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# An Introduction To Augmented Reality With Mobile System

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***Abstract*- Augmented reality (AR) is a live, direct or indirect, view of a physical, real-world environment whose elements are augmented by computer-generated sensory input such as sound, video, graphics or GPS data. It is related to a more general concept called mediated reality, in which a view of reality is modified (possibly even diminished rather than augmented), by a computer. As a result, the technology functions by enhancing one's current perception of reality. By contrast, virtual reality replaces the real world with a simulated one. Augmentation is conventionally in real-time and in semantic context with environmental elements, such as sports scores on TV during a match. With the help of advanced AR technology (e.g. adding computer vision and object recognition) the information about the surrounding real world of the user becomes interactive and digitally manipulable. Artificial information about the environment and its objects can be overlaid on the real world.**

***Keywords*- AR; MARS; WAN; LAN; PAN; software; hardwae**

## I. Introduction

Augmented Reality is an increasingly-recognized paradigm of information visualization that merges a computer generated virtual object onto a real scene to visually augmented reality.

There are three requirements in applications as (1) combines real and virtual (2) interactive in real time (3) registered in 3-D To achieve these requirements we use various computer vision technologies. With a monocular camera, 3-D structure of real scene is sensed to enable overlaying virtual objects with geometrical consistency in real time. Augmented Reality uses three display devices: a head mounted display, a handheld display and projection display. This display superimposes graphics over a real world environment in real time. Getting the right information at the right time and the right place is key in all these applications. For handheld devices such as personal digital assistants, pocket PC etc. can provide timely information using wireless networking and global positioning system (GPS) for tracking the device. In Augmented Reality the users view of world and computer are literally become one.[6]

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## II. What Makes AR work

- **Display**: This corresponds to head mounted devices where images are formed. Many objects that do not exist in the real world can be put into this environment and users can view and exam on these objects. The properties such as complexity, physical properties etc. are just parameters in simulation.
- **Tracking**: Getting the right information at the right time and the right place is the key in all these applications. Personal digital assistants such as the Palm and the Pocket PC can provide timely information using wireless networking and Global Positioning System (GPS) receivers that constantly track the handheld devices

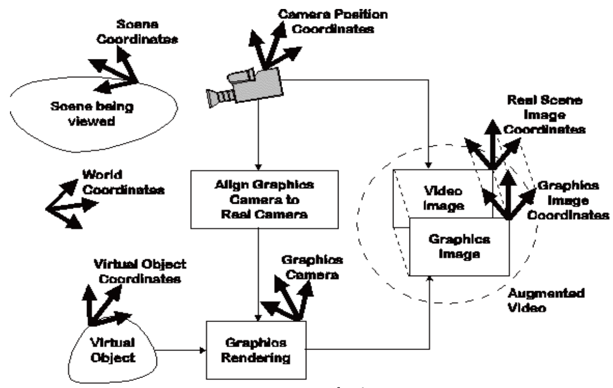

Fig 2.1 set up for AR

- **Environment Sensing**: It is the process of viewing or sensing the real world scenes or even physical environment which can be done either by using an optical combiner, a video combiner or simply retinal view.
- **Visualization and Rendering**: Some emerging trends in the recent development of human-computer interaction (HCI) can be observed. The trends are augmented reality, computer supported cooperative work, ubiquitous computing, and heterogeneous user interface. AR is a method for visual improvement or enrichment of the surrounding environment by overlaying spatially aligned computer-generated information onto a human's view (eyes).[6]

## III. Implementation framework

### A. *Hardware*

The main components of our system are a computer (with 3D graphics acceleration), a GPS system originally differential

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GPS, and now real-time kinematic GPS+GLONASS, a see-through head-worn display with orientation tracker, and a wireless network all attached to the backpack. The user also holds a small stylus-operated computer that can talk to the backpack computer via the spread spectrum radio channel. Thus we can control the material presented on the head worn display from the handheld screen. We also provide a more direct control mechanism of a cursor in the head worn display by mounting a track pad on the back of the handheld display where it can easily be manipulated (we inverted the horizontal axis) while holding the display upright. To make the system to be as lightweight and comfortable as possible, off-the-shelf hardware can be used to avoid the expense, effort, and time involved in building our own. Over the years, lighter and faster battery-powered computers with 3D graphics cards, and finally graduated to laptops with 3D graphics processors [3]

