Augmented Reality

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I. Area of Research in Computer Science

In human history, we are witnessing a time of development what some have called the fourth industrial revolution. At an unforeseen pace, closely interlinked clusters of new technologies are progressing.

Digital technologies, robotics, automation and artificial intelligence, biotechnology and nanotechnology all have large effects on the economy, society and the environment.In this report, I plan to discuss augmented reality technology to construct an immersive learning experience that can help students and learners to easily understand and memorize the structure and models with concrete, augmented reality support.

II. Augmented reality as an area of research

Augmented reality was first achieved, to some extent, by a cinematographer called Morton Heilig in 1957. He invented the Sensorama which delivered visuals, sounds, vibration and smell to the viewer [2].AR powerfully magnifies the value created by those capabilities. Specifically, it improves how users visualize and therefore access all the new monitoring data, how they receive and follow instructions and guidance on product operations, and even how they interact with and control the products themselves [3].

In the US, a quarter of the total e-commerce transactions in 2019 were completed using smart devices and mobile applications (apps) and AR trend in mobile apps adoption is expected to reach 45% in 2020 [4]. The results of this study confirm that an adequate combination of AR technology and specific pedagogical approaches enrich educational settings. Showing a record growth in 2018, the Augmented Reality market is going to be worth $61,39 billion by 2023, according to research firm Markets. Moreover, Augmented Reality is one of the 2019-2020 technology trends to watch [6].

The user experience of AR exists on the reality-virtuality continuum described by Milgram in 1994 that describes the overlap of the physical world and a digital world. 3 Unlike immersive virtual reality (VR) that creates a total virtual experience, augmented, or mixed reality (AR/MR) encompasses the middle of the reality-virtuality continuum and allows for continued interaction with the real world [7].

Augmented Reality (AR) creates an environment where digital information is inserted in a predominantly real world view. It originated from marker-based tracking toolkits (e.g., ARToolkit, ARTag) which are used to determine tracking and registration (where to display the digital contents) and the media contents (what digital content to display) [1]. AR advocates for the inclusion of virtual objects for real-time functionality and experience with them in a real-world environment.

Today, various industries are exploring AR solutions for faster and more effective learning. In the classroom, using augmented reality can turn an ordinary class into an interactive experience. In order to endorse textbook content, AR technology offers interactive examples and incorporates gaming elements. As a consequence, classes are becoming more interactive. AR allows students to better remember the data they have just learned. In classroom education, let's study a few examples of augmented reality.

About 2.4 million positions may go unfilled between 2018 and 2028 as a result of the skills gap. One of the possible solutions is developing training that engages employees. Augmented reality can help make classes more interactive and allow learners to focus more on practice instead of just theory. With the widespread use of mobile devices in mind, augmented reality in education is becoming much more available [8].

An upcoming vital retail trend is the use of AR-assisted shopping apps. 100 million people are expected to be using this technology in the next few months. 50% of people surveyed in a study stated that they would like to shop from retailers who use AR technology [14].

III. Research topic Recognition AR

One of these is to detect the object in front of the camera and provide on-screen object information. This is equivalent to the AR software for travelers (location browsers). The distinction, however, lies in the fact that the AR location browsers typically do not know about the objects they see because they are focused on recognition.

Various vehicle parts that are incorporated into the scene are markers mounted on the prototype surface of the car. With the number of necessary components, the complexity of a suitable 3D model collection and the complexity of position adjustment within a scene are growing significantly.

With projection based AR, your imagination is the only limit. There is a lot of research going on in this field and with time, more and more applications would pour in. If you are really excited about how you can create something like that of your own, we have tips for you at the end of this book. For now, let us see the location based AR [9].

Many optical scanners still use the markers for more precise alignment even though they are able to reconstruct the shape without them (e.g. GOM Atos). Film motion capture is most mostly based on the use of diode markers. The same situation can be observed in the area of human-computer interaction [8]. AR technology focused on recognition has varied applications as well.

There are various types of Augmented Reality. Few of them are discussed below :

1. Marker Based AR

The other name for Marker-Based AR is also called Image Recognition or Recognition based AR. this type of AR provides us more information about the object after it focuses on the recognition of objects. Marker-based AR technology has diverse uses according to market purposes. It detects the object in front of the camera and provides information about the object on the screen [10].

