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Interactive Museum

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Abstract: Museums are where we see many things of artistic, cultural, historical, traditional, and objects of scientific interest. It is a great source of knowledge. It is not only a source of knowledge but also helps us familiarize our history, culture, civilization, religion, art, and the architecture of our country. Usually, a normal museum experience is limited to the sights behind barriers put by the museum authorities and the visitors don't have an opportunity to actually know them. Hence our solution an Interactive Museum achieved through the help of Augmented reality and a little gamification which lets the visitors feel the cultural depth of every artifact and other collection displayed in the museum. The AR camera will provide with details of the objects it recognizes including its origin and historical, religious or cultural importance. As a part of aforementioned project, we did a literature survey and the conclusions we arrived after the survey is given in this paper.

Keywords: AR, Augmented reality, Computer vision, Gamification, MAR, Mobile augmented reality.

I. Introduction

Augmented Reality is an emerging field which piqued the interest of everyone and has been growing steadily, from the face filters used in almost every social media platforms, games like Pokemon Go, customer services provided by companies which let their customers experience their product like the furniture company IKEA proving user experience of how their product will fit in their home, Footwear companies like Adidas and Gucci letting their customers see how their footwear will match the fashion of customer with AR camera, Toyota's recent vehicle demo and Lenskart AR Camera which let the customer try on the frames before you buy them all are a demo of how Augmented Reality is carving its name in the technological sector.

II. Literature Survey

A. A Mobile Augmented Reality System for Exhibition Hall Based on Vuforia [1]

AR is an enhanced reality with virtual content. Using mobile terminals, they enhance the user experience of AR. It is accomplished by the implementation of three technologies:

- Target recognition technology
- Tracking register technology
- Highly efficiency technology (for rendering)

Target recognition is divided into two: Machine Learning, which uses general characteristics, and Image Matching, which uses info and image features in the database and identifies targets. Based on Computer vision utilize technology to calculate current location into that of the observer two methods are used.

- The marker-based method which recognizes specific marker through edge detection and template matching andcalculates the spatial transformation matrix.
- Natural feature-based method acquires general features that match with the real scene and calculate the spatial transformation matrix of the virtual object.

They got higher efficiency using third party software to improve rendering efficiency. Vuforia utilizes computer vision to provide some data to users like multimedia, 3D models, etc. A mobile screen is a hub that connects the real and virtual world and due to other certain features like - Vuforia is more effective compared to other AR SDK providers. The system structure used by the current team in this paper consists of 3 level. Data level includes basic information library, target information library, and augmented information library. The service level

realize intercommunication between the application level and data level, this level contains services like target recognition, augmented information, and rendering. Application-level retrieves input from the user, provides outputto the user, handles video input to the service level, etc.

The creation process utilized target recognition based on image matching and tracking register based on marker. The team used the Display board as their AR target and augmented on it and as a part of increasing the efficiency by extracting the feature model of the display board (which is the target) image and created a feature model library. The conclusion they reached was that AR needs a large quantity of augmented content therefore it requires high production cost.

B. Freeze View Touch and Finger Gesture-based Interaction Methods for Handheld Augmented Reality Interfaces [2]

In the design provided in the paper they discussed the frozen view touch method for interaction in an AR application which when the freeze button is pressed, the AR tracking feature is disabled. The option to press the freeze button only becomes available when the program recognizes a target. After the target gets recognized and the frame is frozen, the camera is no longer needed to be pointed at the target and manipulations could be made upon the object displayed in the place of the target. Examples of manipulations are translation, rotation, and scaling which are made possible with help of a menu. The user can only have one button selected at a time. After the manipulations of the object are done, the freeze button is again pressed to unfreeze the object, in such a way that the manipulated object is mapped to the place of the previous existing object. They accomplished this by combining the detection and description parts with optical flow tracking and created a full-featured robust AR tracking system.

The finger gesture interaction uses gestures instead of a menu with options. Since they use gesture interaction, the input point information is detected from the tip of their fingers.

Pressing the 'Hand' button enables natural gesture interaction mode. Once the hand is detected, the most prominent fingertip will be identified by a white circle and that finger controls translation and rotation modes. The next finger will be identified by a red circle and will control the scaling. The appearance of a big circle indicates that the input gestures will be ignored and vice versa. The same manipulations of the previous method are implemented using fingertip tracking. Scrolling or pinching the fingers in mid-air provides the natural input. A skin color detector that works in HSV color space is used to separate the hand from the background. The curvature-based contour point sampling and elliptical fitting methods are used for identifying the fingertips.

The result they arrived at after a user survey was that although view touch showed better accuracy and efficiency, it was not attractive enough. Though gesture-based interaction appeared to be more attractive, it ended up being not accurate enough.

