Designing Mobile Persuasion: Using Pervasive Applications to Change Attitudes and Behaviors

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Abstract: We have a personal relationship with mobile phones, since they are closer to us then other technological device. They are ubiquitous (60% of the world population owns one), individual, and pervasive through our lifestyle (we have them with us all the time and everywhere). These modern devices are nearly as powerful as personal computers, always connected to Internet and loaded with sensors like GPS and accelerometers. These mobile devices offer the opportunity to persuade users to change attitudes and behaviors towards personal health and environmental issues. For this paper we will focus on the design of a mobile application for reducing in carbon dioxide emissions, using the definition of "Climate Persuasive Services" that can change personal attitudes and behaviors regarding climate change for reducing greenhouse gases emissions. The paper presents design practices that have resulted in a prototype mobile application.

INTRODUCTION

We have a personal relationship with mobile phones, since they are closer then any other technological device. They are ubiquitous (60% of the world population owns one), individual, and pervasive through our lifestyle (we have them with us all the time and everywhere). These modern devices are almost as powerful as personal computers, always connected to Internet, and loaded with sensors as GPS and accelerometers. From these reasons it has been argued that mobile phones can be a very powerful persuasion device (Fogg, 2007).

This persuasion power has been shown for goals as health, an example can be seen in mobile applications for young people with diabetes to monitor their health and along with similar efforts for keeping the elderly physically active (Lee, H et al, 2009, Ijsselsteijn et al, 2006, Goudarzi et al, 2006). The value of individual and location that mobile devices afford also has been exploited for sports training packages that combine heart rate, pedometers, and GPS tracking (Jarvinen et al., 2008). These applications treat the mobile phones as pervasive sensors, and use the personal data flows coming from them to persuade the user to change behavior, in this case to become healthier.

Yet when it comes utilizing these social mobile tools to change people's attitudes towards environmental issues related to climate change as energy consumption or transportation, the design challenge is more formidable. Such applications must depend on accurate data as in the case of health, and use similar type of persuasion techniques. But the characteristics of climate change as a "tragedy of the commons" problem makes the quest more complicated.

Therefore we can position a research question as follows: Can mobile applications be designed to act as powerful tools for persuasion for changing attitudes towards climate change through social pervasive applications?

For answering that we will focus on the problem of reducing greenhouse gases emissions in personal transportation. Transportation, together with food and shelter, is one of the biggest carbon dioxide sources of an individual. In Sweden it accounts to around 30% of total personal emissions (Naturvårdsverket, 2008a). Transportation is also interesting in the way that it's a basic need, but its environmental impact depends greatly on individual decisions and patterns. How can we help in modifying those individual factors?

BACKGROUND

If you want to change it, you have to measure it

The first step to change something, it is to measure what you want to change and make the information personal (Damen, 2007). Making an analogy with the health applications, until now we now that climate change is a problem and we have to reduce carbon dioxide emissions, but we haven't got the right tools to measure it at an individual level. It would be like saying that overweight is a problem, forbid the people to weight themselves or look in the mirror, give them some vague advices, and expect them to lose weight. ICT is making that more feasible by using pervasive sensing to make the patterns and individual decisions visible, including greenhouse gases emissions. This new type of applications based on pervasive sensing (Agapie et al. 2008) can provides us with accurate personal feedback of our behavior and its environmental impact. This data availability is central for the concept of climate persuasive services and the questions in this article.
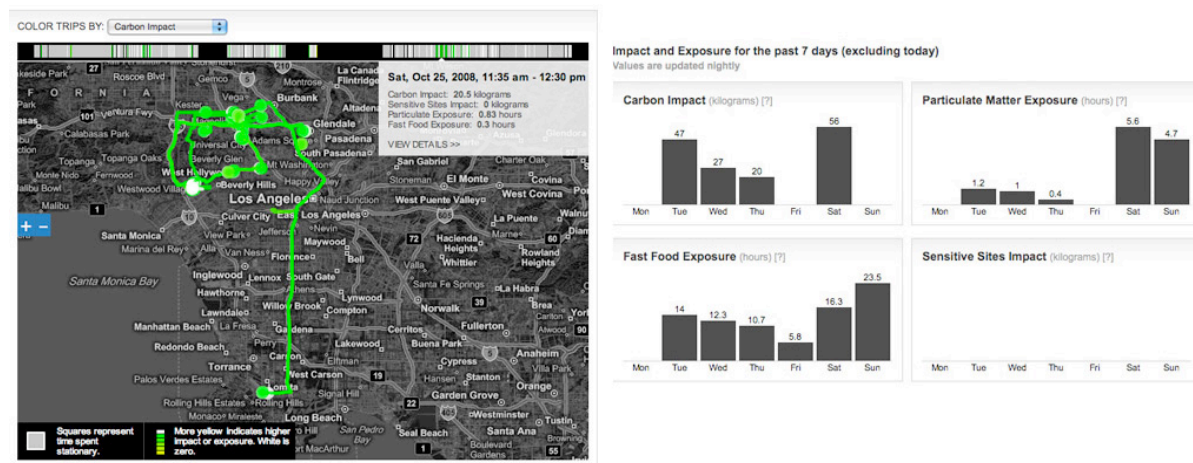

