International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 10 | Oct 2020 www.irjet.net p-ISSN: 2395-0072

GAMIFIED MOBILE HANDHELD DEVICE USING AUGMENTED REALITY

Mrs. V. Selvi[1], M.Raghavimuthu[2], M. Aiswariya[3], G. Umamaheswari[4]

[1]*Mrs.V.Selvi, Assistant Professor, Department of Computer Science and Engineering, Puducherry, India*
[2]*M.Raghavimuthu, Department of Computer Science and Engineering, Puducherry, India*
[3]*M.Aiswariya, Department of Computer Science and Engineering, Puducherry, India*
[4]*G.Umamaheswari, Department of Computer Science and Engineering, Puducherry, India*

ABSTRACT: Gamified mobile Augmented Reality makes the real world by virtual objects to create a new mixed real-world environment by Augmented Reality concept. It is the Handheld mobile AR interface. This Handheld mobile interaction is the new direction in the human-computer interaction field for enhancing the human ability using Augmented Reality in HCI.

It makes the player feels a presence in the real world. The project makes human has a deeper connection with the real world. The Game makes humans feel like a digital experience in the real environment through virtual things. The Game's objective is to navigate the player and reach the target destination avoiding the guards as well as obstacles in the game world. The project is touch-based interaction.

The plan of the Game has the Player Controller, Guard, Obstacles. In AR supported, the user can interact with the virtual objects in the real-world environment. Components of this Game have a handheld device (mobile phone). The Unity Engine is a platform for developing Games supported by the Vuforia Library. The Unity Engine is a software platform for developing Augmented Reality gaming application.

It supports the ios, universal window platform, and Android for AR app development. Unity technologies developed a cross-platform game engine named as Unity. This engine is used to create the three dimensional, two dimensional, Virtual Reality and augmented reality also simulations, and other experiences. The Mobile Augmented Reality takes advantage of using Smart and mobile-based device applications such as games, entertainment, visual knowledge, and digital experience. The Hybrid interaction makes the user interact and manipulate the augmented reality objects in the real 3D space more accurately, not in the 2D space.

Most of the mobile AR applications have limitations in user interaction and do not support the 3D direct manipulation of AR objects entirely. The recent fusion of Augmented Reality(AR) and mobile technologies have enabled the creation of mobile AR applications. In the AR application, the real-time 3D rendering capabilities are more vital than the function.

This paper aims to provide the researchers with background information on AR, and this will be more interesting to those who have interested in the field of 3D interaction. Mobile phone-based augmented Reality is a popular concept in recent years, and it keeps the user interesting while they are playing. Thus, this paper provides an overview of 3D interaction techniques in handheld mobile AR with critical analysis.

Firstly, we describe three main interaction technique categories that applicable in handheld mobile AR, which is touch-based interaction, mid-air gestures-based interaction, and device-based interaction techniques, of their basic concepts on 3D object manipulation. Then, we classify and systematize the highlighted techniques and discuss the advantages and drawbacks of each. Previous researches for widely used technologies. Then comparison among the different techniques based on the crucial elements considered in handheld mobile AR.

1. INTRODUCTION

- Boeing researcher named Tom Caudell introduced the term "Augmented Reality." Augmented Reality (AR) is a technology involving computer graphics image overlay on the real world through a camera.
- This technology is to augment something available in the real world summarized as developments up to a point for describing problems.
- Augmented Reality derived from the word Augment, which means to add something. Augmented Reality is shorty known as AR. AR is an experience of a real-world and virtual object to create a new mixed reality environment.
- Augmented Reality excels in many fields like Gaming Field, Medical Training, Retail, Repair & Maintenance, Design & Modeling, Business Logistics, Tourism Industry, Classroom Education, Field Service. ♣ The different types of Augmented Reality are: a. Marker-Based Augmented Reality b. Marker-Less Augmented Reality c. Projection Based Augmented Reality d. Superimposition Based Augmented Reality .

