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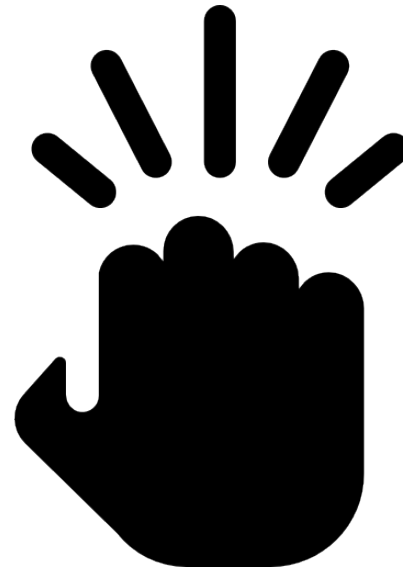
# SurfacePad

Gesture Recognition on Ubiquitous Surfaces  
with a Single Mobile Device

20212927 Jeongwoo Kim

## ■ Summary of Topic

- SurfacePad
  - Gesture Recognition on Ubiquitous Surfaces with a Single Mobile Device



## ■ Comments on proposal

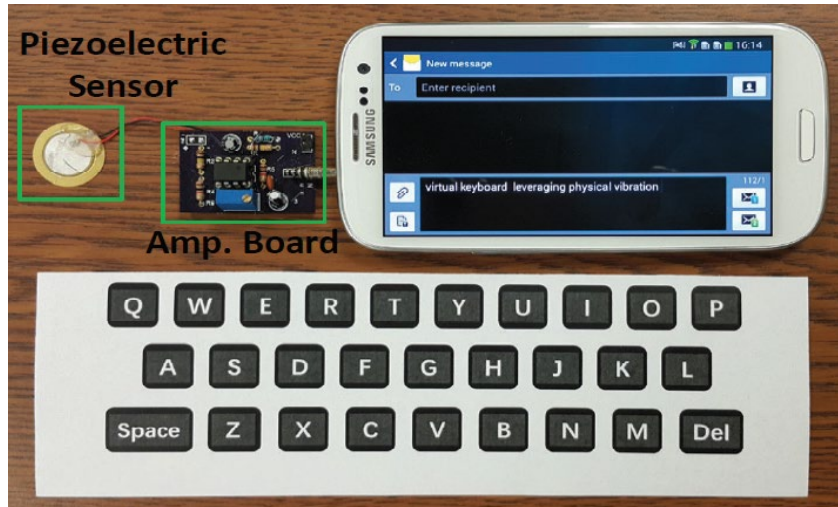
### Anonymous reviewer 5:

- 동기에서 손이 젖거나 더러워서 터치를 하기 힘든 경우를 상정하셨는데, 그런 경우에는 탁자 역시 두드리거나 스와이프하기 힘든 상황이 아닐까 생각합니다. 또, 이걸 구현상 편의를 위해 빅스비를 선택하신거지만, 항상 백그라운드로 실행하기 어려워 빅스비를 통해 호출해야 한다면 그냥 빅스비에게 하고자 하는 행동을 부탁하는게 낫지 않을까 하는 생각도 들었습니다.

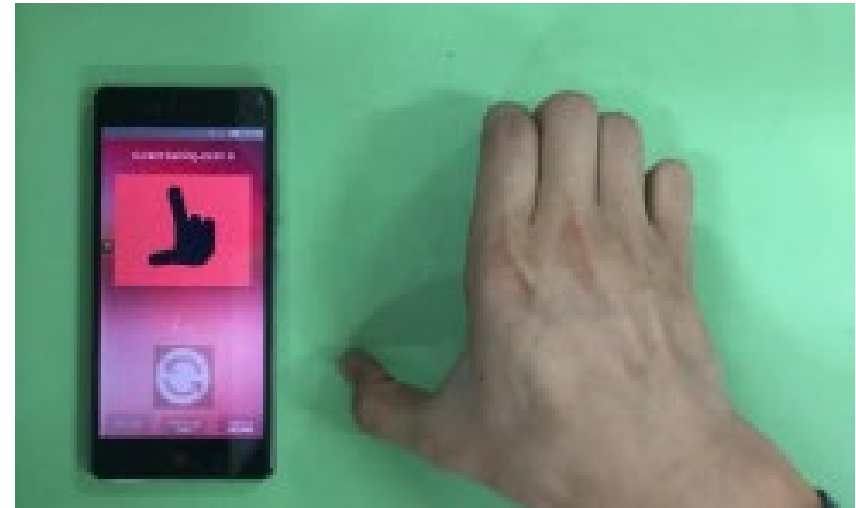
### TA:

