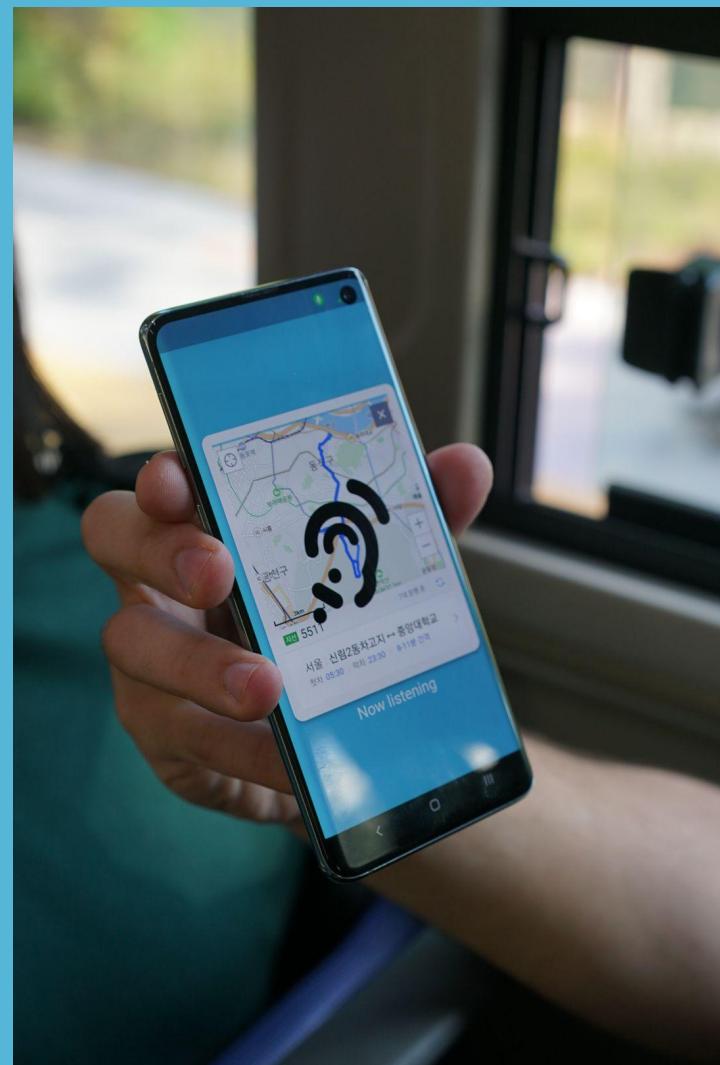


dSTOP: Arrival Alarm App

Presented by Team 9
Talibli Farid, Minhyo Jung, and Jisup Lee
Spring 2022, SNU CSE





Outline

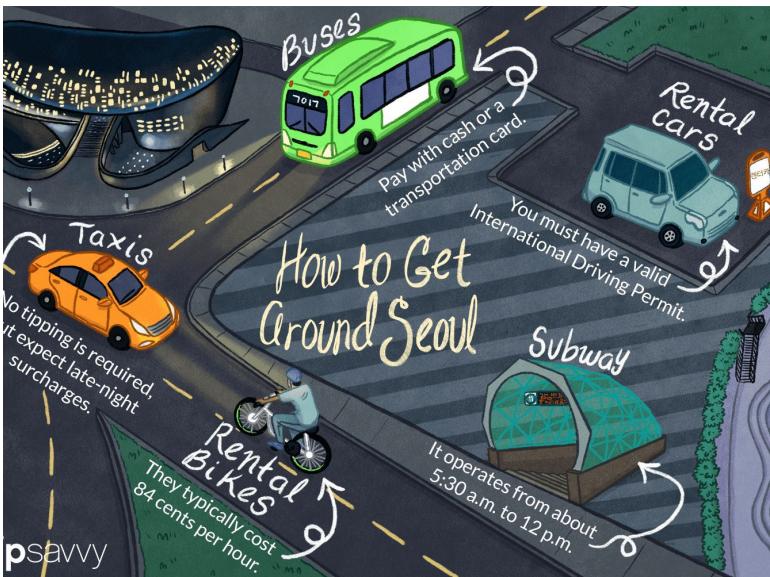
- Quick Recap
- Demonstration
- Technical Details
- Project Management
- Lessons Learnt and Reflections





Quick Recap

- **Motivation**
 - More reliable announce on arrival application to public transportation.
- **Proposed idea**
 - Smartphone application; destination alarm using multi-modal approach (location+sound).
- **Novelty**
 - Unique multi-modal approach to map application.
 - It will be extended to the future works: more sensors and techniques.
 - This may become a new feature of Map Apps.





