Mobile Visualization Design: An Ideation Method to Try

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CHAPTER 8

Mobile Visualization Design: An Ideation Method to Try

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CONTENTS

IN many ways, mobile visualization is proliferating. Yet, most visualizations on mobile devices are still drawing from the experiences we have with visualizations on larger screens. In this chapter, we present an ideation methodology that can help us to imagine future mobile visualizations through a human-centered design approach. We begin by outlining the general approach of the methodology and then describe how it was adapted and changed to fit the needs of three groups. This chapter is an experience report about how three different groups adapted a design methodology to suit their circumstances. All the design method adaptions explored were successful in encouraging a wide range of ideas to emerge.

8.1 INTRODUCTION

The goal of this chapter is to offer a simple, generative process illustrated by our experiences with its use, with which designers can derive a rich set of ideas for mobile visualization applications that are meant to communicate data visually in a specific usage context. Designing visualizations for small carry-able or wearable mobile devices is not an easy task. Many mobile apps that include graphical data representations adjust and simplify desktop-sized visualizations and make them available with simple interactions. These relatively direct design translations point to possible untapped opportunities for visualization and interaction design. Considering both the technological differences and the usage differences in mobile contexts, it seems extremely likely that these untapped opportunities exist. Concerning technological differences, visualizations for mobile devices can take advantage of novel input modalities that do not exist on desktops: accelerometers, gyroscopes, or personal health related sensors for heart-rate, oxymetry, skin temperature, etc. Through sensors, mobile devices have direct access to data and can provide quick contextual information to viewers. Most carry-able and wearable devices also have smaller screens or screens that have completely different form factors than desktop or laptop screens. This opens up opportunities to develop novel dedicated visualizations rather than trying to make existing representation techniques fit. Concerning mobile usage contexts, people's motivation for using mobile visualizations is often much unlike those for stationary office workers sitting in front of larger desktop or laptop screens. In mobile contexts, for example, people: (1) may want to gain better awareness and understanding of their surroundings and current situation, (2) integrate this situational information into their current activities, and (3) understand, share, or analyze data in non-office surroundings with motion, uncontrolled lighting, or noise.

To let go of the limitations that come with designing by translating existing visualizations and adapting them to mobile scenarios, we have devised and explored a flexible design process. This design process can help us to think of mobile visualizations by considering specific contexts of use, mobile-specific tasks, and personal use cases. Specifically, the design process involves stepping into specific usage contexts and tasks, then taking moments to reflect on the current situation and information needs, ideating design ideas, and reflecting on them with others. The goal of the methodology is to create a rich set of different ideas in context of a specific use case. Assessing the "value"

of each individual idea, refining it, selecting or discarding it, is a task intrinsic to the motivation of each idea generating group that uses the methodology. This chapter, therefore, does not discuss methods to assess the novelty, effectiveness, or potential success of an idea. We also do not claim that the methodology produces "better" ideas than other methodologies, if that is even something that can ever be claimed about an ideation methodology. Instead, in this chapter we offer a methodology we explored and found useful for generating rich ideas for mobile visualizations that communicate data visually. We detail how the design methodology works in general, how three different design groups adapted it, and provide examples of the richness of the ideas that emerged in five design sessions.

8.2 RELATIONSHIP TO OTHER DESIGN METHODOLOGIES

The basic ideation methodology, which we used for the workshops we describe below, was first explored and then published as a workshop paper [5] with a focus on in situ journaling by a single person. Here, we give more details on the method, relax the frequency of note taking and sketching, and give evidence about how the method can be adjusted and appropriated to different scenarios. The method discussed here still centers around sketching, a method Buxton [4, 7] describes as a distinct form of drawing that supports exploration and communication of ideas about designs. Dedicated "data sketches" have been found and studied on whiteboards [17] and supported in data presentation and exploration interfaces [3, 10, 11] giving evidence that people frequently think and brainstorm with data. As a support mechanism for data visualization ideation, sketching has been in particular promoted as part of the Five Design Sheet methodology [14] or the Visualization Worksheets [12]. Yet, these approaches focus on specific details about a given part of the ideation process such as designing an encoding. Our method is more closely related to approaches for ideation in situated visualization design. Bressa et al. [2] recently discussed a series of seven design workshops that, similar to ours, used a variety of props and sketching sessions to create ideas for situated visualizations. Discussions during ideation centered around several questions that were different from ours, such as where to and how to place the visualizations in the world but surfaced some similar concerns, such as designing simple rather than complex visualizations that can be parsed at-a-glance.

Much of the visualization design ideation advice has tended to focus on specific situations in which factors such as the data, and domain experts are known (see, for example, Sedlmair et al. [15]), or to provide specific details about a given part of the ideation process such as designing an encoding [14]. Our approach takes inspiration from several sources including behavioral sampling [1, 6], repetitive sketching techniques [7], and enactment of scenarios [8]. Within the larger space of ideation our method belongs to the empathic design methodologies [16]. The goal here is for designers to learn how their designs might be experienced in the intended usage surroundings. Many of the techniques that exist to help designers understand these real-world experiences range from simple "what-could-be" observations, role playing, or taking existing prototypes into target environments. Bodystorming [13] is a technique similar to ours as it focuses on design sessions in the intended context of use

coupled with discussions and further brainstorming on-site. It has been promoted for the ideation of ubiquitous computing interfaces but follows a different preparation phase as it gives participants specific design questions to target.

