Progress Presentation-II

e-Yantra Summer Internship-2020

Project ID - 21 - 3D Perception

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IIT Bombay

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Overview of Project

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Perception task involves object detection, recognition Pose-estimation. We will explore the option of fully utilizing Point cloud data(2.5D data) that will be filtered out using point cloud library then implementing pre-trained PointNet model to classify the objects.

Objective:

- Filtering and Segmenting out the ROI objects.
- Classification on the accelerator(FPGA).

Deliverables:

- Cpp algorithms to create optimized pipeline for filtering and segmentation of objects.
- PointNet on FPGA using HLS.

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✔**Week 1**	Exploring 3D scanning and data representation,Noise filtering methods of Point cloud data.
✔**Week 2**	Creating filter pipelines in CPP to out the noisy data and Segmenting ROI objects
✔**Week 3**	Implementing pre-trained PointNet model to classify 3D scanned objects
✔**Week 4**	Making our CPP scripts independent of APIs
Week 5	Final execution of the task and optimizing our codes.
Week 6	Project Documentation, final report and Project Presentation

Expected End Results

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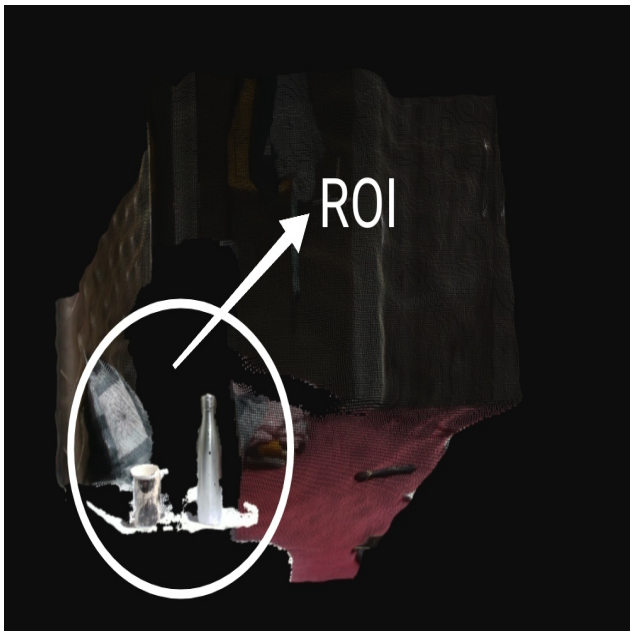

PassThrough filter

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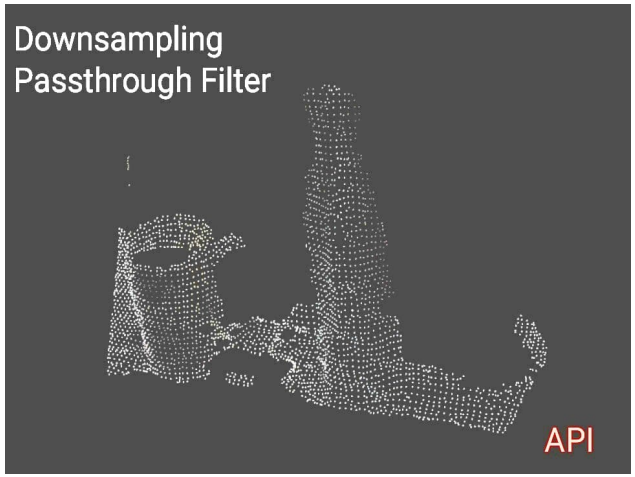

