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A study of Augmented Reality performance in web browsers (WebAR)

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Abstract: **The extensive development of augmented reality (AR) is ascending excessively, Web-based augmented reality (WebAR) is an advent to users which stamp out the friction of downloading an application based on AR, by simply publishing the 2D/3D content in web browsers to be accessible by customised URL. This paper provides a visionary as well as practical understanding of specialized improvement in the WebAR. We examine current trends which help eliminates the agitation of slacken experience. A practical analysis is done using ar.js, integration of Web graphic library with three.js for overlaying digital content with the help of marker. Furthermore, the browser + cloud solution will provide exclusive network capabilities by conquering the service element provided by web AR from the remote cloud server to the edge server effectively to render 3D model using WebRTC, object recognition algorithm integrated with profound JavaScript libraries which will remove the slacken performance optimization when a digital 2D/3D content is rendered in the user device's camera.**

Keywords: ***Augmented Reality, Web-based augmented reality, ar.js, three.js, WebRTC, WebGL.***

I. INTRODUCTION AND BACKGROUND

A. Introduction to Web-based augmented reality (WebAR)

Augmented reality (AR) is a practice where user's physical world/surrounding environment gets overlaid with computer-generated input. "User can create inputs as from sound to video, to graphics to GPS superimposition in digital content which acknowledge in real time to with respect to the user's environment". [1] This technology gained its high peak in the 2016 with the release of Pokemon GO an application on mobile-based augmented reality. Ever since then, there have been many speculations in order to make it more extensive for the users. With the development in the emerging technologies of hardware and software the web-based Augmented Reality (WebAR) is taking part into it. WebAR enables smart phone users to discover AR technology in the easiest way via the webpage without the burden of installation. It offers simple animations, video, and a certain degree of interactivity. Also, supports image target detection. WebAR can be accomplished on almost every device which execute Android 6.0 and above.

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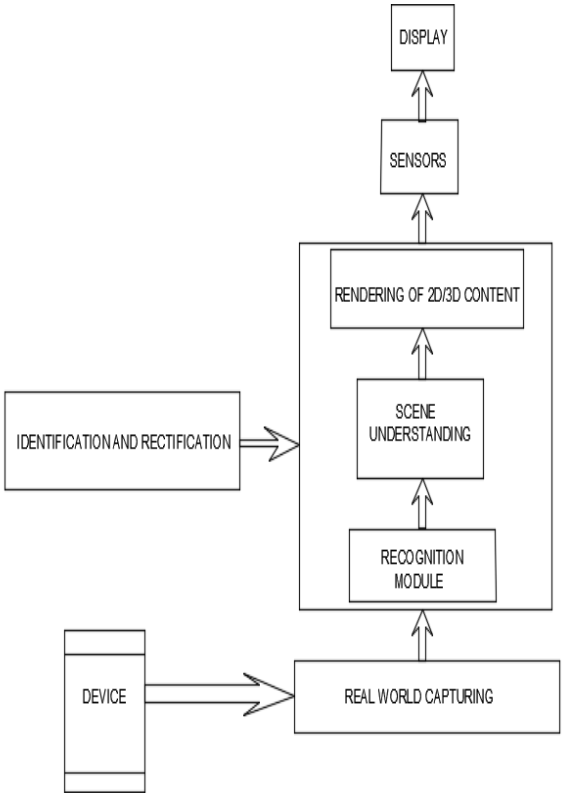

Figure 1.1 Architecture of WebAR

To achieve absolute accuracy, a user device/system is used for real-time description. [3] A viewing device includes sensors to capture the 2D/3D content either an image or video/audio recognition. Firstly, the device identifies the real-world objects and extracts the texture of the content to be displayed. A recognition module has to identify the object on the basis of the captured image or scene in real-time. Then, retrieval of the object comparable to the described real-world object is done. Two approaches can be imposed to get the details of the specified object, that is, marker based recognition and marker-less recognition. [4] In marker-based recognition regarding the object when it targets on the realization of the objects. It helps in detecting the object in presence of the camera and give out information related to the object on the device's screen. Marker-less augmented reality is another type liked by many users. It can also be proposed as Location-based AR for the interest of the accessible opportunity of the characters in the Smartphone's that maintains location detection. This type of AR is widely accessible by the tourists/travellers to help them guide through the location. It helps the users to locate impressive places amidst their present locations.

