Lightning Detection Using Coral TPU and sense hat IMU

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Chosen theme: Life on Earth
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1. Introduction

The goal of our project was to detect and capture footage of lightnings from space and find a correlation with a lightning strike and changes in Earth's electromagnetic field to see if it was possible to detect storms from space. We were hoping to see a spike of some sort in the IMU readings.

2. Method

The program used the Raspberry pi HQ camera, sense hat IMU and the Coral TPU for video classification. The classification was made possible by parsing the recorded clip into individual frames and passing them through the classification process one after the other using a custom model trained on images from last year. The program also saved every tenth video to make sure we would receive at least some data to work with under all circumstances.

After receiving the data, we combined all footage into one large video because most clips lined up. We also imported the CSV file into Libreoffice calc to create a graphical representation of the collected data.

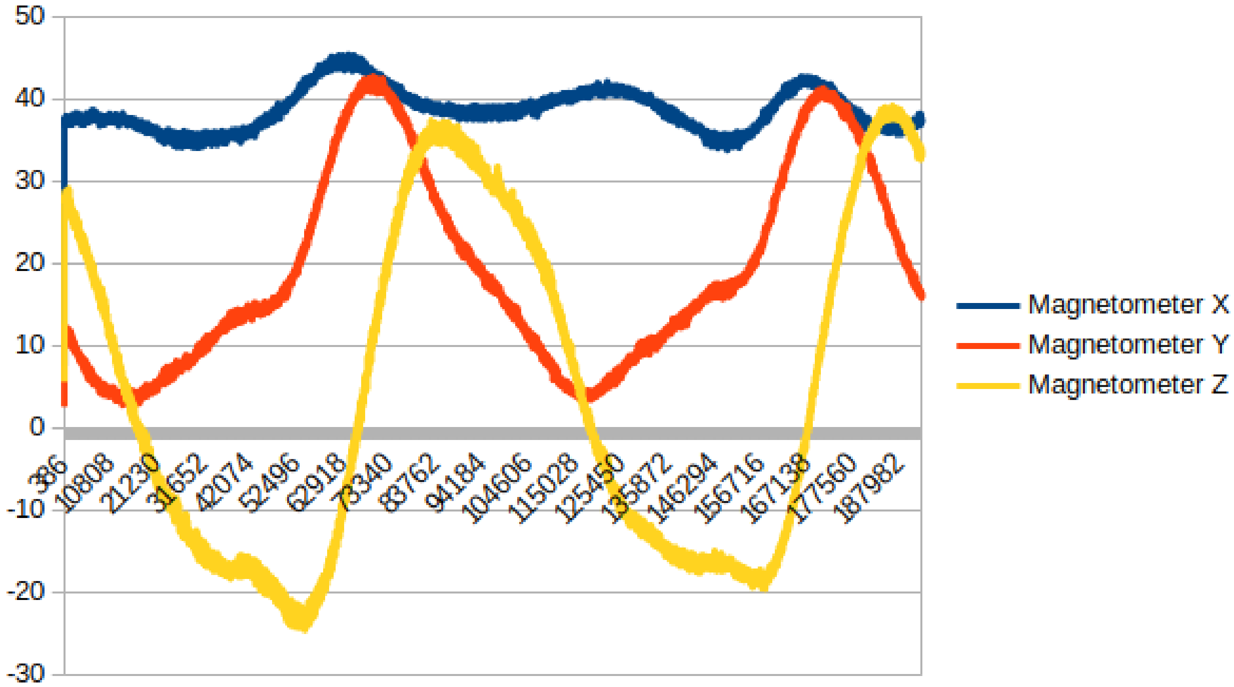
3. Experiment results

We received around an hour worth of footage. Unfortunately because our model was trained on a relatively small and outdated dataset, the classification was not working properly and the program falsely flagged clouds as lightning strikes. This inaccuracy was further increased by the fact that the camera has been placed in a different window this year.

We attempted to find lightnings manually but due to the amount of footage, we likely overlooked something and have not found anything. We also came to the conclusion that the IMU picks up a lot of interference from the Raspberry Pi itself and other electronics close to it so we are fairly certain that detecting lightnings with the current hardware from this altitude is very unreliable if not impossible.

The lack of usable data meant that we had nothing to compare against the NASA database where we also haven't found any useful imagery.

Our magnetometer readings also showed the same anomaly a different team experienced last year where the values changed inconsistently when passing through the electromagnetic field.



Picture 1: The IMU readings chart

4.Learnings

We found out that training an accurate and reliable TFlite model requires a large dataset consisting of very carefully chosen images. We probably should have gone with object detection rather than image classification so we wouldn't rely on the positioning of the camera and the space around it. The problems with object detection were the higher load on the hardware and larger training dataset which was already very limited.

Our team's collaboration was not optimal as we lacked clear role assignments and a systematic division of tasks. The workload became concentrated in the hands of two people. This is something we would like to avoid in the future.

5. Conclusion

Our poorly trained classification model led to an overall failure of the experiment. The magnetometer in the sense that IMU has high enough resolution but due to its placement and interference is basically useless for our application. We detected the same anomaly as a different team from last year and we are still not certain about what exactly happens and why.

We are a bit disappointed about the results but at least we have recorded a unique video of the Earth from space and provided more data about the detected anomaly in Earth's electromagnetic field.

Despite the failure we would like to participate again but this time with a slightly different team to be more effective.