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actively mobile
Mobile design for running

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Abstract

The primary goal of my research is to explore the changing role of the mobile phone as a personal device, and how the mobile phone could adapt to become a dedicated device, designed to fit particular aspects of our lives. Here, I explore the role of the mobile phone in the life of an athletic, active user, and how mobile functions and services might be tailored to the context running. Taking into consideration the mindset of a user while running, I look at their physical and psychological needs and motivations, and design specifically for use during their workouts. The interaction design of an active mobile device can provide insights for other mobile contexts such as commuting or running errands, inspire new services and devices dedicated other contexts, and create new interactions that could be applied to a broader range of mobile use.

Contents

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Special thanks to my classmates, for sharing this experience with me. I've learned so much from all of you.

And last, but not definitely not least, thank you Molly, for always believing I could do it; Mom, Dad, Andrew, Maryelizabeth, and Derek, for encouraging me to keep going; and Sam for holding me together until the end.

I dedicate this thesis to my Dad, who taught me how to run.

1 Introduction

1.1 The Origin of the Thesis idea

The initial idea for my thesis came from a long-distance phone conversation with a friend. We were discussing an idea I had been considering, of how to motivate people to exercise through play. I had been thinking of a stationary machine or a game, and he suggested the idea of a device that people could use at any point in their day. Like a “mobile device?” I said, and from there we were off, adding imaginary features and functions to something that was suddenly the mobile phone. Although we do not typically think of bringing a mobile phone with us when we exercise, I started to wonder how a new type of mobile phone could be designed specifically for the context of physical activity.

Inspired by this conversation, and fuelled by my own experience carrying my mobile phone during long-distance runs, I started talking to people about their experiences – did they take their phones with them when they worked out? If so, why? Or if not, why not? Would they be interested in a phone designed specifically for their active activities? What would they like it to do? I interviewed people in both the UK and the US; competitive runners, triathletes, regular bike commuters, and those who frequent the gym on a regular basis. The range of answers ran from “a device that could do the exercise for me” to “something that would take up less space than (those) I use now.”

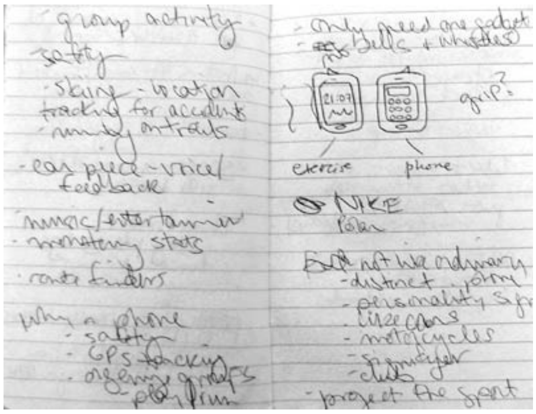


Figure 1: Notes from my initial interviews

All of the people I interviewed were interested in the idea of having one device to take with them that would help them stay “on track” during exercise. Although they were not necessarily interested in making phone calls while they worked out, they all saw value in having a phone with them. Their enthusiasm led to some animated brainstorming sessions and suggestions as to whom to talk to next.

By the end of the summer I knew what I wanted to build: a device for athletic users.

1.2 Key Themes

This thesis explores the changing role of the mobile phone as a personal device, and how the mobile phone could be adapted to better fit an active context. My research focuses primarily on running and cycling, and my design concept is intended for runners.

However, my learning could also be applied to other active contexts, such as other physical activities (cycling), or other on-the-go situations (shopping, commuting).

As mobile phones have become omnipresent in our lives, the role of the phone has changed from a technical device to an extension of who we are. We use our phones as address books, as personal organizers, to maintain our social contacts, and to access information services “on the go.” We almost always have them with us, and we usually leave them switched on. We rely on them to connect us with people and information that that are important to us.

Although mobile living takes shape in different ways, our phones all look and behave in relatively similar ways. Current trends in mobile handsets are that they are designed to appeal to particular “lifestyle” markets; for example, businesspeople, gamers, and the media savvy, to name a few. Although the phones are tailored for different types of users, they all do basically the same thing. Their differences are mostly cosmetic, playing to user’s fashion aesthetic. Some provide bonus features, which appeal to people’s appetite for extra functionality. In contrast, I designed for context and specific situation instead of a lifestyle. My aim is to design for both the businessperson and the gamer whenever either goes for a run.

My starting point was physical activity, specifically, running. Today, taking a mobile phone on a run or on a bike ride is cumbersome. Safety considerations, such as running in a park alone or being injured on a bike, suggest that a phone should play an important role in exercise. During physical activity, many mobile phone users break from their normal behaviour of keeping their phones nearby, because the phone is bulky, difficult to carry, and does not fit within the workout context very well.

In addition to safety, if runners could control the number of the calls that they receive and control the level of interruptions, it could be possible to maintain a connection to the people most important to them. A phone designed specifically for running should not be a challenge to carry. A mobile connection could also offer athletes access to useful information and services specifically tailored to their sport. Already, active people use many devices and training tools to track their progress and improve their workouts. A mobile device designed for active use could bridge their data-tracking requirements by providing location-based services and new communication opportunities, thereby enhancing their workout experience and making it possible for them to carry fewer devices as they run.

My aim is to create a design solution that is derived directly from experience – both my own and the experiences of my test users. I hope my device will give runners a virtual trainer, a workout partner, and a sense of security as they workout. This is possible as my design employs mobile technology in a way that meets users' needs.

2 Background

This chapter summarizes the issues and related work that inspired my interest and research in this thesis.

2.1 The Broad Issues

2.1.1 Mobility

> *Mobile phones get carried around. Phones reside in pockets, in hand bags, on belt clips and in holsters. If these devices did not accompany the user, the main benefit of a mobile phone would be lost – it wouldn't provide immediate access anywhere any more, it wouldn't render the user reachable, it wouldn't be so personal. It would forfeit its bid to be our primary personal communication link to other people and to services.*
> (Lindholm 2)

Mobility takes shape in several ways. It is about convenience, immediacy, and connection. The convenience mobile phones afford us is almost taken for granted these days: we use our phones to call each other when we are running late, when we need directions, and when we have a spare moment to chat. Immediate access to people and information allows us to coordinate and confirm meetings on the spot and receive news updates wherever we are. Most importantly, our mobile phones allow us to always be connected to the people who are closest to us – the ones in our address book, and the information we access most often, such as the URLs that we bookmark.

At the same time, mobile phones can often be inconvenient. Coordinating meetings on the spot is handy, unless we are already in a meeting and we forgot to silence the phone. Mobility allows other people to call us when we might not want to be called, and we have very little control over when our phones might ring. And although we are happy to give directions, when our phone rings it takes some effort to answer it, especially if it is in buried in a bag or deep in a pocket. Although phones are designed to be portable, we have to scramble to answer them before the call "drops," or looses the connection.

Connectivity also presents the risk of distraction. Receiving a call "on the go" takes us away from the context we are in. If we are walking down the street when our mobile phone rings, we are immediately removed from the people around us into a conversation, which the phone enables. It is a link to another context outside of our physical surroundings. Sometimes this link is desired, such as when we are alone in a restaurant or waiting for a train, but more often it creates interruption and distraction from our primary context. It is difficult to mitigate this potential for distraction without sacrificing our presence in our current activities. To be truly mobile, our relationship to a device that affords us availability needs to adapt, so that we are not controlled by its ring, but we are in control of our connection, and the level of disruption we permit.

2.1.2 The Joy of Running

Running is a popular sport for maintaining fitness and cardiovascular health. There are over 35 million runners in the US alone, ranging from professional and elite athletes to hobbyists like myself. There are several benefits to running, including cardiovascular fitness, weight loss, and stress reduction. Many runners find it meditative to run alone. “I focus on me against the elements,” said Adam Kline, 32, a runner from New York City. Others prefer running with a partner or in groups, because it is social and helps the time pass quickly; and also because they find that they push themselves further when they run with others. Another variant within the sport is the level of training. While some runners jog for fitness or fun, on occasion or regularly, others train for endurance and speed. These athletes are more concerned with performance, and therefore require more concentration and focus during their run. Among all runners some things do remain consistent; running requires motivation, persistence and discipline.

Running Gear

There is an enormous market for specialized gear dedicated to running. From essentials like shoes and clothing, to training tools like heart rate monitors and speedometers, to energy bars and hydration drinks. Some training tools are standard for runners training for a race: they require a good chronometer (or stopwatch), a heart rate monitor, and either a speedometer or a route of a known distance. These tools can be cumbersome. During my own marathon training, I wore two watches – one for time, one for heart rate, as well as an MP3 player, a pouch for my money and keys and a water bottle in a holder around my waist. On the body of a runner there is limited space and little tolerance for anything that might bounce, chafe, or add additional weight. An object that incorporates key training tools such as a chronometer, a heart rate monitor, a speedometer, and a music player – would allow the runner to carry one device that fits all of their running needs.

Carrying Mobile Phones

In the past, I have taken my phone with me while running on several occasions. On some occasions I have needed to coordinate a plan with friends, or needed to be reachable during a long training run. It has never been easy though: either I carry the phone in my hand while I am running; or I store it in my pocket, which weighs down the fabric and results in a low-swaying pendulum sensation around my knees. If it rings while it is in my pocket I usually miss the call because I do not hear the phone over the music I am listening to. If I do catch the ring, I need to stop, pull out the phone, look at the screen, and decide whether or not to take the call. And by the time I have already stopped I might as well answer it. The technology built for convenience suddenly becomes more of a hindrance than a help. Like my mobile phone, most phones today are too big and bulky to carry comfortably, and their buttons are too small to negotiate while on the move. In addition, the interaction on most phones relies on visual feedback, which requires a user's attention and visual coordination.

For a phone to work well in the context of running, it needs to be redesigned. Its form and size need to be adapted for use on the move. It needs to be small enough to carry easily, but have large enough buttons to target in motion. Interaction with the phone should be minimal and require as little attention as possible. The service it provides should anticipate what runners need while they are running, and do nothing more, as it is should be dedicated to the specific context of use.

Communication

Communication and running are not an obvious pair. When thinking of jogging, one tends to think of breathing more often than a conversation. However, training experts say that the ideal pace for a casual run is that at which one can hold a conversation. I used to belong to a running group, whose main objective was to keep each other company during long training runs. We would talk, tell stories, and even sing from time to time. Anything to get us through the long miles ahead.

Context-sensitive communication could help runners stay motivated, improve their performance, and enjoy the peace of mind that they can stay focused without making themselves unilaterally unreachable.
I want to give users the ability to connect with other people, but give them control over their communication levels. To give them access to data and information, but allow them to maintain focus on their run, and enhance the experience of running without compromising the context of the activity.

2.2 Products and Services Research

In preparing for this work, I researched a wide range of products in the fitness industry and mobile space. I found that although many mobile phones are specially designed for particular user groups, none provide a complete package -- including a specialized form, features and communication services -- which are designed for a particular context. And while many fitness devices play music or track data, none are designed to enable mobile communication, nor do they take advantage of services that a mobile network could provide.

2.2.1 Mobile Phones

I looked at the design of many phones on the market, ranging from traditional brick-shaped phones, clamshell phones, pen phones and pendant phones. Today's mobile phones have become more and more specialized, from display-less phones with giant buttons to phones that test your blood sugar. These devices were the most influential in my research because they represent a shift in design from standardization to specialization.

Nokia 5140

Figure 2: Nokia 5140

In November 2003, Nokia introduced their first push-to-talk GSM phone geared to the active user. The phone includes a digital compass and fitness coach training software, FM radio, an interval timer, a flashlight, camera and a side button for one-button talk access. The phone housing is more durable and splash proof, and its covers are removable. An active headset is available for one-touch answering and ending calls. The Nokia 5140 is marketed towards active users and outdoors enthusiasts, but is not easy to carry. It is compatible with polar training devices (see below), but requires infrared to transfer data.

Nokia Fitness Monitor

Figure 3: Nokia Fitness Monitor

The Nokia fitness monitor is a stand-alone device, which clips to the user's waistband or belt to track activity level and monitor calorie consumption. Users can transfer the data to the Nokia 5140 Fitness Coach Diary via infrared.

