Detection of Electrical Assets Using Neural Networks

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1 Project Proposal

Planes, drones, and other flight-based machines are being implemented and trained with computer vision software to allow for automated usage. However, a primary danger that exists for these aerial machines are power lines, which potentially obstruct both the machine's line of sight and pathway. As these can pose a hazard to these machines, our project aims to hone the detection of power lines.

Our task is to, given a 2D image, identify whether the image either contains power lines, and to accurately label their location.

The difficulty in this task is that power lines are remarkably variable in both shape and form, as power lines can appear as straight lines superimposed on top of other scenes, curved lines on their own in the sky, and lines almost directly adjacent to building edges and corners, just to name a few options. As such, it will be difficult to decide what are the defining characteristics of power lines, especially if they appear near to other, more prominent features of images. Not only this, but power lines often appear together, so it may be difficult to discern where one ends and another begins.

To address the issue of power lines, we plan to use Convolutional Neural Networks, as their ability to extrapolate features automatically via hidden layers of the neural net will play a significant role in the identification of power lines.

Baseline - For the baseline, we will perform Hough line transforms onto our image and marking the areas that are perceived to be power lines. Because this is a naive implementation with no training, we see the accuracy is low.

Oracle - The oracle for the test data is human identification. Within our group, we identified and labeled whether or not each picture contained or did not contain power lines. When comparing human identification, which was close to perfect accuracy, the baseline paled in comparision - only about 35 percent of the time, in pictures where power lines existed, there was some portion of wires that were detected. Very rarely were all shown power lines detected by the baseline.

Sample Inputs and Outputs - The input is an image, and the output is the same image but marked with the power lines, if there are power lines.

Above: Output image after processing, with bright green line indicating presence of a power line. The input was the same exact image, without the labeling.

Data Sets - We will use a training set consisting of 2000 images containing power lines and 2000 images without power lines [1]. For testing and further training, we plan to comb the internet for additional images, along with the generation of synthetic data using a Blender program that takes 2D images of 3D scenes.

Similar Projects - In the course of researching this problem, we found several interesting projects done so far.

[1] Madaan, Ratnesh, Daniel Maturana, and Sebastian Scherer. "Wire detection using synthetic data and dilated convolutional networks for unmanned aerial vehicles." Intelligent Robots and Systems (IROS), 2017 IEEE/RSJ International Conference on. IEEE, 2017.

[2] Yetgin, Ömer Emre, Zekeriya Şentürk, and Ömer Nezih Gerek. "A comparison of line detection methods for power line avoidance in aircrafts." Electrical and Electronics Engineering (ELECO), 2015 9th International Conference on.

References

[1] Yetgin, Ömer Emre; GEREK, Ömer Nezih (2017), "Powerline Image Dataset (Infrared-IR and Visible Light-VL)", Mendeley Data, v7 http://dx.doi.org/10.17632/n6wrv4ry6v.7