# Paper Published

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<td>Software Oriented Architecture as Designer Approach for Mobile Augmented Reality System</td>
<td>“Presented At AITS-Rajkot</td>
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</table>
Augmented Reality System & Mobile Augmented Reality System

- “The Computer System that combined the real and the virtual in order to assist users in interacting with their physical environments are called Augmented Reality System.”

- “Mobile Augmented Reality System is one in which augmentation occurs through available knowledge of where the user is e.g. user’s location and therefore his surrounding environments.”
Introduction

- Mobile Augmented Reality has indicated increasing usage in smart phones. In this regard many researchers are trying to explore this area to give develop improved utility architecture. As per the Literature Review the so far publish architecture
Introduction

- Are lacking the future development of application used in smart mobile device and also the application develop for targeted device is not compatible / scalable when operating system are changed. There is a need for a architecture suitable for various flavors of mobile devices and the same way user can develop his own services using existing software. So required Architecture to develop the application for Mobile Augmented Reality System.

- The careful study analysis of these architecture have indicated the need of service Oriented Architecture for Mobile Augmented Reality Applications. The Technological growth has brought in remarkable integration level of scattered components used in developing augmented reality system. The availability of smart phone has given significant level of device integration but it is awaiting for a suitable service architecture which for see wide spectrum of utility application development . To bridge the gap of this limitation of architecture this research work propose a web based service
Introduction

- Augmented Reality & Mobile Augmented Reality has very widely used in nowadays Smartphone’s and there are not any Software Architecture available. So when one application will developed for Mobile Augmented Reality will targeted only on one mobile handsets or device. When the device will change for some reason the application will require to Re-Architect because of its operating system and handle the network and GPS. Also the application will required to Install in device and require some kind of storage and some extra libraries to developed Mobile Augmented Reality System.

- A Framework is proposed in order to achieve any Application design using this Software Architecture will run on any mobile device platforms without the need for Installation or no Installation. Architecture will give the “Web Based Interface” so the User’s have some kind of Network support and GPS Support will easily get the Application on any mobile device. Also the framework will based on SOA so web services will design according to handle the Mobile data e.g. Images, Audio, Video etc. to and from the web server. Software Architecture will give the Application to Portability, extensibility, No Need For Installation, Reusability without any code change.
Thesis Organization

- Chapter 1: Introduction
- Chapter 2: Literature Review of Related Work
- Chapter 3: Review Findings
  - 3.1 Background
  - 3.2 Research Gap
  - 3.3 Problem Formulation
  - 3.4 Objective of Research
- Chapter 4: Proposed Work
  - Proposed Software Architecture
  - Proposed Algorithm
  - Algorithms in Details
Thesis Organization

- **Chapter 5: Research Methodology**
  - Implementation with Mobile Apps
  - Browser Based Implementation
- **Chapter 6: Conclusion & Scope of Work**
- **Chapter 7: References**
Literature Review Findings

- **[IEEE Ref 1: KCHARMA: A KML/HTML Architecture for Mobile Augmented Reality Applications]**
  Alex Hill, Blair Maclntyre, maribeth Gandy, Brain Davidson, Hafez Rouzati
  GUV Center Georgia Institute of Technology

- **[IEEE Ref 2: First Steps Towards Handheld Augmented Reality]**
  Daniel Wagner, Dieter schmalstieg
  Vienna University of Technology, Vienna, Austria

- **[IEEE Ref 3: Relization of Mobile Augmented Reality Based Personal Navigation Services in 3rd Generation Cellular Network]**
  Tuukka Turunen, Tinor Pyssysalo, and Juha Roning
  Computer Engineering Lab, University of Oulu
**Literature Review Findings**

- **IEEE Ref 4: Marker-less Vision Based Tracking for Mobile Augmented Reality**
  
  D. Beier, R. Billert, B. Bruderlin, D. Stichling, B. Kleinjohann
  
  University of Paderborn, Intelligent Mobile Systems, Paderborn Germany

- **IEEE Ref 5: Development Actuality and Application of Registration Technology in Augmented Reality**
  