Demonstration: Scenarios

- Recall the first day of SNU
 - Complex description toward the campus
- Okay! You get on the right bus **5511** for *the 2nd engineering building!*
- And then? Whether you may feel comfort or not?

Directions to CALS - Public Transportation

Subway

Get off at Seoul Nat'l Univ. Station (to come to CALS through the main gate) or Nakseongdae Station (to come to CALS through the rear gate) on Line #2. From those subway stations, it will take up to 35 minutes to reach Seoul National University on foot. A bus or a taxi is a convenient alternative to walking.

From Seoul Nat'l Univ. Station:

Exit the station through the Exit #3 and walk toward the Gwanak-gu Office until you reach the bus stop for the shuttle bus or city buses.

The shuttle buses run on two routes (to the Administration Building (Bldg.60) and to the 2nd Engineering Building) with separate bus stops. The buses do not stop between their destinations, and maintain different semester and vacation timetables. City buses run on circular routes: #5511 runs to the direction leading to College of Business Administration (Language Education Institute) and #5513 to the direction leading to CALS.

How to get to CALS

- Get off at Seoul Nat'l Univ. Station.
- Exit the station through Exit #3.
- Take the shuttle bus, city bus (#5511 or #5513) or a taxi.

Bus routes (the numbers represent the on-campus bus stop numbers):

- The shuttle bus to the Administration Building: Seoul Nat'l Univ. Station → Administration Building(4-1) → Seoul Nat'l Univ. Station
- The shuttle bus to the 2nd Engineering Building: Seoul Nat'l Univ. Station → the 2nd Engineering Building
- City bus #5511: runs on the circular route starting from the Seoul Nat'l Univ. Station → Main Gate → College of Business Administration(18) → Administration Building(4)
- City bus #5513: runs on the circular route starting from the Seoul Nat'l Univ. Station → Main Gate → Administration Building(4) → College of Business Administration(18)

From Nakseongdae Station on Subway Line #2:

Exit the station through Exit #4, walk straight until you come to a gas station, take a left turn at the gas station, and get on the local bus #02 at the bus stop in front of a bakery.

How to reach the campus:

- Get off at Nakseongdae Station.
- Exit the station through the Exit #4.
- Take local bus #02 or catch a taxi.

By Subway

Seoul Nat'l Univ. Station/3 to Exit theater

To get to the university, take Subway Line 2 to the Seoul National University station. After departing the station through exit 3, take bus 5511 or 5513. Get off at the Main Administration building or College of Engineering stop. (It takes about 25 minutes on foot from the subway station to the College of Engineering).

How to get to
campus

Get off at Seoul Nat'l Univ. Station → 3 to Exit theater → School Shuttle, City Bus(5511, 5513),
Taxi

By Bus

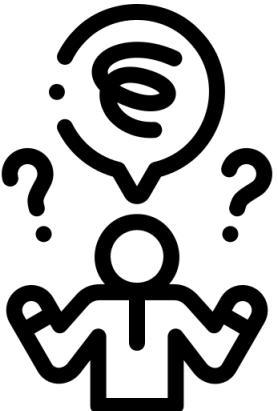
Shuttle Bus Info.

| Bus service route | Hours of operation | Location of bus stop |
|---|--------------------|---|
| SNU subway station Administration building, Gwanak campus | 07:00 ~ 18:30 | Campus bus stops in front of the administration building and at the subway station |
| Sillim-dong, Nokdu Street Administration building Gwanak campus | 07:00 ~ 18:30 | Leave through exit 3 and walk 100 m up Sillim-dong, Nokdu street to the 5516 bus terminal |



DM: Scenarios

- Maybe it's not.



