TJHSST Computer Systems Lab Senior Research Project
Tracking in Persistent Surveillance
2009-2010

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Abstract

The development of a program that can track targets is a crucial development in security and/or surveillance systems. A tracker can be used in the event of a crisis situation to follow potential suspects or targets from the scene of a crime, or to find where these targets originated from, all based on aerial imagery. By using a program to do this, quick, real-time analysis is feasible rather than having humans toil over movies at a later time.

Keywords: tracking, persistent surveillance, urban surveillance, image analysis.

1 Introduction

1.1 Scope of Study

The goal of this project is to create a tracker that can follow a certain object, whether it be a human, a vehicle, or some other moving target, and trace its path through a series of images. The extent of this project is quite variable, due to that there is no apparent limit to how detailed it can become. By adding more and more noise, the problem will increase in complexity and become harder and harder.

1.2 Expected results

Ideally, the result of this project will be a tracker that can successfully track a target or multiple targets through a simulated terrain and through actually aeriel imagery taken of an urban area.

1.3 Type of research

My project is a project of pure applied research. I am not seeking new fundamental understanding of the material, but rather implementing various methodologies such as pixel subtraction. Rather than instituting a brand new theory, I am working to use an established theory and to utilize it, and possibly improve on current models and programs.

2 Background and review of current literature and research

My mentor told me about the step in her project of Persistent Surveillance that involves tracking targets through the area of interest. In the office, some of our colleagues are working on posture recognition, and this is partially related to my project. The similarity is that both attempt to analyze images and provide useful information, all by looking at the pixels and edges of the image. In one paper I read, the tracker is being used on thousands of different images, taken from the 4 orthogonal directions. The new tracker generates simulated humans in different postures, and matches the real image to the closest simulated posture. The generated posture is then compared to the edges of the image, by using an edge detection program on the real image.

3 Procedures and Methodology

3.1 Requirements, Overview, Limitations, Development Plan

In order for this project to work succesfully, I will need to have both aerial imagery as well as computer generated imagery. It needs to be able to track targets through real terrains; the reasoning behind having aerial imagery.

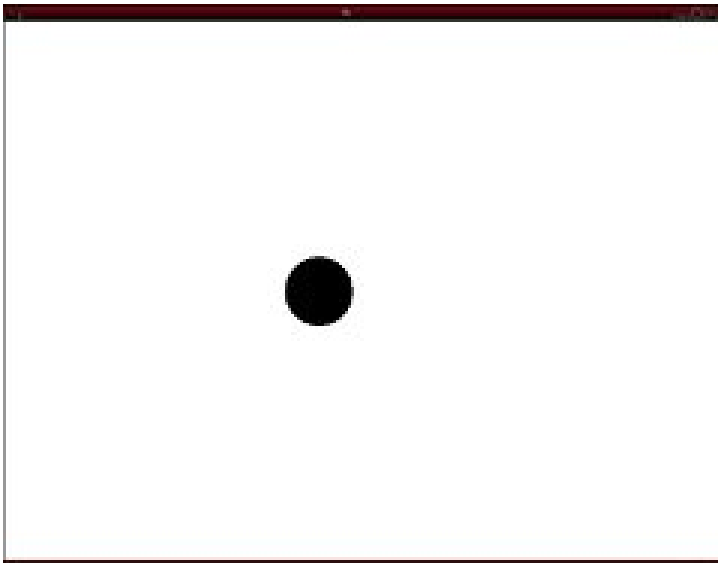

Figure 1: Image of Basic Target

The computer generated imagery will be used as a starting point, and its flexibility in complexity will allow me to develop my program much more easily, by only adding as much complexity as will most benefit me. I will be working mostly in Python, because it has sufficient image processing capabilities for my project. The limitations are most likely going to be the limitation of usable aerial data. While working at my mentorship, one apparent drawback to using aerial data is the difficulty to accurately orthorectify aerial imagery, or in other words, to orient it in a way so that it is an exact birds eye view and also is to scale.

3.2 Research Theory and Design Criteria

The overriding theory in this program is the idea of pixel subtraction. By taking two subsequent images from a movie file, and comparing the two images pixel by pixel, the pixels in which the value has changed are the areas of interest. Prior to the introduction of "noise", or content in the image that isn't the tracker, this theory should be sufficient to track the target. However, as the complexity increases, I will use a filter to help eliminate noise and focus on the target.

3.3 Testing and Analysis

The testing phase of this program will be extremely. The way I can fix parts are by improving the algorithms used to follow the different objects. I can always also work to improve efficiency, because with large images streaming constantly, time will become an issue for the actual project. My testing will vary by using different levels of noise, different objects to track, different backgrounds, and varying numbers of tracked objects. The analysis will involve the accuracy of the tracker, in addition to run time.

3.4 Visual representation of data and results

A visual representation of my program will be graphs including graphs comparing run-time with noise, as well as accuracy with noise. Lastly, a short series of pictures showing my tracker tracing the path taken by the target is a possibility.

4 Results, Recommendations

4.1 Expected Results

The final result should be able to follow a target or multiple targets through both simulated terrain images as well as real world aerial imagery. I will provide the results most likely in a series of images showing my tracker tracing the path of target(s). I could run the program multiple times, and check if the tracker follows the target throughout its entire path, and graph the percent accuracies depending on the complexity of the image. This project has no apparent end, as the algorithm for tracing and the complexity of the image can always be increased.