Extended Reality in Industry 4.0 (ERI)

Lecture 10: Augmented Reality using Vuforia

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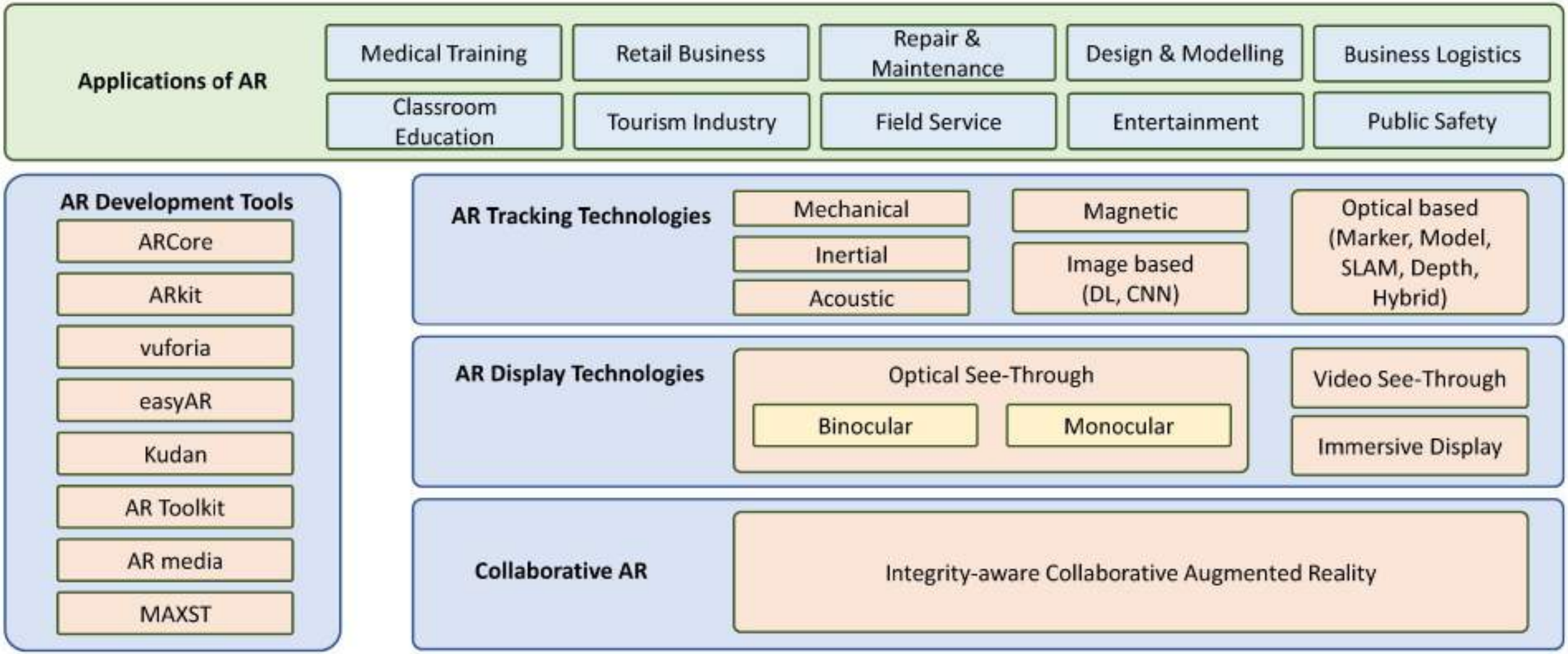
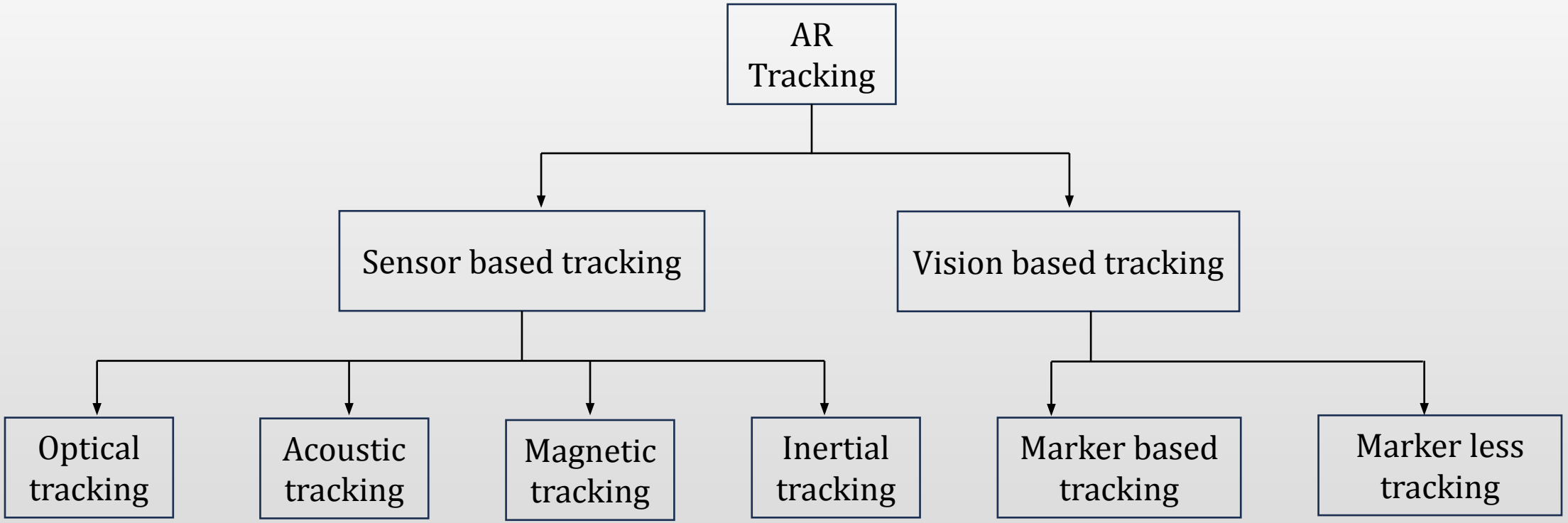
AR applications, tools and technologies