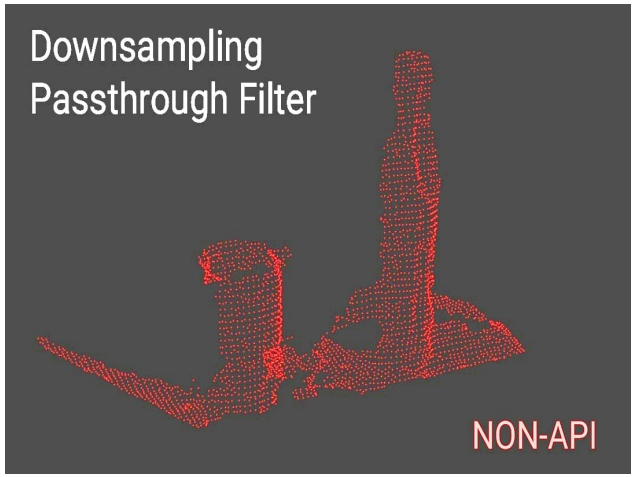

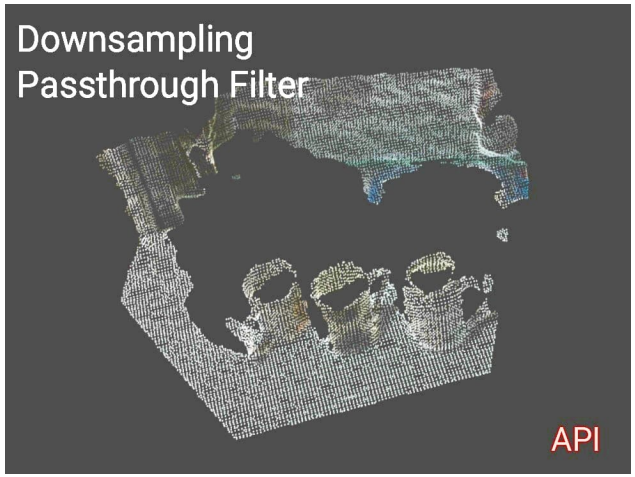

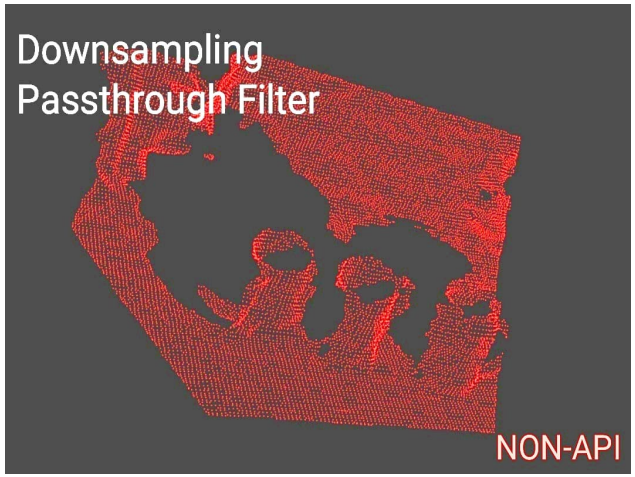

RANSAC- Plane Segmentation

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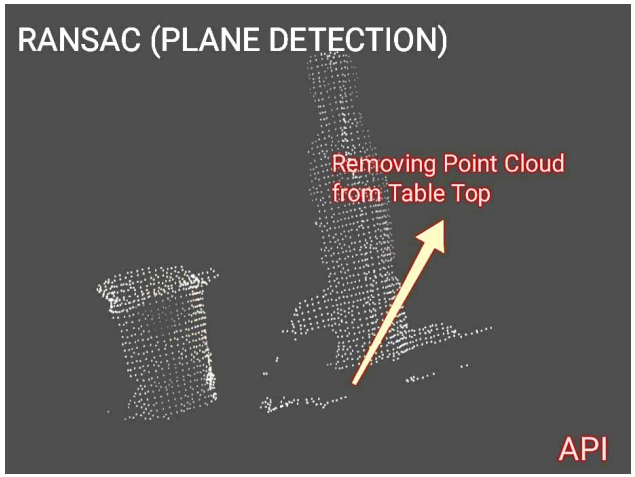

