Environment Identification Robotics S2024

Agenda

Team

Problem Statement

Solution

Tools

Robot

Team

Project AX

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Problem Statement

Given a certain environment, the robot needs to identify and indicate its environment.

- Develop a place recognition CNN for a robot capable of identifying its location in a prescribed possible places.
- Design a controller enabling the robot to gather multiple images when positioned in a specific environment.
- Utilize the collected dataset to train the CNN model.
- Demonstrate the model's efficacy by having the robot illuminate its lights in different configurations (Different Colors)

Consider a robot that might be in one of N places (e.g. inside a class, in the courtyard, in a corridor; or in a simulated room vs a different simulated room). You want to build a place recognition CNN that given an image frame returns in which place the robot is. Design a controller such that, when the robot is placed in one place, it acquires many images of that place. Use the controller to collect a dataset, train a CNN and show that it works (e.g. the robot could light up its lights in different ways)

Solution

Solution includes 6 steps

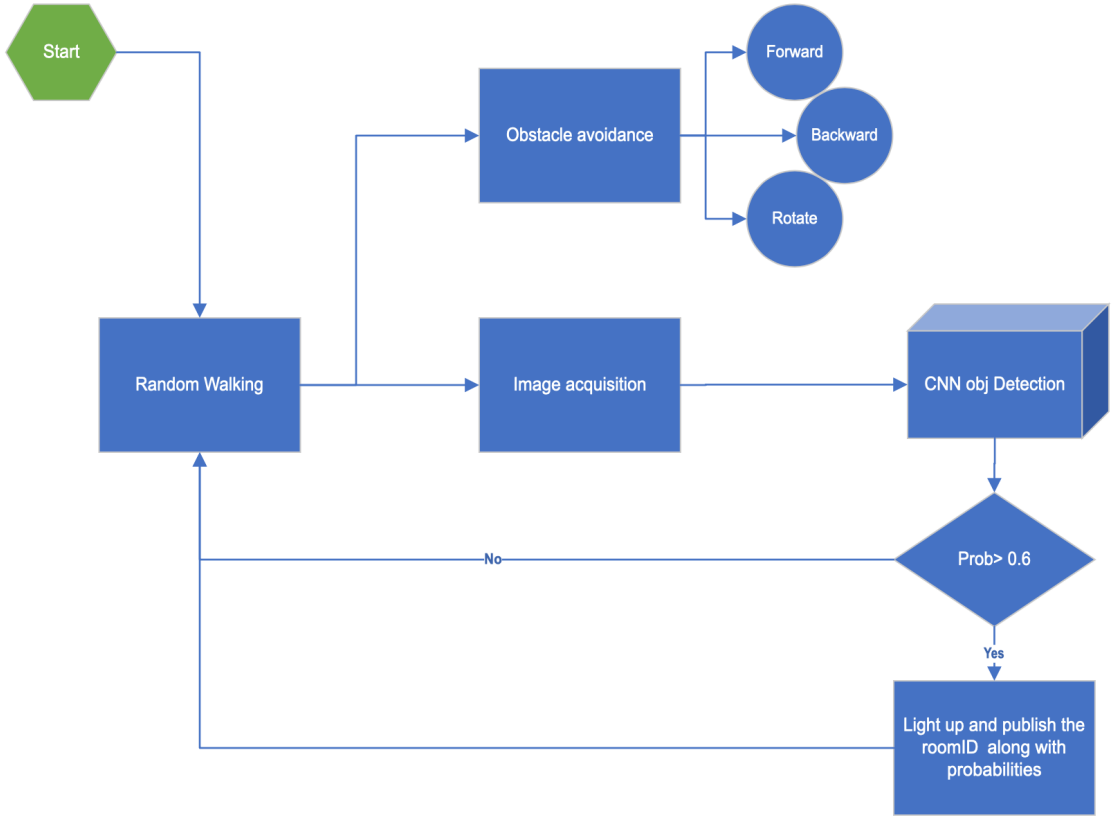
Stage 1 -

- Retrieve the initial dataset.
- Develop a CNN to classify the images into ”N” Classes(2 classes In our case).

Stage 2 -

- Gather Information(Images) from the environment the robot is placed in by moving the robot around.
- Classify the robot environment using the CNN
- In case of lower confidence , move to another place in the environment and re-run detection algorithm.
- After successful classification
  - Light up the robot which indicates the specific environment
  - save the image into the dataset(Optional)

