Design Thinking Final Report 06.02.2024
Simone Leitner
Margot Lechner
Deepa Mohandas

Travel Time Tip:
Design Process of a Smart Glove

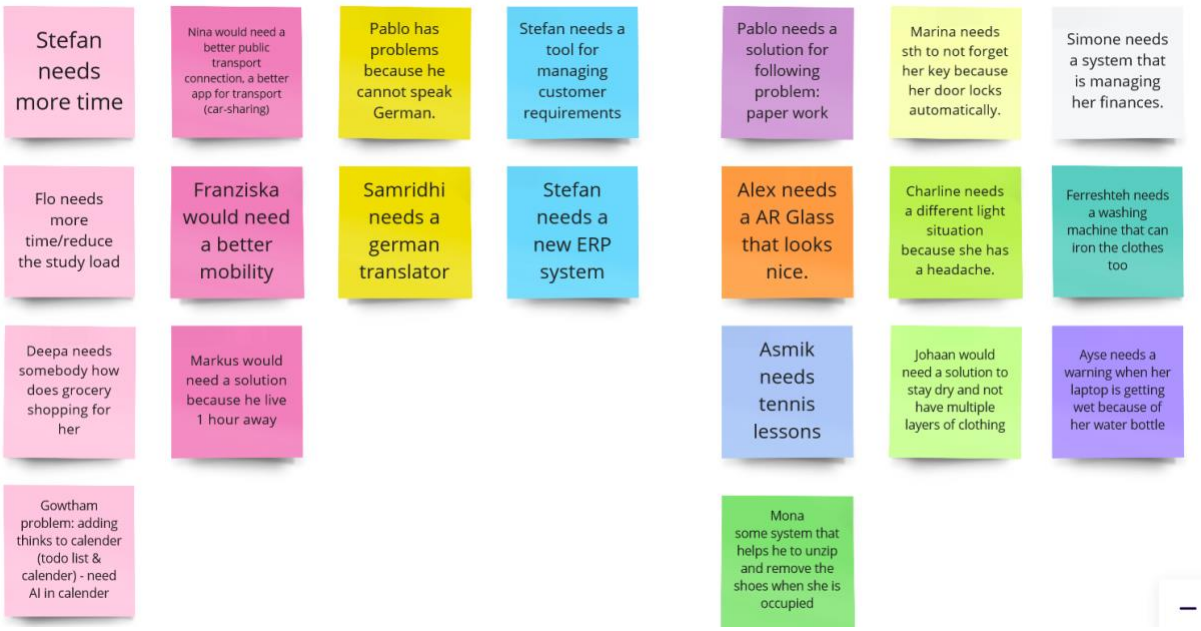
1. Empathise

Need statements

As the first step for the Design Thinking Process we started by finding needs of different people. We did that by going through the University of Applied Sciences in Salzburg, asking random people if they face any problems in their private, institutional or working life or if they have anything in mind that they would need to improve their lives.

We then collected all the needs as post-its, sorted and grouped them. The needs concerned various topics, from public transport to time management to language problems and more.

We decided to focus on mobility and public transport, because it had several sticky notes for the theme, it is something that our group all uses, and is environmentally friendly.



