

A

Smart home Solution for Dogs Left Alone at Home

DogAlone: Your Dog's Caretaker

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Lack of solutions for dogs left home alone

In modern households, dogs are no longer just pets; they have become integral members of the family.

However, many dogs are left alone at home for extended periods, often without receiving adequate care. During these times, they may experience loneliness, which can lead to issues such as separation anxiety, excessive barking, or accidents indoors.

While many pet owners feel guilty about leaving their dogs alone, effective solutions to address this problem remain limited.

3.02
million



Number of dogs
in Korea (2022)

75 %



Percentage of dog owners
who occasionally leave
their pets home alone.

5 hr 22 min



Average time a dog is left
home alone

Smart Home Solutions for Dogs

To address these issues, our team envisioned an application that analyzes dog barks using AI to identify their emotional state and provides appropriate smart home solutions.

- According to the paper "Communication in Dogs", canine vocalizations provide contextual information based on frequency range and specific acoustic patterns.
- Our AI is designed to analyze dog barks by training on spectrogram images to identify the emotions being expressed.
- By referencing the paper and veterinary prescriptions, we recommend tailored smart home solutions for each identified emotional state.

Pitch

Duration

Frequency

Main Functions for 'DogAlone'



Real-time
barking analysis



Smart home solution
recommendation



Barking report

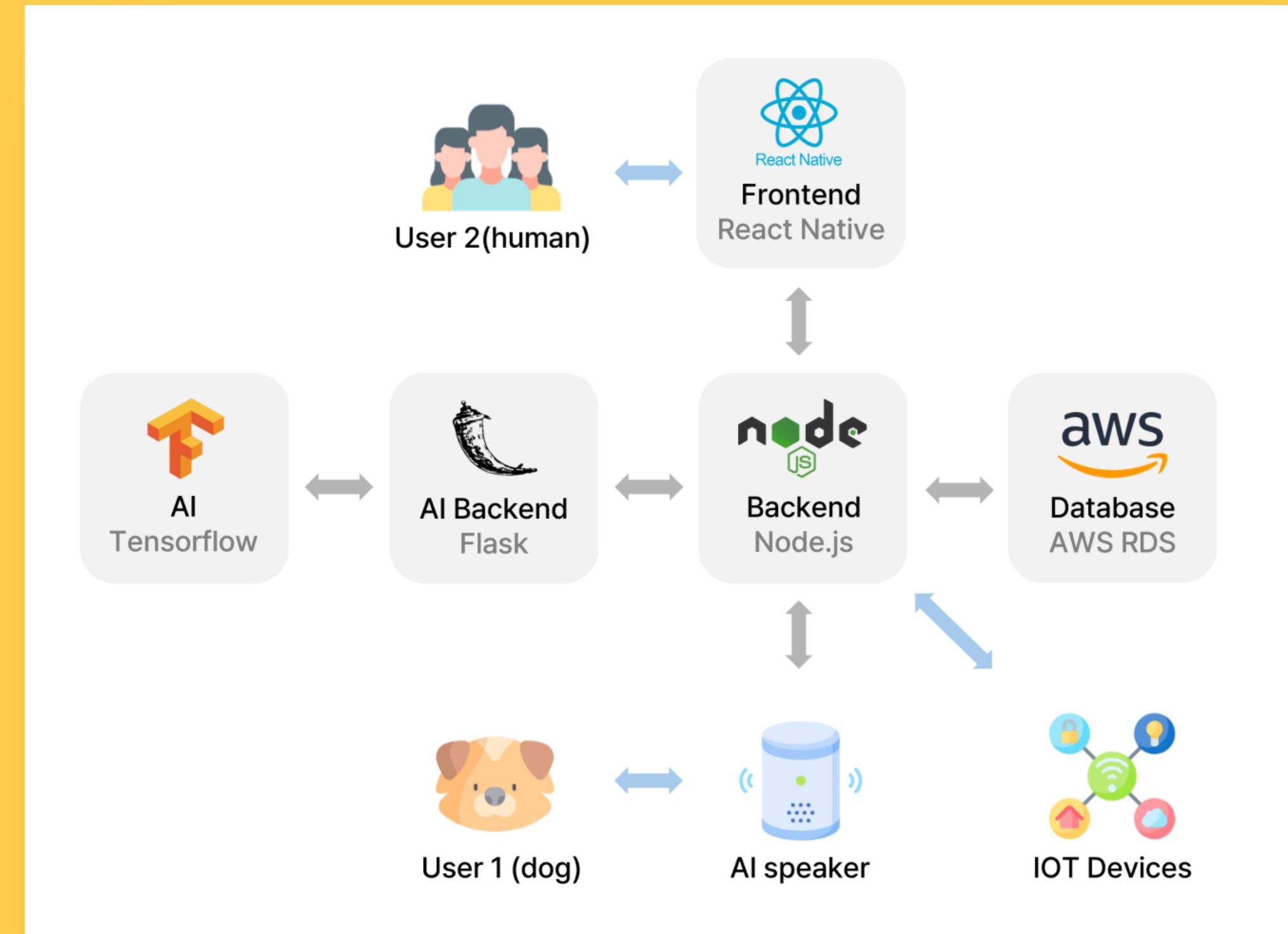


LG smart home
device control



Dog Meal Control

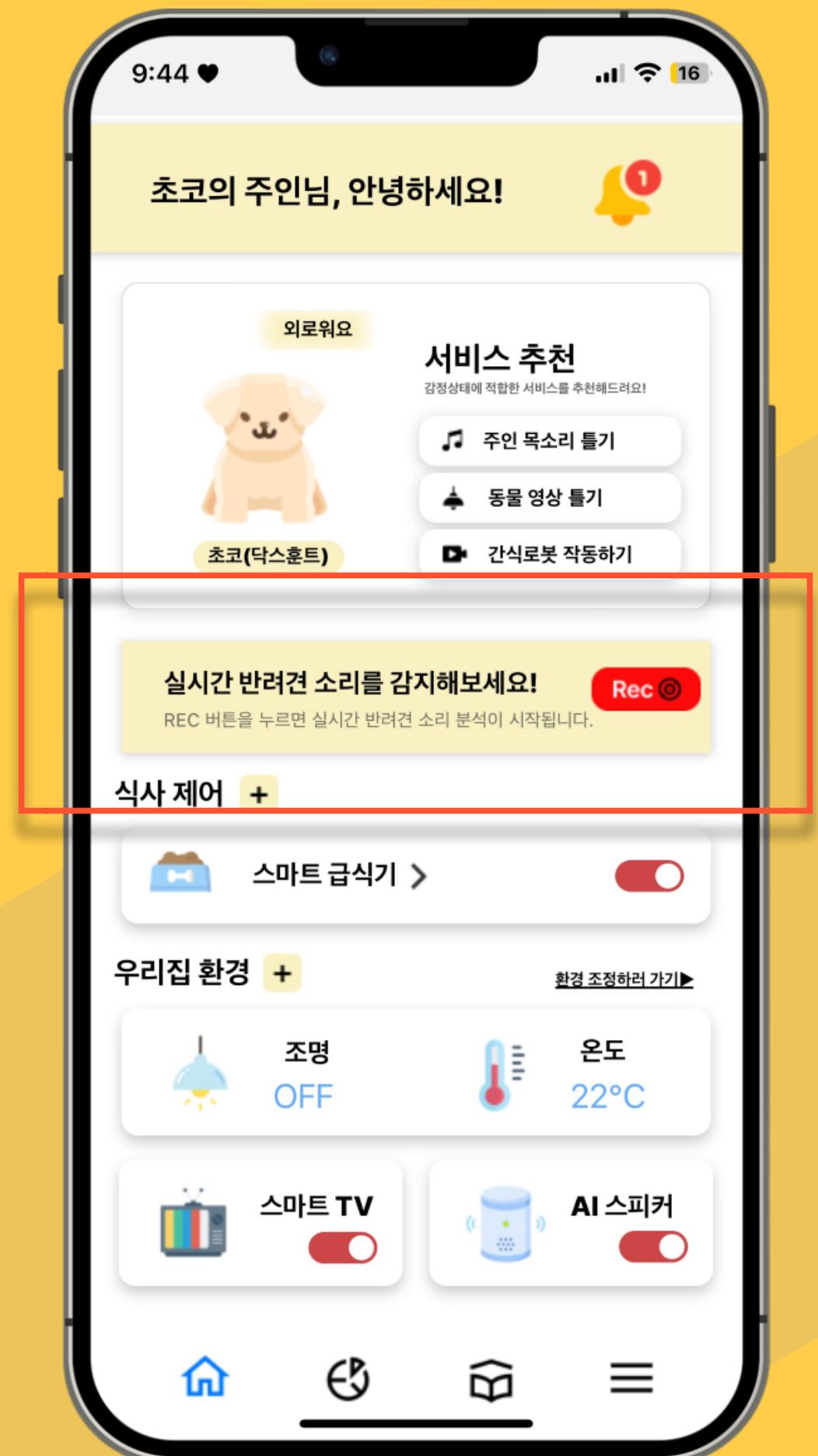
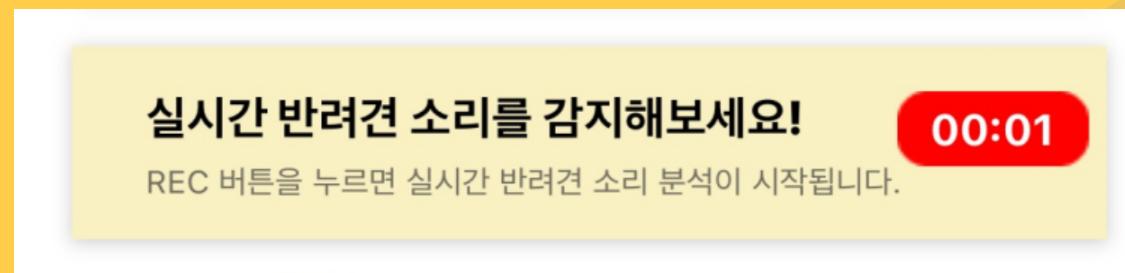
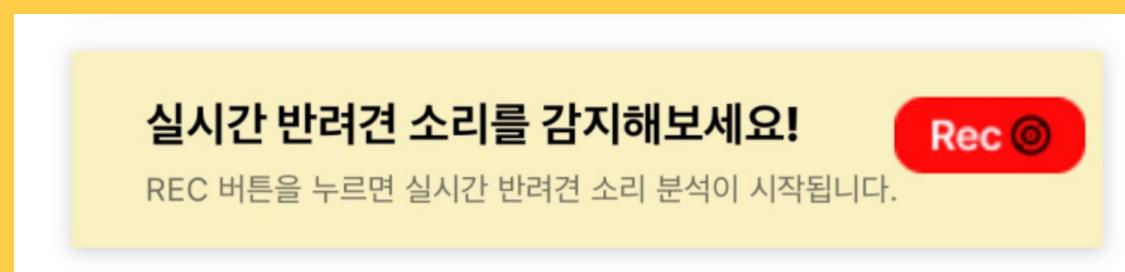
Overall Architecture



Real-time barking analysis

AI emotional analysis

When a user presses the record button, real-time sound transmission through the AI speaker begins, analyzing the dog's sounds with AI and allowing the user to check the results of the emotional analysis.



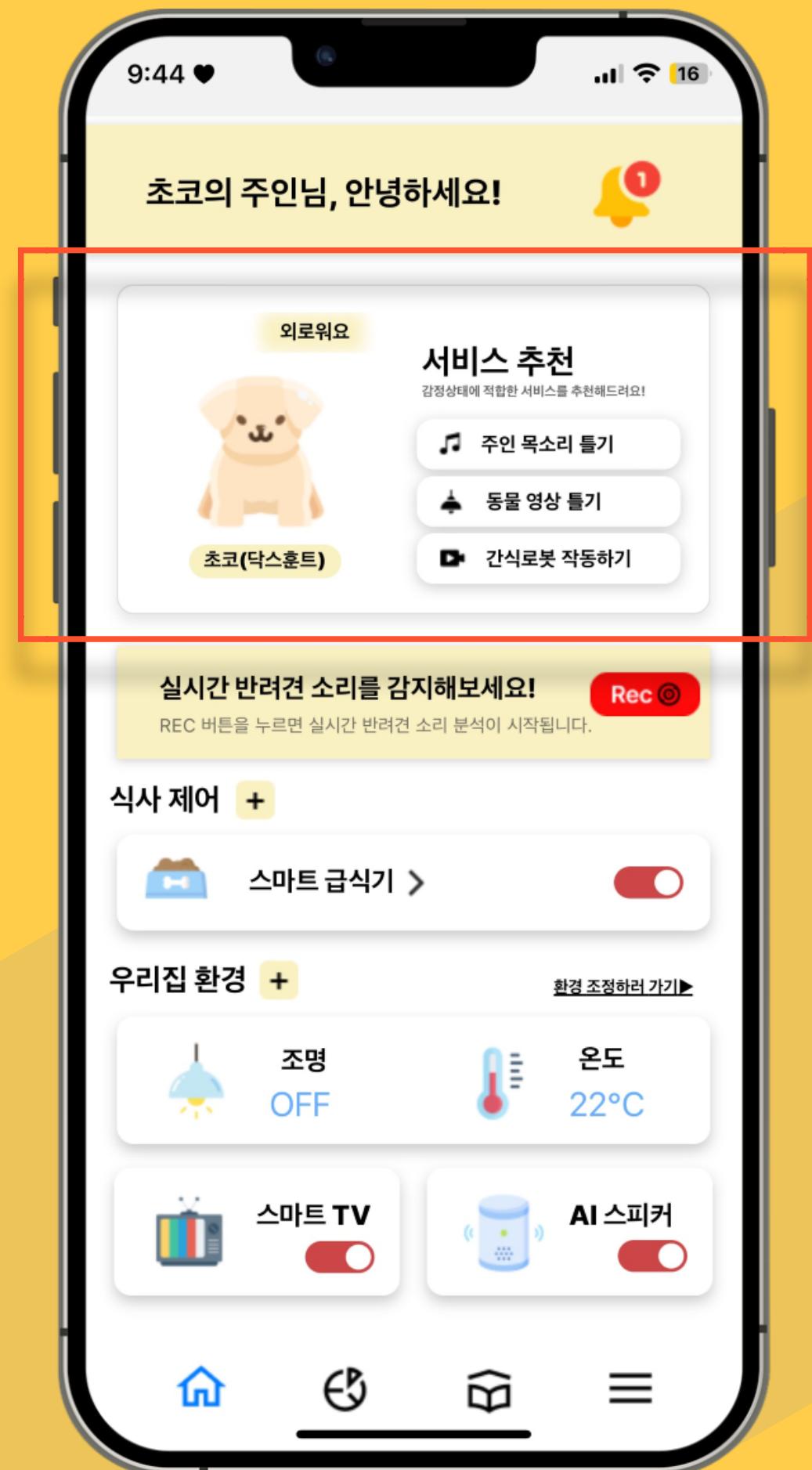
Smart home solution recommendation

Emotion-Based Smart Home Solutions

Based on expert opinions, we provide recommended smart home solutions for each emotion.

