

Intro to AI Platform Final Project



Detection of Mineral Resources in Extreme Environments

Team Name : GSBot

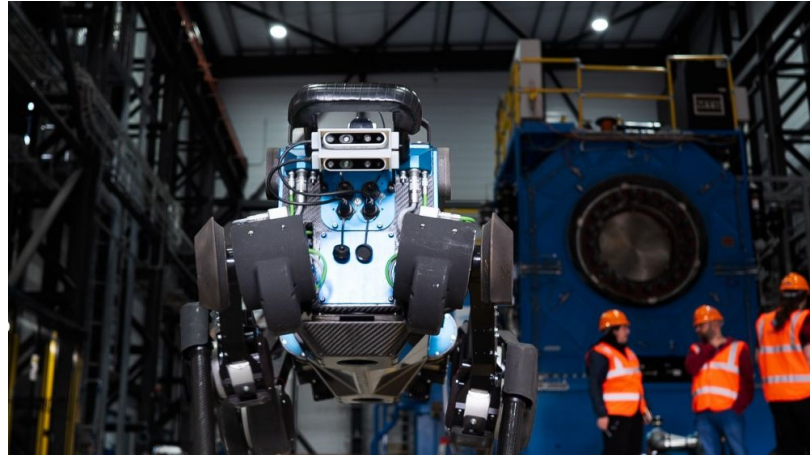
Team Members: Sooyoung Kim, Gaon Choi

Contents

1. Motivation and Objectives
2. Skills / Knowledge / Novelty
3. Demo and Conclusion



1. Motivation and Objectives



**Design a "robot" capable of performing a specific task
on behalf of humans in extreme environments**

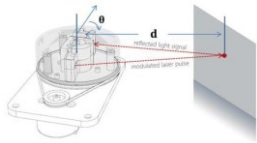
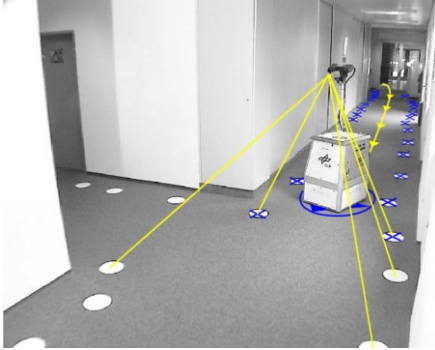
1. Motivation and Objectives



**Detection and extraction of Gemstones
from mines(extreme environments)**

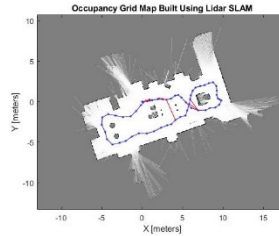
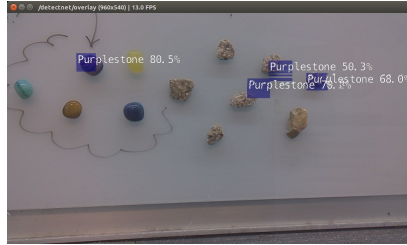
1. Motivation and Objectives