- 아이디어가 아주 새로운 것은 아니고, 오히려 딥 러닝 기술을 이용하여 높은 정확도로 제스처를 인식한 연구가 있었습니다.

## ■ Related Works



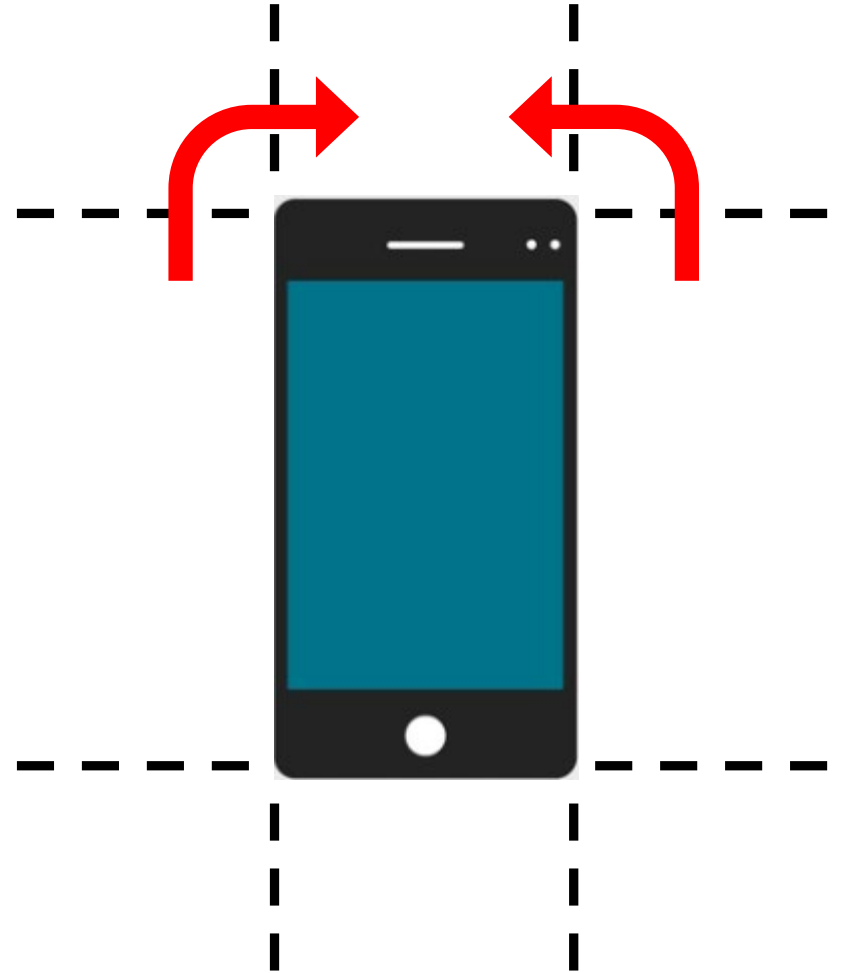
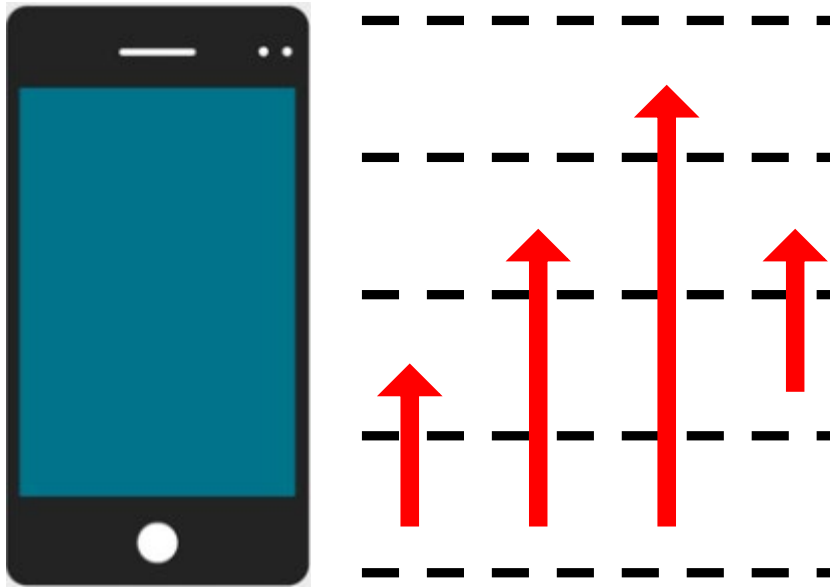
VibKeyboard