2. Marker-less AR

Marker-less augmented reality is one of the most widely implemented applications in the industry. It is also known as Location-based AR for the reason for the easy availability of the features in the smartphones that provide location detection. This type of app is mostly used to help travelers [10].

3. Projection AR

This is one of the simplest types of AR which is the projection of light on a surface. Projection-based AR is appealing and interactive where light is blown onto a surface and the interaction is done by touching the projected surface with hand [10].

4. Superimposition AR

This AR provides a replacement view of the object in focus. This is done by replacing the entire or partial view with an augmented view of the object [10].

IV. How Recognition AR works

A. Marker based AR

Marker-based augmented reality experiences involve a static picture that a person can search using their mobile device using an augmented reality app, often referred to as a trigger photo. An additional material (video, animation, 3D or other) planned in advance to appear on top of the marker will be triggered by the mobile scan [11].

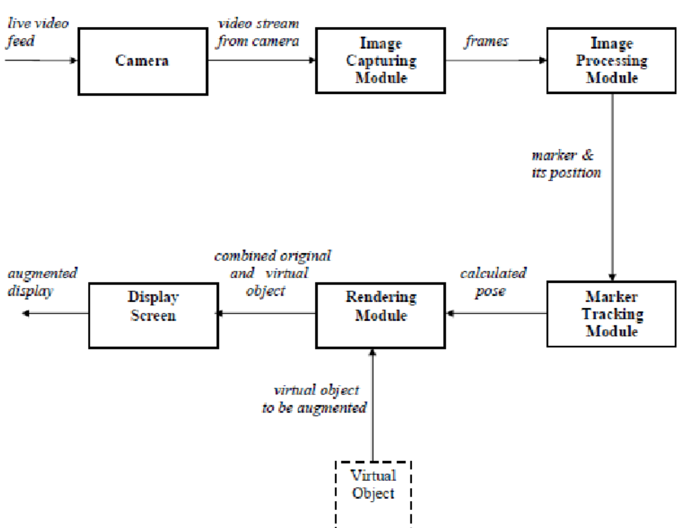

Figure 1: Marker Based Architecture

Marker recognition can be local or cloud-based, which means that it is possible to store marker databases on the device and recognition often occurs on the device. The databases can also be stored on a cloud and identification takes place on a server. Only point clouds are sent to the server by phone. Device-based recognition will occur instantly, but if cloud recognition is used, it will take longer for the information to be recognised. Device-based recognition will happen instantly, but it will take a while longer for the content to be accessed from the server if cloud recognition is used. It normally takes a couple of seconds before any augmented reality experience can be used by the user [11].

Figure 2: Marker of Image

A camera is used with AR software to detect augmented reality markers as the location for virtual objects. The result is that an image can be viewed, even live, on a screen and digital assets are placed into the scene at the location of the markers. Limitations on the types of augmented reality markers that can be used are based on the software that recognizes them. While they need to remain fairly simple for error correction, they can include a wide range of different images. The simplest types of augmented reality markers are black and white images that consist of two-dimensional (2D) barcodes [12] .

B. Marker-less AR

By scanning the surrounding area, Markerless augmented reality works and there is no trigger picture required to retrieve the content of augmented reality.

Apps that provide such features will generally ask the user to find a flat surface for placing the AR components, such as a table or floor, as the objects will not always make sense to float in the air. It needs to be textured in order for computer vision to sense the flat surface. On a white background or on other single colour surfaces, you can find it difficult or even impossible to use [11].

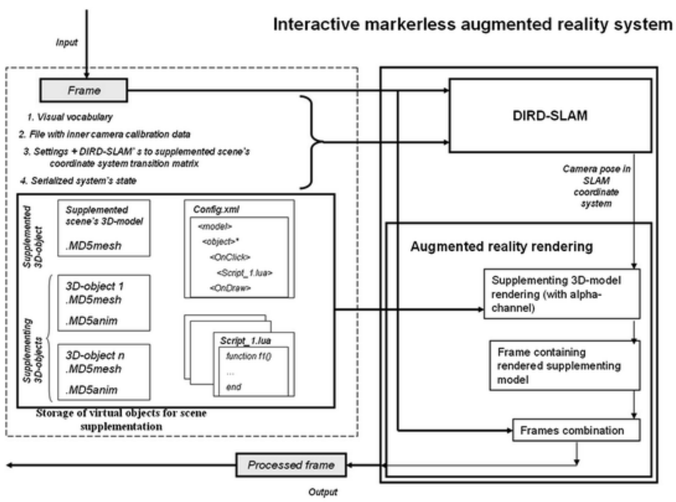

Figure 4: Marker-Less AR Architecture

The development of simultaneous localization and mapping technology (SLAM) improved the accuracy of markerless AR image analysis. SLAM markerless image tracking scans the environment and creates maps of where to place virtual 3D objects. Even if the objects are not within a user's field of vision, they do not move when the user moves, and the user does not have to scan new images [13].