AR Tracking
Sensor based tracking
Vision based tracking
Optical tracking
Acoustic tracking
Magnetic tracking
Inertial tracking
Marker based tracking
Marker less tracking

Vuforia Engine

Vuforia engine is a software development toolkit (SDK) to build augmented reality (AR) applications. It offers a variety of trackable targets to bring the virtual objects in the real world by recognizing the targets and enables the user to interact with virtual objects in AR.

List of Vuforia supported devices for AR applications:

- iPhone
- iPad
- Android
- Universal Windows Platform (UWP) devices
- Eyewear

List of targets provided by Vuforia:

- Image target
- Cylinder target
- Multi target
- Model target
- Object target (3D scanned)
- VuMark
- Area target
- Ground plane
- Cloud recognition

Image Target

- Image target represents the images which can be detected and tracked by Vuforia engine.
- Vuforia engine detects and tracks the physical image captured by the camera by comparing the natural features of the camera image against the target resource database.
- Once the image target is detected by the camera, Vuforia engine tracks the physical image and augments the virtual content over the real image.

Fig. 1. Virtual astronaut augmented on the Image target

Supported formats

The image targets can either be used from the image assets of the Vuforia engine package or created with Vuforia Target Manager using JPG or PNG images in RGB or grayscale.

Fig.2 (a). Image target from the image assets

Fig.2 (b). Image with natural features

Fig.2 (c). QR code for image target

Attributes for an ideal image target

Fig.3 (a). Features

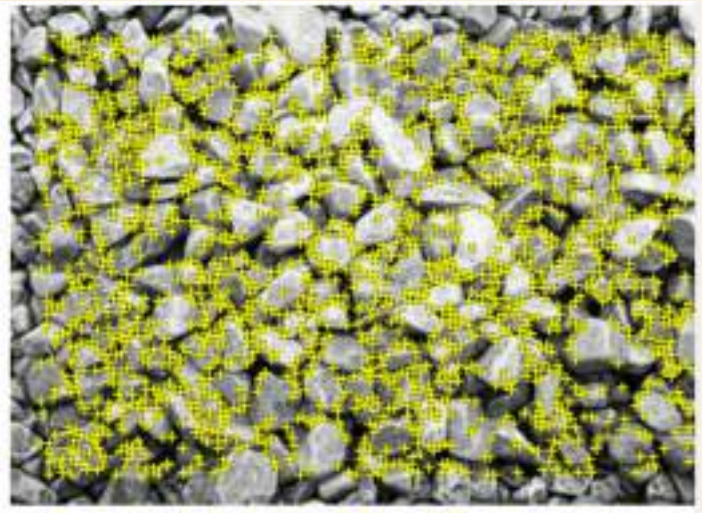


Fig.3 (b). Rich in detail

Fig.3 (c). Good contrast

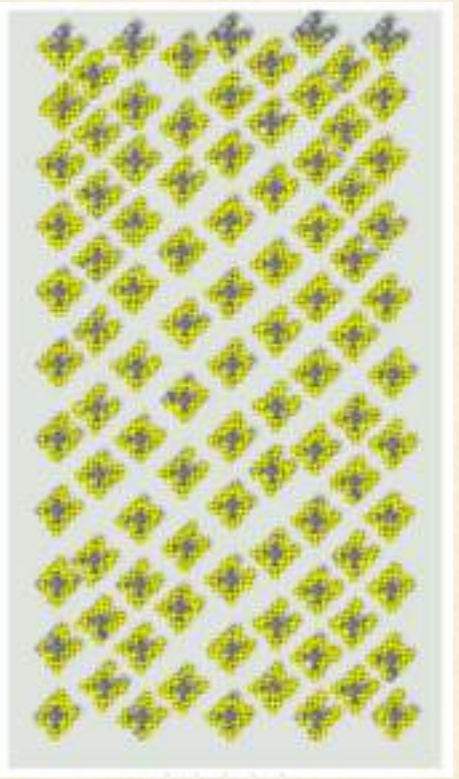


Fig.3 (d). No repetitive patterns

Attributes for an ideal image target

Fig.3 (e). Organic shape with round and soft details

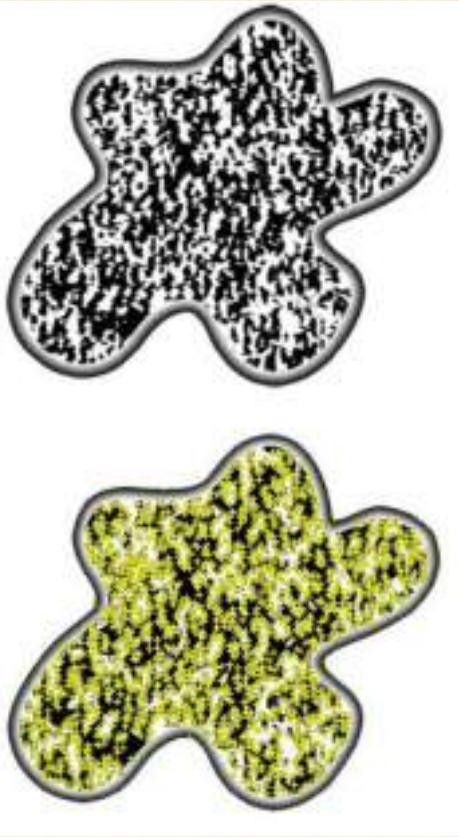


Fig.3 (f). Non-Rectangular image target

Fig.3 (g). Feature distribution

https://developer.vuforia.com/library/objects/best-practices-designing-and-developing-image-based-targets

Physical properties of image targets

Print material – To keep the object in focus, the use of flexible piece of paper should be avoided. A hard material such as card stock, plastic or paper fixed to a non-flexible surface should be used which ensures the flatness of the marker.

Size – The printed image target should be at least 12 centimetres in width with reasonable height. The size of the target varies based on the distance of the target from the camera. The size of the target should be 1/10 of the distance between target and camera.