On a higher level, our method follows in the tradition of the IDEO Method Cards [9], which intentionally provide a minimal description as a starting point—typically, one image, a title, and 2–3 sentences. The idea is that this minimal description helps trigger within each person or group of people an ideation method that best matches their current needs. In this chapter, we provide more detail, intending to focus on mobile visualization scenarios while still offering considerable flexibility in the execution of the methodology. You will note that each group adapted the method to their personal, current situation, but within these variations, all groups found it a rich idea generator.

8.3 MOBILE VISUALIZATION IDEATION METHODOLOGY

In this section we describe the general ideation methodology that can be followed and adapted to conceive new designs for specific mobile visualization contexts. We have successfully applied this methodology in a variety of mobile visualization scenarios, with small modifications. Three design groups started from a basic list of instructions that were adjusted as needed for the specific situation. We started with some initial ideas for taking a pro-active approach to specific future mobile visualization ideation [5] to develop and explore a flexible mobile visualization ideation methodology in use. Through exploration we have learned a lot about the power of these approaches and the effectiveness of many variations.

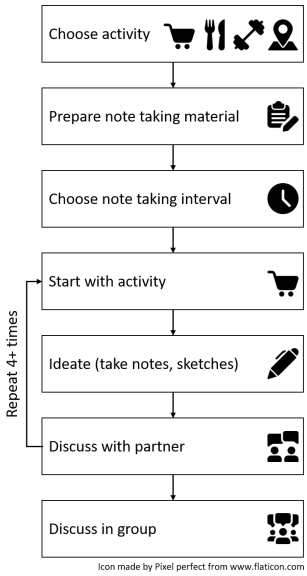


Figure 8.1: General steps of the ideation method.

In general, the ideation activity takes 1–3 hours. It is meant to be done as a paired activity to have another person to share the experience with and discuss ideas with (cf. Figure 8.1). Together both partners *choose an activity* (for example, getting food on campus, going to the mall, going to the gym, going to the library, going home) that is agreeable to both partners as well as the mobile context for which they would like to design (phones, smartwatches, fitness bracelets, etc.). Next, both partners choose and *prepare note taking material* and decide on a note taking procedure. Note taking materials can consist of digital devices, mobile device props made out of other material such as paper or cardboard, or simple notebooks. Once materials and situation are ready, both partners should use a note taking procedure that works for their scenario. Typically, both partners start with their activity and stop after an agreed-upon time interval (*choose note taking interval*), with every 30 minutes being a good first estimate. During every activity gap each partner individually evaluates their information needs in the current situation and sketches a visualization that would address these needs in the current situation for the chosen mobile device (*ideate*). Notes should be added to

the sketches so ideas are clearly communicated for later re-assessment of the sketches. After the sketching time *both partners discuss* their ideas and add comments, adjustments, or variations to their notes and sketches. Then, partners continue with the activity for the next time interval and repeat the previous two steps. It is ideal to try the activity at least four times, or more as needed. After the end of the exercise partners meet as a group to go over all their sketches, generate affinity diagrams, and choose the most promising ideas to iterate on further.

8.4 IDEATION ACTIVITIES – MOBILE VISUALIZATION FUTURES

Next, we describe the ideation activities of three different groups to illustrate how one can adapt and adjust the methodology to specific ideation scenarios. The groups involved professors, researchers, and students at Simon Frasier University (Group 1), the University of Victoria (Group 2), and the University of Stuttgart, Inria, and University of Paris-Saclay (Group 3).

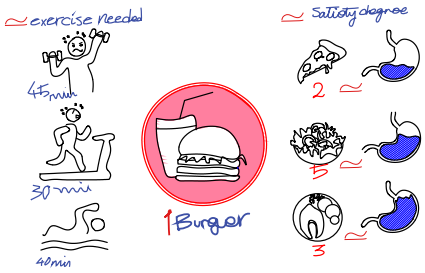
All groups started from the basic activities as described in the methodology section (cf. Section 8.3), however, all did some contextual adjustments. Considering that one of the primary motivations of this ideation methodology is to leverage the reality of one's current situation, it seems appropriate to make adjustments as one's context changes. Therefore, the ideation activity part is separated as follows: Section 8.4.1 includes one person's ideation with notes taken in situ; Section 8.4.2 includes one person's ideation when the immediate situation is not conducive to note taking so note taking is done posthoc; Section 8.4.3 covers two people's ideation variations; and Section 8.4.4 contains examples from an in-context activity during which people separated into pairs for specific activities but reassembled regularly and held discussions as a group.

8.4.1 Approach 1: One Person with In Situ Notes

The ideation activities in Group 1 were part of a larger discussion around the challenge of coming up with ideas that were explicitly for mobile visualization. The five participants in Group 1 discussed the simple methodology and there was a fair amount of skepticism as to whether it would make much of a difference. The initial plan was to try the activity in pairs but the reality of long commutes in different directions resulted in much of this exercises being done individually. These one person ideation activities covered specific use cases often inspired by being alone. People had in particular ideas about supporting private choices and about making alone time more interesting. After each person in the group ideated several times during the activity, they re-grouped and discussed the ideas that had emerged. Everyone was surprised and pleased by the amount, the range, and the richness of the generated ideas. The examples mentioned in this section are just a small subset of those we came up with. The following examples are from different people but we retained the first person pronoun in the descriptions of the examples to give a more active and personal sense of the ideation process.