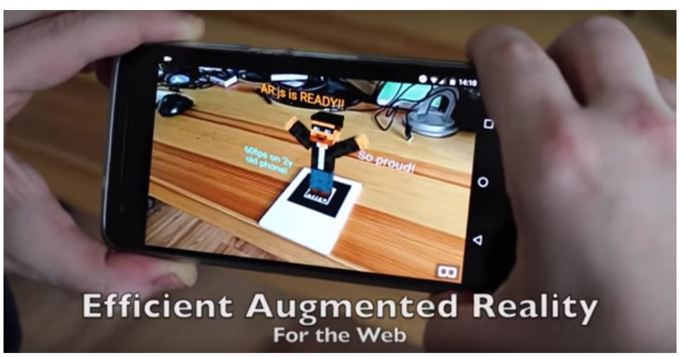

Figure 4: Marker-Less AR

Text heads organize the topics on a relational, hierarchical basis. For example, the paper title is the primary text head because all subsequent material relates and elaborates on this one topic. If there are two or more sub-topics, the next level head (uppercase Roman numerals) should be used and, conversely, if there are not at least two sub-topics, then no subheads should be introduced. Styles named "Heading 1", "Heading 2", "Heading 3", and "Heading 4" are prescribed [12].

C. RANSAC Algorithmic process

The RANdom SAmple Consensus (RANSAC) algorithm proposed by Fischler and Bolles [1] is a general parameter estimation approach designed to cope with a large proportion of outliers in the input data.

Unlike many of the common robust estimation techniques such as M-estimators and least-median squares that have been adopted by the computer vision community from the statistics literature, RANSAC was developed from within the computer vision community [14].

1. Select randomly the minimum number of points required to determine the model parameters
2. Solve for the parameters of the model.

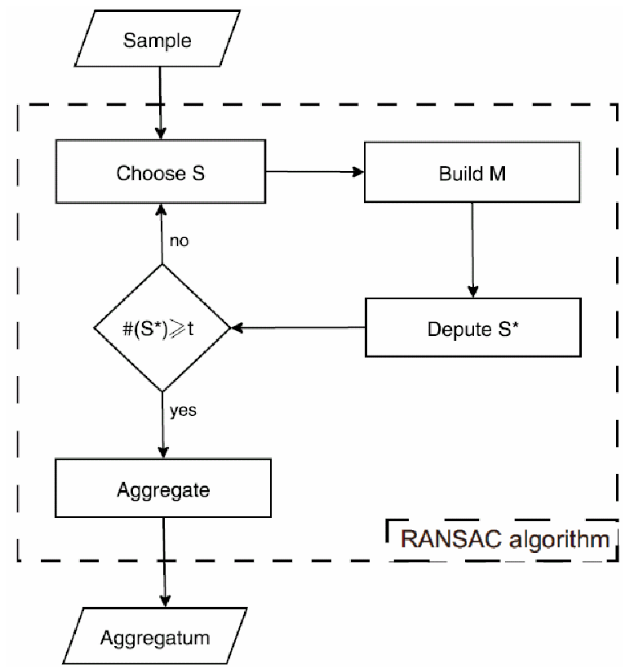

Figure 5: RANSAC Algorithm

3. Determine how many points from the set of all points fit with a predefined tolerance .
4. If the fraction of the number of inliers over the total number points in the set exceeds a predefined threshold τ , re-estimate the model parameters using all the identified inliers and terminate.
5. Else repeat step 1 – step 4.

V. Future plan for complete project

With bated breath, AR is something that the world is waiting for. In the near future, Chrome AR is expected to be released. The reason everyone is so excited about AR is that it offers a browsing experience that is futuristic and powered by augmented reality. In essence, your camera will trigger (with your permission) when you open some connection and the content will be relayed in AR form.

In addition, I would like to suggest a few other approaches in this course that can boost the accuracy and design a more successful Augmented Reality model. I would also like to explain AR based on projection and position.

VI. References

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