Pedometer Phone

This phone by a Japanese phone manufacturer NTT DoCoMo is designed specifically for walkers. It features a pedometer that can send data to other people, counts calories, and manages incoming calls and messages.

NEC 232 phone

Figure 4: NEC 232 mobile: *Fitness* Magazine's phone for women

This phone was developed in partnership with *Fitness* Magazine, and is marketed to women who go to the gym as the "fitness phone." The *Fitness* Phone includes a number of pre-loaded fitness applications such as a calorie counter, BMI index, workout programs and diet tracker. It represents a shift among mobile phone manufacturers towards segmenting their markets and creating phones that target specific groups.

2.2.2 Fitness Industry

There are several existing products in the fitness industry that track workout data such as heart rate, distance and speed. Many are wearable, and can be synchronized with phones or computers, but most require external accessories to do so, and none enable mobile communication or data transfer.

Polar Heart Rate Monitor

Polar has teamed with Nokia to develop wireless training solutions for athletes. Runners and cyclists can send exercise data from the Polar S625X Running Computer and S725 Cycling Heart Rate Monitor wirelessly to the Nokia 5140 mobile phone, using the Polar Java application. Athletes can track and store training data on the phone and send data to training partners or coaches via SMS. This functionality is similar to that which I am exploring, however it does not integrate the mobile technology into the fitness solution – they remain separate tools. In addition, the infrared data transfer between them requires activating applications on both devices and aligning the devices so that the data can transfer from port to port.

Nike Triax

The Nike Triax system provides heart rate and pace information. It connects to a computer to download workout data, and upload workout plans and watch settings. It includes training software for setting goals, building training plans, logging workouts, and analyzing results. Pre-set alarms alert you when you are outside your target heart rate zone. This system provides for data transfer as well, but it also requires a separate step, after connecting the device to the computer.

Garmin Forerunner 201

Figure 5: Garmin Forerunner 201

A Global Positioning System-based fitness measurement tool for use while running, walking, in-line skating and cycling. One of few tools on the market for tracking GPS position, the large display provides easy readout, but the buttons are small and difficult to use.

Timex Bodylink

Figure 6: Timex Bodylink

The Timex Bodylink is a combination of heart rate monitor, data recorder, speed and distance sensor and GPS device, which work together to track workout details. Information can be uploaded to the PC via a USB cable and analyzed using Timex training software.

Adidas Smart Shoe

Figure 7: Adidas smart

Adidas “hacked” a Hasbro Furby doll in order to build the first smart shoe. The dismantled toy helped them to understand what kinds of motors and switches they could use to build intelligence into the shoe, called “Adidas 1.” The battery-operated microcontroller in the shoe allows it to adapt its cushioning level to changing conditions and the runner’s running style during use. This project is a good example of how technology is being used in wearables to enhance performance and enjoyment of the running experience.

2.2.3 Online Services For Runners

Runners are well represented on the web. Most training organizations have an online presence, and there are several well-known coaching and community services accessible online. I see an opportunity to extend online services to the mobile phone, not just for portable access, but for context-sensitive use that enables the runner to interact with the service before, during and after their run.

mapminder

mapminder (http://www.mapminder.co.uk/flm/) is a web-based route-finding and mapping application in the UK. Along with providing city guides and local interest groups, it features a route-measuring tool that caters to runners. Runners can use the site to measure their regular route, find a new route, or join a running group online.

NikeRunning

Nike.com has created a free online space for runners that includes running plans, calendaring and scheduling applications, training logs, and pace calculators. They also feature online community resources for local Nike running clubs and race programs in several large cities.

Runner's World Personal Trainer

Runner's World magazine provides an online training service that offers exercise and nutritional guidelines for a cost of 70 dollars per year. Runners can access customized race training programs that adapt to their abilities, animated exercise demonstrations, diet plans, and progress reports.

2.3 Design Space and Opportunity

The design space for my project falls between these mobile and fitness solutions: a phone that is designed to fit the runner in form and functionality, and a training device that employs mobile technology to seamlessly transfer data, and to connect to services which support motivation and performance needs of the runner. This space is currently being explored by both mobile and fitness companies, and I believe it is rich with possibilities.

The following two charts map my project within each area:

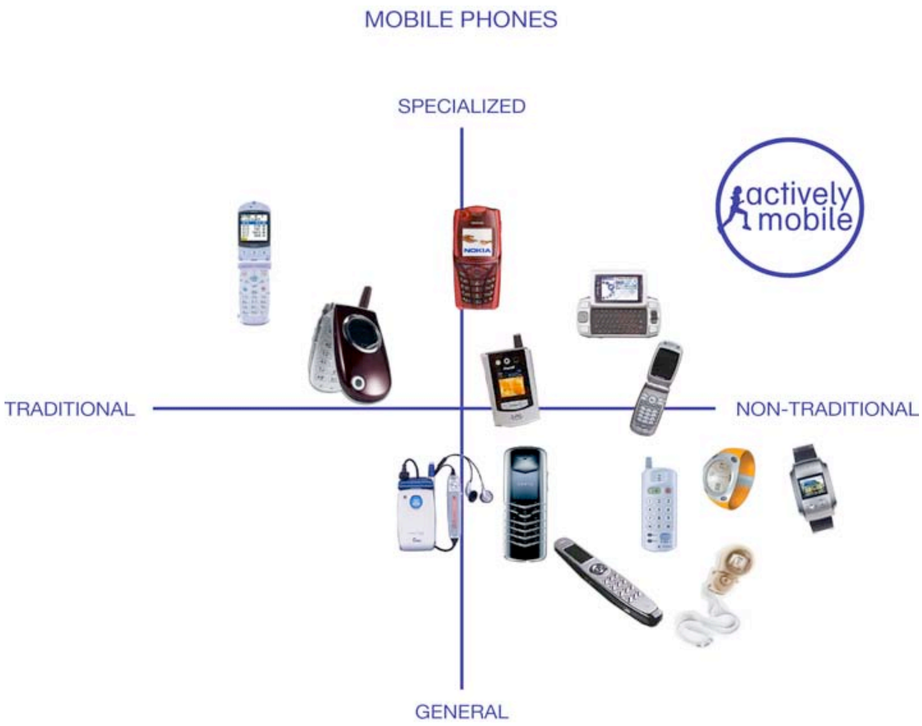


Figure 8: The form of today's mobile phones varies from traditional brick shaped and clamshells to pendants and watch phones. Specialized features range from video to step counting to measuring blood sugar.

Figure 9: Popular fitness devices integrate several training tools into one system, but few consider motivation factors such as music or social applications, and none provide for mobile connectivity and data transfer.

Actively Mobile bridges the gap between fitness devices and specialized mobile phones. It incorporates the biofeedback features of existing devices like the Polar and Timex fitness systems, provides the entertainment of an MP3 player, and enables access to new mobile services such as route finders and remotely-shared runs.
It teams these features with seamless data transfer from the phone to computer or other phones, all packaged in a more wearable form than today's mobile phones. In addition it also gives the user control of their communication so that they do not need to sacrifice their focus for their connectivity.

3 Concept Development

3.1 Phase One

3.1.1 Mobility

“Mobility means something that should work no matter where I happen to be.”

– Charlie Zegers

I started my first phase of design by engaging in user research on mobility and exercise with 15 users: athletes and fitness enthusiasts age 25 to 55. Using a web-surveying tool, I asked them 40 questions about what mobility meant to them, how they use their existing mobile phone, and what devices they use in the context of a physical activity. I followed up my initial series of questions with a two-hour discussion among five of the participants. Here we went into detail about fitness goals and routines, and how communication could enhance the active experience.

“Mobility”, said Charlie Zegers, age 33, of Westchester, NY, “means something that should work no matter where I happen to be.” Like many of my users, Charlie uses his phone for both business and personal calls, to stay on top of work at the office and to stay in contact with his wife and son. For him the mobile phone is both a productivity tool and a security blanket, a way to know he is reachable should his family ever need him in an emergency. Charlie runs daily, training longer distances for a marathon once a year. Instead of taking his phone with him on his runs, he sticks to routes where he knows he can find a public phone.

Jeannine Durfee, age 35, of Brooklyn, NY, explained her thoughts on taking a phone with her when she is in the middle of an activity: “I would like to know if someone was trying to reach me...but not have the pressure of talking when I'm busy doing something else.” She also told me a familiar story: “Usually I have my phone in my bag so I don’t think of it very often unless it rings. This afternoon I was in the fitting room of a clothing store trying on a dress when my bag started beeping and vibrating. Even though I was in mid zip, I felt I had to answer it. It was a friend, calling to chat while she was on her way to an appointment. So I tried to talk to her, and manage the outfit changes at the same time. I was balancing the phone between my shoulder and my ear, trying to respond without distracting the other people in the store.” She explained, “I carry this [phone] with me all of the time, but then I feel somewhat trapped by it when it rings.”

It is common to feel obliged to speak to someone who calls us on our mobile phone. As author Dr. Sadie Plant (30) says, “Incoming calls provoke a sense of expectation, even urgency, which is why we usually feel compelled to answer a ringing phone even when we know the call isn’t for us. A ringing phone demands a response.”

After my initial research, I found three consistent themes amongst my users:

- They usually carry their phones in a pocket or a purse, and need to dig out the phone to see who is calling when it rings, at which point they usually answer it;

- Almost all of my users take their phones everywhere they go, except when they exercise;
- They most often use their phones for coordination on the move.

They all saw great potential in having a device that combined communication and data tracking, as long as it was somehow wearable, and did not have to be carried in their hand.

This research strengthened my hypothesis that a mobile device designed specifically for fitness could answer the needs of my user group, and possibly extend to active people in general. The research showed that the device would need to the following:

- Give users awareness and control over incoming calls;
- Provide an awareness that does not require users to stop what they are doing;
- Enable multi-tasking;
- Prevent unnecessary interruptions.

3.1.2 Idea Generation

Inspired by my user research, I sketched out a number of ideas specifically related to new functions and services of a mobile device aimed at fitness. One of my ideas for new services and functions included audio feedback on a run. This would eliminate the need for a screen while using the device in motion. This idea led to my first prototyping exploration.

3.1.3 Audio and Voice Control

gure 10: Improvised role-play

Following my user research, I began to explore using audio and voice cues while running. In collaboration with Nathan Waterhouse, one of my classmates at Interaction Ivrea, I set up a series of improvised role-play scenarios for using voice control as a way to respond to a phone call that is received during a run. I tested three ideas:

- Using one-word commands;
- Prioritizing calls based on urgency;
- Using preset filters to limit incoming calls.

I learned three key things about control:

- That giving control to runners over which calls he will accept is very important;
- That passive control, such as a one-word command, feels unobtrusive and manageable;
- That pre-set filters work well as they limit interruptions and give the runner the flexibility to customize the list of which calls get through.

At the end of this phase, I began to work on the interactions for my new “active mobile.” I began from two starting points: first that the phone should transform from a normal mode of use to an activity mode of use; and second that the device should incorporate a physical shift approach – such as components that pop out of the back – to signify the change from normal use to use within an active context.

3.2 Phase Two

3.2.1 Context

My goal in phase two of my design was to understand the context of the athlete while running and cycling, and how the circumstances of physical activity could inform the characteristics of my device.
I spent a lot of time running and cycling by myself and with others, documenting the experience and taking notes on several factors. I found that the circumstances of the two activities are very different. For example, runners need to save their breath – running up a hill can result in shallow breaths or panting. So a voice-based input system may work for a slow-paced jog, but not for an all-out run.

I found their communication needs to be quite different as well – whereas runners can easily communicate with running partners along side them, for cyclists it is not so easy. They need to face front and keep their focus on the road, so communicating with cycling partners who are in line behind them is quite difficult. The implications for a mobile communication device are different with each activity. A device for runners would be used to connect them with people who are outside their circumstance; for cyclists it might primarily connect them to each other while en route.