C. Augmented Reality and its Effects on Our Life [3]

- *Negative Impacts of AR:* Even though AR helps us in various applications it can also harm our life. Overuse of AR applications will inversely affect our physical health as well as mental health. It will lead to eye diseases. AR-based navigation systems while traveling will distract and inaccurate information will lead to great risk.
- *Augmented Reality and Virtual Reality:* AR is an enhanced version of the physical world. AR and VR are inverse reflections to each other. Similarities include that a similar type of technology is used in both AR & VR. The user has control over the virtual world, the user can interact deeply with the environment. Both can change acceptably in the medical field (robotics surgery). While they differ by the purpose of technology used as AR magnifies reality by adding virtual objects while VR shapes the real image purely based on the computer. Another notable difference is that AR can be generally used with mobile devices while VR uses HMDS.
- *Threats to AR:* One of the main threats to AR is the privacy concern. Since AR combines both Real and virtual worlds, as long as the AR are being used, it also captures a slice of the real world during the process. This raises concerns for many people whether this footage might get into the wrong hands. Nowadays, since everyone is already spending more time in the virtual world rather than the real world, there is a chance that people might get fed up looking at screens all the time, and the social awkwardness faced by a majority of people while using AR equipment may also be considered as a threat to the acceptance and progress of AR. The inaccuracy in computer vision may lure away potential consumers.

D. Virtual Reality (VR) and Augmented Reality (AR) Technologies for Tourism and Hospitality Industry [4]

AR is made to work efficiently by implementing some technical features like computer vision, object recognition, GPS, accelerometers, etc.

The different technologies used for AR are:

- Marker Based: QR/2D code visual markers are recognized through a camera to give a resultant output. Certain 3D or 2D objects are placed on or near the marker by taking reference to its position on the screen.

- Marker Less Based: This method utilizes inbuilt miniature versions of GPS, digital compass, and an accelerometer to provide data by considering the location and orientation of the device.
- Projection Based: Alterations in artificial light projected onto real-world objects caused by human interactions are considered as input and a desired or pre-planned output is visualized in the virtual world.
- Superimposition Based: A real-life object is partially or fully replaced by an augmented object in this method. Since an actual object has to be replaced by an augmented object from every angle, computer vision and image recognition plays an important role in this method.

Location data is considered as one of the main data in augmented and virtual reality because the movements of the user are reflected in his augmented point of view. In VR, the following concepts play an important role:

- 6 Degrees of freedom for the detection of movement of a rigid body in 3D space.
- Orientation, which is based on the combination of yaw, roll, and pitch of a 3D object.
- Coordinates of the objects.

Each tracking system produces a signal detected by a sensor. The AR/VR unit processes this signal and forwards it to both CPU and GPU.

With the advancements in this technology, the application areas are rapidly being explored. The immediate areas for hospitality and tourism are as follows:

- As AR devices create almost realistic and easy navigation travelers can have a detailed look and feel of the place to visit. Thus AR/VR technology can be used as an effective tool for planning.
- VR can be implemented in various theme parks to provide a virtual based environment. Thus, this technology can be used as an effective entertainment tool.
- A VR model can be an efficient means of communication of large amounts of information as it brings out the user's perceptual abilities. Thus it can educate people via games and other interactive sessions.
- The new AR/VR tourism experience can be added to existing applications considering visitor's requirements by simply modeling and animating, so virtual attractions can be made at effective cost.
- Exploring the restaurants and hotels and interactive dining experience can be brought with help of this technology. A virtual tour of restaurants and hotel rooms is possible through this. Also, they can book the rooms by virtually surveying the room before visiting them. Also, users can virtually order food from restaurants. In restaurants, the AR images of the menu may be projected in a dining table that allows guests to select items of their choice.
- The technology can make translation simple and effective which is a big problem for travelers facing language barriers.
- This technology can apply in navigation maps and augment the direction with some additional elements that ensure safe and easy traveling.
- AR technology enhances guest satisfaction through a process of effective marketing, scanning images in billboards, etc.
- The advanced AR can be used for staff training in hotels and other fields and it can also create blueprints allowing investors to look through the final product.

E. Implementation of Augmented Reality System for Smartphone Advertisements [5]

This paper describes implementing an augmented reality system for smartphone application service to the provider's diversified information on advertisements to users. This system aims for two way communication between user and application. It uses position information or information from sensors to provide more accurate information. The conventional mobile applications have limitations such as a margin of error to offer the information.

When there are more than two contents to be displayed in the same position as a smartphone screen with a limited size, overlapping can block users from obtaining proper information. Also, it does not take into account a user's possibility of actual movement so that if a neighboring content is displayed on an obstacle that a user can't pass by, it is difficult to decide the user's actual moving path. Furthermore, since it can recognize only positions, changing the information on the real world leads to updating the information on augmented reality. As a result, it does not guarantee the reliability of the information

In AR applications that use positioning systems such as iNeedCoffee, Wikitude, and Ovjet, etc, But since they used GPS for positioning, they have a decreased accuracy. Also, if errors exist in the magnetic compass, that result in inaccuracy. Most of the markers less AR apps that integrate advertisements don't go further than just to trigger the user's interests.

