CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

Johnny Ho

Project Number

S1412

Project Title

Post-Disaster Response Using a Novel Adaptive Object Recognition Algorithm on High Resolution Satellite Images

Abstract

Objectives/Goals

The purpose of the project was to design a fast and accurate automated system for recognizing objects in satellite images. By locating tents, this automated system would then help NGOs locate displaced populations and allow them to use their resources more effectively in a post-disaster situation. This system is necessary because current manual methods are ineffective, and current algorithms do not work well on tents.

Methods/Materials

The experiment was carried out on a standard personal computer, and also utilized publicly available satellite imagery. The novel object recognition algorithm was divided into four components. First, images are compared by constructing feature histograms. Second, to improve accuracy, multiple filters (Edge detection, line detection, Gabor, Tamura, etc.) are combined when comparing images. Each of these filters contributes unique feature data to the algorithm. Third, a noise reduction algorithm is applied to the feature histograms, allowing for more accurate comparison of histograms. Fourth, simulated annealing is used as a learning algorithm to weight the strongest of the multiple filters. After running the system over the entirety of Haiti, the accuracy of the results was measured using an F score. The system was then compared with a publicly available set of manually-labeled tents, and also tested on various types of test data.

Results

The system was more effective than the manually-labelled data, as it was more accurate, efficient, and required less manual work. The final system produced an accuracy rate of 95.2%, which was 189% higher than that of the manually-labeled data. This multidimensional system was also determined to be 94% more accurate than any of the individual filters alone. In addition, the final system was similarly accurate when tested on various other types of data, such as trees or collapsed buildings.

Conclusions/Discussion

The automated system successfully recognized objects in satellite images, and was thoroughly tested in the process. The system was able to accurately and efficiently identify satellite images, surpassing a previous attempt at manually labeling tents. This shows that it is possible to more effectively locate displaced populations using automated systems and satellite images. Furthermore, this system can be extended to a large variety of other applications, such as deforestation or road detection.

Summary Statement

To improve upon current manual methods, I constructed a novel adaptive object recognition algorithm for locating displaced populations using satellite images.

Help Received

Parents constantly supported me throughout the project; Brother (Tony Ho, Harvard class of 2014) guided me in the exhibition process.