Attention and focus are key elements of both activities. Therefore a mobile device that respects the context of the activity should create minimal distraction. Input from the user should be passive wherever possible. This observation led to the idea of setting functionality in a set-up mode, thereby minimizing interaction with the device during the activity. This type of set up mode also addresses the ritualistic aspects of running and cycling. Most athletes maintain predictible routines, within which workout presets could provide a repeatedly reliable experience. A device that knows the athlete's habits would be the least disruptive of all.

3.2.2 Prototyping Interactions

Along with the user observation that I conducted in my second phase, I also continued my exploration of interactions with the device. Building on the role-playing exercises that tested communication parameters of the device, I developed a second round of prototyping exercises to gather criteria for its physical design.

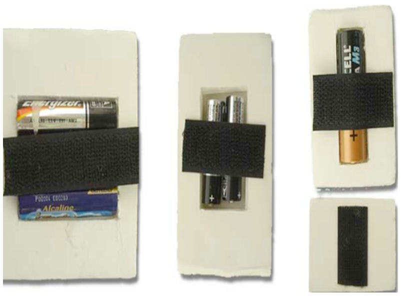


Figure 11: Foam-core props used for prototyping

I used simple foam core pieces to test weight and positioning of the device, and how individual components might be distributed on the body. Each component was a different size and weight, and users were asked to attach them to themselves using Velcro, and an armband or a belt. The users then went through a series of pre-defined tasks, while either running or cycling, and to verbally describe their thoughts. They were asked to initiate and respond to phone calls, check their voice mail and text messages, and define a list of callers whose calls they would accept. They tried audio commands, gestures, and their own spontaneous ideas on how to interact with the device, which responded through simulated audio feedback.

Findings

I found audio to be the best way for the device to communicate with the user for both running and cycling, because it is not disruptive and it does not require any additional movement. Audio cues could also

Figure 12: Video still from prototyping exercise

be used for performance motivation, learning, and feedback on pace and time.

Voice input proved to be good for interactions that lead to vocal communication such as answering calls, and for complex input such as dialing a number. Among the three types of vocal input tested, user-defined commands such as “accept” or “answer” worked best. Although voice worked quite well for cycling and light jogging, it did not work consistently for running. Therefore for simple commands such as volume adjustment, buttons or gesture could be easier.

The runners unanimously agreed that the device needed to be minimal, lightweight, and dispersed on the body. One user aptly suggested, “I want it to become part of the gear.” Each user had a different preference for positioning, ranging from the arm to the wrist to the hip. This finding was not very surprising given the range of fitness products on the market – most are geared for the arm, the wrist, or the hip.

For the cyclists there was less debate. Since balance is essential in cycling, most movements that require crossing the body are difficult, The most logical placement for a cyclist’s device proved to be on the handlebars of the bike, with the earpiece embedded into the helmet.

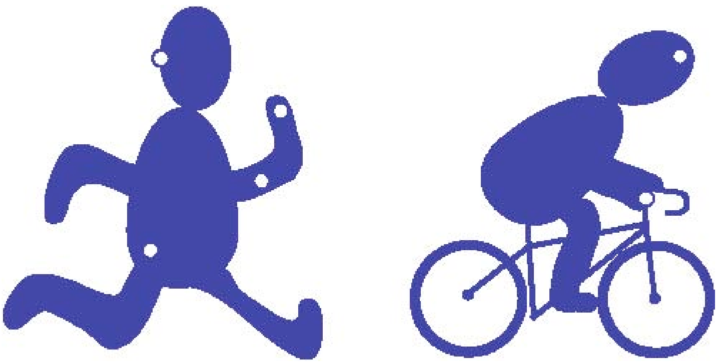


Figure 13: Recommended placement of a mobile device for runners and cyclists.

Based on these findings, my concept moved toward a minimalist, modular device, that uses only the key parts of the phone's functionality, and as few buttons as possible. I realized that solutions for running and cycling would need to be different, based on the different user needs within each activity. I decided to further prototype a device for runners, pursuing the idea of a kit of parts that can be separated and then put back together.

3.3 Phase Three

3.3.1 The Convertible Mobile

At the start of phase three I began investigating the kit of parts concept, which I dubbed the "convertible mobile." I started with a foam core device which separated into three pieces – a traditional mobile phone shell, including the keyboard and screen, an earpiece that popped out from the bottom of the phone, and a small square embedded in the back of the phone, which when removed could control a subset of the device's functionality. The small square (the "remote") would be worn on the body – on the arm, wrist or hip – and paired with the earpiece to operate the device while in motion. This concept was rooted in the idea of leaving the bulk of the phone behind, including the screen and the keys, and taking along only the necessary parts.

Working with the concept of modes, I categorized a runner's interactions with the device into one of three types: device setup mode, activity-mode, and post-activity mode. Thus runners could configure the features of the device before detaching the remote (using the screen and the keyboard), and then use only the remote and headset once they are in motion. Likewise, once they return home and re-assemble the device, they can manage the data they have tracked during their workout.

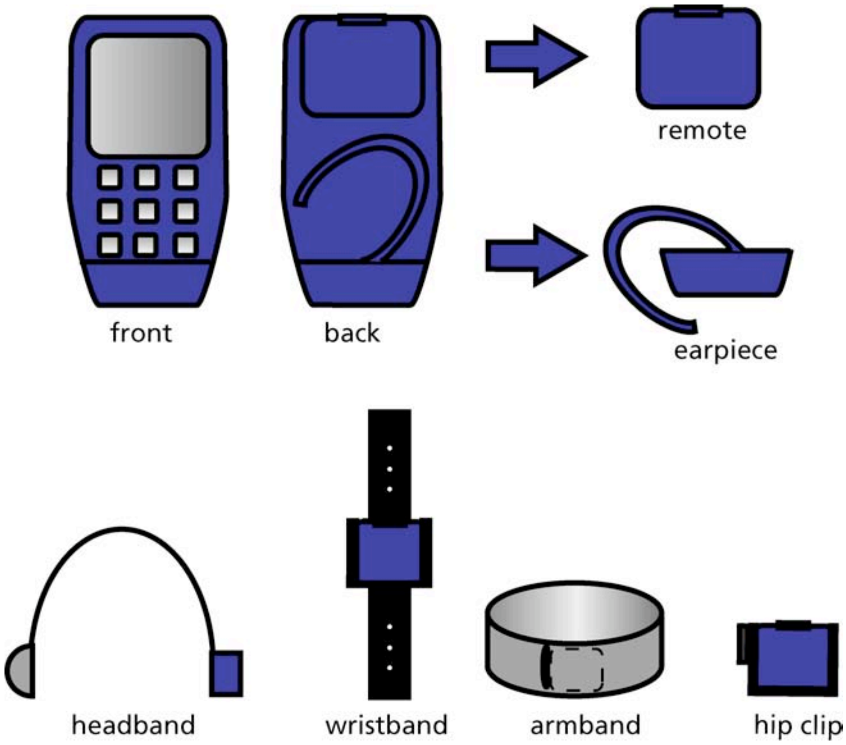


Figure 14: Sketches of the “convertible mobile” concept. The earpiece fits into a stereo headband, and the mobile ‘remote’ fits into a wristband, armband or hip clip.

3.3.2 Modes

The different mindsets of the runner during different stages of activity, and their corresponding needs at each stage, are central to the convertible mobile concept. Therefore, while prototyping the form of the device I also focused on analyzing the modes of the runner. I did several iterations of task analyses to better understand the mindsets a runner goes through and their implications for my device

Starting from runners' preparation stages, I mapped each of their actions to the devices they might use. For example, runners have little use for a heart rate monitor while they are tying their shoes in preparation for a run, but once they get going they will be very interested in this feature. I then mapped runners' interactions with each device throughout the stages of their activity.

context	**task description**	**applications**						
		chrono		speed	heart rate	mp3	phone	
		time	stop watch	mph/ kph	BPM	digital music	make calls	receive calls
decide to run	change clothes							
	grab gear	x	x	x	x	x		x
start out door	check time	x						
	choose mp3 track list					x		
	volume					x		
	start heart rate monitor				x			
	start chronograph		x					
	start spedometer			x				
	behind						x	x
	OR set phone to running mode	*x*	*x*	*x*	*x*	*x*	*x*	*x*
	choose route							
start running	fiddle with music					x		
	change tracks					x		
	notice when hr climbs into range				x			
mid run	adjust volume					x		
	skip track					x		
	check time lapsed		x					
	check heart rate				x			
	check speed			x				

Figure 15: Excerpt of task analysis (see appendix for full worksheets)

Runners will want to choose appropriate running music before they head out the door, for example, but once they start running they will make more use of the volume and "skip this track" functions. I wanted to separate out the interactions that fall into a "preparation mode" and those that are required while the runner is in motion, so that I could design as few interventions as possible – a minimal experience that represents minimal distraction from performance. Lastly, I mapped each of the runner's interactions with the device while in "running mode" to two buttons on the remote.

3.3.3 Functionality

I identified the following functionality for The “Convertible Mobile” device, relatively unchanged in my final solution:

- Phone – Designed to be used primarily for emergencies and important phone calls. The device receives incoming calls and makes outgoing calls. Users program the device so that only certain calls are announced, and choose at any time whether or not to accept a call or to hold all calls. They can also request status on any missed calls at any time.

- MP3 player – Music has a motivational impact on many runners. The MP3 player is the most common piece of equipment carried by runners, so it is a key component of my device. Users can download music and set up track lists before they start running, and then use simple functions like volume adjustment and track skipping once they are moving.

- Chronometer - A chronometer is an essential training tool for runners, allowing them to time their runs and compare them to past workouts. The chronometer can be activated from the remote or by voice, and workout times can be saved to the phone for future reference.

- Speedometer - By integrating an accelerometer into the device, runners can also track their speed with a simple press of a button. They can also program the device to deliver feedback at set intervals, such as in between songs or every 5 minutes.

- Heart Rate Monitor – Using a sensor clipped to the ear (attached to the device headset) or a heart rate belt, the device can track the runner's heart rate and indicate when the runner within his desired training zone. The user can set up various training profiles to customize device feedback.

- Location tracking – A GPS module within the remote allows the user to tag two locations on his route and track the time it takes him to run from one to the other. This route is saved in the device so that he receives automatic feedback on his performance each time he passes by the tagged locations.

Users have the choice of using pre-programmed voice commands or the buttons on the remote to interact with the device while they are running. All feedback from the device is audio. The device can be worn on the arm, the wrist or the hip, wherever the runner feels is most comfortable.

3.3.4 Video Prototype

gure 16: Scene from the video
rototype

To test my concept I turned once again to role-play. I wrote a narrative about the events in the day of a runner (based on user research and my own experience), and then documented the scenario in video to illustrate the concept and test its validity. In working with a runner to visualize the concept, I was able to pinpoint the issues that needed further thought. For example, my initial concept for switching among the features of the device was to press down on a small button at the top of the remote, but tapping the remote repeatedly to tab through the features (in this scenario, worn on the arm) quickly proved to be impractical. Several viewers of the video echoed this observation, among other feedback that the video generated. For this reason, I found the video prototype a valuable tool for evaluating my concept and learning where to focus further iterations of my design.

3.3.5 Audio Feedback Prototype

At this point I also implemented my first technical prototype, a script designed to provide a preliminary idea of how audio feedback to interaction with the device would work best. I tested two simple interactions: Tabbing through the device features, and receiving a phone call.

In my first test, when users tapped the device twice (simulated on a computer screen) the device would respond with the words "chronometer," and then "speedometer." Although tabbing through the device features proved to be laborious, I found the audio cue was an effective way to orient users as to what feature they were accessing.

In my second test, I wanted to simulate the interaction between the phone and the MP3 player if a call came in while music was playing. By lowering the music to coincide with an incoming call announcement such as "new call from Jennifer," I was able to test how users would experience audio feedback from the device while listening to music.