HCI on the Table

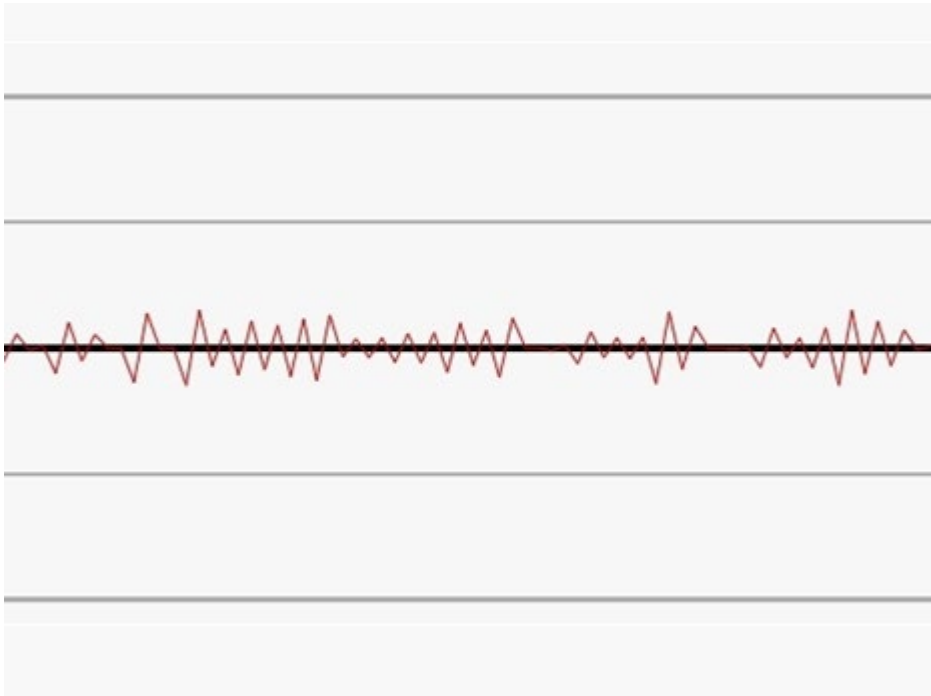
## ■ Project Revision(Goal)

- Gesture(Tap, Knock, Swipe) recognition
- > Gesture(**Swipe on the Grid**) recognition



## ■ Project Revision(Approach)

- Multiple Sensors(Stereo MIC, Accelerometer, Decibel) for recognition  
-> Stereo MIC and Machine Learning for recognition



## ■ Plan(Previous)

	~4/4	~4/11	~4/18	~4/25	~5/2	~5/9	~5/16	~5/23	~5/30
Related works									
Sensor analysis									
Gesture recognition model									
App design									
S/W development									
User study									