Food Choices and Exercise as Concrete Visualization

I started my ideation activity in a restaurant I visited alone. I am a health-conscious person and wanted help to choose between a meat lover pizza and a cheeseburger that both tempted me. In this particular moment, I had two information needs: 1) I wanted to see how long I would have to run to burn off either food option and 2) how satiating each food would be—that is, to what extent the food choice would contribute to me feeling full. I sketched a visualization on my phone that would help me answer these two questions and plan my future workout and diet consciously. The sketch shows a hamburger compared to other options which are equal to two slices of pizza! Meanwhile, I can also see how long I should do a specific exercise to burn the calories I gained. On the right side, the satiating power of each of the options is illustrated.



Foroozan Daneshzand
Primary idea generator

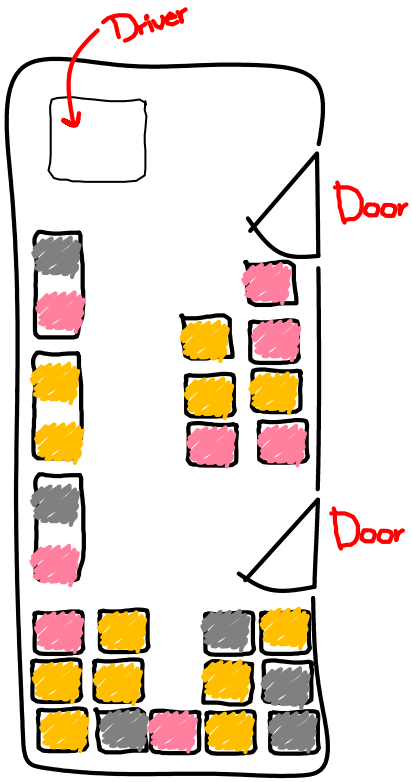
What is Nearby?

I would like to enrich the dead time during my commute—such as when I am waiting for or sitting on a bus. I realise that I often miss information about events near where I live. For instance, when walking home, I saw a flyer for the art exhibition of one of my favorite artists. She has been in town and I missed it! Perhaps there are many events, festivals, courses, and exhibitions happening around us which we might be eager to join but we never learn about them. To get information about these types of activities, we need to sit in front of the monitor, spend hours searching and reading about them on different pages. A phone visualization could help us find the best spot in a short time. By sorting the events based on our interests, we can figure out which one is closer to us, people liked the most, is more affordable, etc.

Foroozan Daneshzand
Primary idea generator

Enroute on Transit

My ideation activity was conducted as I took a long hour and a half commute from school to a friend's place. I conducted the ideation activity at the bus stop and while in transit, considering what information would make my commute more interesting as well as informative.

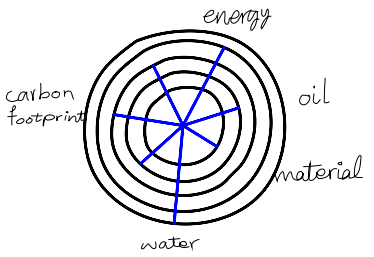


While boarding the bus, I was interested in seeing a bus seat heat map showing the most popular seats on the bus. Such a heatmap would be interesting for me but also bus maintenance staff. During the bus ride I wanted to see status information on my journey including possible delays. I also considered how little I knew about the neighborhoods I was passing through. Commuting is a chance to learn about the neighbourhoods and the buildings around us. An interactive visualization can show an overview breakdown of neighbourhood data as well as more detailed building level data to find out how these buildings are used. For example, one area might be more business-oriented while another is more residential. Each intersection could also present data on pedestrian traffic or past traffic accidents. All of this information could be presented as an overlay on the route to create an engaging navigation experience. Later, I was transferring from my bus to a train and I noticed that the station felt emptier than usual that day. This got me thinking about how crowded or busy some of the other nearby stations might be. I would like to see whether there are certain stations that I might want to avoid because of overcrowding and at which stations I am more likely to find a seat at and not have to wait for multiple trains to pass before I can board. Once I was on the train, I started thinking about all sorts of train-related data that I would love to have visualized. First, it would be great if I could just see a map showing the real-time location of all the trains active on the system and some extra trivia about each train. The track has a few different train models running on it, some of which are much older than others, so seeing what types of trains there are across the whole transit system would be neat. I would also love to see how the track elevation changes across the system somehow, spanning from several stories underground all the way up to tall bridges and overpasses. Finally, learning more about the particular vehicle I am on could make me feel more connected as a rider because I am not just getting on any train, but a particular one with its own history and maintenance schedule.

Peter Buk, Lien Quach, Laton Vermette
Primary idea generators

Technology Shopping

After a long commute, I arrived at my favourite technology store. With climate change being a hot topic amongst people these days, I pondered about the environmental impact of buying new devices. As a consumer, I realized I knew nothing about the manufacturing process of appliances and electronics. That is when I thought of a new visualization: GreenTech.