4 Design & Implementation

4.1 Phase Four

4.1.1 Device Design

Figure 16: Three-button interface

My first challenge in this phase was to solve the problem of tabbing through features presented by the two-button device interface. I created a series of flash prototypes that simulated interface variations for accessing the main features of the device. The features I tested included: the phone, MP3 player, chronometer, speedometer, and heart rate monitor. I also tested starting and stopping a function and checking its status

I tested various interaction mappings and navigation flows through the functionality of the device. By simulating physical input and audio output, I was able to quickly pinpoint the issues with each interface layout. For example, a simple three-button interface – one large button in the middle with two smaller buttons on either side – required that the user tap the large button to start the chronometer, and then hold down the same button for a few seconds to access to the heart rate monitor. The amount of time and attention required to cycle through the features in order to stop the chronometer was unacceptable. This exercise confirmed that independent access to the main functions of the device was necessary.

I tested several versions of a multiple-button layout, and refined each one until the combination of physical input and audio output was satisfactory. Following are for four examples of my flash prototypes:

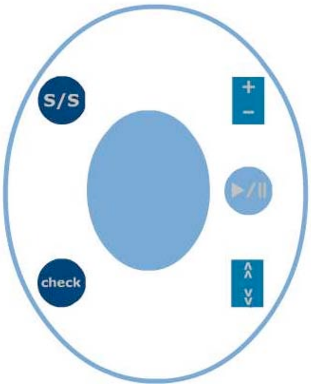


Figure 18: Moving a finger along the perimeter of the middle button accesses each function

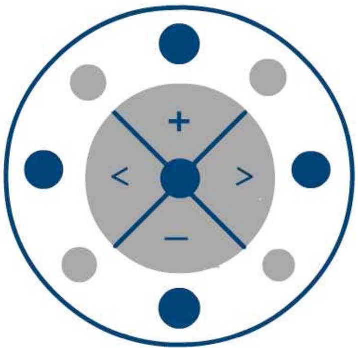


Figure 19: Controls are in the middle and functions are accessed on the outside ring, positioned like numbers on an analog clock or telephone.

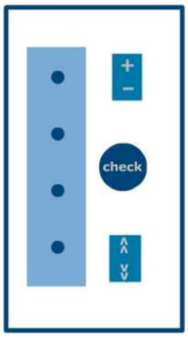


Figure 20: Functions are accessed along a vertical strip.

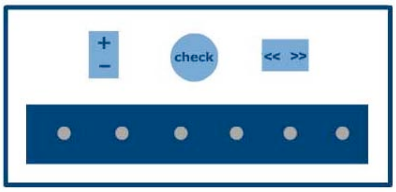


Figure 21: Functions are accessed along a horizontally strip.

Once I narrowed the possibilities to a few, I then tested the placement of each layout on the arms runners to see which orientation worked best. To do this, I created a simple prototype using foam pieces and a felt armband. The foam pieces represented a range of buttons positioned vertically, horizontally, and in a circle. I found that finger memory and accuracy while in motion was most successful with a vertical layout, because the button placement mirrored the natural position of the fingers.

My next step was to create a physical prototype of the device interface and define the form of the device. I used forest foam to cast the imprint of my fingers across my arm and my wrist. This prototype helped me understand the curve of the fingers and define the ideal placement of the buttons within a three-dimensional form.

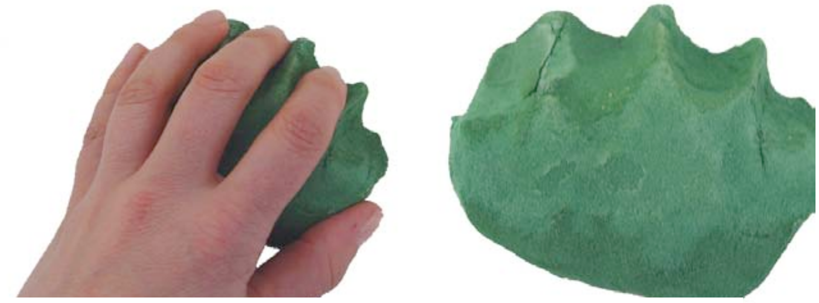


Figure 22: Using forest foam, I cast a mold of my fingers. This helped me determine a natural form for the physical interface.

Next I created a series of sketches and physical prototypes of the device to determine its ideal shape and size. I tested a number of ideas and evolved the shape of the device from 3D sketch into a defined interface layout.

Figure 23: Three-dimensional models of the device at different stages of development

4.1.2 Service Design

In my design, both the services and object are integral to the final the solution. Therefore in tandem with designing the physical device for Actively Mobile, I began exploring the mobile services that users could access through the device.

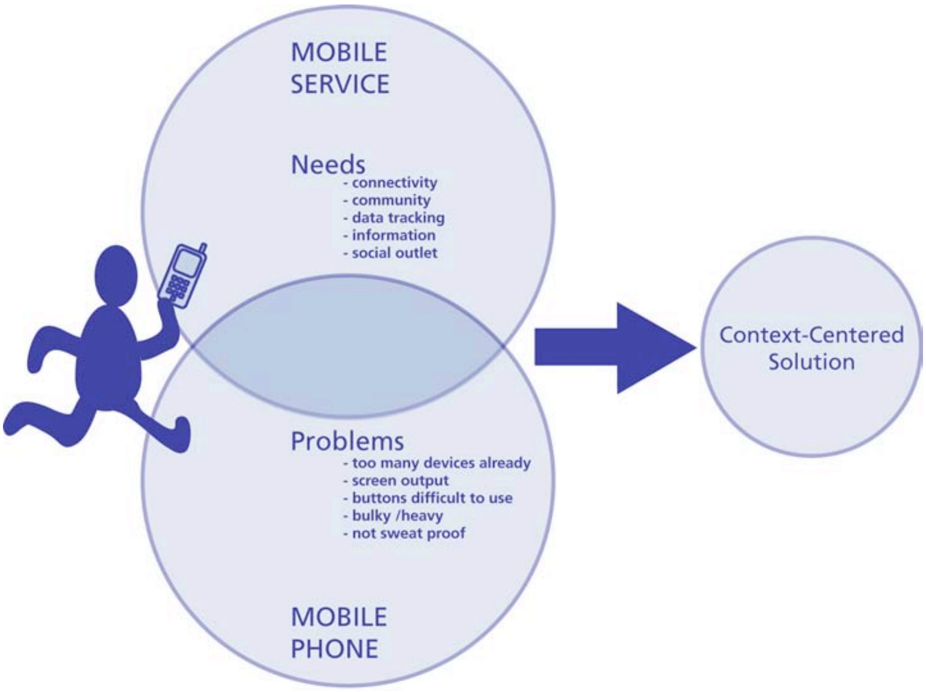


Figure 24: My context-centered solution is derived from looking at both the device and service-level opportunities.

To begin my service exploration I went back to my user research. Based on my users' interest in social, informational, and performance-related services, I brainstormed several service opportunities:

- Buddy runs – Two runners in different locations can create a direct connection during a run.

- Goal setting/motivational prompts – The runner sets up goals for time, pace and heart rate, and can received automated prompts and encouragement based on performance. Results can be stored and compared to previous results online or via mobile.

- Locating a partner en route – When one runner arrives late to an organized meeting point, he can find the other runner.

- Pace setting – When two people run in different locations, either at the same or different times, one runner can set the pace for the other.

- Route finder – A runner can download audio narration based on desired location and distance of a run, and then follow the audio guide for a narrated tour along a new course.

- Route tracking – When two people run in the same location at different times, one can set a route for the other. The second runner can "follow the tracks" of the first runner.

- Shared audio tracks – Two people running simultaneously can synch their audio tracks to the same music.

- Smart playlists –The runner chooses music based on pace and/or mood. The device changes tracks depending on heart rate, pace, or mood input.

Each of these services makes use of the training features of the device, adding a layer of network access (UMTS), to enable communication and data transfer. For example, two friends in two different locations could run together, linked through their devices. They could pace each other by accessing a soundtrack of the other's speed, and chat while they are running (if they are able to, that is). Or if running partners need to run at two different times, one could save route and pace information that another could access at a later time. Any biofeedback and workout data could be saved to the phone for future reference.

services/features	UMTS	MP3	HRM	GPS	CHR	SPD
buddy runs						
goal setting/ motivational prompts						
locate partner enroute						
pace setting						
route finder						
route tagging						
shared audio tracks						
smart playlists						

Figure 25: Table shows the combination of features accessed for each service idea

I mapped these services on a scale from informational to performance-based activities, and from individual to social experiences:

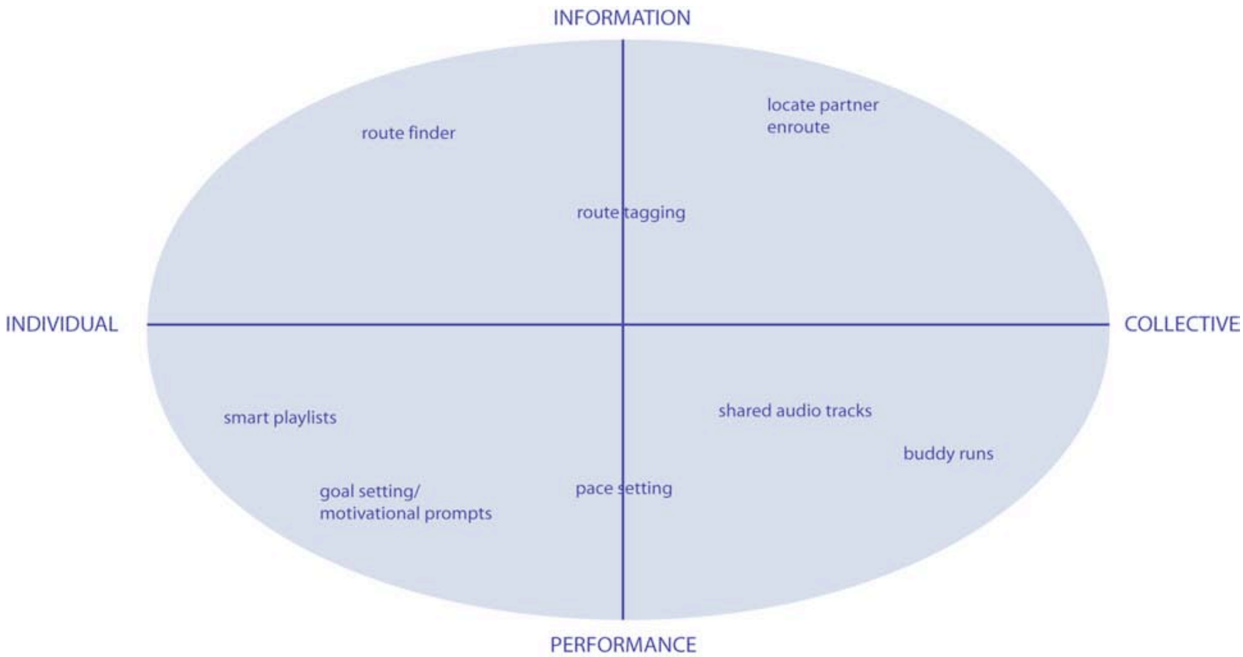


Figure 26: Service ideas mapped along social and informational axis

After validating my ideas with several runners, I chose several services to prototype further and incorporate into my device: goal setting, pace setting, route tagging, route finders, and buddy runs.

Experience Prototyping

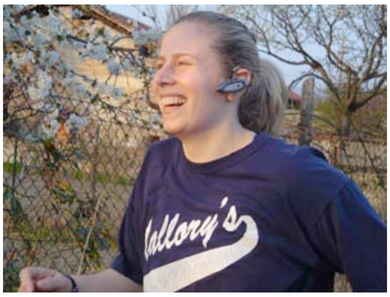


Figure 27: Runner 1 enjoys the conversation and distraction of running with a friend

To test the concept of shared runs I set up an experience prototype. I used another runner and myself as test subjects, and planned an outing to "meet," and then run "together," connected by the hands-free headsets on our mobile phones. We ran for thirty minutes, and found ourselves chatting away for most of it. Discussions with the runner about the experience confirmed that the strength of the idea us was in the motivation to meet and the distraction we provided each other. The experience was remarkably similar to running along side someone, apart from the occasional remark on the noise we could hear in each other's surroundings.