Bus

The city buses that stop at the on-campus bus stops depart from Seoul Nat'l Univ. Station, Nakseongdae Station or Sillim Station.

At Seoul Nat'l Univ. Station:

Bus #5511: Buses #5511 and #5512 were combined into #5511 as of June 1, 2008.)
 Main Gate → College of Business Administration → Veterinary College, Graduate school of Public Health → Graduate School of International Studies → Gwanak Samgeori → National Center for Inter-University Research Facilities → Gene Engineering Research Center → Energy & Resource Research Center → Sinsojae → Institute of Construction and Environmental Engineering front → The 2nd Engineering Building → The 1st Engineering Building → Energy & Resource Research Center → College of Engineering - College of Agriculture and Life Sciences → Jayeondae, Administration Building → Cultural Center → Law School, College of Society → Main Gate

Bus #5513:
 Main Gate → Law School, College of Society → Jayeondae Administration Building → College of Agriculture and Life Sciences → College of Engineering → Sinsojae → Institute of Construction and Environmental Engineering front → The 2nd engineering building → The 1st engineering building → Gene engineering research center, Semiconductor joint research center → Professor clubhouse → Gwanak samgeori → Graduate School of International Studies → Veterinary College, Graduate School of Public Health → College of Business Administration → Main Gate

At Nakseongdae Station:

Gwanak #02 (Bus):
 Nakseongdae station → SNU back gate → Dormitory → Open-air auditorium → National center for Inter-University Research Facilities → Gene Engineering Research Center → Energy & Resource Research Center → Sinsojae → The 2nd Power plant → Institute of Construction and Environmental Engineering → The 2nd engineering building → The 1st engineering building → Gene Engineering Research Center → Professor clubhouse → Open-air auditorium → Gwanak Samgeori → Dormitory → SNU back gate → Nakseongdae station

At Sillim Station:

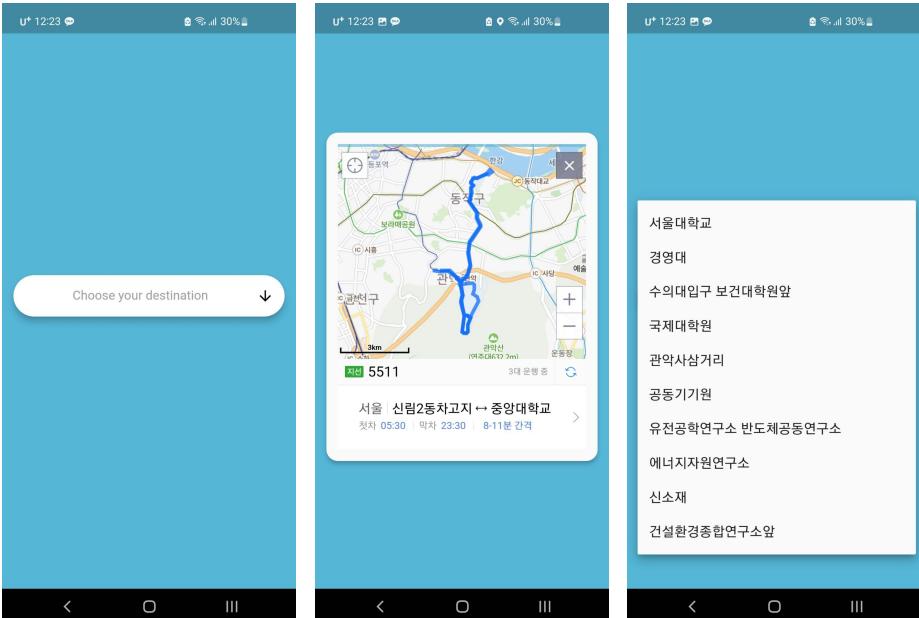
Bus #5516:
 Sillim Station → Main Gate → Law School, College of Society → Jayeondae, Administration Building → College of Agriculture and Life Sciences → College of Engineering → Sinsojae → Institute of Construction and Environmental Engineering front → The 2nd engineering building → The 1st Engineering building → Gene Engineering Research Center → Professor clubhouse → Gwanak Samgeori → Graduate School of International Studies → Veterinary college, Graduate School of Public Health → College of Business Economics → Main gate

※ Notes
 If the bus you are on does not go any further into the campus, get off the bus at the Main Gate and transfer to other buses that do so or to the on-campus shuttle bus, to reach the Administration Building, Engineering building, Dormitory, etc.
 For more detail on the routes and stops of each bus, please refer to the official bus route information website (<http://m.seoul.go.kr/lang/main/index.do>).