  Li Yi-bo, Kang Shao-peng, Qiao Zhi-hua, Zhu Qiong
  
  Department of Auto-control, Shenyang Institute of Aeronautical Engineering, Shenyang 110136, China

- **IEEE Ref 6: Real-time Composition of Stereo Images for Video See-through Augmented Reality**
  
  Masayuki Kanbara, Takashi Okuma, Haruo Takemura and Naokazu Yokoya
  
  Graduate School of Information Science, Nara Institute of Science and Technology
  8916-5 Takayama-cho, Ikoma-shi, Nara 630-0101, JAPAN
  
  Phone:+81743725298 Fax:+81743725299
Review Findings

- In Augmented Reality the focus was only on hardware setup and in it GPS Tracker, Camera -Wearable HMD and sent to communicate with the device. The Software to be developed was dependent on Hardware and Application requirement. The Challenge with this approach is that the effort of development is multiplied in developing application software for other application.

- This challenge can be given an appropriate solution to reduce the device dependency and effort to develop software application for different application, the proposed work has given “Web Based Software oriented Architecture” and use of mobile to reduce proprietary hardware and Integrity a set of device as a handy device – Mobile. This also reduce the risk transportation of set of an remote area.
Further the use of mobile device and development of general purpose software for proposed architecture and the software that is not to depend on OS of Mobile Handsets.

Limitation of Old Hardware/Software

General Purpose Hardware used in Augmented reality:

Augmented Reality System Uses Number of Hardware depends on the type of Augmented Reality Applications.

Hardware Components are: Processor – Servers for Augmentation, Display – Head Mountain Display, Eyeglasses, Contact Lenses, Virtual Retinal Display, Eye tap, Handheld etc. Sensors, GPS Receiver, and Input Devices.
# Background: General Purpose Hardware

<table>
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<tr>
<th>Component</th>
<th>Requires External Power</th>
<th>Power (w)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head-mounted display</td>
<td>Yes</td>
<td>14.000-15.000</td>
</tr>
<tr>
<td>Orientation Tracker</td>
<td>AAA Batteries</td>
<td>0.7000-01.000</td>
</tr>
<tr>
<td>Firewire digital camera</td>
<td>Yes</td>
<td>0.9000-01.000</td>
</tr>
<tr>
<td>GPS Receiver</td>
<td>Yes</td>
<td>03.500</td>
</tr>
<tr>
<td>Keyboard</td>
<td>No (Through USB)</td>
<td>00.035</td>
</tr>
<tr>
<td>Touchpad</td>
<td>No (Through USB)</td>
<td>02.500</td>
</tr>
<tr>
<td>Laptop Computer</td>
<td>Yes</td>
<td>68.000</td>
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</table>
Hardware used and it’s problems

- As per Application, the hardware are used and Software is design for targeting hardware and Application type. So there is not any common architecture for Augmented Reality application and limitation of the software is if requirement changes than software architecture will also changed.

- So Need for the Software Architecture that will reduce the time as well as cost and easily use for other type of augmented reality application.

- Use Modern mobile computing devices instead of Traditional AR Hardware like Smartphone and tablet computers contain these elements which often include a camera and MEMS sensors such as accelerometer, GPS, and solid state compass, making them suitable AR platforms.

- Use Modern mobile computing devices instead of Traditional AR Hardware like Smartphone and tablet computers contain these elements which often include a camera and MEMS sensors such as accelerometer, GPS, and solid state compass, making them suitable AR platforms.
Background: Comparative Analysis

- Comparative Analysis of Existing Architecture or Framework targeted to fixed AR Application
  - S/w architecture must be Re-Usable and Loosely Coupled So Hardware and Area of Application is changed that leads to the need of Re-Architecture of Software.
  - Software developed for one area of application may not fit for another area of application e.g. Architecture for Navigation and Architecture for Medical Imagines are different
  - They have not a common architecture, so boundary of network will change then software architecture will also change.
  - Generally architecture is based on Client Server – Network based or Quality of Services based So, Need the Common Architecture that targeted to Each Area of AR Application and using that architecture user can design their own application for AR using single device or Multiple Device having different OS, Processing Power, and Storage Capacity.
Augmented Reality and mobile computing are often mentioned together, as many mobile computing platforms rely on some kind of head-up or head-mounted display to provide continuous access to information, often coupled with hands-free operation.

