Interactive Paper based on Augmented Reality

Yasser A. Ragab
College of Computing and Information Technology
Arab Academy for Science & Technology AAST
yasseritc@ieee.org

ABSTRACT

Digital pen and paper technologies provide the basis for linking digital content and services to printed materials in the form of interactive paper publications. To realize the potential of these technologies, it is important to develop platforms and tools that can support the large-scale publishing of interactive paper documents. However, creating successful augmented reality applications is not simply a matter of coming up with a new technology, no matter how clever. Because of the potential for confusion between the real and the virtual, augmented reality requires a multi-disciplinary approach, with a strong emphasis on the user. New technologies may offer fundamentally new ways of empowering users; but successful applications will have to be integrated into real-world activities. [01]

INTRODUCTION

To produce digital materials we need for emerging technologies such as **Anoto** digital pen solution [02] based digital pens can be used to bridge the paper-digital divide, enabling users to directly access digital content and services by interacting with printed materials. For the publisher, this presents two major challenges. The first concerns the design of such cross-media materials since it opens up many new exciting possibilities in terms of the various forms of interaction that can be supported and there are currently no conventions or guidelines for the design of the book as an interface. The second challenge is how to support the production of interactive paper.

BACKGROUND

Anoto digital pen solutions were developed for the capture of and written information and, originally, interactivity was limited to specific command buttons for actions such as sending data or changing pen stroke attributes. Recent developments in the pens and patterns support more general forms of interactivity based on real-time streaming of data. Provides a number of desktop applications where users can, not only interact with the application using the pen, but also sketch their own interfaces.

INTERACTIVE PAPER

The presented interactions will be supported by concrete examples of applications outlining the potential of interactive paper documents in terms of both the innovative physical-digital interfaces and the supported management of information across paper-digital document workflows. This will allow us to classify paper-digital interactions on a two-dimensional scale that will be used throughout this paper to characterize both the developed applications and the tools enabling their development.[03]

AUGMENTING PAPER DOCUMENTS

The idea of augmenting paper documents and enabling paper-digital interaction. The existing technologies already represent the first steps towards bridging the paper digital divide and allow printed documents to be linked to digital content and services. The most advanced approach is certainly the Anoto technology and even if the technology was originally developed for the digital capture of handwriting, nowadays digital pens are available that can deliver the position information in real-time, enabling paper to be turned into an interactive medium. This new interaction paradigm supports what we call Interactive Paper documents, a novel first-class medium in the context of an interactive information system. By exploiting the Anoto technology and introducing geometrical shapes on paper as a specific form of interactive areas on a page. Interactive paper documents enable links between printed and digital materials to be defined, as well as the development of highly-interactive applications, where users can easily move back and forth between the printed and digital worlds. In the remainder of this thesis we will focus on systems based on such an interaction paradigm, highlighting the problems that currently arise in using this technology and generating paper instances of digital documents. An extensive overview of other related technologies and applications can be found in [04].

We will describe the Anoto technology in detail, as illustrated in Figure 2 introducing existing related frameworks and tools. For a thorough analysis and description of this technology and the issues of creating, managing and publishing Anoto-based documents

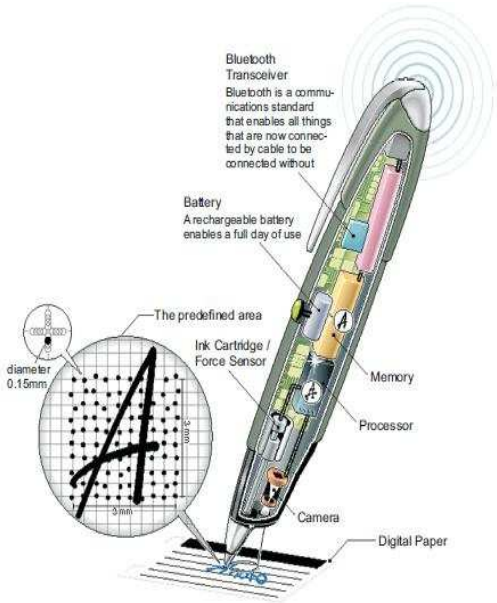

Fig. 1. Anoto Digital Pen and Paper technology

DIGITAL PEN AND PAPER

As illustrated in Figure 2. The Anoto pattern consists of tiny dots, covering all of the printed document, and resulting in a very light grey background that normally does not disturb the reader. In order to encode position information, the printed dots are distributed on paper over a virtual grid with a resolution of 0.3 mm. A dot is printed at every junction of the virtual grid, slightly displaced up, down, left or right with respect to the grid junction. These four possible displacements of the single dots encode 2 bits of information. Since the camera integrated within the digital pen can read a matrix of 6x6 dots, a unique 72 bit sequence can be encoded in a 1.5 mm patterned square. By multiplying this bit sequence with the grid resolution, we can calculate the size of the available non-repetitive pattern space: 60,000,000 km2

This pattern is mapped to a 2-dimensional absolute coordinate space and decoded by means of the digital pen. The pen may continuously track the position of its stylus on paper and either store this information in the integrated memory or send it via Bluetooth to specialized software on a computer responsible for processing it further.

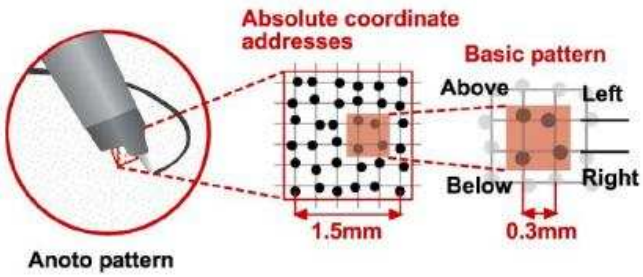

Fig. 2. Anoto pattern

CONCLUSIONS

The "paperless office" is clearly a myth and paper continues to be an essential component of many complex, collaborative work settings. Augmented Reality provides a powerful alternative to the "keep it or replace it" choices traditionally faced by system designers. Yet, just as there are an almost infinite variety of paper and uses of paper, interactive paper offers an equally wide range of possible implementations. Although interested in the technological aspects of interactive paper, our main interest is how to embed it in real-world settings. We do not believe in an "ideal" interactive paper technology:

Minor technological differences in how information is captured, interpreted and presented, as well the registration between the real and virtual, may cause users to appropriate the technology in very different ways. The situated nature of paper "in use" has important design implications: designers must consider how users will adopt and co-opt interactive paper in the context of their daily work this implies a strongly user-centered and participatory design process. We advocate exploring the design space with users, rather than immediately seeking a single solution. We also advocate "evolutionary design", which leaves much of the control of the on-going evolution of the application in the users' hands.

REFERENCES

[1] Michael Grossniklaus, Moira C. Norrie, Beat Signer and Nadir Weibel "Producing Interactive Paper Documents based on MultiChannel Content Publishing" Third International Conference on Automated Production of Cross Media Content for Multi-channel Distribution"

[2] Anoto AB, http://www.anoto.com.

[3] Nadir Weibel "A Publishing Infrastructure for Interactive Paper Documents Supporting Interactions across the Paper-Digital Divide" Dipl. Informatik-Ing. ETH born February 18, 1978 citizen of jonschwil , SG, Switzerland

[4] K. Elissa, “Title of paper if known,” unpublished.

[5] Wendy E. Mackay & Anne-Laure Fayard ORSAY-CEDEX, FRANCE " Designing Interactive Paper: Lessons from three Augmented Reality Projects"