Click the button to get a smart home solution.

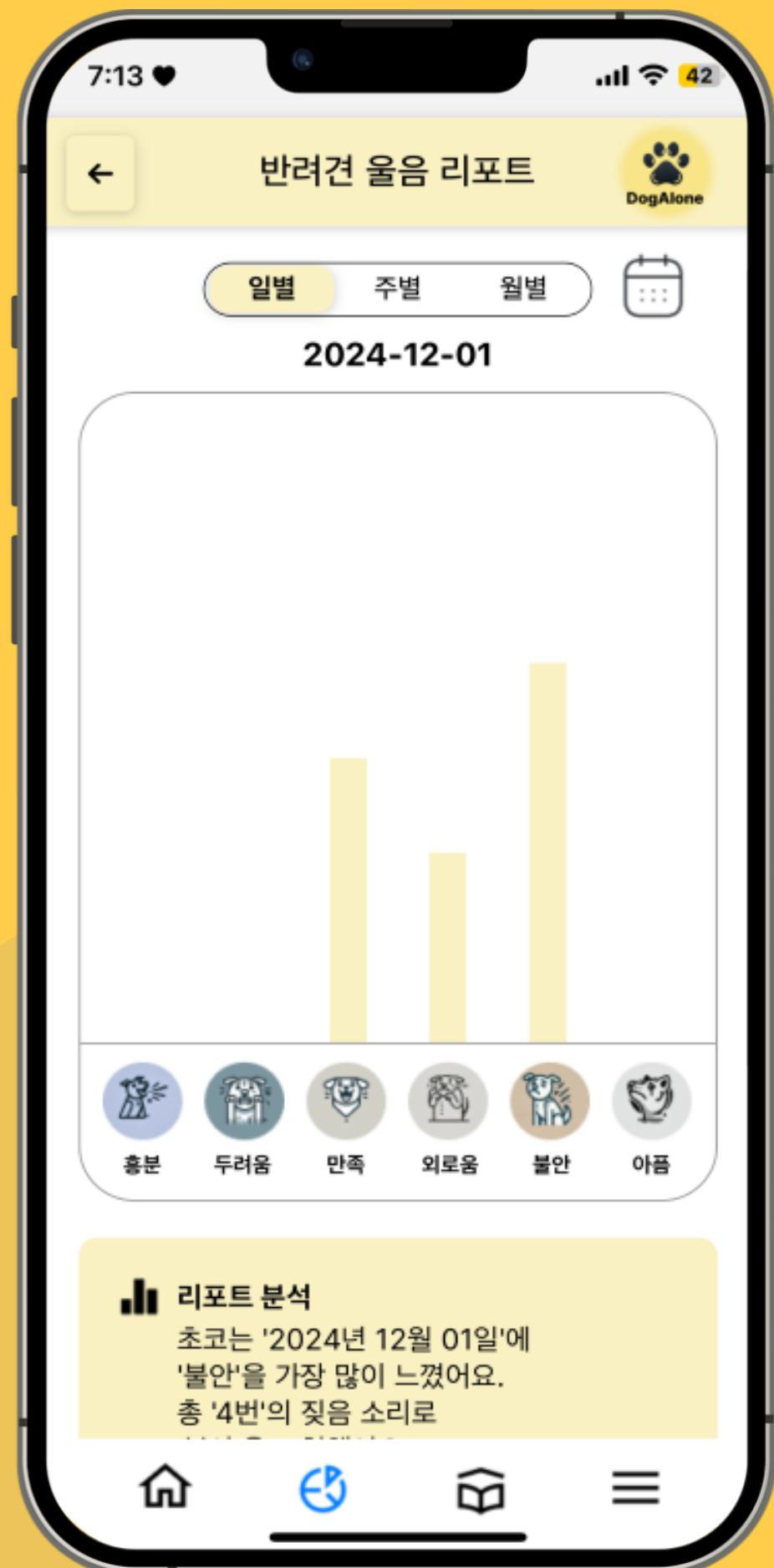
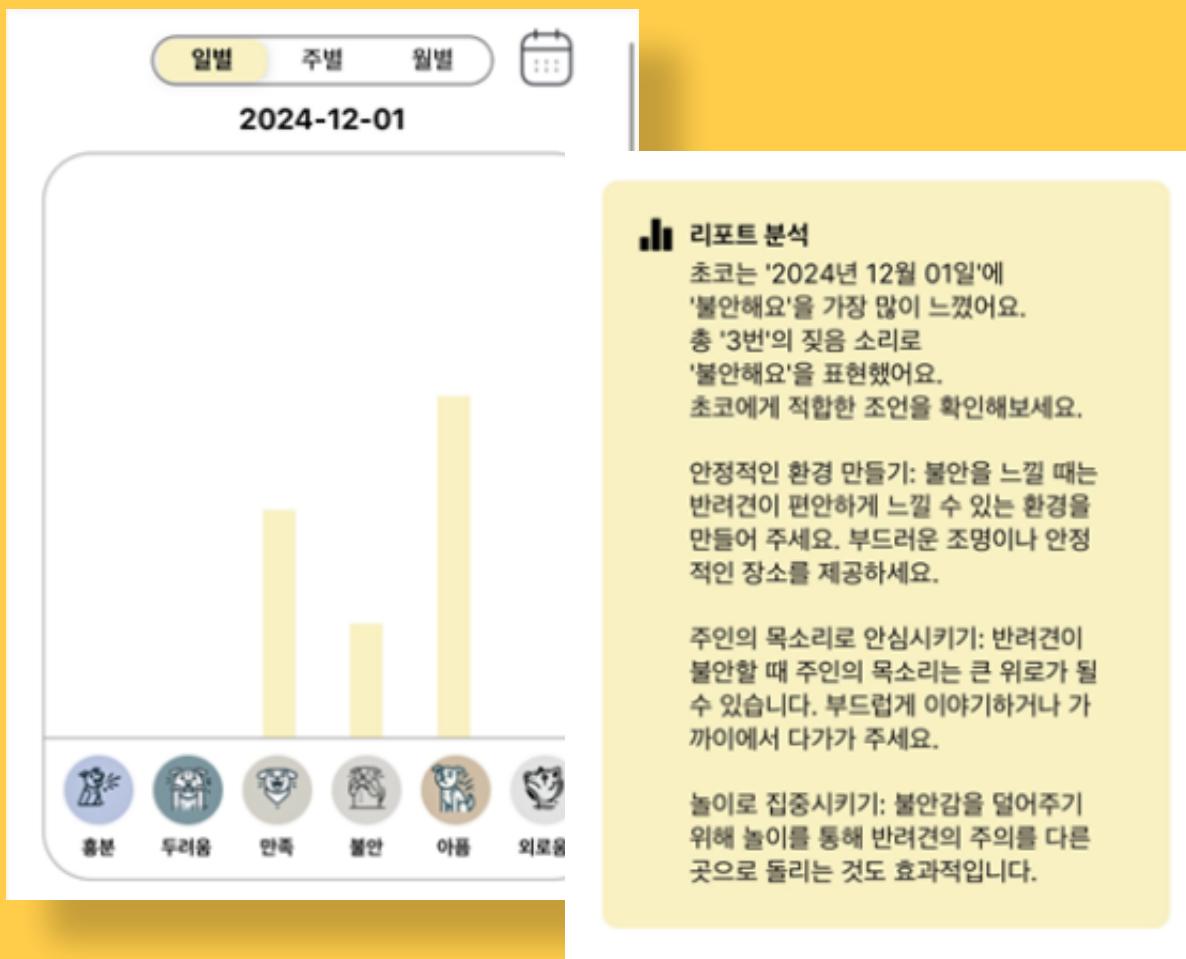
It is implemented to help your dog regain stability.