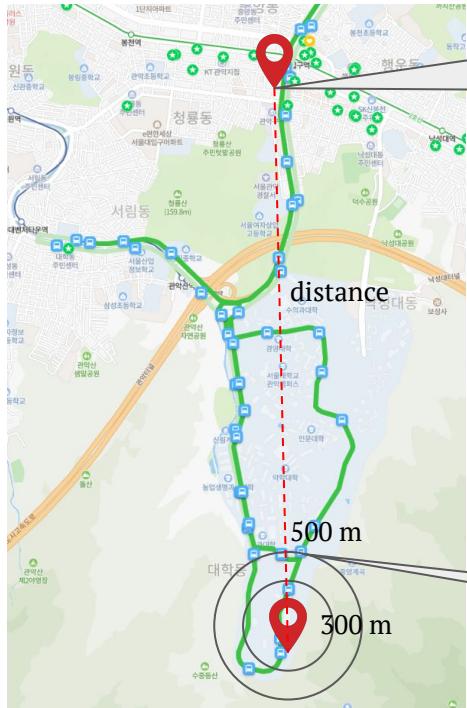
DM: Scenarios

- **dSTOP** can help you ‘lie back’ on the seat.
- When destination is entered, it notifies you when arrival.
- Based on the location and the bus announcement.

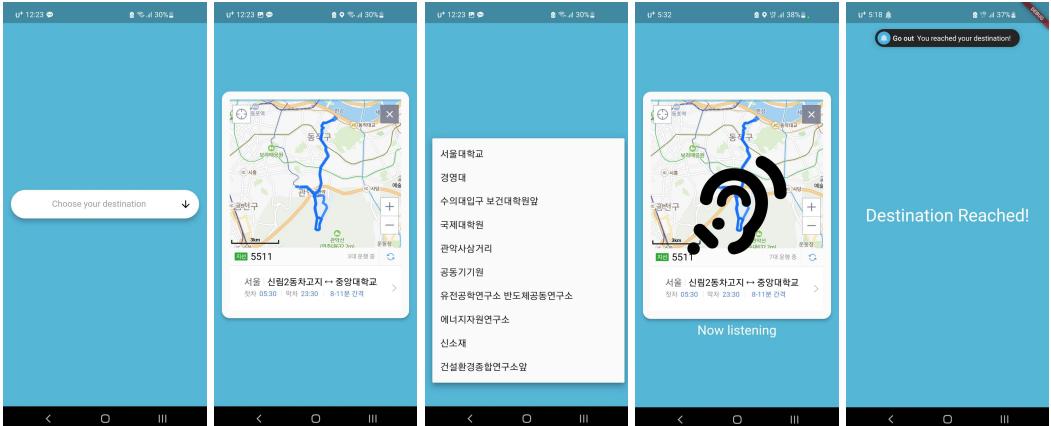




DM: Scenarios



- User enters **destination**
- System log start GPS location
- Keep calculating the distance along the way



- 500m Speech Recognition activated
- 300m Soft notification
- When stop name is caught, alarm pushes user.



