Problem Statement

Nowadays, the mobile robot used for industrial production has become more frequent. However, the traditional outdoor solution for automatic robot tasks like navigation cannot be approached like GPS in the indoor environment. That is why the designer needs to use robot recourse for navigation such as depth/RGB camera. The RGB depth camera is the input of the problem, and the output is such a data feature that could help solve the robot navigation problem.

Technical Challenges

The first technical challenge is that the input data such as RGB and Depth images are complex. For example, the Depth sensor could produce hundreds of thousands of points every second, which is challenging to store process analysis.

The second challenge is that all computations of algorithms and programs need to be on a mobile robot that is relatively small and does not have a large number of resources. Also, the program needs to be in progress with the other robot's algorithms, such as engines controls.

Moreover, The third challenge is that algorithms and methods must work in real-time because it influences the robot trajectory planner, which needs to work in real-time.

Related Works

One of the possible and promising ways of compressing the initial long-range images of artificial environments (various rooms, buildings, factories, and urban areas) is their representation in the form of a set of geometric primitives: planes, faces, lines, segments, edges, vertices, angles. Compared to the original image, such linear geometric objects are characterized by a much lower dimension and noise, as well as the possibility of finding various relationships between them and transitioning to a semantic description of the surrounding space

The most common method is RANSAC, Hough Transform, Local Normal Algorithm. Unfortunately, all these algorithms are too slow and could be applied to real-time problem

Approach and Result

The main idea of my work is to use RGB data instead of depth to reduce our space. We could find the critical object on the frame by using RGB video. The critical object is a nonmovable, static object which not change during the robot's movement. These objects are used to reconstruct the navigation map using the position on the RGB frame. The data from the depth sensor could use the other technical methods with an RGB camera to calculate the distance to the object.

I use the object detection Tenser flow AIP to find the critical object. First, I prepare the data by taking the COCO dataset's necessary category. After that, I took the pre-trained SSD mobile net and used my data to create a custom model. After that, I create a different quantization to apply it to NVIDIA Jetson Nano. Moreover, do a test where I check the fps of the program. And then try to use other applications such as video to check if it is possible to run other programs together with the object detection on this embedded system.

The SSD Mobilenet coped with these tasks and demonstrated fps enough for real-time work.

Broader Impact

My work shows that for robot navigation in indoor space enough, use the RGB camera or use RGB camera like mane navigation sensor. The other people could learn how to create an object detection model on custom data. My program for use the model could be used only on Jetson Nano. Also, it could not work correctly if the RGB sensor moved fast. And if it many objects in a frame. The project's future improvement is creating a consumption test and applying a program to create a map by using the critical object that the model finds.