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AR Foundation for Augmented Reality in Unity

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ABSTRACT- ARFoundation provides many libraries and SDKs in the development world to create Augmented Reality Applications. Their functionality differs depending on the use of the user to detect, track and place one or more than one object, point or features in a scene. In this paper, we will discover ARFoundation and one of its SDK, ARCore, an open library that not only displays, but also detects a virtual content in the real world. It can interact with the components of the device and real world by inserting virtual content.

Keywords-ARFoundation, ARcore, Augmented Reality, Plane Detection

I. INTRODUCTION

Augmented reality is a method or technology for inserting virtual objects into the real world through devices in a realistic way [1]. Augmented reality adds some virtual content to the real world and offers a real-time interaction to users, unlike Virtual reality, where the user is immersed in a fully different or digital world. Virtual objects provide relevant and contextualized information providing a new meaning to the user of the AR system.

The main objective of an augmented reality system is to know the pose of the camera by recording the scene in relation to a known object in the scene [2]. The goal of the pose The estimation is to find the translation and rotation between a known object in the real world and the camera[3]. Isassumed that the intrinsic parameters (focal length and main point) of the camera are known [4], that is, the camera is calibrated, this problem is solved by giving a list of correspondences between the known 3D points of the object andtheir 2D projections on the camera screen [5]. There are 2 techniques to calculate pose in Augmented reality. Marker-based and markerless method [6].

A marker based augmented application needs an image to be recognized and is mostly used because they are easy to track, recognize and don't require powerful devices [7][8]. But in a marker based augmented reality, when the marker's position is changed, AR experience disappears and has to be scanned again, extended tracking is possible, but in most cases, it makes things worse. Scanning will not work if the marker reflects light in certain situations and markers must have strong edges / contrast between black and white for more stable tracking. The smooth color transition will make recognition impossible. For this reason, markerless augmented reality is considered better than marker based, as there is no image to be tracked and it would work better when the environment is scanned/plane is detected and once the object is placed, it is more flexible than marker based augmented reality. A markerless augmented application recognizes the object without registering them in advance[9]. For an algorithm to identify the object, it must recognize different things, such as patterns, colors and other characteristics that exist in the particular scene [10][11].

We can integrate augmented reality into mobiles using a Framework Purpose built for Augmented Reality and it's specific SDK (Software Development Kit). These SDKs have their own specifications and the choice is made according to certain criteria. ARFoundation is the Purpose-Built Framework which contains AR components for both IOS and Android. Some of the SDKs available are ARCore by google(for android) and ARKit by apple(for IOS).
(Fig.1 and Fig.2 shows the difference between ARFoundation and ARCore and ARKit).

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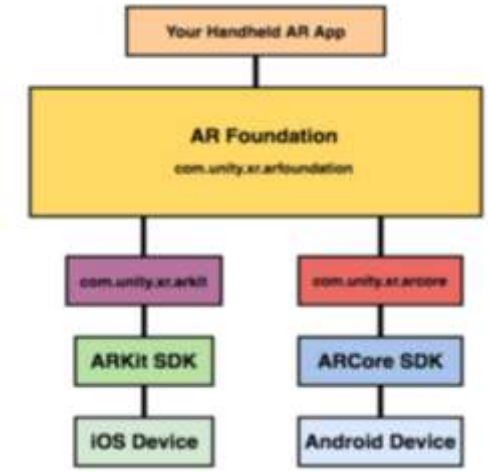

Fig.1 ARFoundation

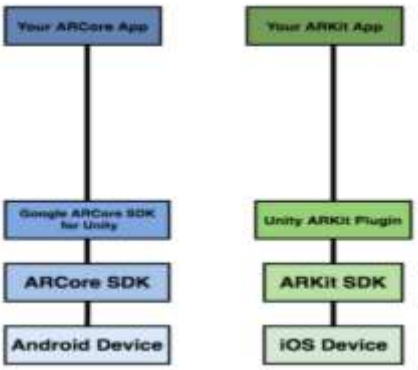

Fig.2 ARCore and ARKit

1. AR Foundation

AR Foundation allows us to work with augmented reality platforms in a multi-platform way in Unity. The package presents an interface for Unity Developers to use, but doesn't implement any AR features itself.

Separate packages needed for the target platforms are:

1) ARCore XR Plugin on Android
2) ARKit XR Plugin on IOS
3) Magic Leap XR Plugin on magic Leap
4) Windows XR Plugin on Hololens

1.1. Unity's ARFoundation supported Features:

- **Tracking :** ARFoundation supports Device tracking (track the position and orientation of the device in physical space), Face tracking (detect and track human faces), 2D image and 3D object tracking (detect 2D and 3D images and objects and track 2D images), Body tracking (2D and 3D representations of humans recognized in physical space).
- **Plane Detection :** It detects horizontal and vertical surfaces.
- **Anchor :** It is an arbitrary position and orientation that the device tracks.
- **Light Estimation :** It estimates the average color temperature and the brightness in physical space.
- **Environment Probe :** It is a means for generating a map of cubes to represent a particular area of the physical environment.
- **Meshing :** Generate triangular meshes that correspond to the physical space.
- **Collaborative Participants :** Track the position and orientation of other devices in a shared experience AR.
- **Human Segmentation and Occlusion :** Applying distance to objects in the physical world to the 3D content rendering, which achieves physical and virtual realistic combination of objects.
- **Raycast :** A raycast is essentially a ray that is sent from a position in 3D or 2D space and moves in a specific direction.
- **Pass-through Video :** Optimized rendering of the mobile camera image on the touch screen as the background for AR content.
- **Session Management :** Platform-level configuration manipulation automatically when RA features are enabled or disabled.

