Supporting Active Participation and Situated Use in Mobile Interaction Design

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Abstract—**Most mobile applications are designed for interaction only when a user is standing still and able to pay visual and mental attention to the device. New interaction techniques are needed to replace this "stop-to-interact" paradigm. But how can we design for novel non-idiomatic mobile interactions? To inform the mobile interaction design process, I propose a design methodology driven by situated use and active participation. I draw upon a case study co-designing mobile hand gesture interfaces with runners to illustrate how the use of participatory design workshop and field study in a coherent manner can support the design of novel mobile interfaces.**

Keywords-Co-Design; Situated Use; Active Participation; Mobile Interface; Hand Gesture Toolkit.

I. INTRODUCTION

Mobile technology is changing our daily lives. This transformation is less about mobile devices and more about the activities we perform using these devices. That is why Suchman et al. [1] argue that "the study of how new technology emerges should shift from a focus on invention to an interest in ongoing practices of assembly, demonstration, and performance". They request a shift from an analysis in terms of form and function to a performative account. Alike Dourish and Bell [2] call for a deeper understanding of how social and cultural practice is carried out in and around emerging information technologies. They claim that "the vision of ubiquitous computing technologies is already fulfilled", but that we need to pay considerably more attention to just what it is being used to do and its effects. Here, I am especially interested in how mobile technology is used for running and how I can design meaningful mobile interfaces that support runners.

The use of mobile phones for physical activity has become popular. There is a vast amount of mobile health apps available for Android in the Google Play Store. Several research prototypes [3][4] for mobile devices have been developed for investigating the effects of mobile technology on exercise motivation, obesity prevention, and on users' overall fitness. These sport applications operate mainly as digital training diaries collecting performance data on the way, using multiple sensors, such as GPS, heart-rate monitors, and pedometers. They support four essential training functions: performance feedback, navigational means, competition, and entertainment [4]. Before exercising a sport setting must be chosen in the application. Performance feedback is given visually and as audio [3]–[5] directly at the mobile device, forcing the athlete to interact with the device during exercising, which disturbs the running movement [6].

In this paper, I do not present a new sports application, instead I explore how a participatory and situated approach deployed as co-design workshop and field study involving runners during design time and use time can help to understand and design for better mobile interactions. The aim of the study has then been to investigate *how can we apply an approach driven by situated use and active participation to inform the design of mobile non-idiomatic interfaces that support the running experience.* The paper presents a design case of mobile interfaces for runners based on eyes-free hand gestures. Moreover, I discuss the concept of *engaging mobile prototypes* to utilize a participatory and situated approach in mobile interaction design supporting participants' needs, empowering them as co-creators, and studying mobile experiences by integrating their prototypes into their practice. After outlining the challenge for current mobile interaction design (Section 2), I will describe how I responded to that challenge presenting a case study in Section 3. I summarize my findings and discuss the approach and the concept of engaging prototypes in Section 4.

II. A CHALLENGE FOR MOBILE INTERACTION DESIGN

Research in mobile interaction design is concerned with the use of technology while being mobile. So far most mobile systems request the user to "stop-to-interact", designed for interaction only when a user is standing still, paying visual and mental attention to the device [7]. Research has shown that the user's ability to interact with technology in motion is decreased even for simple activities like walking [8][9]. Lumsden and Brewster [10] requested "a paradigm shift in terms of interaction techniques for mobile technology" already in 2003. Since then, mobile technology has been an important theme in HCI research. Liu et al. [11] published a review focusing on keyword analysis of CHI publications to understand how the landscape of the HCI field has evolved. They list mobile phone as the most frequently used keyword between 2004-2013. Still Marshall and Tennent [7] claim that mobile interaction does not exist. They highlight four challenges

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designing interactions for mobile devices: cognitive load, physical constraints, terrain and other people. So how can we understand and design for mobile interaction?

