Report Date: 06/17/2022
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Summary

During this week, the first outdoor test was done on Tuesday. Before having the experiment, the environment and limitations were set. Besides, related papers are searched and summarized, and presented by all team members.

Throughout the next week, analyzing the data of the first outdoor test will be done. Then, using the analysis, a new environment setting will be made. After setting up, the second outdoor test will be done at Mr.Smith's farm.

What K2S3 completed this week:

- Having the first outdoor test
    - After setting up the environment for the outdoor test, the data is collected at Mr.Smith's farm on Tuesday. Before flying two drones in the sky simultaneously, only one was flying to set the range of altitude and the projected distance between two drones for the second outdoor test.
    - All the weather conditions and types of various noises made during the first outdoor test were documented.

- Analyzing the first collected data obtained from the outdoor test
    - When having the first outdoor test, the drone, DJI Mavic 2 Pro, was flown at five different altitudes and projected distances. Although both the visual and audio features should be collected for the project, only the audio was recorded to analyze the limited distance that the audio device can hear.
    - The audio was collected using two iPhones to compare: iPhone 6 and iPhone 13. The team members are still working on analyzing the collected data. The analysis will be done during the next week.

- Researching and reviewing related papers
    - Papers that are related to audio-video multimodal or drone position estimation were searched and reviewed by all team members. Each team member made a presentation or a summary of a specific paper to explain specific algorithms or the process of the experiment. The information earned from the related papers can be applied to this project.

Things to do by next week

- Finishing the analysis of the first outdoor test
  - Using Mel frequency cepstral coefficients(MFCC) feature extraction, the audio features will be analyzed. The difference between different altitudes and projected distances and the difference between the data recorded by iPhone 6 and iPhone 13 will be examined.
  - The new environment will be set up for the second outdoor test. For example, specific ranges of altitudes and projected distances will be fixed to test with two drones flying in the air.

- Having the second outdoor test
  - After finishing the analysis of the first outdoor test, the second outdoor test will be done at Mr.Smith's farm. For the second outdoor test, two drones, DJI Mavic 2 Pro and EVO 2, will be flying in the air at different altitudes.
  - Both the video and audio data will be collected to analyze. The video data is planned to be collected using the camera attached to the drone.

- Continuing researching on related papers
  - To use the visual-audio multimodal technique, more related papers should be summarized by all team members. Also, papers that are related to distance or position estimation of drones need to be searched.

Problems or challenges

- Searching for the related papers was challenging
  - Although many papers that are related to drone detection were easily found, finding papers that are about position estimation of drones using the audio-visual multimodal method was challenging. So, the team members searched for two separate topics of papers: position estimation papers and audio-visual multimodal method papers.

References

[1] B. Yang, E. T. Matson, A. H. Smith, J. E. Dietz and J. C. Gallagher, "UAV Detection System with Multiple Acoustic Nodes Using Machine Learning Models," *2019 Third IEEE Int. Conference on Robotic Computing (IRC)*, pp. 493-498, 2019

[2] Leong, Wai Lun, et al. "Vision-based sense and avoid with monocular vision and real-time object detection for UAVs." *2021 Int. conference on unmanned aircraft systems (ICUAS)*. IEEE, 2021

[3] N. Jiquan, K. Aditya, K Mingyu, N Juhan, L. Honglak, N. Andrew, "Multimodal Deep Learning", *ICML 2011*, 2011 [Accessed June 16, 2022]

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