*Journal of Information Hiding and Privacy Protection*
DOI:10.32604/jihpp.2021.017254
***Article***

Tech Science Press

# Realization of Mobile Augmented Reality System Based on Image Recognition

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Received: 25 January 2021; Accepted: 29 March 2021

**Abstract:** With the development of computation technology, the augmented reality (AR) is widely applied in many fields as well as the image recognition. However, the AR application on mobile platform is not developed enough in the past decades due to the capability of the mobile processors. In recent years, the performance of mobile processors has changed rapidly, which makes it comparable to the desktop processors. This paper proposed and realized an AR system to be used on the Android mobile platform based on the image recognition through EasyAR engine and Unity 3D development tools. In this system, the image recognition could be done locally and/or using cloud recognition. Test results show that the cloud-based recognition is more efficient and accuracy than the local recognition for the mobile AR when there are more images to be recognized at the same time.

**Keywords:** Mobile augmented reality; local recognition; cloud recognition

## 1 Introduction

Augmented reality technology refers to the technology of superimposing information that does not exist in a certain region of the real world based on a certain media after simulation to the real world, which is perceived by human senses. It enables the real environment and virtual objects to be displayed in the same picture or space in real time, so as to achieve sensory experience beyond reality [1]. It is an extension of virtual reality. Different from virtual reality, AR technology lays more emphasis on the interaction between users and reality. Users can experience the combination of virtual and real effects, so as to obtain a better sense of immersion and interest [2], thus enhancing users' sense and cognition of reality [3–4]. At present, AR technology has been integrated into relevant business and marketing technologies by the market and enterprises to give full play to the advantages of AR technology. The AR service provided by IKEA enables users to simulate the experience effect of products at home. The manufacturing industry and the medical education industry are also rapidly integrating into this technology [5].

With the development of mobile devices, especially features such as high speed and low latency of 5G technology, mobile augmented reality has a good opportunity for development [6]. Mobile augmented reality is a technology that inherits three characteristics of augmented reality, namely, three-dimensional registration, real-time interaction and combination of virtual and real [7], and applies augmented reality to mobile intelligent terminals, so as to have high mobility. Steven Feiner from Columbia University was the first person to get involved in Mobile Augmented Reality technology. He developed a navigation system in 1997, which was named Mobile Augmented Reality System [8]. In 2006, Nokia Research Institute's Mobile Augmented Reality Applications [9] developed a system based on ISMAR06 Mobile intelligent terminal. The AR technology developed by mobile terminal has gradually become the mainstream in the development of augmented reality.

In order to make the AR application easier used on the mobile communication devices, this paper gives a designs of an augmented reality systems based on local image recognition and cloud image recognition respectively. Then, the performance of the system was tested and analyzed. Test results showed the AR system could run with both image recognitions. And the recognition rate and accuracy are somehow equivalent. As the number of images increases, the recognition rate and accuracy for the AR system with cloud recognition are better.

## 2 AR System Design

Generally, an augmented reality system mainly contains four parts, virtual graphics rendering module, camera tracking and positioning module, 3D registration module and display module. For mobile devices, such as Android terminals, the camera would be used to capture images. Then the device analyzes these images through certain algorithms, and use sensors to obtain the user's interaction information [10–11], so as to enhance the understanding of the environment.

As mentioned above, the image capture could be realized by the device's camera. Then the analysis can be on local due to current powerful mobile processors or on the cloud due to the high speed communication. In this paper, both were employed to realize the AR system. EasyAR was used for the image recognition engine and Unity 3D was used for the AR enhancement.

### *2.1 Local Image Recognition*

Fig. 1 gave the scheme of the AR system with the local image recognition. Firstly, images captured by the camera, which were organized and put in the local folder according to the format standards. Then the image of the target was associated with the entity through the EasyAR and the 3D information was generated and associated with the captured image by Unity 3D software. After install the generated .apk file from EasyAR, the Android device could run the app and realize the AR process.