The ultimate goal is to make the mobile computer a part of the user’s normal daily life. Augmented Reality as a user interface for mobile computing is particularly powerful when the computer has access to information on location and situation, so it can provide contextual information.
Problem Formation

- Use PDA/Mobile as Mobile Augmented Reality Device

- Instead of using this generalized hardware, Mobile/PDA has all the facility like Camera for Video, GPRS, Bluetooth, Wi-Fi for sending data over the network. So Using Mobile/PDA as Device of mobile augmented reality are a revolutionary approach because all other general purpose hardware required power, and maintenance cost is very high and also it’s not so mobile in the area of Battlefield, Medical Surgery etc. So use Mobile/PDA’s device having Camera for video & some network feature can use as a Mobile Augmented Reality Device.
<table>
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<tr>
<th><strong>2G Network</strong></th>
<th><strong>GSM 850 / 900 / 1800 / 1900</strong></th>
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</thead>
<tbody>
<tr>
<td>3G Network</td>
<td>HSDPA 900 / 1900 / 2100</td>
</tr>
<tr>
<td>Display : Multitouch</td>
<td>Yes</td>
</tr>
<tr>
<td>Memory Card</td>
<td>Up to 32 GB</td>
</tr>
<tr>
<td>Internal</td>
<td>8/16 GB storage, 512 MB RAM, 2 GB ROM</td>
</tr>
<tr>
<td>GPRS</td>
<td>Class 12 (4+1/3+2/2+3/1+4 slots), 32 - 48 kbps</td>
</tr>
<tr>
<td>EDGE</td>
<td>Class 12</td>
</tr>
<tr>
<td>Data Speed</td>
<td>HSDPA, 7.2 Mbps; HSUPA, 5.76 Mbps</td>
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<tr>
<td>WLAN</td>
<td>Wi-Fi 802.11 b/g/n, DLNA, Wi-Fi hotspot (Android 2.2)</td>
</tr>
<tr>
<td>Bluetooth USB</td>
<td>3.0 with A2DP via USB 2.0</td>
</tr>
</tbody>
</table>
Mobile/PDA’s limitation as mobile augmented reality device

- **Operating system:**
  - In Market, lot’s of company are provide the device with different network capacity and various range of operating system and also the library provided for end-user development are different. Application develop for mobile augmented reality system target some area are run smoothly for targeted operating system in device but the same application will not work on when operating system are changed or even if the version of mobile operating system are change. So the architecture should be flexible enough for different operating system and versions.
Mobile/PDA’s limitation as mobile augmented reality device

- **Network Capacity**
- In mobile augmented reality system, the data will send/receive from the server continuously whenever the user will login. The application is enough capable for the accessing the mobile network symmentelliously, so to communicate with the server for augmentation is continuously with the all other task of mobile without interruption. Every device has method for accessing network API so need for different code to be written for different device.
Mobile/PDA’s limitation as mobile augmented reality device

- **Processing Capacity, Memory and Storage:**
  - Traditional Software develops for Mobile AR system needs to install on target on device, that’s target to particular device, and required space and memory and large processing. All devices has different OS version and its capacity, so to develop the software for one device are not compatible for another or different series of device. Application needs to be designed as far as the device processing capacity, memory usage in mind because of the various flavors of device is available in the market. Its better to be less processing at the client side so less memory and storage will used so device other functionality will smoothly run without crash.
Mobile/PDA’s limitation as mobile augmented reality device

- **Bandwidth Issues:**
- Current Mobile/PDA’s are capable of 3G/4G network standards that use high data transfer rate for uplink and downlink using GPRS standards but it’s very few devices, major devices use 2.5G standard that is currently use in India. Major areas the 3G services are not available and its depends on service provider. In mobile augmented reality system need real time data captured by device with sensors information continuously, also the augmented data get back to the server at the same time for viewing the results.
Factors for Design Prototype Algorithm Design

