ISAACS: Visualizing Pedestrian Path Prediction for Semi-Autonomous Robot Navigation

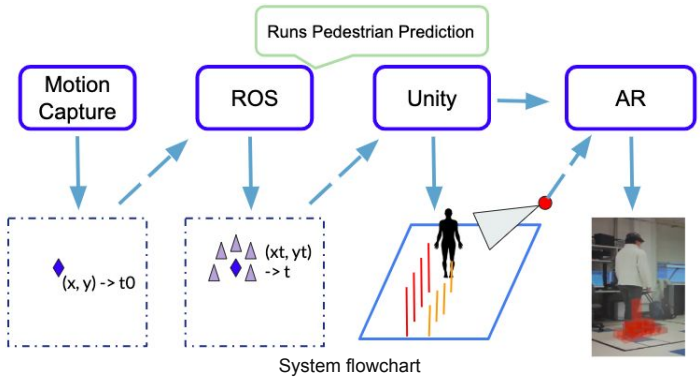
We help robot operator see the future by using AR.

Problem Statement

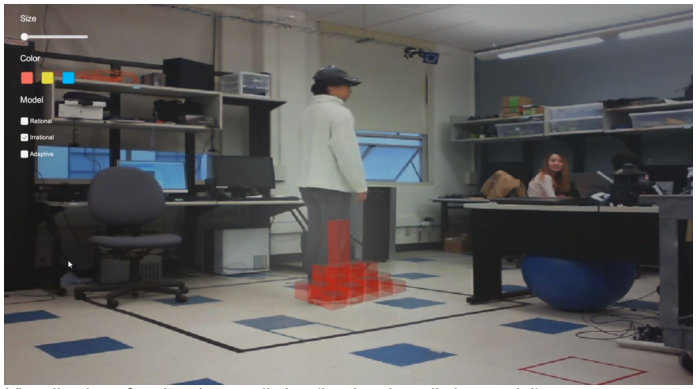
In the present world, semi-autonomous robots are becoming widely spread. Their applications are very broad, ranging from casual tasks including entertainment, filming and delivery, to more serious scenarios such as in military and medical settings. As robotic technology is emerging and the limits of robots' abilities are pushed constantly, many challenges of controlling them to be more accurate, efficient and harmless also appeared and attracted our attention. Specifically, we noticed the problem of robot's constant collision with pedestrian in daily life, and want to improve the flawed collision detection in robotics in terms of visualization.

Solution

Assuming adding human control would bring down the potential risk of collision to pedestrian in case of autonomous algorithm goes wrong, we aim to provide visualizations to help the user (controller) manipulate robots' reactions when potential collision is detected. In particular, we will apply path prediction algorithm for walking pedestrians, and FaSTrack path planning algorithm for drones, then visualize pedestrian's path and robots' trajectories using Augmented Reality technologies.

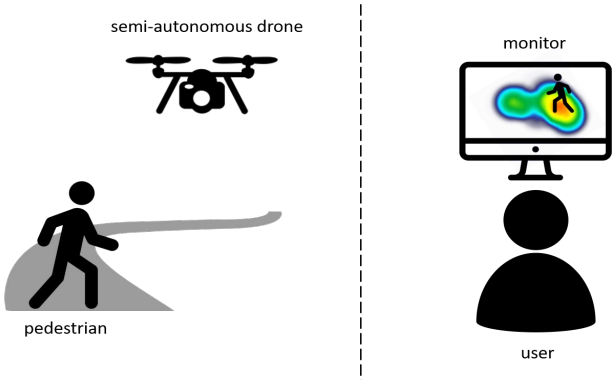


System flowchart



Visualization of pedestrian prediction (irrational prediction model).

Kiwibot is a good example of semi-autonomous robot with flawed collision detection.



Visualization of pedestrian prediction and flight trajectory overlay on streaming video by using AR. Then, user can change confidence level of the prediction to avoid collision.

Implementation Details

Our current version of the system consists of 4 modules, as shown in the system flowchart. We use Optitrack motion capture system to track the position of the pedestrian and the drone (mounted with first person camera). Then the pedestrian path prediction algorithm running on ROS generates prediction data continuous. The Unity computer integrates this data and creates the virtual elements at their correct position. Finally, we render the virtual elements as an overlay to the WebCam view port, generating an AR image.

Evaluation and future work

We will implement the function about visualizing drone trajectory and conduct several user studies in this semester. We expect our system to have higher task success rate, shorter time on task, and lower error rate.

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