Project Proposal - MapScan

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1 Problem Motivation

Maps currently available on the Internet like Google Maps, Bing Maps or Mapbox do not have a lot of detail about the terrain or land usage (farms, forests, type of vegetation, biomes, etc). They usually separate the areas in either urban (gray), rural/forests (green), or water (blue), as demonstrated in Figure 1.

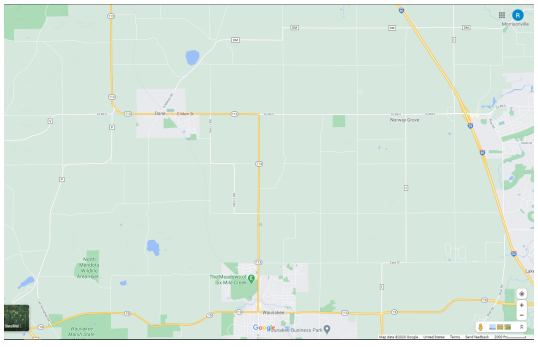

Figure 1: Map View on Google Maps of Waunakee and Dane Wisconsin

The same area can be seen in much more detail in Figure 2.

Figure 2: Satellite View on Google Maps of Waunakee and Dane Wisconsin

Here it is possible to see some of the green labeled areas are farms, some are forests, and the borders between cities and nature are actually much smoother than shown in the map view, where they are usually shown as squares.

Our proposal, known as MapScan, is to evaluate the power of computer vision algorithms to segment and classify regions of the planet in much more detail than currently available, making a distinction between farms and forests, different biomes (desert, rain forest, temperate forest, savannas, etc), and more accurate city borders, for example.

2 Existing Work

There currently exists a great deal of literature in the field of satellite image processing. Satellite image processing has been used to for specific tasks such as monitoring deforestation rates [1], classifying crop types for crop yield estimation [2], or determining areas prone to flooding [3].

In these works, a number of different techniques have been proposed to solve domain-specific problems. Such techniques include and are not limited to Transfer Learning, Autoencoders, Convolution Support Vector Machines (CSVM), and Convultional Neural Networks (CNNs). Much of the current research in this domain involves data collection of detailed satellite imagery, feature extraction, and training to create models that can infer information about satellite imagery. However, there is still much exploration in this field to which methods and techniques are best equipped to process and analyze immense amounts of satellite imagery.

3 Project Outline

The satellite images used can be from these different sources:

- Mapbox API (https://docs.mapbox.com/api/)
- NASA Landsat (https://landsat.gsfc.nasa.gov/)
- NASA MODIS (https://modis.gsfc.nasa.gov/)

Deep learning has recently attracted a lot of attention and resources in the Computer Vision context. We would like to evaluate the power of deep learning-based methods, using traditional K-means clustering algorithm as a baseline. The possible algorithms to evaluate are:

- K-means clustering
- Mask R-CNN
- SegNet
- DeepLab (DeepLabv3+)

The metric used for comparison is Intersection over Union (IoU) which is the number of pixels correctly classified over the total amount of ground truth pixels for each class. This metric is also explained graphically in Figure 3.

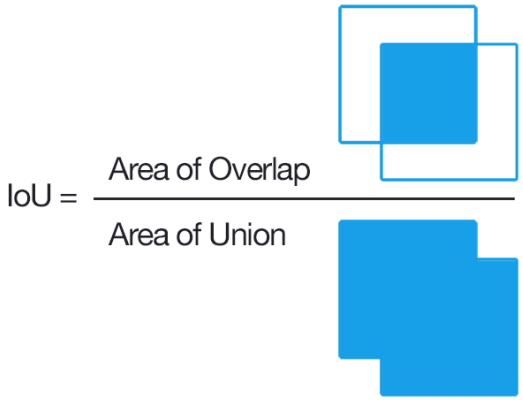

Figure 3: Graphic of the Intersection over Union metric

4 Timetable

Task	Completed By
Explore satellite image sources	October 5th
Extract images from chosen source	October 12th
Label Images (segmentation and classes)	October 19th
Implement K-mean clustering	October 23rd
Implement Mask R-CNN	October 26th
Midterm Report	November 2nd
Implement SegNet	November 16th
Implement DeepLab	November 23rd
Final Results, Discussion, and Report	November 30th

Table 1: Project Timetable for MapScan

5 References

1. http://www.lvc.ele.puc-rio.br/projects/ChangeDetection/index.html
2. http://www.lvc.ele.puc-rio.br/projects/CRF_CropRecognition/home.html
3. https://www.sciencedirect.com/science/article/pii/S1464343X19301529?via%3Dihub