2. TYPES OF AUGMENTED REALITY

✓ **MARKER BASED AUGMENTED REALITY**:

The other name for Marker-Based AR is Image Recognition AR or Recognition based AR. This type of AR provides information about the image it recognizes. It detects the object in front of the camera and provides information about the object on the screen.

- Marker-based AR, supported by a mobile device app, allows you to render another image, 3D model, the video makes interaction with it using your device by scanning physical images markers that are each edge.
- Recognition based augmented Reality is to identify visual markers or objects camera usages, such as a QR/2D code and NFT markers named Natural Feature Tracking, to overlay a showcase only when the device senses the tag.
- Image recognition AR or Marker-based AR uses a camera in a mobile device to detect a marker which is predefined that then triggers a certain computer-generated content. Tags can be AR-codes, physical objects, or printed images as it appears in the Absolut Vodka Augmented Reality app.

✓ **MARKER-LESS AUGMENTED REALITY:**

- Marker-Less tracking is a method of positional tracking the determination of the position and orientation of an object within its environment. In this type, there is no need for image detection, the name itself says its a Marker-Less AR.
- Marker-Less tracking is a method of motion that is used by specifics that make it a more flexible approach. This method is more extendible for the developers to work on it. Marker-Less AR is one of the most widely used applications in the industry. o Another name for this Marker-Less AR is Location-based AR, which means it takes advantage of using Mobile availability features in the smartphones that have location feature active.
- Marker-Less AR is used to denote an AR that doesn't need prior knowledge of an environment users to overlay a content of 3D into a scene and a fixed point in space. o Travelers use this type for detecting the location using Augmented Reality. It helps in discovering exciting new places in a nearby area.
- This AR method works by reading information from Mobile's GPS, Accelerometer, and Compass digital. This AR takes the merit for the prediction of user focusing. This method is also used by detecting the places by the device camera.

✓ **TOUCH BASED INTERACTION**:

- Touch-based interaction becomes the research mainly focused on AR after introduced the touch screen handheld mobile device. In the previous days, approaches on the mobile touch screen, that is designed to use the fingers to navigate on the screen. It alters the interaction experience with the application of mobile phones so the user can directly have interacted with the on-screen objects by their fingers.
- In Augmented Reality, three-dimensional interaction is one of the main concepts defined in its definition. Three-dimensional objects have manipulated the challenge for the interface designer from it involves the control of the six degrees of freedom.
  In this, it includes the three degrees of freedom for objects translation (x, y, and Z-axes) and 3DOF object for objects rotation (x, y, and zaxes), so does AR. Their account that threedimensional object manipulation was essential in AR interfaces.
- The touch-based concept was utilized by using touch input by multiple contact points instead of using the traditional keyboard or mouse inputs. It has already verified much slower than real objects manipulation. The performing touchbased interaction user can perform direct manipulation by touching the three-dimensional data content.
- However, touch-based interaction explored by the two Dimensional object manipulation that includes x and y-axes only when the depth manipulation (z-axis) is still unexplored. It arises because of the difficulty of twodimensional mapping touch points to three-dimensional attributes to perform the complete three-dimensional object manipulation.

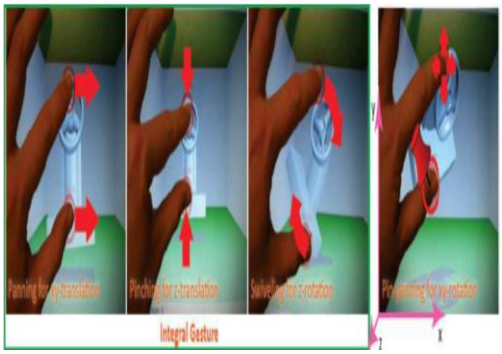

FIGURE1

- In contrast, the three-dimensional object manipulations consist of are mostly executed

in virtual environments significantly. Thus, to understand touch-based interaction better firstly, we have to learn more about the basic concepts that rely early on the multi-touch tabletop display.