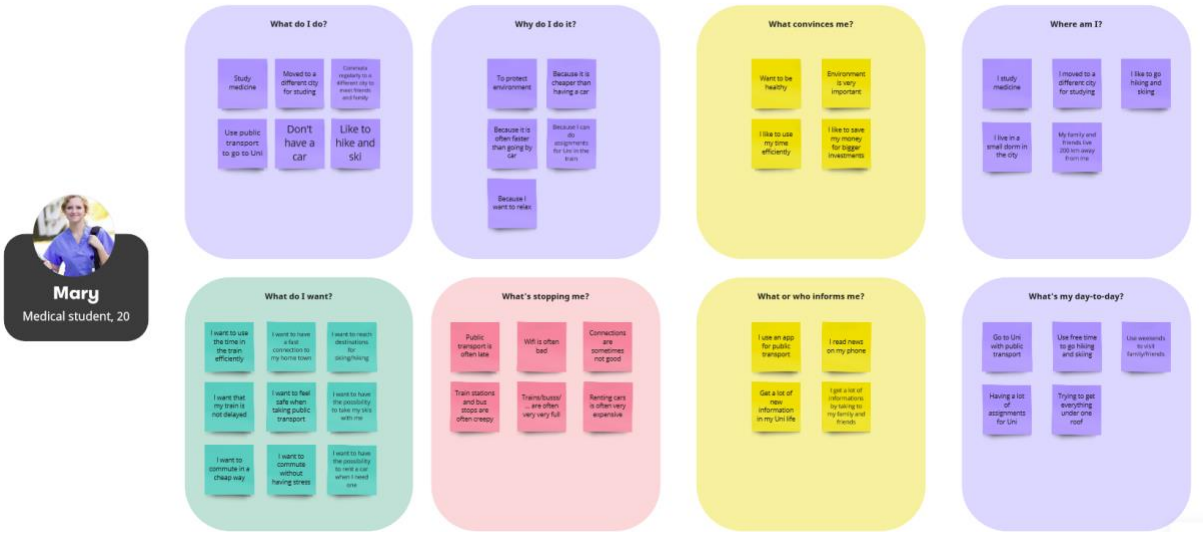
Empathy Map

Moving on, we created an Empathy Map with a fictional user “Alex”. The Empathy Map was focused on themes/problems Alex associated with public transit and mobility. After brainstorming we filled in the four fields of the Map (Thinks, Does, Feels, Says) with the different aspects that we came up with and also with the aspects that we collected in the Needs statements. The aspects concerned accessibility topics, some which can only be influenced by train companies and also small private aspects like food and luggage.

Using the Empathy map, we gained a deeper connection to our user “Alex”. We began to uncover themes of accessibility, comfort, and the emotional differences between catching a train and missing a train. Working progressively through each section in a structure of “says” > “thinks” > “does” > “feels” helped us gain a richer understanding of how our user Alex “feels”. This exploration revealed a contrast between feeling calm/relaxed sitting on a train and knowing what services are available, versus feeling worried/anxious not knowing if you would miss a train, or the lack of accommodation for user necessities (i.e. stroller or wheelchair). Considering the Empathy Map, we knew we wanted to delve deeper into themes of accessibility, and how information (relevant, up-to-date, clear and accessible) can affect different people’s use of public transit.

Personas

With the Empathy Map completed, we proceeded to the next step of creating Personas. Given our previous work, we decided to create personas using different needs of how/why the person uses public transit. The first persona is a student commuting with public transport. The second one is a parent using public transport to commute and sometimes with their child, and the third persona is an elderly person with disabilities. Completing the Personas helped really bring our ‘users’ to life. For our project specifically we gained a lot of insights about their hindrances, what informs them and the contextual realities they live in.



Personas Continued

2. Define

After the Empathise phase, we continued to the Define phase. The goal for this phase was to keep all the insights gained from the Empathise phase and create a problem statement. This problem statement should also be specific, measurable, achievable, relevant and time-bound.

During this phase we discussed our insights and tried to use empathy to further define what impact specifically we wanted to focus on. i.e. we discussed how it felt to sit outside at the bus stop in the rain, or if you have a stroller and aren't sure how full the bus will be/if there will be space for you. Elements like context, comfort and information continued to come-up, and we tried to make them more cohesive and concise. At the same time we were having a hard time letting go of accessibility and trying to make sure to include users who might not fit a 'typical public transit user'. Therefore we made the problem statement broader and chose to focus on how information affects comfort and convenience for all users of public transit.

The problem statement that we developed is the following:

“The lack of information about public transit (i.e wheelchair users needing to know a train has a handicapped accessible toilet) and while riding public transit (i.e. a passenger within the train needing to know about potential connection delays) can make it inconvenient and uncomfortable for users of public transportation. Data analytics can measure relevant transit statistics, and user opinions will gauge convenience and comfort factors. Impact should be visible after the product enters the market.”

