Project Report

Accessibility solution for wheelchair users for the bus transit system in Israel

B.Des P1 Project • Tarun Mugunthan • 16U130001

Acknowledgements

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This was a group project with group members Lior Volovnik, Eden Elias and Maor who were engineering undergraduate students at HIT. Without their help to overcome the language barriers for user studies, this project and its insights would not have been possible. They provided their technical expertise and have taken up the task of pushing out the proof of concept of this product to pitch it to relevant companies. I thank them for their attempts to make this project a reality.

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Introduction to Project

The project was done as part of a course I did at Holon Institute of Technology(HIT, Israel). It was a group project where my role was to design the solution which would be followed up with prototyping/deployment by the rest of my team mates who were engineering students. The duration of the project was 2 months with weekly progress meetings in between.


Buses and stops in Israel

The brief given to us was broad; to give a proposition to improve quality of life of citizens of Tel Aviv in a defined context and provide a completely detailed out solution with a prototype. We had freedom to choose any context we wished to work with. Through brainstorming, we came up with several ideas out of which we picked the idea of improving wheelchair user experience and accessibility of the public bus transit system in Israel.

Preliminary Knowledge and Reading

The first thing that we did was to understand the how the bus system in Israel accounted for the special needs of wheelchair users. Having been regular users of buses there, we all knew most of the information about the infrastructure present
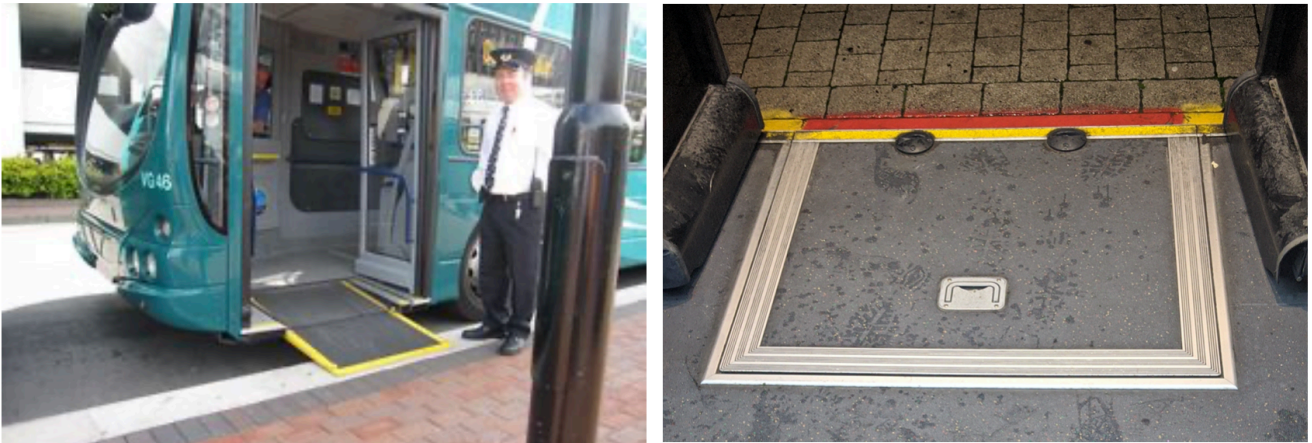
Automatic Ramp and Manual Ramp in Buses

