Aston University

CS3040 Mobile Design & Development

Research Paper Synopsis & Critical Review Form

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Paper Reference: Ketabdar, H., Roshandel, M., & Yüksel, K.A., (2010), MagiWrite: Towards Touchless Digit Entry Using 3D Space Around Mobile Devices, in Proceedings of MobileHCI'10, September 7-10, 2010, Lisboa, Portugal, 443-446

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 was written about a new digital system specifically designed for small hand-held devices. It has been created to improve text/digit entry within these small devices by implementing magnetic technology. The researchers believed that interaction with small devices such as smart-phones and smart watches can be restricted if the devices screen is physically small. A generic task such as entering text or numbers can be difficult on these devices if there is no external support from another piece of hardware/software. As a result, this is where the enthusiasm originated from for the researchers for their potential replacement for digit entry, MagiWrite.

MagiWrite is based on the principle of Around Device Interaction (ADI), which is a framework that proposes using the space around the device for interaction with the device. ADI has a wide array of techniques for using different sensory outputs such as camera, infrared distance sensors, proximity sensors etc. MagiWrite is implemented through the device's magnetic sensor (which most devices already possess). The device's magnetic field can be manipulated by another magnetic force within its vicinity. The researchers have used this technology with MagiWrite by detecting patterns of fluctuations within this magnetic field.

In order to use MagiWrite, the user to hold a magnet of a specific shape in their hand. The user then 'draws' a digit in the air, in front of the device which causes the fluctuation, which is then used to calculate the digit that the user drew. The fluctuations can be measured and mapped to an X, Y, and Z grid (ranging from 128 to -128), for the strength of the magnetic pulses. The system is initially implemented with preset patterns of predicted fluctuation for each digit; it is then able to compare the user's currently drawn pattern to the preset pattern within the system to determine which digit was written. This technique is called Dynamic Time Warping (DTW).

An issue which the researchers had to consider when implementing this solution was the magnetic field of the device can easily be influenced by external magnetic interferences. One of the major interferences was the Earth's planetary magnetic field. Although this will always have an impact on the device, in order to reduce the impact, the researchers have had to implement a time derivative operator.

To test the systems functionality and reliability, the researchers implemented this system within an iPhone 3GS as a mobile application. This application had 3 screens of functionality; the training screen which allows the system to learn the user's writing style, the testing screen to see if the system is able to determine which digit the user is attempting to write, and finally the save/load screen which allows the user to save their own template for a digit. The user can also implement their own rules for entering numerical data in a faster way. For example if the user writes in front of the device, the original number is detected and entered. However if they write the same number behind the device, then the detected number plus 10 will be entered. However this is no reported statistics of its use.

The researchers are adamant that this technology holds several benefits over standard digit entry due to the fact that the device and the magnet do not have to be within line of sight. The system should still be able to detect digits as long as it within the spatial surroundings of the device. As it stands, the application has been solely designed for numeric characters; however the system can be further developed to handle alphanumeric characters. This is something that the researchers are intending to do however this involves much more sophisticated signal processing and template matching techniques.

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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, the researchers have created an appropriate replacement for data entry within small devices. In doing so, they have also reduced the impact of the drawbacks found within in traditional methods and have also been able to increase efficiency of digit entry. However I cannot see myself using MagiWrite for several reasons, those of which I shall explain further on in this review.

In several aspects, MagiWrite does improve on the traditional methods used. One of these aspects includes the efficiency of entering digits. Due to how MagiWrite is implemented, users do not need to hold/see the device to interact with it. This can be invaluable if you are multi-tasking as you are able to easily enter digits within the device without having to pay attention to the device itself. In addition to this, the device can remain in a pocket/bag and full functionality is still expected from the device. On the other hand, there is no mention of any feedback when the device is not in-hand. Meaning the user will not be sure if the device has picked up the fluctuation, or that the correct digit was detected. Another aspect where MagiWrite is effective, is that it does not require any advanced hardware updates to the mobile device, as most smart-phones already posses a magnetic sensor. The only hardware that is required is the specialized magnet, which is inexpensive.

However there are several reasons where MagiWrite does not perform well. One reason is that the gestures made by the user when trying to write a digit may not be socially acceptable. This is because- to other people- the user would be making quick inhumane gestures with their hand without any purpose, especially if the user is not holding or looking at the device. In addition to this, others who are aware that the user is using MagiWrite, will be will able to determine what digit the user is trying to enter based on the shape of the gesture. This can be a breach of privacy. Another reason why MagiWrite may not be as well-designed as the researchers hoped, is that this type of technology has multiple drawbacks if not implemented correctly. Firstly, the battery on the smart-phone may get drained at an abnormal rate due to the magnetic sensors constantly being active, in order to detect fluctuations. Also, if there is another user who is also using MagiWrite, there may be some interference between the magnets that the users' are holding and the devices magnetic fields. Finally, there may be some health implications when being exposed to a specific magnetic field for a long period of time.

MagiWrite does possess the capability to be developed into an appropriate working solution. As mentioned in the research paper, the system can be used to detect alphanumeric characters in addition to digits. But also the system can be used to detect generic gestures such as a swipe to help increase functionality. For example, a horizontal swipe across the device could change the volume, depending on which direction the swipe is. And a vertical swipe can be used to skip a song.

As there is sufficient capability for this technology to be improved, MagiWrite can be a system which will replace traditional methods. While it does still resolve the researcher's initial problem with data entry, there is a large area for further development to enhance the system and its usability.