Fluidtime: Developing an Ubiquitous Time Information System

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ABSTRACT

Increasingly, people live and work with a new set of habits regarding time, such as the increased use of the mobile phone to quickly schedule or change appointments. However, aside from the phone, few tools or services exist that support this new way of life, especially when people interact with public or private services.

With these new habits in mind, the Fluidtime prototype system was created to provide people with personalised, accurate time-based information directly from the real-time databases of the services they are seeking.

This abstract describes the case studies that have been implemented, presents first insights from the trials and discusses the design issues these trials raised.

Keywords

Time, mobility, ambient displays, interaction design, service design

INTRODUCTION

We have to wait when our personal time schedules do not coincide with the schedules of the people and services with whom we interact. Since both people and services are in constant flux, precise appointment times are not the most useful means of coordination. When people are provided with continuously updated time information about a service or appointment, the activity of waiting becomes more tolerable. [8]

Currently, most people are left wondering if their doctor's appointment is on time, when their bus will arrive, or when their package will be delivered. The unpredictable nature of events requires a flexible model of time that is not reflected in the static and abstract nature of traditional timing systems.

People increasingly use the mobile phone for scheduling since it allows them to make instant appointments and change them according to unforeseen personal circumstances. Instead of arranging activities in reference to the clock, people can plan in accordance to the real-time information of the people or service they are seeking. This allows them to flexibly arrange and adjust their appointments by coordinating their own schedule with the changing availability of the service or of their friends. This use of telecommunication technology reveals an increasing trend towards flexible time planning. [7] With real-time information, people can adjust their behaviour accordingly and take control over how they wish to spend their time.

A survey by Joanna Barth [3] that was done as part of the research project investigates 19 working services, applications, and devices that deliver real time information about public services and private appointments. Especially in the context of travel, people can find real-time travel information at train stations or airports. More and more city transport authorities provide people with up-to-date information. This travel information is increasingly available through the Internet and recently also through SMS. For example, many airport websites provide a real-time update of the arrival and departure schedule. An example for real-time updates in the context of public transport in cities is NextBus Inc. [9] It provides information for several cities throughout the US. In Europe, in the city of Turin, Italy, travelers can use SMS to access real-time information of the arrival of buses. [1]

These few examples among many show a clear trend towards the use of communication technology for coordinating the timing of services. Providing people with up-to-date information is becoming more accessible and is appreciated by the customers. [5]

In the context of hospitals and medical examinations, where the timely coordination between doctors and patients is still characterized by standard procedures, where patients need to wait in order for doctors to have patients ready at te right time. But a survey in the UK has estimated that there are about eight and a half million missed doctor's appointments a year, which sums up to 150 million British Pounds of lost appointment time. [4] A department at the Homerton Hospital in east London started a trial that uses SMS messages to remind patients of their upcoming appointments as a possible solution to this problem.[6]

It is not only financial motivations that make hospitals use communication technologies to coordinate patient schedules. It is also the increased awareness for an improved doctor-patient relationship that inspires doctors and hospital authorities to look at new scheduling possibilities.

Time and money

Ever since Benjamin Franklin made his "time is Money" statement, time has become an important and valuable business factor. In some cases, time has been the only product that was sold.

Samuel Langley was one of the first ever to market time as a product in the end of the 19^{th} century. [8] His product was standard time, which was used to set a common time standard on which a train schedule could be based. Langley broadcasted the observatory's time signal and other cities paid him in order to receive and use this standard time.

Especially today, people are willing to pay for time since it is a highly-valued commodity. A survey that was done after the implementation of the new traffic information system in Turin [5] indicates that people would be willing to give money for real-time arrival information. A report by Alpern et al. [2] shows possible revenue model of how money could be made on real time information for public transport.

In many operations, from travel services to home services, accurate time information is a by-product of upgrading the business operations to digital systems. It is the decision of individual management whether this by-product is offered to customers for free (in order to improve the service experience), or if it is used to generate revenue. The future will show which models will work and which ones the customers will not accept.

Fluidtime

The Fluidtime project aims to contribute to these developments by finding engaging, convenient and effective means to view and interact with real-time information. Especially through advances in wireless Internet technology, it is possible to create ubiquitous access to real-time information.

Current systems have the drawback that they are not accessible through easy-to-use interfaces or products whether the customer is at home, in the office or on the move. For instance, travelers first need to go to the train station in order to find out if the train is delayed, or in the case of a SMS-based updating systems, any timing changes are not reflected until the next SMS is sent. If, however, every fluctuation in the schedule produces a SMS message, the recipients could easily be flooded with too many messages..

