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From: What is today's lunch?

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Summary
A team has been set up. Team with six people has been split up into two groups of three equals. There was a test about basic techniques normally applied in Machine Learning field to get divided.

Paper topics have been approved by Dr.Matson and Yaqin. Equipment inventory check has been followed.

What 'What is today's lunch?' completed this week
- Team has been divided into two groups of three equals.

  At first, The team was split up into two groups with four people in one group and two people in another group. There was a test for a group with 4 people to have one member move his/her team to another group. After the test, both team members were set.

  Names of Team members are as follows. Ilmun Ku, Seungyeon Roh, Gyeongyoung Kim for Team 'What is today's lunch'. Eunyoung Bang, Yeongmin Seo, Jeongyoun Seo for Team 'TN' which is a temporary name.

- A test covers 3 papers, related to team project topic, which is Unmanned Aerial Vehicle(UAV) detection using deep learning algorithm with acoustic nodes. The test included 10 questions. Time limit was 60 minutes. Below are questions used in the test .

  - What is Convolutional Neural Network? Explain it as much as you can. Include its definition, the way it operates, and examples, pros and cons.
  - What is Recurrent Neural Network? Explain it as much as you can. Include its definition, the way it operates, and examples, pros and cons.
  - What is Gaussian Naive Bayes? Explain it as much as you can. Include its definition, the way it operates, and examples, pros and cons.
  - What is Support Vector Machine? Explain it as much as you can. Include definition, the way it operates, and examples, pros and cons.
  - What is Mel-Frequency Cepstral Coefficient? Explain it as much as you can. Include definition, the way it operates, and examples, pros and cons.
  - What is K-Nearest Neighbors? Explain it as much as you can. Include definition, the way it operates, and examples, pros and cons.
  - According to second paper, what are three limitations of experiment?
  - According to first paper, what is a purpose of audio segmentation?
  - According to second paper, what is a heuristically optimal segmentation time?

- According to second paper, what does spectral feature represent?

- Subjects were approved by Dr.Matson and Yaqin.

    - Team 'What is Today's Lunch' has a subject of UAV payload detection using deep learning algorithms with acoustic nodes. At first, there were two subjects so that the team can select one. One is UAV classification using deep learning algorithm and another one is UAV payload detection using deep learning algorithm. Dr.Matson prefers the latter. In perspective of anti-terrorism, it would be much worth for us to detect whether UAV has a payload or not. When anti-terrorism team can recognize payload in advance, they would be able to take action faster and save lives more.

    - One of important limitations in [1] is that researcher only used MacBook Air with 8GB RAM, which means it is restrained to use deep learning algorithms. Therefore, it is inclined to secure more resources and apply deep learning algorithms such as Convolution Neural Network, Recurrent Neural Network, and Convolutional Recurrent Neural Network. By utilizing deep learning algorithms, it is expected to optimize performance better than performance that only employs machine learning algorithms.

- Equipment inventory check has been conducted . As of 05/06/2022, team has every equipment required.

    - UAVs(Drones): 10 different UAVs are prepared in airport. Mia will get in contact with Dr.Matson by next week to request UAVs.
    - Three Microphone is ready in inventory of K-Square.

Things to do by next week

- A meeting with Yaqin is scheduled on Wednesday. In this meeting, it would be discussed about the details of UAV payload detection and how to proceed the experiment.
- The article about deep learning structure of audio will be summarized by each team member.
- Since feature extraction is more suitable for training than raw data, a research and summary of feature extraction will be carried out.
- Yaqin will give the UAV acoustic dataset that was used in previous research, and data collection can be begun after equipment request to Dr. Matson.
- An introduction will be written about the subject of UAV payload detection.

Problems or challenges:

- There are dataset which 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 original dataset.

- Dr.Matson pointed out that it takes too much time to train deep learning model for UAV detection, which means utilizing deep learning algorithms has a drawback for real-time UAV detection [2]. It is required to discuss this issue with Dr.Matson and Yaqin in the future.

References

[1] Yaqin Wang, Facundo Esquivel Fagiani, Kar Ee Ho1 and Eric T. Matson, "A Feature Engineering Focused System for Acoustic UAV Payload Detection", *ICAART,* 2022, pp.470~475

[2] D. Utebayeva, M. Alduraibi, L. Ilipbayeva and Y. Temirgaliyev, "Stacked BiLSTM - CNN for Multiple label UAV sound classification," *2020 Fourth IEEE International Conference on Robotic Computing (IRC)*, IEEE, Taichung, Taiwan, 2020, pp. 470-474

[3] 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", *The International Conference on Acoustics, Speech, & Signal Processing*(*ICASSP*), IEEE, 2017, pp.131-135

[4] S. Al-Emadi, A. Al-Ali, A. Mohammad and A. Al-Ali, "Audio Based Drone Detection and Identification using Deep Learning," *2019 15th International Wireless Communications & Mobile Computing Conference (IWCMC)*, IEEE, Tangier, Morocco, 2019, pp. 459-464

[5] S. Jamil, Fawad, M. Rahman, A. Ullah, S. Badnava, M. Forsat, S. Sa, "Malicious UAV Detection Using Integrated Audio and Visual Features for Public Safety Applications", *MDPI, Basel, Switzerland*, 2020, pp.1-16.

[6] V. Kartashov, V. Oleynikov, I. Koryttsev, S. Sheiko, O. Zubkov, S. Babkin, I. Selieznov, "Use of Acoustic Signature for Detection, Recognition and Direction Finding of Small Unmanned Aerial Vehicles", IEEE, Kharkiv, Ukraine, 2020, pp.1-4.