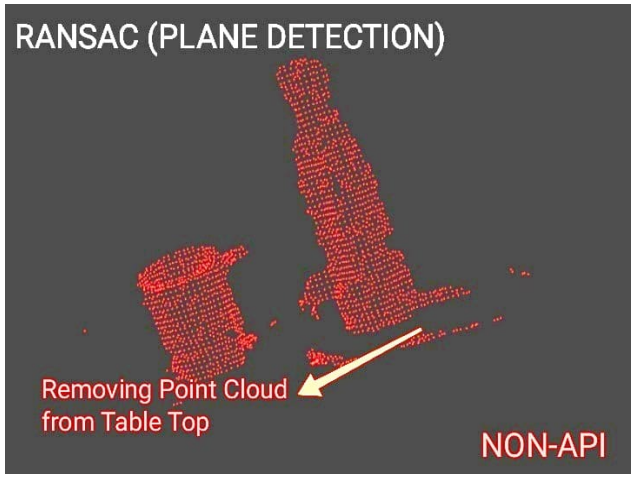

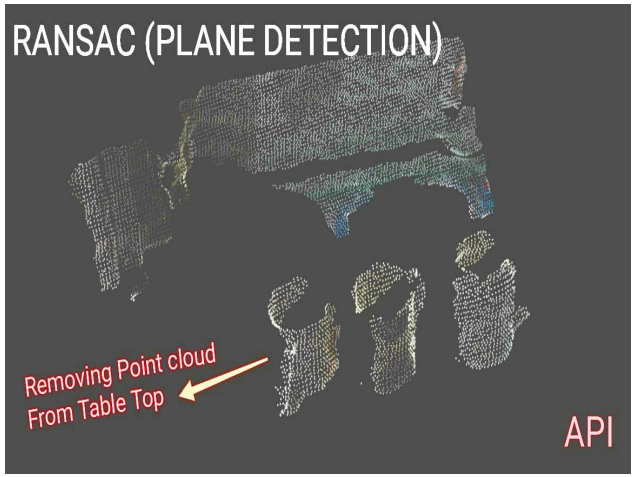

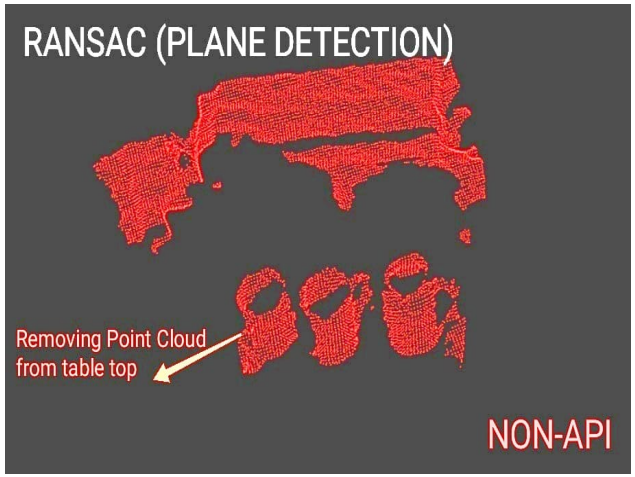

Euclidean Clustering

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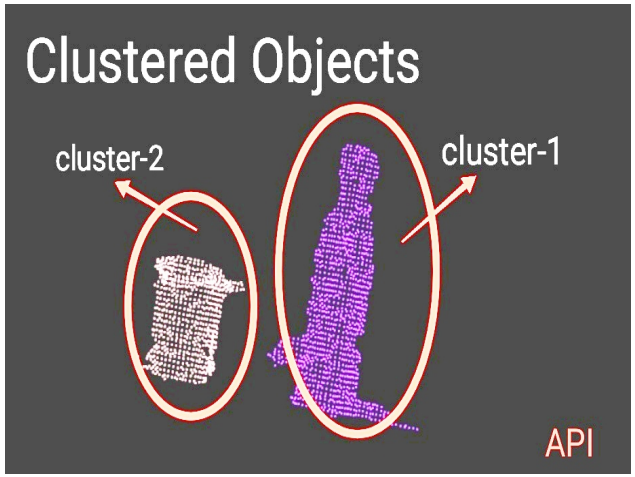