3. HANDHELD MOBILE AR INTERFACE:

- Handheld mobile interaction has been upheld as the new direction in the human-computer communication (HCI) field to enhance human ability in HCI using AR. Due to this concern, communication in AR becomes the main topic and research interest among researchers.
- One of the critical aspects is creating appropriate interaction techniques for AR applications that allow end-users to interact with virtual content intuitively.
- In AR, there are several categories of interaction technique, and basically, interaction id divided into three major parts:
  - Tangible user interaction
  - Multimodal input and
  - Mobile communication.

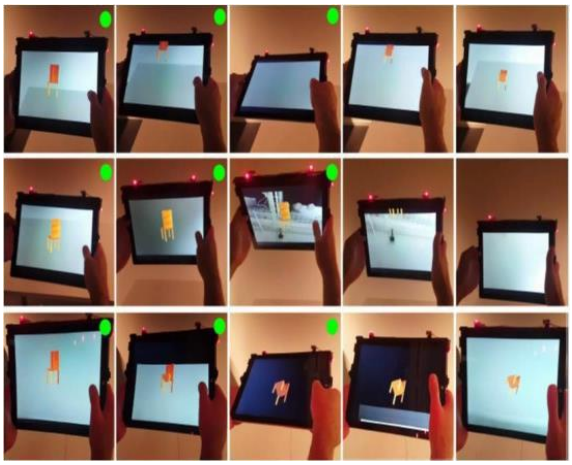

FIGURE2

- Since interaction is a broad topic, this paper focuses on handheld mobile interaction. It entails 3D interaction in AR due to the rapid advent of the application on cell phones, and now smartphones and tablets, bringing AR almost to the mainstream. In this paper, handheld mobile AR is our main focus. Handheld mobile AR represents the AR system based on handheld mobile devices, especially smartphones
- Recent available handheld mobile AR applications promote advanced tools such as Layer and Junaio that show the potential of handheld mobile AR interface in consumer markets. In several studies reviewed in this paper, researchers using the word "mobile" AR to represent mobile/smartphone or tablet-based AR in their studies while some other studies using the name "handheld" AR to represent mobile/smartphone or tablet-based AR system.
- To avoid any confusion of the primary concern of this paper, we combining the term "handheld" and "mobile" to "handheld mobile." We are also avoiding for using "handheld" AR which not only represents mobile/smartphone based AR since handheld devices also bringing the meaning of entertaining handheld devices such as Vive controller.
- In handheld mobile AR, there are several significant differences between using a handheld mobile AR interface and a traditional desktop/tabletop AR interface, including: 1) different input options, 2) limited screen and 3) limited activity time due to the battery operation.
- Therefore, the paper devoted to handheld mobile devices due to their robustness than HMDs to enter the mass market.

Three-dimensional object manipulation for handheld mobile displays:

- Compared with three-dimensional object translation, three-dimensional object rotation is a crucial problem in touch-based interaction, as discussed previously. Therefore, we did similar research focusing on three-dimensional object rotation by applying z-technique on a small touchscreen display. Besides, it came out with a relevant study by introducing the surjection as the main criterion instead of integration for three-dimensional object rotation.
- By improving the existing three-dimensional object rotation technique is produced by considering surjection, it claimed that it would provide better results in the future. Instead of large-scale multi-touch display in tabletops common as discussed above, the touch-based interaction technique had to investigate its possibility after the obtainability of touchscreen handheld mobile devices commonly referred to as smartphones because of its popularity and mobility nowadays. ⎫ In the early stage, they conducted a study relating to touch-based interaction that considers as the small touch-based display screen. In their research, they proposed a two finger gesture for full six degrees of freedom three-dimensional object manipulation on a portable small touch-based display. They have improved the work done by some of the

researchers.〕In which two moving fingers on a single hand are used for three-dimensional object translation and rotation on one axis, totally consisting of four degrees of freedom of three-dimensional object manipulation. In contrast, another two degrees of freedom (2 more axes for 3D object rotation) by using one moving finger with another fixed finger.

