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From: SWATTER

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Summary

Over the course of this week, We wrote most of the experiment parts. By comparing different feature extraction functions and different ml algorithm functions, we found the best feature combination. Tables and figures were modified or produced according to the ieee format, and pictures of drones were inserted. We also made feature plots of mfcc and chroma_stft to visually confirm the functional differences. Our server program was tested for communication with packets and calling our Machine Learning model.

What SWATTER completed this week:

- Wrote most of the experiments parts
    - After the application is developed, we will write the result part.
- I wrote and submitted the paper to Minji Lee.
- The sound of the drone was recorded using Figure 1 and Figure 2.
    - This data was produced with the help of Yachin
- Figure 3 was recreated to follow the style of ieee.
- This paper, NN, SVM, KNN, and GNB models were adopted.
    - All parameters of the linear model except for the NN model were set to GNB's default values. Figure 4 shows the structure of the NN model.
    - The parameter C was set to 10, the kernel was set linearly in the SVM model, and the n_neighbors parameter was set to 6 in KNN.
- Feature extraction was performed and a suitable ML algorithm model was adopted.
    - Figure 5 shows the analysis of the UAV acoustic detection experiment through NN.

        - Chroma_stft showed the highest accuracy and F-1 score in the table (0.94). Overall, it performed better than GNB, with all accuracies and F-1 scores less than 9.5.
    - Figure 6 shows the analysis of the UAV acoustic detection experiment through SVM.
        - The accuracy and F-1 score of mfcc were the highest in this table (0.99).
        - The accuracy and F-1 score of chroma_stft was 0.97, showing high performance.
        - Overall, all features had high performance, and contrast and tonnetz had low accuracy and F-1 score compared to other features.
    - Figure 7 shows the analysis of the UAV acoustic detection experiment through KNN.
        - Mfcc has the highest accuracy and F-1 score in the table (0.97). Contrast had high accuracy and F-1 score performance. KNN has the room for use because it is effective for binary classification \cite{b32}.
    - Figure 8 shows the analysis of the UAV acoustic detection experiment through GNB.
        - Mfcc and chroma_stft both showed the highest accuracy and F-1 score (0.93). Compared to other tables, tonnez had the highest performance, but overall accuracy and F-1 score were low. Mel had very low accuracy and F-1 score compared to other tables.
- As shown in Figures 9 and 10, the visual characteristics of mfcc and chroma_stft were compared.
    - It was confirmed that the features are different from each other.
- Succeeded in calling Python script in the server program (C++)
- Succeeded in communication between a client and our server program

Things to do by next week

- Writing Results
    - The paper will be written as soon as the development is confirmed.
- Rewrite all parts of paper.
    - May continue to change all parts (abstract, etc.).
- We will make a ppt and prepare a presentation.
    - Presenter: Gwangwon Kim, Hyunjong Jang
    - Question Respondents: Joonki Rhee, Min Seop Shin
- Uploading the server program to Cloud computer(Azure).
- Implementing a communication function on our application.

Problems or challenges:

- A mobile application must be developed before the conclusion of this thesis can be reached.
    - Develop and test as quickly as possible.
- It is difficult to follow the format of the thesis.
    - In particular, there are many difficulties in the reference part.
    - Look at the received ieee form manual and check it once again.