Barking report

Report by period

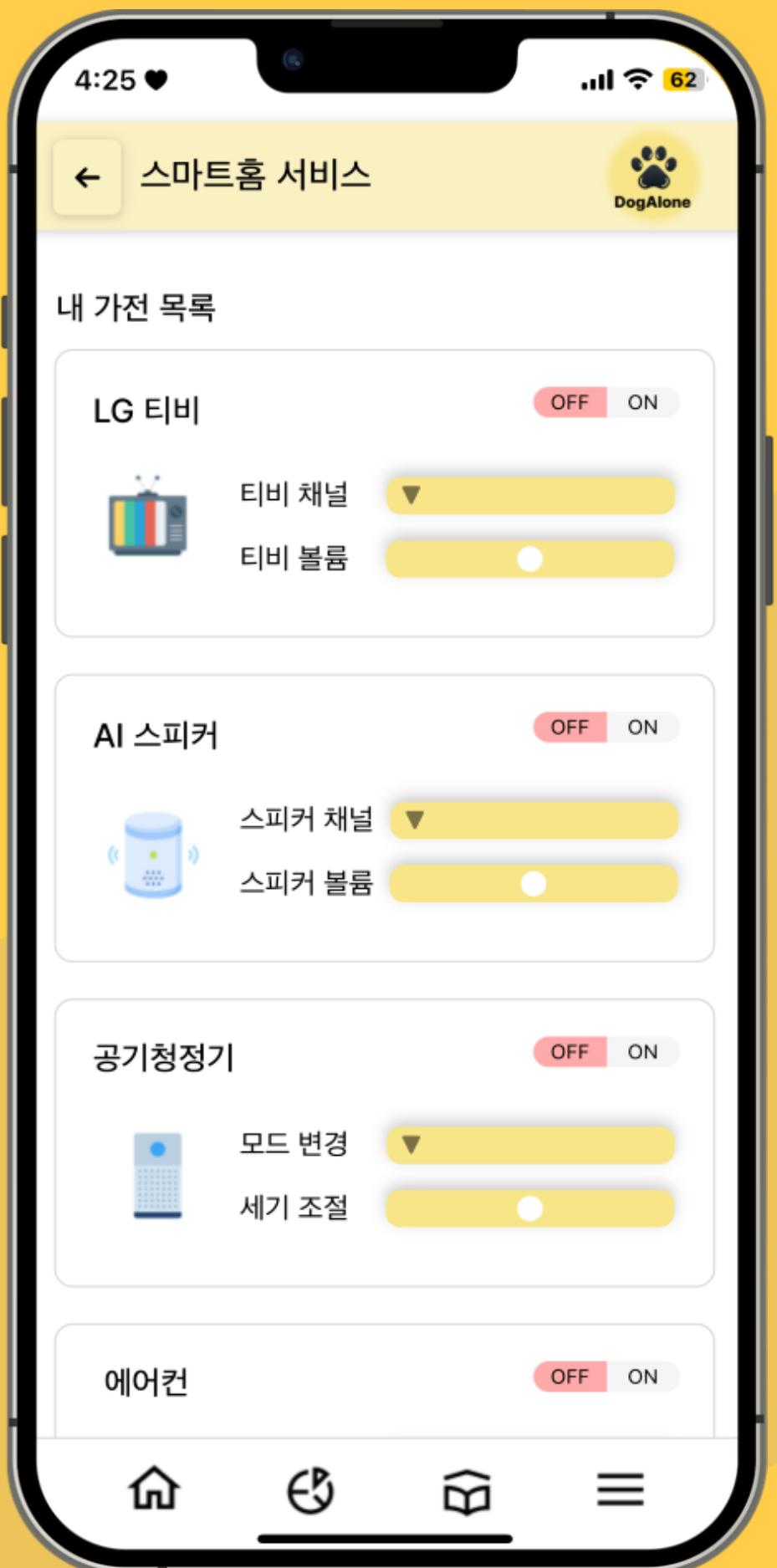
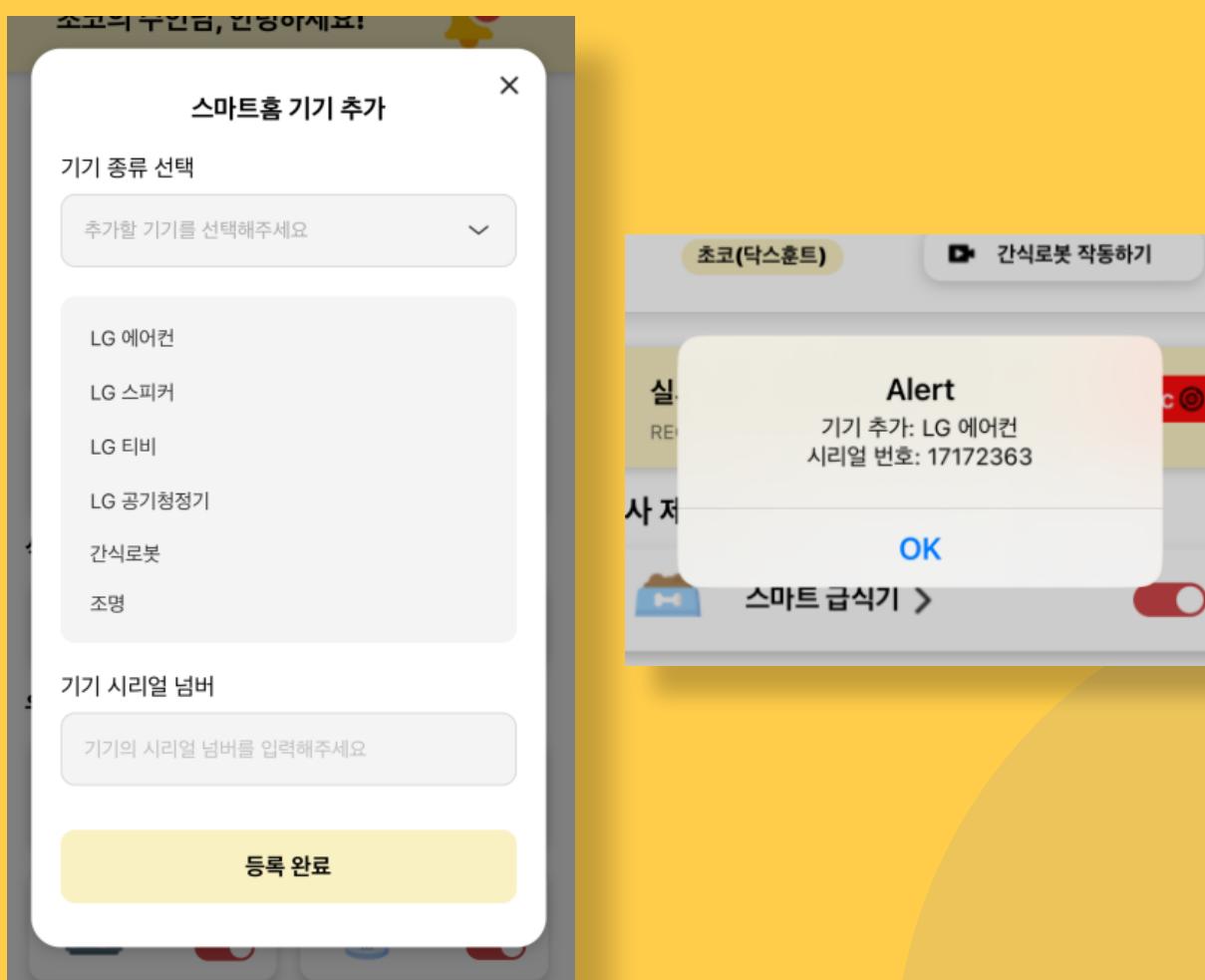
Users can view the frequency of dog barks on a daily, weekly, and monthly basis through graphs. The most frequent emotions and corresponding advice can be found in the report analysis.



