Deep Learning Based Autonomous-Driving Cart Using ROS for Computation Offloading

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Vision & Prominance

| Vision

Provide accessible artificial intelligence IoT services by embedding ROS and autonomous driving function into shopping carts

| Mission

- Provide safe and precise Object Detection, Object Tracking
- User friendly designed carts
- Smooth integration of SLAM Mapping, Human Indexing and Keyword Spotting
- Cut out unnecessary computation for IoT devices

Development Environment

PyTorch, pyAudio Analysis, OpenCV, GitHub, ROS, amazon web services, Raspberry Pi

System Architecture & ROS Structure

| System Architecture

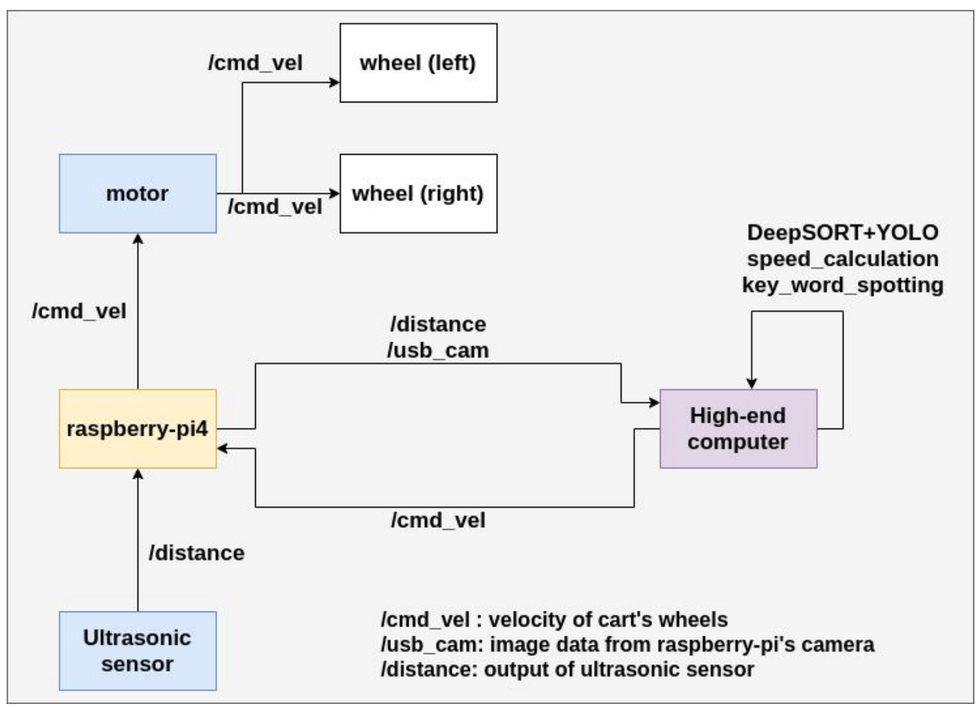
MEME Structure

System designed for specific client

| ROS Network

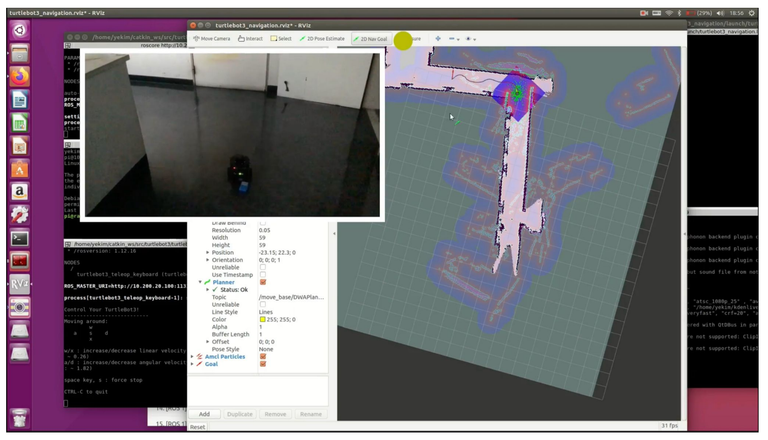
Main computer	Raspberry pi
Use image recognition, keyword spotting model to publish client's position	Use asynchronous web server for processing real time camera input
	Get current position using subscriber and determine next movement vector/ Publish distance of obstacle ahead using ultrasonic sensor
Get status using subscriber and publish emergency bit if needed	
	Get current status / emergency bit using status node

