A SURVEY ON EXTENDED REALITY TRENDS AND DIFFERENT FRAMEWORKS USED FOR AUGMENTED REALITY GAMING.

Dr.C.Punitha Devi¹, Dr.T.Vigneswari², Surya S³, Hariharan R S⁴, Vishnuprasad M⁵
¹Professor, Department of Information Technology, Sri Manakula Vinayagar Engineering College, Pondicherry, India. E-mail: c.punithadevi@gmail.com
²Professor, Department of Information Technology, Sri Manakula Vinayagar Engineering College, Pondicherry, India. E-mail: vigneswarirt@gmail.com
³Department of Information Technology, Sri Manakula Vinayagar Engineering College, Pondicherry, India. E-mail: heysurya7@gmail.com
⁴Department of Information Technology, Sri Manakula Vinayagar Engineering College, Pondicherry, India. E-mail: harannisha1999@gmail.com
⁵Department of Information Technology, Sri Manakula Vinayagar Engineering College, Pondicherry, India. E-mail: vishnupanther24@gmail.com

ABSTRACT

The adoption of AR and VR technologies is surging rapidly thus driving the extended reality market. To proceed with Extended Reality, this paper projects an inclusive review depending on different trends and different frameworks used for augmented reality. Various trends of extended reality are analyzed like augmented reality shopping, AR navigation, AR in automotive industry, and their market growth in the future are also studied. The framework of augmented reality includes Vuforia, Kudan, EasyAR, Maxst, Onirix, Pikkart, Layar SDK, Lumin, AR.js, ARCore, and ARKit. The difference between these frameworks is analyzed, and the most appropriate framework for the project is decided. This paper examines a comparative study of augmented reality projects with their advantages and drawbacks.

I. INTRODUCTION

An emerging umbrella term for all immersive technologies is Extended Reality. We have virtual reality (VR), augmented reality (AR), and mixed reality (MR) today. The reality we undergo is experienced either by blending the virtual and “real” worlds or by creating a fully immersive experience by all these immersive technologies. The virtual objects are overlaid in the real world in augmented reality. The real world is enhanced with digital details such as animation, video, text, and images. Users are not disengaged from the real world and can still interact with digital objects. Extended reality is changing the landscape in many industries. There has been a fantastic growth for augmented reality in 2020. The use of this technology as commercial has been increased due to its use by market leaders like Google, Snapchat, Flipkart, Google, Apple, and Amazon.[1][5]

II. RECENT TRENDS IN EXTENDED REALITY

Mobile AR

Apple ARKit and Google ARCore are majorly used augmented reality development tools for smartphones. These kits are open source and any developer can use them free of cost to construct their augmented reality application. Since 2017, these tools have helped software developers ease into the AR market. Due to this kits’ greater app support, AR-capable devices and their users have vastly increased. Some of the latest advances include location anchors, new depth API, and enhanced face tracking. [5]

Shopping & Retail

Customers are given a virtual alternative to shop by some retailers, like Sephora, Uniqlo, Lacoste, Kohls, American Apparel. Others have made virtual fitting rooms a reality for their clients. This permits clients to have an insight into the product from home. This is particularly significant in the Covid-19 pandemic situation because of how social separating arrangements influence retail. AR is in an incredible situation to determine this issue.
This doesn't simply apply to attire. IKEA's application permits clients to perceive what furniture and different items may resemble in their homes utilizing AR innovation. AR retail experiences are set to significantly change the client's shopping experience.[5][7]

Navigation
With more data transfer capacity and command over an inside climate, the benefits offered by AR for the indoor route are clear. There is a wide scope of devices that can be utilized to upgrade this involvement with various scales, for example, Bluetooth guides, roof receiving wires, and QR codes. Notwithstanding, in situations where a strong Wi-Fi network as of now exists, Apple's iPhone AR is adequate to deal with indoor situating by utilizing Wi-Fi RF designs. ARKit and ARCore based applications help purchasers with discovering their way through air terminals, shopping centers, and different areas. The in-store route stands to improve incredibly from progress in AR innovation. This can help clients find precisely the thing they are searching for while shopping face to face. Google's AR Live View strolling headings for Google Maps has developed since it previously entered beta in August 2019. The mix between Live View and Google Maps area sharing is likewise being carried out to purchasers in a matter of seconds. The height is additionally a significant part of the cycle, which improves Live View's presentation in sloping areas like San Francisco.