Explore Harsh Env



Camera & Lidar

Data Processing



Detection & Mapping

Jetson Inference



Save detected obj
& its location

Baseline

Gemstones Images

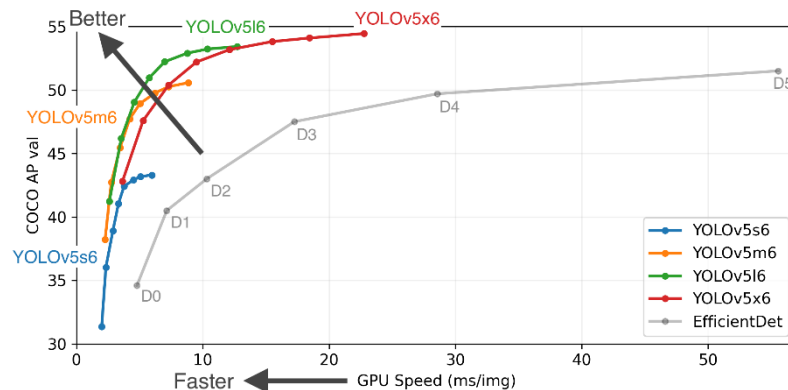
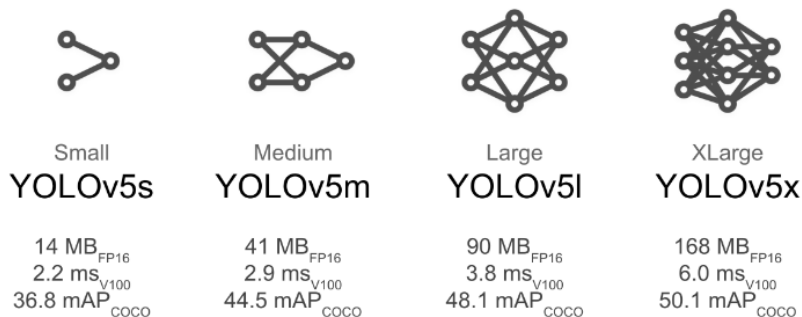
87 classes of gemstones for classification



- 87 classes, total 3,000 images (approximate)
 - images and labels → original purpose: classification
 - our purpose: detection → images + labels + bounding boxes
-

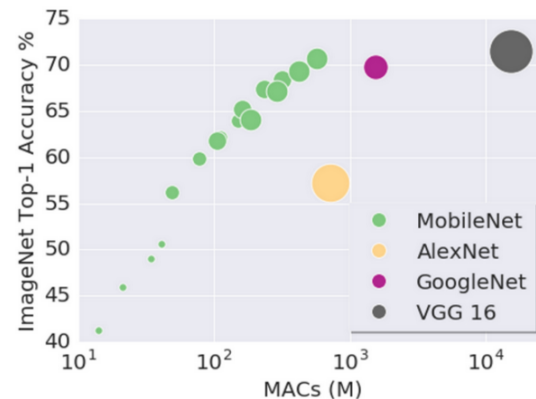
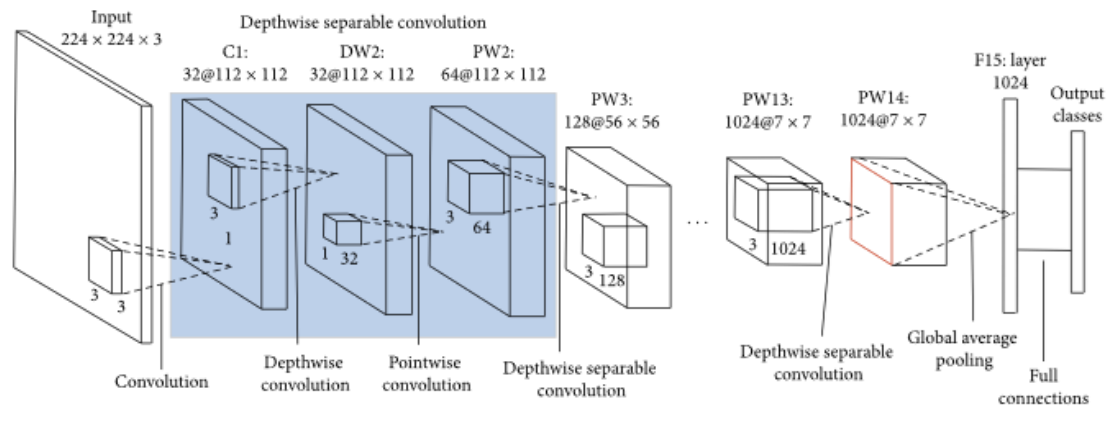
Baseline

- 1st try: YOLOV5 → e.g. dog and cat detection problem
- <https://github.com/ultralytics/yolov5>
- .pt → .onnx, but not .onnx → .engine