in the bus. All city buses are equipped with manual or automatic ramps which are deployed by the driver either by hand or by a button press when a wheelchair user needs to get on the bus. The ramp is 2ft wide and sticks out around 1 ft from the bus when extended. Wheelchair users have a specific place reserved in the bus for them. There is a backrest which provides support from the back and a seatbelt attached to it to secure the wheelchair and the user to the backrest. This keeps the wheelchair from moving when the bus is in motion. There are stop buttons all throughout the bus which passengers can press to signal the driver to stop at the
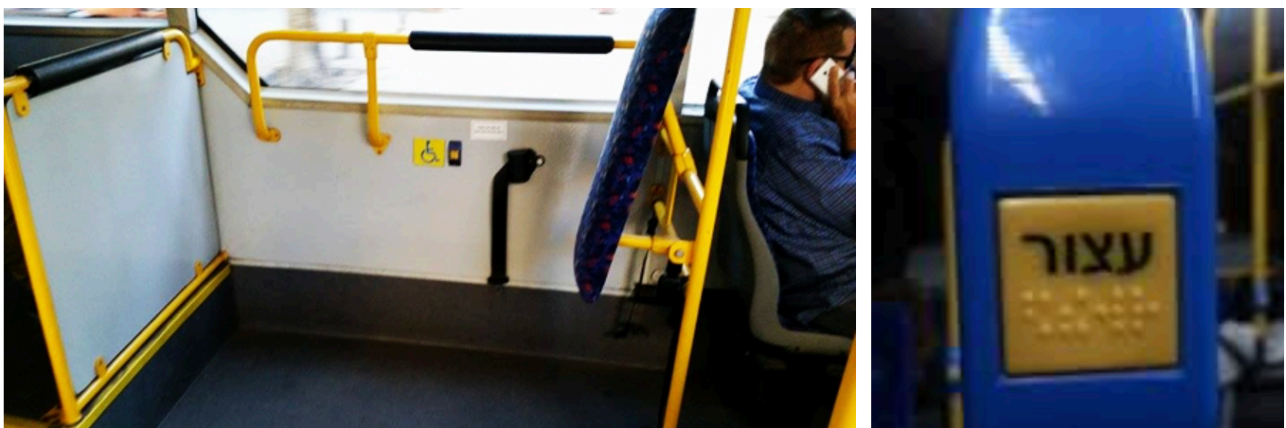
Special wheelchair spot with stop button like the on right

next stop. Such a button is also placed at the wheelchair spot. All of these features were used regularly but had issues associated with them as we found out later.

The second part was digging deeper into the measures which exist to support wheelchair users. We looked up the rules related to the same and found a code of conduct for drivers on a government website (kolzchut.org.il). Instructions pertaining to wheelchair accessibility are as follows:

- The driver must get as close as possible to the bus stop.
- The driver must be responsible for operating the automatic/manual ramp to allow someone in a wheelchair to board or exit the bus.
- The driver must open the ramp at the bus stop in order to allow the wheelchair onto the bus.
- The driver must secure a wheelchair after loading with the back of the wheelchair facing the direction the bus is moving.

In another government report(people with disabilities, facts and figures, justice.gov.il), we found that rules like the ones mentioned above were not strictly followed all the time. It said:

"Israel has laws and regulations regarding construction and planning, which mandate easy access to public facilities for people with disabilities. However, these laws are not sufficiently enforced7 and people with disabilities find that they are unable to access public places, commercial facilities, and even some of the structures where they are supposed to receive services."

The real extent of how well the support structure worked in real life could only be found out through doing our own user research.

User Study

Observed User

We had limited number of subjects to gather information from since we did not know many wheelchair users. One of my teammates had a neighbour who was in a wheelchair, another teammate had a co-passenger in a wheelchair in her daily bus. Given the time constraints and my lack of knowledge of Hebrew to guide the interviews, we treated them as informal conversations where we asked them questions and heard their experiences. Following this, I came across a wheelchair user on the bus who I observed throughout the duration of the ride. A summary of our findings follows:

Findings:

- From both personal experiences and the narratives of the people we spoke to, we know that buses often stop considerably far from the bus stop in terms of lateral distance. This happens because the buses in Israel almost always run behind schedule and drivers try to cut down on time by not pulling up close to the station.