Artificial Intelligence
The part of computerized reasoning in increased reality can't be downplayed. The high requests set upon expanded reality programming essentially can't depend entirely on human programming to show virtual articles against a genuine setting. Neural organizations and AI can achieve these errands with far higher effectiveness and can improve increased reality encounters definitely. AI and man-made reasoning can't work without a solid group of information science engineers. Investigation and assortment of preparing information are fundamental for the achievement of an AI program intended to help AR programming. The specialists additionally need to deliberately adjust and improve the model before coordination and sending. Simulated intelligence can likewise assume a strong part close by AR. For instance, programmed ideas can be given to face-to-face customers at a store utilizing an AR experience on their cell phones. These ideas would be driven by chatbots fueled by normal language preparing (NLP) advances. Deloitte Research presumes that increased reality and man-made brainpower will change the customary medical care plan of action by offering AR/MR-empowered sans hands arrangements and AI-based indicative instruments. [1]

Automotive Industry
Augmented reality generally enhances the auto business. One of the more clear utilizations of this innovation is using heads-up shows (HUDs) which buyers will be comfortable with within their #1 computer games and films. However, AR HUDs will fill a reasonable need for drivers that will permit them to deal with data that upholds their perspective out and about, instead of deters it. The main pragmatic use of an AR HUD for drivers is security. The HUD can make drivers mindful of potential dangers that may have gone unseen without representing an interruption or discouraging their perspective out and about. Nissan's Invisible-to-Visible (I2V) innovation as of now utilizes AR and AI to make drivers mindful of expected perils, like close-by objects. The framework can likewise divert a driver's concentration to the street if their consideration starts to meander. Besides AR's applications for driving, AR can be utilized for auto promoting. BMW and Accenture planned an AR application that permits clients to encounter another vehicle in their carport without going to the business. They can likewise see what the virtual vehicle resembles in various tones. An especially fascinating instance of AR improvement with regards to the car business is Volvo's utilization of the Varjo XR-1 blended reality headset to show virtual items to a driver while out and about. This has applications for driver's schooling, as it very well may be utilized to plan drivers to stop for virtual dangers that show up before them. This innovation can likewise be utilized to exhibit new vehicles to clients. [3]

Remote Education
Augmented reality has numerous applications that can help improve the learning experience for e-learning pupils. Wikitude has made an application called Ai.R-Cord. This application is pointed toward aiding grade school understudies learn ideas by utilizing augmented reality encounters. The innovation additionally makes coaching methods at home more assorted by growing visual substance for students with more curiosity. One of the essential benefits of increased reality in the instructive space is the capacity for a pupil to review a model from a wide range of points all alone. Above all, it permits children the advantage of at-home experiential learning.[7]
Augmented Reality Market Outlook

Augmented reality applications are created on unique 3D projects, which empower engineers to incorporate logical or computerized content with this present reality progressively. Augmented reality offers a practical client experience of the fake world in an intuitive reenacted climate. The increment in penetration of cell phones and associated gadgets in different application areas and the advancement of the gaming business helps the virtual and Augmented reality market development. The worldwide increased and Augmented reality market size was $11.35 billion in 2017, and the virtual and augmented reality market figure is projected to reach $571.42 billion by 2025, developing at a CAGR of 63.3% from 2018 to 2025.

Fig 1. Global Augmented and Virtual Reality Market

The gaming section ruled the general market in 2017 and is relied upon to proceed with this pattern during the figure time frame, because of the development of the versatile gaming industry.

Video game is one of the significant uses of virtual and augmented reality innovation. Previously, the quantity of gamers worldwide has expanded at a quick speed. This is credited to expanded interest for increased and augmented reality-based games, along these lines driving the market development.

