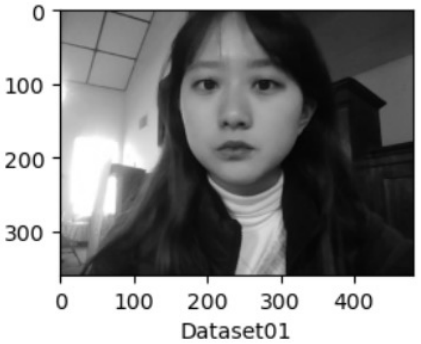
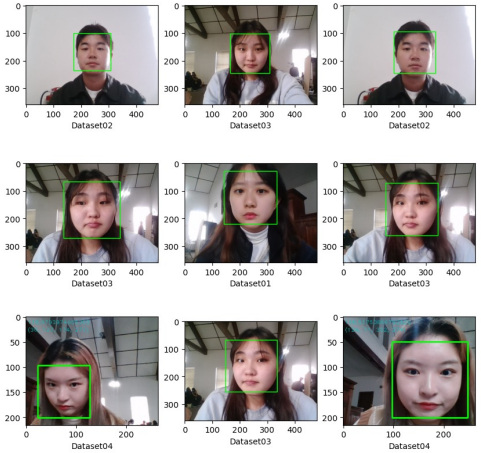
3. Methodology

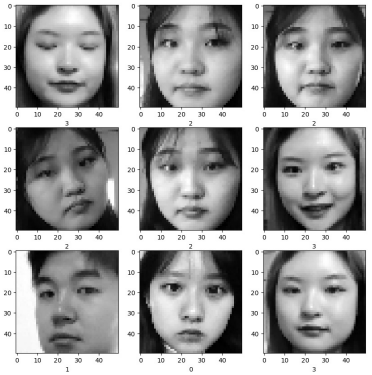
Face Recognition with Computer Vision and ML: Preprocessing



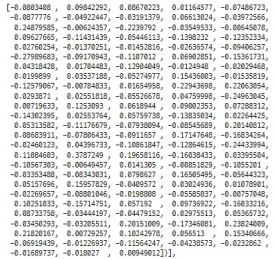
1. Read the face image dataset as a gray scale.



2. Extract the face from the gray scale image using the Haar Cascade Classifier.



3. Crop and save the face based on the returned coordinates.

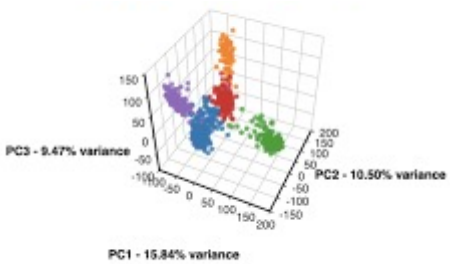


4. Encode the saved face using the Python face recognition library

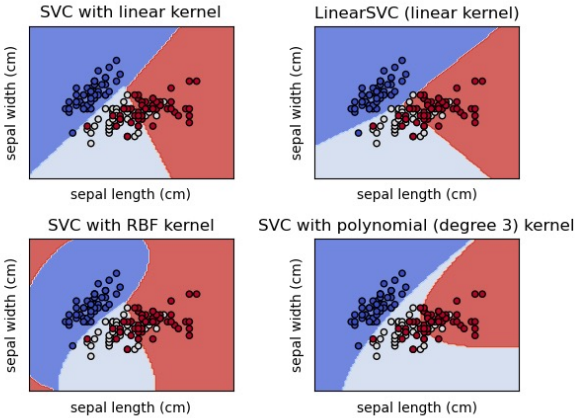
* Haar Cascade Classifier:
A machine learning-based object detection algorithm.
It is used to detect objects in a video or image based on a feature. It returns coordinate value of face position.

3. Methodology

Face Recognition with Computer Vision and ML: Training and Evaluation



5. Compress the encoded high-dimensional values with **PCA.**



6. Process face classification with **SVM** trained on the face feature vectors.

	precision	recall	f1-score	support
0	1.00	1.00	1.00	58
1	1.00	1.00	1.00	69
2	1.00	1.00	1.00	57
3	1.00	1.00	1.00	49
accuracy			1.00	233
macro avg	1.00	1.00	1.00	233
weighted avg	1.00	1.00	1.00	233