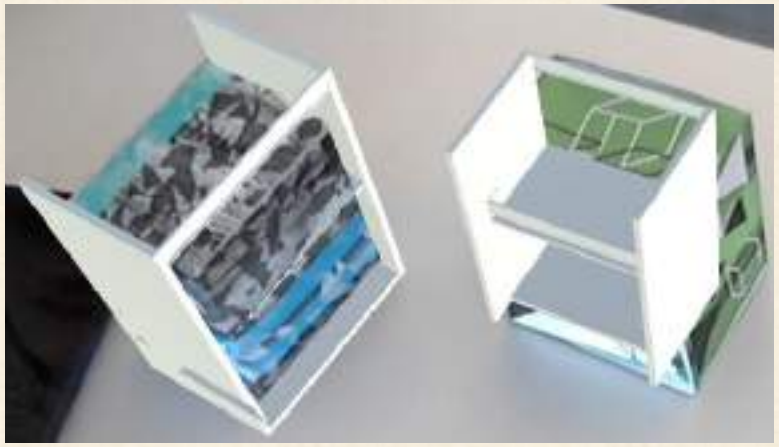
Surface finish – The printed image targets should not be glossy. Under certain angles, light sources can create glossy reflection which may cover a large part of original texture of the printed image.

Fig. 4. Image with glossy reflection.

Multi Target

Multi targets are the combination of image targets defined in a geometrical arrangement such as boxes or cuboid. This allows the detection and tracking of object from all the sides. Due to the three dimensional arrangement of the images, all the faces of a multi target can be tracked at the same time.

(a)



(b)

(c)

Fig. 5. (a) and (b) Augmentation of virtual object on the multi target, (c) augmentation of the virtual faces on the real faces of the cuboid and (c)

Object tracking methods

Object tracking method allows the camera to detect the physical objects by its geometry and overlay a virtual content on the real object.

There are three types of object tracking methods:

1. **Object target** – Object targets are created by scanning the physical object from all the directions. The physical object is placed on a printed image target while scanning. The generated object data file is uploaded on Vuforia Target Manager which is used for tracking the real object.

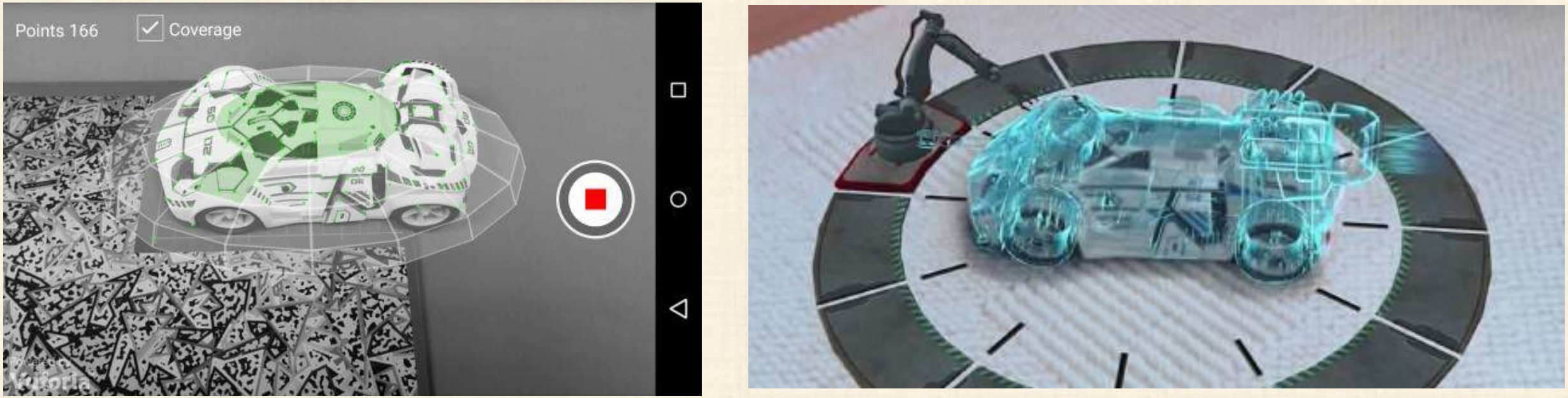


Fig. 6. (a) Scanning the physical object by placing on a marker and (b) Augmenting the virtual content on the physical object after detection.

Object tracking methods

2. Model target – It requires a CAD model of an object and its physical counterpart. The CAD model of a physical object is imported to the Model Target Generator to generate the model target. Vuforia uses the model target to detect the real object and augment the virtual content on it.