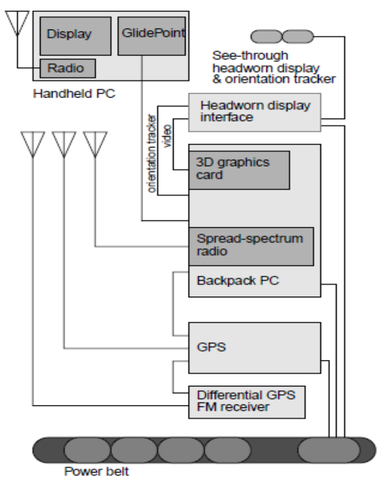


Fig 3.1 hardware framework

## B. *Software*

Software infrastructure Coterie, a prototyping environment that provided language-level support for distributed virtual environments. The main mobile AR application ran on the backpack computer and received continuous input from the GPS system, the orientation head tracker, and the track pad (mounted on the back of the handheld computer). It generated and displayed at an interactive frame rate the overlaid 3D graphics and user interface components on the head worn display. In the handheld computer we ran arbitrary applications that talked to the main backpack application via Coterie object communications. In our first prototype, we simply ran a custom HTTP server and a web browser on the handheld computer, intercepted all URL requests and link selections, and thus established a two-way communication channel between the backpack and the handheld.[3]

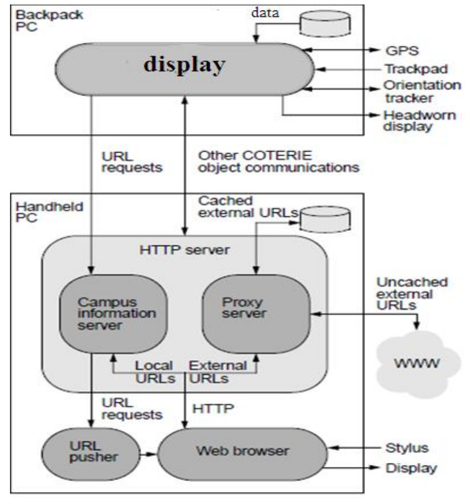


Fig 3.2 software framework

# IV. Mobile augmented reality system

Augmented reality (AR), in which 3D displays are used to overlay a synthesized world on top of the real world, and mobile computing, in which increasingly small and inexpensive computing devices, linked by wireless networks, allow us to use computing facilities while roaming the real world. In exploring user interfaces, systems software, and application scenarios for MARS, our main focus is on the following lines of research:

## A. *Main components of MARS*

- computer (with 3D graphics acceleration),
- GPS system
- A see-through head-worn display
- A wireless network

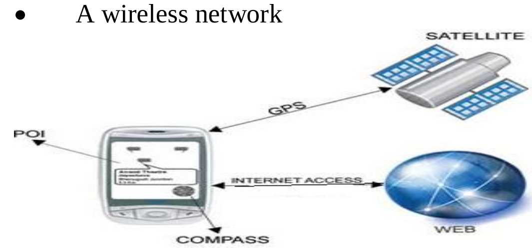


Fig 4.1 MARS components

The MARS user interfaces that we will present embody three techniques that we are exploring to develop effective augmented reality user interfaces: information filtering, user interface component design, and view management. Information filtering helps select the most relevant information to present, based on data about the user, the tasks being performed, and the surrounding environment, including the user's location. User interface component design determines the format in which this information should be conveyed, based on the available display resources and tracking accuracy.

### B. *Wireless Networking for Mobile Augmented Reality*

This section will discuss the impact of wireless networking in AR. Wireless network characteristics differ quite markedly from wired in latency, bandwidth, bandwidth fluctuations and availability. These have direct impact on the performance and quality of user experience in AR.