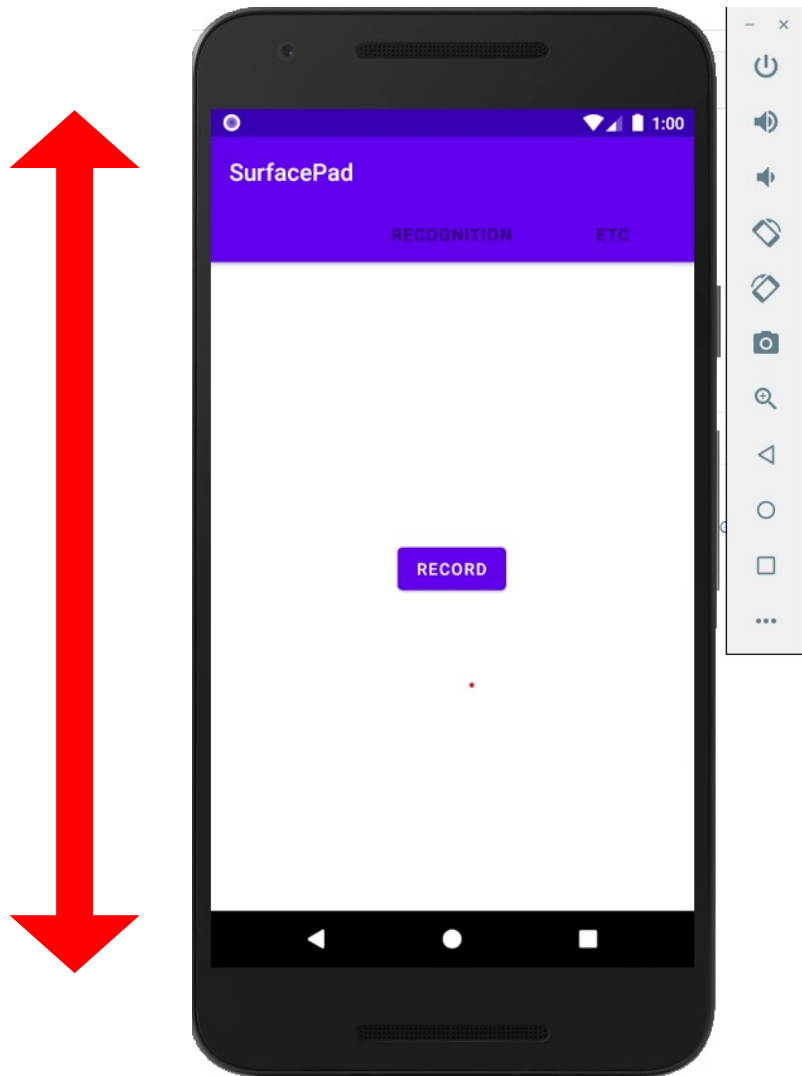
## ■ Plan(Revised)

[illegible]



## ■ Done

- Develop application to get stereo MIC data



```
jwkim0417@DESKTOP-E6HCJ10:/mnt/c/Users/HVR/Desktop/Ubuntu$ ffmpeg -f s16le -ar 44.1k -ac 2 -i 2021-04-23-06_55_32.pcm data.wav
```

```
Output #0, wav, to 'data.wav':
```

```
Metadata:
```

```
ISFT : Lavf58.29.100
```

```
Stream #0:0: Audio: pcm_s16le ([1][0][0][0] / 0x0001), 44100 Hz, stereo, s16, 1411 kb/s
```

```
Metadata:
```

```
encoder : Lavc58.54.100 pcm_s16le
```

```
size= 2354kB time=00:00:13.66 bitrate=1411.2kbits/s speed=1.85e+03x
```

```
video:0kB audio:2353kB subtitle:0kB other streams:0kB global headers:0kB muxing overhead: 0.003237%
```

## ■ Tried

- Many attempts to get MIC data
  - Can I get stereo MIC data?
  - In what format will the file extension be?
  - Which audio library to use?
  - Where to store the obtained data?
  - Arguing with permissions and numerous errors

## ■ Tried

- Can I get stereo MIC data?

### AudioFormat

```
public final class AudioFormat  
extends Object implements Parcelable
```

[java.lang.Object](#)

↳ [android.media.AudioFormat](#)

int	<a href="#">CHANNEL_IN_MONO</a>
int	<a href="#">CHANNEL_IN_PRESSURE</a>
int	<a href="#">CHANNEL_IN_RIGHT</a>
int	<a href="#">CHANNEL_IN_RIGHT_PROCESSED</a>
int	<a href="#">CHANNEL_IN_STEREO</a>

#### [CAMCORDER](#)

Microphone audio source tuned for vic orientation as the camera if available.