- Their technique focuses on small touch-based display, but the gesture to rotating a three-dimensional object using the 1f and 1m method is sometimes tricky from the action itself may cause the difficulty in making sure that a finger fixing on a position. Slice motion occurs and causes the inaccuracy of the three-dimensional object by the small touch-based display screen.

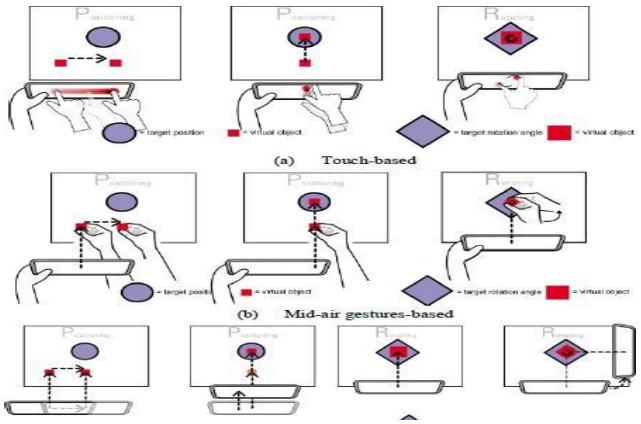

FIGURE 3

4. TOOLS USED IN AUGMENTED REALITY:

- Vuforia is a software development kit (SDK) used in Augmented Reality for Mobile phones that enables for implementation of augmented reality.
- This image recognition capability allows developers to position and orient virtual objects, such as 3D models and other media, about real-world objects. Tracking of virtual objects in real-time can be done;
- The perspective of the viewer corresponds to the target of view.

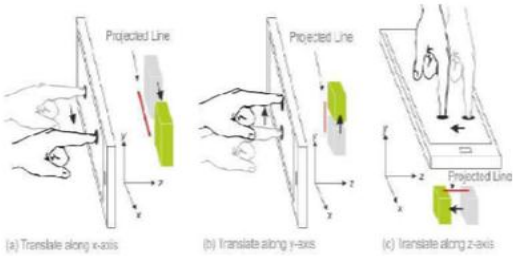

FIGURE 4

- The Vuforia Software Development Toolkit for supporting 2D and 3D includes markerless image targets, the Model target of 3D. Additional features of the Vuforia SDK includes device localization in space, localized Occlusion Detection using 'Virtual Buttons,' runtime image target selection, and the ability to create and reconfigure target sets programmatically at runtime.
- Vuforia provides Application Programming Interfaces (API) in C# and the .NET languages through an extension to the Unity game engine. In this way, the SDK supports the development of AR applications in Unity that are easily portable to both platforms.
- Vuforia Engine is a Software platform supported by Unity for creating Augmented Reality apps. Developers can use this efficiently by accessing the advanced functionality of the vision computer, allowing it to recognize objects and images to interact with the real world.

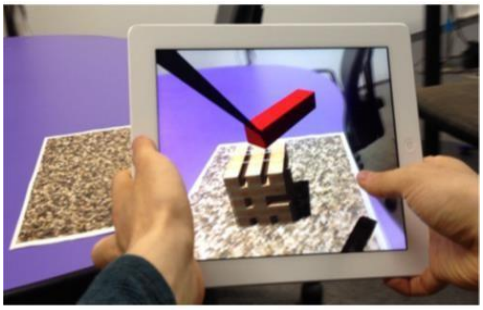

FIGURE 5

- The Vuforia Engine platform supported by unity AR app development is run and built in the different versions of Android, iOS, and UWP devices.

5. DISCUSSION

- For over 20 years, different techniques were proposed by researchers to manipulate 3D objects either in virtual or augmented environments that provide the basement and improvement space towards 3D object manipulation in handheld mobile AR.
- Augmented Reality is an interactive experience in the real world with virtual objects and combines both the imaginary world and the real world. This Game also brings the same mixed world real-world environment.
- AR systems have some characteristics they are: 1) combine both real and virtual world together. 2) We have interactive in real-time.