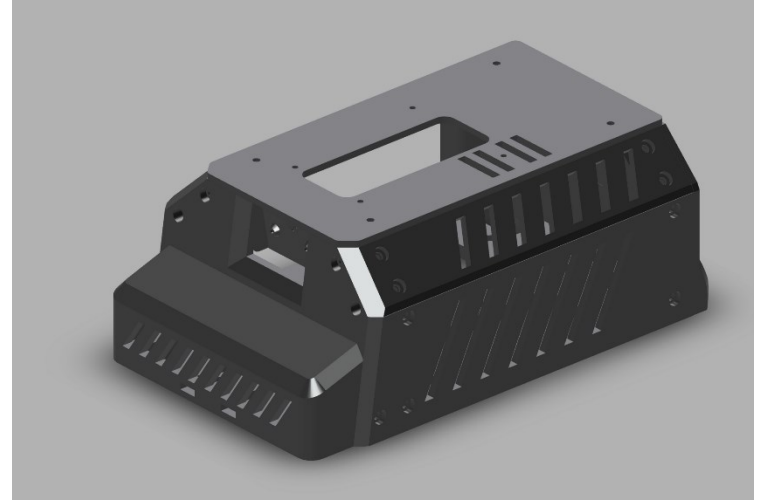
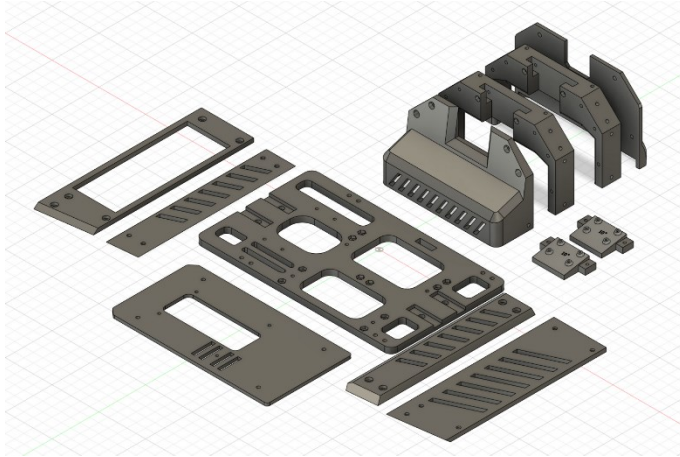


Baseline

- 2nd try: MobileNet
- .pt \rightarrow .onnx \rightarrow .engine : became our final AI model



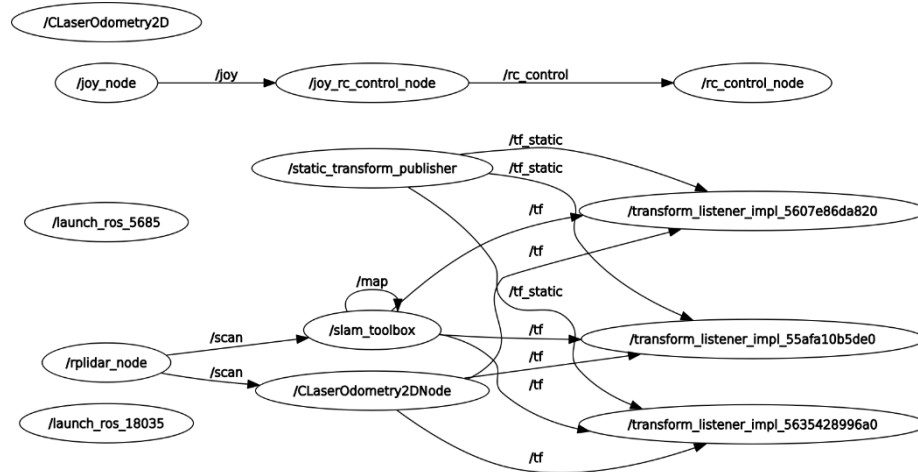
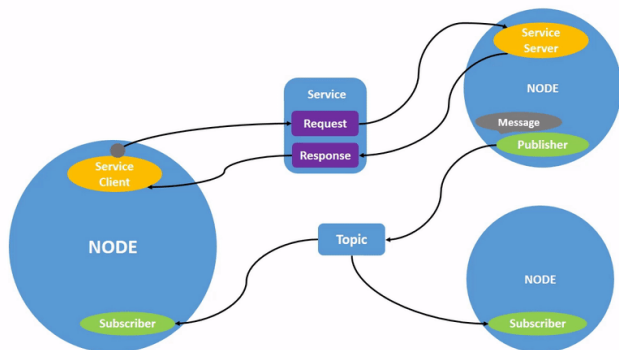
Skills - Robot Design & 3D Printing



