Usability Study of an NFC-Enabled Static Tourist Map

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Abstract

Near Field Communication (NFC) is becoming more prevalent in smartphones. Using NFC tags enables additional information to be added to physical objects which can be access via a mobile app, which could be of particular use in tourist environments where users have limited knowledge of the area. This paper presents an innovative use of NFC-tags within static tourist maps with the aim of making the maps easier to use and providing additional information without obscuring the map itself. A prototype map and app system was developed and tested with the aim of assessing user interaction with the technology. The results showed that the concept was of interest to the users, but that improvements in usability are required.

Keywords: NFC, static map, smartphone, tourism, accessibility

1 Introduction

The use of smartphones has increased dramatically over the last few years. One of the drivers for this is the ability to connect to the internet at any time, from anywhere, which means they are an invaluable tool for travellers. However, research has shown how important perceived usefulness and ease of use are with tourists (Ryan and Rao 2008, Kim, Park and Morrison 2008).

The integration of smartphones with the Global Positioning System (GPS) has made navigation to and between places much easier. But in order to use these, you need to know where you want to go. A tourist may not know all of the places that are available in a city and so may resort to the large static maps which are placed around city centres. However, these maps provide minimal information and are sometimes hard to read. In this paper, we present a prototype of an enhanced map utilizing Near Field Communication (NFC) to improve ease of use and increase the information contained in the map without obscuring the information already available. Previous research into the incorporation of NFC into different kinds of maps demonstrates that this would be of interest to tourists (Ronay and Egger 2014, Hardy, et al. 2010).

2 Literature Review

NFC, evolved from Radio Frequency Identification (RFID) by Sony and Philips is a wireless technology for data transfer in a short range (Pesonen and Horster 2012). NFC technology enables building tangible user interfaces for mobile devices. Mobile Phones can contain NFC readers which are able to read NFC tags which are placed in the environment. When a mobile phones is near tag the data contained in the tag is transferred (Pyykkönen, et al. 2012). Compared to other wireless technologies NFC has very fast set-up time, high security, better usability and user experience (Dubey, et al. 2011). NFC tags are very small and cheap and do not require line-of-sight for

communication. Data written to the tag can be read by any NFC-enabled device. For example the NFC tag can contain a web address, and when the device reads the tag the browser is automatically opened and the webpage displayed.

While easy data exchange is available between devices with NFC technologies and physical effort is decreased, users can use these devices without the need to know about the technology (Ok, et al. 2010). There are many applications for NFC technologies, such as E-ticketing, Data exchange, E-Wallet, Rating, and Smart Posters (Ok, et al. 2010, Ho and Chen 2011). As Pesonen (2012) stated NFC will be a huge technological progress with an effect on the tourism business and tourism research.

The use of NFC in tourism is a relatively new compared to other applications., but offers new applications as the usage of mobile phones by travellers will become unavoidable (Ronay and Egger 2014). A pilot study in Hanau ,Germany tested the public transport system to make bus schedules accessible via NFC. Another research study undertaken by Google allows visitors to read and write recommendations, enabling the customer to view them without having to search for a restaurant or store (Pesonen and Horster 2012). Borrego-Jaraba et. al. (2011) proposed a service with maps and text information where NFC tags provide information on a traveller's location and help them find places of interest. The authors described the structure of smart posters with NFC tags which could allow users to access information and services. Moreover, Ronay and Egger (2014) developed a prototype of a NFC-enabled City map with the aim to measure users' perceived value when customer satisfaction was also investigated. NFC tags were attached to a map and relevant information was retrieved when the tags were read by a mobile phone. The result indicated a higher preference for the smart map over the regular paper map.

3 NFC-Enabled Map

We have developed an interactive map system which includes an NFC-enabled map and an Android mobile application. The aim is to improve the usability of large physical maps and to enhance the information they provide, and ultimately make the map more accessible, for example to those with sight impairment or learning difficulties. The mobile application has two main aims:

- to make it easier and quicker to find locations of interest on the map, including the current location of the user
- to provide additional information about the locations on the map which would be useful for tourists

3.1 The Interactive Map

The Interactive Map is created by placing NFC tags on the back of the map behind each place of interest. By placing them on the back we do not obscure any of the map itself, meaning that it can be used as normal by people without NFC-enabled phones. The tags are encoded with an ID for the location, a name and the coordinates of the location within the frame of reference of the map.

A prototype map was created using an A0 print out of the map of Nottingham Trent University (NTU) Clifton Campus which is available on the University's website. The

locations are identified on the map by a name and/or number, with a key provided to the numbers. The location ID encoded in the tag does not relate to the number of the location on the map as some locations are not identified by a number. 26 locations were tagged, covering all of the buildings on the map, but not the outdoor spaces.

3.1 The Mobile Application

The mobile application has two functions - 'location finding' and 'explore map'. A prototype application was developed on a Google Nexus 4 mobile phone which has NFC technology. For the prototype, the application contains a list of location on the map including ID, name, coordinates and detailed description. However, in a real system this information would be cloud-based to allow for information to be changed easily and shared between maps.