- **Wireless WANs and 3G Networking**: The wireless wide area networks (WWANs) are ideal for AR systems that need to support large scale mobility, for example nation-wide or in a large city. Systems that provide location-based services are a good a very good example of such an application. Virtual reality systems which used modem-based slow speed connectivity for sharing data such as in Net Effect Viktorsson make an interesting use of the SIM (Subscriber Identity Module) card used in GSM phones. SIM card is typically used by the user to store his personal information such as contact information of people he knows, his preferences and other personal information. Information about avatar characteristics for a user can also be stored in a SIM card. It can then be moved from one access terminal to another. A virtual world, which the avatar is designed to enter, can then be accessed from many different access terminals by means of inserting the SIM card and entering a personal identity Number (PIN) code. Thus, besides making it possible to access a virtual world from different access terminals, this technique also makes it possible to use avatars in new applications.. The 3G virtual disco is presented to the users as a 3-D animated virtual building with several floors representing different music clubs and styles of music according to the selection and tastes of the listeners. In the intro sequence the user can select an animated 3-D character (avatar) as his or her virtual persona and visit the different music rooms in the, virtual disco. Users can download or stream music in combination with high quality 3-D animation clips showing synchronized dancing avatars. GPRS (General Packet Radio Service) is considered as a 2.5G network and is built on top of a GSM network. Their VR applications included a multi-user community where users could see each other’s avatars, a conversational virtual character and a 3D multi-user game. As expected, with low data rates and high latency, they found the GPRS network to be insufficient for supporting the networked VR applications. an experimental performance evaluation of networked VR systems in UMTS (Universal Mobile Telecommunication System) network. UMTS is considered a 3G network.
- **WLANs**: Wireless local area networks (WLANs), as the name suggests, are wireless networks implemented in a local area such as a home or an office building. WLANs typically will support much higher data rates (between 11-54 mbps) and lower latency than WWANs but their support for mobility is limited than in WWANs. Currently, WLANs can be built using any of the IEEE 802.11a/b/g/n standards compliant equipment. Human Packmen is an interactive role-playing, physical fantasy game integrated with human-social and mobile-gaming that emphasizes on collaboration and competition between players. By setting the game in a wide outdoor area, natural human-physical movements become an integral part of the game. In Human Packman, Packmen and Ghosts are human players in the real world who experience mixed reality visualization from wearable computers. Human Packman uses WLAN technology to enable mobility in small scale environments. While the transmission range of one WLAN base station or access point is typically 100 meters, a number of access points can be used to provide coverage in much larger areas. The migration between different networks happens transparently to the application. To test their overlay network, they have developed a Compaq iPAQ-based first person shooter game called Real Tournament for this game, their overlay network works on top of IEEE 802.11b and GPRS. WLAN capability in game machines has become very popular. As a result, many of the new game machines now come with built-in support for WLANs or provide attachments for WLANs. Wi-Fi Max for Sony PSP is a good example of such an attachment. By plugging-in Wi-Fi Max into an internet enabled PC, one can create a wireless access point. Five PSP machines can wirelessly connect to this access point and play games with one another as well as with other internet PSP players. Similarly Microsoft Xbox 360 can be made WLAN ready by installing a Wi-Fi adapter card in it.
- **WPANs**: The wireless personal area networks (WPANs) are short-range (typically a few meters), high-bandwidth wireless networks used for applications such as printing, file transfer and remote control. Often WPANs are implemented using Bluetooth or infra-red communication technologies. In VR, WPANs have been extensively used in combination with PDAs to interact with 3D VR environments. To control 3D environments, users often need to provide inputs through buttons, sliders and menus. Such input can be provided through a handheld device which can communicate with the VR environment through WPANs. Watson have investigated the contention between 2D and 3D interaction metaphors and involved the use of a 3Com Palm Pilot handheld computer as an interaction device to the VE, allowing the use of 2D widgets in a 3D context. Tweek presents users with an extensible 2D Java graphical user interface (GUI) that

communicates with VR applications. Using Tweek, developers can create a GUI that provides capabilities for interacting with a VE. Tweek has been used in VR Juggler, an open source virtual reality development tool. More recently, use of handheld devices and WPANs has been extended to interaction with real-world scenarios. For example, Ubibus (2004) is designed to help blind or visually impaired people to take public transport. The user may use either a PDA (equipped with a WLAN interface) or a Bluetooth mobile phone. The system is designed to be integrated discretely in the bus service via ubiquitous computing principles. It tries to minimize both the amount of required changes in the service operation, and explicit interactions with the mobile device. This is done by augmenting real-life interactions with data processing, through a programming paradigm called spatial programming.[6]