- Architecture will less dependent on the mobile device
- Minimum use of mobile networks, only send the sensors and captured data
- Minimum processing on the device, less memory usage,
- Required no or minimum installation
- Operating System problem when device is changed
- Architecture needs to be scalable, portable and reusable
- The architecture is flexible enough for the application
Objective of Research

- Proposed a kind of Architecture that should be more robust, scalable and portable so many mobile devices will use the features of mobile augmented reality with some minimum hardware, network features and browser. Application will run when the user will change his mobile device without the worry about operating system, sensors, camera, and 3D display.
Proposed Architecture

- The Goal of the developed Web Based Service Oriented Architecture deal with the following Web Services:
- Develop Client that Register themselves and authorized to access the Web Services
- Develop Services that talk with other services or linked with other services -middle layer or Interface
- Develop the Server side client that can receive, process and sent back the data to and from web services.
Proposed architecture

- Client side web Based Service is responsible to easily access on client browser, so client can register themselves to authorized for access other required services. Main responsibility of the client is send data to the middle level services to reach the destination (linked with other web based services – n level) and receive the augmented data from directly from server side client or middle level services.
Client

- **Design**: access from any device [like Nokia, Sony Ericson, Motorola, etc.] and compatibility for any mobile or pda’s OS [e.g. Symbian, UIQ, Palm OS, Brew], activate camera and for sending data through services.

- **Role**: Send/Receive authorized data to and from client, linked with middle level services

- **Responsibility**: Bi-Directional means at the same time sending data and display augmented data.
Middle Level

- Middle level web services are very important because it’s will communicate with both client side web services and server side web services or other traditional web services for his different type of category and data. Main responsibility of middle level services is receive the data from client and send them to appropriate server to process them, and also receive the augmented data from server side web services, and Also linked with other web services for reaching to the remote place. So design the middle level web services this all point should be consider for the architect.

- After successfully registered of client side web services, he access the other services require by his choice’s e.g. category of application like entertainment, Medical Surgery, or type of data wants to processed like video, image, or audio and data from client.
Middle Level

- **Design**: Directly talk with client/server, design other services using client.

- **Roles**: Find the remote server, link with other middle level or server side services.

- **Responsibility**: data send/receive to and from server side services.
Server Level

- The Server Side should be responsible for receiving data from middle level web services, also this data should be processed that’s the main goal because data should be augmented. The Server Client Web Service can access & sent back and also calling process service resides at own or at remote server. After finishing augmentation, augmented data sent back using Server side client and this server side client can send data to the middle level or directly to the client.

- So this point are strictly consider when to design the Server Side Web Services.
**Server Level**

- **Design**: communicate with any middle level services, compatible for any mobile
- **OS web server like IIS, Apache etc.**
- **Roles**: find the remote server, link with other middle level or server side services.
- **Responsibility**: data send/receive to and from other Web Services.
Proposed Algorithms

- **Start Algorithm**
- Client Page for Registration
- Send data to server for identifying client devices e.g. Android, iPhone
- Check for Wi-Fi, GPS, GPRS, EGDE, Browser multitasking, Camera, Audio/Video Type Support as per client device type
- Store all the details to server in database for giving services as runtime or installable for client suitability e.g. Camera start, GPS Services start, Wi-Fi after completing the registration, now client device can authenticate for augmentation.
Proposed Algorithms

- Using type of augmentation services, client will augment for this category. E.g. Navigation, Searching ATM’s, Restaurants, Coffle shops, Advertisement, Event Promotion, Browsing 3D Models.

- After selection, client will update his location to server using Push Notification services for continuously get the updated data from server so type of middle level service will provide to cater the client device.