Buses stopping almost over 6-7 ft away from sidewalk

- This causes a problem. When the bus does not come close to the stop the ramp cannot reach the sidewalk. Getting off the sidewalk, onto the road is very difficult for a wheelchair user on their own as it is 6-7 inches high. Hence it is essential that the bus pulls up close to the sidewalk before deploying the ramp.
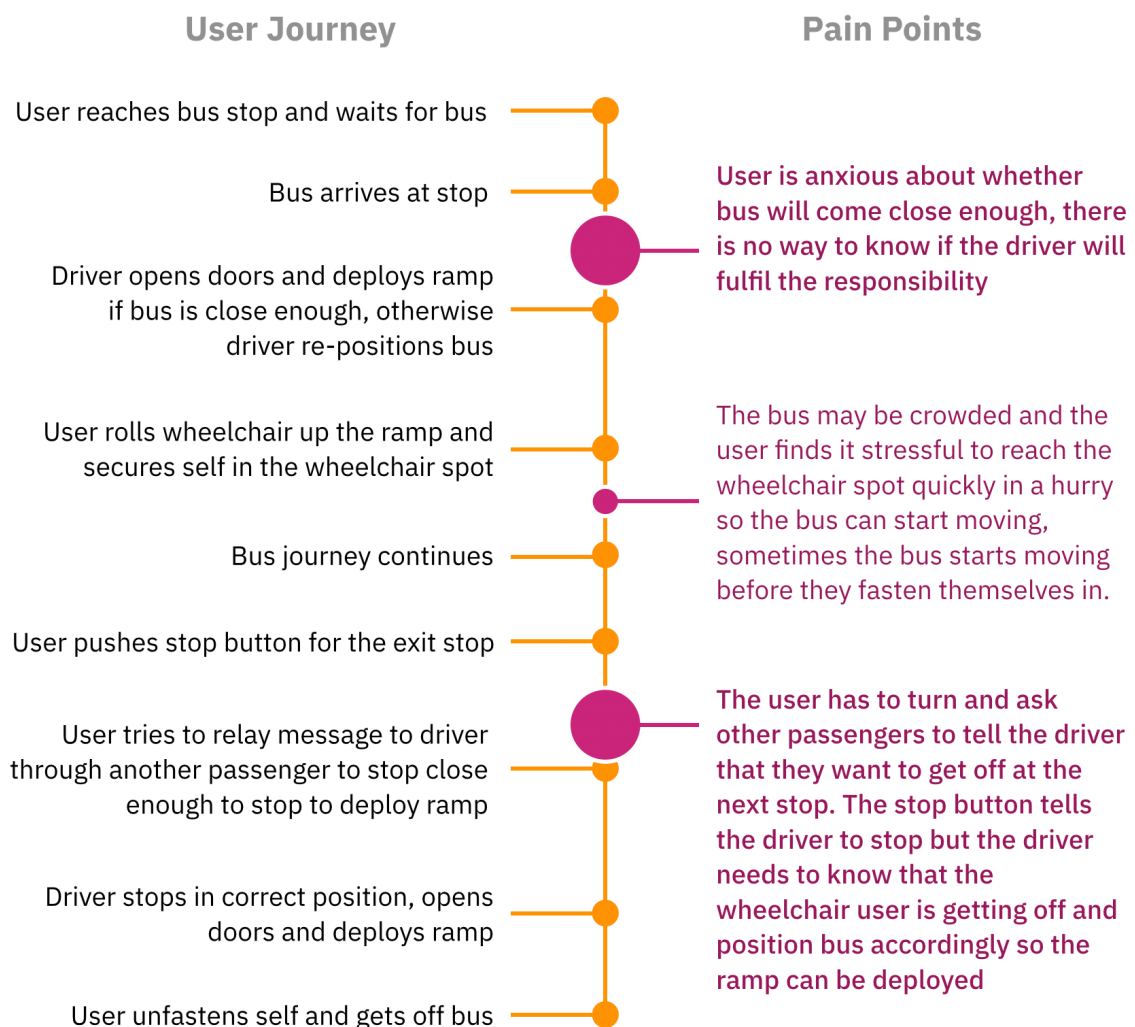

6 inch high sidewalk

- When a wheelchair user waits at the bus stop for a bus, the bus driver may or may not spot the user depending on the crowd at the stop, his focus on the road and his hurry to quickly move on from the stop. This means that bus drivers often don't pull up close to the stops to cater to the wheelchair users.
- The interviewees said that while waiting for the bus, the question of whether the bus will come close enough usually is on their mind. They sometimes ask other people at the stop to signal to the driver to pull up close. This is their main source of stress when using the bus service. If the bus does not approach the bus stop in the proper manner, the driver usually has to reposition the bus which either takes extra time or further displaces the bus parallelly.
- Usually after the ramp has been deployed the users roll their chairs into their bus themselves. On asking if they get assistance from people around, the interviewees said even if they do, they prefer to move themselves.
- The users then go straight to the wheelchair spot. This spot is approximately 6ft from the door of the bus where they get in from. The place also happens to be the only large open space in the bus. This means that people are usually are standing there. One of the interviewees said that he sometimes faced trouble in getting to the spot through the crowd of people and securing himself with the seatbelt before the bus started moving. This problem was faced only in buses with automatic ramps as the deploying and retracting process is so quick that the driver can start moving before the person has had time to secure himself in the

wheelchair spot. On asking about the frequency he said it happens rarely and is not a major issue according to him.