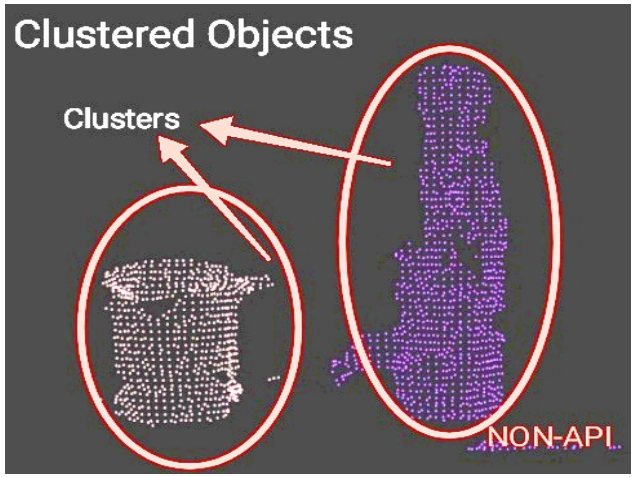

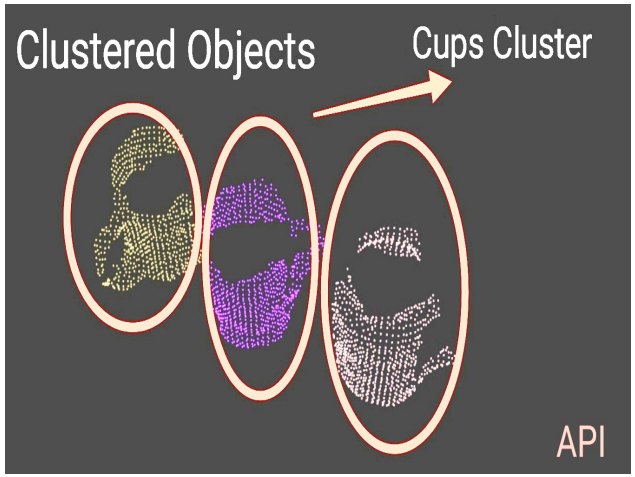

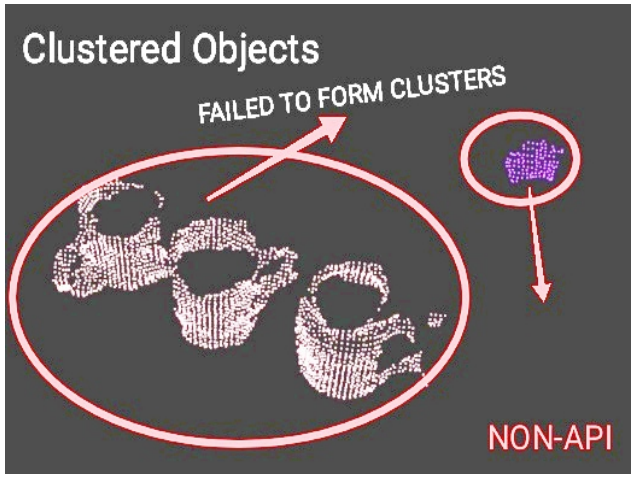

Creating Dataset

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- point clouds of 3 classes(Cup,Bottle,Box) for classification task
- Data Augmentation (increasing the dataset by...)
  - translation
  - rotation
  - Adding noise(while training)
- Labeling Dataset

Custom CNN based on LeNet

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Custom CNN based on LeNet

Why ?

- To get used to CNN and to analyse the behaviour of pointcloud to CNN model.

How ?

- Modified the CNN layers to fit in for pointcloud data.
- Input - 3 Channel (X,Y,Z coordinates single channel each).
- Maxpool layer 1D-size N(N is the no. of points in poincloud)

Custom CNN based on LeNet- Result

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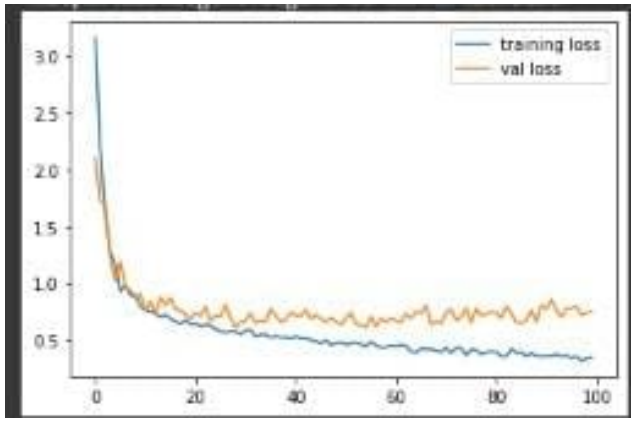
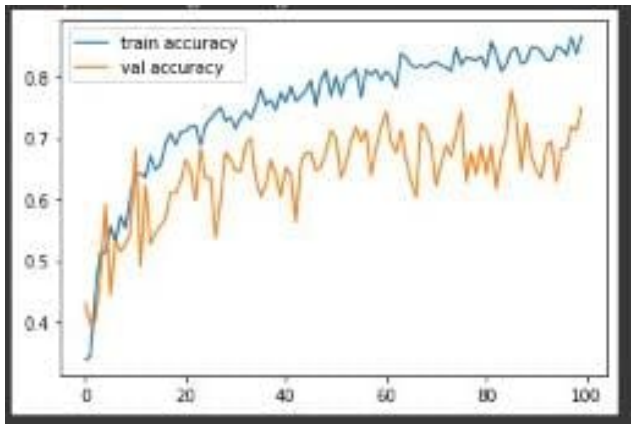
Object Classification Model Results:





- Model didnt give better results with test dataset -(67-70 percent overall model accuracy)

