Paper Computing

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Abstract

In this work, we will introduce the main features of a paper computing system, their advantages and how they can be used to improve our everyday activities. We will understand the main advantages of paper when compared to digital systems and analyze some examples of paper computing systems. The final part of our work is about future speculations in this area and how it has evolved during the last few years. We will conclude that a vision of a paperless world is far from true and that paper based systems can and will be a part of our future.

Goals

The main goal of this research is to understand the real application uses of paper computing and the advantages that we can acquire by using it on some tasks mainly on enterprises, but also in some personal applications. We will present some examples of the utility of this technology and try to understand what kind of future it will have.

Why paper computing?

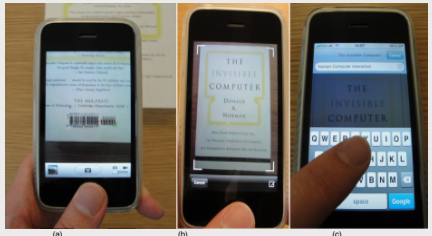
Various studies confirm paper has inherent advantage over electronic platforms in many forms of activities. Paper sheets can be bent, folded, shredded, recycled, stapled and written on at a very low cost and without the need for software upgrades or everlasting battery supplies. Despite the prediction of a paperless future, paper documents are still widely used in our everyday activities**. Paper is not dead** [2].

Integration areas

There are a variety of interactive paper applications covering different domains. In addition to different hardware solutions, there exist a number of software frameworks for the digital pen and paper technology. In the remaining part of this paper, we would like to outline some future technical as well as non-technical challenges to stimulate a discussion between interactive paper application and framework developers [4] as well as which areas of knowledge can take use of this technology.

Examples

- Searchable Books
Paper books remain popular, as many readers prefer the reading experience that paper books provide, which digital interfaces cannot. In this example, the goal is to improve users' reading experience by enhancing books with digital functionalities.
This application can be used on a mobile phone to scan trough a book with a camera, recognize the information, and ultimately be able to search any contents within the text. In essence, we are virtualizing books, keeping both the physical and virtual paper advantages.



(a) (b) (c)
An illustration of book content search via a mobile phone. (a) shows the application capturing the book's ISBN barcode, while (b) illustrates using the book's cover page (c) illustrates a user entering a search after the book has been identified.

- TheNeverendingStorytellingMachine
A conceptual system that would augment storybooks with 3D and anaglyph content that is oriented according to the reader's posture and registered right on the paper. The system allows direct finger interaction with the projected graphics to create an immersive and entertaining user experience during reading. This system has been used with a great outcome in teaching lower aged students.
Engaged by both physical and digital dimensions, users are no longer constrained by traditional story writing means, but instead, are encouraged to explore stories as multisensorial

Figure 1– Here we can see an example of this kind off books and how the images will be projected into the paper. This images can be in 3D by adding the 3D effect with special glasses.

Direct Latitude/Longitude Identification of Paper Maps Using a Camera Phone
This system adopts a new technique to embed geographical coordinates into paper maps and directly identify them using a camera phone, which is particularly useful for travelling. Through a simple photo from the camera, the system can easily trace back the map coordinates for that region, which can be exchanged with GPS devices to find the way around. This provides real-time recognition via print maps on most commercial mobile phones.

(a) (b) (c)
Figure – Snapshots of the system, (a) the paper map and the mobile phone, (b) the latitude/longitude indicator shows the latitude/longitude coordinates (green number) of the center cross, (c) photos pop up over the camera image.

- A Paper Interface for Code Exploration
This augmented reality system is designed to offer active exploration tools for programmers confronted with the problem of getting familiar with a large codebase, methods, classes and relations. In a typical scenario, new programmers coming to an institution have to learn about a project in order to start their own contribution.
With this application programmers can easily browse through classes, edit methods trough simple steps, and preview their changes on a large class diagram display. One of the main advantages of this application is the quick and intuitive code editing; the user only needs to select a class to edit its contents, and by selecting a method or variable will automatically highlight it. He can thereafter apply the changes he wants in the computer and update them in less than a second.

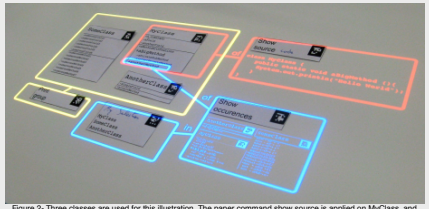


Figure 2- Three classes are used for this illustration. The paper command show source is applied on MyClass, and projects its result in red. The paper command print group has been used to produce the paper object representing the three classes circled by the yellow box. The paper command show occurrences is applied on one of the methods of MyClass, and the resulting set of class is restricted to the previously mentioned group. The results are projected in blue.

Discussion

The development of interactive paper solutions has become a very active research area. While different interactive paper frameworks support the application development, the question is whether these frameworks are missing a common abstraction layer. It might be the right time to reflect and share some wisdom. The definition of common data formats and design guidelines could be a first step towards real cross-application and cross-framework interoperability.
There is also the need to debate whether these applications, despise being useful in practice, can be an economically viable source of investment.
There can also be many technical constrains in this kind of development, such as device independence (so that different devices can communicate with each other in an optimal way), digital ink abstraction and application deployment.
One of the most challenging obstacles to overcome would also be the need of precise cross-application operability, as well as more advanced data recognition, data processing and rendering algorithms that fit a useable device on our everyday use. Afteral, that is the main premise of Weiser's vision.

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