3) It has been registered in three-dimensional content.

- The definition of the AR technology, which: 1) Combines real and imaginary world 2) it is interactive in the real world and 3) it registers the virtual objects with the real world in three dimensions.
- AR technologies in different aspects, the current definition may be modified based on various cases and separate conditions. It has an example; the specific display technologies are not supported by Augmented Reality, which only focuses on the sense of sight, and Augmented Reality could be potentially applicable to all the reasons, like hearing, touch, and even smell.
- The recent fusion of Augmented Reality (AR) and mobile technologies has enabled the creation of mobile AR applications. In the AR application, the real-time 3D rendering capabilities are more vital than the function.
- Augmented Reality takes advantage of using Smart and mobile-based device applications such as games, entertainment, visual experience, and digital experience. Augmented Reality is the variation of the virtual environment or virtual Reality.
- Unlike Virtual Reality that immerses users inside a synthetic environment and the user cannot see the real world around him/her but Augmented Reality allows the user to see the real world with virtual objects composite with the real world.
- The Hybrid interaction makes the user interact and manipulate the augmented reality objects in the real 3D space more accurately, not in the 2D space. Let's see about the touch-based interaction and projection-based interaction and some of the types of Augmented Reality

6. CONCLUSION AND FUTURE DIRECTIONS

•Currently, many of the existing handheld mobile AR. Due to insufficient functionality, applications are not considered very practical, and they do not fully answer to the needs of the users.

• Many design and technical challenges remain, and 3D object manipulation (including 3D object translation and rotation) is one of them. For handheld mobile AR to become widely accepted, the users must be able to create AR contents.

• At the same time, solutions can speed up the 3D object manipulation with a high accuracy rate in handheld mobile AR. Realistic AR experience also had been added as one of the future directions, while solutions are focused on improving the AR experience.

• Wireless networking is one more issue to focus on in the latest versions. Wireless networking is needed to communicate with other people and computers while on the run. Dynamic and flexible handheld mobile AR will rely on up-to-the-second information that the computing device before application run-time. • In AR, wireless networking is crucially essential in handheld tour guides and applications. Location-based AR applications such as AR outdoor navigation system always need wireless networking to access a remote server to update the current information.

• Even a tracking process that requires GPS also needs the wireless network to function correctly. For 3D object manipulation, the wireless network is essential, when the 3D content registered are stored in the remote server or involving multiple users.

• The main issue related to wireless networking in handheld mobile AR may point to its stability and speed, especially in rural areas. It provides insights into the fundamentals of interaction techniques for 3D object manipulation, as well as issues relating to each technique category.

• These interaction techniques focus on achieving 3D object manipulation tasks, that is, the complete 6DOF of 3D object manipulation of virtual content in handheld mobile AR environments.

• Besides 3D object manipulation, further discussion in addition to improving the user's AR experiences, including occlusion, hand and finger tracking or recognition, and other specific issues relating to each technique should achieve a quality of interaction experience as high as possible

7. REFERENCES

[1] Dinesh Tavasalkar Professional Freelance Trainer and Developer. Engineer Developer Technical Trainer (Robotics, Internet of Things, Arduino, Andriod App Development, 3D Game Development, Web Development, Robotics Hacking) Feb 2013.

[2] P. Milgram, and F. Kishino, "A taxonomy of mixed reality visual display," IEICE Transaction on Information Systems, vol. E77-D, no. 2, pp. 1321–1329, Dec. 1994.

[3] R. Azuma, "A survey of augmented reality," Presence: Teleoperators and Virtual Environments, vol. 6, no. 4, pp. 355- 385, Aug. 1997.

[4] V.D. Krevelen, and R. Poelman, "A survey of augmented reality technologies, applications, and limitations," The International Journal of Virtual Reality, vol. 9, no. 2, pp. 1-20, Jun 2010.