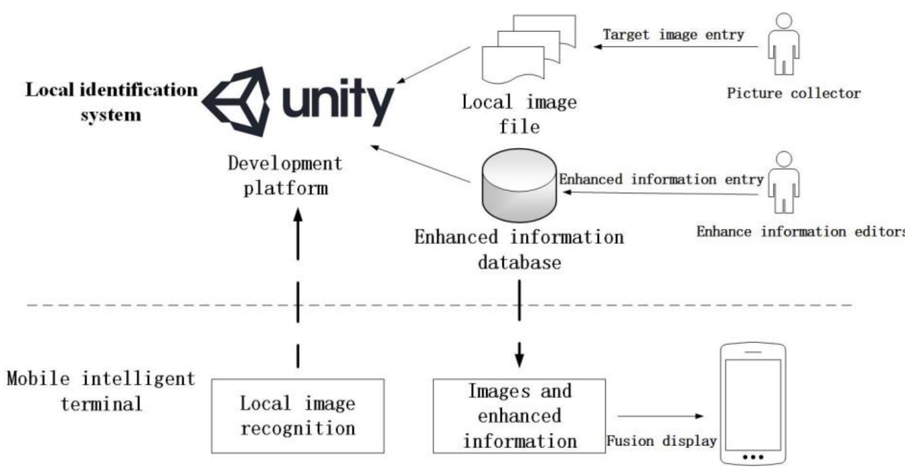


**Figure 1:** Overall architecture diagram of the local identification system

### *2.2 Cloud Image Recognition*

Different from the local image recognition, the AR system with cloud image recognition adopted the cloud identification localization function of EasyARCRS, which made image recognition on the cloud. The process was shown in Fig. 2. Firstly, the target image acquisition module must be used and captured images need to upload to the cloud gallery through the Internet. After that, the cloud identification parameters in the Unity 3D should be configured. Then, the enhanced information was set and associated with the image captured from the entity. After install the generated .apk file from EasyAR, the Android device could run the app and realize the AR process.

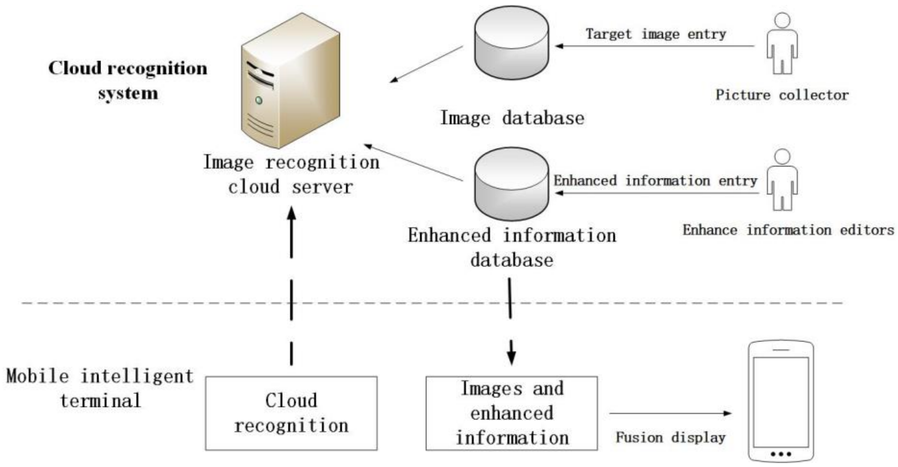


**Figure 2:** Overall architecture diagram of the cloud identification system

## 3 AR System Test

Based on the schemes showed above, an AR system was realized with local image recognition and/or with the cloud image recognition. The generated .apk file was in-stalled on an Android mobile phone, HUAWEI Honor 8 for the AR test.

### *3.1 AR Based on Local Image Recognition*

For the AR test, 3 typical images of instruments were used. The AR effects were shown in Fig. 3. It took about 0.2 s to 0.5 s that the AR system with local image recognition between the time images captured and the time the AR enhancement information displayed on the screen.