LG smart home device control

Smart Home Service Integration

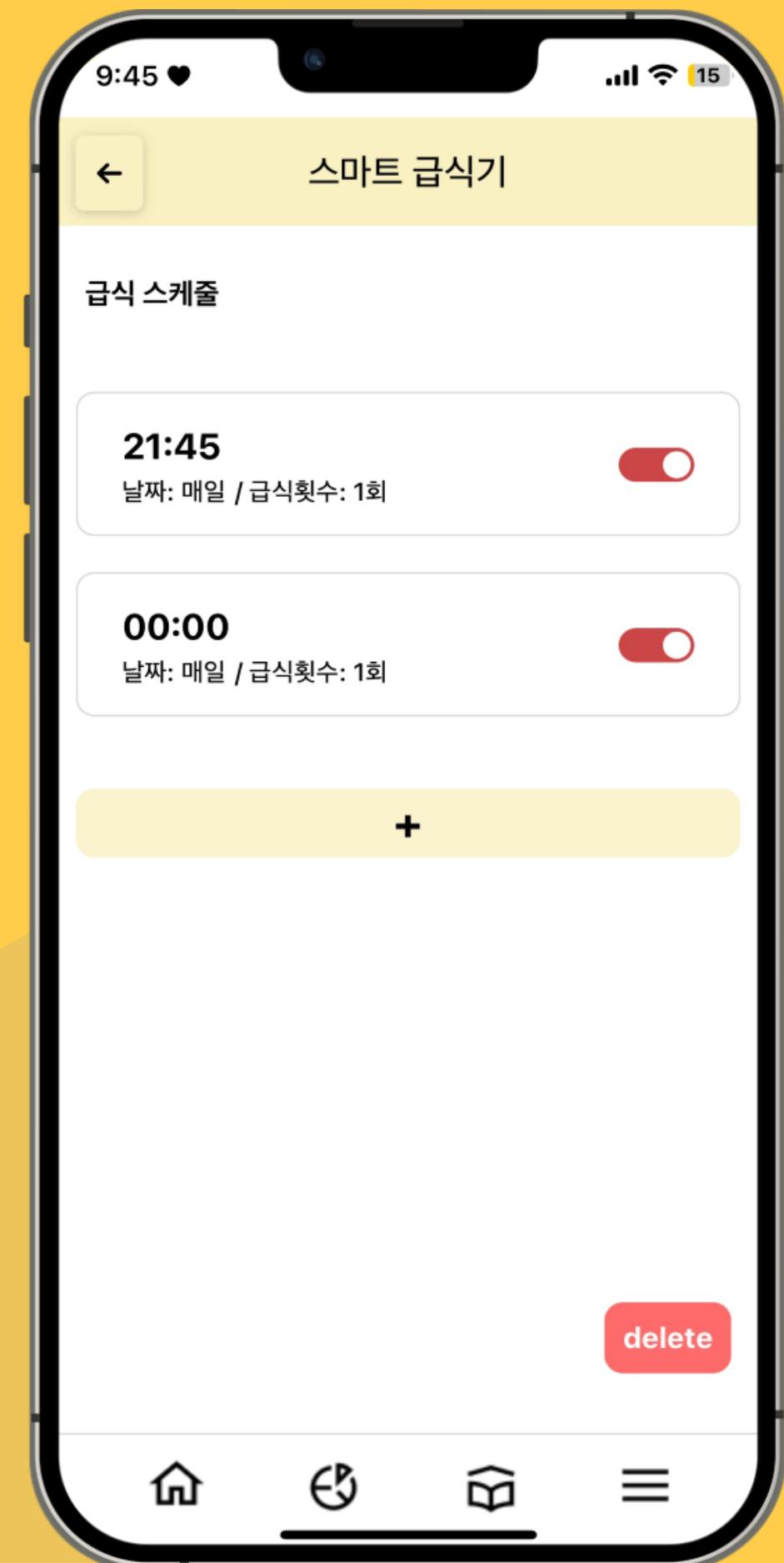
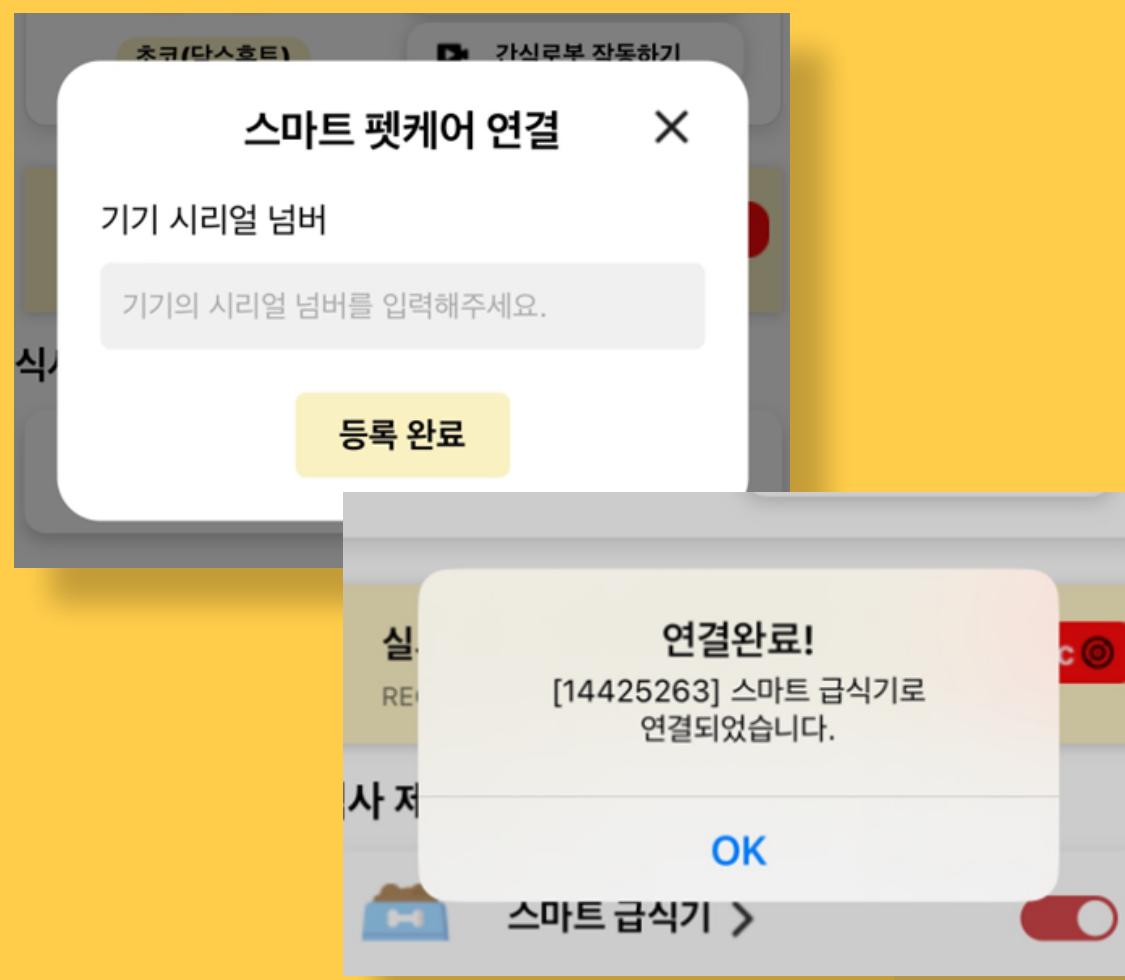
By registering LG smart home devices on the app, a user can easily control and manage them from anywhere.