With the Fluidtime project, we want to investigate the use of ambient displays that reside in the background or wireless mobile devices that allow the user to monitor the information constantly and utilize the advantages to the use of real time information. We hope to build a pervasive information environment that is subtle and pleasing to use.

PROTOTYPE DEVELOPMENT

The Fluidtime system

We developed a time information system and interface prototypes in order to investigate the opportunities and impact of using real time information. The system works by tapping into already existing real-time logistical information from bus companies and laundry services and makes it available to the Fluidtime users via wired and wireless networks. Using SMS, e-mail and the mobile and stationary Internet, the service performs simple tasks, such as time monitoring, and user reminding.

Prototype contexts

The two contexts that were chosen for the prototype development were the public transport in the city of Turin [1] and the laundry service at the Interaction Design Institute Ivrea.

Up to 400000 rides are taken with the transport facilities in Turin every day. Turin transport authorities have already implemented a system that tracks all the buses and trams. The first service prototype makes this data visible to travellers at home, at work or on the move. They can find dynamic information on mobile screen-based devices; while at home or at the office, people can get the same information on mechanical display units.

The second service prototype is a scheduling and time monitoring system to help Interaction-Ivrea students organise their use of shared laundry facilities. The 50 students and researchers share the use of a washing machine. Having to book a time slot, remember to bring the dirty laundry, keep the appointment in mind, and check the washing machine in the basement to see when it's finished—all add up to a less than comfortable experience.

Using different interface modalities, the service performs simple tasks, such as reminding users in the morning to bring their laundry to the Institute, or letting them know when their laundry slot is ready or their washing is done. Since the system knows the users' profiles and how busy the day is, it can adjust it's behaviour regarding reminders from being either strict or more relaxed.

Ambient devices allow the laundry users to monitor the progress of the machine and know when it is time to collect the laundry. The system prototype also allows users to take advantage of a free laundry slot with enough advance notice if needed. It does this by both checking the schedule and getting confirmation from those who are affected.

INTERFACES

The challenge for interface design was to create a simple and effective system of interactions. The intrinsic problem with time planning systems is that they require time to be used. On one hand, they help us free up our time or organise our activities in a better way, but on the other hand, they require time to be operated, and thus reducing the overall effectiveness.

We developed two categories of interfaces: one that was meant to be mobile and accessed anytime and anywhere, and a second category that was stationary, and designed to be used in the context of the home or office. It is worth mentioning that with the physical object interfaces we focused on the exploration of the quality of interaction and information representation. We don't see them as proposals for products that should be built and go to the market tomorrow, but that explore some basic functionality and quality. Alternatively, using a generic mobile phone allowed us to explore interfaces that are on the market now and wouldn't require special investment from customers.

Mobile Interfaces

The interface is based on a Java software application that runs on a standard mobile phone (we used the NOKIA 6610) connects to a server to get the real-time information and then visualises the data.

We created an optional wristband that allowed test users to wear the phone interface on the lower arm, just like a regular watch. Once the application was activated, it allowed them to check any changes of time information just by looking at the display, since the application was always on and always connected.

FI1 (Fluidtime interface 1): Perspective visualisation

The interface shows how far a certain pre-selected bus is away from the chosen stop. (See Figure 1) The application permanently updates the visualization with data originating from the Turin transport authorities.

FI2: Iconic representation of time

An icon on the upper part of the screen indicates the state in which the user should be in order to catch the next bus. (See Figure 1) If the icon displays a tranquil character, the user can be relaxed. If the icon is a running figure, the user knows that the bus is due to arrive.

Figure 1. Fluidtime interface 1 and 2 (FI1, FI2)

FI3: Overview of three routes and stops

With this interface, the user has increased planning control. (See Figure 2) It allows the user to define up to three different routes at up to three different stops. This information is necessary for travellers that need to change buses. Test users also relied on it to decide which bus stop to walk to.

FI4: Washing status indicator

This interface shows the status of the washing machine, informing the user when it is the right time to go to the facilities in order to unload the machine (See Figure 2).

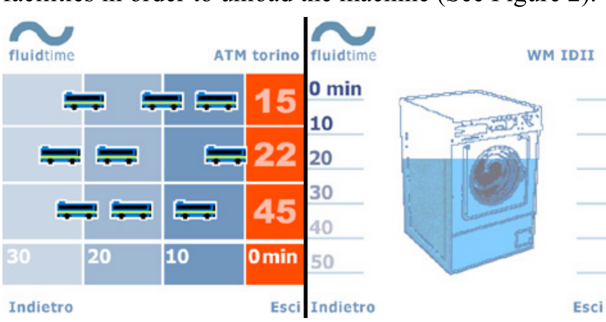

Figure 2. Fluidtime interface 3 and 4 (FI3, FI4)

Physical object interfaces

FI6: Mechanical display unit with icons

This is an object for the transport context. It has the dimensions of a small hi-fi stereo (See Figure 3) and is meant to be placed in the home or office environment. Through the glass fronts of the object, the users can see small iconic representations of the buses that move from the background to the right hand corner in the front. The position of the miniature bus tells the users how far the bus is from the bus stop. The user can configure the bus routes and stops through a web interface.