Both the unity package and Vuforia SDK are used to implement this kind of a marker less AR experience. For the databases present, MySQL is used. PHP and XML maintain the data flow between the AR app and the database.

The implementation of a user's direct booking in a store is given. Which uses a leaflet or outdoor signboard of the store to augment the 3-D model. They visualized multiple objects in the same image target using different coordinates. When a 3-D object from the leaflet is recognized it only augments that particular object. 3-D representation of

seating arrangement is augmented with live data from the database.

F. Augmented Reality and Gamification in Heritage Museums [6]

To implement an effective AR application, it is important to identify the feedback factor which will depict the user's satisfactory level. Here artifacts are the primary medium and augmented reality is the second. The curator creates targeted content and the AR developer will transmit the message and visitors will decode it. This paper describes 3 ways of getting feedback from a visitor.

- The first way follows by surveying, verbal or non-verbal reactions and facial expressions and interviews along withthe visit. The visitor is aware of this process and can contribute to it.
- The second way is through system statistics. The system will analyze the time that visitor consumes when they run AR.
- The third method is receiving feedback from Social media websites.

The communication model starts with the sender. The person who is responsible to prepare the content that needs to be delivered. The person might be an archaeologist or a curator. This person carefully delivers the information and interpretations which could be textual visual or auditory. A part of the sender's role is given to the AR developer /designer whose role is to choose the most suitable devices which do not disturb or burden visitors.

There are two types of noises that may arise are internal and external noises. Internal noise may arise in AR due to 3 reasons:

- Tracking

  Sensor-based tracking is very sensitive to noise as it may be disturbed by the ambient magnetic field. Vision-based tracking that is feature-based would be problematic if the marker is occluded. That which is Model-based may be a problem if the tracking model is lacking texture. Hybrid tracking is a combination of several sensing technologies including vision-based tracking.

- Interaction

  Regarding tangible AR, it is difficult to determine the state of the computerized data that is associated with the physical tool. Besides, using a marker less tracking technology without the clarity of texture, the system will fail. Collaborative AR could cause noise if the people roam around more while using AR. Hybrid AR could be complex if the user is in a situation that needs to deal with all the functions together.

- Display Technique

  It consists of see-through HMD projection-based display and handheld devices. See-through Head-Mounted Displays. The VST-HMD that the state, Keller, and their team created was having a very sophisticated design. Constant use of these devices produces fatigue which negatively affects the efficiency provided by these devices.

External noises are those which are caused by the crowd at the place of implementation of augmented reality.

Applying the basic elements of gaming in any other field is called gamification. The main outcome of combining gaming elements with augmented reality is to educate people about a certain topic in a very interesting manner. Here, 'Horus' is such a game that makes people aware of the history and culture of ancient Egypt. The game is designed to be played in a particular hall of the museum which contains certain tags. These tags are the key elements that help to implement augmented reality. The game starts with a 2D video which shows a background story and then the gameplay starts with the player getting to be the character 'Horus', whose aim isto demolish the evil villain 'god Seth'. The player scores by shooting the flying scary monsters which are seen in the game. A simple and practical game is implemented here which can be played by all ages. Two reasons that limit the gameplay here are the available space of the hall and the duration ofstay at the museum. When high scores are earned, the player gets to post it to social media during the intervals between the levels. These achievements create a sense of satisfaction between the players. Finally, the players get to understand the whole concept portrayed, in an exciting way.

III. Conclusion

AR adds the element of the potential required to make the surroundings of reality more informative and contentful. Unlike VR, AR enhances the current reality rather than make up a wholly virtual environment. Due to the present day's advancements, mobile augmented reality is more convenient and affordable to the vast majority of people hence it has great potential. The types of tracking and recognition technology are mainly classified into two types: marker-based and marker less based. In mobile augmented reality where the terminal used is a smartphone, there are mainly two interaction methods: The freeze View touch method and the Finger gesture method. The rendering of the augmented view is made more efficient by using third-party applications like Vuforia, AR Core. The occlusion of augmented elements is one of the reasons for decreased efficiency in renderings. Since rendering and tracking efficiency is directly related to image recognition and image recognition is directly related to image quality, better quality frames contribute to better functioning of the system. Games can be implemented using augmented reality by utilizing simple markers. The possible gameplay is more immersive compared to the conventional gameplay due to the combined participation of the audience. Internal and external noises may be present

in AR. External noises are those caused by the crowd where AR is implemented. Internal noises are caused in scenarios like tracking, interaction, and usage of display techniques. The 3 levels in the AR system structure are data level, service level, and application level. The main threats faced by augmented reality are privacy concerns and fatigue caused by long use.

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