Parts Design with 3D CAD and Print them through 3D Printer

Skills - Robot control system through ROS

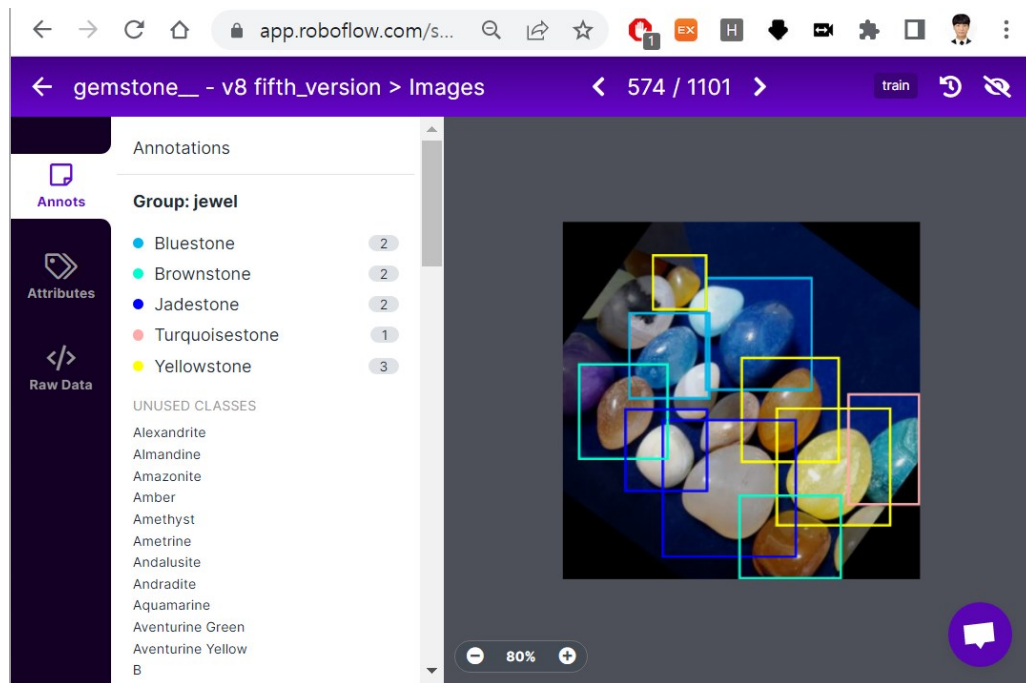
2



Robot Operating System (ROS) for Hardware Control and Sensor Driver

Improvement & New Ideas

Dataset Annotation using Roboflow



Improvement & New Ideas

Dataset Annotation using Roboflow

- Drawing bounding boxes with corresponding labels
- Data Augmentation Technique
 - Resize: 416 x 416 sized images
 - Horizontal & Vertical Flip
 - Random Crop(min-max zoom 7%)
 - Horizontal & Vertical Shear($-15^{\circ} \sim 15^{\circ}$)
 - Random Saturation($-9\% \sim 9\%$)
 - Random Brightness($-9\% \sim 9\%$)