FI7: Mechanical display unit with shoes

This object looks just like a small shoe rack that people keep in their homes. (See Figure 3) When the user activates the object, the movement of the shoes indicates the distance of the actual bus. If the shoes move slowly the bus is still far away, and the user could walk slowly and still catch the bus. If the pairs of shoes start to "run" then the user would also need to run in order to catch the bus. Since the moving of the shoes creates an acoustic pattern, the user can listen to the information even if he is not in the same room as the object.

Figure 3. Fluidtime interface 6 and 7 (FI6, FI7)

FI8: Mechanical display with ribbons

This wall-mounted object has a discreet appearance and indicates the status of the washing machine. (See Figure 4) The turning angle of the central cube indicates the progress of the washing machine. Once the washing cycle has finished ribbons will appear and clearly indicate that is time to pick up the laundry. As soon as the washing machine door is opened the object turns back to its initial state.

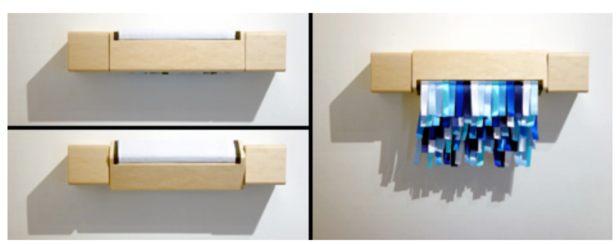

Figure 4. Fluidtime interface 8 (FI8)

TRIALS

The interfaces for mobile phones (FI1 – FI3) described above were tested in Turin between May and June 2003. Four candidates in their early thirties were given a mobile phone, with the applications installed on them and two of them received a wristband for optional use. A fifth user received the interface FI7 to test. A small printed manual described the use of the applications. Since the applications were quite simple, the users required not much learning.

All of the candidates were commuters that used buses everyday to travel to and from work. The candidates were interviewed three times during trial period. These interviews aimed to capture their use habits regarding the prototypes, the functional value of the interfaces, the usability and aesthetic quality, and the emotional and social attitudes of the test candidates

Looking at the use habits, we concluded that the interfaces were consulted on a daily basis. Each one of the users interacted with it either on their way to the bus stop or once arrived. Only in cases where the apartment or office was close to the bus stop, they started the application before leaving the place. If people could estimate the time it would take them to the stop (e.g. using elevator) they only started the application once out on the street.

Over time, the users gained experience in estimating their timings. One of the users adjusted her "leaving the office" routine over time. She would start the application and if the bus was still distant, surf the web or chat with colleagues, until the bus was due to arrive.

The applications' release used by the trial candidates did not allow the storage of frequently used bus routes and stops. This turned out to be the biggest handicap of adoption. As mentioned in the introduction of the interfaces section, if time applications take too much time to operate, the value gained by the time information doesn't equal with the effort put into accessing the information.

A second usability handicap was the fact that the application can only be started from within the application menu of the mobile phone. Again, this effort is too big in order to be useful on a frequent or daily basis.

All users found the interfaces aesthetically pleasing and gave them marks like "beautiful", "cute", or "entertaining" On a social, psychological level, the team found interesting that real-time services not only support those who like to plan ahead and want to compare different route possibilities in order to save time or be more efficient, but that it also gives people less inclined to plan more possibilities to seize the moment. This supported our hypothesis that time information devices don't necessarily save time, since they depend on the person that uses it. In the case of Fluidtime, the aim is to give people more control over time -- it is the user's choice that of how to deal with the information.

CONCLUSIONS

The aim of the project was to develop a prototype infrastructure and a set of interfaces that allowed users to access real-time information in the context of everyday life (commuting and doing the laundry).

It was important to provide the fully functional prototypes to the test users in their particular everyday life contexts in order to study the direct influence of the new technology into their daily habits and rituals

In ubiquitous computing environments, the flow of everyday interaction has to be as smooth as possible. The value gained by new applications is often not equal to the effort put into learning and using them.

Ubiquitous solutions are difficult to test in the everyday life context, since many factors influence the results of the investigation. Nevertheless, we found it particularly helpful to spend time with the users while employing the system on the streets in their everyday environment.

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