Report Date: 05/13/2022
To: ematson@purdue.edu, ahsmith@purdue.edu, lhiday@purdue.edu, and lee3450@purdue.edu
From: What is today's lunch?


- Ilmun Ku(mun90505@hufs.ac.kr)
- Seungyeon Roh(shtmddus99@konkuk.ac.kr)
- Gyeongyeong Kim(kky57389@sunmoon.ac.kr)



**Summary**
A specific goal of the paper had been set in a meeting with Mia. A comparison between Machine Learning(ML) algorithms and Deep Learning(DL) algorithms would be carried out. Furthermore, architecture design concerning data collection had been conducted. There would be three classifications of Unmanned Aerial Vehicle(UAV) payload detection, which are unloaded UAV, UAV with one payload, and UAV with two payloads.


**What 'What is today's lunch?' completed this week:**

- Setting a goal of paper with Yaqin.
    - The goal of this paper is to compare the performances of UAV payload detection between the DL model and the ML model. ML model was utilized in Yaqin's previous paper.
    - A cost-effective data collection method would be a major contribution to this paper. In Yaqin's previous paper, Raspberry Pi was used to collect acoustic data, which is a too complicated and time-consuming method.

      In this paper, a microphone on a laptop or cellphone would be utilized so that anyone could collect sound data conveniently. When data collection is finished, data would be split into 5~10 seconds to make sample data.
    - Data augmentation would be another contribution of this paper. To use DL algorithms, a lot of data are required to feed DL models. However, Yaqin only has around 600 acoustic data. Even though there will be more data collection scheduled in the future, securing enough data would not be possible due to equipment issues. A battery of a UAV discharges so fast when the UAV holds more than one payload and battery charging takes more than 10 hours.

      To fix this issue, data augmentation would be employed. Shifting time or masking out methods are considered. Dr. Matson and Yaqin were positive about the method of data augmentation. Research and study about audio dataset augmentation should proceed in the future.

- Designing architecture of data collection with Dr.Matson and Yaqin.
    - Equipment

For data collection, only a laptop(Macbook pro) and microphones included in smartphones are required. This can be a selling point as this method doesn't need extra equipment and is cost-effective.

Fig. 1. Imitations of explosives

Objects in Figure 1 are payload objects that are imitations of explosives from Dr.Matson. The weight of each is 570g. These objects look well than the bottle of water that Yaqin utilized before. Furthermore, their weight can be distributed as their shapes are flat.

There are three classifications for a UAV payload detection, which are unloaded UAV, UAV with one payload, and UAV with two payloads.

- Architecture

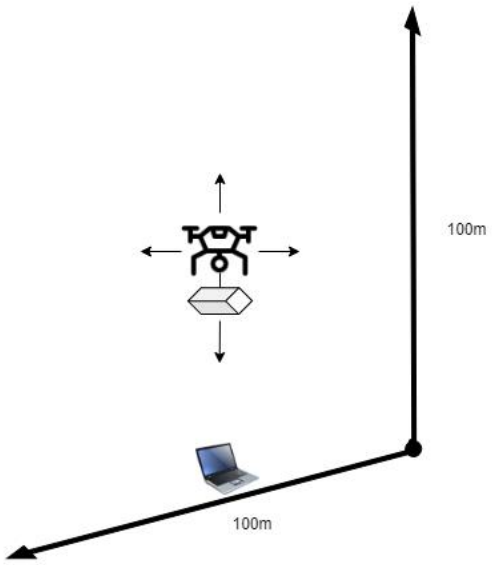


Fig. 1. Equipment Setting

Figure 2 is an architecture of data collection with a UAV payload. a laptop or smartphone would be employed to record the sound of the UAV. The collection range will be 100m around the laptop and the valid altitude would be 100m high, but it could be changed depending on a recording device.

**Things to do by next week**

- Get feedback on the introduction and literature review draft by next Tuesday from Mia.
- Research on data augmentation method and select the most proper method.
- The UAV schedule must be checked in advance due to limited drone resource which has to be shared with the other two team,
- Write A simple program automatically splitting audio clip into 10 seconds.

**Problems or challenges:**

- There are datasets that Yaqin has collected. However, it is not large enough to apply Deep Learning algorithms. Therefore, it is required to collect more data or apply data augmentation to the original dataset.

**References**

[1] Vladimir Kartashov, Vladimir Oleynikov, Igor Koryttsev, Sergiy Sheiko, Oleh Zubkov, Stanislav Babkin and Ivan Selieznov, “Use of Acoustic Signature for Detection, Recognition and Direction Finding of Small Unmanned Aerial Vehicles ”, *IEEE* , 2020, pp.377-380

[2] Shulin Li, HyunJong Kim, Sukhoon Lee, John C. Gallagher, Daeun Kim, SungWook Park, Eric T. Matson, “Convolutional Neural Networks for Analyzing Unmanned Aerial Vehicles Sound”, *ICCAS*, 2018, pp.862-866

[3] Dana Utebayeva, Manal Alduraibi, Lyazzat Ilipbayeva, Yelmurat Temirgaliyev, “Stacked BiLSTM - CNN for Multiple label UAV sound classification”, *IEEE*, 2020, pp.470-474

[4] Shawn Hershey, Sourish Chaudhuri, Daniel P. W. Ellis, Jort F. Gemmeke, Aren Jansen, R. Channing Moore, Manoj Plakal, Devin Platt, Rif A. Saurous, Bryan Seybold, Malcolm Slaney, Ron J. Weiss, Kevin Wilson, "CNN Architectures for large-scale audio classification", *IEEE*, 2017, pp131-135

[5] Feng Rong, "Audio Classification Method Based on Machine Learning", *International Conference on Intelligent Transportation, Big Data & Smart City (ICITBS)*, 2016, pp.81-84