B. Why to use WebAR?

There are many reasons as to why we should have the knowledge of web-based augmented reality:

a. [4] WebAR helps the users to lower the storage handling of the mobile or desktop. There is no need of installation of separate application.
b. WebAR including with the minimal contribution will save capital and time synchronously.
c. Removal of language barrier, Google translate AR mode which provides text in more than 40 different languages to users. All clients has to do is activate AR mode, point their device's camera at foreign words, and their device will display the scene, but in the user's native language.
d. Allows for the retailers to make the interactive advertisement for the benefits for marketing, sales, and brand awareness
e. To more of its knowledge, it will give the users an advantage of understanding of the object or products with 2D as well as 3D virtual image. A user can also be able to manipulate the particulars of the virtual content available to the user and easily make the decisions accordingly.

In the following section, we highlight the related work on AR display with Basic fundamentals of WebAR system. And provide a framework of browser and cloud solution with the help of ar.js its integration with three.js and WebGL to resolve the performance upsurge issue when it is viewed in the browsers.

II. LITERATURE SURVEY

[8] The utilization of recognition module for productive rectification of tracking of data so that the framework can be employed to compile using C++ code with Javascript library called asm.js is beneficial. [9] The camera is penetrated completely and code simply extracts the data written in HTML5 canvas component with WebGL (WebGraphic Library). The readiness to be needed to fulfil the requirements is satisfied at the user level. Satisfactory approaches are factually maintained [7] The geo-location has also been around AR lately, and the tourism sector is gaining interest by the users to have knowledge about the surrounding location this can also be done using HTML5 and JavaScript library. [10] Web developers are ascertained with an elementary collaboration to a wide range of interaction controllers and usage of WebGL to render digital content with the help of device pose and timing knowledge contributed by WebXR. Ultimately, the API will seemingly comprise of concept like anchors, hit-testing with the surrounding, and allowance of formation from available sensors. [11] The researcher oversees the developing technology of 5G with the mobile edge computing, device-to-device communication for WebAR. The D2D communication of the 5G networks at the radio access network (RAN) results in improvement of latency as well as frame-per-second (FPS). Network slicing helped in maintaining the resources across the network.[10] An AR target is an object used to anchor digital content in the real world. In charge for AR to appear realistic to the observer, it is relevant for the positioning adjustment of the computational virtual object in the real scene matches the user's prospect. To achieve this, an objective is used to decide the actual composition.[12] The target is built well-known to the AR operation all along the development. When a camera acquaints the target, the AR application evaluates and acknowledges the target's position in the environment of the real world. The performance interprets into mobile augmented reality (MAR) text perceptibility with enduring instinctive object awareness, recognition and small impression achievable interaction for the Web AR method. [12] WebAR can be done using many JavaScript libraries available for the user, like, AR.js is a fully implemented as marker-based library. The concern of this library is that it administrates absolutely on the web, it is achievable to practice an AR content constructed in AR.js just by opening a website link, without installing any application. This is probable by employing WebGL, WebXR and WebRTC characters of present-day web browsers. [13] There are some feature extractions, detection algorithm like ORB for matching performance, which is essential towards removing distortion is also available to users.

III. IDENTIFIED RESEARCH GAP

Ritsos, Panagiotis D., James Jackson, and Jonathan C. Roberts (2017) in "Web-based immersive analytics in handheld augmented reality" proposed the work based on augmented reality observed in browsers using D3.js and Argon framework with A-frame.

Drawbacks: Investigation lead to the suggestion that there was annotation, and to have full effective implementation there must be usage of more highlighting and selection strategies for data visualization must be considered. Also, this was the only first collaboration of D3.js with A-frame which was used and can be improved.