References

Fig. 1. The Autel Evo 2

Fig. 2. DJI Phantom 4

Fig. 3. Flow chart of two methods for drone detection

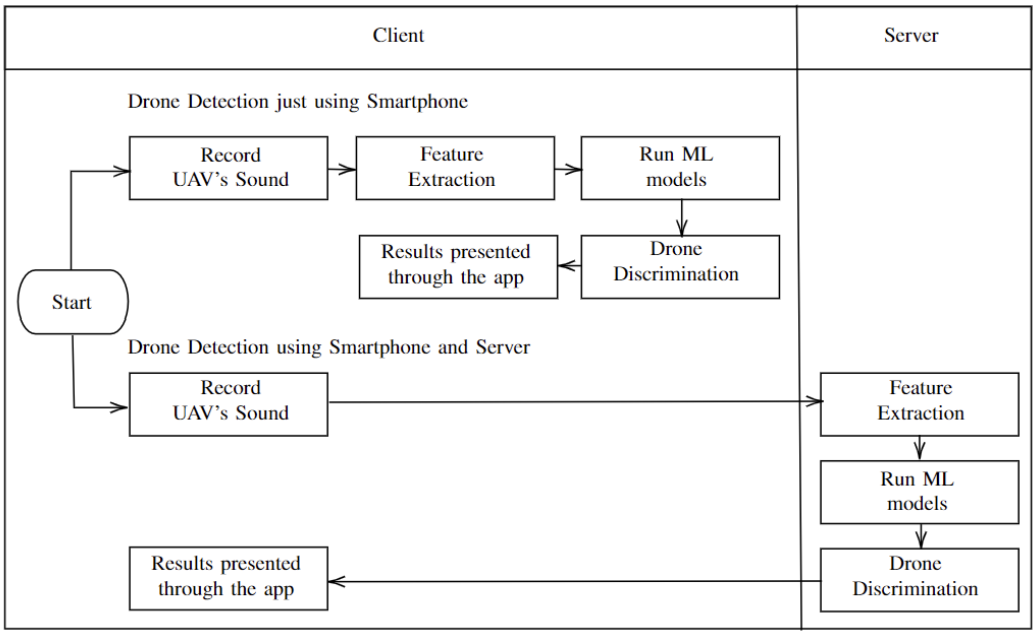


Fig. 4 .Neural network model structure

```
Model: "model"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 input_1 (InputLayer)        [(None, 40)]              0

 dense (Dense)               (None, 128)               5248

 activation (Activation)     (None, 128)               0

 dropout (Dropout)           (None, 128)               0

 dense_1 (Dense)             (None, 128)               16512

 activation_1 (Activation)   (None, 128)               0

 dropout_1 (Dropout)         (None, 128)               0

 dense_2 (Dense)             (None, 2)                 258

=================================================================
Total params: 22,018
Trainable params: 22,018
Non-trainable params: 0
_________________________________________________________________
```

Fig. 5. NN

TEST RESULTS BY NN

Feature	Accuracy	Recall	Precision	F1 Score
1. chroma_stft	0.94	0.94	0.94	0.94
2. mel	0.89	0.89	0.89	0.89
3. mfcc	0.84	0.84	0.9	0.82
4. contrast	0.84	0.84	0.84	0.83
5. tonnetz	0.86	0.86	0.86	0.86

Fig. 6. SVM

TEST RESULTS BY SVM

Feature	Accuracy	Recall	Precision	F1 Score
1. chroma_stft	0.97	0.97	0.98	0.97
2. mel	0.86	0.86	0.87	0.87
3. mfcc	**0.99**	**0.99**	**0.99**	**0.99**
4. contrast	0.84	0.84	0.85	0.83
5. tonnetz	0.84	0.84	0.85	0.83

Fig. 7. KNN

TEST RESULTS BY KNN

Feature	Accuracy	Recall	Precision	F1 Score
1. chroma_stft	0.91	0.91	0.93	0.91
2. mel	0.85	0.85	0.87	0.85
3. mfcc	0.97	0.97	0.98	0.97
4. contrast	0.9	0.9	0.93	0.9
5. tonnetz	0.84	0.84	0.84	0.83

Fig. 8. GNB

TEST RESULTS BY GNB

Feature	Accuracy	Recall	Precision	F1 Score
1. chroma_stft	0.93	0.93	0.93	0.93
2. mel	0.6	0.6	0.71	0.6
3. mfcc	0.93	0.93	0.93	0.93
4. contrast	0.86	0.86	0.88	0.86
5. tonnetz	0.9	0.9	0.9	0.9