DM: Our Techniques



- Tracking Geolocation
 - GPS Sensor and Naver Map
- Announcement (speech) Recognition
 - Triggering by the distance between the destination and current location. (Effective)
 - The bus announces within 300m before the stop. (based on our experimentation)
 - Assumes 40km/h speed, speech recognition activated within 1 min.
 - Recognizing “*regular expression*” of the announcement (Robust)
 - Focusing also on the announcement “This stop is” with the specific stop names
 - Wildcard characters (*) are used to detect names. (smoothes error)
 - Google speech API



DM: Our Techniques

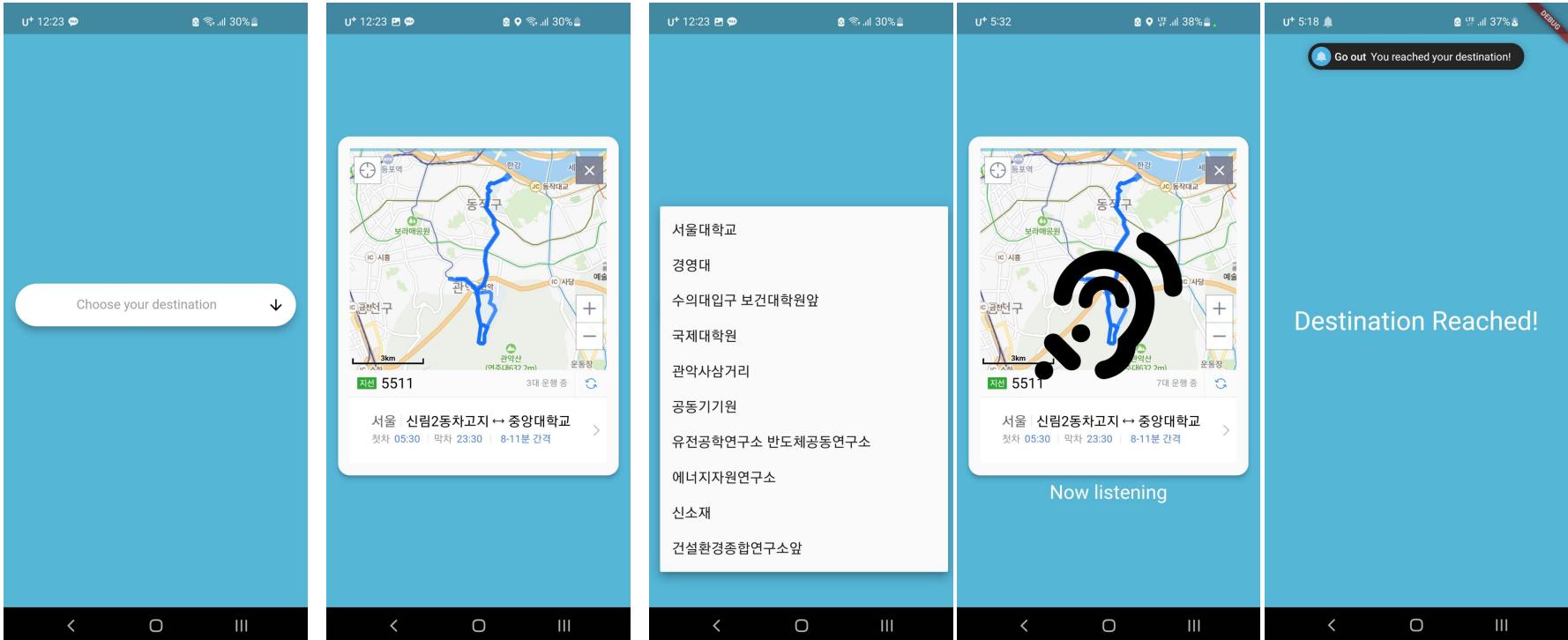
- Distance Calculation
 - Haversine Formula. Rather precise at short distance.
 - The distance become smaller than threshold (500m - empirical number)