III. RESEARCH ON VARIOUS FRAMEWORKS USED IN AUGMENTED REALITY

Vuforia

Vuforia is intended to make AR applications for cell phones. Vuforia's Augmented Reality SDK utilizes PC vision innovation to distinguish and follow continuously picture targets and essential 3D items. Vuforia is viable with Android, iOS, UWP, and Unity Editor stages. One of Vuforia AR SDK's essential advantages is its straightforward arrangement system. This makes it simple to establish an advancement climate, introduce the right SDK form, and fabricate an application. The fundamental, free form of Vuforia incorporates Vuforia watermarks and a base arrangement of apparatuses. Included with Vuforia's paid plans are highlights like a high-level camera, improved help, and that's only the tip of the iceberg. Utilizing pictures, like solid shapes, cuboids, or chambers as targets, Vuforia intently copies 3D following. By expanding the number of following strategies, Vuforia may turn into a more cutthroat player for the best position. [2]

Kudan

Kudan utilizes its restrictive SLAM (Simultaneous Localization and Mapping) innovation to simultaneously limit a sensor concerning its environmental factors while planning a 3D design of the encompassing territory. Kudan has authorized SLAM to outside improvement accomplices in a few arising innovations including robots, mechanical technology, and self-driving vehicles. Hammer can be utilized with any camera or sensor. Its following precision on cell phone cameras is exact down to simple millimeters. The rapid/low-utilization
framework utilizes under 5% of a cell phone's CPU and keeps on working under outrageous lighting conditions. Kudan offers engineers a free form of its AR SDK for testing. A creation permit costs £1,000 per application each year. [2]

**EasyAR**

EasyAR is offered in both a free fundamental adaptation and a Proform at a $499 authorizing charge that begins from 100 uses each day. Victor of the 2016 World Augmented Reality Expo's Best Software Award, EasyAR is prepared to do all the while perceiving and following various 3D items continuously. Accessible in adaptations for iOS and Android, EasyAR can be utilized with the two PCs and cell phones. Different advantages incorporate the shortfall of watermarks and no aggravating time restrictions. A potential disadvantage: a few clients have revealed troubles with EasyAR's picture solidness. [2]

**Maxst**

Maxst works in giving AR programming answers for an assortment of businesses including design, distribution, travel and recreation, and publicizing. The organization dispatched its previously Augmented Reality SDK in South Korea. Later it made and presented the AR Virtual Fitting System which permitted customers to essentially take a stab at garments and attire before making a buy. Other Maxst items and administrations incorporate picture preparing, Augmented Reality visits, and AR games. Like its rivals, Maxst additionally gives Cloud acknowledgment and SLAM support. [2]

**Onirix**

Onirix is an AR stage that gives various devices expected to assemble all AR application parts for all conceivable use cases. Onirix SDK additionally opens admittance to Onirix Studio (it tends to be likewise utilized as an independent item). Onirix Studio is extraordinary programming that gives the usefulness expected to configuration, distribute, and have AR content. Aside from 3D models and sounds, Onirix Studio makes it conceivable to plan complex scenes, share them with others, and test the outcomes immediately. Onirix upholds ARKit, ARCore, and Tango endeavoring to cover a sensible number of cell phones and tablets. [2]

**Pikkart**

This Italian startup is centered around the innovative work of its following and acknowledgment framework, just as picture acknowledgment calculations and profound learning. Pikkart furnishes its AR SDK viable with all major platforms. Pikkart offers a few particular highlights. Its AR Logo innovation makes it conceivable to connect one picture with various AR encounters. An exceptional CMS helps oversee markers and substance. With area-based markers, it is feasible to join the route and Augmented Reality. Additionally, Pikkart gives cloud facilitating to fast application scaling. [2]

**Layar SDK**

This AR SKD is currently given by BlippAR and targets business AR arrangements. Layar SDK makes an organization's marked AR applications and matches them to a disconnected brand picture. Numerous worldwide brands, like Coca-Cola, Honda, Elle, Procter and Gamble, and others, have appreciated the joint effort with Layar as an AR-based client experience. Engineers can incorporate an AR module into existing applications utilizing Layar SDK when such applications contain custom highlights. Likewise, Layar gives a high-level investigation framework on application utilization by various client gatherings. The organization gives diverse permitting alternatives, designer documentation, and backing. [2]