Löwgren [12] argues that mobile interaction design research explores interaction possibilities outside the established screen idiom, making design methods used for common UIs inadequate. New methods and techniques need to be explored to understand and design for mobile experiences of user-and-technology interplay over time. Moen [13] calls for a non-technological, people-centered point of view in order to create embodied and engaging interaction experiences. Suchman et al. [1] suggest a performative account using working artifacts and Shengdong Zhao [14] requests an interaction shift from device-centric to human-and-environment-centric. I see two major themes from these demands for mobile interaction design: users' active participation and their situated use of technology.

So far, Stigberg [15] describes two common ways of including people in mobile interaction design research, as *informants* at design time and *evaluators* at use time. Work by Ruiz [16], Kim [17], Feng [18] and Pakanen [19] invited participants in early design time, ideating about future interfaces. They stress the importance of participants as *informants* and *co-designers* and explore the design space resulting in design implications, such as end-user inspired gesture sets [16][17], device form factors [18] or design recommendations for wearables [19]. Even though these studies rely on user's participation during early design time, they do not enable participants to experience their imagined mobile technologies in situated use. At use time previous research projects [6][20]–[25] invited participants to evaluate social acceptability [20][23], usability [21][25] or overall device performance [6][22][24] of commercial mobile technologies [6][20][22] and novel prototypes [21][23]–[25]. Participants are seen as *evaluators* of mobile technology most often in a context of use proposed by the researchers. The participants are not able to integrate these prototypes into their exercising practice to afford embodied and engaging interaction experiences. Stigberg's review exposes a gap between, how mobile interaction design research is conducted so far, and what is suggested by Dourish and Bell [2], Suchman [1] or Zhao [14].

III. SITUATED USE AND ACTIVE PARTICIPATION FOR ENGAGING INTERACTION DESIGN.

There is a well-established body of knowledge on situated use to rely on, such as Rogers [26] concepts of a wild theory, or Crabtree's [27] breaching experiments. The outcome of field studies in general demonstrate different results from those arising out of lab studies [28]. They show how people come to understand and appropriate technologies on their own terms and for their own situated purposes. They afford greater motivation for participating - "it is one thing for people to volunteer for a short-term experiment and another for them to integrate a novel technology into their lives" [26]. And the locus of control shifts from the researcher to the participant, making it more difficult to study specific effects. Equalizing power relations between researchers and participants is one of the major principles of participatory design [29]. *Co-design* or *participatory design (PD)* [30] refers to the activity of researchers and people not trained in design working together as equals in the design process. Often workshops and/or toolkits are deployed to engage participants in the design process [31][32]. Examples of PD at use time are less explored. Suchman et al. [1] describe three practices of *design-in-use*: incorporating an artifact into an existing infrastructure; re-configuration and customization of any actual technological solution; as well as co-operative prototyping. Dittrich et al. [33] explore how participatory design can evolve in the wild. They use the term *design-in-use* to "capture practices of interpretation, appropriation, assembly, tailoring and further development of computer support in what is normally regarded as deployment or use" and request new methods for sustainable, distributed co-constructive design processes.

Summarizing I see three approaches from previous work on situated use and active participation to inform mobile interaction design:

- Co-design to engage participants during design time.
- Field studies or breaching experiments to experience technology in practice
- Design-in-use to appropriate technology at use time.

IV. RESPONDING TO THE CHALLENGE: AN EARLY EXPERIENCE

To utilize active participation and situated use, I conducted a case study including a co-design workshop followed by a field study. The co-design workshop included activities for telling, making, and enacting [34]. The participants could tell their mobile interaction story, make their own mobile hand gesture interface, and enact their story using their created artifacts at *design time*. The artifacts are prototypes with working behavior and were used in the participants' everyday workouts during a one-month evaluation period following the workshop. The participants could revise their prototype at *use time* as an ongoing practice of *design-in-use* as suggested by Suchman et al. [1]. In the following I describe toolkit, workshop and field study in more detail.

