
Wayfinding Situations

Synopsis

Ph.D Thesis

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Introduction

One of the primary ways we perceive the world is spatial; the physical form and appearance of our environment is key to our actions and perceptions within it. The emergence of communication technologies has fundamentally affected the nature of visual presence in everyday life, so that the individual's image of the city (Lynch 1965), which they use to navigate and orientate themselves within urban space, is no longer confined to physical elements and configurations. In attempting to un-weave the experience of space in increasingly mediated environments there is a need to reconsider how we think, act and interact in spatial settings. In this context the domain of wayfinding provides a way of understanding and responding to the ways in which we act and navigate in space. Wayfinding is a purposive, directed and motivated activity (Golledge 1999). Humans use different wayfinding strategies depending both on their own individual spatial awareness, and also their knowledge of the environment they are travelling through. Perception and action in space is in part made possible by our ability to act on mental models of the space (e.g. Siegel and White 1975, Tversky 1993). When we move and act in the urban environment in a motivated manner, we acquire knowledge about it, which is transformed into mental representations. These representations can be retrieved to make decisions during navigation, but we also use graphic representations such as maps and mobile maps to assist us. Assistance in the form of paper maps is increasingly being superseded with dynamic maps operating on mobile GPS enabled devices. We propose that since such technologies enable the individual to offload knowledge they are not encouraged to learn about the environment as they undertake a task. As such the cognitive abilities of individuals are not necessarily well supported by current models of interaction in such applications. To investigate this topic further, the first stage of the research describes a study which compares knowledge acquisition on a series of spatial tasks depending on whether the participant's accessed a paper map or mobile map. The second stage of the empirical work seeks to understand how individual's perceive the spatial setting when it is embedded with communication technologies and examines the case of wireless networks. These findings are drawn together in a summary which seeks to characterize wayfinding situations, and this is then extended to provide the basis for the design of an application which proposes to support such wayfinding situations in a specific urban setting.

Approach: Wayfinding Situations

This thesis takes the standpoint that rather than seeing individuals, the environment and technology as separate entities, the way we interact with the world means that our actions are situated. In this manner, wayfinding is not an activity that can be studied by focussing on one aspect, but must be seen in a holistic manner as a process undergoing change affected by a whole range of dynamic aspects. In its approach it draws on the concept of 'situated actions', a concept developed in 1980's by Lucy Suchman which attempts to find a way of understanding and responding to the relationship of humans with technology in real world situations (Suchman 1987). This research seeks to adopt such an approach in order to investigate wayfinding situations as they actually take place, rather than as an abstract set of processes, and in particular it aims to assess how an individual's relationship with technology affects the nature of the situation.

Primary Research Questions

The research questions addressed in this thesis develop through three levels of investigation:

Investigation: What is the nature of individual's spatial knowledge acquisition when space is experienced through mobile and wireless technologies?

Evaluation: How is this experience of urban space changed and how can we enable technologies to respond to the situational aspect of the interaction?

Implementation: How can we find better ways of enabling the situated interaction between individual, device and urban space so that wayfinding in the environment is supported?

Methodology

This thesis purposely takes an interdisciplinary approach, as demanded by the subject matter. In its methodological structure it seeks to respond to the identified research problem by opening up a series of questions and to seek, through a series of empirical studies, to explore suitable answers rather than proving or disproving a pre-defined hypothesis. The methods adopted produce both qualitative and quantitative results which are in most cases considered to possess equal merit. The final stage of the thesis responds to an analysis of empirical findings with a proposal for implementation within a real world scenario.

Empirical Study One: Differences in Spatial Knowledge Acquisition between Maps and Mobile Maps in Urban Environments

Introduction

A number of recent empirical studies have shown that individuals who use navigation applications with mobile maps (e.g. Muenzer et al 2006, Ishikawa 2007) have poor spatial knowledge acquisition. In order to better understand the nature of spatial knowledge acquisition with mobile maps we conducted an empirical experiment which evaluated participants' spatial knowledge acquisition in a large-scale environmental setting by comparing participants who had learned the environment from a map and those who had learned it using a map on a mobile device (a mobile map) in a real environment.

Method

The effect of different modes of information provision on spatial knowledge acquisition in a large-scale environmental setting was investigated by comparing [two groups of](#) participants, those who had learned the environment from a map and those who had learned it using a mobile map. The experiment was conducted in an external urban environment and consisted of two phases; an initial learning phase, and a testing phase where participants were asked to provide orientation, Euclidean and route distance estimates.