#### [DEFAULT](#)

Default audio source \*

#### [MIC](#)

Microphone audio source

#### [REMOTE\\_SUBMIX](#)

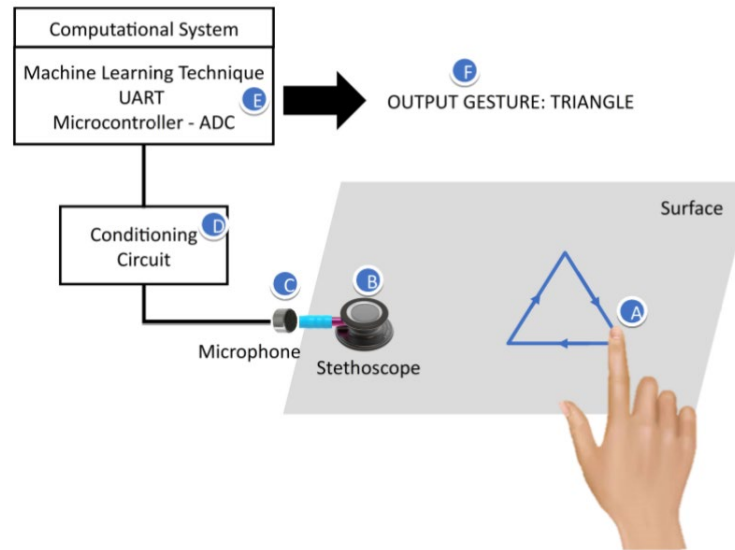
Audio source for a submix of audio str

#### [UNPROCESSED](#)

Microphone audio source tuned for un available, behaves like [DEFAULT](#) other

## ■ Tried

- In what format will the file extension be?



- Acoustic Sensing based on a Hidden Markov Model
- Luigi Rosa interface toolbox in MATLAB
  - WAV file for machine learning

## ■ Tried

- Which audio library to use?

### AudioRecord

---

```
public class AudioRecord
extends Object implements AudioRouting, MicrophoneDirection,
AudioRecordingMonitor
```

```
java.lang.Object
└─ android.media.AudioRecord
```

- PCM
- Can control audio buffer(Raw file)
- Less example codes
- HCI on the Table use this! (AudioRecorder?)

### MediaRecorder

---

```
public class MediaRecorder
extends Object implements AudioRouting, AudioRecordingMonitor,
MicrophoneDirection
```

```
java.lang.Object
└─ android.media.MediaRecorder
```

- AAC, AMR, MPEG, OGG, 3GP, WEBM
- Cannot control audio buffer
- More example codes

## ■ Tried

- Where to store the obtained data?
  - External Storage(SD card)
    - I need a lot of audio data.
    - Since I will conduct machine learning on the desktop, external storage is better.
  - Need more permissions
  - MediaStore!!
- Internal Storage(In app)

## ■ Tried

- Where to store the obtained data?

### MediaStore

---

```
public final class MediaStore  
extends Object
```

[java.lang.Object](#)

↳ [android.provider.MediaStore](#)

- Has changed since Android 10
- Need this to store in external storage
  - Direct access is deprecated
- Only MIDI, MPEG, WEBM, OGG, WAV
- Hard to access data in Android Studio

## ■ Tried

- Convert PCM to WAV
  - Bunch of code

```
writeString(output, "RIFF"); // chunk id
writeInt(output, 36 + rawData.length); // chunk size
writeString(output, "WAVE"); // format
writeString(output, "fmt "); // subchunk 1 id
writeInt(output, 16); // subchunk 1 size
writeShort(output, (short) 1); // audio format (1 = PCM)
writeShort(output, (short) 1); // number of channels
writeInt(output, 44100); // sample rate
writeInt(output, RECORDER_SAMPLERATE * 2); // byte rate
writeShort(output, (short) 2); // block align
writeShort(output, (short) 16); // bits per sample
writeString(output, "data"); // subchunk 2 id
writeInt(output, rawData.length); // subchunk 2 size
```



## ■ Tried

- Where to store the obtained data?