A. Mobile Hand Gesture Toolkit

The mobile hand gesture toolkit [35] consists of hardware, software and paper tools (Figure 1). A Myo Gesture Control Armband based on surface electromyography [36] can recognize five different hand gestures (Figure 2). The armband communicates via Bluetooth with a LG Nexus 5 mobile phone running Android.

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Figure 1. The mobile hand gesture toolkit including (a) Paper tools: invitation and gesture cards, (b) Hardware tools: Myo Gesture Control Armband and LG Nexus 5 phone, (c) Participant performing *Wave In* gesture

The phone has a set of pre-installed applications: *Tasker*, *Secure Settings, AutoInput, MyoTasker Plugin,* and *MYO Phone App* are software utility tools needed for creating gesture interfaces; *Nike Run Club, RunKeeper, Strava, Spotify, StopWatch,* and *BVR* are software action tools providing desired functionalities for runners. *Tasker* is an application for Android, which performs *tasks* (sets of actions) based on *contexts* (application, time, date, location, event, gesture) in user-defined profiles [37]. Here *Tasker* provides a way of mapping gestures to tasks. I prepared a set of possible runners' tasks in *Tasker* to provide examples, and to reduce the workload for the participants during the workshop. The toolkit is a result of designing the design space: providing possibilities to add new tasks, new devices, and new mappings during the workshop and in future use.

Figure 2. Available hand gestures: Fist, Wave In, Wave Out, Fingers Spread, and Double Tap (from myo.com)

B. Co-Design Workshop

I conducted a co-design workshop with four runners (2 male, 2 female) in their twenties to thirties recruited from a local running club in Sweden. All of them used mobile phones for exercising. To inform the participants before the workshop, they received an invitation one week before the date including three questions related to their activity: *what digital equipment do you use; which functionalities do you use from your digital equipment; do you have any problems or limitations with your digital equipment?*

The design workshop was made up off two parts and lasted about 1.5 hours. The first part was a paper-based co-design workshop with three activities using the available paper tools to create a design concept. The use of paper tools was a conscious design choice to lower the threshold for participation and to focus on the participants' experiences and creativity. In the second part of the workshop, I utilized the hardware and software tools and the participants created their functional prototype. I expected this to be the most intense part of the workshop, introducing a new technology, the concept of end-user-development using *Tasker,* and helping participants to create their own working interfaces.

In the first part, we started with a *telling* activity where the participants described a mobile interaction story from running using their notes from the invitation. Each participant defined one scenario that they would like to work on. We continued with a *making* activity there I presented paper cards with pictures of available gestures. Each participant could write functionality that should be accomplished by the illustrated gesture on the card, e.g. "take a picture" written on the fist gesture card. The first part ended with an *enacting* activity there the participants' were asked to demonstrate their designed interface by showing the selected gestures and telling what should happen.

In the second part of the workshop, we utilized the hardware and software tools and the participants created their functional prototype. After I handed out the hardware, I asked the participants to adapt the armband to fit their arm using the included plastic brackets and to try out the *Myo Phone App* to practice hand gestures. Next, I introduced the participants to *Tasker* and I demonstrated how to match gestures to tasks by example (Figure 1). For this *making* activity participants could use the prepared tasks or create new ones. We concluded the workshop with another *enacting* activity there the participants demonstrated their working artifacts. After the workshop, the participants were interviewed about their prototype and their experiences from the workshop.

C. Field Study

To support experiencing this mobile technology in practice and explore design-in-use time, I asked the participants to use their prototypes in their everyday practice, at least three times, during one month. They received a how-to sheet for using and altering their prototype and I encouraged them to adapt their interface, if they were unsatisfied. I communicated with the participants through phone calls, text messages and Facebook conversations. I used text messages to remind the participants to use the prototype once a week. The participants were asked to write down short experience notes after each workout and send them to the researcher. Further the participants were able to get technical support throughout the whole time. After one month I collected the prototypes and conducted a second interview with each participant.