- The other major source of stress for wheelchair users was when they had to get off the bus. The usual process for a normal passenger is to press the stop button before arriving at the stop they want to get off at. There is similar button in the bus at the wheelchair spot which can be used. This however does not do enough because the same problem of the bus needing to pull up close to the sidewalk when the user needs to get off using the ramp.

- When the interviewees needed to get off the bus, they would either try to call the driver by yelling or by telling another passenger to do the same. They would communicate to the driver that they want to get off at the next stop so that he positions the bus correctly. When asked how often they did this, they said they had to do this almost all the time just to completely ensure that the driver knew when to pull up close to the bus stop. When I was observing a wheelchair user in the bus, she asked me to relay the information to the driver.

- They also mentioned that when they were in the bus, the driver pull up close to every subsequent station on the off chance that they would get off there. This is meant to be the ideal practice for drivers but it forces them to take time with each stop leaving no room to take shortcuts.

Analysis and Defining Problem

After compiling all our findings, we could clearly see that the single problem lied in the fact that drivers do not always come close enough to the sidewalk to effectively deploy the ramp. This stems from a fundamental lack of information for the driver about which times he/she has to do that. While a driver ideally should pull up close to every station, this practice is clearly not preferred by the drivers. They also get away with it because most people do not mind going the few extra steps to get on the bus. This evolved social practice however leaves wheelchair users at a disadvantage. Drivers are willing to pull up closer when they find out that a wheelchair user is at the station but they don't explicitly look for them. This is logical given that its a relative rarity.

User Journey

Pain Points

User reaches bus stop and waits for bus

Bus arrives at stop

User is anxious about whether bus will come close enough, there is no way to know if the driver will fulfil the responsibility

Driver opens doors and deploys ramp if bus is close enough, otherwise driver re-positions bus

User rolls wheelchair up the ramp and secures self in the wheelchair spot

The bus may be crowded and the user finds it stressful to reach the wheelchair spot quickly in a hurry so the bus can start moving, sometimes the bus starts moving before they fasten themselves in.

Bus journey continues

User pushes stop button for the exit stop

User tries to relay message to driver through another passenger to stop close enough to stop to deploy ramp

The user has to turn and ask other passengers to tell the driver that they want to get off at the next stop. The stop button tells the driver to stop but the driver needs to know that the wheelchair user is getting off and position bus accordingly so the ramp can be deployed

Driver stops in correct position, opens doors and deploys ramp

User unfastens self and gets off bus

We defined the problem statement as this:

"We need a way to let the driver know at which stops he/she has to pull up close to deploy the ramp for a wheelchair user"

Please note that there are obvious infrastructure based solutions like a sloped sidewalk at the bus stop, a longer ramp, different shape of bus stop etc. We chose to acknowledge but not pursue these paths because changing public infrastructure at scale is usually a tedious, capital intensive, less feasible solution. We thought thinking of this as the information based problem, which it came out to be through our interviews, was a valid approach and sit well with how the existing system works without requiring major infrastructural changes.
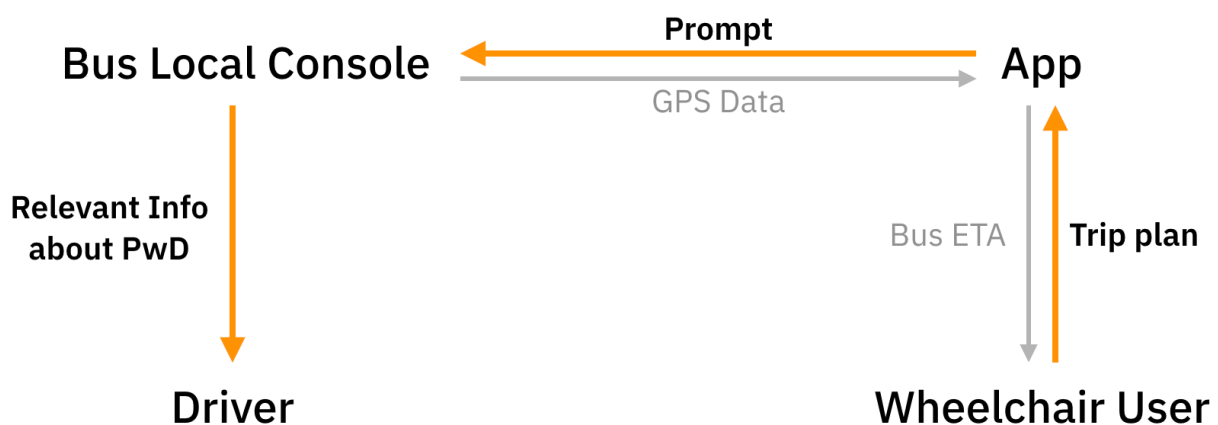
The Solution