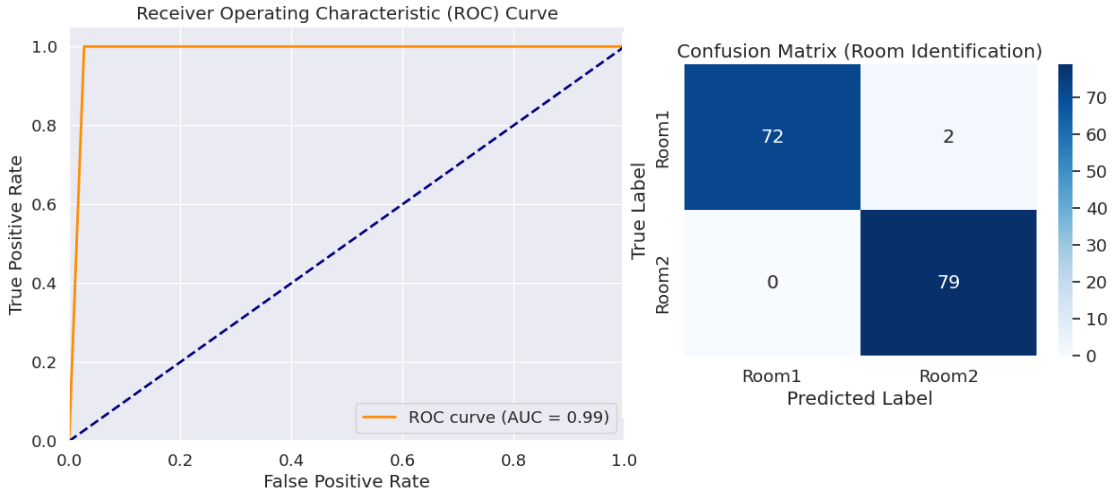
Flowchart


Start
Random Walking
Obstacle avoidance
Forward
Backward
Rotate
Image acquisition
CNN obj Detection
Prob> 0.6
No
Yes
Light up and publish the roomID along with probabilities

Model Study

MobileNetV2

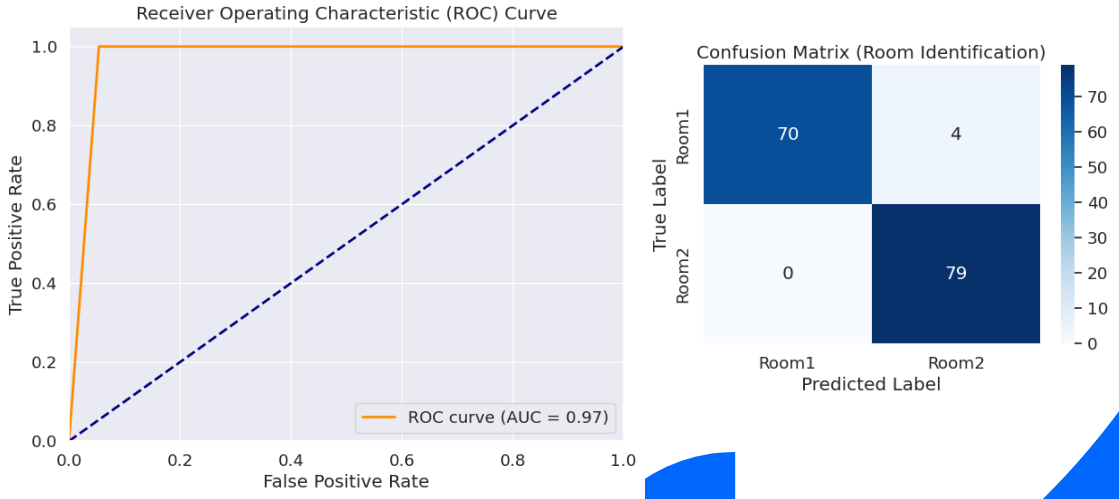
- Pretrained model , can be tailored to our need.
- Faster Training
- Light model
- Accuracy - .98



MobileNetV2 was chosen due to higher Accuracy and F1 Score.

Custom CNN Model

- Simple architecture
- Architecture can be changed based on application.
- Fast training (in case of binary classification)
- Accuracy - .96



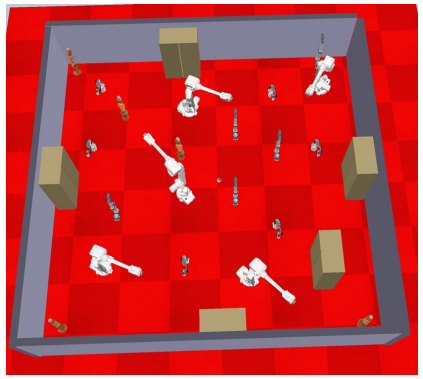
Environments

Balanced dataset (approx. 450 images from each room)

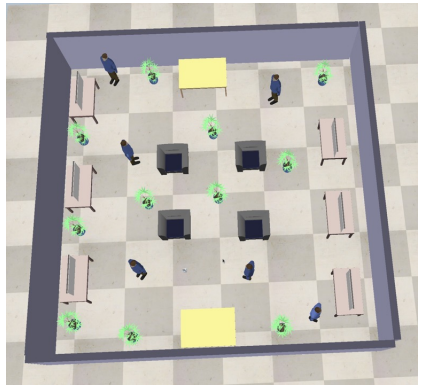
Analyze the images and clean images which show no information. (low variance !!)

Data augmentation to make model robot robust.

Robotic Garage



Waiting Room



Demo

Tools and Robot

1. ROS
2. Python
3. Pytorch

1. MyT

Send feedback

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Questions

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Thank you