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D. Data Analysis

During design time, I collected data from: 4 completed invitations, 4 sets of completed paper cards, 32 photos taken during the workshop, 6 pages of workshop observation notes, and 51 min audio recordings from interviews. The analysis started after the workshop and has been an on-going process throughout the field study. This continuous process allowed me to refine the questions and directions of the investigation as part of the field study. The collected data from the workshop worked as initial exploration of the domain. I understood what functionality is important to runners during their activity and how they imagine accessing that functionality through an eyes-free hand gesture interface. During the interviews, I reviewed with participants their prototypes. The field study in the wild was a necessity to explore participants' understandings, practices and eventual uses of their prototypes. But it was difficult to observe when and how participants actually used their prototype. The data collection during the field study consisted of: 12 experience notes from participants, and 127 min audio recordings from interviews. All audio recordings were transcribed and together with observation notes and experience notes were analyzed by me and a second researcher using the software TAMS Analyzer. We coded the data regarding three themes: participants' needs for alternative mobile interfaces, their means to co-create a mobile prototype and their experiences from situated use with that prototype. Quotations from the interviews are reported in anonymous form using participant A-D.

E. Findings

I retrieved three main insights from the case study, (1) diverse individuals' needs, (2) challenging mobile interactions, (3) the necessity of evaluating mobile interfaces in situated use, are summarized in the following. (1) When designing for mobile interactions, it is important to provide flexibility and tailorability for mobile technology both during design and use time. All four participants created diverse interfaces during the design phase and three of them adapted their interface during use. They appreciated the openness of the mobile hand gesture toolkit. As participant C expresses: "I felt that it gave me a sense of control to design the interface according to my own needs. It felt like, that only my imagination could set the limits. Nor did I feel that it was particularly difficult either."

(2) All four participants identified mobile interactions using the touch screen as problematic. They agreed that minimal hand gesture interactions as probed in this study are a better alternative to control the phone while in motion. Participant A explains: "It is usually not possible to press on the phone screen directly during exercise. Any type of gesture control for the mobile is really needed."

(3) The probed technology based on electromyography is non-optimal for gesture recognition in the wild. The participants felt, that their prototype worked much better during design time sitting down at the workshop compared to use time when they were in motion. Participant D expresses her disappointment: "It works well when you sit with the phone in front of you and you see what's happening. Feedback and technology work well if you sit still and concentrate. When training, everything needs to work straightaway. It must react directly and it did not."

In the following, I present the designed mobile gesture interfaces, findings from the workshop at design time and in the wild at use time.

1) Mobile Gesture Interfaces

Four participants created four different personal interfaces. They used expected functionality, such as call management, music and media control as well as activity and performance tracking. But the combination of functionalities into tasks and the mapping from gesture to task was varying between participants.

Participant A created an interface for interval training for biking and running. The participant assumed that *Fingers Spread* gesture would be the only accessible gesture when holding a bike handle so *Fingers Spread* gesture starts a stopwatch application, sets a new lap, and reads out the duration of the last lap.

Participant B's interface is designed for trail running. *Fingers Spread* records 30 sec scenic videos using BVR. *Fist* pauses and resumes activity tracking in RunKeeper. *Double Tap* reads out the current activity time, distance and pace from RunKeeper. *Wave In* skips to previous song and *Wave Out* skips to next song from current Spotify playlist if playing.

Participant C designed an interface for handling calls while runnig. *Fingers Spread* accepts incoming calls and stops current activity tracking in RunKeeper. *Fist* ends a call and resumes current activity tracking in RunKeeper. *Wave In* decreases the volume, and *Wave out* increases the volume.

Participant D plans to use the designed prototype mostly as a music player control. *Fingers Spread* starts the music and activity tracking in RunKeeper. *Fist* pauses music and activity tracking in RunKeeper. *Double Tap* skips to the next song. *Wave In* decreases volume, *Wave ou*t increases volume.