Figure 28: Runner 2 is motivated to run faster because she can hear the

In a second experience prototype, I simulated the idea of pace sharing between two remote runners. Through this experiment I confirmed that the sound of a faster pace does help to motivate runners to run faster, much like hearing a faster partner's cadence in person. This led me to mimic the real world circumstance of pace sharing in my design, wherein one's pace is public information that others can use to their benefit if they choose. I decided to incorporate the pace-sharing concept into the "buddy run." Once the link is established between two partners, either one can choose to listen to the other's pace if they feel it might help their performance.

My third exploration of these ideas was additional user research. I consulted with 15 runners of various levels, and asked them about their goal-setting and performance-tracking habits. Their experiences ranged from those who kept training journals daily to those who maintained a vague idea of their running times, but never kept record of the information. "It's a good way of determining what kind of shape I'm in," said one runner, a comment that was echoed among several responses. Most of the runners who did not record their workout data expressed interested in the feedback were it easier to obtain. This confirmed my belief in my goal-setting and performance-tracking ideas, which I incorporated my design of the feedback functionality of the device and a virtual training service.

I asked the same runners about the criteria they used when selecting new running routes, and how they found good routes when they were away from home. The criteria they used were collectively similar –

green scenery such as a park, rivers and lakes, traffic-free zones, interesting buildings and city landscapes. They all agreed that running while away from home was a great way to experience a new location. One runner commented that it was “a fun way to see a new city, because you cover more ground faster by running than by walking.” Another explained, “An interesting new route to me is one that either lets me see a part of a city I wouldn't see otherwise, or a beautiful scenic course.” I used the runners’ feedback to design the selection parameters of the route-finding service.

4.1.3 Mobile interface Design

My third stream of work in this phase was the design of the on-screen interface used for setting up the Actively Mobile system. The on-screen interface is an important component of the system because it enables the user to configure their experience before activity. Its parameters were complex, but the interactions needed to be simple and require minimal effort. I started by documenting all of the settings that I needed to represent, and organized the information by feature, by importance, and by frequency of use. I created a hierarchy within each feature group, and then tested which information was primary, and how much could information fit on a screen without overwhelming the user. I decided to create a status screen that would display the current settings, so that users could view their most recent selections and decide which settings (if any) to change. After several rounds of sketches, I created three iterations of the status screen and related editing screens:

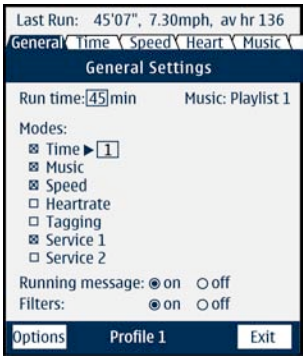


Figure 29: This version contained too much information and too many screens; it was quickly revised.

Figure 30: In this version, users could input numbers, toggle functionality, select from pull-down menus from the status screen. Too many editing options weakened the status view.

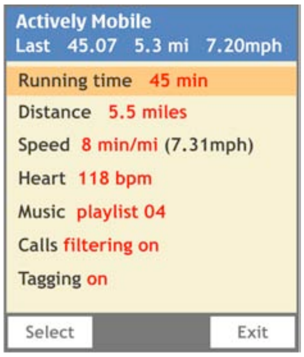


Figure 31: In the final version, one element is highlighted for each function. Selecting a function leads to an editing screen, where minimal information is presented.

My first version of the interface was based on a tab navigation scheme. This way of accessing information was too linear and required users to “tab” through too many screens to reach the menu they needed. In my second version, I relied on joystick navigation to “tab” users through editing fields and access additional settings. This was an improvement my first draft, but the complex editing options on the main screen conflicted with its purpose, as a capsule view of current settings. The main screen in my final design provides a view of the most important information, and users can enter an editing mode for any feature by selecting the line of text. The left soft key is then contextualized for each action the users take to edit settings.

4.2 Functionality Prototyping

In my final phase of development I focused on prototyping the device functionality: building the electronics, creating a refined 3D model, and incorporating the service experience into the device interactions.

Based on my previous experiments, I mapped the functionality of the device to the interface. I grouped the device features according to their similarity and frequency of use, and arranged them according to their frequency of use and the natural position of the hand resting on the device:

- Time, distance/speed, and heart rate
- Scroll/start/stop
- Music play/pause/stop, forward, back
- Volume up, volume down
- Location tagging

I then built a radio circuit to prototype interaction with the device. Through this circuit, voice commands or physical inputs from the device trigger audio feedback from a headset to simulate the experience of using the device.

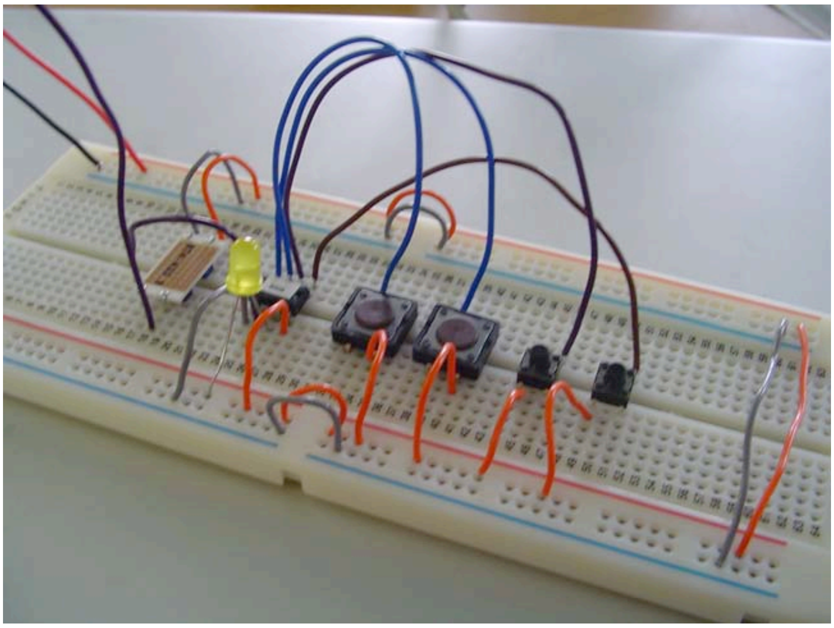


Figure 32: The transmitter unit sends radio signals (see appendix 10.4 diagram)

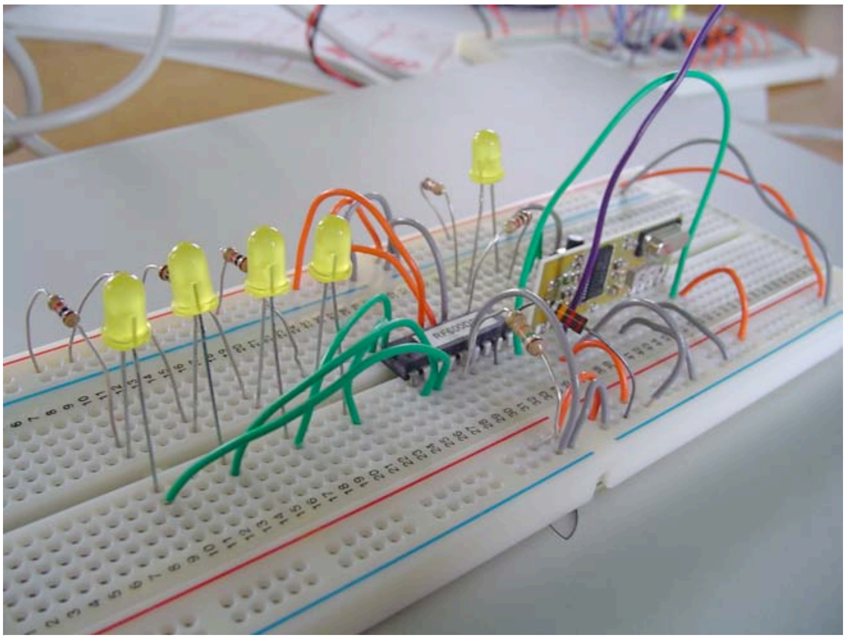


Figure 33: The receiver unit reads radio signals (see appendix 10.5 diagram)

My next step in prototyping was to code a simulation of the device interactions. For this I used Macromedia Flash MX, which I interfaced with the Wiring[1] microcontroller platform, to receive input from the device and output audio feedback. Using the techniques described in Instant Soup[2], I passed the user's input from Wiring to Flash, which then simulated the device's audio response. I was able to simulate the use of voice commands in a similar way, by linking the Macintosh speech recognition server with Flash. The audio feedback triggered by Flash is passed via Bluetooth to a mobile headset. The goal of the final prototype is to enable users to start and stop basic device functionality by using voice commands or the physical interface of the device, and to receive audio feedback from a headset as if the device was working.

[1] Interaction-Ivrea thesis project by Hernando Barragán. For more information see http://atari.uniandes.edu.co/wiring/.
[2] Interaction Ivrea project by Yaniv Steiner, Giorgio Olivero, Massimo Banzi and Paolo Sancis. For more information see http://instantsoup.interaction-ivrea.it

5 Design Solution

5.1 What It Is

Figure 34: Final prototype of the Actively Mobile device

Actively Mobile is a mobile solution for runners, which integrates traditional training tools with new mobile services, and enables voice communication with control. Because it is designed specifically for running, it is easy to use and supports the mindset of the runner in motion. The primary touch point of my solution is the Actively Mobile device. It is a small disc worn on the wrist, arm or hip of the runner – wherever is most comfortable. Through this device the runner can access functionality only available currently by carrying several devices: a stopwatch, a speedometer, a heart rate monitor, an MP3 player, and a mobile phone. Integrating these features creates new opportunities to support the running experience, including specialized services designed to aid motivation and performance.

5.1.1 Basic Functionality

Interaction with the device is based on its context of use. When the users are not running, they can pair it with a screen and keyboard shell, and use it like a traditional mobile phone. Before they head out on a run, they switch the phone to active mode, set up their running program, and remove the keyboard and screen. Once the disc is separated from its shell, feedback is delivered via audio through a Bluetooth headset, which also snaps into the shell for normal microphone use.

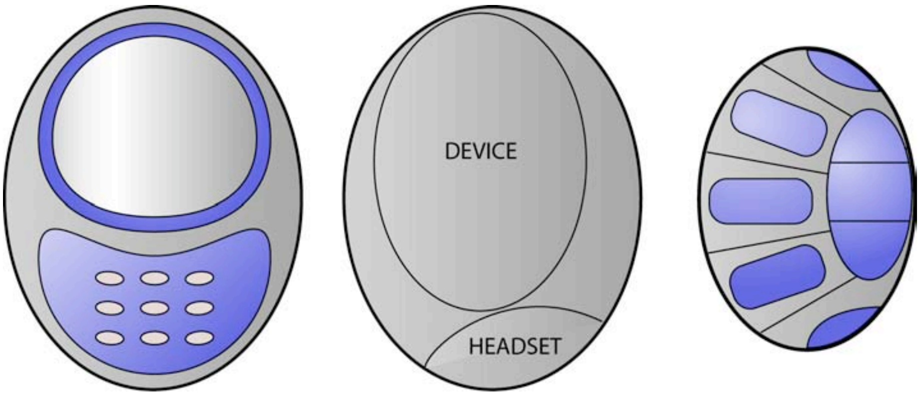


Figure 35: The device and headset can be paired with a screen and keyboard shell for normal phone use.

The user interacts with the device through voice commands or a small number of buttons that are shaped to fit the hand. They can use it in the following ways:

Time Tracking

Runners can preset their goal running time, and select either automatic feedback (set to a time or distance interval), or manual progress check. They start the chronometer when they are ready to run, with either the “time start” command or a button press. Throughout their run they are automatically notified of the time elapsed, according to the preferences they have set. The duration of their run is stored in the device memory and can be automatically transmitted to other mobile devices or computers through the mobile network (long range) or Bluetooth (short range).