Results

The results show that there are differences between the spatial knowledge acquired and that mobile map users performed worse than map users, particularly on Euclidean (straight-line) and route distance estimation, and that this was a consequence of the format and presentation of the spatial information. We propose reasons for the variation in performance as deriving from differences in

cognitive schematic frameworks used for learning, and also requirements on attention during the task.

Discussion

We examined the reasons for these differences, and stated that mobile map users acquire a fragmented set of knowledge about spatial features, whereas map users act on a framework within which features are located. Although the map participants spent considerably shorter time learning the map they were able to act on it fairly consistently. The key factor was that the learning effort for the map took place in a planning stage, so that the learned map was remembered as a single static clear representation. A further key factor is that it was not the graphic representation of the mobile map that distinguished it from a cartographic map in the effect on performance, but rather the delivery and attention it required of the individual. However the mental process of committing information to memory, or learning, is itself an effortful task that requires conscious attention. A mobile map essentially enables and even encourages someone using it to switch off, and to become the passive receiver of information, and as such does not support learning in a constructive manner.

Empirical Study Two: Spatial Perception of Mobile and Wireless Technologies in Urban Environments

Introduction

The second phase of experimental study moves from the individual's interaction with spatial assistance to a focus on understanding of how space embedded with technologies is perceived and how this affects spatial behaviour. This seeks to position the knowledge investigated into a real-world environmental setting, to situate the way in which the city is experienced and conceived. The main purpose of the study is to understand how mobile and wireless technology are perceived in terms of their spatial presence in urban public space. The study comprises three sub-studies; the first looks at perception of the spatial presence of a WiFi node in space, the second identifies the physical location in space and how this relates to urban public space. The final phase investigates the WiFi usage dependent on its location and thus the consequential effect on spatial behaviour.

Phase 1: Perception of Presence of a Wireless Node in Urban Public Space

The first stage of the study seeks to understand in more detail, the nature of perception of the spatial presence of a single WiFi node. This was undertaken through a study of sketch maps of the perceived presence of a public wireless node in a café space. It establishes that people perceive the presence of wireless networks in public space in terms of spatial behaviour and not in purely visual conceptualisations.

Phase 2: Locating the Wireless Network in Public Space

The second stage of the project involved using a series of mapping techniques to establish the actual location and density of the pattern of wireless nodes. This seeks to establish if the way the nodes are located in urban space has any link with the spatial form and structure of the environment.

Phase 3: Effect on Behaviour of the location of Public Wireless Nodes in Public Space

This phase of the study investigates whether there is any link between the usage of public wireless nodes and their location within relation to public space. In order to work within a defined community of practice the study focuses on the public WiFi nodes of the Boundless network located within the environmental setting. Usage statistics for individual nodes reveal patterns of behaviour, depending on time and volume of use which are then related back to the physical location of the node within its spatial and social setting. If individuals are conceptualising the nodes in terms of how they are located within a spatial setting it would be expected that patterns of behaviour would overlap between the technological spaces and the environment.

Discussion:

The way in which we view public space it has a visible appearance with salient features that structure it; there are landmarks, visually familiar places, open viewpoints, and closed spaces. But as demonstrated in the study of the perception of the spatial presence of a wireless node, wireless technologies are not visible structures in public space. The presence of networks in public space exists in a manner more similar to our concepts of a social network. Our notion of the social network of friends, relations and acquaintances exists as a highly developed framework in the mind of an individual, not as a visuo-spatial mental image, but instead as a network of possible relations connected through threads of weak and strong ties. If we see urban space not just as a static construction but as a setting enacted by the patterns of behaviour of people moving within it, then people's everyday practices are affected by their interaction with wireless technologies.

Evaluation of Empirical Work*Definition of a Wayfinding Situation*

Three sets of findings were discussed; the first a redefintion of the wayfinding situations not as result of a set of interactions, but instead as a process of enacted practices. The second finding reviewed how wayfinding situations can best be guided when they are mediated through technologies. This underlines the importance of enabling the individual to construct a relational quality between the different aspects of the situation as they act in real world settings. The final, and perhaps most critical outcome of the review of the empirical work was that the social aspect of wayfinding situations is fundamental, and that this is characterised by ideas of how spaces are connected through social ties as well as the physical boundaries that frame situations. The chapter concluded with a definition of a wayfinding situation. These findings provide the basis for a more differentiated response to the original research problem identified in the second chapter of this thesis.

Derived from the above characteristics a wayfinding situation can be defined as follows:

'A wayfinding situation is an enacted practice, framed by a rich mix of social and spatial factors, where an individual seeks to make sense of local information guided by a background of experience in order to move and act in a spatial setting.'