The solution we came up with was a system based intervention with an app based component which I designed. There were also some modifications to the existing driver's console on the bus. The solution builds on top of existing infrastructure

Bus Local Console ——— GPS Data ———→ **App**

App ↓ Bus ETA ↓ **User**
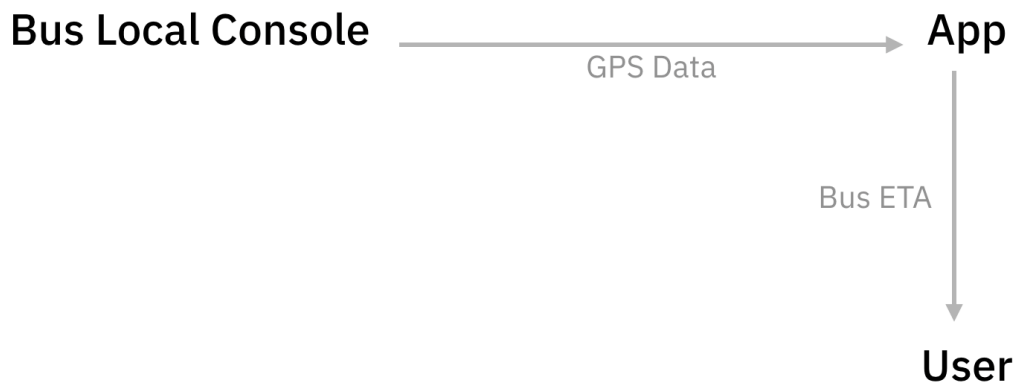
Existing Infrastructure

which is used to convey bus ETAs to transit apps. There exists a one-way connection from the bus GPS in the driver's console to the apps which is used to calculate wait times for arriving buses. We propose a two way connection between the app and the driver's console with the user getting bus ETAs as usual on one end and on the other end, the driver getting prompts to approach bus stops correctly if a wheelchair user wants to get on or off.