### MediaStore

---

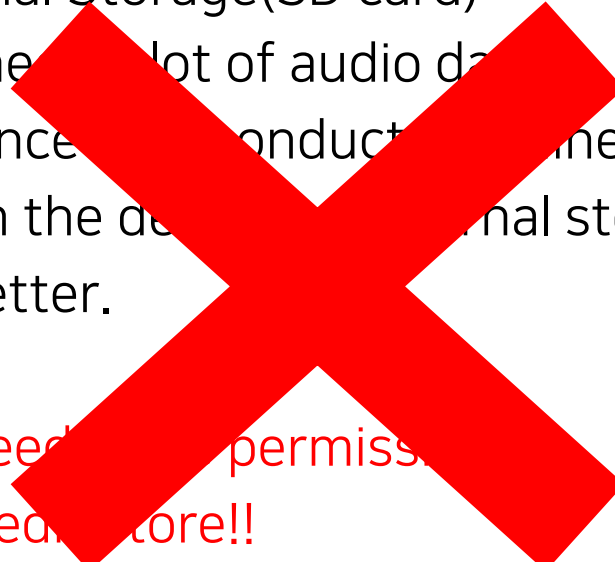
```
public final class MediaStore  
extends Object
```

[java.lang.Object](#)

↳ [android.provider.MediaStore](#)

- Has changed since Android 10
- Need this to store in external storage
  - Direct access is deprecated
- Only MIDI, MPEG, WEBM, OGG, WAV
- Hard to access data in  
Android Studio

