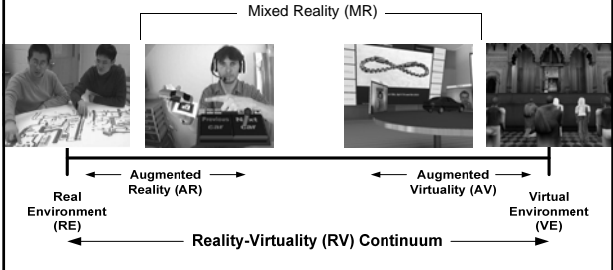


Enabling BIM of On-site Visualization: Mobile Augmented Reality Systems (MARS)

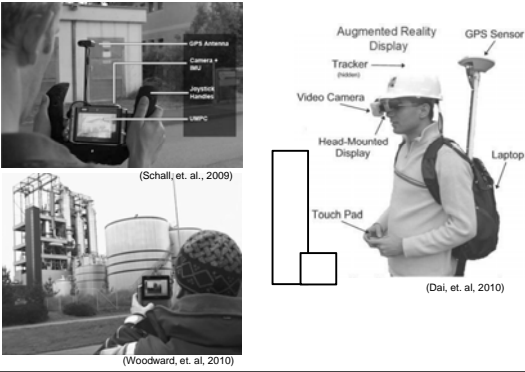
Dr. Xiangyu Wang
The University of Sydney
8th Dec. 2010
Department of Civil and Environmental Engineering,
Yonsei University, Korea

Introduction

- **Augmented Reality (AR):** an environment where the virtual world objects/information are inserted into a predominantly real environment.



Wearable AR Devices



Location Awareness

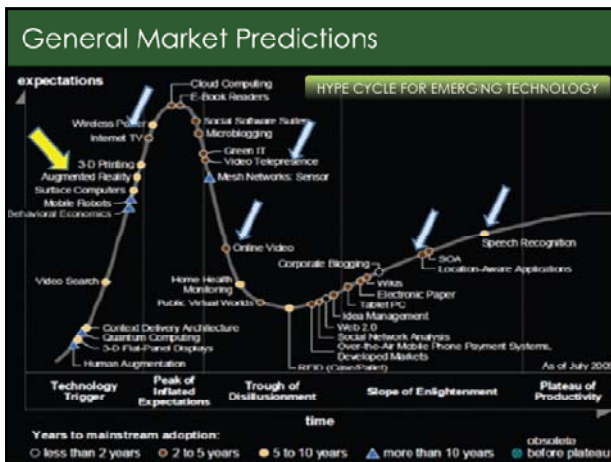
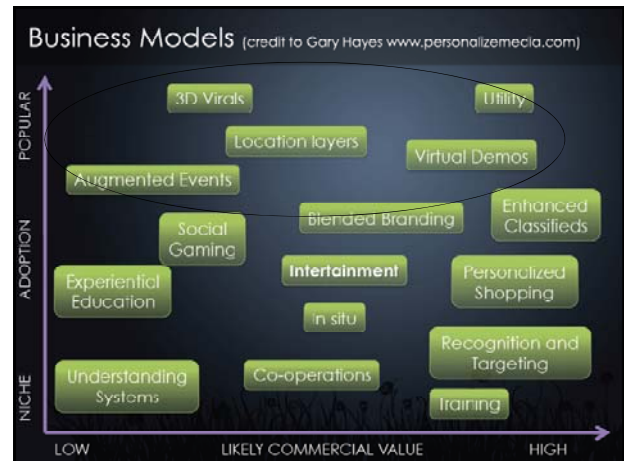
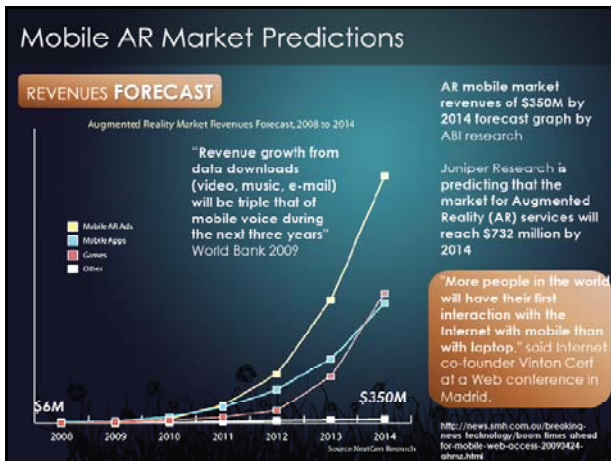
"Some researchers see location-aware computing on a global scale as a legitimate successor of the World Wide Web as we know it today (Spohrer, 1999)"

AR technology in varied fields

- Assembly and construction.
- Maintenance and inspection
- Navigation and path finding
- Tourism.
- Geographical field work.
- Journalism
- Architecture and archaeology
- Urban modeling.
- Entertainment
- Medicine
- Military training and combat.
- Personal Information Management and Marketing
- ? ?

