Investigating Socially Aware Navigation for Robot Accompaniment

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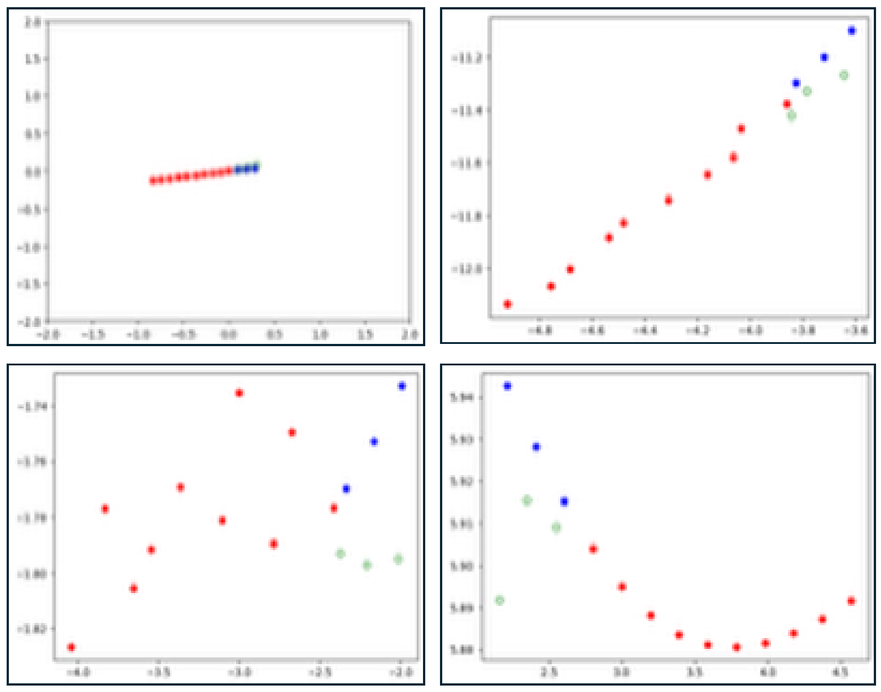
Overview

- Outdoor parks and trails play a critical role in fostering healthy, active lifestyles and supporting sustainable communities
- To support and encourage a broader range of people to increase their time spent outside, this project investigates the practicality of deploying robot companions to naturally accompany people walking both indoors and outdoors
- Our multi-modal sensing model combines distance sensors and computer vision to localize potential people and obstacles in the robot's environment while ensuring that the robot respects social norms and personal space during interactions with other park users
- We deployed and evaluated the model on a real robot in field settings

Figures



The figures below demonstrate some results of the paths predicted by the model. The red dots demonstrate the history of the person's path that the model is trained on, the blue dots are the actual future positions that the person was at, and the green dots are the predicted future positions of the person outputted by the model. These are all measured in meters.

Site Details

Location
Applied Motion Lab
100 Union St SE
Minneapolis, MN 55455

Site Supervisors
Professor Stephen J. Guy
Zach Chavis

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https://motion.cs.umn.edu/

Mission
Develops artificial intelligence and computer vision technologies to advance autonomous robotics and the computational analysis of human movement and behavior

Methods

- In the beginning, we trained a multilayer perceptron (MLP) on crowd data collected of people walking to predict their future trajectory
- We compared the loss from the predicted trajectories to some baseline models as well, from a person standing still to if the person was maintaining their current velocity
- We also augmented the data during training, centering the trajectories to start at the origin so the model learns from relation positions rather than absolute positions, rotating trajectories, and adding noise to past trajectories
- After we were satisfied with the performance of the neural network, we migrated the network to a simulation, where we used the model's predictions to create a target position for the robot to navigate to while accompanying the person

Me (left) standing next to Zach (right), the graduate student I was working with, and the robot, a Unitree Go-1, I programmed during the summer

Results

- During the lab experiments that we did, the robot was able to somewhat follow the person
- However, due to constraints on speed and ensuring safety, the robot was unable to match the person's speed or move quick enough to walk right next to the person
- Recording the data from the sensors, we noticed that there was a lot more noise than we had originally anticipated when training the model , which had impacted the robot's performance when running tests
- There was a lot of jitter in the robot's movement, leading the robot to occasionally obstruct the path of the person that the robot was accompanying
- From the training and simulations results, the robot performed best on linear paths and when the person was standing still, but performed with less consistency when the path was curved

Future Work

- Future uses and directions is training the robot on data for more than one person, potentially having the robot be able to accompany a group of people rather than just a singular person
- Have robot learn more socially aware behavior, having the robot learn from trajectories of two people walking together so that it can mimic more human behavior and where it should be in the future.

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