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CS3040 Mobile Design & Development

Research Paper Synopsis & Critical Review Form

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Paper Reference: Pielot, M., Poppinga, B., & Boll, S., (2010), PocketNavigator: Vibro-Tactile Waypoint Navigation for Everyday Mobile Devices, in Proceedings of MobileHCI'10, September 7-10, Lisbon, Portugal, 423-426

Short Synopsis

In your own words, summarise what the paper was about. What were the key objectives? What key arguments did the author(s) make? What practical work was done and how? What results are discussed?

This paper involved a group of researchers who created a new means of navigation through the use of mobile devices. Their motivation arose from a significant problem that occurs when mobile users use their smart-phones to navigate to a chosen location whilst walking. The problem is that current navigation applications provide continuous directions, which require the user's constant attention. This can be a problem as it is impractical for the user to be focusing on the application and walk safely towards their destination. Because of this, researchers believed these short bursts of attention could result in decreased performance in watching a mobile device's screen. This may cause the user to miss a direction, as they also have to be aware of their physical environment when walking in busy areas. In addition to this, alternative options such as audible navigation can be considered unsuitable as the user becomes isolated to their environment due to them reducing the amount of focus on external sounds.

One approach which had not been entirely investigated was tactile feedback; the use of this technology seemed to mitigate the issues of using current mobile navigation methods. Hence why it was used by the researchers to create a new mobile application called *PocketNavigator*. This system provides navigation from the user's current location to a specific location- chosen by the user double-tapping on the map. It uses a sequence of tactile pulses- called *Tactons*- to help represent a particular direction to travel in. The sequence in which Tactons are played can be manipulated in 3 different ways to help represent the direction; the first manipulation is that the length of the pause between the pulses represented the remaining distance to the destination (the shorter the pause, the shorter the distance), the length of the 1st pulse represented how far left the user must turn/rotate while the 2nd pulse remained short, finally the 1st pulse remained short whilst the length of the 2nd pulse was increased (proportional to the rotation to the right). There was an exception if the destination was behind the user, in which the system would use 3 equally sized pulses. And if the destination was straight ahead, it would use 2 equally sized pulses. This was known as the *TwoPulse* method. In order to reduce the amount of confusion when determining which direction the user should face, the compass can be used in 2 different ways. The first way is to use the GPS, in which directions are given in relation to the GPS compass. The second way is use to use the device parallel to the ground and scan for the next waypoint. This approach was introduced to reduce the amount of attention required by the user to interact with the device, whilst also being efficient in providing accurate directions.

In order to assess their approach, they performed a field test in order to measure the applications performance. Their test involved 14 participants who had to reach 3 different destinations. Each participant was restricted to a particular method of navigation for each journey. The methods were using *PocketNavigator*, using a map or using both; however the order of the methods were counter-balanced to increase reliability of the results. The only information the participants were given was the location of the destination, this meant users had to calculate their own path to the destination, which may involve deviating from the provided route on *PocketNavigator*. For each method, they measured the time taken to reach the destination, the visible interaction with the device and how many salient objects were spotted throughout the forest.

Their results show that the Tactile Compass method was effective in directing the user to the destination. In addition to this, this method also showed that there was less visible interaction with the device itself. On the other hand there were no significant differences in the time taken to reach the destination or the number of salient objects spotted, between all 3 methods. To conclude, although the PocketNavigator did not provide a significant advantage compared to generic navigation methods, it still provided directions in a more privacy-respectful manner.

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Critical Review

Reflect on what you have read. Identify what you think were the strengths and weaknesses of the work reported in the paper. What do you think the author(s) could have done better/differently? What do you think they did particularly well? What can you "take away" from this paper and apply in your own work? Has reading this paper sparked any ideas in your own mind? What are the key things you have learned from this paper?

In my opinion, PocketNavigator possess the potential to replace current methods of navigation whilst walking. I believe this as I personally do walk in areas where navigation is necessary and one issue which I face is how tedious it can be to constantly check that you are on a correct path. Especially when travelling in busy/unfamiliar areas; PocketNavigator would reduce the impact of this.

One aspect in which PocketNavigator out-performs its competitors (Google Maps, Apple Maps etc.) is that it does not require the user to keep an eye on the application or listen out of directions- whilst using a speaker/set of earphones. By using tactile feedback, this system engages an otherwise redundant human sense of touch. Meaning no extra effort is required in receiving instructions. The user can simply feel for a direction, preventing deviations from the user's attention, resulting in more focus on the user's environment. This can prove to be invaluable when walking in unfamiliar areas, as you are unaware of any potential hazards and dangers which could have occurred if you had been isolated from the environment by using another application. Another aspect in which PocketNavigator is more effective is that it can be more privacy-respectful. This means that others will not be able to notice if you are taking directions from your mobile device. This will also become more socially acceptable as no-one is aware that you are doing so. Thus improving safety as criminals will be less inclined to confront someone if they know where they are.

However a problem that I can see with using Pocket Navigator is that you are unable to control when the pulses occur, which could be dangerous and inefficient. If you develop a motor sense for the pulses and have adapted to how the pulses are used, taking directions can become natural. For example if you are crossing a road at a set of traffic lights and you feel 3 equally-sized pulses, this means you have taken the wrong direction and the destination is behind you. Your natural human instinct would make you turn around and walk back to the correct side of the road; however this could be very dangerous if you are not paying attention. In addition to this, there needs to be sufficient contact between the user and the device in order to ensure that pulses are correctly followed. If the user is wearing loose/thick clothing, then pulses may be not be felt which could result in incorrect directions. And there is no mention within the report that there is functionality to repeat a missed pulse.

In regards to the experiment, I believe that the researchers made a suitable choice when deciding where the experiment should take place. This is because there would be less significant dangers in a city forest compared to being in the city streets, meaning participants would be less cognitively aware and more focused on the task in hand. In addition to this, the infrastructure of the city forest would have been suitable for system and the task as it would have been much more difficult to craft a route through the city. Finally the measures they had taken were also appropriate as they did help to assess the performance of the PocketNavigator application. On the other hand, there are some aspects of the experiment where they could have improved. One of which was the navigation methods they compared PocketNavigator to. They should have introduced another application such as Google Maps as this was what PocketNavigator is trying to replace. This would have been much more accurate as it would have been evidently clear about which application requires more attention. The time taken to reach the destination could also have an impact on this comparison, which would assess the PocketNavigator's performance. In addition to this, it is not clear what the researchers classed as a salient object. Hence this result can be insufficient in providing information about the navigation methods. Instead they could have measured the amount of time spent moving away/towards the destination. This could have been used to determine the efficiency of the methods compared to the time taken.

Overall, I believe PocketNavigator utilizes this technology and has created a much more suitable approach to navigation whilst walking; I can see myself using such an application in familiar areas. However due to some of the major drawbacks of the app, PocketNavigator must be refined and tested appropriately in order to replace some of the leading competing applications.