Figure 1 The PEIR System

The example we will use is PEIR, Personal Environmental Impact Report, a project from UCLA that uses GPS data from mobile phones to track personal travel patterns. Running in the background, it detects the different activities (as driving or walking) and calculates both the impact of the user's transportation in the environment (CO_2, PM) and the exposure of the user to pollutants (PM).

PEIR has two central features that make it ideal for persuasion:

• Personal and accurate feedback.
• Auto data input, effortless for the users.

   We will explore what it is possible to do once you have this data stream, to persuade people through the mobile phone. For that the special design challenges of designing persuasive applications for mobile phones need to be identified.
   For this paper we will focus on the application of such technologies for reducing in carbon dioxide emissions, using the definition of "Climate Persuasive Services" as ICT applications that change personal attitudes regarding climate change and/or that change behaviors towards reducing greenhouse gases emissions (Zapico et al, 2009). This definition is based on the Captology framework developed by Fogg (2003).
   This change of attitudes / behavior is not based on coercion or deception. The idea is to use technology to align our behavior with our goals (Kass, A. 2007), not to force us to make something we do not want to. In the case of Sweden, all the population is aware of climate change and around 70% (Naturvårdsverket, 2008b) want to change and reduce their emissions. They are willing to do it, but they need help to reach their goal, and that's where climate persuasive services goes in.

AIM AND METHODOLOGY

Our aim is to explore design possibilities for mobile persuasive applications that aim to reduce greenhouse gases emissions for personal travel. We will start from the position that accurate and individual travel information is available using the PEIR system. If individuals have access to detailed information about their travels and its

impact, with real time feedback from their decisions we can formulate some guidelines to explore how to design social mobile applications and sytems:

- How do we use that information for changing attitudes and behavior?
- Which kind of climate persuasive services can be design for that purpose?
- How can they be designed? Which persuasion principles can be used?

In order to design a mobile persuasion we will study the research framework of Captology for persuasion technology. Carry out a series of workshops with a number of users to sketch out different ideas and possibilities. Make an analysis of the results to discover important trends and ideas. Use these results to propose a prototype for further development based on that analysis.

Methodology

Design is a complex activity that calls for a challenging discipline of design thinking. Winograd (2006) emphasizes the importance of the dual roles of designers, as they work both with the hardware and software to create artifacts with desired behavior and appropriate use of resources. In addition, the designer needs to take the perspective of the people who will live with and alongside the system, with the primary concern for their intentions, actions and experiences. What makes this user centered design different from other types of interaction like human-computer interaction is that it is concerned with the wider implications of practice beyond the design, evaluation practices, and performance of interactive computing systems. One technique that helps with these design challenges is to actively involve and work directly with the stakeholders throughout the design process through a series of brainstorms and workshops. The goal of these methods is to create an experience design process whereby development is dictated by a thorough consideration of the contextual elements of user experience (Polson & Morgan, 2008). Various interaction design practices utilize participatory approaches that focus on user experience while being iterative and informative for each activity. One of the roots of interaction design is Participatory Design, a movement founded in the 1960's and 70's that can be described as a work-oriented design approach with democratic participation and skill enhancement (Ehn, 1993). It grew out of researchers' and the workers unions' desire to create an industrial democracy in Scandinavia where the workers' skill and product quality could be addressed with the introduction of new computer-based systems. Ehn (1993) when reflecting argues that the design process must be organized in a way that makes it possible for ordinary users not only to utilize their practical skill in the design work, but also to have fun while doing so.

Participatory design (PD) can be seen as a social innovation, described by Rogers (1995) as the process by which results are communicated through certain channels over time among the members of a social system. What is important about the early roots of participatory design is the realization that the introduction of systems, like any innovation, is a cultural shift between people and technology, with the emphasis on people. In other words, the study of the diffusion of innovation is the study of how, why, and at what rate new ideas and technology spread through cultures. PD has influenced different design theories and practices because of its focus on the human experience in context.

In order to design for mobile persuasion we started with a series of two brainstorming workshops. Brainstorming is an associative technique and aim is to help a group of people quickly generate and organize a large number of ideas starting from a given question or problem (Löwgren & Stolterman, 2005). From these workshops we have chosen to further develop several of the ideas into to interactive sketches to continue the iterative cycle of design. Sketching can be seen as an activity that is central to design thinking and learning by presenting artifacts (sketches) that continues the design conversation. The key purpose of sketching is to recognize the problem setting or the larger social and physical context that with in which is it supposed to function (Buxton, 2007).