PointNet Architecture

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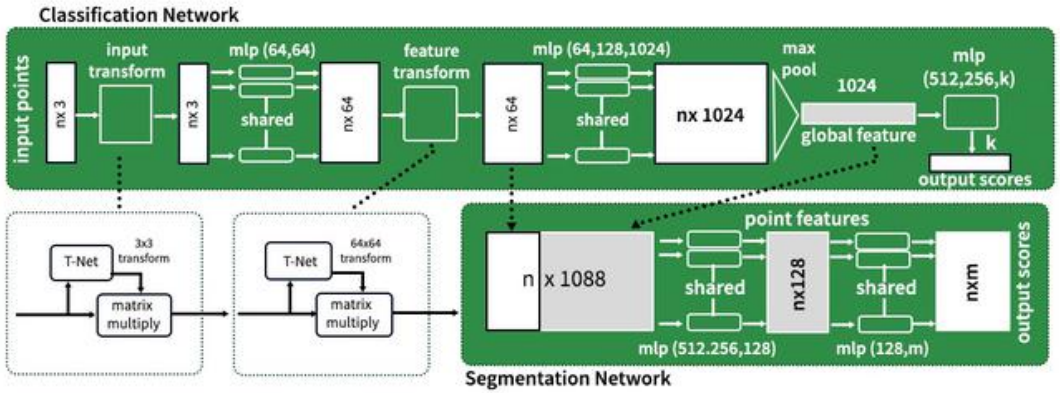
PointNet Architecture

Why PointNet ?

- Permutational invariance
- invariant to rigid transformations.
- Network captures interactions among points.



PointNet - Result

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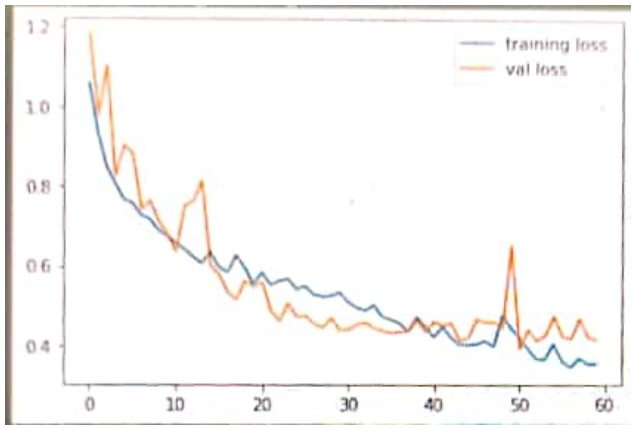

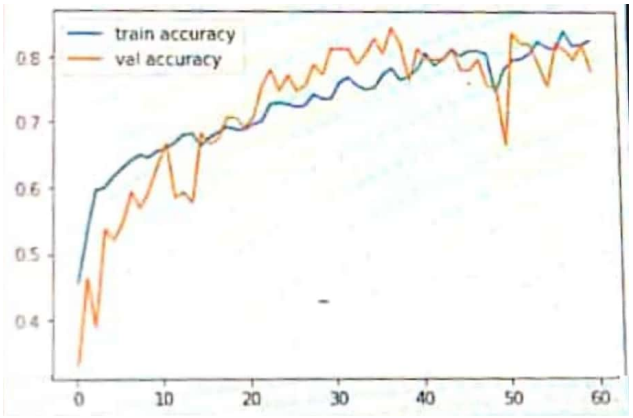

Class	**Accuracy**	**Dataset size:** before	after augmentation
Bottle:	78.09	17	170
Box:	58.54	6	160
Cup:	100.0	4	160
Overall model:	78.88	-	-

Challenges

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- Point Cloud coordinate range.
- Overfitting overcame by
  - Regularisation techniques(dropout,L2).
  - Shuffling dataset.

Final outcome

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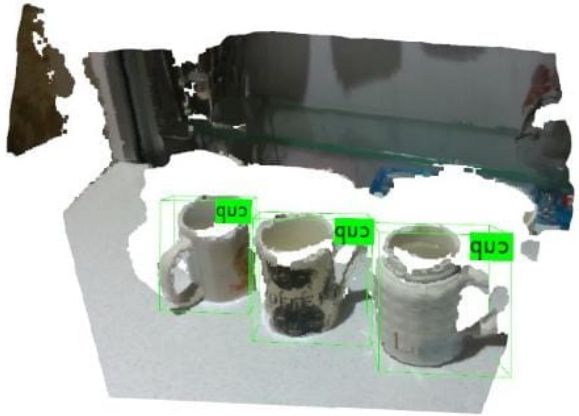

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- Euclidean Clustering Algorithm free of API
- GPU test bench

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- To-Do