2) Design Time

All four participants provided positive feedback towards the organization of the workshop. Participant C tells about his experience from the workshop: "The workshop worked well. It became clear what we would do. There was no question mark. It was fun to attend. An exciting idea was presented."

I handed out invitations in beforehand to prepare the participants for the workshop. Participants experienced the invitations as important for the success of the workshop. Participant D summarizes it as: "The invitation was easy to fill out. Good with some time for consideration. It's nothing I think of all the time, so it was great to think about that before the workshop."

In the first part of the workshop, we started with a *telling* activity where the participants described a mobile interaction story from running and biking using their notes from the invitation. Each participant defined one scenario without problems. We continued with a *making* activity there I presented paper cards with pictures of available gestures.

a) Gesture Mappings

The participants had varying strategies for mapping gestures to tasks. Participant C and D thought that it was easy to come up with meanings. Participant D states: "I immediately came up with how I wanted to control the features. It was easy to write tasks on paper cards. The gestures were clear. It was like using sign language."

She explained her thoughts about the mapping as following: "When you open your hand you start something. That is easy. And then you close your hand, and it will stop."

Participant C agreed that mappings were intuitive to him: "It was quite obvious which task every gesture would have. They were easy gestures for simple tasks, making it easy to remember."

Participant D explained how she connected some gestures to previously known interactions: "I thought of the Apple's headphones when you switch a song you double tap. Easy to remember."

Participant B however felt that none of the mappings were obvious. She said: "There is no gesture task combination that feels completely natural. You just have to choose one."

Participants B, C and D had mappings for four to five gestures. Participant A had a different approach: "I try to use as few gestures as possible. Maybe I add more then. It's important to start with a little thing to remember and see if it works." He felt limited by his bike handle to which gestures he was able to choose from: "Especially with the bike, then I hold the handle bar; I do not want to let go of it to make a gesture."

b) Making the Prototype

In the second part of the workshop, we utilized the hardware and software tools and the participants created their own functional prototype. I introduced the participants to *Tasker* and I demonstrated how to match gestures to tasks by example. For this *making* activity participants could use the prepared tasks or create new ones. Participants felt that it was important to them to learn to create their own interfaces. Participant A states: "It's important to try it out myself and do my own thing. It's always easy to listen to someone else but then often hard to do it myself."

Participant A, B and D felt that it was important to have a workshop. Participant D explains: "I received quite a lot of help from you to create new tasks, so it was easy. If I did it completely by myself, it would have been more difficult."

Participant C disagrees: "Would I sit with that by myself for a while, maybe I would have learned it too. But it was really easy and user-friendly in the workshop."

Participants felt a sense of mastering at the end of the workshop. They were proud that they managed to create their own interface. Participant B says: "I was pleasantly surprised that it actually worked, as I had imagined."

3) Use Time

Participant B reports from a 15km trail run: "Then I was running in some scenic nature I wanted to record and did the double tap gesture to unlock and wave in to record. It vibrated twice and it felt that everything was all right."

The participants exercised with the armband between 5 to 8 times each during one month. They reported back to the researcher after each use with an experience note via Facebook. I conducted final interviews with all participants at the end of the use time to discuss their experiences in more detail. After testing the technology and creating their personal prototype during the workshop participants' expectations were high. Participant A described his experience with the prototype during the final interview: "It works ok, but exercising is delicate it becomes important that it has to work directly. It puts very high demands on technology."

Participant B and D expressed similar thoughts. Only participant C stated that he expected some bugs, and that one cannot assume perfection of a prototype.

a) Breakdowns and Design-in-Use

As anticipated by the researchers the participants experienced issues with the use of the Myo armband in the wild. Sathiyanarayanan and Mulling [38] conclude in a related project from 2015 that Myo has the potential to be used for controlling applications, but needs improvement of physical device as well as gesture recognition optimization. In this study Myo gesture control armband was the available technology to test mobile gesture interfaces and I do not focus on its technical issues. Instead I am interested in findings on how the participants' experienced and coped with experienced breakdowns and how their prototype evolved during use time. I documented two types of breakdowns: when the Myo armband recognized unintentional gestures; and when the Myo armband did not recognize the performed gestures.

