TRSI – Rezumat

Comșa Filip-Emanuel

The idea behind this project is to create a machine learning model based on deep learning which should be capable of classifying certain images by the follow criteria: whether an image contains, or not, a visible light source.

The initial idea came as a humanitarian purpose, because of the light pollution issues that the world is currently facing. Light pollution is an issue that affects all of us, while also having negative effects on the wild life as well. What's more, it contributes to the raising levels of carbon dioxide from the atmosphere. This issue has become an international problem, affecting over 80% of the world population, and over 99% of the population from US and Europe.

The dataset was manually built as I was unable to find any light source related datasets online. The dataset currently contains about 700 images, split into 2 classes: yes and no, corresponding to whether the image from the class contains, or not, a visible source of light.

Before moving forward, let's discuss what we actually mean by a light source. There can be 3 types of light sources: natural ones, such as the sun, or other celestial bodies visible during the night time, or, while indoors, the window can be considered a light source. Another type would be the artificial ones, such as bulbs, leds, screens and other objects that emit artificial light. And lastly, we have reflections, which could be mirrors or any polished surfaces capable of reflecting light.

The technology that was used was comprised of the python programming language together with tensorflow and keras models.

The experiments consisted of different trials with the goal of achieving maximum accuracy. Throughout our testing, I have experimented with different types of models. At first, I tried to work with EfficientNet, B0-B7, to see whether this could prove to be the answer to my problem. Unfortunately, it was not. Later on, I moved on to some AutoML frameworks, AutoKeras specifically, to see whether it could optimize itself to achieve high accuracy results. This too failed though. The final approach, on which the following experimentation was also done, was a self-made model architecture, using convolutional layers. The experimentation done on this consisted mostly on different configurations of data preprocessing and augmentation.

The preprocessing part was mostly focused on combining the luminance formula and matrix multiplication on the images, while also changing the format of the images (pixel color range was changed from [0, 255] to [0, 1], and the images were also resized).

When looking for information about the light detection problem I was unable to find much in combination with AI. Most algorithms would perform some mathematical analysis on the images to find out whether it contains a light source, and would also gather some extra data that they mostly found useful.

The real-world applications of this paper are mostly thought such that the algorithm is a possible solution to the light pollution problem we have discussed earlier.

In conclusion, through the experiments that I have run I have discovered that machine learning can indeed be an asset when it comes to the detection of light, even though not much research was done on the matter. Even with a small dataset I was able to reach quite confident accuracy stats, of up to 85% in some configurations.