Report Date: 12/09/2022
To: ematson@purdue.edu, ahsmith@purdue.edu, lee3450@purdue.edu
From: The Team Gangsture (Gesture Drone Control)

- Hyeongbin Park (The Leader / mtanger@kw.ac.kr)
- Seunghwan Kim (franz0602@stu.jejunu.ac.kr)
- Yujin Lee (yj5878@kw.ac.kr)
- Soeun Lee (thdms8477@jejunu.ac.kr)

Summary

Every part of the development has entered the final development stage by fixing the remaining errors and modifying the UI of the iOS application. Several tests have been conducted to check the system's performance and results were recorded. Additionally, the final presentation is in development.

What "Gangsture" completed this week:

- **Prepared for the final presentation**
  - The draft of the script is being written. The index is the same as the one on the paper. Introduction and half of the implementation [1]-[3] were composed and corresponding slides were drawn up.
- **Attempted to improve the face recognition function and extracted the model**
  - There were delays with the face recognition model, so it should be improved or changed in terms of computer vision algorithms.
  - The following methodologies were tried; (1) HOG descriptor (2) MTCNN and FaceNet (3) SVM and PCA [4] (4) Comparing face encoding distances [5] (5) HaarCascade classifier [6].
  - Finally, the trained SVM model was extracted based on the compressed face data by PCA.
- **Optimized and aggregated AI part codes to create a prototype with a webcam**
  - Unnecessary codes were removed. Several development flows were reconstructed to optimize and fix errors. Detailed comments were added.
  - All of the improved codes were aggregated in the demo code for indoor testing of the drone. If the face recognition is successful, hand gesture recognition begins. Additional code was made to print success or failure.

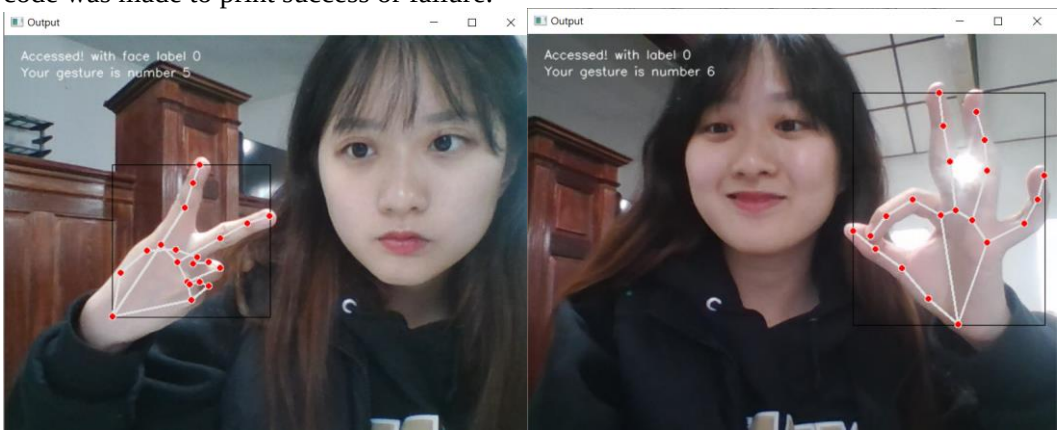

Fig. 1. Testing face and hand recognition with two types of hand

- **Applying GUI to iOS app**
  - App GUI was designed with figma design tool to make images and document designs.
  - App design was applied to iOS apps and was modified.
- **Updating the MediaPipe version is in progress**
  - Landmark coordinates are getting from the recent version of MediaPipe.
  - It needs to be decoded from data type to landmark type [7]-[9].
- **Combined AI gesture recognition model with drone controller and video recorder**
  - The three modules were thread-aligned to prevent a collision in the process.
  - To increase safety in gesture recognition, set a certain stack value according to the gesture to send commands when the stack builds up to a certain extent [10].
- **Succeeded in steering and flying the drone with gestures**

Fig. 2. The video display
from the recording, drone, and controller camera

Things to do by next week:

- Write and revise the draft paper
- Prepare for the final presentation
- Fix remaining errors and advance the structure of code
- Add comments on all the codes

Problems or challenges:

- **Delays due to the high computation volume of AI models**

    - Processing AI models requires numerous computing powers, including preprocessing dataset. This naturally causes latency in real-time video.
    - The problem caused by the machine learning model was fixed by reconstruction of development flow.
    - As mentioned above, various approaches have been attempted to handle issues occurring by the deep learning model. Although using SVM with PCA was selected, efforts to produce higher accuracy with lower resources will continue.
- **Decoding problem when obtaining landmark value**
    - Since the landmark is obtained as a data type, it must be decoded as the landmark type defined in the 'Landmark.proto' file of the Google Framework.
    - Using the swift-protobuf library, the proto file was converted into a Swift file and it will be used to decode landmarks.
- **Improving landing command with safer and more sophisticated procedures**
    - Unlike other commands, the landing command makes other processes stop and the drone land function can only be used once [11].
    - A time loop would be added to the landing command to send commands when recognized for more than a few seconds.

References

[1] 911 security, "Data link," *Drone Communication*. [Online]. Available: https://www.911security.com/learn/airspace-security/drone-fundamentals/drone-communication-data-link. [Accessed: 09-Dec-2022].

[2] N. Cast, "How drones communicate with the controller?," *Remoteflyer*, 26-Oct-2021. [Online]. Available: https://www.remoteflyer.com/how-drones-communicate-with-the-controller/#h-wi-fi-controls. [Accessed: 09-Dec-2022].

[3] "Tello SDK 2.0 user guide - dl-cdn.ryzerobotics.com ." [Online]. Available: [https://dl-cdn.ryzerobotics.com/downloads/Tello/Tello SDK 2.0 User Guide.pdf](https://dl-cdn.ryzerobotics.com/downloads/Tello/Tello%20SDK%202.0%20User%20Guide.pdf). [Accessed: 09-Dec-2022].

[4] M. Javed, "Building a facial recognition model using PCA & SVM Algorithms," *Medium*, 21-Nov-2020. [Online]. Available: https://towardsdatascience.com/building-a-facial-recognition-model-using-pca-svm-algorithms-c81d870add16. [Accessed: 09-Dec-2022].

[5] Ageitgey, "Face_recognition/readme_korean.MD at master · ageitgey/face_recognition," *GitHub*, 13-Nov-2019. [Online]. Available: https://github.com/ageitgey/face_recognition/blob/master/README_Korean.md. [Accessed: 09-Dec-2022].

[6] Real Python, “Face recognition with python, in under 25 lines of code,” *Real Python*, 05-Mar-2019. [Online]. Available: https://realpython.com/face-recognition-with-python/. [Accessed: 09-Dec-2022].

[7] “MediaPipe on IOS,” *mediapipe* . [Online]. Available: https://google.github.io/mediapipe/getting_started/ios.html#prerequisite. [Accessed: 02-Dec-2022].

[8] Szotp-Lc, “SZOTP-LC/Handtracker: Detect 3D hand landmark from video stream.,” *GitHub*. [Online]. Available: https://github.com/szotp-lc/HandTracker. [Accessed: 02-Dec-2022].

[9] Noppefoxwolf, “NOPPEFOXWOLF/Handtracker: Detect 3D hand landmark from video stream.,” *GitHub*. [Online]. Available: https://github.com/noppefoxwolf/HandTracker. [Accessed: 02-Dec-2022].

[10] J. Brownlee, “Python threading: The Complete Guide,” *Super Fast Python*, 19-Oct-2022. [Online]. Available: https://superfastpython.com/threading-in-python/. [Accessed: 09-Dec-2022].

[11] “Timed loop python with code examples,” *Programming and Tools Blog* -, 05-Oct-2022. [Online]. Available: https://www.folkstalk.com/2022/10/timed-loop-python-with-code-examples.html. [Accessed: 09-Dec-2022].