90° Rotate



Crop



Rotation



Brightness



Exposure



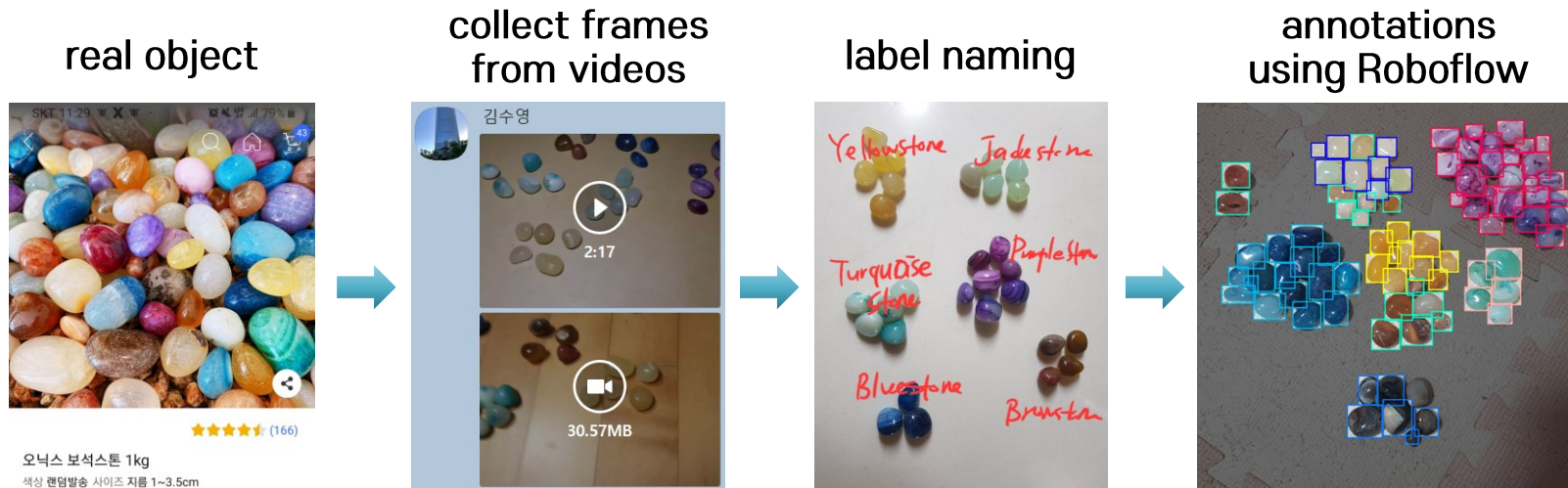
Blur



Noise

Improvement & New Ideas

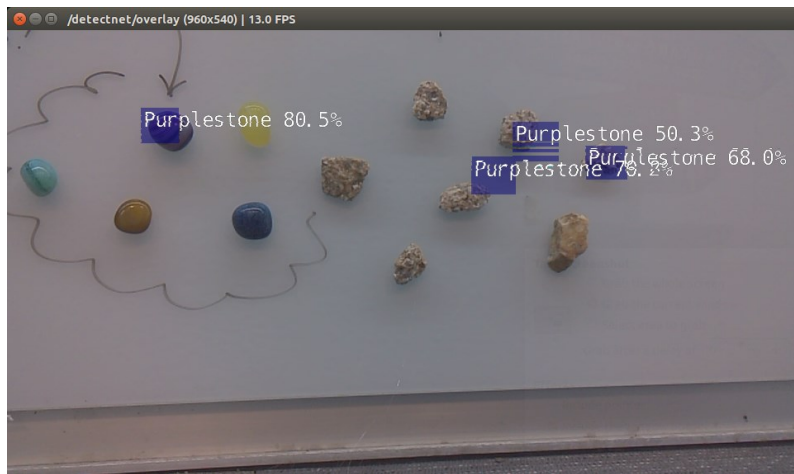
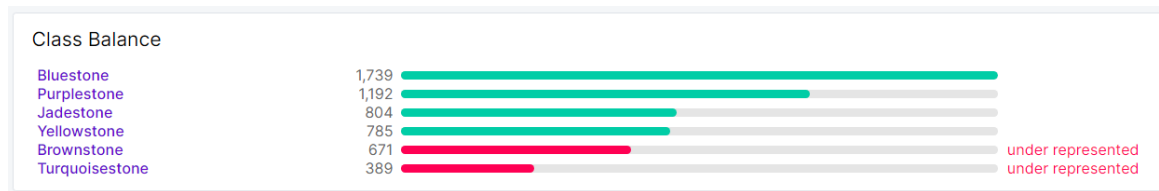
Custom dataset and Solving data imbalance problem