Dog Meal Control

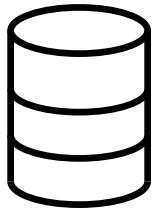
Smart feeder linkage

If user registers a smart feeder in the app, user can set the smart feeder to serve a specific amount of food at a specific time.



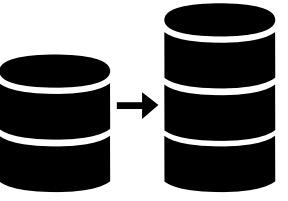


AI Training Process



Dataset collection

Collected 600 pieces of barking sound data through Kaggle and YouTube



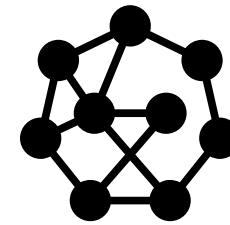
Data labeling

Classified barking sounds into 6 types according to pitch, length, and frequency referring to the paper



Spectrogram transformation

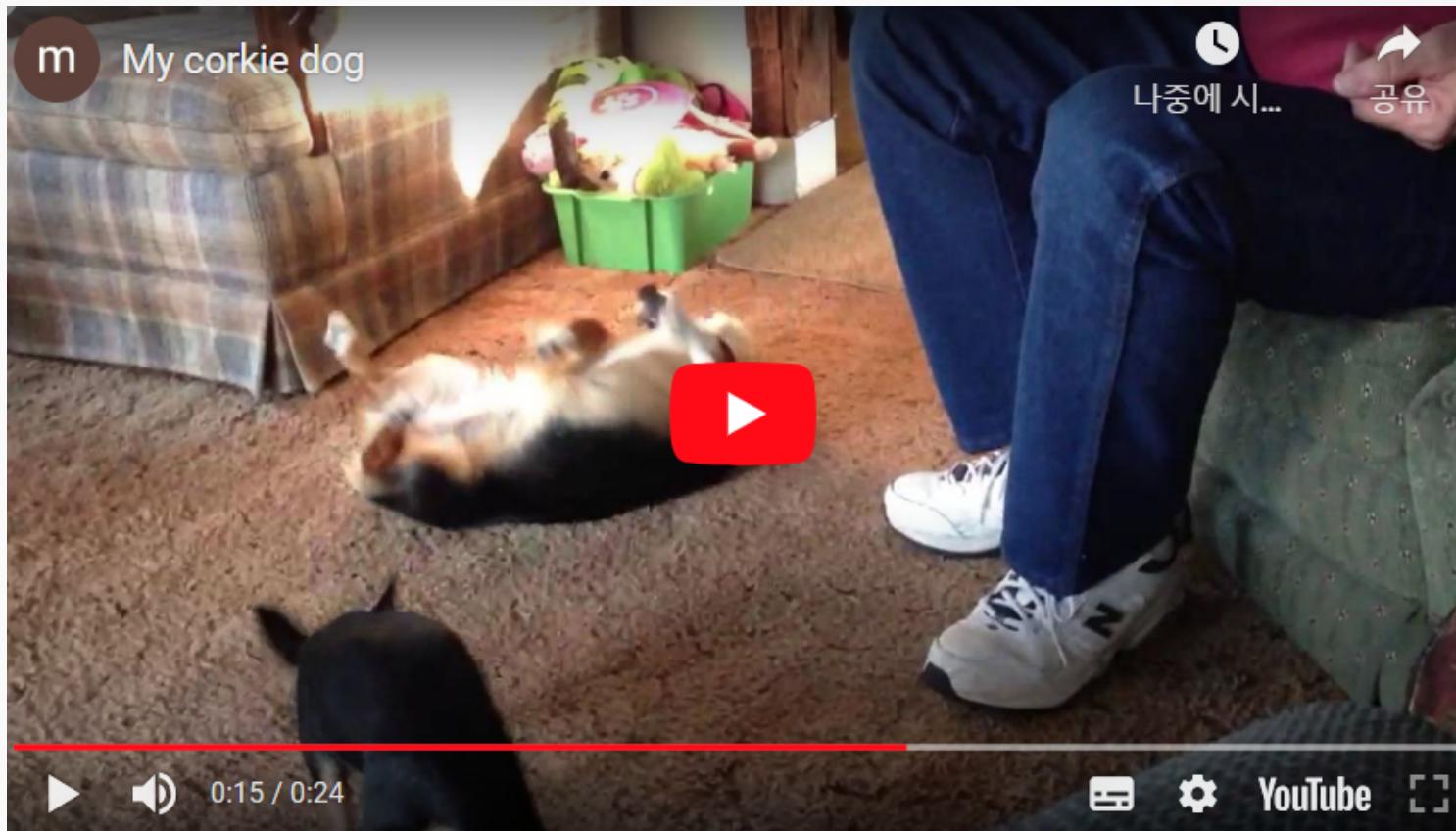
By converting WAV data into spectrograms (PNG), the characteristics of the barking sound are visualized and can be learned .



CNN model training

With strengths in pattern recognition and feature extraction, the CNN model, typically used for image classification, is trained.

Dataset Collection



Dog voice emotion dataset (Demo-Lite)

Classification of Dog voice emotion

Data Card Code (0) Discussion (0) Suggestions (0)

About Dataset

The dataset comprises four classes: other animal bark, normal dog bark, dog grunting, and dog growling. It contains 163 audio files, with files allocated for training and 48 for testing. The class distributions are as follows: 36 training and 14 testing files for other animal bark, 23 training and 13 testing files for normal dog barks, 23 training and 11 testing files for dog grunts, and 23 training and 10 testing files for dog growls. The other animal bark (cat) and some normal dog bark samples come from the open-source cat-dog audio dataset on Kaggle, at 16KHz. Dog grunt and growl recordings were collected from a 1.5-year-old female dog using a voice recorder app and sampled at 44.1KHz.

- We found three types of audio data on Kaggle, but we determined that the dataset lacked sufficient quantity and diversity.
- Therefore, we extracted various dog barks from YouTube videos one by one to create a dataset.
- Many of the videos had poor audio quality due to background noise, so we invested considerable effort in filtering these sounds.

Data Labeling

- We faced difficulties in establishing the criteria for distinguishing and classifying dog barks.
- To address this, we first studied the **phonetic characteristics of dog barks**.
 - ✓
- By referring to phonetics-related papers and research, we understood that **acoustic features such as pitch, duration, and frequency** can convey different meanings.
- Based on this, we classified the sounds and emotions into six categories.

	Pitch	Duration	Frequency	Emotion
Bark	HIGH - MID	SHORT	REPETITIVE	EXCITED
Growl	LOW	LONG	REPETITIVE	FEAR
Grunt	LOW	SHORT	NOT	CONTENT
Whimper	HIGH	SHORT	REPETITIVE	ANXIOUS
Howl	LOW	LONG	NOT	LONELY
Yip	HIGH	SHORT	REPETITIVE	PAIN

We newly realized that even **slight variations in sound** can have significant meaning in communication. To improve the accuracy of emotion analysis, we understood that **precise data labeling and a variety of sound samples are essential**.

Spectrogram Transformation

After collecting 100 pieces of voice data for each of the 6 cries, convert them into a spectrogram; a graph that visually represents the frequency components of the signal over time.