1.2. Platform Support and Feature Support per Platform:

AR foundation does not implement any AR features on its own, instead, defines a multi-platform API that allows you to work with functionality common to multiple platforms.

ARFoundation parts/features which are relevant on ARCore and ARKit:

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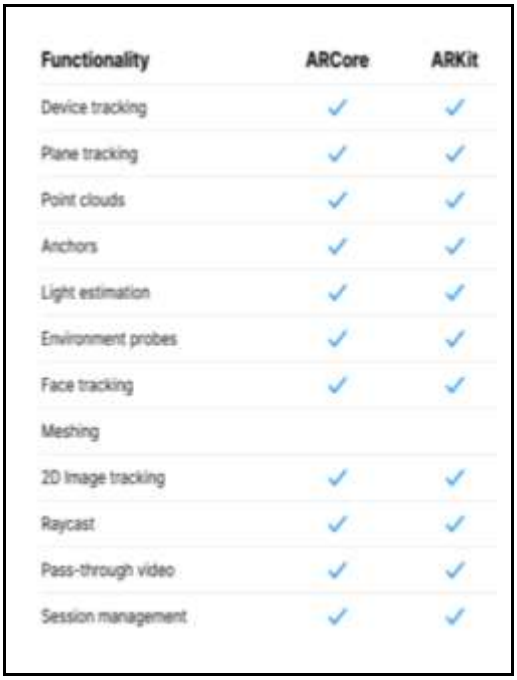

Functionality	ARCore	ARKit
Device tracking	✓	✓
Plane tracking	✓	✓
Point clouds	✓	✓
Anchors	✓	✓
Light estimation	✓	✓
Environment probes	✓	✓
Face tracking	✓	✓
Meshing		
2D Image tracking	✓	✓
Raycast	✓	✓
Pass-through video	✓	✓
Session management	✓	✓

Fig.3 Unity's ARFoundation features supported by ARCore and ARKit

1.3. Subsystems

Subsystems are the base of ARFoundation. It is a platform-agnostic interface for surfacing different information. The AR Subsystems package has AR-related subsystems and uses the namespace Unity Engine. XR.ARSubsystems. Each Subsystem handles specific functionality.[12]

2 ARCore

In 2014, Google released its first Tango SDK dedicated to augmented reality, it needed a smartphone equipped with a depth-sensing camera to work. Tango's particularity was to allow its users to map environments in 2D and 3D. Lenovo Phab 2 Pro was the first commercial smartphone with Tango technology. Asus Zenfone AR, announced at CES 2017, was the second commercial smartphone with Tango technology. It ran Tango AR and Daydream VR.But this project did not last longer because it required some special essential sensors in smartphones that were not there by default. And in the meantime, Google and its competitors like Apple have figured out ways to bring AR features to phones with just the hardware that's already built in.

Google launched its Augmented Reality Project, ARCore in March 2018. Unlike Project Tango, ARCore is usable on smartphones (Android versions 7.0 and above). But it is still based on Project Tango with fewer features that do not require any special camera [13][14].

2.1. Main Features

- **Motion tracking :** Motion tracking feature of ARCore uses the phone's camera and allows the phone to understand and track its position as well as its orientation relative to the world.
- **Environmental understanding :** It allows the phone to detect the size and location of all types of surfaces : Horizontal, Vertical and angled surfaces like the ground, a table or walls.
- **Light estimation :** It allows the phone to estimate the environmental lightning conditions.

2.2.Result

To test ARCore, we chose to work with POCO F1 smartphone, using Unity for development and C# as a programming language.

1) Feature points :

ARCore scans the environment and visually detectsdistinct entities in the images are called key points/feature points and use these points to calculate their change in location.

2) Plane detection :

ARCore searches in the scene for groups of key points that can build horizontal and vertical plans, it can also determine the boundaries of each plan.

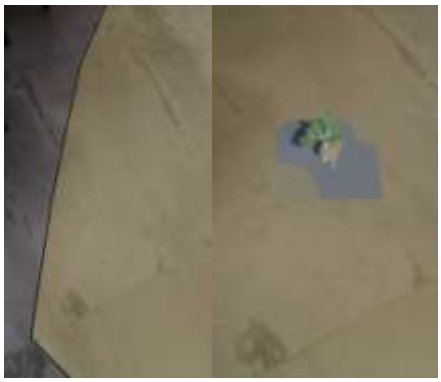

Fig.4 Plane detection using ARFoundation and ARCore in the device

3) Image tracking :

Users can create augmented reality experiences pointing your phone's camera at specific images that havepreviously saved in the application database.