### *C. Tracking and Registration for Mobile Augmented Reality*

- **Tracking with GPS, GSM, and UMTS**: Probably, the most predominant system for outdoors tracking is the Global Positioning System (GPS). GPS is a time measurement based system and can be applied in almost all open space environments except narrow streets or covered sight to the sky due to trees or other obstacles to receive the signals from at least 4 satellites. The accuracy of the localization can vary between 3 and 10 meters depending on the satellite connection and the continuity of the navigation of the receiver. The accuracy can be increased by so called Differential GPS (D-GPS) by terrestrial stations to an accuracy of 2 to 5 meters. GPS receivers are becoming less and less expensive as they are introduced in mass-market devices such as PDAs and mobile phones. Standard GPS for outdoors location tracking and a 3-DOF orientation tracker mounted on the HMD for orientation tracking and registration of a virtual guide on the real outdoors environment. A method to enhance the position tracking accuracy of GPS, for more accurate and believable registration for mobile AR systems. They propose a new hybrid tracking system of improved accuracy for military operations, where an AR helmet has three rate gyroscopes, two tilt sensors, a GPS sensor and an infrared camera that occasionally observes small numbers of mobile infrared beacons added to the environment which help to significantly correct the sensor errors. Another upcoming solution is locating users by triangulating signals of their GSM mobile phones. However, the accuracy of this localization method is quite crude and subject to huge variations. In particular in rural areas with wide phone ID cells the accuracy is not acceptable. With the advent of the third generation mobile standard UMTS, the accuracy of localization will improve significantly
- **Outside-in and Inside-out Tracking**: Tracking a user with an external camera is an example of outside-in tracking, where the imaging sensor is mounted outside the space tracked. Outside-in tracking can be used to produce very accurate position results - especially when multiple cameras observe the tracked object. In inside-out systems, the imaging sensor is itself head-mounted and any rotation of the user's head causes substantial changes in the observed image. a comprehensive overview of latest inside-out as well as outside-in tracking methods, not limited only to mobile AR systems.
- **Visual Marker-based tracking**: A still common approach for more demanding augmented reality applications is to make use of fiducials: easily recognizable landmarks such as concentric circles placed in known positions around the environment. Such fiducials may be passive (e.g., a printed marker) or active (e.g., a light-emitting diode); both types of fiducial have been used in AR applications. While many passive fiducial-based tracking implementations for AR exist, none can match the ubiquity of the freely available AR Toolkit system.
- **Visual Markerless tracking** : A number of recent visual tracking algorithms can provide realistic real-time camera tracking based on different approaches (natural feature detection, edge detection, planar methods etc.) but require large amounts of processing power posing difficulties on the additional AR rendering tasks. A planar surface tracking algorithm, where 3D planes of building facades are used to recover the camera pose, by tracking natural features extracted from them. Another Markerless tracking algorithm suitable for mobile AR, where it starts from 2D matching of interest points, and then it exploits them to infer the 3D position of the points on the object surface. Once the 3D points on the object are tracked it is possible to retrieve the camera displacement in the object coordinate system using robust estimation. , a robust Markerless real-time visual tracking method was introduced based on the Boujou system from 2D3™ which can recover from complete occlusion or extreme motion blur within one frame. At a first pre-processing stage of the scene-to-be-tracked, a model of the scene which consists of 3D coordinates together with invariant descriptors for the feature appearances is automatically created based on Structure-from-Motion techniques. During real-time operation, this database is traversed and compared against the real-time detected scene features, providing the estimated camera matrix. An edge-based tracking system mounted on a tablet-PC for visual inside-out tracking. The tracking system employed relies on the availability of a 3D model of the scene to be tracked.

This 3D model should describe all salient edges and any occluding faces. Using a predicted estimate of the camera pose, an estimate of the tablet camera's view of the model can be recovered at each frame.

- **Sensor based tracking**: Infra-red LEDs can output light across a very narrowly tuned wave-band, and if this band is matched at the sensor with a suitable filter, ambient lighting can be virtually eliminated. This means the only thing visible to the imaging sensor is the fiducials, and this vastly reduces the difficulty and computational requirements for tracking. For this reason, LEDs have long been used in commercially available tracking systems and real tracking applications; IR-LEDs for robust tracking of mobile phones, based on the vision of spatially aware handheld interaction devices. Based on outside in tracking methods they allowed for the augmentation of a real map with digital content in a focus + context fashion. RFID (radio frequency identification) tags have also been recently used in mobile AR systems. RFIDs consist of a simple microchip and antenna which interact with radio waves from a receiver to transfer the information held on the microchip. RFID tags are classified as either active or passive, with active tags having their own transmitter and associated power supply, while passive tags reflect energy sent from the receiver. Active RFID tags can be read from a range of 20 to 100m where passive RFID tags range from a few centimeter's to around 5m (depending on the operating frequency range). Employed mobile phones that incorporate RFID readers for creating games in which players interact with real physical objects, in real locations. A recent promising technology for wide-area indoor tracking is the commercially available Ultra-Wide- Band (UWB) local positioning system by Ubisense™ (Steggles et al [52]). Based on network of small size sensors and tags this system allows for estimating the 3D position of a tag within 15cm accuracy of tens of meters distance of a tag from a sensor.
- **Wireless-LAN tracking**: Due to the fact that networked mobile AR users are enabled with wireless radio communication network interfaces (such as Wi-Fi), protocols that provide location estimation based on the received signal strength indication (RSSI) of wireless access points have been recently becoming increasingly accurate, sophisticated, and hence, popular. The main benefit of RSSI measurement-based systems is that they do not require any additional sensor/actuator infrastructure but use already available communication parameters and downloadable wireless maps for the position determination. Their shortcoming for mobile AR is precision and often multiple access points as well as tedious training offline phases for the construction of the wireless map. A Wi-Fi-localization based method for PDA-based Mixed-Reality system for visualizing virtual character 3D content.[6]

## Conclusion

AR requires very accurate position and orientation tracking in order to align, or register, virtual information with the physical objects that are to be annotated. Without this, it is rather difficult to trick the human senses into believing that computer-generated virtual objects co-exist in the same physical space as the real world objects. There are several possibilities for classifying tracking methods. Tracking methods and sensors, categorized based on their a) Accuracy, b) resolution, c) delay, d) update rate, e) Infrastructure and operating range f) cost g) degrees of freedom and h) portability and electrical power consumption. However, the low cost of video cameras and the increasing availability of video capture capabilities in off-the-shelf PCs has inspired substantial research into the use of video cameras as means for tracking the position and orientation of a user

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