[5] R. Azuma, Y. Baillot, R. Behringer, S. Feiner, S. Julier, and B. MacIntyre, "Recent advances in augmented reality," IEEE Computer Graphics and Applications, vol. 21, no. 6, pp. 34-47, Nov/Dec.Jan 2001.

[6] P. Milgram, and F. Kishino, "A taxonomy of mixed reality visual display," IEICE Transaction on Information Systems, vol. E77-D, no. 2, pp. 1321–1329, Dec. 1994.

[7] R. Azuma, "A survey of augmented reality," Presence: Teleoperators and Virtual Environments, vol. 6, no. 4, pp. 355385, Aug. 1997.

[8] V.D. Krevelen, and R. Poelman, "A survey of augmented reality technologies, applications, and limitations," The International Journal of Virtual Reality, vol. 9, no. 2, pp. 1-20, Jun 2010.

[9] M. Mekni, and A. Lemieux, "Augmented reality: Application, challenges, and future trend," in (ACACOS'14), Kuala Lumpur, Malaysia, 2014, pp. 205-214.

[10] A. Dey, M. Billinghurst, RW Lindeman, and J. Swan, "A systematic review of 10 years of augmented reality usability studies: 2005 to 2014," Frontiers in Robotics and AI, vol. 5, no. 2018, pp. 37, Apr. 2018.

[11] P. Fraga-Lamas, T.M. Fernández-Caramés, Ó. Blanco-Novoa, M.A. Vilar-Montesinos, "A review on industrial augmented reality systems for the industry 4.0 shipyard," IEEE Access, vol. 6, no. 2018, pp. 13358 – 13375, Feb. 2018.

[12] D. Catzopoulos, C. Bermejo, Z. Huang, P. Hui, "Mobile augmented reality survey: From where we are to where we go," IEEE Access, vol. 5, no. 2017, pp. 6917 – 6950, Apr. 2017.

[13] A. Erol,G. Bebis, M. Nicolescu, R.D. Boyle, and X Twombly, pp. 52–73, Oct/ Nov. 2007.

[14] J. Rekimoto, "A new you: From augmented reality to augmented human," Dresden, German: ACM, 2014, pp. 1-1.

[15] F. Zhou, H. Duh, and M. Billinghurst, in Proceeding of the International Conference on Mixed and Augmented Reality (ISMAR), Cambridge, UK: IEEE & ACM, 2010, pp. 193-202.

[16] A.W. Ismail, M. Billinghurst, M.S. Sunar, and CS Yusof, "Designing an augmented reality multimodal interface for 6DOF manipulation techniques," in Intelligent Systems and Applications, eds., vol. 868, K. Arai, S. Kapoor, and R. Bhatia, IntelliSys 2019.

[17] M. Billinghurst, H. Kato, and I. Poupyrev, "The MagicBook: a transitional AR interface," Computers & Graphics, vol. 25, no. 5, pp. 745-753, Oct. 2001.

[18] M. Hancock, T.T. Cate, and S. Carpendale, "Sticky tools: Full 6DOF force-based interaction for multi-touch tables," in Proc. ACM Int' l Conf. Interactive Tabletops and Surfaces '09, Alberta, Canada: ACM, 2009, pp. 133– 140.

[19] J.L. Reisman, P.L. Davidson, and JY. Han, "A Screenspace formulation for 2D and 3D direct manipulation," in UIST '09 Victoria, Canada, 2009, pp. 69–78J.M.

[20] Rehg, and T. Kanade, "Digiteyes: Vision-based hand tracking for human-computer interaction," in Proceedings of IEEE Workshop on Motion of Non-Rigid and Articulated Objects, Austin, Texas, USA, 1994, pp. 16–22.

[21] CF Yusof, . Bai, M. Billinghurst, and M.S. Sunar, "A review of 3D gesture interaction for handheld augmented reality," Jurnal Teknologi Sciences & Engineering, vol. 78, no. 2-2, pp. 15-20, Dec. 2016.