Augmented Reality Devices

| web | mobile | kiosks | AR glasses |
|---|--|--|--|
| | | | |
| <ul style="list-style-type: none"> •Virtuality try on products •Augmented panel •Interactive panel •Point and gesture control •Assembly and prototyping •Property views | <ul style="list-style-type: none"> •Sector win comps •Discovery creative •Point of interest locations •Annotated GPS •Outdoor games •Outdoor advertising | <ul style="list-style-type: none"> •Virtuality try on products •Animated packaging •In store & tradeshow •Interactive shop window •Terminal or big screen •Event entertainment | <ul style="list-style-type: none"> •Virtual monitor •Gesture based control •Leverage mobile screen •Enable peripheral digital •Location intelligent •Safe and containing |



- ### Mobile Computing Platforms (AR)
- Notebook computers
 - UMPC (Ultra Mobile PC's)
 - Mobile phones
 - Wearable technology (growing customer base in industry, government, and military)

- ### MARS
- Mobile Augmented Reality Systems
 - (MARS) provide this service without constraining the individual's whereabouts to a specially equipped area.

- ### Technologies to assist MARS
- global tracking technologies
 - wireless communication
 - location-based computing (LBC) and services (LBS)
 - wearable computing

Effectiveness and Adoption

- From the user's point of view, the important question is how to get to ...
- the most relevant information with the least effort and how to minimize information overload.**

Supporting Technology

- 4G
 - Samsung – South Korea 3.6Gps
- LTE
- RFID + NFC (near field communication)
- Pseudolites
- Contact lenses?

LTE

- LTE (Long Term Evolution)** is the trademarked project name of a high performance air interface for cellular mobile telephony. It is a project of the 3rd Generation Partnership Project (3GPP), operating under a named trademarked by one of the associations within the partnership, the European Telecommunications Standards Institute.
- LTE is a step toward the 4th generation (4G) of radio technologies designed to increase the capacity and speed of mobile telephone networks.

RFID

The Future of Documents xerox

Read more about RFID

ALIVE INSIDE

RFID TECHNOLOGY BRINGS GUINNESS' BRAND POSITIONING IN IRELAND TO THE FORE WITH A SPORTING WORLD FIRST THAT COULD BE ORIGINATED BY LIFECYCLE HOW STANDS SUPERCHARGE THE GAME OF RUGBY / BY EMILY HARE

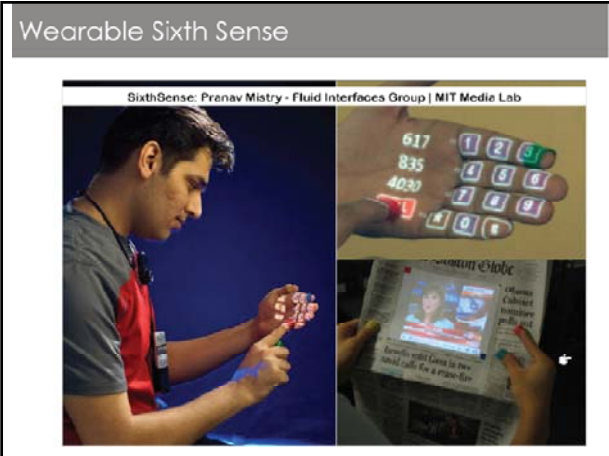
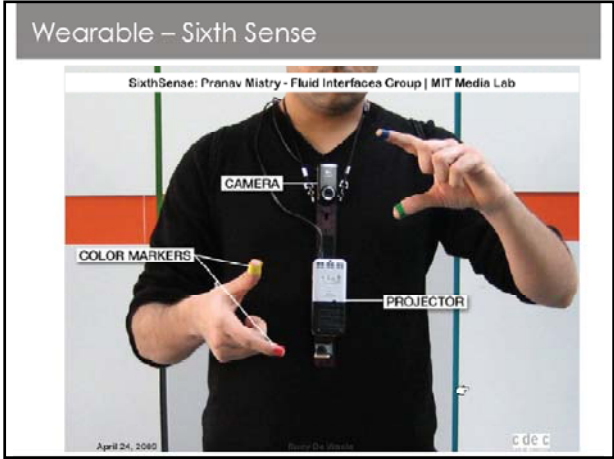
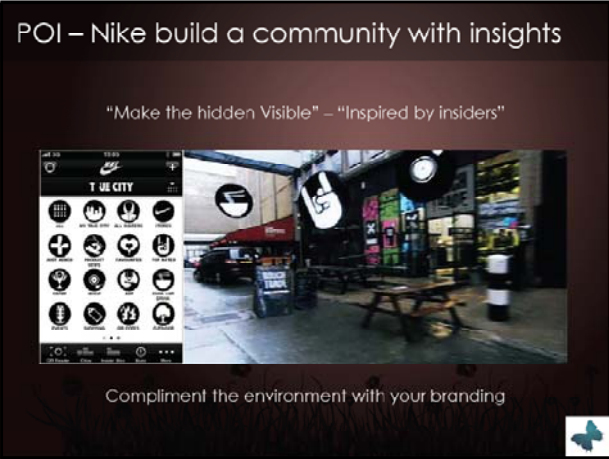
RFID combined with mobile AR and HMD's can transform our world.