**Lumin**

Magic Leap—perhaps the most-supposed AR equipment new companies—effectively conveyed its Magic Leap One in June 2018 and kept chipping away at its environment. Aside from its head-mounted showcase, Magic Leap additionally offers Lumin OS and Lumin SDK to work on programming advancement for its custom stuff. This AR SDK is viable with both Unity and Unreal Engine to guarantee an agreeable improvement work process. Additionally, Lumin SDK gets normal execution upgrades and new highlights. It even offers a library for spatial 3D web encounters. Lumin endeavors to give something similar or more elevated level improvement instruments that other SDKs for cell phones and MS HoloLens give. [2]

**AR.js**
This system makes Augmented Reality applications accessible right from the program. It is an adaptation of ARToolkit extraordinarily ported to an internet browser. The advancement group guarantees similarity and elite across all programs that utilization WebGL and WebRTC. A functioning demo of an AR application is accessible soon after a few lines of HTML code. AR.js is an open-source item allowed to use by everybody. The advantage of AR.js for clients? No compelling reason to introduce an application. Clients need just output an AR-Code with a telephone camera to arrive at the content. Use it for prints, promotions, and transient advertising efforts with strict spending limits. [2]

ARCore

ARCore is a tech monster Google's system for making Augmented Reality applications proposed to rival Apple's ARKit. ARCore replaces the Tango tool compartment which was initially intended to create AR applications on exceptional equipment furnished with profundity estimating sensors. ARCore began as a refreshed and improved rendition of Tango, however without the requirement for specific equipment. As per Dave Burke, Google's Android Engineer VP, the organization desires to catch 100 million Android gadgets. This is 5% of the assessed 2 billion dynamic Android gadgets being used before the finish of the review period. Also, ARCore makes multiplayer games conceivable and upholds a few iOS gadgets, including iPhone SE, iPhone 6S, iPhone 7, iPhone 8, and iPhone X. [2]

ARKit

ARKit is Apple's partner to Google's ARCore. It is intended to utilize iPhone/iPad equipment. It was introduced at WWDC 2017 as an instrument to make phenomenal local AR iPhone/iPad applications and to rival other tech organizations like Facebook, and Microsoft. ARKit upholds significant AR motors like Unity, Vuforia, Unreal Engine, and others. Being a crude innovation toward the start, ARKit gets consistent upgrades, from identification of 2D articles, screen captures, and photographs in ARKit 1.5 to industrious experience (clients can continue later), shared insight (AR multiplayer is presently conceivable), and object recognition and following (to join portable items into AR encounters) in ARKit 2. Fresh out of the plastic new ARKit 3 is fit for different face following, community meetings, synchronous following of front and back camera, and that's only the tip of the iceberg. [2]

<table>
<thead>
<tr>
<th>Type</th>
<th>Onirix</th>
<th>Pikkart</th>
<th>Layar SDK</th>
<th>Lumin</th>
<th>AR.js</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>Free, Commercial</td>
<td>Free, Commercial</td>
<td>Free, Commercial</td>
<td>Free, Commercial</td>
<td>Free</td>
</tr>
<tr>
<td>Platform Support</td>
<td>A, iOS, W</td>
<td>A, iOS</td>
<td>A, iOS</td>
<td>Lumin OS</td>
<td>Web</td>
</tr>
<tr>
<td>Geo-Location</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Smart glasses support</td>
<td>-</td>
<td>yes</td>
<td>-</td>
<td>yes</td>
<td>-</td>
</tr>
<tr>
<td>Unity3D</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>-</td>
</tr>
<tr>
<td>SLAM</td>
<td>yes</td>
<td>-</td>
<td>yes</td>
<td>yes</td>
<td>-</td>
</tr>
<tr>
<td>Cloud recognition</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>-</td>
</tr>
<tr>
<td>Open CV</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>7</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>

Fig 2. Comparison study on Frameworks and SDKs
### A COMPARATIVE ANALYSIS OF THE VARIOUS AUGMENTED REALITY GAMES