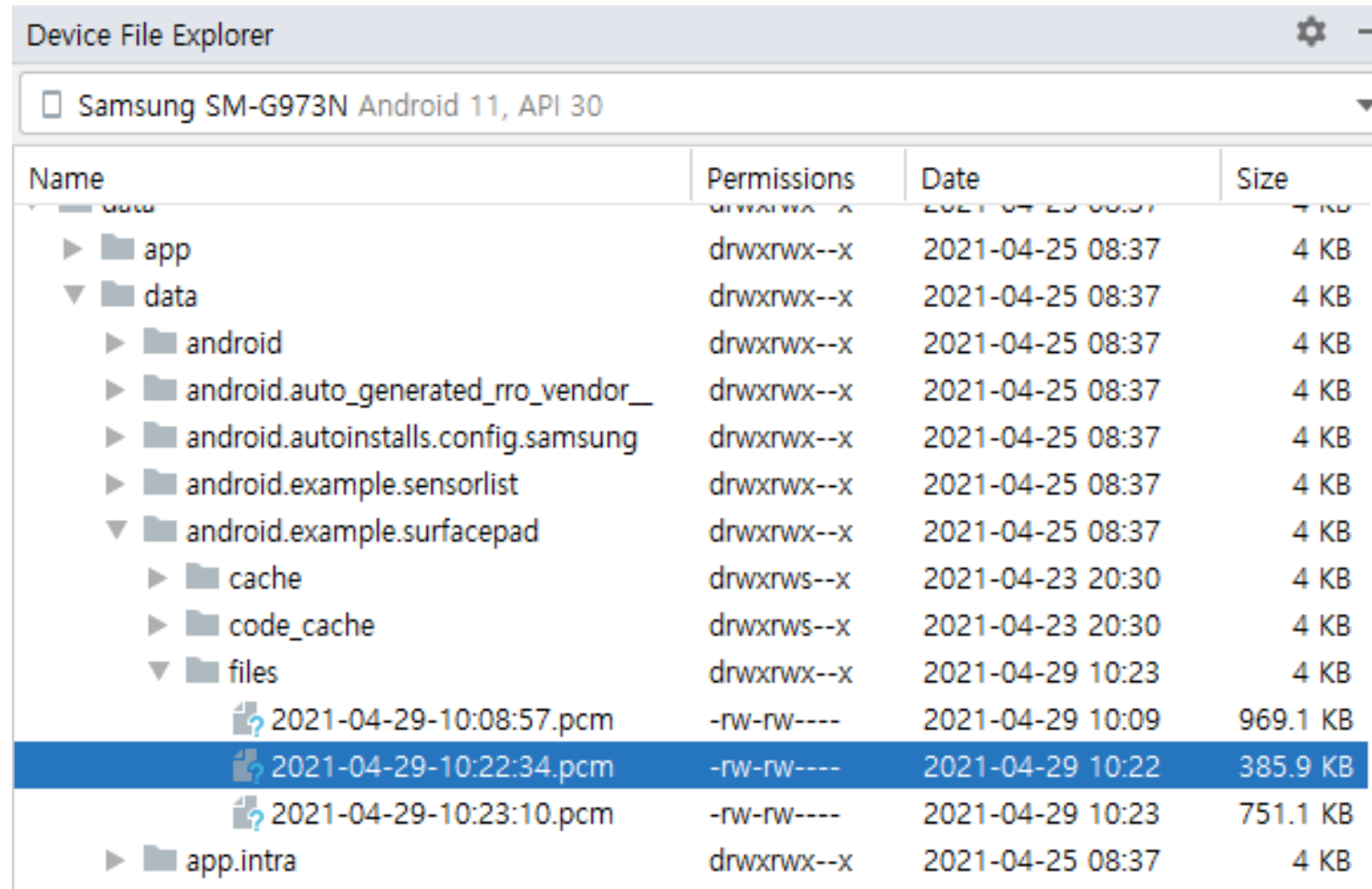
## ■ Tried

- Where to store the obtained data?
    - External Storage(SD card)
      - I need a lot of audio data
      - Since I conduct online learning on the device, external storage is better.
    - Need permissions
    - Media store!!
- 

- Internal Storage(In app)
  - No permissions
  - Hard to access from outside the app

## ■ Tried

- Internal Storage



Name	Permissions	Date	Size
data	drwxrwx--x	2021-04-25 08:37	4 KB
▶ app	drwxrwx--x	2021-04-25 08:37	4 KB
▼ data	drwxrwx--x	2021-04-25 08:37	4 KB
▶ android	drwxrwx--x	2021-04-25 08:37	4 KB
▶ android.auto_generated_rro_vendor_	drwxrwx--x	2021-04-25 08:37	4 KB
▶ android.autoinstalls.config.samsung	drwxrwx--x	2021-04-25 08:37	4 KB
▶ android.example.sensorlist	drwxrwx--x	2021-04-25 08:37	4 KB
▼ android.example.surfacepad	drwxrwx--x	2021-04-25 08:37	4 KB
▶ cache	drwxrws--x	2021-04-23 20:30	4 KB
▶ code_cache	drwxrws--x	2021-04-23 20:30	4 KB
▼ files	drwxrwx--x	2021-04-29 10:23	4 KB
2021-04-29-10:08:57.pcm	-rw-rw----	2021-04-29 10:09	969.1 KB
2021-04-29-10:22:34.pcm	-rw-rw----	2021-04-29 10:22	385.9 KB
2021-04-29-10:23:10.pcm	-rw-rw----	2021-04-29 10:23	751.1 KB
▶ app.intra	drwxrwx--x	2021-04-25 08:37	4 KB

## ■ Tried

- Convert PCM to WAV

```
jwkim0417@DESKTOP-E6HCJ10:/mnt/c/Users/HVR/Desktop/Ubuntu$ ffmpeg -f s16le -ar 44.1k -ac 2 -i 2021-04-23-06_55_32.pcm data.wav
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Output #0, wav, to 'data.wav':
  Metadata:
    ISFT                : Lavf58.29.100
    Stream #0:0: Audio: pcm_s16le ([1][0][0][0] / 0x0001), 44100 Hz, stereo, s16, 1411 kb/s
    Metadata:
      encoder           : Lavc58.54.100 pcm_s16le
size=   2354kB time=00:00:13.66 bitrate=1411.2kbits/s speed=1.85e+03x
video:0kB audio:2353kB subtitle:0kB other streams:0kB global headers:0kB muxing overhead: 0.003237%
```

■ Thank you