accuracy score: 1.0

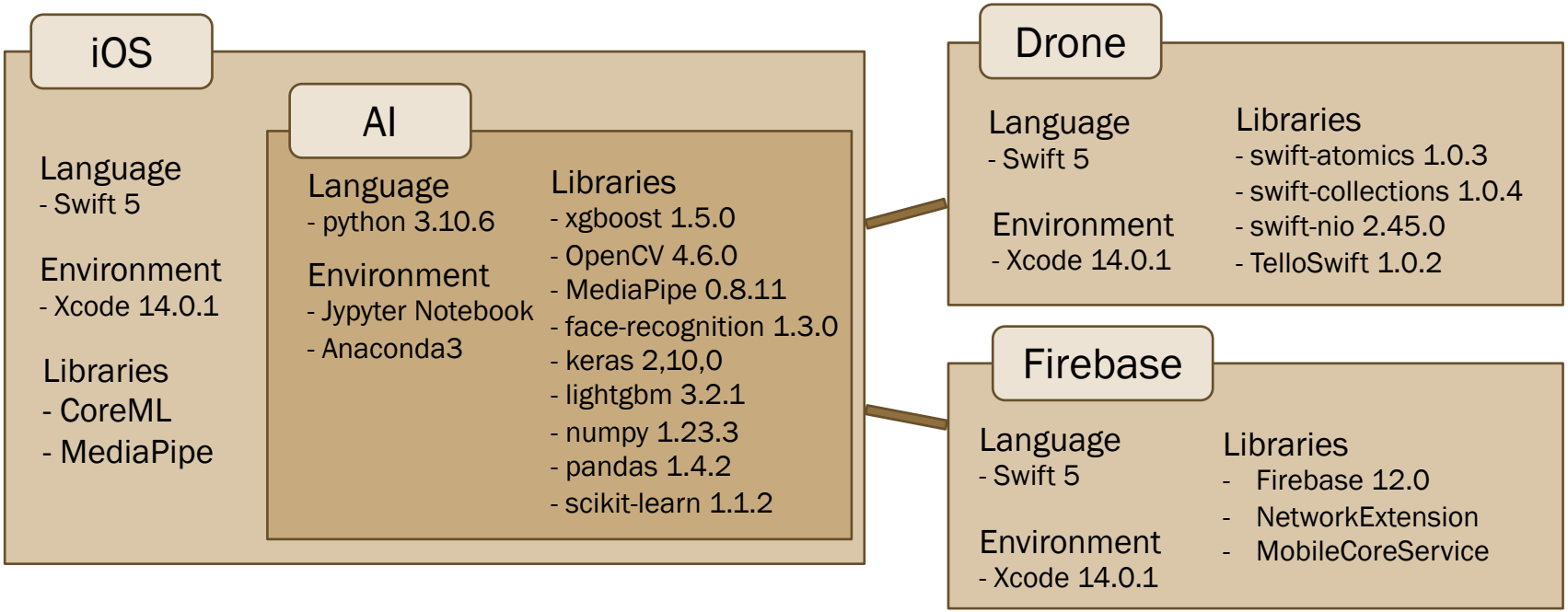
- **Multi-Class Classification (4 class)**
- **SVM with radial basis function kernel**
- **Evaluation Metrics**
  Precision / Recall / F1 Score / Accuracy
- **Train/Test and Train/Valid as 8:2**

* PCA, Principle Component Analysis: a representative dimension reduction algorithm for extracting core features.

* SVM, Support Vector Machine: a supervised learning model, it is used for pattern recognition and data anlysis, classification and regression analysis.

4. Implementation

System Architecture with Dependencies



4. Implementation

System flow 1. Face recognition in iOS application

Face recognition
사진

Detect facial features through edge detector

The output is compressed to list and entered to the AI model.

4. Implementation

System flow 2. If it is true, do hand detection in iOS app

Hand detection
사진

- The front camera's screen is delivered to the MediaPipe every moment and the MediaPipe provides 21 normalized landmarks.
- The AI model using Python was packed in CoreML format , iOS's artificial intelligence framework, and added to the iOS.
- CoreML allows you to obtain the result value of artificial intelligence embedded in the application

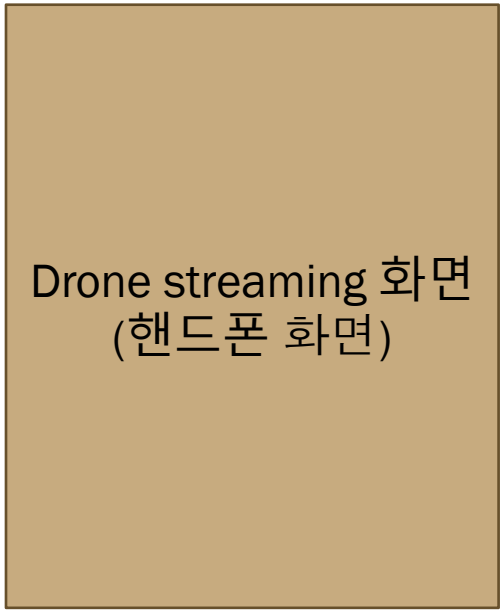
4. Implementation

System flow 3. Send command using UDP socket

- Set up a UDP client on the mobile device to send and receive messages from the Tello via the same port.
- Before sending any other commands, send “command” to the Tello via UDP PORT 8889 to initiate SDK mode.