<table>
<thead>
<tr>
<th>Author</th>
<th>Contribution</th>
<th>Limitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adrian David Cheok, Xubo Yang, Zhou Zhi Ying, Mark Billinghurst and Hirokazu Kato.[8]</td>
<td>Touch-Space is an embodied computing based Mixed Reality game. It provides the full spectrum of game interaction experience ranging from the real physical environment, to augmented reality, to the virtual environment.</td>
<td>It requires a dedicated entire room to play this game. It is a multiplayer game and it is not designed for single player gameplay.</td>
</tr>
<tr>
<td>Seok-Han Lee, Yong-In Yoon, Jong-Ho Choi, Chil-Woo Lee, Jin-Tae Kim and Jong-Soo Choi.[9]</td>
<td>AR Squash uses AR technique to estimate geometric information of images taken from a CCD camera. By the geometric information and motion data of a ball related internally, a realistic scene is generated, in which the ball moves like a real one.</td>
<td>It requires a CCD camera to capture the environment. It is not supported in mobile devices.</td>
</tr>
<tr>
<td>Dagmar KernMark Stringer, Geraldine Fitzpatrick and Albrecht Schmidt[10]</td>
<td>Curball is a prototype collaborative game that can be played between an older person and a child. The game is based on a bowling game and makes use of tangible devices, sensors and augmented reality components.</td>
<td>Here tangible objects are used as an input device for the game. It’s mainly based on older person and a child, not for people on all ages.</td>
</tr>
<tr>
<td>Ana Grasielle Dionisio Correa, Gilda Aparecida de Assis, Marilena do Nascimento, Irene</td>
<td>GenVirtual is an Augmented Reality musical game and is proposed to help the patient in creativity, attention, hearing and memory. This game uses Augmented Reality to allow people with physical disorders to</td>
<td>The GenVirtual game requires a therapist to instruct how to engage with the players.</td>
</tr>
<tr>
<td>Authors</td>
<td>Game Description</td>
<td>Details</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Maribeth Gandy, Blair MacIntyre, Peter Prestí, Steven Dow, Jay Bolter, Brandon Yarbrough and Nigel O’Rear[12]</td>
<td>In AR Karaoke the users can perform their favorite dramatic scenes with virtual actors. Prototype implementations were created to evaluate various user interfaces and design approach reveal guidelines that are relevant to the design of mixed reality applications.</td>
<td>This game is based on scenes of a movie where the user can experience inside of a film experience but the scenes are limited. It requires a virtual reality box to experience the game.</td>
</tr>
<tr>
<td>Bruce Thomas, Ben Close, John Donoghue, John Squires, Phillip De Bondi, Michael Morris and Wayne Piekarski[13]</td>
<td>ARQuake is an extension of the desktop game Quake. It present an architecture for a low cost, moderately accurate six degrees of freedom tracking system based on GPS, digital compass, and fiducial vision-based tracking.</td>
<td>It is a mixed reality game which is dependent on a Virtual Reality Box. It requires a handheld device to shoot the enemies.</td>
</tr>
<tr>
<td>Duy-Nguyen TA Huynh, KarthikRaveendrany, Yan Xuz, Kimberly Spreenx, Blair MacIntyre[14]</td>
<td>Art of Defence is an example of what we call an AR Board Game, a class of tabletop games that combine handheld computers (such as camera phones) with physical game pieces to create a merged physical/virtual game on the tabletop.</td>
<td>It is a tabletop game, which is marker based. It can be played only on a plane surface, it will not execute if the surface is uneven.</td>
</tr>
<tr>
<td>Juan, M. Carmen; Toffetti, Giacomo; Abad, Francisco and Cano, Juan[15]</td>
<td>In this paper, we present an Augmented Reality (AR) game for finding and learning about endangered animals in a fun way. It uses tangible cubes as the user interface.</td>
<td>This game is like an activity there are no goals in this game. The user cannot interact with the animals, they can only visualize their existence.</td>
</tr>
<tr>
<td>FotisLiarokapis, Louis Macan, Gary Malone and Genaro Rebolledo-Mendez, Sara de Freitas[16]</td>
<td>This paper presents a pervasive augmented reality serious game that can be used to enhance entertainment using a multimodal tracking interface. The goal of the game is to start the car and move around the track without colliding with either the wall or the objects that exist in the gaming arena. Users can interact using a pinch glove, a Wiimote, through tangible ways as well as through I/O controls of the UMPC.</td>
<td>The Game is not fully functional in the absence of a pinch glove or a Wiimote. It depends on hardware equipment.</td>
</tr>
<tr>
<td>Minoru KOJIMA, Maki SUGIMOTO, Akihiro NAKAMURA, Masahiro TOMITA, Hideaki NII and Masahiko INAMI.[17]</td>
<td>This paper propose a novel display-based game environment using augmented reality technology with small robots. In this environment, the small robots can be augmented by a display image according to their positions and postures.</td>
<td>This project works only on a marker based platform. It doesn’t have different types of levels based on the difficulty.</td>
</tr>
</tbody>
</table>
IV. DISCUSSION