Distance/Speed Tracking

Runners can preset a goal distance and speed, and select either automatic feedback (set to a time or distance interval) or manual progress check. They start the speedometer when they are ready to run, with either the “speed start” command or a button press. Throughout their run they are automatically notified of their mileage and speed, according to the preferences they have set. Like their running time, the runners’ distance and speed are stored in the device memory and can be automatically transmitted to other mobile devices or computers.

Heart Rate Monitor

Runners can adjust their target heart rate range, and select feedback in beats per minute or percentages. Once they start the heart rate monitor, with either the “heart rate start” command or a button press, they will be notified of their current heart rate or when they are out of range, according to the preferences they have set.

Music Player

Runners can download music playlists to their device from their computer or a network server. They select a playlist to listen to before they start their run, and can then skip forward and backward with in the selection while en route. They control the music with simple voice commands (i.e. “music start”, “music skip”) or a button press. The music volume is synchronized with the feedback volume so that both sounds are audible at all times.

Mobile Phone

Runners decide whose calls they will accept. They can maintain a set list of allowed callers, or choose to edit a list before each run. Calls from people who are not on the list are automatically sent to voice mail. Allowed calls are announced through the audio headset. Runners can accept the call by responding “answer” or by pressing any button on the device. If they do nothing the caller is sent to voice mail. They can also preset a custom running message (i.e., “I can’t talk now because I’m on a run!”) to be played for all or selected callers. Runners can disconnect from a call by voice command – “end call” – or by pressing any button on the device. Music and audio feedback audio are automatically paused for the duration of calls.

Runners can make outgoing calls by using the voice command “new call” plus a name from their address book. To call a new contact they can dictate the phone number and save it to their address book for future use. For added safety, the voice command “SOS” automatically calls the local emergency service. Text messages can be sent and retrieved by voice.

5.1.2 Services

Pairing the training tools that runners are accustomed to with a mobile connection creates new opportunities for dedicated services. The services I outline below are three examples of services that could be implemented through the Actively Mobile device.

Buddy Runs

For many runners, setting a time to meet someone else is the only way to get them out the door. Logistics and distance often make this difficult, however, and people who prefer to run in groups are often left to run alone. The Buddy Run service allows two or more people to run “together” in different locations, so that they can benefit from the motivation of meeting friends without the location logistics. After the friends set a time for a shared run, one runner schedules the run in the Actively Mobile calendar (through the mobile phone or the web). When the scheduled time arrives, the communication link is opened, and each friend receives a message that the Buddy Run has started. The runners can then join the group by switching to “Buddy Run”, using a navigation wheel on the device. Through the Buddy Run link runners can talk to each other as if they were running side by side, encourage each other to keep going and push themselves further.

One of the benefits of social running is keeping pace. Two runners will often run faster together than on their own because they unconsciously match each other’s pace. Through the “Buddy Run” link, linked runners can listen to each other’s pace as if they could hear the other’s footsteps. When they select “pace track” from the Buddy Run menu, they can access an audio click track that matches the pace of the other runner, much like a metronome used to keep time in music. This pace meter helps runners push themselves and each other toward better performance.

Virtual Trainer

Some runners, especially competitive ones, depend on quantitative data to measure their performance and push themselves further. For these runners Actively Mobile provides several ways to track performance and analyze their progress. The integration of functionality within the Actively Mobile device makes this possible. Runners can access a log of their past workouts through the Actively Mobile application on their mobile phone or a computer. They can compare their run times, distance, speed, and heart rate to the goals that they preset, and enter additional information about their workout. They also can visualize the relationship between the different types of data, for example how their speed affects their heart rate, and how their distance affects their pace.

In addition to basic data tracking, runners can use the GPS functionality to tag locations on their route for automatic feedback. For example, within my regular route, I might run three laps in a park. The tagging feature would allow me to tag the start and end points of the first lap, at which time I would hear my time and pace for that lap. As I complete my second and third lap, Actively Mobile tells me my time and pace again, and automatically compares my performance: Time – "10'32. Average pace – 9.2 min per mile. 46 seconds faster than last recorded time." Or for example, runners who jog home from work everyday can tag their start and end points, in this case their office and home, and automatically hear feedback on their pace from day to day. "Time – 44'15. Average heart rate –136 BPM. 7 BPM higher than last recorded heart rate." Runners can preference the feedback they are given in the setup screens, and delete their tags at any point. (Creating new tags automatically deletes the last set of tags.)

Runners can also configure the Actively Mobile device to automatically send their workout data to another mobile phone or computer while they are running. Those who are training for a race can sign up with an Actively Mobile trainer, who can help them plan their workouts, analyze their results, and even provide remote coaching during a run by tracking the runners' performance online.

There are many opportunities for third-party collaborations with the Virtual Trainer service. For example, recognized running experts and training centers could provide their services through the Actively Mobile system; or alternatively, runners enrolled in other virtual training programs from trusted brands such as Nike or Runner's World could automatically feed their data into their existing training log.

Route Finder

Many runners enjoy exploring new routes when they are travelling or looking for a change in routine. Most runners tend to look for something scenic, by greenery or water, away from the pollution and traffic of cars. To find new routes, they often ask other runners, or look in guidebooks or on websites. The actively mobile "Route Finder" service connects runners to new routes and provides an audio tour tailored to tourism on the run. Runners can access the route finder from their Actively Mobile phone, which knows where they are. They can select their current location or a new location, and view a selection of routes in their area, based on their mileage preferences. They can view details, comments, and a map for each route, and choose the route that suits their mood. When they select a route, an audio track is downloaded to their phone, and they receive sms instructions on how to arrive at the starting point from where they are.

At the start of the route they start the audio guide, by pressing the play/pause button or saying, “guide start.” As they run along their new route, the guide introduces them to the scenery around them, instructing them on where to turn and what to expect to see. The guide is calibrated to the runners’ average speed and knows their location through GPS, so it provides a seamless audio experience. If the runners want to pause the guide for any reason, however, then can use the play/pause button or say “guide pause.” The guide is automatically paused if a phone call comes in, and can be restarted, or skipped forward or back at any point

The “Route Finder” service can be paired with various third parties to provide specialized route types and audio guides. For example, an outdoors magazine can offer nature tours or trails runs, and a city guide such as *Time Out* could provide tourist guides for visiting runners.

5.2 How It Works

The Actively Mobile device is designed for use on either side of the body. The layout of its buttons symmetrical, and includes a tag button, start/stop button, and navigation wheel – easiest to use with the thumb – on both sides of the device. Along with the voice commands the device has the following inputs:

- The three buttons on which the fingers rest access the timing, distance/speed, and heart rate functions. To start or stop these functions, tap the function and the start/stop button, which is easy to do because the fingers and thumb automatically fall into place. To clear the data in any of these functions, tap the function button and then hold down both start/stop buttons for 3 seconds.

- The three raised buttons control the music player. You can start and pause the music by tapping the middle button, or stop the music altogether by holding down the play/pause button for 3 seconds. The buttons to the right and left of play/pause skip the music track forward and backward one song.

- The navigation wheel is used for accessing audio menus for Actively Mobile services, as well as for modifying presets during a run. When navigating the audio menu, start/stop acts as a select key.

- The tagging button is used for recording locations during a run, in order to automatically track performance data between two set points within a route. To tag a new location, hold down the tagging button until you hear the feedback "Point 1 tagged." To tag the second location, hold down the tagging button again, until you hear "Point 2 tagged." To clear the tags, hold down both tagging buttons for 3 seconds.

- The audio volume of the audio can be adjusted along the side of the device.

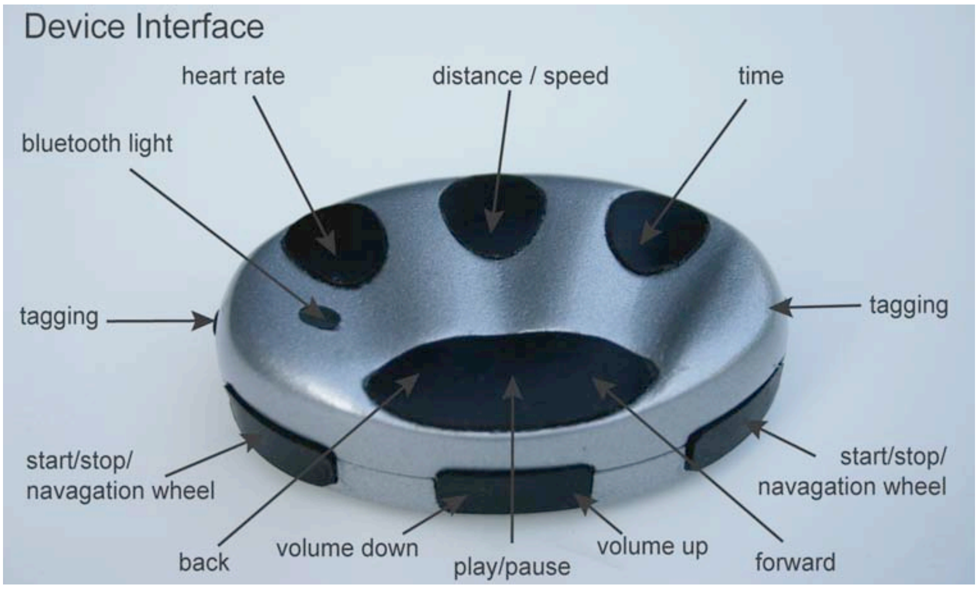


Figure 36: Diagram of device functionality

5.2.1 Workout Settings

Users can preset a preferred workout program before they head out the door. They can see the details of their last run and their current preferences for each feature of the system on the status screen of the Actively Mobile application, accessed from their mobile phone or a computer. Within a few clicks they can change their goal running time, the music they want to listen to, or the callers who can get through while they are running.

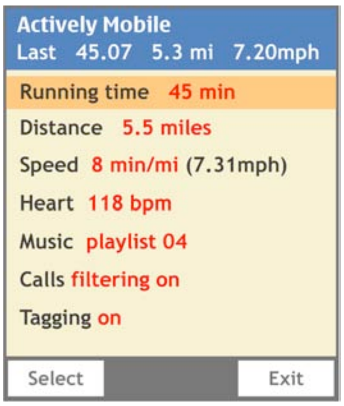


Figure 37: Status screen of the Actively Mobile application

Following is an example of the runner’s path through the setup screens:

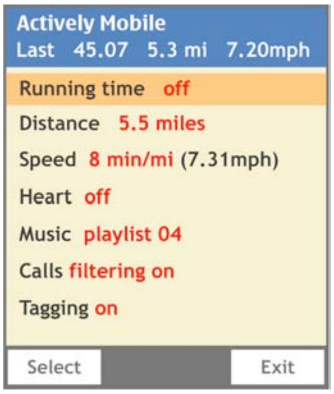
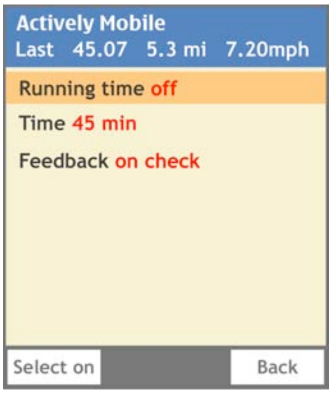
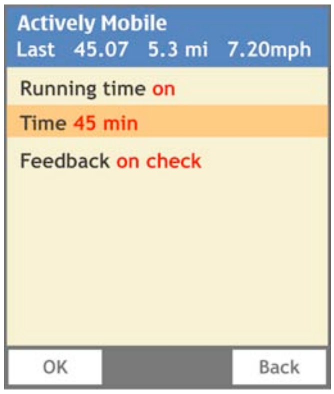


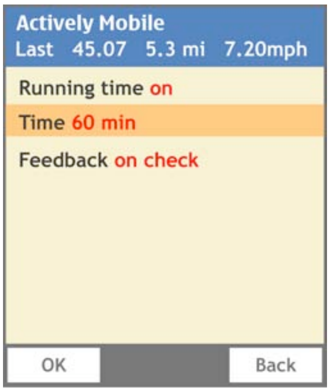
Figure 38: 1- From the status screen, the runner opts to change the first line, “running time”



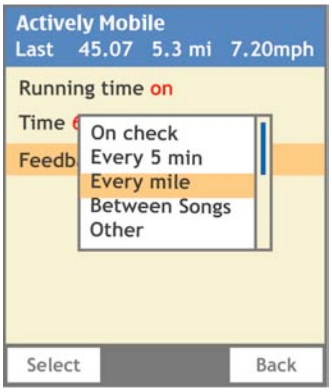
2-From this screen he can turn the timekeeping feature on and off, change the time, and his feedback options.