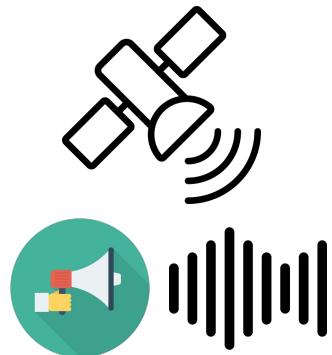
DM: Demo

- Demo video

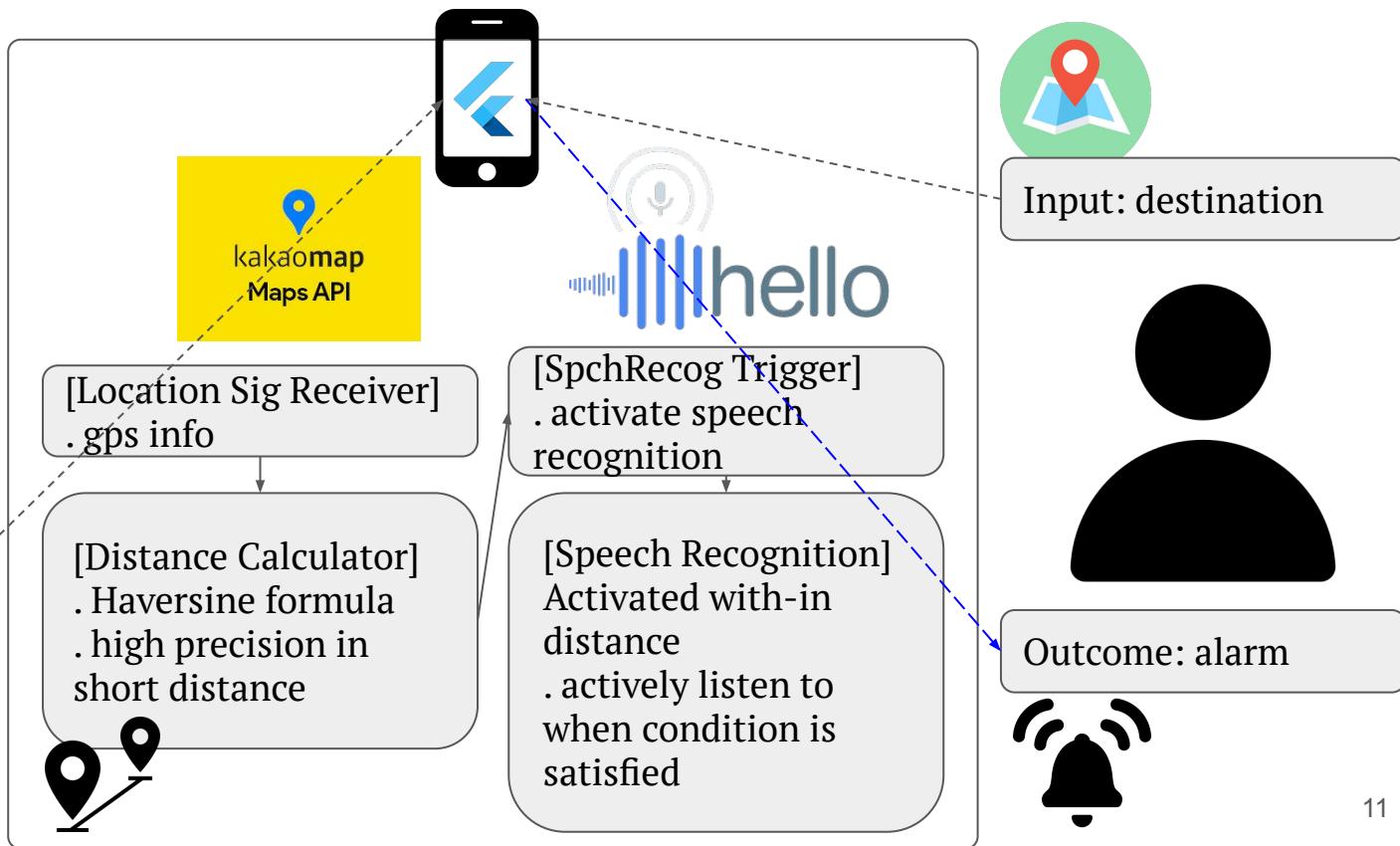




Technical Details: System Architecture Overview



Pervasive inputs
. GPS signal
. Sound (announcement)





TD: Challenges

- Underlying stuffs in the term “multi-modal”
 - Difficulties to develop each function similarly
 - Integration between various modes
 - Hard to build the inertial functions from scratch
- Difficulties in real-world condition
 - Noises / Hard to catch the speech
- Data gathering
 - Bus stops (name, coordinates)





