1. Introduction

The term ‘Augmented Reality’ (AR) exists now 17 years. Tom Caudell, a researcher at aircraft manufacturer Boeing, first coined the term in 1992 [Chen, 2009]. During the past two decades AR has mainly been developed in labs and at high-tech enterprises. At conference series, like SIGGRAPH (short for Special Interest Group on GRAPHics and Interactive Techniques) and ISMAR (International Symposium on Mixed and Augmented Reality) many innovative prototypes for AR have been presented. In Architectural Design research also many AR-related papers are emerging (68 AR papers in the Cumincad database, d.d.1/9/2009).

2. Getting AR through the hype-cycle

This year, Augmented Reality suddenly became a hype: the spread of technology into mainstream applications is illustrated by the amount of Google searches for AR, which is now exceeding the searches for VR (Fig. 1).

The ‘hype’ does not come unexpected. Most of the technical conditions to make AR accessible (for laymen / outside laboratories) have been met recently. The low-threshold for using AR comes due to the availability of real-time 3d rendering techniques, ubiquitous webcams and small phone/gadget devices with built-in cameras, compasses, and positioning systems such as the Global Positioning System (GPS), Wi-Fi Positioning Systems (WPS) and cell phone tower triangulation [Wagner, 2009]. Recent updates of Smartphone operating systems, such as Google’s Android and Apple’s iPhone OS 3.1 (probably to be presented one week after this paper was written), allow for making rendered overlays on top of life video images.

The abundance of expressions and impressions, related to AR, could best be illustrated by searching YouTube films with ‘Augmented Reality’ as a keyword (3940 films with often more than 100.000 views per film, d.d. 1/9/2009).

Our own background in AR research is twofold. Augmented Reality has been discussed in a theoretical overview of ‘changing approaches to the real world’ [Stellingwerff, 1997]. A large quote from that 12-year-old paper still fits rather well with my expectations for the near future:

“I have been thinking a quite long time about what could be the impact of ubiquitous computers and augmented interaction for the design of buildings and their materialization. The
application of these techniques in the production of buildings is quite clear. In a factory or on the building site, small chips in tools and machines can provide a more specific use of building components and complexity can be dealt with more easily. The components can be labelled and monitored during the building production and the whole life-cycle and reuse of the building. Smart buildings can become more pleasant and more cost efficient.

For centuries we use media, which provide information of buildings and building sites. We use that information in design offices. The design is not made ‘on site’. This situation is similar to that of soldiers who do mainly exercise in a simulated war area. They are shut off from reality. For the instruction of cold-blooded warriors that might be an advantage, but an architect needs to feel and perceive the context in an uncensored, most realistic way. We are used to this separation of the building site and the design office for a long time. Therefore it is difficult to imagine that these two new techniques enable us to design while standing on the place where finally the building or the urban space will be made.

The idea of a design approach with the use of ubiquitous computers and augmented interaction is opposite to the virtual reality approach. The material reality is perceived directly and all yet developed CAAD and sketch tools can be used for ‘design on site’. In one possible future, vr-gadgets get a semi transparent screen, through which the design image is superimposed over the directly perceived reality. Surrounding buildings are identified and linked to their database of a Geographic Information System. Through a Global Positioning System the location of any object can be measured. By means of an advanced solid modeller the spatial design can be made while it is immediately checked and refined for materialization. Finally (…) the contractor and his or her architect investigate a site and sense the ‘genius loci’; they get a more realistic image of the future building in front of their mind’s eyes. The image is shared and based on realistic data. Then we do not need the dark caves of virtual reality anymore.”

Now in 2009 the core tools to make AR prototypes for the above described ‘future design scenario’ are available and it is much easier to achieve interesting results for innovative approaches.

The other, long-term interest is related to AR in the Industrial Design Process for new design support systems. A series of publications [Verlinden et.al. 2003-2009], report on the research for projected design images on top of design prototypes. The
combined caption and projected augmentation of the design artefacts makes it possible to interact in unprecedented ways with developing prototypes, in a combined digital and physical modus. As Dourish [2001] states, such embodied dialog yields a tangible and social interface – suited for collaborative design and review settings.

3. Types of Augmented Reality

While looking at TV broadcasts, in most cases, we are not aware of the many added visual and audio cues. Switch to a stock market discussion channel, and the idea of tickertape-augmented views becomes instantly clear. In sports, like Olympic speed swimming contests, the white frontline of the first swimmer is indicated, as if it is moving over the pool; this is also a good illustration of AR. However, AR becomes intriguing if you really interact with it for the first time. Yesterday, 31/8/2009, a blogger at Augmented Times compared the excitement with the beginning days of cinema, when people were excited about a short film depicting the arrival of a train by the Lumiere brothers. (1) We are at the infancy of AR, and need useful and entertaining applications.

If the many approaches and applications for AR are explored, a few main tracks of developments can be determined. Interaction design approaches are still at their infancy, e.g. Lamantia [2009] proposes four paradigms, summarized in Table 1.

Very recent applications combine social networking and Google-map-like services by making relatively simple textual and iconic AR overlays on top of Smartphone video images. Early key-players in this industry are the Dutch firm ‘layar’ and a firm at the other side of the world, called ‘mobilizy’.

A second type of AR allows to track black and white marker images and present 3d geometry, based on the 3d coordinates from the markers [Kato and Billinghurst, 1999]. This is not yet much available on Smartphones, but it is coming. Already many

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1 http://artimes.rouli.net/2009/08/looking-for-modern-day-chaplin.html
people experiment with this type of AR by using pc's with a webcam. They show the printed marker images in front of the camera and on the screen, they see themselves with the augmented version of the image. When they turn the piece of paper, the object on screen moves accordingly. An important ten-year-old open source program for this kind of AR is ARToolKit. Many other applications draw from ARToolKit and provide more modern interfaces as a shell around ARToolKit. Examples are ATOMIC, OSGART, DART, BUILDAR and FLARToolkit.

This second type of AR surfaces as well in more expensive enterprise versions, used in e.g. car advertisement. An example for a mini cabrio show can be seen at YouTube. (2)

A further step is natural image tracking.

Ultimately comes full-automated perception as tracking system for the augmentation.

Agenda

This year we have set up a joined education program, called the ‘Minor on Advanced Prototyping’. It is an elective full-semester curriculum, available for all technical / design / engineering students in their third BSc year. We combine the expertise and laboratories of both of our groups, of the Faculty of Architecture and the Faculty of Industrial Design Engineering. In one of the courses, we will work in small groups on different types of Design Support Instruments. Regarding Augmented Reality, two groups of six students will be working on a research for and with AR technologies.

The first research group focuses on ‘Projector-based Augmented Reality’: Augmented Reality technologies allow blending the physical and virtual world; they offer attractive modeling principles to designers and engineers. Two specific aspects should be considered: 1) the visualization and interaction with annotations and 2) creating stunning 3D graphics effects. This project includes: creating physical setup and 3D modeling and animations (Maya or 3D studio Max).

The second research group focuses on ‘SketchBlocks and 3D tracking’: Two techniques need connecting: easy 3D modeling and optical position-sensing. Both are available for free on the web, but need consideration in developing new applications. This project includes: some programming, early usability studies and interaction sketching.
Although it is very early in the process, we will present starting ideas of both groups, at the EAEA conference in Cottbus.

References