Applying the Empirical Findings*Introduction*

As a response to the various factors affecting orientation and learning in the spatial environment with mobile devices, a proposal for an application is outlined. The proposal intends to provide a way for delivering spatial information for those navigating a specific setting so that it is meaningful and engaging for the individual. However it is not introduced as a total solution to the research problem identified or as a definitive solution to the problems of supporting wayfinding situations. Instead the implementation stage of the research is intended as a suggestion of an alternative way of approaching the issues raised in the empirical investigation, and as such it is a strategy under development. The project takes the central area of the city of Weimar, Germany as real world setting for a pilot project responding to a defined wayfinding scenario. The requirements of the particular proposed implementation are then defined through a series of semi-formal mapping and ethnographic studies. The features of a prototype are described, and the results of a pilot usability study are discussed. Finally the benefits and drawbacks of the proposed system are reviewed, and an outline for the further stages of research required are discussed.

Scenario

A visitor to Weimar approaches the city with prior expectations and probably plans about how they will experience the city. Typically they will spend a relatively short period of time in the city itself, and may come away at the end of a trip without having engaged with the real city; its local residents and the everyday stories of the place; they will have superficially touched the city in the role of a 'tourist'. In order to create a different level of engagement the scenario proposed is that at specific key points in the trip they will be able to interact with everyday stories and memories of the city as recorded by those who know it intimately.

Requirements

Requirements for the system were developed through a series of site specific empirical studies; firstly a sketch map study and secondly a semi-formal ethnographic study of wayfinding practices in the urban space. In order to understand the local spatial characteristics of the particular urban setting a sketch map study was undertaken. The intention was to identify how the city is experienced not as a series of static physical spaces but instead as inter-linked sets of spaces.

Conceptual Design

The proposal is a series of interface elements which enables technologies to be implemented in the city so that people are encouraged to cross over from concentrating in information delivered by the interface of the device and engage with local knowledge of the city. They seek to establish ways in which visitors or locals to a place can exchange knowledge and so create meaning about the place. In this study, one element has been chosen to develop to a prototype: Storypost is an application which seeks to enable the delivery of local narrative based technologies, and so assist wayfinding and discovery of local places. At key nodes in the city of Weimar illuminated posts will be located. These posts metaphorically host stories about the place. The Storypost is a physical metal post with an illuminated top section installed in the street in the city of Weimar. Hidden inside the base of the post will be the Bluetooth marketing system, with power supply and a WiFi connection to a remotely located server/PC controlling the delivery and reception of messages.

Prototype Development

A prototype was developed based on the features above. The model for the prototype was as follows:
Listen and Receive: People in the zone of the bluetooth Storypost receive a bluetooth message with the text 'do you want to hear a story about this place?'. If the person accepts, an audio file from the selection in the database is randomly selected and sent via bluetooth to the person's mobile. They then open the audio file and listen to the story.

Speak and Send: People record with their own voice a short audio on their mobile phone describing an event or feature of the place that is important to them. They then send this audio file via bluetooth to the Storypost. The stories are stored in order of being received. The database can only hold 10 stories at a time in the prototype phase.

Creating a Loop: The narrative loop can then continue if the listener chooses to record their own story about the place and sends it back to the post.

Working model

A prototype working model of the storypost application, with the iterations described above, is available for testing in the environment. Usability studies were undertaken with the application.

Conclusion

Review of Research Questions

Research Question One was answered by the methods devised in Empirical Study One and the discussion of the results and outcomes of that study. The empirical work provided an understanding of the effect on spatial knowledge acquisition in an urban environment when it is supported by mobile spatial information.

Research Question Two was answered by the methods devised in Study Two and the analytical outcome of that study. This research provided an understanding of the effect on perception and behaviour with respect to the situated nature of interactions and the relationship to the physical urban environment in which these interactions occur.

Research Question Three is answered by the application described. A prototype was designed based on the understanding of physical and social context provided by Studies One and Two. The two empirical studies were used to characterize wayfinding situations and the prototype, called storypost, was designed as a response for exploring alternative approaches to applying these findings.

The main outcomes from this research show that using a holistic approach to understanding physical and social context of an urban environment results in a more meaningful understanding of the characteristics of wayfinding situations. Results also show that this is a useful and understandable mechanism for incorporating elements of the user's current situation thus forming a link between the digital, physical and social layers of mediated urban environments.

Scientific Contribution

Contribution One

* Understanding of the effect on spatial knowledge acquisition of using mobile maps to navigate an urban environment

Contribution Two

Understanding of how spatial perception and action in urban public space is affected by the presence of wifi technologies

Contribution Three:

* Alternative method for supporting individuals as they enact wayfinding in urban public space with mobile and wireless technologies.

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