
- ▶ [Tracing End Effector using Inverse Kinematics](#)
- ▶ [2-D Inverse Kinematic](#)
- ▶ [Building Robotic Manipulator through rigidBodyTree](#)
- ▶ [Pick and Place Workflow using Stateflow](#)