Mobile Augmented Reality: An Emerging Technology

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Overview

• Research Project
• Purpose:
  – Understand augmented reality
  – Use in mobile environment
  – How it can be used in an instructional setting
AUGMENTED REALITY BACKGROUND
Definition

Augmented reality is the overlay of real-time, real-world environments with digital information designed to enhance a person’s perception of that view.
History

• Concept appeared in 1960’s & 70’s: computerized headsets, just-in-time training.
• Term coined by Tom Caudell in 1990 to refer to digital display headset used as a guide in aircraft assembly.
• Well-established technology tied to specific location or bulky equipment.
• Extensive use in Science fiction (e.g., Star Trek)
Applications

- **TV Broadcasts**
  - Examples: “first down” line on football fields, virtual line indicating world record time in swim meets.
- **Medicine**
  - Used in radiology & surgery to provide additional information such as test results, scans, surgical training
- **Military**
  - Immersive training environments for combat preparation; maintenance and repair
- **Tours of colleges and historical sites**
- **Marketing**
- **Gaming**
- **Training**
  - Example: complex electronics assembly and repair
  - Turning sketches into 3D objects
Mixed Reality Continuum

- Augmented Reality vs. Virtual Reality
- Designed to apply to immersive technologies, usually involving helmets or special glasses

(See Milgram & Kashino’s (1994) Mixed Reality Spectrum, as cited in Klopfer, 2008)
Augmented Reality Continuum

Designed to describe non-immersive environments

Augmented Reality

Lightly augmented
Heavily augmented

Real-world input
Virtual input

Location-based mobile games

(Klopfer (2008))

Immersive technologies
MOBILE AUGMENTED REALITY
Mobile Media Devices in Education

• A potentially disruptive force
  – Portability
  – Price Point
  – Usability
  – Functionality
  – Ubiquity

• Enable
  – Connectivity
  – Social interactivity
  – Context sensitivity
  – Individuality
Mobile Augmented Reality

• Enabled by mobile media devices combining
  – Camera
  – Screen
  – GPS location
  – Compass and accelerometer
  – Image recognition capability
  – Internet access
  – Affordability

• Availability of AR Browsers, apps
Mobile Augmented Reality Approaches

- **Marker-based Augmented Reality**
  - Use specific visual cues (logo, etc.) to call up info from a database or direct users to a website
  - QR codes, ‘Magic Symbols’, Semacodes read by mobile app

- **Markerless Augmented Reality**
  - Uses GPS capability of smartphones combined with AR Browsers
  - Geotagging, geolocation, ‘floaticons’
Educational Applications

- AR Books
- Dynamic 3-D objects
- Field Trips to Museums & Historical Sites
- Just-in-time learning
- Skills training
- Discovery-based learning
- Educational Games, or structured activities with game-like qualities
Educational Philosophy

• Aligned with
  – Constructivist philosophy of education
  – Socio-cultural learning theory
  – Situated model of cognition
  – Authentic learning experiences
  – Discovery learning

• Build 21st century skills:
  – Collaboration
  – Analysis
  – Synthesis
Characteristics of Mobile Augmented Reality Games

• Story-driven learning experiences rooted in particular places
• Role-playing
• Designed around authentic resources
• Require social interaction with other game participants
• Exploit real physical environment in which game is located
• Authentic and engaging
### Examples

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Limitations

• Logistical support and management
• Hardware/software issues
• Student cognitive overload
• Portability
FUTURE DIRECTIONS
Augmented Reality Software

• Enable creation of AR applications
• Browsers, Tools, API’s
• Examples:
  – AR Toolkit: open-source, marker-based tool
  – Layar: markerless augmented reality browser
  – Junaio: image and object recognition, mixes marker-based & markerless methods
  – Google Goggles: http://www.google.com/mobile/goggles/#text
  – Tagwhat: www.tagwhat.com
Technology convergence

• Context aware computing
• Gesture-based computing
• Holographic images
New Educational Possibilities

• Toolkits for developing Mobile Augmented Reality Games for education
  – MIT’s *Outdoor Augmented Reality Toolkit*: drag and drop authoring tool.

• Museums, cities, historic sites developing MAR content
  – Museum of London: “StreetMuseum”
  – iTacitus (Intelligent Tourism and Cultural Information through Ubiquitous Services) Project
  – CultureClic

• Student-developed MAR content
  – “Augmented Reality Scratch” tool from Georgia Tech’s AR Lab
  – Wikitude.me

• Incorporation into project–based learning opportunities
References


Frequency 1550

- Hybrid reality game about Medieval Amsterdam designed to be played in one day
- Groups of 4-5 children are divided into 2 teams – a city team, who walk the streets of Amsterdam, (each group is assigned a different area of the city) and a headquarters team who are at a computer back at the school.
- Teams communicate via cell phones and switch places after lunch.
- The city team can view a map of Medieval Amsterdam on their smart phones; the headquarters team can access that map and a map of present day Amsterdam.
- The city team has tasks to complete, and the headquarters team can follow them through GPS and can use other computer resources to guide them.

Explore!

• Enables interactive explorations of archaeological sites in Italy by groups of 3-5 middle school students
• Each group given 2 cell phones;
  – one phone contains the game application, which provides the information necessary to play the game,
  – the other phone contains an application which provides further hints for identifying the places in the park and contains 3D reconstructions of how the places may have looked.
• Game built on a platform that can be adapted to a variety of different historic sites

Alien Contact!

- Designed to teach math, language arts and scientific literacy skills to middle school students
- Adapted to any outdoor environment, superimposes a map of a virtual world on that space based on GPS coordinates:
- Based on scenario that aliens have landed on earth; teams of students consisting of a chemist, cryptologist, computer hacker, and FBI agent must figure out why (peace, plunder, invasion, etc.)
- Students can interview virtual characters, collect digital items, and solve science, math and language problems to answer the question
- Students see different pieces of evidence depending on role they play, requires team work to solve
- Game based on Massachusetts state standards, and fosters multiple higher order thinking skills.

Environmental Detectives

- Students play the role of environmental scientists exploring the source of a hypothetical toxic spill.
- Real environments used, and students engage in complex, collaborative problem solving typical of real environmental engineers.
- Each pair of students is given a mobile media device equipped with GPS and can see their location on a map.
- Students conduct virtual interviews with people in designated locations in the physical space; some of the experts they interview can provide documents, and students can take virtual samples of the water and the soil.
- Developed by researchers in MIT’s Games-to-Teach project, in conjunction with faculty in the environmental science department.


Charles River City

- Example of the second generation of games being developed by MIT’s Games-to-Teach project
- Students participate on teams in an investigation of a large-scale outbreak of illness coinciding with a major event in the Boston metro area
- Similar to *Environmental Detectives*,
- Enhancements made to foster collaboration among participants, including distinct player roles, increased data beaming from player to player, and cascading events, in which some events trigger other events

Layar

Layar is an application that overlays your view of the real world with waypoints representing your favorite coffee place, the movie theatre you're trying to find, or in this case, where some of that $787 billion from the American Recovery and Reinvestment Act is going.