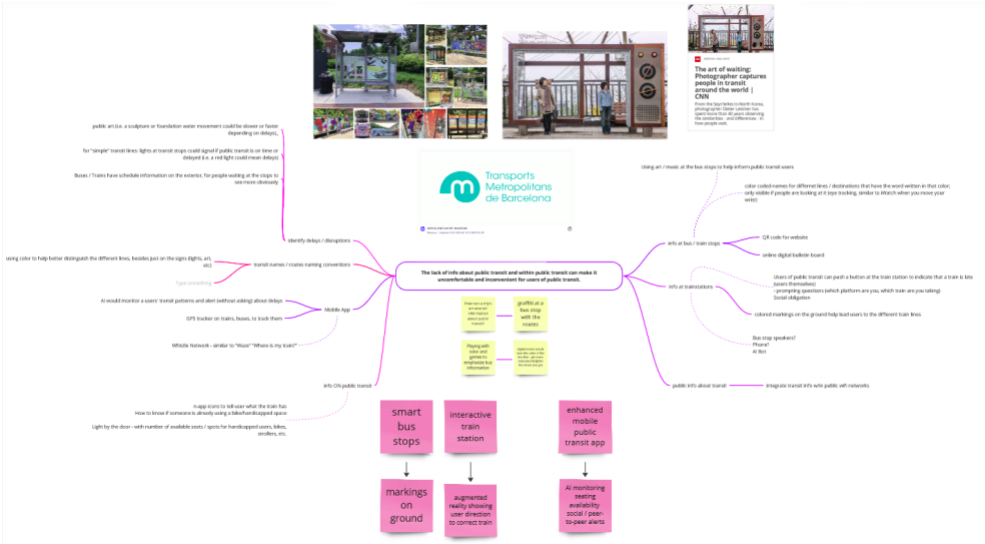
3. Ideation

Once we agreed on a specific problem, we continued with ideating solutions. For the ideation phase, we had good discussions about how people get information in their environments (i.e. city maps, train station announcements). We investigated what was already out there: mobility Apps or cities we personally found had usable transit systems. Additionally we played with the “How might we” strategy and tried to push ourselves away from logical thinking, including using the opposites scenario. Afterwards we tried using ChatGPT, which helped widen our perspective and to think outside the box (i.e. suggestion for a type of music that plays from a bus stop, only if a train is late).

Our ideas ranged from extension of mobile apps to bus stops using art and music. We narrowed down our ideas and picked our three favorites:

- **Smart Bus Stops**: Bus stops should have visual and audio indication if the bus is delayed or not. This can also be combined with some form of art. The use case of this idea is that users see from a far distance if their bus is coming on time or not.
- **Interactive Train Stations**: We thought of extensions for train stations, for example AR mapping that is showing the path to the next platform in case on a train switch. Another idea was a button that enables the user to replay audio announcements at the train station, in case they didn’t hear them.
- **Wearable:** Something a person wears that enhances public transit apps. We wanted to make some kind of extension for a public transit app that is wearable and helps using the app, especially when the user is on the move.

After presenting to our classmates, we realized our ideas were too broad and feasibility might not be possible (considering timeframe and resources). We decided to pivot from more contextual ideas to user wearables. The original wearable idea was a bracelet of sorts that could tell us if a train was on-time or delayed, but this was very similar to a smartwatch. Then the idea came from our own winter environment to create smart gloves that are able to display the departure time and the platform of the next train. There would also be an audio function that enables users to listen to the departure time and platform. Furthermore, color coding of the displayed information would indicate, if the train/bus is on time or delayed. The gloves would work in combination with a mobile app, where users could enter the connection they want and it would automatically synchronize onto the gloves interface.



4. Prototyping

In the next phase we started to prototype our idea, in order to be able to test it later on. We started with our low fidelity prototype by sketching and imagining our idea. Afterwards we continued with a paper prototype, which included our ideas for functionalities.

Following the creation of the paper prototype we moved on to using a real glove from one of our group members. We then created interface elements made out of paper (train time and train track number) and attached them to the glove using velcro. This simulated how the displays would change based on a train delay for testing, as well as simulated the glove turning on and off. Additionally we used a craft googly eyeball to simulate the haptics of an on/off button on the base of the glove near the wrist.

