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Visual segmentation and recognition of moving objects and people for drone inspection applications

Problem statement

In this thesis we are going to investigate machine learning and image understanding techniques to optimize UAV-based inspection applications. We will apply and evaluate different state-of-the-art algorithms for multiclass pixel-level semantic segmentation, to enable accurate object detection of both moving and stationary objects. At the same time, we will investigate techniques for manipulating and adjusting the viewpoint of the UAV to improve scene understanding over time. The algorithms will be evaluated using a realistic simulated 3D environment.

Use case

The use case for this project is to help with inspection tasks such as: inspecting for rust on a ship, security in the sense of looking for unauthorized personnel, missing or out of place objects and general inspection tasks.
This project has the potential of benefitting the industry in terms of less man hours used and quicker and more efficient inspection of the ship. The focus is on the maritime industry but it can easily be extended to other businesses or fields where inspection tasks are costfull and time consuming.

Proposed solution

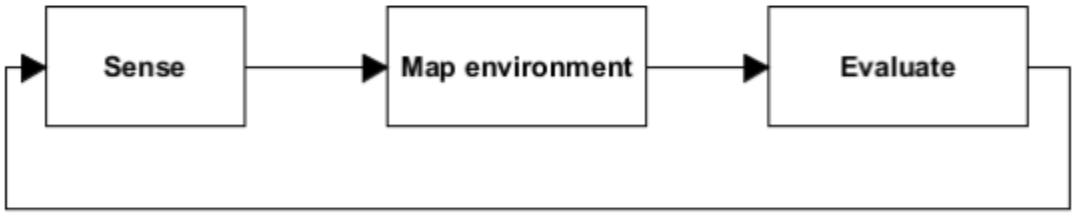

Figure 1: Sense, map environment and evaluate methodology

Sense: Use camera and onboard sensors to gather data.
Map environment: Generate list of objects and their location
Evaluate: Evaluate if an object is missing or unknown. If unknown, adjust viewpoint of drone and sense again.

These drones are supposed to be used in inspection applications such as inspecting harbors for unauthorized access and misplaced objects(containers, cars and so on). The scope for this thesis will mainly be the first and last phase of the project as the second phase will be delivered by other people in the project team. The drone will run the robot operating system(ROS) and the machine learning algorithms will be constrained within the ROS operating system. The project should attempt to fulfill the following goals:

- Investigate different different state-of-the-art algorithms for multiclass pixel-level semantic segmentation
- Implement the chosen image segmentation algorithm
- Implement next-best-view planning software to better support the active mapping algorithms
- Evaluate the algorithm using Airsim to determine its performance

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Project plan

A rough estimation of the project in early stages, and will be updated as the project work begins.

TASK	Week 1	Week 2	Week 3	Week 4
Literature review				
ROS ans AirSim hands on				
Investigate state-of-the-art algorithms for pixel-level semantic segmentation				
implement and Evaluate differtent algorithms for pixel-level semantic segmentation				
Control for UAV minpulating and adjusting viewpoint implementation				
Report writing				

Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14	Week 15	Week 16	Week 17	Week 18

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Supervising plan

A weekly meeting with Postdoc (Rui Pimentel de Figueiredo), Research associate (Jonas le Févre) and the main supervisor (Erdal Kayacan). The meetings will include the current state of the project, the project process and future steps to be taken in the project. The format of the weekly meeting will be a short presentation.