- labels: Yellowstone, Jadestone, Turquoise Stone, Purplestone, Bluestone, Brownstone

Improvement & New Ideas

Custom dataset and Solving data imbalance problem

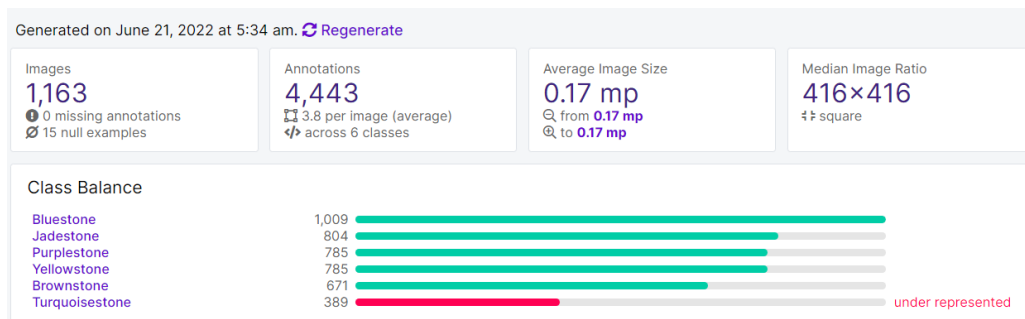


Imbalanced dataset distribution can make out model more biased and skewed!

Thus, balanced distribution is required for most AI model design.

Improvement & New Ideas

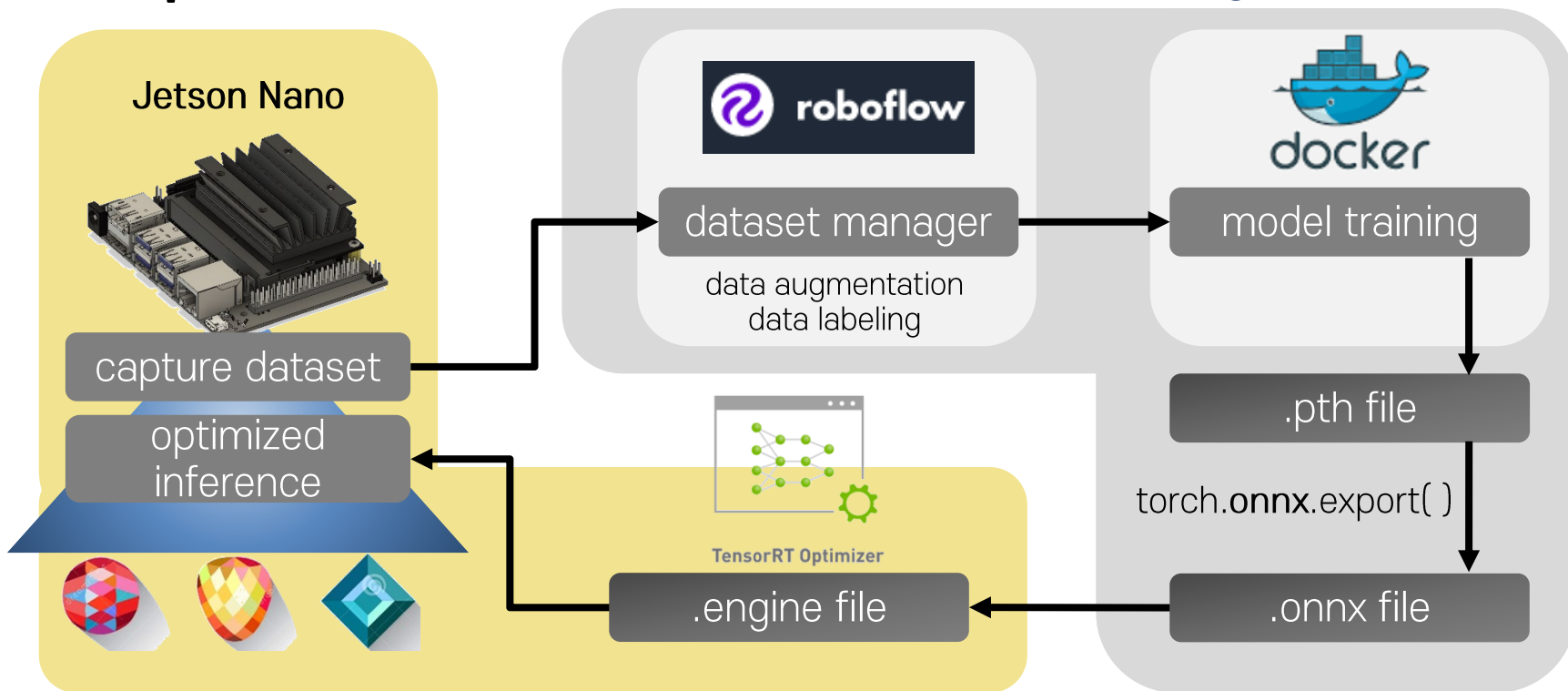
Custom dataset and Solving data imbalance problem