During the prototyping phase we went through a lot of ideas adding and subtracting from the low fidelity prototypes prior to testing. While going through the initial prototyping process, having a real glove and collaborating as a group was invaluable to our process. Key concepts our group debated were: learnability of the informational finger interface (space limitations, horizontal or vertical layouts), technical components (battery, including a microphone), and material feasibility (washing gloves, etc.).

After we created the low-fidelity prototype, we wanted to raise it to the next level, and began implementing a numerical display (7-segment display) with an Arduino and breadboard into a thicker winter glove. The thicker glove allowed us to rip one layer of seams out to fit the numerical display, which would replicate and simulate a clock interface. This was our final prototype: a thick winter glove with the numerical display sewn into one layer of the index finger, wires to the Arduino breadboard sewn through and hidden via the palm of the glove, and the Arduino board attached to an external battery (which could be put into a pocket).

To keep it simple, we only installed one display that showed a “time” interface. Although we did not include all three displays, as our low-fidelity prototype showed, our primary goal with this prototype was just to see how it looks if a display is built into a glove.

5. Testing

The testing sessions were focused on main questions we wanted answered about our prototype. We wanted the test user to go through the task flow of checking the glove for the transit time, as well as answer questions like: What do you think if the time turns red? How do you think the audio function works, how does it feel to listen to your glove like this?

The testing sessions alternated with enhancements of the prototype and were essential to our prototype improving with user feedback.

During the testing sessions we teamed up with another group to give each other feedback. There we got a lot of constructive feedback, which we had not considered before. The primary discussion was related to positioning of the displays and the buttons.

- **Audio Button**: Previously the Audio button was located on the little finger, but one of our test users showed us how moving and raising your arm to that position is not very comfortable, therefore the Audio button was moved to the middle finger.
- **Time Reference**: User tester explained that it's hard to know if you are on-time for a train (even if it is displayed green), if you have no reference to the current time. Decision to add the current time on the thumb, after a few iterations of different placements.
- **Left or Right Hand**: which hand should the glove be worn on? While testing we found that the best solution was to use the left glove for right-handed people, and a

right, smart glove for left-handed people. As people tend* to carry items in their ‘stronger’ hand/arm, their other hand would be free to use for the information from the smart glove (*we would need to further test this, because no one was left-handed)

- **Glove User Interface**: our concept was not complete, we need to re-think how information is displayed on the glove and why.

Our glove after testing: index finger showed train/bus number and departure time of current bus/train (green on-time, red delayed), middle finger showed the connecting train/bus using the same concept (number, departure time color-coded). After testing and iterating further as a group, we decided to add probability indicators to show how likely a person would be to catch their train and/or connecting train. Furthermore we added a function to change the connection, if the connecting train cannot be reached, by pressing the on/off button once.

Final Product: Travel Time Tip

The final product as a result of the design process is a smart glove called ‘Travel Time Tip’. It provides up-to-date information about public transit time, the transit track number or stop, as well as probability indicators for how likely a user is to catch the public transit.

During harsh winter months users of the Travel Time Tip Gloves have transit information at their fingertips. Displays are woven directly into the glove exterior fabric, meaning users do not feel any discomfort on their hands or fingers. The intention is for gloves that feel the same as “normal” gloves and look the same as well (when turned off).

<u>Functionalities:</u>

The smart glove will the following functionalities:

- on/off button (including Bluetooth functionality)
- display the current time
- display arrival time and platform of current train
- display departure time, platform and indication of probability to reach this connection for the next train

The final prototyped glove had 1 button with multiple functionalities: turn the glove on and off, activate bluetooth (button pressed for 2 seconds to respond), and update a missed connection (if button pressed twice in a row).