Location Finding. From experience we know that it is often difficult to find locations on a large map. We therefore developed a method to show the direction of the location of interest from where the user is currently looking, using the coordinates of the locations within the frame of reference of the map. The user is required to select the location they want to find from a drop-down list (spinner). When the phone is then placed over any of the buildings shown on the map the NFC tag will be read, and the direction of the location of interest from the current location is calculated from the pair of coordinates, using basic geometric rules. The direction is then used to rotate an image of an arrow on the phone screen to point in the direction of the location of interest. If the phone is then moved across the map, other tags will be collected and the direction of the arrow will be adjusted if necessary. In future, we will investigate different output methods, rather than an image, to make this function more accessible.

A 'Where am I?' button is also available which takes the current location as the place of interest. In the prototype this was hard-coded within the application, but in a real system could be found by adding a map ID to allow for maps at different locations.

'**Explore Map'**. It may be that the user is not interested in one particular location, but rather wants to find out about what is around. We developed the 'Explore Map' function to allow the user to find out additional information about any of the locations on the map. If this function is selected and the phone is placed on a location on the map, the tag is collected as before. However, this time the ID of the location is used to access the detailed information about the location and to output it to the user both as text and as audio. For the prototype, we added information about the School the building belonged to, or the purpose of the building. In a real system, information about opening times, contact information and special offers could be added, for example.

4 Methodology

The map was tested at a workshop for local businesses held at NTU City Campus. 7 people tested the map, their usage was observed and they completed a questionnaire at the end of the test.

Two sets of 3 locations were generated, one to be used without the app and one with the app. The use of each set was alternated for each tester. Initially, the testers were

asked to find one set of locations on the map,. Following this, the app was introduced and usage was briefly explained but not demonstrated. Further assistance was available in both cases to ensure that the user completed the tasks.

Following this, they were asked to select the 'Explore Map' function and to hold it to the map as before. Finally, the testers were asked to complete a questionnaire rating their opinion of the app and providing for more detailed information about their thoughts and perceptions.

5 Results

The aim of this initial trial was to assess the usability and potential of dynamic map technology that makes use of NFC tags. The trial asked participants to navigate around a prototype dynamic map of a University campus and find pre-determined locations and were asked to comment on the ease of interaction with the technology. To that end, 57% of our participants found it easy to find a location when using the prototype. However, this is the same ratio as those who also found it easy when not using the device and instead used the simple static map; suggesting that the use of the technology within the context of the trial may be inappropriate.

Indeed, 86% of our participants stated that the map would be useful within a tourist context. In particular the ability for the mobile device to provide more information about the various locations on the map was specified as a benefit that the technology adds: "…extra information about the spot you are focussing on because the amount of information printed on the map is limited" and "especially liked that it told me not only the building but the lecture theatres inside too". Furthermore, other participants stated that the prototype would be useful as a "navigation tool" and could be adapted for use with a tourist map "to check information about each spot". Hence, the use of technology in such a way can provide a greater degree of detail than a static map can, providing contextual location information as well as location and direction instruction without cluttering the map itself.

Participants highlighted the usability benefits of such an application of this technology stating that it would allow a greater degree of access for the visually impaired specifying that the mobile device allows for "additional/more detailed audio" and that in doing so this would "improve usefulness". Furthermore, the use of mobile devices as presented here for navigation or map reading allows users to utilise any pre-existing accessibility functionality built into their devices (e.g. screen readers) potentially making traditionally inaccessible media available to a wider audience. Finally, one participant also stated that the inclusion of additional languages would be beneficial and, indeed, the we can make use of pre-existing feature of mobile devices to include a variety of languages without adding to the noise of the map.

Although, this initial user trial has highlighted the benefits dynamic map technology can provide, there are some usability challenges to be overcome. Given the close proximity required of the mobile devices to the NFC tag on the map a significant portion of the relevant map area was obscured by the mobile device itself during navigation. This could potentially be overcome using the device's front facing camera to replicate what is being obscured on the map onto the screen. Participants also

tended to expect tags to be in certain positions on the map where they were not present. A marker or small icon could be placed in key positions on the map to indicate a tags presence. However, such an approach should not be too prominent and defeat the advantages that a hidden tag provides; i.e. dynamic information without adding to the noise of a static map. Finally, the screen size and the use of drop-down menus can be an issue for navigating intended destinations with one participant stated that it can be difficult to click accurately with arthritic fingers. Screen size and mobile devices is a well-documented usability issue so there is the chance that such menus will never be "big enough" on such devices. However, the prototype could make use of voice control and audio feedback (already prevalent in the technology) to increase the usability and accessibility for a wider audience.

6 Conclusion

While static maps are still displayed by tourist centres, they provide minimal information in an age where we are used to huge amounts of information. We have presented the development and testing of a novel use of NFC within smartphones to increase the information available from such maps, and inprove usability. While the new technology proved somewhat difficult for users at first, familiarity may improve this. User perception of usefulness was high, particularly relating to the information potential. We conclude that the map has great potential, but that further work on usability is required.

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