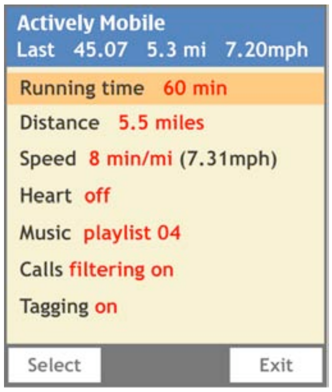
3-He turns the chronometer on, and selects the selects the time.



4-He inputs a new time – 60 minutes.



5-And changes the feedback to automatically announce his running time at every mile.



6-He returns to the status screen and can see that his goal time is set. He keeps the other settings as they were, and exits the application.

The application saves the runners’ preferences to the device, and once the device knows their preferences, it responds to their needs without requiring additional attention. If the runners need to over-ride a preset preference, to disable call filtering, for example, they can do so through the navigation wheel.

5.2.2 Technology Assessment

The technology behind the Actively Mobile solution is available today. The mobile device itself would contain the components of a high-end mobile phone: 3rd generation mobile service (UMTS); Assisted Global Positioning (AGPS); a SIM card, which stores the telephone number; flash memory, for storing workout data; Bluetooth, which communicates with the mobile headset and body sensors; and a battery.

There are two body sensors that can be used with the device: a heart rate sensor and a speed sensor. The heart rate can be measured by a traditional chest strap, using ECG technology, or by a clip embedded into the headset, which attaches to the ear. The ear clip uses oximetric technology, which can also measure the oxygen levels in the blood. The speed of the runner can be tracked by a small accelerometer embedded into a chip that is tied to their shoelaces. The headset and sensors each contain a Bluetooth module and battery as well. Once paired with the mobile device, each of the Bluetooth modules creates a secure connection that allows for seamless data transfer across the system.

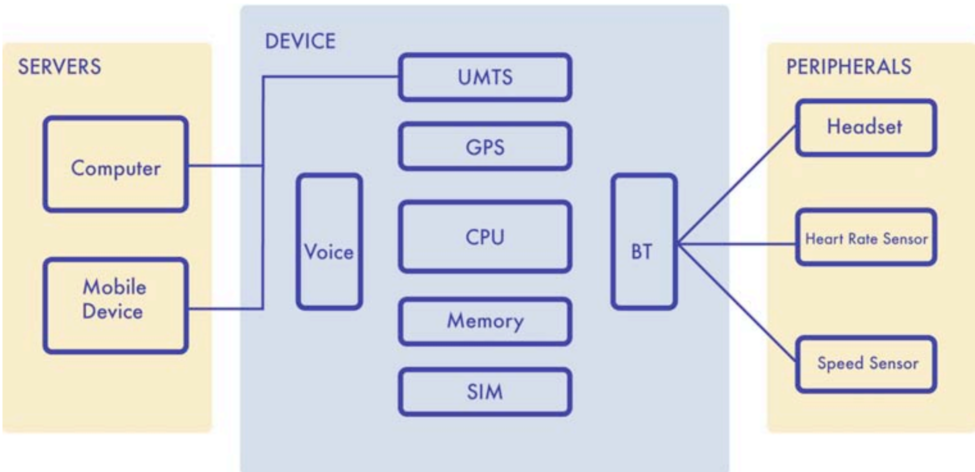


Figure 39: The device communicates with the headset and body sensors via Bluetooth, and transfers data to computers and other mobile phones through UMTS.

6 Economic Study

The mobile phone is the world's most rapidly growing and widely adopted technology of all time (Deloitte 3). By the end of 2005 there will be nearly 2 billion mobile subscriptions world wide; and in some markets, saturation will surpass 100 percent (5).

As more phones enter the market, handset manufacturers are differentiating themselves with specialty offers that cater to particular user segments. Companies such as Nokia and Motorola already target outdoor and active users with several of their product offerings. Motorola, for example, has recently partnered with Burton to create a snowboarding jacket with mobile phone controls in the sleeve. Actively Mobile would strengthen the active product line of the handset manufacturer, and could become the first in a series of phones that are designed and dedicated for active contexts.

Initial development of the Actively Mobile phone will require a substantial investment from the manufacturer. Although the technology is readily available, it will take some engineering to optimize the device for mass production. Its cost structure will be similar to that of a recent Nokia "smart phone," costing approximately

50–60 Euros per unit for manufacturing, and retailing for around 500–600 Euros.

After developing device and software for the Actively Mobile services, the handset manufacturer can then sell the package to a network operator such as Vodafone or 3 for a percentage of its revenue. Because the intelligence of the system lives on the application server rather than in the device, operators can use the system as a platform for future services, enabling growth of their customer relationships and potential for selling new services.

To reach a competitive price point, the network operator should subsidize the cost of the phone when purchased with a subscription to the Actively Mobile service. For example the phone could cost €299 with a one year subscription to the service, at €14.99 per month. This cost is low enough to attract a large number of users, many of which will not ultimately use the service. The operator can also partner with third parties such as fitness centers or sporting goods companies to offer additional services for an added charge.

Within this model, users can transmit unlimited workout data from their device, download new running routes, access unlimited GPS and GPRS, and open buddy run connections with users on the same network for free. Normal voice calls, text messages, and buddy runs across networks would cost an additional fee.

7 Evaluation & Analysis

7.1 Project Analysis

My work touches upon several areas of interaction design, and views them through the lens of a single context. This multi-disciplined approach has been challenging at times, but has allowed me to consider the runner's experience in a holistic way. The interactions I have designed for accessing features and services – through an on-screen interface and a physical device – follow the mindsets of runners, before, during and after their workout. I have integrated functionality that is normally accessed through separate devices, and designed one device with several modes of use, which will the support the running experience and enhance motivation and performance. I consider this result a success, one through which I have learned far more than I could have imagined.

7.2 Process Evaluation

I started my work with a clear goal: I wanted to design a mobile phone that would meet the needs of people who enjoy physical activities like my friends and I do. I divided my work into four themes

– mobility, context, modes, and services. Within each theme I gathered empirical data from my user group, either through direct user research or my own observation and analysis, and then used this information to test an aspect of my design idea. Through several rounds exploration and analysis that fed into prototyping and evaluation, I narrowed my focus from a mobile device for active people to solution geared specifically toward recreational runners.

My process was very linear, and perhaps could have benefited from more diverse stimulation, but I was very pleased with the foundation that my user research and observation provided. I wanted to create a real-world, usable solution, and I feel that by basing my design on empirical data from my user group I have been able to ground my solution in reality.

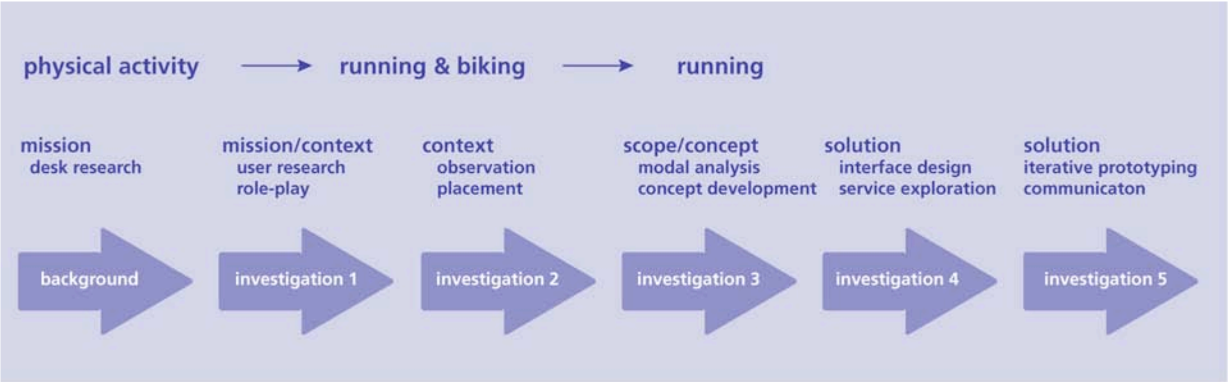


Figure 40: My process was very linear. Within each phase iterated my ideas through user research, analysis, and prototyping.

If I had more time I would like to be able to expand my concept to meet the needs of other active users, including cyclists and gym goers, and create solutions that work across different mobile contexts. I would also like to further explore the service side of my project, including performance-enhancing services for elite runners.

7.2.1 Collaboration

I have benefited from inspiration from within the design community as well. Working with Nathan Waterhouse, I was introduced to improvisation as a technique for evaluating an idea. We collaborated on two occasions – once to test voice commands within an improvised running context, and then for an improvisational idea generating session. I found the first session much more effective than the second. In my first phase of work, we used improvisation to get to the runner's gut response to an incoming call. Through this exercise I was able to determine the level of distraction caused by incoming phone calls while running, and the least intrusive way of managing communication while moving.

At the end of my second phase of work, Nathan and I set up an improvisational workshop around my research question with six designers from Interaction-Ivrea. I wanted to open my exploration up to new ideas, and explore new links between communication and physical activity. We set up several brainstorming and improvisational exercises that were designed to inspire new ways of looking at my design challenge. The session was a lot of fun, and the participants were enthusiastic and very creative. But unfortunately none of them were athletes, and as a result few of their ideas were grounded in the practicalities of training. Their ideas were very imaginative and certainly inspiring, but I found myself disappointed with the results because the session did not leave me with any direct routes of exploration. In the future I would try this technique again with athletes and people who are more knowledgeable about fitness training.

Toward the latter stages of my project I began collaborating with Tom Stovicek, another classmate, on brainstorming and analysis work. A few times a week we traded each other an hour of our time, to each focus together on the other's project. I found it extremely helpful to be able to discuss ideas with another designer, and my work was better for the input and criticism of someone from a different design background. I wish I had started this routine much earlier in the design process.

The most influential collaboration of my project was with the designers from Turin-based Studio Ape, Gianluca Alessio and Francesco Zannier. With their help I was able to communicate and realize my ideas for the physical form of the device and prototype variations on the form to arrive at a refined physical interface. They taught me a process of discovery and trial-and-error that I can apply beyond the challenges of three-dimensional design.

7.2.2 Learning

Needless to say, I have learned a lot from this experience. Through the course of the year I have been exposed to a number of new techniques for exploring ideas, including role-play, and I have learned how to use sketching and video prototyping to communicate my ideas. A personal goal for this project was to go through the process of three-dimensional prototyping. Working with industrial designers and electronics engineers, I have gained tremendous learning about product development and 3D design, designing and testing electronics circuits, and negotiating between these two sides of the process. With their help, I have learned ways of thinking about interfaces, devices, and the 3D form, and been exposed to numerous prototyping techniques that can used throughout the design process. Finally, I have learned that there is no substitute for trying things out in context.

7.3 Directions for Future Exploration

I chose to explore a number of different aspects of interaction design with my project. I wanted to work in the realms of user research, interface design, three-dimensional design, and service design. I have been fortunate enough to touch all of these areas with my design, and to examine the implications of an active context on each of them.

I would like to continue my investigations along these lines, continuing to involve the users in my process. I want to test my final solution with runners, to iterate my design based on their feedback and fine-tune my prototype until it is a functioning representation of a well-tested concept.

I would also like to delve deeper into the service side of the project. There are many opportunities useful services within the context of running, and I would like to pursue a more in-depth design of the service structure.

This project could be extended to cover a wider range of features, and expanded to explore other physical activities or additional mobile contexts. More time could also be devoted to enhancing performance at the elite athlete level.

With assistance from an industrial designer, a deeper investigation into the ergonomics of the device could be made, along with further iterations on its physical form.