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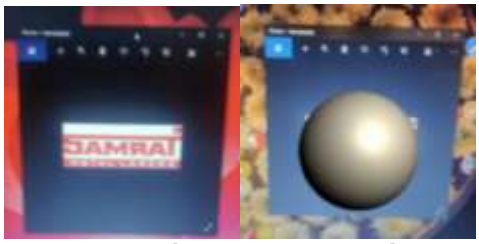

Fig.5 Image Tracking using ARFoundation and ARCore in the device

4) Light estimation :

Light estimation in ARCore allows the phone to estimate the environmental lightning conditions and give its user a realistic experience.

Fig.6 Light estimation using ARFoundation and ARCore in the device

3. Efficiency

We tested our application on an android device and concluded the following factors :-

1) Time to detect the plane :

Minimum Time : 4 sec

Maximum Time :10 sec

Average Time : $\frac{\text{Minimum Time} + \text{Maximum Time}}{2}$

$\frac{4+10}{2}$sec = 7 sec

2) No of objects placed :

Max Object Placed : 9

Min Object Placed :2

3) Scanned Area :

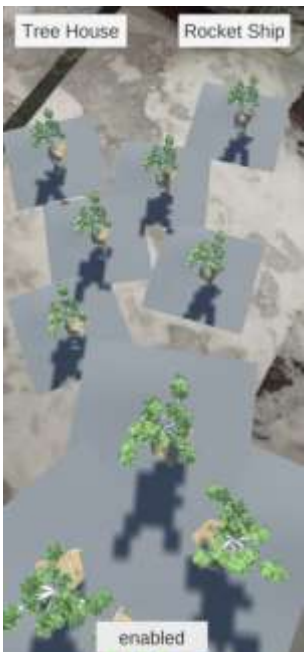

Fig.7 Objects placed on scanned area

From above screenshot we can infer that the size of the screen of the device we are using will determine the area scanned. Therefore these two factors are dependent on each other and thus we were able to place 9 objects within the scanned area. The resolution of the camera will determine the picture quality of the generated object.

II. CONCLUSION

It is very fair that AR can be deployed for many eventual conveniences. Given how harsh and rough 2020 is. Gartner, who indicated in a 2019's predictions report that by 2020 up to 100 million consumers are expected to use augmented reality in their shopping experiences, was right.

As for the investment front, existing technologists are investing in the next-gen digital viewing format and should reap handsome rewards if it continues to take off. Facebook is one of the leaders of AR/VR moment via its Oculus subsidiary, The Oculus Rift headset (which requires a PC) and the Quest headset (a freestanding unit) are best-known for video game and entertainment use, but the business world is also a fast-growing application. The Oculus for Business platform includes a Quest headset, helping organizations put together virtual training modules and build collaborative work environments. In fact, IDC (International Data Corporation) thinks half of global AR/VR spending this year will be for commercial use and come close to surpassing virtual entertainment use for the

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first time. AR/VR training is expected to grow at a more-than-60% rate through 2023 and become the largest sub-segment of the industry. EA already has a library of games that feature a VR mode, like those accessed via Sony's PlayStation VR or an Oculus headset. But investment in AR/VR game modes is picking up pace. EA has announced a handful of titles that were built from the ground up to be used with a virtual headset.

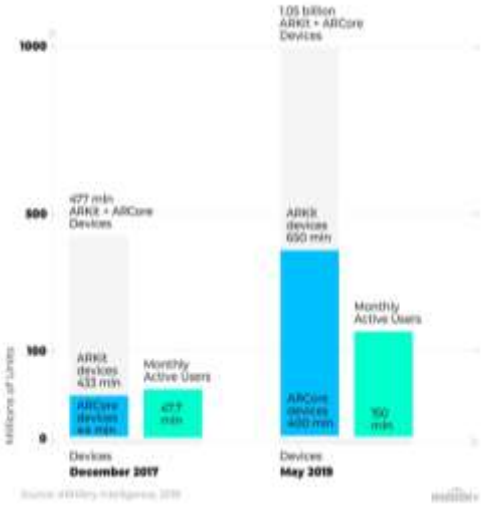

Fig.8 Mobile AR installed Base: ARKit + ARCore

5G mobile network technology represents an opportunity to accelerate the adoption of AR and VR in stores. Gartner's recent 5G enterprise survey indicated that AR/VR applications of 5G attract the highest expectations for becoming drivers of new revenue, across all use cases and respondents. 5G capabilities can support multiple use cases, such as real-time rendering for immersive video, shorter download and set-up times, and extension of brands and shopping experiences beyond stores.

"Gartner expects that the implementation of 5G and AR/VR in stores will transform not only customer engagement but also the entire product management cycle of brands," said Sylvain Fabre, senior research director at Gartner. "5G can optimize warehouse resources, enhance store traffic analytics and enable beacons that communicate with shoppers' smartphones." [15][16]

Fig. 9 AR credit Card

For the AR assisted subsequent implication, we have an example of an AR credit card (Fig.8). This credit card can be viewed under an application which enables us to view our balance and timely expenditures. The card is interactive with sophisticated application-like User Interface and rich User Experience.

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