Based on the study on this survey paper, we can say that Extended Reality is a rapidly growing technology, it is changing the landscape in a number of industries. We analyzed various trends and market value of many fields in augmented reality and came to know that gaming industry is the fastest growing field and also has a great scope in the future. Many types of framework and SDK were discussed to construct an application in Augmented Reality and the most appropriate SDK for an application which focuses on wide range of users is ARCore. In the comparison table of framework and SDK we can see that ARCore has a better score as it is free of cost and supports unity 3D, it also supports both Android and iOS platforms. AR games have been used to stimulate cognitive functions such as attention, concentration and memory, it helps physically or mentally challenged people to improve their conditions like people suffering from Sluggish Cognitive Tempo (SCT) to enhance their reaction speed, also people having Attention Deficit Hyperactivity Disorder (ADHD) can also improve their attention by playing augmented reality games. Some of the games are used for educational purposes like learning about the endangered animals and steps to do in case of an earthquake.

V. CONCLUSION

In this paper, the studies that relate to Extended Reality have been discovered and discussed. Recent trends in this technology along with their market are discussed. Different Frameworks used in AR gaming and their comparison is done. The various AR games and their limitations are analyzed. Finally an overall discussion is made by comparing our game with the existing one in the market.

REFERENCES

1. A Review of Extended Reality (XR) Technologies for Manufacturing Training Sanika Doolani *, Callen Wessels, Varun Kanal, Christos Sevastopoulos, Ashish Jaiswal and Harish Nambiappan and Filia Makedon *, Department of Computer Science and Engineering, The University of Texas at Arlington, Arlington, TX 76019, USA; callen.wessels@utdallas.edu (C.W.); arun.kanal@mavs.uta.edu (V.K.); christos.sevastopoulos@mavs.uta.edu (C.S.); ashish.jaiswal@mavs.uta.edu (A.J.); harish.nambiappan@mavs.uta.edu (H.N.)
4. An Analysis of the Educational Potential of Augmented Reality Games for Learning Birgit Schmitz Valkenburgerweg 177 6419 AT Heerlen Netherlands birgit.schmitz@ou.nl, Roland Kleemke Valkenburgerweg 177 6419 AT Heerlen Netherlands roland.kleemke@ou.nl, Marcus Specht Valkenburgerweg 177 6419 AT Heerlen Netherlands marcus.specht@ou.nl
5. Augmented Reality: Applications, Challenges and Future Trends Mehdi Mekni Andre’el’emieux University of Minnesota, Crookston Campus TANYT, Quebec (QC), Canada mmekni@umn.edu, A lưng@emieux@Tanyt.com
7. Extended Reality in IoT scenarios: Concepts, Applications and Future Trends Tiago Andrade, Daniel Bastos BT Adastral Park Research Labs British Telecommunications plc Ipswich, UK tiago.andrade@bt.com, daniel.bastos@bt.com
8. Touch-Space: Mixed Reality Game Space Based on Ubiquitous, Tangible, and Social Computing Adrian David Cheok1, Xubo Yang1, Zhou Zhi Ying1, Mark Billinghurst2 and Hirokazu Kato3 1National University of Singapore, Singapore; 2Human Interface Technologies Laboratory, University of Washington, Seattle, WA, USA; 3Hiroshima City University, Japan