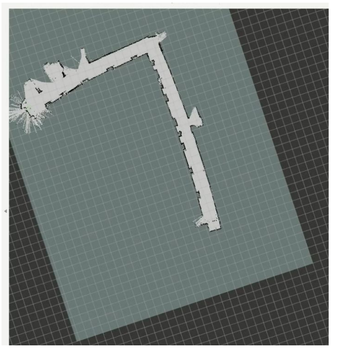
| ROS Architecture



Used Algorithms

| Mapping using LiDAR



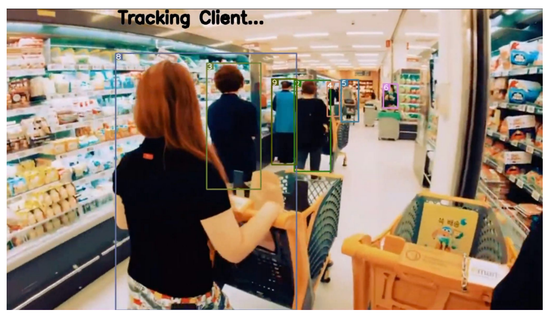


Use map for driving

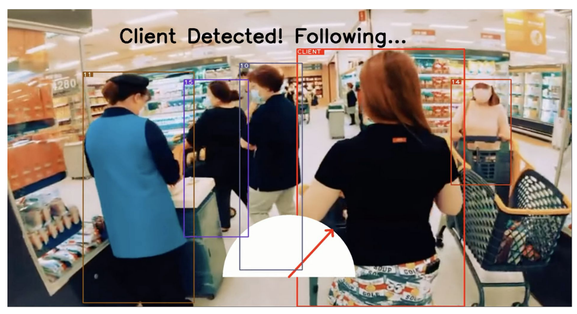
Use LiDAR and GMapping to map current environment. Map allows real time position recognition/ helps choose next movement vector

| Object Detection & Tracking

Object Detection with YOLOv4



Object Tracking with DeepSORT

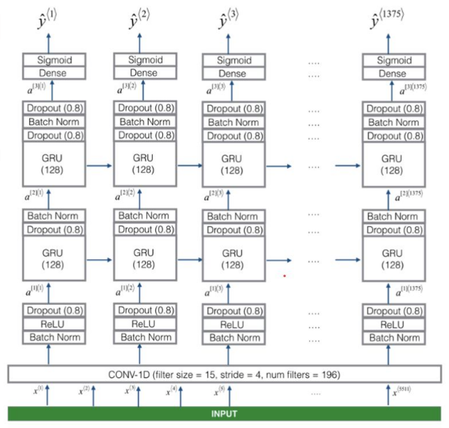


Detect client using YOLOv4. Choose most frequently seen client in given time as its client

Process YOLOv4 output with DeepSORT and determine new movement vector

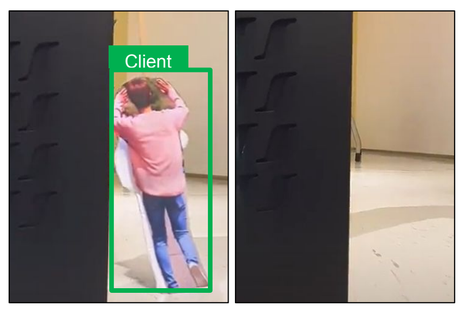
| Keyword Spotting model structu

Pre-process data: voice data of "MEME", random words data, 10sec Background noise data
→ Process data: add positive voice data and negativ voice data to background noise 10sec
→10sec Speech Dataset
Accuracy of 86%



| Exception Hnadler

1. Mistakes other person as it client



2. Client speed is faster than cart's maximum speed

Conclusion and Future Work

1. **Increase enterprise's revenue**
   - Enhancing customers in-store experience will increase revisit rate and increase revenue.
   - allow customers of different age or physical abilities to shop easily.
   - cart's accumulated path data can be used in creating better marketing strategies
2. **Applied to diverse fields**
   - Not limited to in-store movements → can be used for delivery services in the future
   - Can be enhanced to help with storing/loading supplies in storage facilities
3. **Improve offloading computing in IoT devices**
   - Trigger future research for IoT and ROS integration
   - Eliminate limitation of small computing power of IoT devices
   - Improve IoT market