IV. PROPOSED SOLUTION

A. Overview of the framework for WebAR

Using WebAR with the help of ar.js, and Three.js which works as a crows-browser JavaScript library helps in creating as well as displaying the 3D content in a web browser along with WebRTC (Web real-time

communication) which executes web applications and sites to implement the video/audio data with exchange of data among the browsers. It comprises of interrelated APIs and protocols used to provide capabilities to the web, including support for audio, video conferencing, file exchange, screen sharing, etc. WebGL is a Web Graphics library use for rendering of 2D/3D data in any web browser.

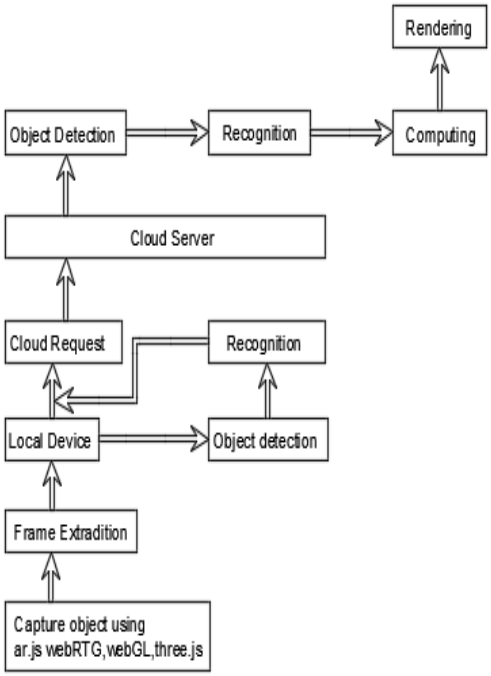

Figure 3.1 Flow chart of defined system

The ar.js library tries on an advantageous terminal, artoolkitjs, which is necessary as an influence comprehensive dependency for ar.js and be engaged for loading first. Orientation of camera and marker to get identified by the camera also depends upon the orientation of the device. Therefore, the assets response is depending on the changes its orientation, rotation of the device as well.

V.DEPLOYMENT OF METHODOLOGY FOR PERFORMANCE EVALUATION

A. System Framework

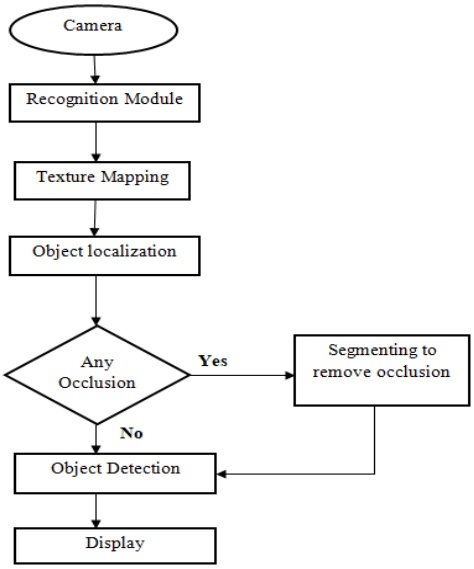

Fig 3.2 Object detection algorithm

The classical object detection algorithm is used which helps detecting the objects in a real-time. Camera detects and device does the texture extraction for identifying the real-time objects based on captured image and extracts features. Recognition module help identifying the object and texture mapping is done for retrieving virtual object corresponding to real-world. Identification of locations of multi objects is done using object localization. If there is occlusion (which happen when a 3D object blocks other 3D object) it is removed or minimized, and if there is no occlusion then the object will get displayed onto the screen.

B. Results and discussion

The edge server has greater computational capability, and the image-matching time can be reduced effectively compared to the same matching algorithm on the terminal side. Although uploading images to the edge server adds extra time, the total processing efficiency

still improves. Henceforth, the network suspension is not sustained for web AR. In the case where multiple images need to be compared, users' end devices apparently cannot meet the performance requirement of the web AR application owing to their limited computational capability. Migrating the service module (i.e., the web AR application) from the remote cloud server to the edge server effectively eases the issue of network delay caused by the frequent image transmissions.