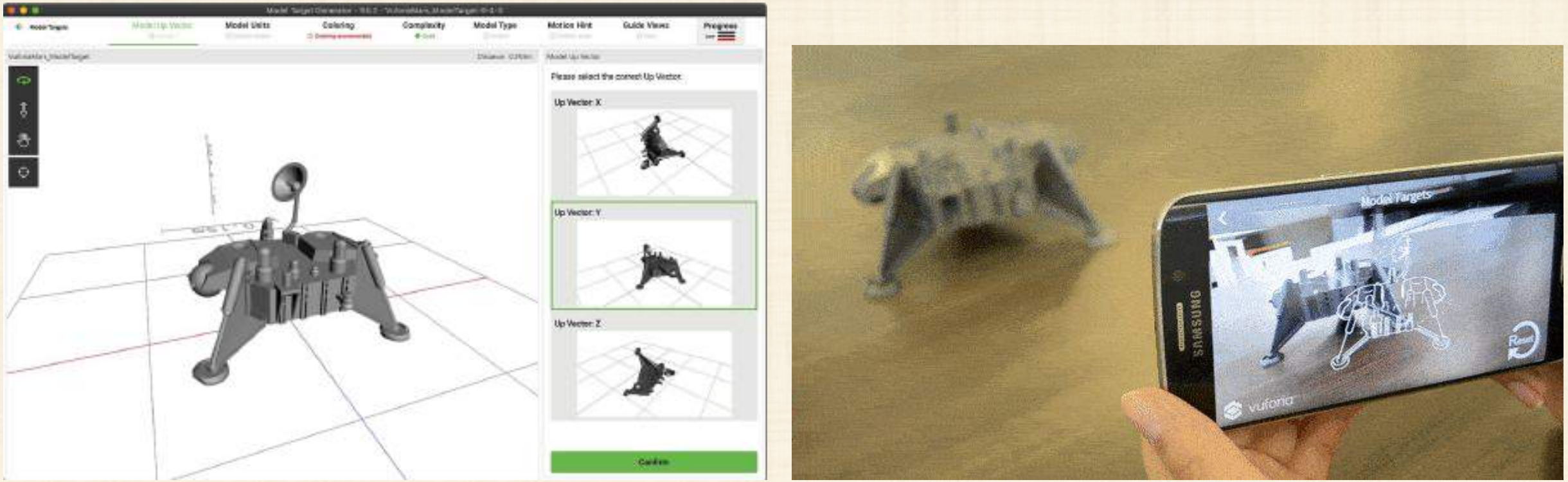


Fig. 7. (a) Importing the CAD model to the model target generator and (b) Augmenting the virtual object on the physical object after detection.

Object tracking methods

3. Model target from 3D scan – When the CAD model of the object is not available, a mesh can be created from 3D scan. The model targets are generated from the 3D scan of the real object by using hardware aided scanning with occipital structure sensor.

Fig. 8 (a). Model target generated from 3D scan.

Fig. 8 (b). Detection of physical object.

Cylinder targets

Cylinder targets enable the camera to detect and track image targets wrapped into cylindrical or conical shape. Soda cans, coffee cups, drum container and beverage bottles are suitable objects for cylinder targets. Vuforia can track the sides,flat top and bottom of the cylinder target.

Fig. 9. Augmentation of an animation on Cylinder target .

Ground plane

Vuforia ground plane enables digital content to be placed on the horizontal surfaces in the environment, such as floors and tables. It supports detection and tracking of surfaces and also enables to place virtual content in mid-air using Anchor point.

Fig. 10. Augmentation of virtual object on the ground surface to the specified location by the user

Area targets

Area target is an environment tracking feature enables to track and augment areas and spaces. A 3D scanning devices such as Matterport Pro2 3D camera, ARKit devices with LiDAR sensors can be used to scan the environment and create the area targets. The virtual content can be augmented to the stationary objects in the scanned environment.