9. AR Squash Game Seok-Han Lee, Student member, IEEE, Yong-In Yoon1, Jong-Ho Choi 2, Chi-Woo Lee 3, Jin-Tae Kim4, Jong-Soo Choi1, Member, IEEE 1Dept. of Image Engineering, Graduate school of Advanced Imaging Science, Multimedia, and Film, Chung-Ang University, Republic of Korea [chithus, younyi, jschoi]@imagealab.cau.ac.kr 2 Dept. of Electronics Engineering, Kangnam University, Republic of Korea jhchoo@kangnam.ac.kr 3 Dept. of Computer Engineering, Chonnam National University, Republic of Korea leeew@chonnam.ac.kr 4 Dept. of Computer & Information Science, Hanseo University, Republic of Korea jkim@hanseo.ac.kr
10. Curball—a Prototype Tangible Game for Inter-Generational Play Dagmar Kern Embedded Interaction Research Group University of Munich dagmar@hcilab.org Mark Stringer, Geraldine Fitzpatrick University of Sussex [m.stringer, geraldin]@sussex.ac.uk Albrecht Schmidt Embedded Interaction Research Group University of Munich albrect@hcilab.org
11. GenVirtual: An Augmented Reality Musical Game for Cognitive and Motor Rehabilitation Ana Grasielloni Dossio Correa, Member, IEEE, Gilda Aparecida de Assis, Marilena do Nascimento, Irene De Luca, Roseli De Deus Lopes
12. AR Karaoke: Acting in Your Favorite Scenes Maribeth Gandy1, Blair Machaty2, Peter Presti2, Steven Dow1, Jay Bolter3, Brandon Yarbrough2, Nigel O’Rear 3 1Interactive Media Technology Center, 2College of Computing, 3School of Literature, Communication and Culture GCU Center, Georgia Institute of Technology Atlanta, GA 30332, USA [maribeth,blair,steven]@cc.gatech.edu, peter@imtc.gatech.edu, jay.bolter@cc.gatech.edu, [gto750u,go55u]@mail.gatech.edu
13. ARQuake: An Outdoor/Indoor Augmented Reality First Person Application Bruce Thomas, Ben Close, John Donoghue, John Squires, Phillip De Bondi, Michael Morris and Wayne Piekarski School of Computer and Information Science, Hanseo University, Republic of Korea
14. Art of Defense: A Collaborative Handheld Augmented Reality Board Game Duy-Nguyen Ta Huynh_, Karthik Raveendranany, Yan Xu, Kimberly Spreenx, Blair Machaty1 School of Interactiv Componets and GCU Center Georgia Institute of Technology
15. Tangible Cubes used as the user interface in an Augmented Reality game for edutainment Juan, M. Carmen; Toffetti, Giacomo; Abad, Francisco InstitutoUniversitario de Automática e Informática Industrial Universidad Politécnica de Valencia Camino de Vera, s/n. 46022 Valencia mcarmen@dsic.upv.es Cano, Juan Escolad’Estiu Universidad Politécnica de Valencia Camino de Vera, s/n. 46022 Valencia
16. A Pervasive Augmented Reality Serious Game FotisLiarokapis, Louis Macan, Gary Malone Interactive Worlds Applied Research Group Coventry University Coventry, UK [F.Liarokapis, macanl, maloneg]@coventry.ac.uk Genaro Rebollo-Mendez, Sara de Freitas Serious Games Institute Coventry University Coventry, UK [G.Rebollo-Mendez, s.defreitas]@coventry.ac.uk
17. Extended Coliseum: An Augmented Game Environment with Small VehiclesMinoru KOJIMA*, Maki SUGIMOTO*, Akihiro NAKAMURA*, Masahiro TOMITA*, Hideaki NIH*, and Masahiko INAMOTO*2*3Graduate School of The University of Electro-Communications [kojima, sugimoto, nakamura, nihi@hi.mce.uc.ac.jp *2Department of Mechanical Engineering Intelligent systems,The University of Electro-Communications [torita, inami]@hi.mce.uc.ac.jp *3Japan Science and Technology Agency, PRESTO