- Middle level service’s will load the data to client e.g. Google Maps for his personal Navigation guidance using by walk etc. as per client device position middle level service will load data to client.
Proposed Algorithms

- Also client data will continually send to server and augmented data will back to client device location.
- Server will process the data as per client will select the services
- Augmented data will receive by client for viewer
- End Algorithm
Client Selection of Web Services for Augmentation

- → Client Registration
- → Client Required Data for Augmentation
- → Client Send/Receive data using browser
- Client Registration
- Client Primary Details
- e.g Name, Userid, Password, Emailid, Address, His current Location for Client Authentication and Authorization for Augmentation
- Client Device Network Support Details:
  - Wi-Fi, EDGE, GPRS, For Data Communication in Network
  - GPS For his Location share, Push Notification Web Services will check using client Device GPS for updating current location to server for every minutes or seconds.
  - All details are required for server because of client type device server will start services for client camera, GPS, GPRS for Augmentation.
Client Selection of Web Services for Augmentation

- Client Device Camera Details (Camera Type, Capacity, etc.) for Capturing and Comparing Image, Video or Audio or Text Data for Object Recognition.
- Client Device Memory/Storage Capacity and Processing Capacity for Send data to server and received data view on client device
- Client Device OS Compatibility e.g. Multitasking Support
- Client Selection of Web Services for Augmentation
- After Completing Registration, Client will authenticate for augmentation. Before start the augmentation, client device will select the type of augmentation will provide by service provider.
- e.g. Person’s Navigation systems
- → Client Device will share his current location to server using client GPS and Push Notification services provided by server for every Minutes or seconds.
Client Selection of Web Services for Augmentation

- As per User’s Location, Server will provide locations to the client so the client will select the destination to mention the searching parameter.
- → Client will also select the type of services will choose for Navigation e.g. By Walk, By Car, By Train etc. as per this parameter Push Notification will update the server with client location for provide next data for Navigation.
- → As per searching location data and User’s Location client will navigate continuously guided by server using arrow to indicate his current position for every seconds until client reach to the destination.
  - e.g 3D Model Browsing
- → Client will search the different model from web provided by service Provider.
- → Client will select the different type and size for the same model as per choice.
- → After searching, model will load to client device using web services
Middle Level

- Middle Level Web Services will use for communicate With Server to send data and Augmented data get back to client.
- As per Client type and Augmentation Type Middle Level Service will design e.g. Services for Android Device, Services for iPhone Devices, Services for Windows Devices
Middle Level

- Service will type of Client devices so communication with the server and client devices for send/Receive data is very smoothly.
- Also communicate with the Other Web Services or Loosely Coupled with client as well as server.
Server Side

- Server will authenticate client for augmentation.
- Server will receive the client data for augmentation.
- Server architecture is based on Providing services to client type devices. E.g. same service provider will give services to android devices, iPhone devices, windows devices, blackberry devices separately or combined as per his choice.
- Server Software architecture is design as per client requirement to provide augmented data to client so various types of web services will design as per client type. E.g. Google Maps data provide to client for Navigation.
- Using Different algorithms or technique provided by OpenCV or Custom algorithm design by others server will augment the data for client.
Server Side

- Server will store data and identify the objects or Dynamic Object Recognition matching with them for sent back to client as per the area provided services to client.
- Server will continuously update the client position to his database until the client is exit from augmentation.
- Push Notification Services will continuously track the position of client and should send the notification, so current position and data will send by client to server and server to client.
- Capacity of server to processing large number of user’s and large number of data e.g. image, calculation of client, video capturing, audio etc. so required good processor, memory, and storage capacity.
Research Methodology

- This Research includes both methodology and Prototype - Web Based Service Oriented Architecture for Mobile Augmented Reality System. Use a Mobile/PDA’s as a Mobile Augmented Reality Device is the key solution because of its size, mobility, network standards, mounted with camera, and freely use at anywhere. Important part is the architecture of software that is used in a Mobile/PDA’s Device to solve the problem facing at the time of using. Following essential research problems need to be addressed to solve this problem.
Research Methodology

- Develop the kind of architecture that is loosely coupled and reusable targeted the range of mobile devices with their limitation also the using the developed application, the end user can add his own component and published it to the public without need for installation or any change. The architecture will span over three component mainly are server – major role in this architecture, middle level and client having minimum load.