7.4 Knowledge Contribution

Our perception of mobile phones has grown from technical objects to personal devices, however our devices have not grown to meet our needs. An optimal personal device should suit our environment and our changing communication needs, instead of pulling us out of our contexts at the call of the ring. With my design I have explored how a mobile device can be tailored to fit the focused context of running, but my learning can help designers to design personal devices for other mobile contexts.

I hope my work can provide insights and inspiration to other interaction designers in the field of mobile research, and suggest a new approach to user-centered design. By exploring the mindset of users in specific contexts of use, we can create dedicated products and services that truly support the user experience.

My project contributes specifically to the running community for whom it was designed. It provides access to entertainment, data tracking, and communication tools in one device; along with access to services that enhance their workouts, and enable them share their experience with others. This in itself is new. In addition, the device is designed to be easier to carry than a traditional mobile phone, which makes it easier for people who engage in outdoor activity take it with them. Along with access to mobile communication and services, the GPS-enabled device is useful for emergencies and increased safety.

7.5 Potential Project Stakeholders

There are several potential stakeholders for my project. On the primary level, device manufacturers (such as Nokia or Motorola), mobile phone operators (such as Vodafone or 3), and the runners themselves are directly connected, as product and service providers and consumers. In addition, third party services such as fitness centers, and sports brands such as Adidas could sponsor aspects of the service through advertising and promotions, trading their brand loyalty for exposure to potential new customers. Thirdly, local governments, public works and health systems could use the project as a platform for publicizing local health and wellness initiatives.

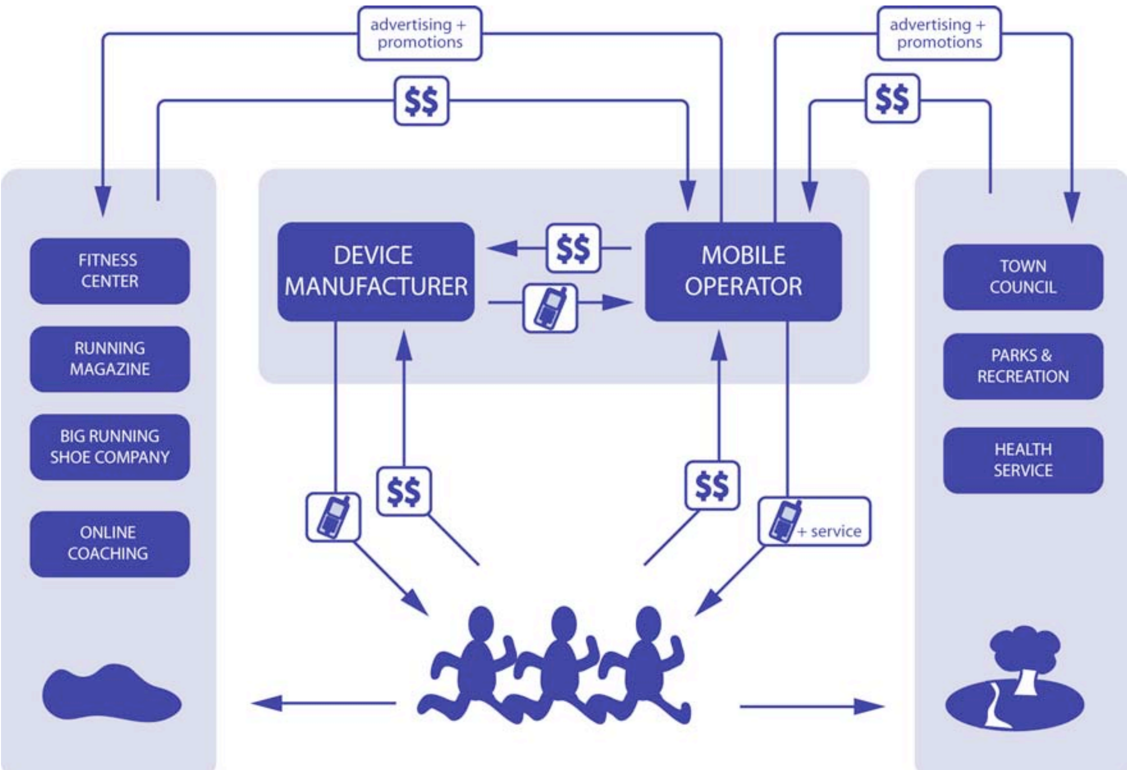


Figure 41: Potential stakeholders for Actively Mobile include device manufacturers, mobile operators and runners, along with third party sponsors and advertising partners.

8 Conclusion

This year has been a journey of discovery. I began my project with a strong sense of the community for whom I intended my design, and I worked diligently towards living up to their requirements. I tested new theories, implementing new techniques and extrapolating from them new ideas, to reach a solution that truly supports the context of running. In the process I gained invaluable experience in interaction design, and so much more. I look forward to continuing my pursuit of the ideal experience for the active mobile user, and to using my solution myself one day soon.

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Xelbri < http://www.xelbri.com>

10 Appendices

10.1 Task Analysis - Runner

task description	applications											
	chrono		spee d	heart rate	mp3	phone		addres s book	sms		route finder	location tracker
	tim e	stp watc h	mph/ kph	BPM	digita l music	mak e calls	receiv e calls	access info	send sms	receiv e sms	downloa d route	tag location s
change clothes												
grab gear	x	x	x	x	x		x					
check time	x											
choose mp3 track list					x							
volume					x							
start heart rate monitor				x								
start chronograph		x										
start spedometer			x									
behind						x	x	x	x	x	x	x
OR set phone to running mode	x	x	x	x	x	x	x	x	x	x	x	
choose route											x	
fiddle with music					x							
change tracks					x							
notice when hr climbs into range				x								
adjust volume					x							
skip track					x							
check time lapsed		x										
check heart rate				x								
check speed			x									
phone rings					x		x					
sms arrives					x					x		
make call					x	x		x				
send sms					x			x	x			
tag locations												x
track location distances		x										x
slow down												
walk												
stop / save elapsed time		x										
stop / save speed			x									
stop / save heart rate				x								
turn off music					x							
check missed calls / messages							x			x		

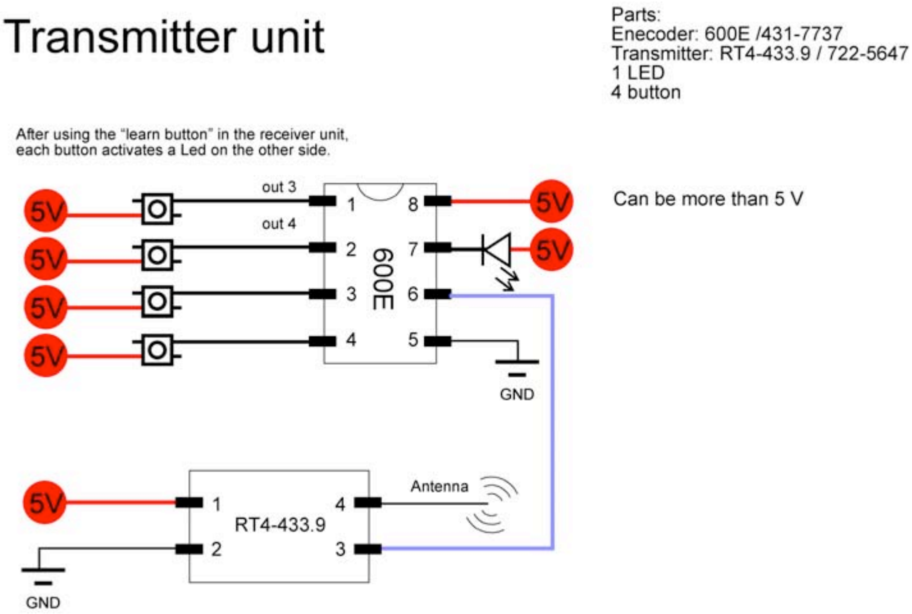
10.2 Task Analysis - Functions

application	function	interactions			
		action	device input	g	device output
chronograph	time	check time	button press or voice	B	audio time
	stopwatch	start stopwatch	button press or voice	A	audio cue
	stopwatch	check running time	button press	B	audio time
	stopwatch	stop stopwatch	button press or voice	A	time
	stopwatch	save running time	button press	A	audio cue
speedometer	speedometer	start speedometer	button press or voice	A	audio cue
	speedometer	check speed	button press	B	audio speed
	speedometer	stop speedometer	button press or voice	A	speed
	speedometer	save speed	button press	A	audio cue
monitor	heart rate monitor	attach ear piece	clip ear piece	--	audio cue
	heart rate monitor	start heart rate monitor	button press or voice	A	audio cue
	heart rate monitor	notice heart rate range	-- preset--	--	audio cue
	heart rate monitor	check heart rate	button press	B	audio heart rate
	heart rate monitor	stop heart rate monitor	button press or voice	A	audio cue
	heart rate monitor	save heart rate	button press	A	audio cue
mp3 player	mp3 player	attach headphones	snap to earpiece	--	audio cue
	mp3 player	choose track list	presses	--	screen display
	mp3 player	start music	button press or voice	A	music starts
	mp3 player	increase volume	button press	B	volume up
	mp3 player	decrease volume	button press	A	volume down
	mp3 player	skip track	button press	B - hold	track skipped
	mp3 player	repeat track	button press	A - hold	track repeated
	mp3 player	stop music	button press or voice	A	audio music off
phone	calls	phone rings	--	--	audio alert
	calls	answer call	button press or voice	B	audio call
	calls	decline call	button press or voice	A	audio cue
	calls	make call	voice	--	audio cues
	sms	receive sms	--	--	audio alert
	sms	read sms	button press or voice	B	audio sms text
	sms	save sms	button press or voice	A	audio cue
	sms	send sms	voice	--	audio cues
	sms	msgs	voice	--	audio cues
downloadable	--	download content	presses	--	screen display
navigator	--	start application	button press	--	screen display
	--	input route length	button press or voice	--	screen display
	--	input location - menu	button press	--	screen display
	gps	input location - gps	button press	B	audio cues
	pre-recorded audio	start route narration	button press	A	route starts
	pre-recorded audio	increase volume	button press	B	volume up
	pre-recorded audio	decrease volume	button press	A	volume down
	pre-recorded audio	rewind route	button press	A - hold	route repeats
	pre-recorded audio	skip ahead	button press	B - hold	ahead
	pre-recorded audio	stop route narration	button press	A	route stops
tag locations	gps tagging	tag location a	button press	A	audio cue
	gps tagging	tag location b	button press	B	audio cue
	stopwatch	start stopwatch	automatic	--	audio cue
	stopwatch	stop stopwatch	automatic	--	time

10.3 Task Analysis - Device

	general	phone	chronometer	speedometer	mp3 player	heart rate monitor	location tracker
Device mode 1:	set to running mode	edit list of allowed callers	set target time	set ideal speed	choose playlist	set target range	view set locations
running mode set up	check preferences	set all others to "run message"	set feedback intervals	set feedback intervals	if smart playlist check parameters	set beep on/off	view last times
	check "run message"	set status checking preferences			set new parameters if necessary		
Device mode 2:	start tracking functions		start counter	start spedometer	start music		
start of run	turn on music				volume		
Device mode 3:		comes in -->gets run message and is transferred to voicemail					
call comes in		comes in --> caller Id announced			volume lowers automatically		
		press button A to accept call, start talking	how to pause counter?		volume stays low until end of call		
		press button A again to end call			music volume goes back up		
		button B to send call to vm					
Device mode 4:		to get call status					
check status		feedback - you've missed 2 calls	how to pause counter?		volume lowers automatically		
Device mode 5:			chonometer counts time	spedometer records speed	music plays	records heart rate	tap to tag location a
other functions			press button to check time	press button to check speed	hold down buttons to change	press button to check heart rate	tap to tag location b
			preset feedback	preset feedback	change tracks	preset feedback	automatic between a
Device mode 6:	system asks - save data to phone?	message" and filtering deactivated					
	check overall stats						
re insert remote							

10.4 Circuit Diagram – Transmitter Unit



10.5 Circuit Diagram – Receiver Unit