CNN Model Training

After augmenting and preprocessing the spectrogram image data, a CNN model is designed and trained for multi-class classification to create and store a dog cry emotion classification model.

```
19/19 [=====] - 24s 1s/step - loss: 0.0757 - accuracy: 0.9733
Epoch 94/100
19/19 [=====] - 23s 1s/step - loss: 0.0848 - accuracy: 0.9650
Epoch 95/100
19/19 [=====] - 24s 1s/step - loss: 0.0757 - accuracy: 0.9733
Epoch 95/100
19/19 [=====] - 24s 1s/step - loss: 0.0757 - accuracy: 0.9733
19/19 [=====] - 24s 1s/step - loss: 0.0757 - accuracy: 0.9733
Epoch 96/100
Epoch 96/100
19/19 [=====] - 25s 1s/step - loss: 0.0724 - accuracy: 0.9633
Epoch 97/100
19/19 [=====] - 23s 1s/step - loss: 0.0869 - accuracy: 0.9667
19/19 [=====] - 23s 1s/step - loss: 0.0869 - accuracy: 0.9667
Epoch 98/100
19/19 [=====] - 20s 1s/step - loss: 0.0643 - accuracy: 0.9750
Epoch 99/100
19/19 [=====] - 23s 1s/step - loss: 0.0913 - accuracy: 0.9700
Epoch 100/100
19/19 [=====] - 24s 1s/step - loss: 0.0748 - accuracy: 0.9667
```

Amount of Data	600
Epochs	100
Batch	32
Accuracy	96.67%

Data Transfer Process

Connect the audio server and AI server to transmit sound data and receive analysis results

```
(NOBRIDGE) LOG Starting recording...
(NOBRIDGE) LOG Stopping recording...
(NOBRIDGE) LOG Recording saved at: file:///var/mobile/Containers/Data/Application/5E639968-2058-4944-9BFC-292A0F1E49A9/Library/Caches/ExponentExperienceData/@anonymous/MyNewProject1-5526b0b9-27c7-4f4c-a5ec-e91512e77b74/AV/recording-2D0E46D0-99E3-4926-B04C-3020606FC19B.wav
(NOBRIDGE) LOG Base64 데이터 길이: 901100
(NOBRIDGE) LOG Audio data sent to the server
```



```
Received audio data in Base64 format
Audio Saved!
WAV file saved to: C:\Users\SeoyeonKim\Documents\hanyangUni\4th_grade\1st_sem\SW_Eng\dev\link\backend\server\audio_data\audio_1733145208107.wav
File sent to AI server.
AI 분석 결과: { analyze_result: 'Whimper', current_time: '2024-12-02 22:13:28' }
Sent data to DB and Client
Deleted file: C:\Users\SeoyeonKim\Documents\hanyangUni\4th_grade\1st_sem\SW_Eng\dev\link\backend\server\audio_data\audio_1733145208107.wav
```



```
Predicted Emotion: Whimper
Prediction Probabilities:
Bark: 0.00%
Growl: 0.00%
Grunt: 0.35%
Howl: 0.00%
Whimper: 99.62%
Yip: 0.04%
192.168.0.47 - - [02/Dec/2024 22:13:28] "POST /analyze_audio HTTP/1.1" 200 -
```



```
(NOBRIDGE) LOG Received aiResult data: {"analyze_result": "Whimper", "current_time": "2024-12-02 22:13:28"}
(NOBRIDGE) LOG Whimper
(NOBRIDGE) LOG Recommendation data: {"data": {"emotion": "Whimper", "id": 76, "recommendation": "통화 연결하기, 부드러운 조명 켜기, 동물 영상 틀기", "time": "2024-12-02T13:13:28.000Z"}}
```

Frontend (React Native)

Once recording begins, data is transmitted to the audio server in real time

Backend (Node.js)

Data transmitted in Base64 format is saved in wav format and then transmitted to the AI server. The analysis results are returned from the AI server and sent to the frontend and DB

AI Backend (Flask)

Convert wav data into spectrogram and analyze with learned AI
Analyze the similarity for each of the six emotions and return the emotion with the highest similarity.

Frontend (React Native)

Displays the most similar emotions and recommendation system together

Full integration

Connection of frontend, backend, AI

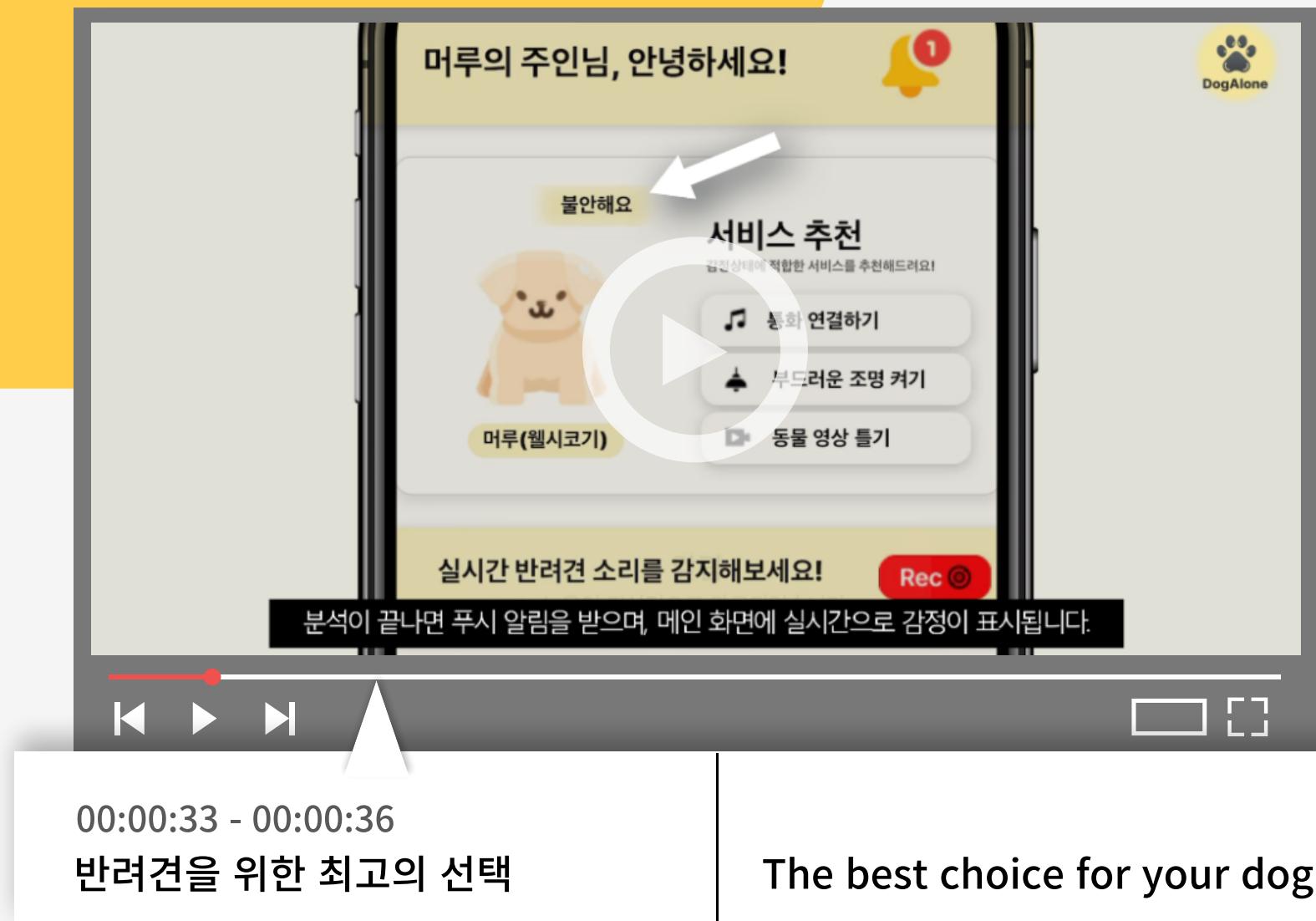
- When we entered the integration stage, it took a long time to correct because the implementation method and data format we had in mind were different.
- In particular, when connecting the AI model and the Flask server, the environment in which the model was trained and the environment in which the server runs are different, so the AI model had to be retrained.

```
jhjs1@LAPTOP-LH040HCL MINGW64 ~/Desktop/dog-alone/backend/server
$ node server.js
C:\Users\jhjs1\Desktop\dog-alone\backend\node_modules\@firebase\auth\dist\node\totp-7195c207.js:5
    throw createErrorInternal(authOrCode, ...rest);
    ^
FirebaseError: Firebase: Error (auth/invalid-api-key).
    at createErrorInternal (C:\Users\jhjs1\Desktop\dog-alone\backend\node_modules\@firebase\auth\dist\node\totp-7195c207.js:5:14)
    at _assert (C:\Users\jhjs1\Desktop\dog-alone\backend\node_modules\@firebase\auth\dist\node\totp-7195c207.js:10:14)
    at Component.instanceFactory (C:\Users\jhjs1\Desktop\dog-alone\backend\node_modules\@firebase\auth\dist\node\totp-7195c207.js:10:14)
    at Provider.getOrInitializeService (C:\Users\jhjs1\Desktop\dog-alone\backend\node_modules\@firebase\auth\dist\node\totp-7195c207.js:10:14)
    at Provider.initialize (C:\Users\jhjs1\Desktop\dog-alone\backend\node_modules\@firebase\auth\dist\node\totp-7195c207.js:10:14)
    at initializeAuth (C:\Users\jhjs1\Desktop\dog-alone\backend\node_modules\@firebase\auth\dist\node\totp-7195c207.js:10:14)
    at getAuth (C:\Users\jhjs1\Desktop\dog-alone\backend\node_modules\@firebase\auth\dist\node\totp-7195c207.js:10:14)
```

```
(NOBRIDGE) LOG Bridgeless mode is enabled
(NoBridge) ERROR [AxiosError: Request failed with status code 404]
(NoBridge) WARN ⚠️ React Native's New Architecture is always enabled in Expo Go, but it is not explicitly enabled in your project app config. This may lead to unexpected behavior when you create a production or development build. Set "newArchEnabled": true in your app.json.
Learn more: https://docs.expo.dev/guides/new-architecture/
(NoBridge) ERROR 일일 보고서 조회 중 오류 발생: [AxiosError: Network Error]
(NoBridge) ERROR 데이터 로드 실패: [AxiosError: Network Error]
(NoBridge) ERROR Failed to fetch recommendations: [AxiosError: Network Error]
```