- The distribution of data for each class should be the same. (not skewed)
- The distribution of train data = The distribution of test data(validation data)
- If the distribution is imbalanced, the output of our model can be skewed.
 - There are several ways to solve this problem.
 - such as Over-sampling(e.g. SMOTH), Down-sampling, etc.

Development Process

assistant computing device



Optimization Techniques using Jetson Inference

Boost Up Frame Speed!!

Jetson Inference (CUDA Based Image Pixel transformation)
(more than 30fps at 1280 * 720 resolution)

Camera Change V4L Webcam to CSI Camera

Optimization FP16 Optimization in Jetson Nano

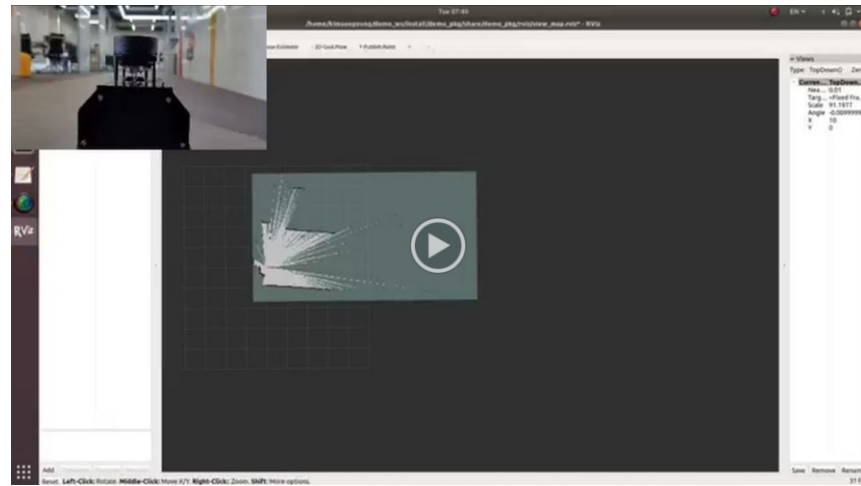
Miscellaneous Swap Area, Cooling Fan, LXDE used...



But... It drops to 10fps when Robot Starts to move... 

3. Demo and Conclusion

Demo Video



Conclusions

- We have designed a robot which explores for mineral resources and classify its category with ML methods.
 - Data analysis is one of the important process in machine learning engineering.
 - the purpose of data → classification? detection? or something else?
 - the distribution of data → e.g. class data imbalance
 - Optimization technique accelerates model inference speed.
-

Member & Rule

- 김수영 :
 - Robot Design
 - Parts Selection
 - Control System
 - Model Training
 - 최가온 :
 - Dataset preparation
 - Annotation, Manage dataset, Conversion
 - Model Optimization
-

Thank you for your attention!