GPS support for AR

- Plain GPS**
without selective availability is accurate to about 10–15 meters.
 - WAAS**
GPS using the wide area augmentation system (WAAS) is typically accurate to 3–4 meters in the US and other countries that adopt this technology.
 - Differential GPS**
Typically yields a position estimate that is accurate to about 1–3 meters with a local base station.
 - Real-time-kinematic GPS**
(RTK GPS) with carrier-phase ambiguity resolution can produce centimeter-accurate position estimates.
- The latter two options require the existence of a nearby base station from which a differential error-correction signal can be sent to the

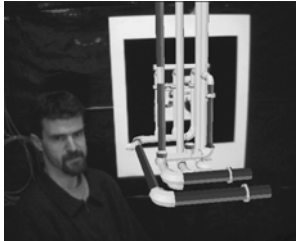
OLED and other forms of non-rigid





Potentials of AR+BIM

• **Construction Visualization:** “build as you see it, where you see it.”

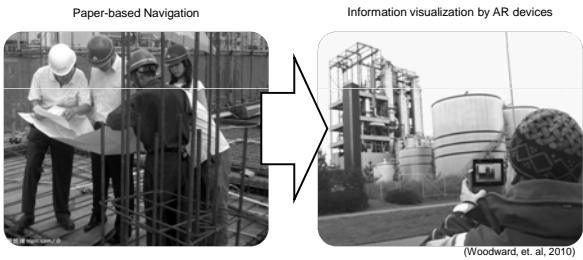


Piping Installation

Potentials of AR+BIM

- Onsite Visualization of As-Planned Information
- Onsite Validation of Construction Operations/Processes Design
- Easy Retrieval and Editing of Digital Data

Onsite Visualization of As-Planned Information



Onsite Visualization of As-Planned Information



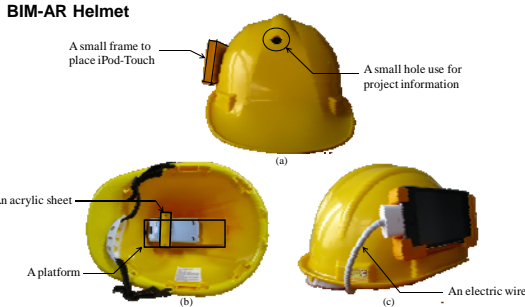
(Source: Azuma et al. 2001 by Courtesy of Siemens Corporate Research)

Onsite Visualization of As-Planned Information



(Virtual bridge across a real river; Source: Klinker et al. 2001)

Onsite Visualization of Existing Building Information



(Kang et al. 2010)

Manipulation Module(2/2)

Slide

Slide from left to right

Slide from right to left

Gesture Control

Look up

Look down

Onsite Visualization of Building Information

(Virtual facility management data overlaid onto a real indoor setting
Source: Kensek et al. 2000)

Onsite Visualization of Existing Infrastructure Information

AR Viewing of Underground Utilities (Source: Roberts et al. 2002)

Onsite Validation of Construction Operations/Processes Design

2D Drawings and 3D Simulation

Operation-level Guidance

Onsite Validation of Construction Operations/Processes Design

• Bored Piles

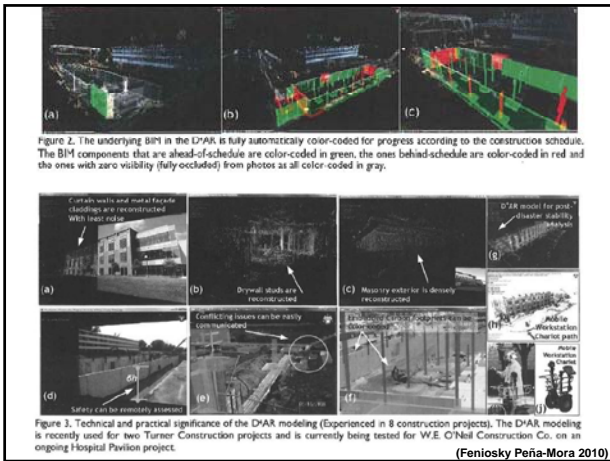
• Pipeline

(Fung and Lu, 2010)

4-D AUGMENTED REALITY CONSTRUCTION MONITORING

Figure 1. The D*AR model for Student Dining and Residence Hall construction project reconstructed with 160 images collected along the sidewalk @ 2Mbps. (a) to (c) visualizing point cloud of the basement and project surroundings from synthetic views. (d) joint image and point cloud representation; (e) see-through image visualized along with 4D BIM plus the 25-built point cloud; (f) A BIM element is color-coded according to progress and is visualized in the D*AR model.

(Feniosky Peña-Mora 2010)



Easy Retrieval and Editing of Digital Data

- Equipment Maintenance for Mechanic
 - Browse spatially correspondent digital information
 - Follow virtual procedural guidance