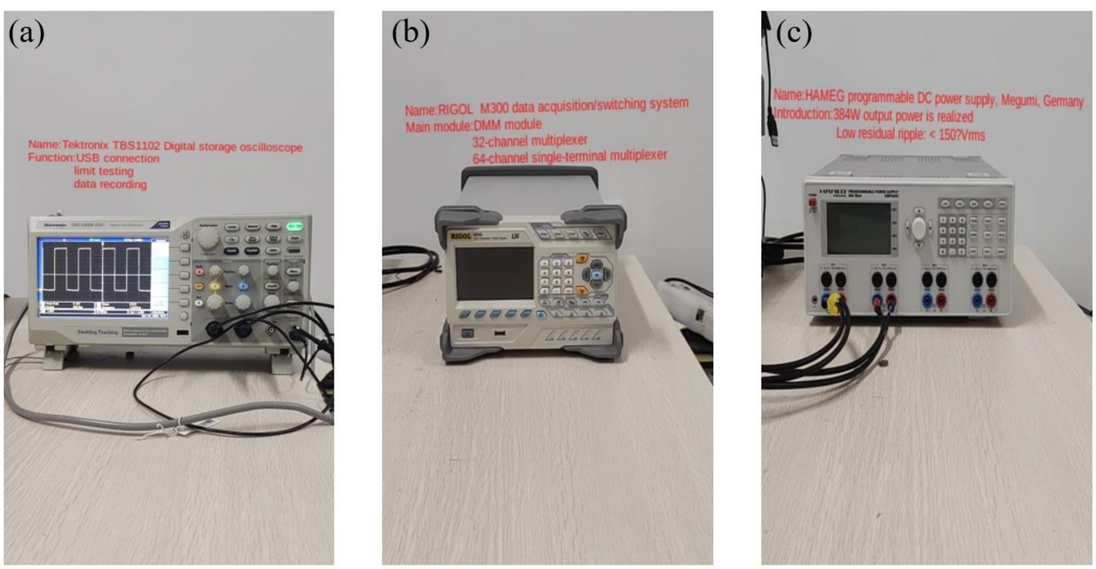


**Figure 3:** AR test results based on local image recognition

### *3.2 AR Based on Cloud Image Recognition*

For the AR test, 3 typical images of instruments were used. The AR effects were shown in Fig. 4. It took about 0.1 s that the AR system with local image recognition between the time images captured and the time the AR enhancement information displayed on the screen.

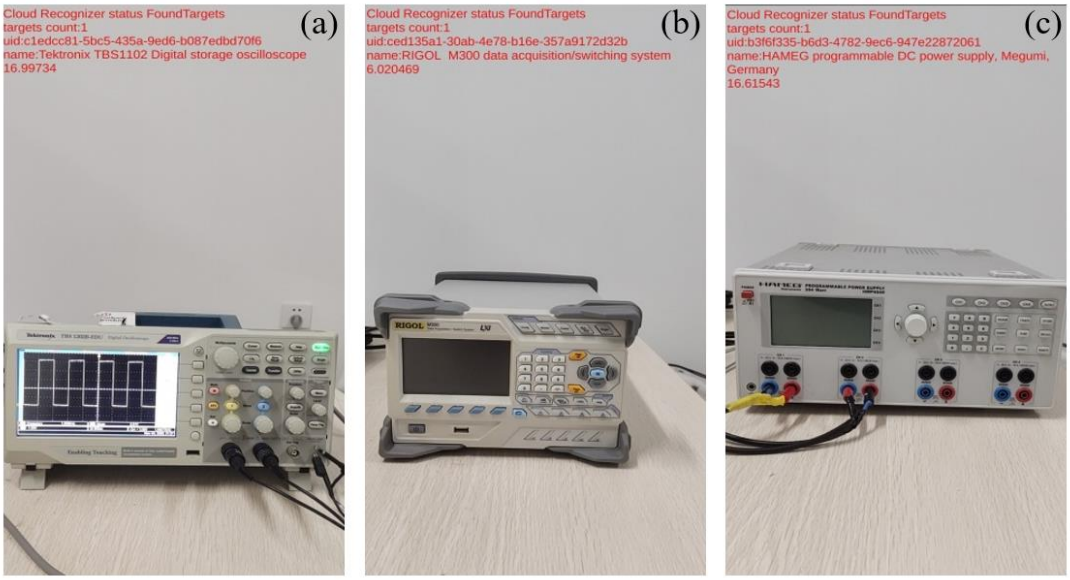


**Figure 4:** AR test results based on cloud image recognition

### *3.3 Efficiency and Accuracy*

After the AR effect tests, the efficiency and accuracy of the AR system were characterized. 3, 15 and 25 groups were used for tests respectively to explore the relationship between the number of object images and the efficiency and accuracy of image recognition. Test results were shown in Tab. 1.

As shown, the AR system with cloud image recognition was more efficient by using the simple and efficient API of EasyARCRS. Meanwhile, due to the parallel computation on the cloud, many images could be processed in the same time, which also enhanced the recognition efficiency to make the time for the AR effect just 0.1 s. On the other hand, the accuracy was also higher for the cloud recognition because of the big data of images on the cloud. However, all these results were opposite when the number of images was small. Detailed comparison results were shown in Tab. 2.

**Table 1:** Comparison results of identification efficiency

| Target objects | Local recognition efficiency | Cloud recognition efficiency |
|---|---|---|
| 3 | 0.21 s | 0.12 s |
| 15 | 0.28 s | 0.1 s |
| 25 | 0.51 s | 0.11 s |

**Table 2:** Comparison results of recognition accuracy

| Target objects | Local recognition accuracy | Cloud recognition accuracy |
|---|---|---|
| 3 | 99% | 100% |
| 15 | 95% | 99% |
| 25 | 87% | 98% |

## 4 Conclusion

In this paper, a mobile AR system based on local image recognition and/or cloud image recognition was designed and realized. AR effect as well as the efficiency and accuracy were tested. Test results showed that when the number of images was small, the efficiency and accuracy of image recognition and information AR enhancement was little difference. However, as the number of the images increased, the efficiency and the accuracy of the local image recognition would be decreased. Therefore, the more images, the better of the AR system with the cloud image recognition

**Acknowledgement:** Authors would like to thank Dr. Zhaoyu Sun for useful discussion.

**Funding Statement:** The authors received no specific funding for this study.

**Conflicts of Interest:** The authors declare that they have no conflicts of interest to report regarding the present study.

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