Unintentional gesture detection was reported both before and under the workout for all participants. Participants adapted their interfaces and inactivated gestures that were frequently faulty. Participant A describes his experience while getting ready: "It reacts to movements that you haven't thought of, so I started the time unwillingly, because I tied my shoes or pointed at something."

Participant D reports similar problems: "I connected the Myo to the phone without problems. Then I tied my shoes the Myo detected lots of gestures, started Runkeeper, paused, resumed, and went really nuts. So I thought next time I get ready before I connect to the Myo."

Participants reacted on breakdowns by adapting the interface as participant B described: " Then I started running, I started Runkeeper by making a fist and started music by waving out. This worked fine. But I noticed that the Myo armband was vibrating the whole time even though I did not do a gesture. Runkeeper was paused and resumed several times and my tracking status was read up without me doing anything. So after about 500m I stopped and removed Fist and Double Tap gestures from Tasker, so that they would not trigger all the time. I restarted my run and now it was fine."

Participant D changed her interface and removed the double tap gesture that did not work as expected: "I used Myo on Saturday. Run about 5 km on a hilly track. I removed the function to change song (double tap) because it swapped the song unintentionally last time."

Participant C tried to come up with an explanation for these breakdowns: "I think it had problems to disguise my

gestures from muscle tension and vibrations caused naturally while running."

Participants A and C were mostly effected by non-respondents from the interface. Participant A reports from his first use: "It worked fine to start the time. Looked at the phone and the time was set. I thought testing the armband when I was almost finished warming up. I did a double tap, but nothing happened."

Participant A found that gesture detection improved when he moistened his arm. After a couple of uses he stated that it gets better the more he uses it. Participant C describes his problems with the armband: "Everything worked great at first, but after a few hundred meters, it stopped working. I tried to reset by flexing out the hand as it should be done, then it vibrated and worked again as it should."

Participant C did not change his interface during use: "I found that all the gestures I chose from the beginning were easy to remember and logical."

While participants B and D removed parts of their functionality during use, participant A came up with new functionality that he added to his interface: "I just had start and stop time. During testing I came across more things I wanted to know, such as distance and cadence and so forth. So I added start and stop tracking in Strava."

V. REVISITING THE CHALLENGE

I am aware that this case study only involved four participants. I did not collect enough empirical data to argue for gesture-based interfaces as alternative mobile interactions. However, my goal was to explore how situated use and active participation can be integrated in mobile interaction design to deepen user engagement and to afford a better understanding of what mobile interactions are and how to design for them. The findings reaffirm that mobile interactions are personal and situated, participants' needs are diverse, and their gesture mappings are individual. I have observed that participants' needs can be hidden at design time and emerge during use. I utilized flexible functional prototypes that participants engaged with both during design time and use time. I call them engaging mobile prototypes, they are:

- personal: they are created by the participant
- functional: they are experienced in situated use
- changeable: they can be altered during use

In the following, I discuss how these prototypes can be used to support active participation and situated use and how this approach informed the design of mobile non-idiomatic interfaces supporting the running experience.

A. The Use of Toolkits in Mobile Interaction Design

There exist a number of making tools available to support mobile prototyping for programmers and interaction designers in the HCI literature [39]–[41]. Prototyping toolkits that enable non-programmers to design and experience novel interaction interfaces are not yet commonplace. One example is Mogeste [42], a mobile phone tool for users to create rapid, in-situ mobile gestures, however the tool does not support working interaction interfaces, since gestures cannot be coupled to phone functionalities. In this case study, I demonstrate how commercial mobile and wearable technology can be combined to enable non-programmers to be *engaged* in making their own functional prototypes inspired by participatory design toolkits [31] for low-fidelity prototypes. During the workshop the participants create, experience and revise their solution with little help of a researcher.