DESIGN CHALLENGES

The mobile phone is a device with a very close relationship with the user. This creates opportunities but also design problems when designing mobile experiences for persuasion. Fogg (2003) defines Captology as Computers as Persuasive Technologies and some of the basic principles that we will use are:

- *Principle of Mobile Simplicity*: Mobile applications that are easy to use will have greater potential to persuade.

- *Principle of Mobile Loyalty*: Mobile applications that are perceived to serve the needs and wishes of the owner first, rather than those of an outside party, will have greater persuasive powers.

- *Principle of Mobile Marriage*: Mobile applications designed to persuade should support an intensive, positive relationship between the user and the product.

- *Principle of Kairos:* Timing and context are critical for persuasion, and the pervasiveness of mobile phones makes them ideal for acting when these factors are appropriate. Fogg (2003) identifies this as the Principle of Kairos: Mobile devices are ideally suited to presenting the message at the opportune moment, to increase the potential to persuade. In this paper we want to study the design challenges of designing mobile games as climate persuasive services.

The challenges arises in how to design for Captology that takes in consideration the problem setting and the problem solving aspect that provides the motivation for users to engage in positive changes (Buxton, 2007). At the same time we need to consider how to design for future scenarios that enable use of social mobile media that can be used in persuasive activities.

BRAINSTORMING WORKSHOPS

Two workshops were carried out during March 2009, the first at KTH with 5 participants including ourselves. The second workshop was carried out as a part of ongoing computer games course at VXU with 14 students. As part of exploring design practices we used different brainstorming methods, for KTH we used a variation of 635 method were six participants get information about the problem, and each one writes down three draft ideas for solutions. The ideas are passed around all participant five round, so each one revise, extend and modified all others ideas. Having only 5 participants and limited timeframe of 2.5 hours, we opted for 2 ideas and 4 rounds. This workshop was a 524 brainstorming (variation of the 635 methodology) in KTH with five participants including us that developed 2 ideas each and that were then passed around 4 times. Afterwards each person presented their evolved idea and the group rounded out the concepts into a concept. Figure 2 shows the worksheets from the 524 brainstorm. For VXU we broke the class up into 3 groups and each group developed and idea and then pitched the concept to the entire group at the end of a 1-hour session.

From the different ideas coming out from the workshops we have identified some trends and emerging ideas. The general concept that can be drawn from all ideas is that traveling, commuting, is more than something that one person do by herself, but an action that has relationships with a bigger context: with the environment, social with other people, and with the local community. Table 1 presents the 13 concepts developed during the two the brainstorms with a brief description and categorized across type of application and with the below themes. All the applications and ideas from the workshops can be seen as increasing sustainability in these following relationships.

  a. **Environment**: Making the traveling better for the environment.

    - Smart planning of trips and commuting.

    - Using persuasive feedback for environmental impact.

  b. **Social**: Making travel more social

    - Increasing serendipity and social interaction.

  c. **Local Community**:

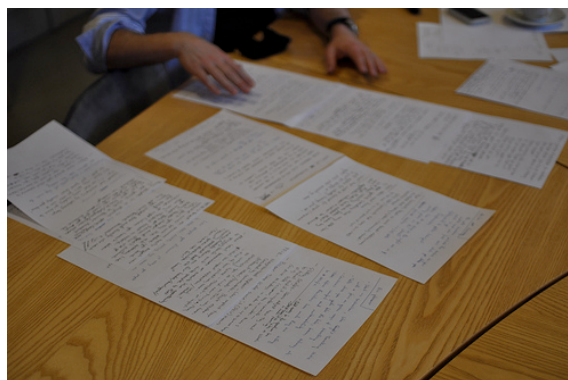   - Increasing the contact with the context, the community the travel

Figure 2 the 524 Brainstorm method work sheets

		description	type	Theme
KTH -524 Method				
office collab		teams of colleagues work together to lower CO2 footprint in office	group	Environmental
ping people		system uses data to connect people with common transport goals	group social network	Environmental Local Community
common trials		system uses data to connect people with location based	group social network	Environmental Community
hood explore		system uses data to foster exploration of local environs with green options	group social network	Environmental Local Community
eco planner		green travel planner	individual	Environmental
slow transport		green vacation planner that offers a travel concept like slow food	individual+social network	Environmental Social Local Community
decentralized work		work commuting / work from home	individual + social network	Environmental
learning on the tube		mobile learning while commuting	individual +social network	Environmental Social
adhoc car pooling		car pooling on the fly	group social network	Environmental Social Local Community
personal carbon trading		carbon trading	individual+social network	Environmental
VXU- Brainstorm				
virtual pet		Mobile and Online virtual pet that helps you visualize and experience you carbon footprint	individual+group +social network	Environmental Social Local Community
social net app		A mini application that enables you share your carbon footprint	individual+social network	Environmental Social
eco rally		A game / contest that challenges teams of people to create the most eco friendly way to get around town	muli-player game	Environmental Social