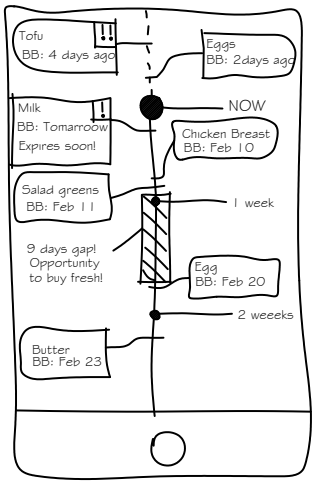


DETAILS ON ENVIRONMENTAL IMPACT

GreenTech would allow people to scan a product to receive information about the manufacturing process and environmental impact the product had. My motivation for this visualization was to bridge the knowledge gap between manufacturers and consumers. By being mobile, GreenTech would allow consumers to access this information quickly, granted that they had a mobile device. Thus, increasing ecological awareness of consumerism. This could help people make more informed decisions while decreasing their carbon footprint. In addition, I wanted a visualization tool that would let me see notable discounts for my store as well as more details about a product and a price history graph to allow for comparison. A feature to see what items have been popular lately at the current store location would be interesting. A similar visualization could be useful for store employees as well.

Lien Quach
Primary idea generator

At the Grocery Store



I started my trip with a visit to the grocery store to pick up some ingredients for a shared meal, and a few things to bring home. As I was picking things out, I wished I had a better idea of what was already in my fridge and pantry at home, and in particular when certain things were going to expire. I wanted some way to see how those best before dates clustered over time, and whether there were any multi-day gaps in the near future that might be a good opportunity to stock up on fresh food. Then being able to compare how those dates line up with what is available at the store would be useful! I would also benefit from being able to filter and see whether, for instance, I have a steady supply of eggs to boil up over the next few weeks. I wanted to see a heat map where in the grocery store I typically spend most of my time, to reflect on the types of food I eat and what places I pause a lot to make food decisions (I know I can be rather choosy in the meat aisle!).

Laton Vermette
Primary idea generator

The examples above are just a small subset of the ideas generated by one person using this methodology and taking at least preliminary notes on location. We had 27 ideas and many of them did not include sketches. Authors in this group generally felt surprised and delighted at their and each others ideas when we discussed them as a group after the ideation activity. Everyone came up with ideas, even those who were initially somewhat skeptical.

Bus and train commuting were part of the context explored by all and offered rich opportunities for engagement and empowerment as part of the typical journey. Additional ideas included: Data on how busy the bus route is throughout the day; Alternative times and routes if one route has problems, is too delayed, or too full; Data during bus route, how far along route, typical according to traffic times, insights into real time traffic data along with historic data; Data about the bus/train car you are taking, how long it has been in service, last maintenance; What section of tracks have lower/higher average speeds? What is the noise level inside/outside the train; noise level at this location? Map average "track screech" levels across the entire system; accessibility data (how many flights of stairs? Is the elevator/escalator working? etc.); and Transit payment information, compass card vs credit card.

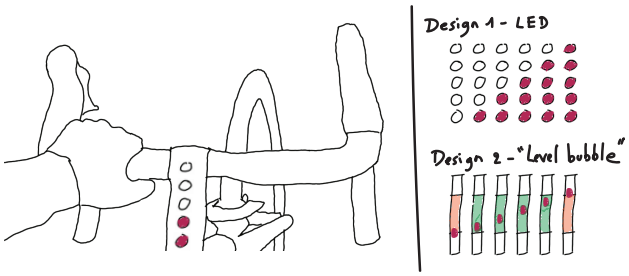
Other ideas centered around learning about other people, who were on the same bus, in the same store, etc. or alternately taking a broader look at the city, possibly collecting data from a vast range of people. Activity and emotional data could be collected anonymized and visualized so that it is not intrusive, to increase people's empathetic understanding and awareness of the world around them. This could help make the concept of "sonder," the profound realization that every stranger around you is living their own lives just as complex as your own, more possible.

8.4.2 Approach 2: One Person with Post Hoc Notes

Sometimes taking notes in situ is awkward or uncomfortable, such as when one is walking alone at night. Sometimes it is not possible such as when one is riding a bike. However, as the examples below show, this does not mean that these situations are not amenable to good mobile visualization application. However, one has to adapt the above methodology. When sketching is impossible, it is important to still ask oneself the questions outlined in the methodology above: what information need does one have at the present moment and then mentally envisioning a mobile solution. To aid the later sketching of ideas, if possible, one can take quick markers, such as a "pin" in a GPS device or photos from a phone or head-mounted camera, as memory aids about the triggered moments to ideate.

The Green Waver

The activity for this example is bike commuting. With this activity comes constraints that led to several adjustments in the original methodology. First, commuting by bike is usually a single-person activity. Although in this example there was a child present, the child was in a trailer at the back, therefore, this was a one-person ideation process. I set an alarm on my watch to get a notification at a time I knew I would be commuting (once in the morning and once in the evening). Upon being notified, I "visualized" in my head a mobile visualization that I would find handy right at that time. Finally, I sketched the idea once I arrived at work / at home with some rough notes.



The first ideation was triggered at one of these frustrating times while waiting at a red light. When notified by my alarm, I was thinking about the green wave traffic lights popular in northern Europe. The idea behind green wave traffic [18] is to synchronize traffic lights so that if one maintains a constant speed they will get only green lights. For bikes, the target speed is usually between 15–20 km/h. This train of thought made me think of two simple designs, aimed at providing the same information to cyclists. The first design uses a series of LEDs while the second one is more continuous and uses the metaphor of a level bubble. Both ideas are designed to fit on the frame of the bike, always visible when cycling, not requiring to pay too much attention, and most importantly being in line of sight of the cyclist. These designs assume close connection to a phone for computation and network access.