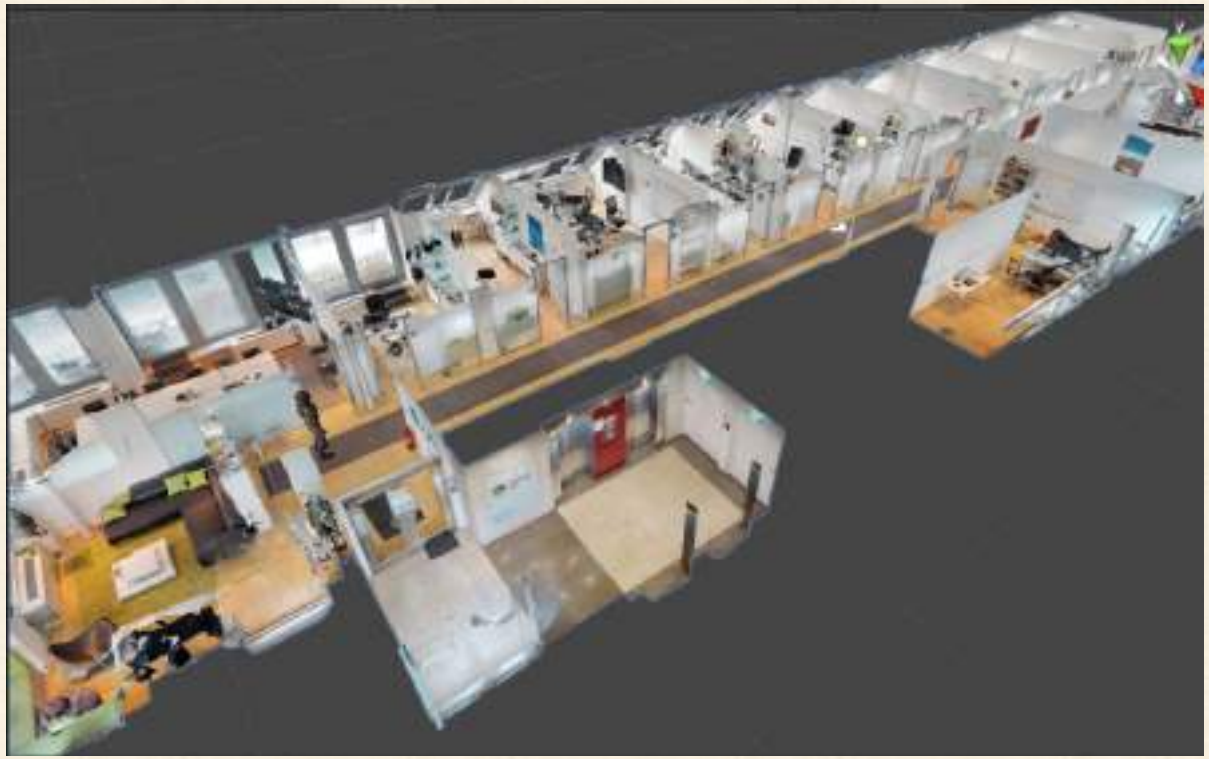
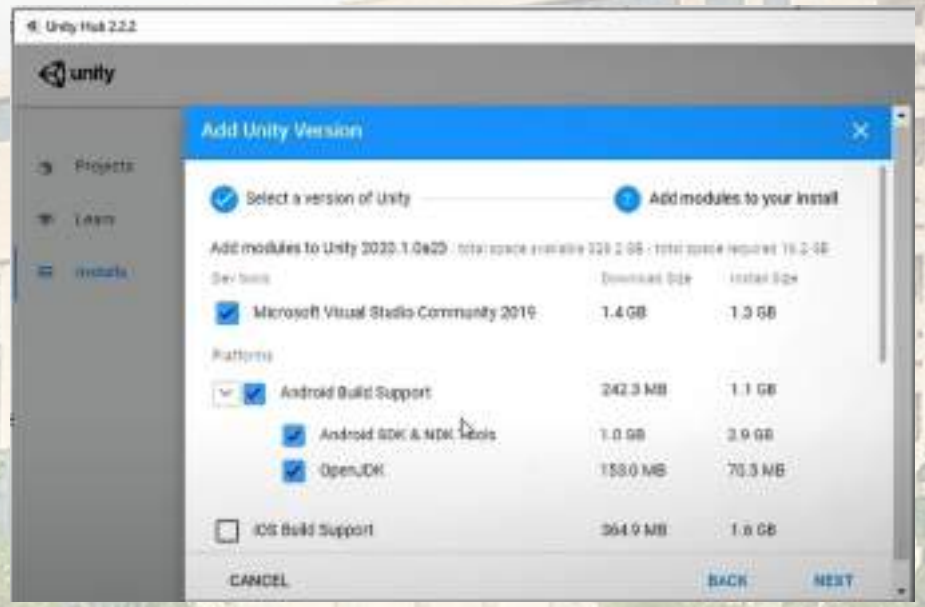


Fig. 10 (a) 3D scan of an area and (b) augmentation of virtual content in the scanned area.