Table 1 Brainstorm concepts

CONCEPTUAL DESIGN

We have chosen one idea (the virtual pet) to develop further and create some mock-up design prototype of a climate persuasive service, based on some of the ideas from the different workshops. Our decision was guided by finding a concept that covered the 3 themes while engaging the users using persuasive principles from Fogg's (2003) Captology. Figure 3 illustrates the mobile prototype.

Virtual Pet

The original concept is to use an analogy of a pet to provide behavioral feedback linked to real life data. In this case, using information from PEIR to control the well being of a virtual creature in your mobile phone. If your travel is environmental friendly, it thrives, but if you travel too much or choose only high carbon alternatives, the pet gets worse.

The use of virtual representations for providing feedback and persuading in changing behavior is an idea that keeps coming back. These types of avatars are now a pervasive analogy thought the digital society, from the Nintendo's Miis to all kind of logos and ego-representations on Internet. They work because we are emphatic with them (Fogg, 2003). From the early Tamagotchi to the Aukotch with a pedometer that promoted walking, the idea of linking our behavior with a pet it's an attractive one at it seems to be one of the ones that easily come when brainstorming around this theme.

But in our conceptual design we want to go further from providing individual environmental feedback (Principle of Self-Monitoring), and to add other design features to include social and local community aspects.

Linking to the rest of users

Being able to see that other users are doing the same, to see how they are performing and how are you doing compare to them. These are powerful persuasion features. The simple act of showing that there are other users at the same time trying to reach the same goal, helps to perform better (Principle of Social Facilitation) and creates normative pressure (Cialdini, 2007). The creating of community feeling is essential for climate change as a

"tragedy of the commons" problem. The gain of the whole, and the fact that everyone is making its part, needs to be highlighted against focusing only in the personal effort. This can be done in several ways: From a map showing all users around your geographical location, or all active in that moment around the world or just a simple aggregation of users and the whole impact they are having.

Figure 3: PEIR virtual pet mock-up

Competing with other users

The previous feature can be extended by the creation of competition between the users (Principle of Social Comparison). This can vary from just having a highest-score panel where the best performers are shown, to more specific games between a few users. A social feedback can be created to show that improving your traveling habits towards low-carbon alternatives have positive impacts in the rest of the users.

The pet agent

The pet representation can be more than just a graphic feedback of your behavior. It can also be a personal coach, an intelligent software agent. Having access to your transportation patterns and being context aware, it could provide passive and proactive help to improve your habits. From suggesting routes, nudging the user in the moment of transportation mode decision to persuade towards the sustainable alternative, or providing car sharing options with other users.

Increasing serendipity

The use of the virtual pet as an intelligent agent can be used to increase serendipity, promoting accidental interactions and discoveries. The usually individual travel patterns can be integrated with both other users and with the local community. Examples are the promotion of alternative routes to explore other neighborhoods, creation of community knowledge bases, promoting interaction with fellow travelers, increasing conversation.

CONCLUSIONS

The data from the workshops points to several trends for different kind of applications that can be designed when we have a pervasive flow of information about our behaviors. One interesting point is that from a narrow view of sustainability in the workshop definition (mainly pointing to climate change) is that the ideas point to more holistic solutions of sustainable transportation. The ideas can be grouped in three categories:

1. Applications that persuade the user to improve the relationship between transportation and the environment.
2. Applications that persuade the user to enhance the social aspect of traveling.
3. Applications that persuade the user to integrate her travel into the local community.
4. The ideas point a willingness to use these new tools for moving from an individual transportation (alone in a car) to traveling in a social, environmental and local context.

From this ideas we developed a conceptual design for a climate persuasive service that:

- Creates a feedback for more responsibility that provides real time behavioral feedback of the user and their peers.
- Provides normative influence by enhancing the social capabilities for feeling a communal responsibility.
- Focuses on the game qualities and expand the mobile application functionality.
- At the same time it takes a broader view at sustainability, by including social and local community components. It points to a holistic view of transportation in a social, environmental and community context.

For the next version of the conceptual design the aim is to implement a working prototype under the implementation of PEIR in Stockholm at the Centre for Sustainable Communications.

In addition when comparing the output of the two styles of brainstorms workshops the more systematic 635 inspired method resulted in more depth in the conceptual output. This raises interesting possibilities for further research in the future about brainstorming methods for social mobile media.

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