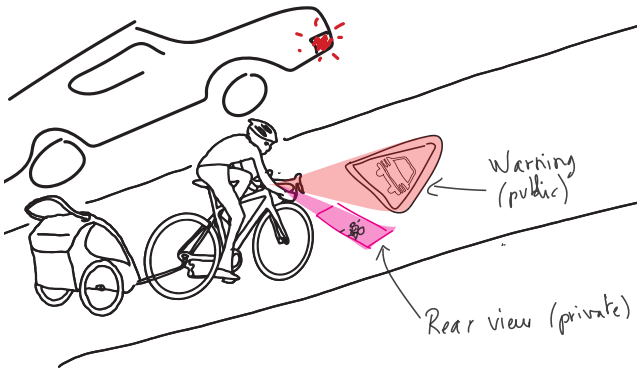
Design 1 uses a series of LEDs to indicate how close one is to the "ideal speed". If the number of LEDs on is too low or too high, the cyclist is too slow or too fast and needs to adjust their speed if they want to benefit from the green wave. Design 1 has the advantage of being relatively simple and cheap to build and implement.

Design 2 is slightly more advanced and uses the metaphor of a level bubble: the bubble in red indicates how "stable" the cruising speed of the cyclist is, and the goal is to keep this bubble as centered as possible. When the bubble is inside the "safe area" the background is green, and when the bubble goes outside the "safe area" the background turns orange to warn the cyclist to adjust their speed.

Charles Perin
Primary idea generator

The Augmented Commuter

The idea for the augmented commuter was triggered from an adrenaline boost after a car had turned right across the bike lane without checking to see whether cyclists were coming. The sketched mobile visualization uses micro-projectors to display information on the ground that is aimed specifically at informing the cyclist only, or other cyclists, pedestrians, cars or bus sharing the road. Such information can include real-time events like sensing a car coming, and historical data like number of recent road accidents at the next intersection.



Several micro-projectors can be used to project information on the road or bike lane for both private and shared information. For example, a small view, right beneath the head of the cyclist, is mostly visible by the cyclist only. In this example, it could be used to show a rear-view mirror image, or even a view on their child in the trailer. This mobile visualization might benefit more people than just the bicycle rider and the car driver. In this example, the warning projected on the ground is a type of public display that other cyclists attempting to pass the person if they slow down, can use to understand each other's behavior. Here, the public warning displays information about the car that is about to turn right and might be dangerous for any cyclist on the bike lane.

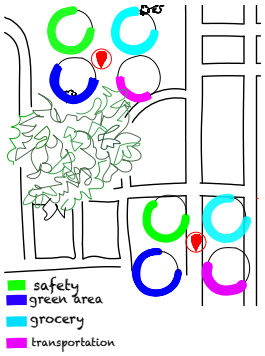
Charles Perin
Primary idea generator

The ideation exercise conducted during bike commuting differed quite a bit from the original methodology as only one person participated and no in situ note taking was possible. Nevertheless, the performed in situ ideation (in one's mind) resulted in two mobile visualizations that can certainly be of benefit to cyclists.

8.4.3 Approach 3: Two or more People in Discussion

The ideas discussed next arose from pairs conducting the ideation exercise together. Contrary to the original methodology, however, in these pairs one person took the lead and the second person took a more supportive role.

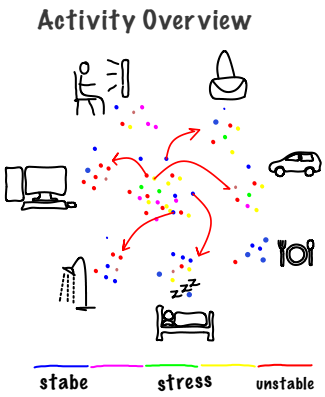
Choosing a Neighborhood to Live



We started this activity during the afternoon of a busy day, when my friend and I were looking at some places she might rent. We set out to see places and to help her decide on a place to rent. This is a challenging decision. She had moved to a new country and I have been here for less than a year, so we did not have enough information about different areas, gathering valid and relevant information for different factors was hard and comparing all different options in terms of those factors was harder. A phone visualization showing the ease of access to grocery shops, train and bus stops, green areas, health care centers, the rate of locals about the safety of the area, population and nationalities living there, could help me to make a better decision right at the location.