Fig. 9. MFCC feature plot

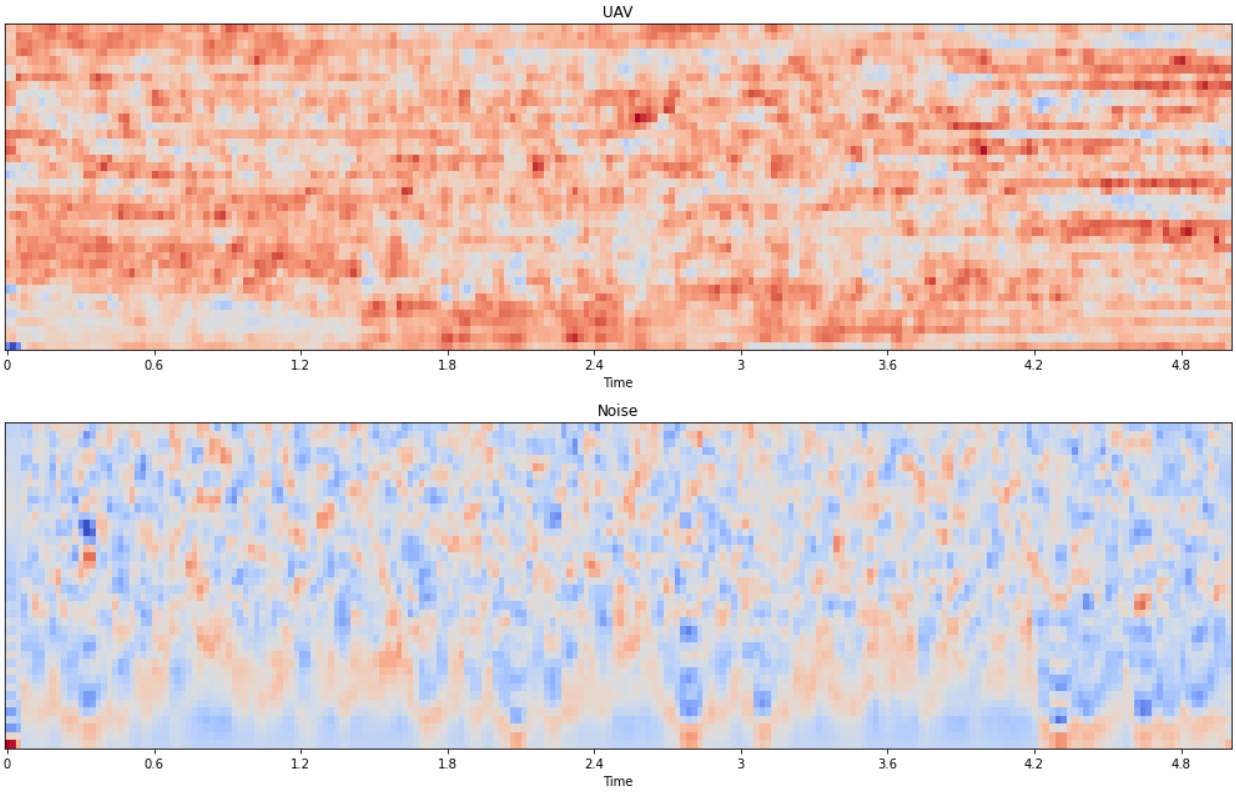
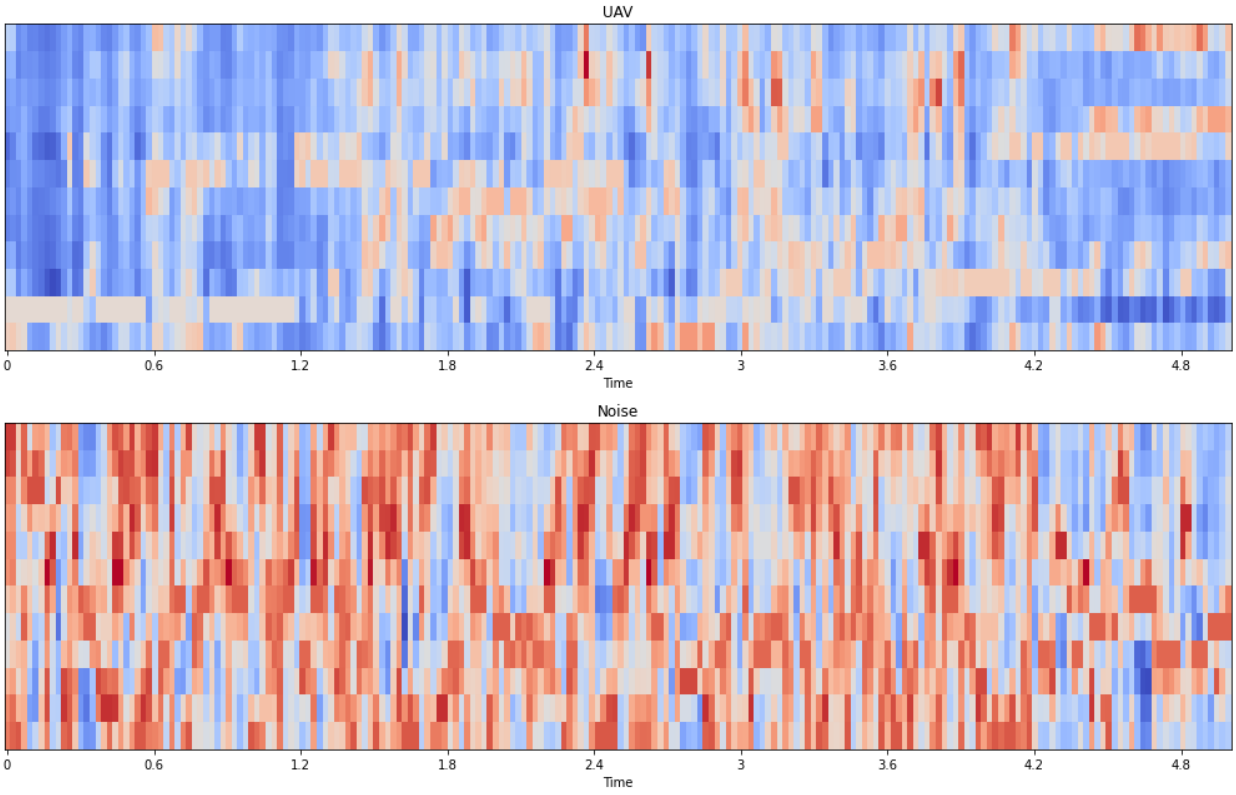


Fig. 10. chroma_stft feature plot



```
[root@localhost Debug]# ./TCPServer.out
CanStart
_listener was set
Accepted
Listener's Dispatch
Listener's ProcessAccept
OnConnected()
RegisterRecv succeed
Session::Dispatch
```

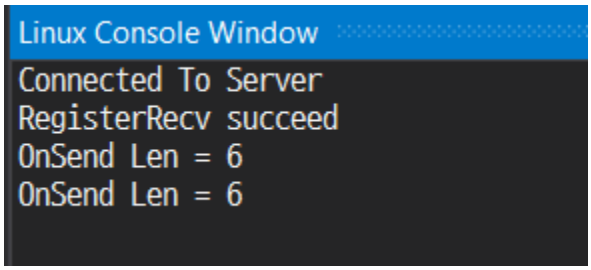


Fig. 12. Testing of the server program