TD: Solution Approaches

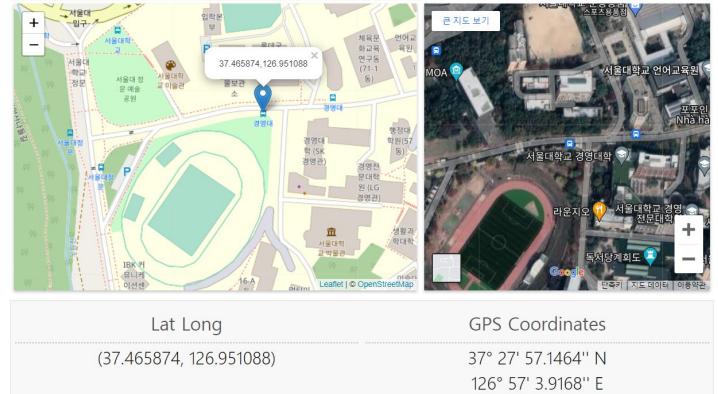
- Focusing on two modes; location and speech recognition.
 - Both are provided APIs with powerful supports.
 - Integrating them with our techniques. (Distance Calculation-thresholding)

- Scenario Refinement

- Only listening the specific situations when the announcement sound is expected.
- On the road public transportation.
- Use regular expression and wildcard character.

- Data Acquisition

- Gather stop info with narrowed-down scenario.
- Latitude/Longitude by <https://www.latlong.net/>





TD: Evaluation and Final Deliverable

- Evaluation results
 - In-lab test (data source: youtube - similar to the real)
 - SR accuracy: ~70%
 - Similar to the real (Noise from bus and people's talk)
 - Real-world test (We were on the 🚍!)
 - SR accuracy: ~60% (SR+GPS: almost 100%)
 - Taking on 5511 with less crowd.
 - Latency: almost respond in real time
 - There's a delay between server and device but user may not notice the delay (10+ secs).
- Final deliverable and success criteria
 - Smartphone application
 - This can push a notification when you arrive at the destination naturally(!).





PM: Stats and Schedule



- Our progress is shown in left figure through git stats.(clear two peaks 😂)
- Ideation - mid march
- Proof of Concept - april~may
- Early June - Implementation and Validation



PM: Roles and Contributions

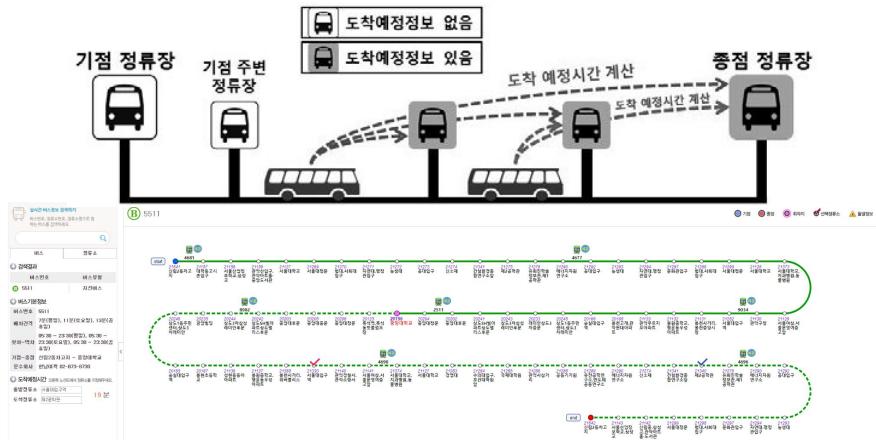
- Farid
 - Investigated and choose suitable frameworks and libraries
 - Designed the application logic and planned implementation
 - Studies speech recognition and location libraries
 - Created application context management controllers
 - Implemented the application
- Minhyo
 - Manage whole project (Distribute tasks, arrange schedule)
 - Design User eXperience and UI also
 - Studies on the inertial sensors and gathers raw data
 - Data processing - match the bus stop names and its coordinates (KOR/EN)
- Jisup
 - Studies on location library
 - Manage schedule





Lessons Learnt and Reflections

- Consider other established approach (e.g. Bus Information System)
- Importance of fast iteration between development and validation of idea.
- Naive idea will not work with real-world testing sometimes.
- More process of validation will help the idea.





Thank you!

- Q&A