Foroozan Daneshzand and friend
Primary idea generators

Visualizing Activities and Emotional States

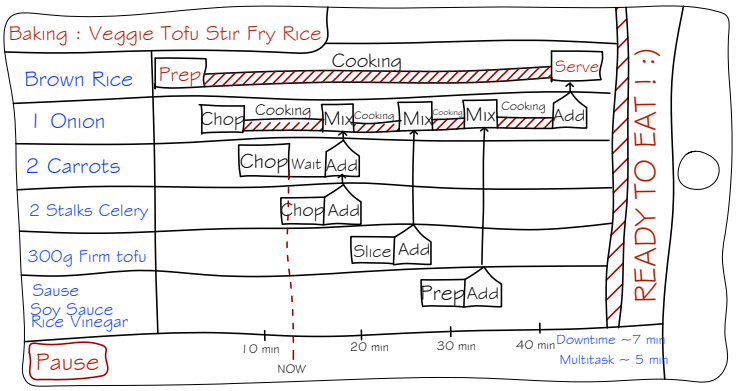


During my daily commute, I sat down near the back of the bus with my friend. We are both on our phones during the bus ride. Getting bored of staring down at a screen, I started to look at the people around me. It was at this moment that I created CityU, a visualization that gathers anonymous data about peoples' current activity and their emotional state. As I surveyed the bus, I noticed that everyone else was on their phones. I got curious about them. "Who are these people? Where are they going?" This train of thought expanded as I considered not only the bus but the city around me. "I wonder what everyone else is doing in the city right now? How is everyone doing right now? What is their emotional state like?" I thought of the ways this data could help the city improve citizens' lives. If the city had a record of high numbers of stressed and mentally unhealthy citizens, they could develop programs to help improve it. I pitched the idea to my friends, who I was commuting with. They loved it and shared their visualization idea to increase city literacy. We thought about the people around us on this crowded ride. Everyone keeps to themselves as they go on their personal commute. We wondered how many are going home, or heading to a late shift. A visualization that shows where people are going and their reason for taking transit at that moment can help connect us momentarily. Of course, such data would be anonymized and aggregated for privacy reasons, but it would still help us feel more connected with our fellow commuters.

Lien Quach and Peter Buk
Primary idea generators

Cooking Dinner for the Group

I had started cooking dinner at my friend's place and it occurred to me that when I am cooking a lot of things at once, due to poor planning, I often end up having to frantically multitask during parts of it to not burn anything or let things get cold before everything else is ready.



However, there are also some periods of downtime when there is nothing for me to do but wait around or maybe stir a bit. So I got thinking about how useful it would be if I could visualize and plan out the "pipeline" of all my different ingredients and dishes, to schedule when different things will be done and make the best use of my time. I have seen scheduling diagrams that might work well for something like this, showing how long my various foods need to be prepped, cooked, combined, and served for the most effective use of time, and to avoid having to do too many things at once. Maybe I could manually adjust these timings depending on my own personal speeds. Maybe I could also drag different items along the schedule diagram to see if I can make things work better and see updates on how much downtime or multitasking time there is going to be.

Laton Vermette and friends
Primary idea generators

All three of these examples did not use the initial idea of paired ideation, though more than one person was involved. For example, one author essentially suggested the visual decision support for choosing a home, but discussions between the author and her friend formed some of the source of the ideas. In contrast, the idea about visualizing people's activities and emotions, emerged separately from two of the authors and was then discussed together. The third idea about scheduling cooking so that all the parts of the meal are ready at the same time, is mainly a solo idea but it emerged in a social situation with several friends who all had an interest in the meal working out coherently.

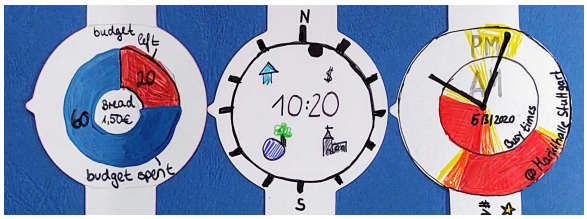
8.4.4 Approach 4: Larger Group with Ideation in Stuttgart

The examples reported below were conducted with a group of six people while sightseeing in Stuttgart, Germany. In contrast to the initial instructions, the group

chose to stay together throughout the activity and do the design exercises in changing pairs. After each activity the pairs discussed their designs and ideas together randomly, some pairs sketched together, some apart, some sketched just one design and some made multiple sketches. The design exercise focused on smartwatch applications and involved a physical paper prop in the shape of a smartwatch. The group conducted the ideation activity at various locations: at a market hall, the town hall with a famous paternoster elevator, twice in a museum with a historic clock collection, and during lunch. After the ideation sessions three members of the group met to group, categorize, and discuss the different ideas. During the meeting they wrote down observations, grouped sketches, redrew and combined ideas, as well as discussed questions that came up. The following idea descriptions are grouped by the locations where the smartwatch visualizations were thought of.

Stuttgart Market Hall

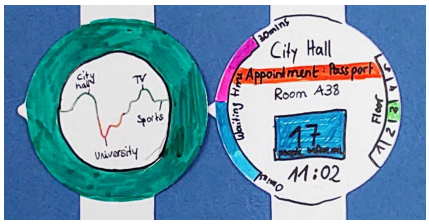
We created eight sketches, which we categorized into three groups. One group of four sketches was about apps that would help with shopping inside the market hall, such as a shopping list, a budget manager, or a product info display. One sketch described a smartwatch application to find sights in proximity to the wearer's current location. Three sketches concerned apps, which give additional information about the current sight, such as opening or busy time periods and facts about the place, ratings by other tourists, or how one can pay for products (cash or credit). The left image shows a budget manager for souvenirs, money already spent, and how much a current item of interest costs. The middle image is a smartwatch face with an abstracted map background that shows sights in the vicinity. Each icon can be touched for more information. The right smartwatch face gives detailed information about the current sight being visited. The two inner rings show busy times while the wristband (not visible) shows additional information and ratings about the place.