- Research overcome the major problems of mobile augmented reality system, mobile device operating system and memory problem, proposed a kind of
Research Methodology

- In augmentation the data should be changed at various level as per the service provider so the range of data are stored is a big challenge also the data in augmentation is required in time for processing. So we can’t store data at client device because of the various level of data with secure manner. Cloud are the best solution for storing, faster retrieving and in secure manner. So the server will handle these using middle level services for accessing the data from cloud or any rdbms.

- Architecture should be portable, scalable and smoothly run on client device e.g. mobile or laptop or also a desktop. So the challenge for the architecture is the level of performance are same in all kind of device.

- architecture so to use them without or minimum installation having different range of mobile devices. That’s the big
Research Methodology

- Proposed architecture is web based so to access it using the web or internet are the key features, and also the handle many users at the same time with security issues, registration for using this, authorization, authentication are needs to be deal with the architecture.

- Prototype Implemented Using Algorithm design for any area of Mobile Augmented Reality System. Algorithm Basically Divided in three Parts, 1) Client Device 2) Middle Level 3) Server Level.

- All Three parts have its Own Mechanism to work with Mobile Augmented Reality System and every parts have its own Roles & Responsibility to send Data from Client to Server and Getting Augmented Data Back to Client Device.
Implementation with Mobile Apps

- Implementation Part demonstrate how whole architecture should work. Tools for the developing application same are Phonegap, Wikitude, Jquery for Mobile and design sample Navigation Application that works on more than two platforms e.g. Android, iPhone.
Map
Map Header

Latitude: 22.73284
Longitude: 71.6145497
Altitude: null
Accuracy: 1644
Altitude Accuracy: null
Heading: null
Speed: null
Timestamp: Tue Jul 16 2013 22:28:33 GMT+0000 (GMT)
Map
Browser based Implementation

- New Application will using the tool of JSARToolkit, HTML5, X3DOM and supported browser. The screen shot are as here, showing some 3D objects rendering on screen without tracker and another is tracker based rendering. All apps will directly accessible by web browser. Here I have used Firefox for mobile which supported webGL for run this application. Also the mobile support 3D rendering graphics library support and having accelerometer, gps and compass sensors so using single mobile device.
Browser based Implementation

Hello, Jatin Shah - Mobile Augmented Reality

This is my my page with 3d objects.
Hello, Jatin Shah - Mobile Augmented Reality

This is my my page with 3d objects.
Browser-based Implementation
Browser based Implementation
Browser Based

- Fig. shows the Tracker based Mobile Augmented Reality System. The Tracker will open at Laptop and when device run the apps from mobile device using browser, the camera will automatically starts using HTML5 and when the camera from mobile captures the tracker the augmented data render on the screen.
Conclusion:

- The Thesis show the “Web Based Service Oriented Architecture for Mobile Augmented Reality System”, using this architecture users can design their own Mobile Augmented Reality System having Web Interface and Current Location and Data will send using smart device without any network boundary for Augmentation and view the augmented data in mobile device at the same time. Using this architecture user’s can design the application, which will run on any Mobile Device Operating System. Portability, extensibility, power management, memory management, and storage problem all this issues will solve using the proposed architecture. A demo Application – Model Navigation System will shows the how easily the system will build and run on more than one platform without changing the code.
Recommendation for Future Work:

- User can extend the services and develop the new architecture for the Mobile Augmented Reality System. Using the common architecture, The Wearable device can used for the Mobile Augmented Reality System for the developing application.
- The Existing System can be extended for following
- Design Web Interface for Wearable device like smart watch etc.
- Design Mobile Augmented Reality Based Smart Card for Multi Purpose uses e.g. Use the Card as ATM Card, Work as License.
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[8] Li Yi-bo, Kang Shao-peng, Qiao Zhi-hua, Zhu Qiong, Development Actuality and Application of Registration Technology in Augmented Reality, 978-0-7695-3311-7, IEEE Computer Society, 2008 International Symposium on Computational Intelligence and Design, DOI: 10.1109/ISCID.2008.120

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THANK YOU