Bus Local Console ←— **Prompt** — **App**
GPS Data ———→

Relevant Info about PwD ↓

Trip plan / Bus ETA

**Driver**   **Wheelchair User**

How the solution fits

The user registers onto the app as a wheelchair user. The app is used by the wheelchair user to plan trips for commute. It works with both pre-planned and spontaneous trips. The details of the trip i.e. where the user is getting on and off are sent by the app to the driver's console which displays an icon with the stop signal for the driver. This icon shows whether at the coming stop a wheelchair user is waiting to get on the bus or if a wheelchair user on the bus is going to get off. This simple intervention gives the required information to the driver in a place it is required at the right time to pull up close and deploy the ramp.
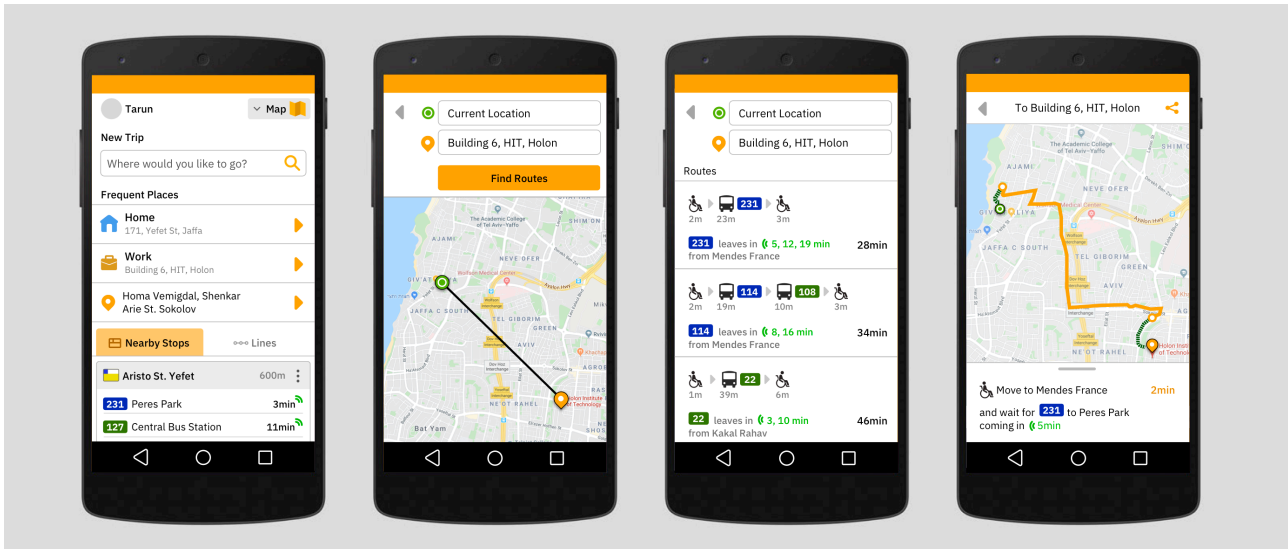
The App

The design of the app was based on another transit app called Moovit. There were subtle differences in the UI elements but largely a standard user flow. The difference is seen in the back end connection of the app to the driver's console. The onboarding will be done only once in the beginning with the user entering basic information about themselves.
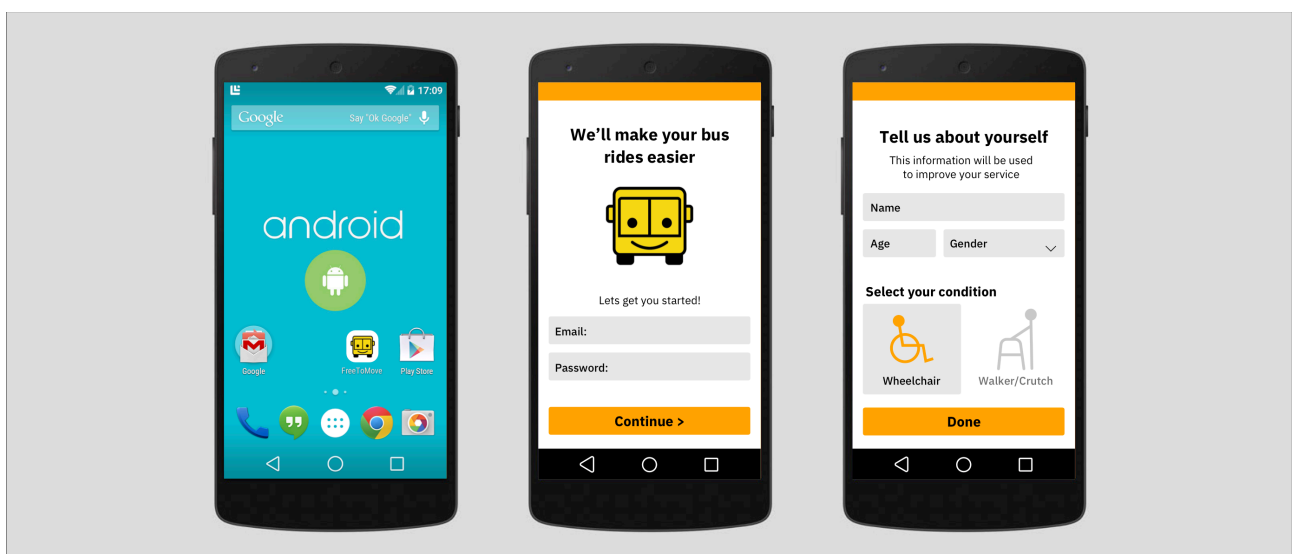

On-boarding

The app will have a standard trip planning flow. The basic design decisions were based off of other trip planning apps like Google maps and Moovit which people are familiar with. However a few tweaks were required like having Wheelchair Symbols instead of walking symbols and accounting for the wheelchair travel speed. When the trip is planned the information will automatically be relayed to the driver console as per the details of the trip.