Alaul Islam, Tanja Blascheck, Petra Isenberg, Pantelis Antoniadis, Cristina Morariu, Anne Reuter
Idea generators

Town Hall—Riding the Paternoster

Stuttgart's main town hall has one of the few remaining functional and publicly accessible paternoster elevators, which is a hidden tourist attraction in the city. Here, we collected seven sketches in three different categories. Two sketches focused on a smartwatch app related to elevator riding more generally, with information about which floor one was on, which services are available on the floor, or potentially also the position and waiting time for other elevators. One participant enjoyed the ride on the paternoster and drew an app which would capture his excitement throughout the sightseeing trip—showing a spike during the visit at the paternoster. The outside ring color represents an average level of excitement for the day (left image). Three apps were related to an imagined visit to the town hall for administrative purposes (right image). The purpose of the visit, place and time of the appointment are shown, as well as an average wait time and an indication about how many people (17) are in front in line. All three were focused on way finding in the rather large administrative building of the Stuttgart town hall. One app focused on also showing waiting times for certain services, and one visiting times for a local exhibition.



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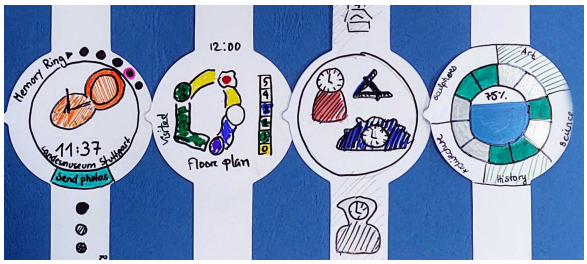
Idea generators

Landesmuseum Stuttgart—Clock Exhibition

Next, we went to a local museum that featured a historic clock and scientific measurements exhibition. Here, we had two ideation sessions during which we collected 12 different sketches. Three sketches contained an app that would help with the problem of taking photographs of exhibition pieces for memory keeping (left image). Two further sketches included floor plans of the museum with tracking of which rooms one had already visited (second image). Three sketches showed apps that would allow to have a closer look or get general information about exhibition pieces close by (third image). Two sketches (right image) were concerned with giving an overview, recommendation, and ranking of exhibition pieces in the museum as a guide on what to view next. As we were getting closer to lunch and the end of our sightseeing activities two sketches showed information about upcoming events and the time left for the museum visit.



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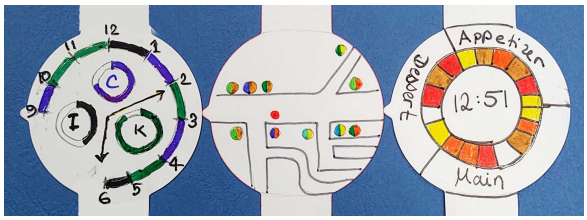
Idea generators

Lunch

To conclude our ideation activity we went for a joint lunch in a local café and after ordering foods and drinks, we did one more sketching session that resulted in nine sketches. Three sketches were concerned with the day as a whole. Two displayed a history of activities throughout the day and one focused on showing the weather to inform future sightseeing activities. One app showed a daily overview of the sightseeing activities of the day with measures of knowledge or calorie gain and burn (left image). Six sketches were related to the restaurant experience with four focusing on apps that would help to find a restaurant based on price, type of food, or ratings (middle image). One app was related to choosing a menu item based on customer reviews, for example, which dessert other people spoke positively about on public ratings (right image). One app concentrated on more detailed information inside the restaurant such as waiting times, the table one was assigned, restroom information, or other people one could meet based on social media connections.



Alaul Islam, Tanja Blascheck, Petra Isenberg, Pantelis Antoniadis, Cristina Morariu, Anne Reuter
Idea generators

Sightseeing, an inherently mobile activity, was a rich context for the ideation activity. The large group context and extended activity allowed the team to collect a large number of sketches. Going through these sketches with a few team members and grouping the ideas into clusters also helped to uncover interesting questions for the smartwatch visualization context. For example, the group had previously not considered the importance of showing the time. Some participants consistently included a display of time, others did not. From the collected sketches some designs could be used as smartwatch faces (8 sketches) while others might be dedicated apps (28 sketches). One participant wearing a smartwatch with a square display also drew square designs, pointing to a possible limitation of having used a round paper prop. Potentially, 17 of the sketches would also work with a squared smartwatch, but the other half (19 sketches) were designed with a round watch in mind. In hindsight offering a larger variety of smartwatch-sized props might have been useful for coming up with designs that are less focused on a particular display format. However, using the paper prop also gave the opportunity to think into the future. As the wristband could be drawn on several sketches included information displays on the wristbands even though there are currently no consumer watches with wristband displays.

8.5 DISCUSSION

In this chapter we contribute an ideation method for designing mobile visualization as well as examples of using the method to generate designs for a variety of contexts and scenarios.

Our motivation for this project was to start developing methodologies that will encourage us to design mobile visualizations directly by basing the design process on: 1) visualization needs that emerge while we are on-the-go and 2) visualization designs that were thought of directly for on-the-go technology. We want to encourage thinking about mobile visualizations that are initially intended to be used while on-the-go.

In conceiving this mobile visualization design ideation process, we initially thought that we would leverage: context—by performing the ideation in situ; props—making use of actual props, such as one's own phone or smartwatch, or a paper mock up of the intended mobile device to keep the features and limitations in mind; socio-genesis—the ability of two or more people to generate ideas through discussion; enforced repetition—to loosen up our thinking processes by practicing generating new ideas; and immediate journaling and sketching—by taking notes on the spot to take advantage of capturing the ideas while they are fresh.