Learned various **debugging methods** and the importance of **environment configuration**
 Realized the significance of **clearly defining the implementation details** before starting development.

Lessons



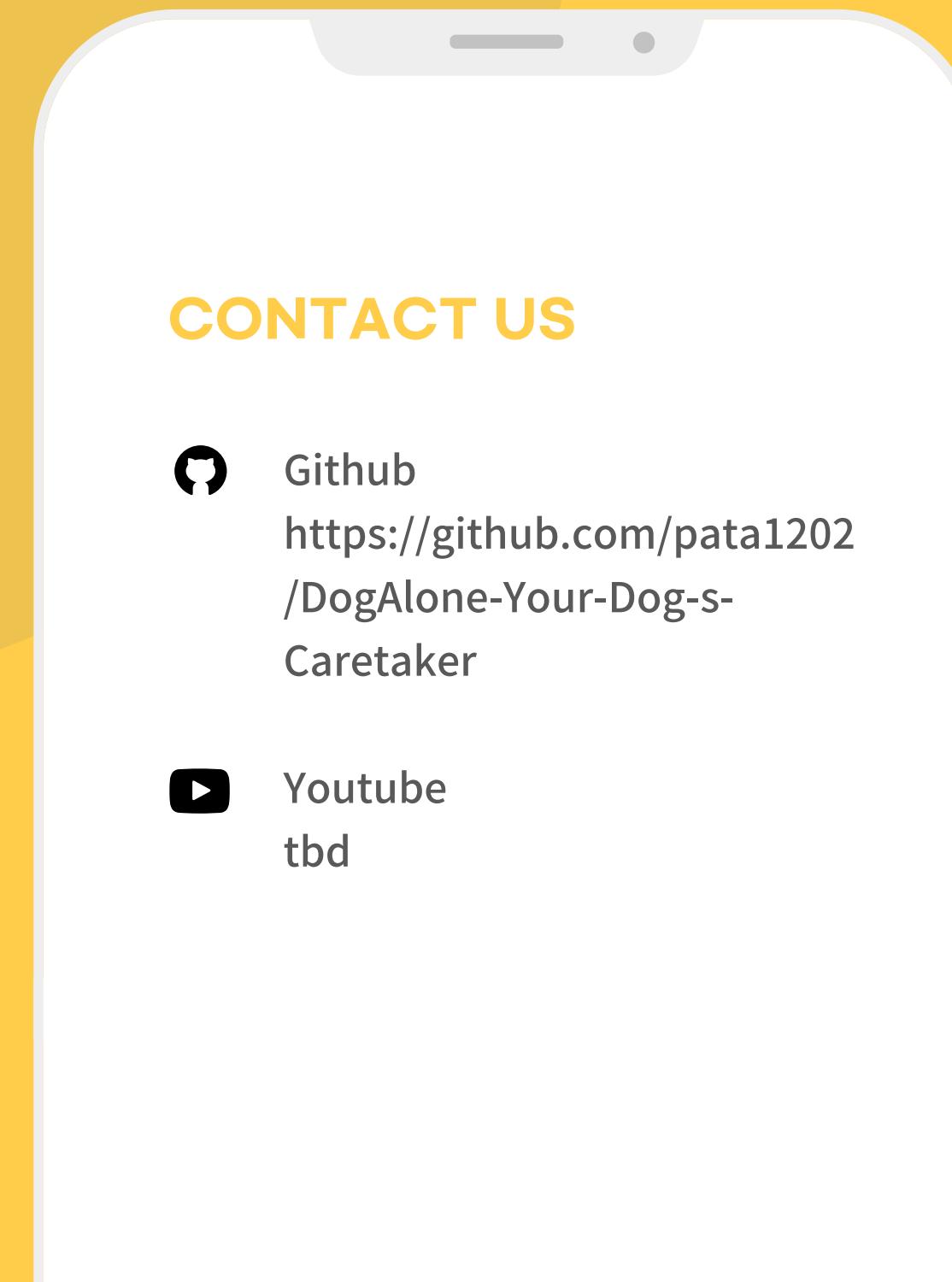
The combination of phonetics and AI technology was a project that made me realize that it is not just a technical process of processing data and training models, but also requires an **academic approach to deeply understand and interpret the data**.

Also, we realized that the task of classifying emotions comes with **ethical responsibility**. Incorrect analysis or judgment could have inappropriate effects on a dog's behavior, so I learned the importance of being more careful in data analysis and interpretation.

Future Plans

	AI model advancement	Improved accuracy by collecting more diverse barking
	Smart home Expansion	Connecting additional smart home devices
	Cloud based system	Increase app speed and stability while ensuring scalability
	App launch	After launching as a beta version, collect feedback from real users

THANK YOU



CONTACT US



Github

<https://github.com/pata1202/DogAlone-Your-Dog-s-Caretaker>



Youtube

tbd

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AI Developer
Document

Junhyeong Byun

Backend Developer
AI Developer
Project Manager

Dongryul Lee

Frontend Developer
Design

Chaeyeon Jun

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Document

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