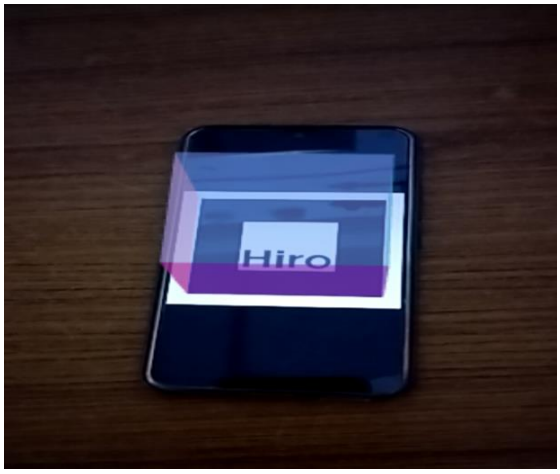

Fig.3.3. 3D cube over Hiro Marker

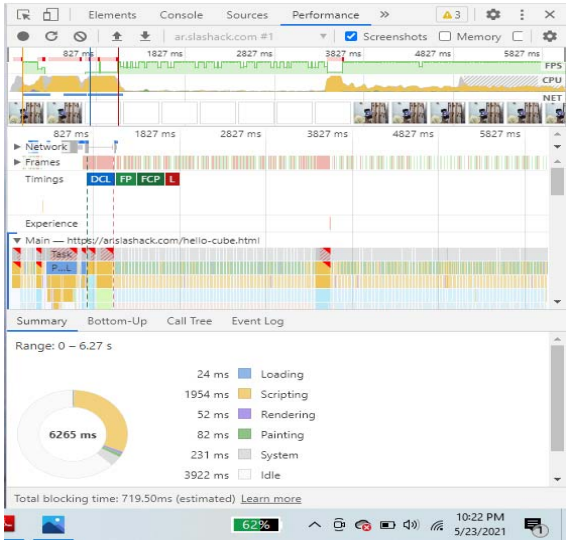

Fig 3.4 Performance evaluation of a 3D cube over a Hiro marker.

We examine the WebAR service on Amazon AWS and generated an HTTP request to get first byte of input data from the web serve which is TTFB (Time to first byte) the demanded resource can outset being dispatched to the browser.

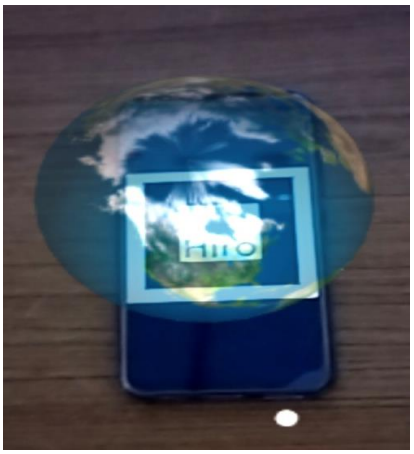

Fig 3.5 3D view of Rotating Globe using a marker

On average a TTFB falling under 100 ms is incredible. And between 200-500 ms is considered as standard/normal, between 500 ms - 1 s is not considered as a good one. We examined the interpretation of a 3D cube and a rotating globe. Therefore, our interpretation turned out to be effective as the results were less than 24 ms.

The experiment results show the importance of browser + cloud solution to embrace AR in the web pages for future purposes when integrated with other emerging technologies.

VI. CONCLUSION

Augmented reality has the probable outcome to be an essential and successful tool to improvise customer needs as well as deliver data with high productivity. In this research, we discussed about the values of both Mobile augmented reality and Web based augmented reality. This research implies the modelling of 3D data experience to remove the barrier of downloading any application based AR rather the user can gave the

augmented reality experience on the web browser as well.

VII. FUTURE DIRECTIONS

WebAR is suspected to be the driving force in the various fields. Many industries can take advantage of AR and operates simultaneously with real world. It provides better customer engagement. Ar.js has more capabilities which when integrated with improved immersive technology like IoT the experience can be improved. More effective object optimising techniques can be employed for browser computational requirements.

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