4. Implementation

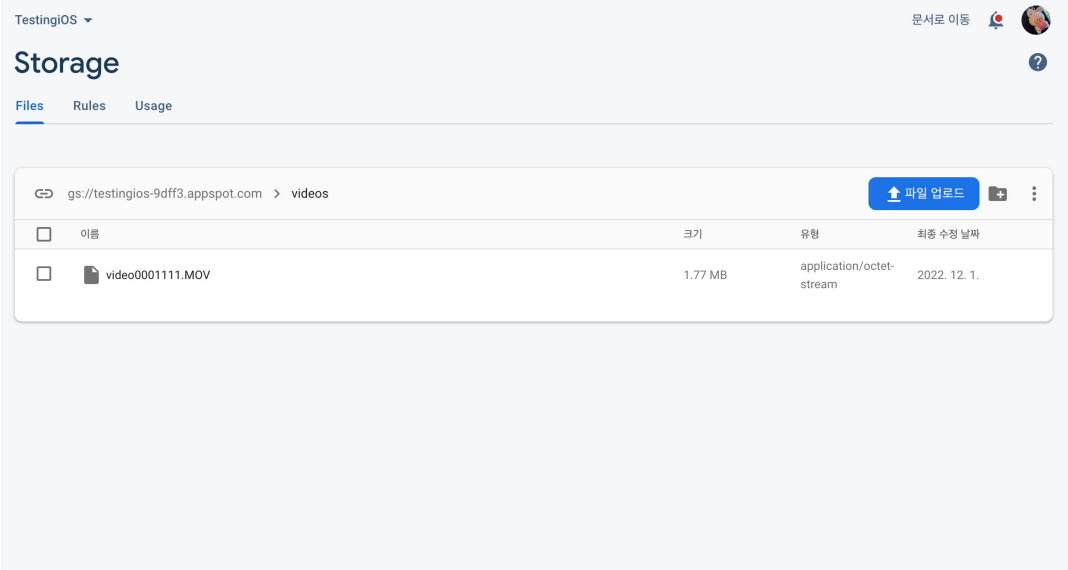
System flow 4. Streaming and Recording while controlling



- Translated to h264 format through AVFoundation and transmitted to the iOS screen in the real-time
- Automatically stored when the flight is over
- Video recordings take place in separate threads.

4. Implementation

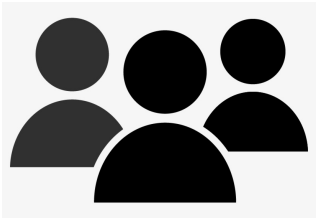
System flow 5. Upload to Firebase



iOS UI 화면

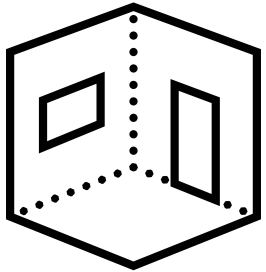
4. Implementation

Experiment Design with Drone Gesture Controller



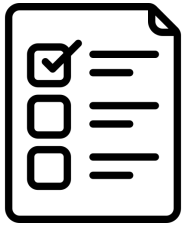
6 Subjects

- People who haven't used a drone before
- Three women and three men
- Over 22 ages



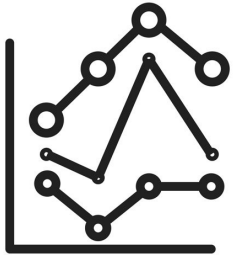
Environment

- KSW Square building
- With 4 assistant for safe experiment
- One obstacle
- One sign over the obstacle



2 types of tasks

- One is to check up and down movement
- One is to check left and right movement
- Common task is reading over obstacles
- Each three people is assigned a task



Evaluation

- Total experiment time
- Time to pass each task during the experiment
- Total number of trials
- Number of successes and failure
- Number of hits

5. Conclusion

Experiment Results

Subject Number	Trial	Success	Fail	Hits	Total Time	T1	T2	T3	T4	Note
1	2	1	1	1	103	29.5	35	25	29	hit
2	3	1	2	1	132.67	52	44	18	50	hit and landing miss
3	1	1	0	0	136	35	43	15	53	
4	1	1	0	0	197	38	26	20	113	
5	1	1	0	0	116	29	22	9	56	
6	2	1	1	1	123.5	53.5	41	25	74	hit
Total	1.67	1.00	0.67	0.50	134.69	39.50	35.17	18.67	62.50	

5. Conclusion

Demo and Future Plan

데모영상

It is impossible to control the drone with gestures at a moment when face is invisible.
Even if the face detection is cut off for a while, control will not be affected

Reference

polytechnic.purdue.edu

/ TechPurdue

PURDUE UNIVERSITY | Polytechnic Institute