Trip planning

There is another, more common scenario where trips are not planned beforehand. This is what is done when it comes to day to day commute. People just go to their regular stops and wait for the bus. If this is the case then the app uses your location to determine if you're waiting at a station and sends you a push notification with the incoming buses. After selecting the right bus, select where you want to get off and you are set to go. The selection of where to get off can be pre-made based on your frequent trips.
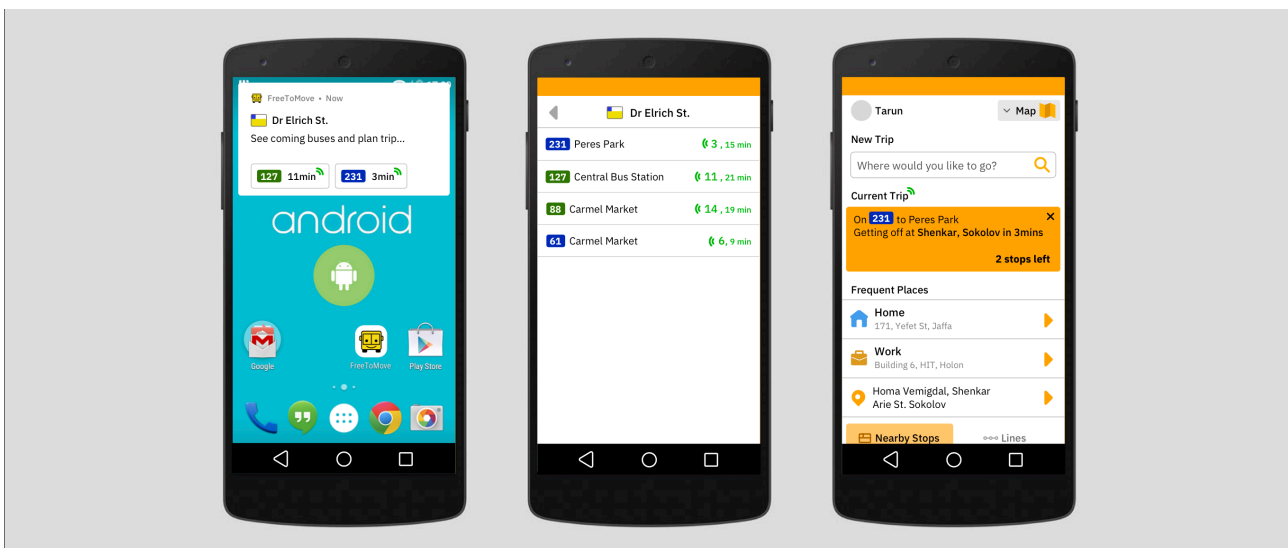
Spontaneous trip setting with push notification

The Driver's Console

The driver's console is used by the driver to look at information in the bus including if he needs to stop at the next stop for someone to get off. This is where we feed the information about the need of a wheelchair user to the driver.

Notification showing on driver's console that wheelchair user is getting on at next stop

The information appears as symbols indicating whether at the next stop a wheelchair user is getting on or off.

Symbols showing wheelchair user getting on or off at next stop

Conclusion and Further Work

This is a simple but logically effective mechanism which interferes minimally with existing practices. It is for this reason that we feel it is valid to consider this a serious solution to the problem at hand. The app itself can be any transit app with the additional data of the user being in a wheelchair and a back end connection to the bus. It can also be scaled to include other populations in need of such an intervention like elderly with walkers, pram pushers etc.

The goal is to introduce this as a systemic solution to private bus companies who operate in Israel. The course itself was thought of as a nursery for valid real world solutions which can be pushed out by the Start-up Cell of HIT. The UI designed will be used to develop a proof of concept by my team. This can be used to pitch the idea to companies looking to improve their service for wheelchair users.

References

https://www.kolzchut.org.il/en/
Accessibility_for_People_with_Disabilities_on_Buses
https://www.justice.gov.il/Units/NetzivutShivyon/sitedocs/jointeng03.pdf
https://www.egged.co.il/Article-9720-Accessibility.aspx