The initial emergence of these ideas started with a discussion between two of the authors. However, the first enactment was done by just one person and was not that successful. The follow up discussion led to thoughts about possible difficulties. Problems arose from 1) the initial enforced time gap of 15 minutes that was too short and interfered life proceeding such as getting to the next place; and 2) the crowded context made stopping to do an activity awkward and sometimes embarrassing, or in the evening downtown raised issues of personal safety. This experience led to the idea that this might be more successful in pairs, which would bring in the advantages of socio-genesis, and that we should try longer and more flexible time intervals.

At this point we thought that the paired ideation was one of the factors of success. However, as noted in this chapter, the next phase is the fruit of three distinct discussions. One was a group of six people who planned to pair up for the activities, but as circumstances happened many of these were actually done solo. One was always intended as a solo activity. One was discussed and planned as a group, which broke in pairs and re-grouped for discussions.

One author pointed out that while the activities—shopping, commuting—were familiar, doing this activity solo gave her the chance to take her time to think and recall. She queried whether this thinking and recollection would happen less with a partner suggesting that doing this by herself, was more focused on the activity, observing and sketching without distractions. In favour of pairs, one observation was that there was power in discussing the same situation from more than one perspective and that this discussion could challenge assumptions about the features of desired mobile visualizations. It is possible that the paired interactions have more quickly reached a more refined state of ideation, with more of the details thought through and worked out.

We also had a lot of variation in use of props. The idea behind props is to help focus one's mind on the technology in question. This is certainly evident in the group's activities using the circular smartwatch prop, during which most ideas emerged as circular smartwatch possibilities. It is also evident in the group who used their actual cell phone for the solo activities. Here again the ideation results reflect this. Perhaps most interesting in this regard is the ideation while riding on a bicycle. Maybe the

lack of props contributed to the innovative suggestions for using technology to provide informative mobile visualizations while riding on a bicycle.

We think that a great deal of flexibility in this ideation methodology is not only possible but should be encouraged and explored. We also think that the two most powerful aspects are the in situ work and the repetition. We think that the context had a significant impact on our design processes. When it was possible to sketch on-site, one could transfer thoughts directly to the sketches, minimizing chance of missing ideas. However, some places were not comfortable enough for sketching, and, if possible, people took quick notes, maybe keywords and a vague sketch that made sense in the context. Sometimes these worked but some people said that quick notes often were too brief and they could not recall the intention when trying to sketch them at home. Another influencing factor related to context is the different observation opportunities each context offers. Riding a bus lends itself to opportunities to observe people for relatively long times in a stable environment. However, observing people while they are shopping might be awkward and uncomfortable, and sketching while biking or driving might be dangerous or impossible. This diversity of contexts requires flexible methodologies that one can adapt. For example, sketching the idea later at home can give more time and tools than when doing the ideation and sketching simultaneously in situ, at the expense of requiring good recall and perhaps more memorization effort. We have explored just a few contexts: transit, shopping, bicycling, and sightseeing. There are countless other possible scenarios to be investigated: isolation, wilderness, and sporting events to name just a few.

8.6 CONCLUSION

We set out to explore a mobile visualization design ideation methodology through a series of activities as a step towards discovering the potential of mobile only visualizations. We note that this chapter is an experience report, where we proposed a methodology but allowed, if not encouraged, people to adapt it to their immediate circumstances. Our combined experiences suggest that a wide range of adaptions are probably viable. Our combined activities suggest a series of possible mobile visualization directions. This offers opportunities for starting mobile visualization designs by thinking about the purpose and the context of the visualization as mobile right from the beginning of the design process. We hope this will encourage the design of new mobile visualizations to break away from the still relatively common tactic of designing simpler and smaller versions of larger desktop visualizations.

In reflecting on all of our activities we suggest that several quite consistent aspects across all the trials that led to a successful design experience with rich ideas:

- Being in-situ: one important part of this methodology is that we tackled the idea at a location of possible use, with the individuals doing the ideation being actually physically present at the given location. While one participant did successfully use imagining of the being in location, we suspect that needing this vivid imagination may not work as well for all people.

- Being at the moment: this idea is essentially a time-wise ‘in situ.’ It is our

impression that this immediacy was useful in triggering ideas, but as one of our examples show, for some re-imagining a very recent past may also work well.

- The repetition: while the idea of trying to think of a new idea every so many minutes did not appear to be necessary to be rigidly applied, notion of repetition seemed to be generative. That is, getting one idea and then getting another and then another and so on, seemed to be freeing in itself. In a way this took the pressure away. A person did not have to get the perfect idea first, they could just keep going.

- The props: the way different individuals dealt with the device trigger varied from: looking at a physical device (phone or watch); imagining a physical device because current circumstance made pulling one out embarrassing; having a drawing or facsimile of a physical device. All three of these were successful and hint at possibilities of designing for novel devises by being able to draw one or create a mock-up.

- The notes and sketches: we made strong suggestions that note taking and sketching were done immediately, however, in reality this was not always possible. While it may be possible that some nuances were lost, on the whole post hoc notes were also successful.

In take-away we suggest trying this ideation approach bearing primarily in mind: being in situ; being at the moment; and having or creating a device mock-up. We do hope that some of you readers will try these activities. We have found them to be delightfully effective. After we started, ideas just seemed to flow forth. In addition, it seems that a great deal of flexibility can be applied to this methodology without losing its generative power. We are now interested in whether we can further adjust, or invent new ideation methodologies that can help us tease out new ways we can generate ideas that also leverage more of the unique features of common mobile devices, such as their input, output, and sensory capabilities.

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