Unlike mobile prototypes in previous research, the resulting prototypes are personal, created by and for each participant. They enable two dimensions of freedom: the type of support requested during running (functionality); and the mapping of gestures to this functionality. Even though the case study only involved four participants, the findings indicate that both functionality and gesture mappings seem to be personal. Ruiz et al. [16] created a gesture set for common mobile phone functionality using a consensus of user-defined gesture sets. They too, found tasks with poor agreement scores and recommend gesture toolkits to allow end-user customization to support different gesture mappings.

However designers need to balance between complexity of the toolkit and openness of the design space defined by Alan Perlis as the turing tar pit and its inverse [43]. I limited the prototype to five possible gestures for one hand, based on the available hardware. Participants will design different user interfaces having support for more diverse gestures or two hands. Future research can explore alternative hardware components using the toolkit to allow other gesture sets.

B. Active Participation in Mobile Interaction Design

The goal of this study was to engage runners in the design and evaluating of a mobile interface based on eyes-free hand gestures. Previous research [24][44] indicated that hand gestures are feasible for running interfaces and I explored what functionality runners would choose, how they would access that functionality through an eyes-free hand gesture interface, and how they experience such an interface integrated into their use practice. I learned that participants answered each of these questions differently. For two participants the gesture functionality mappings were intuitively, the other two just "picked a combination". The co-design workshop enabled all participants to ideate and build their personal engaging prototype despite different technology literacy. This type of active participation supported participants' understanding of technology limitations and made them comfortable handling their prototypes at use time. "It's important to try it out myself and do my own thing" as participant A stated during the first interview. The active participation continued throughout use time. The participants reported on several occasions that they adapted their interfaces during use and explained in detail why and how they did these changes.

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C. Experiencing Mobile Prototypes in Situated Use

The mobile interface must be meaningful for the runner; otherwise it is a needless gadget. The engaging prototypes contain only functionality that matter to the participants, spanning participants' ideas from design time to use time. But despite creating personal interfaces at design time, situated use cannot be completely anticipated. Participants, at use time, discovered mismatches between their needs and their prototype, and unexpected technology behavior leading to breakdowns [43] and changed requests. Two types of breakdowns were reported: when the Myo armband recognized unintentional gestures; and when the Myo armband did not recognize the performed gestures. These breakdowns were discouraging factors during use time and participants adapted their prototypes to avoid them. Further, one participant uncovered hidden needs during use time and added more gestures to the prototype. One problem was data collection during use time, since the locus of control is shifted from researcher to participant [26]. I collected no use data from the prototypes; instead I relied on experience notes from the participants and interviews with them after the field study, since I was interested how the participants experienced their interface integrated into their use practice. For future research I consider using tools such as AWARE [40] framework, to register additional usage data for more insights during use time.

VI. CONCLUSION

Marshall and Tennent [7] claim that mobile interaction does not exist, that we are trapped in a "stop-to-interact" paradigm. Löwgren [12] argues that mobile interaction design research should explore interaction possibilities outside the established screen idiom, making common design methods inadequate. Inspired by participatory design and in the wild studies, I studied an approach driven by situated use and active participation to inform the design of mobile non-idiomatic interfaces that support the running experience. At design time, I conducted a co-designing workshop with four runners. They used a hand gesture toolkit to create their own personal mobile prototypes. At use time, I led a one-month field study integrating these prototypes into their running practice. Three of the participants changed their prototypes during use. I found that mobile interfaces ought to be individual and situated; affording different user needs and practices. My suggestion is to provide flexible and functional prototypes that can be experienced in situated use and altered by the participants during use. I believe that an approach of co-designing engaging mobile prototypes can inspire research of non-idiomatic interfaces in other mobile contexts.

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