Problem Explored

"The lack of info about public transit and within public transit can make it uncomfortable and inconvenient for users of public transit." - revised problem statement

As our starting point, we used the information from our user needs statements (need for car-sharing, not enough public transit connections) as a springboard to discuss public transit on a broader scale. We were very interested in the concept of increasing public transit use, if it were more comfortable and convenient, because of its environmental benefit and to spark a conversation about accessibility and public transit. Gleaning from the empathize process we realized how much context played a role and how accessibility could indeed be limited in public transit.

When we look back at our process, we realize that these broad themes were difficult to consolidate, and made our problem statement too broad to tackle as a specific solution. Our turning point was critical feedback from a larger group discussion prior to prototyping - we needed to focus on a more specific problem. We went back to our empathy process data and talked about:

- How it feels to sit outside, after you miss a bus or train (weather, context)
- How relieving it feels to know your train is on time and you will reach it (informational updates)
- Mobility concept and awareness that some people need public transit and are dependant on catching transit and potentially connecting transit for their mobility
- Keeping track of train connections and delays can be difficult
- Checking connection on your phone or smartwatch in cold weather can be very difficult with so many warm layers on

Technical problems explored during prototyping:

- *Need to make a new transit application?* Explored integration of a 'Glove' feature within an existing transportation application, possible via API plug-in implementation
- *Battery Power?* Consider solar power as energy source and integrate solar panel into the back of the gloves to recharge
- *Material feasibility?* Finding a technology allowing for a digital display to be integrated within a fabric, which is also robust and waterproof (especially for washing) Fabric Digital Display video example
- *Lost glove(s)*? Many times people lose gloves or a glove, idea to integrate GPS tracking on gloves, to locate one or both of them

Arguing for Added Value of Outcome

We argue that our gloves are created for and add value for users living in cold climates, who use public transit and are oftentimes dressed very warmly to be outside. Being dressed warmly and in many layers can make accessing your smartphone or smart watch difficult, and not everyone owns a smart watch. The gloves could be first targeted at colder climates with public transportation systems and applications (i.e. Scandinavian countries)

Gloves allow users to easily check their connections, increasing convenience and easing stress during travel. Being able to simply flip your hand and confirm the train time, and train

track number is incredibly beneficial, especially on-the-go. The information displayed will have immediate consequences, the user will either know they will make their next train, hurry up, or know that they need to re-configure their travel plans. We see it as an added value in informational accessibility, transparency and relevancy. It adds to a user knowing what to expect and being able to predict certainty and control over their mobility situation. Many people wear gloves in the winter, colder months - why not make them 'smarter'?

Technical added values explored:

- *Audio function*: idea for audio feature could be useful to all users, especially accessible for any users with visual impairments, expand to headphones and hearing aides
- *Automatic updates*: feature to automatically update glove interface to display the next available connection (if connection will be missed), helps in time-saving and ease of travel
- *Map Interface:* added value of seeing where you are going when going to a transit stop or connecting between stops (recommended from a user test)
- *Interaction design*: we did not have time to develop the interactions further but were aware of the value and need for more detailed flow of use (i.e. numbers turn 'red' and a train connection will be missed, but how does a user know unless they are looking?)

Group decision: keep it simple, gloves should be understandable with little explanation. Accessibility should be further explored, rather than a band-aid solution for a stamp of approval.

Critical Reflection

The application of the design process worked well for our group. We enjoyed exploring the problem space and developing ideas together, although we found the time limitations to have a great effect when it came to brainstorming and re-working ideas. It is clear to us that in the early stages, when gathering real user data, how integral and valuable this is to later stages. We found that our early data and needs statements were constrained, as in reality we would have hopefully found specific users of public transit.

We can also reflect on our experience working with high-level concepts, that sometimes these can only bring you so far, eventually a problem or idea might need to become more specific and tangible. Learning the fine balance of knowing when to be more specific and when to be more broad was a good lesson. This also emerged in our wanting to include accessibility features and meet more diverse needs (i.e. audio option for visually impaired users), because they were maybe too specific to one group, and our primary insights were not gained from this group.

Overall we found the actions of reiterating and rethinking the problem/solution to be critical to our process, and that a linear design process is not really a goal to strive for, rather a process of adapting and knowing when to re-evaluate.