Vuforia installation

Steps:

1. Install Unity version 2020.3.1f1 (later 19.2) by checking the Android build support.

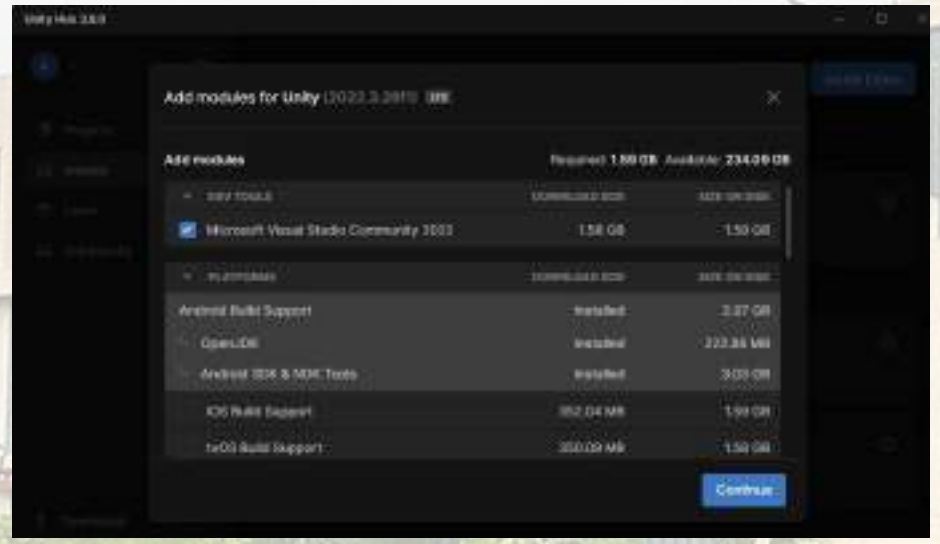


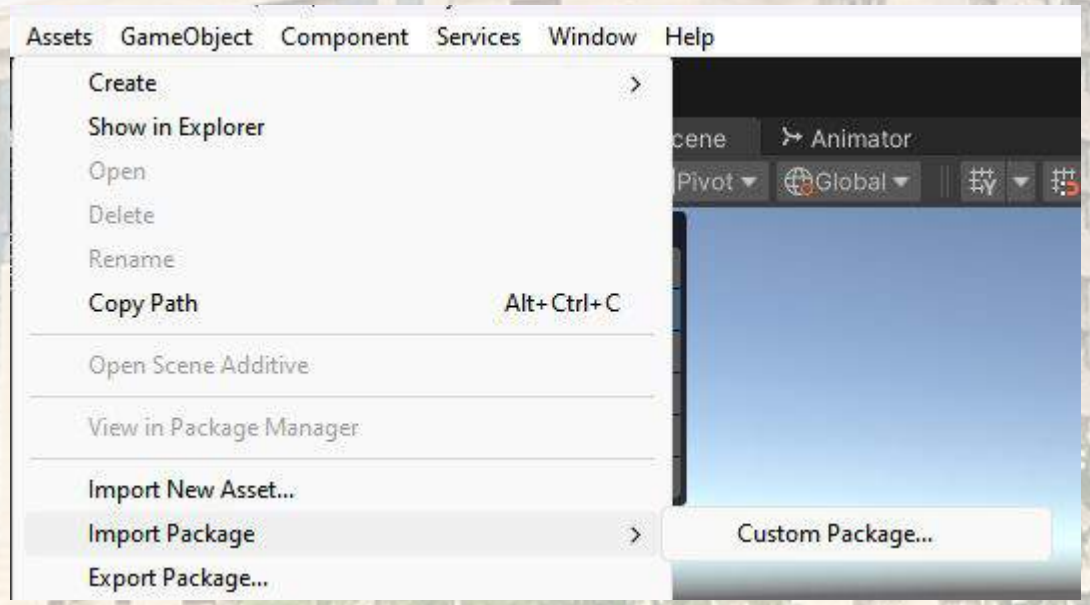
2. Go to the webpage by clicking the link"https://library.vuforia.com/articles/Solution/vuforia-engine-package-hosting-for-unity.html".

Vuforia installation

Steps:

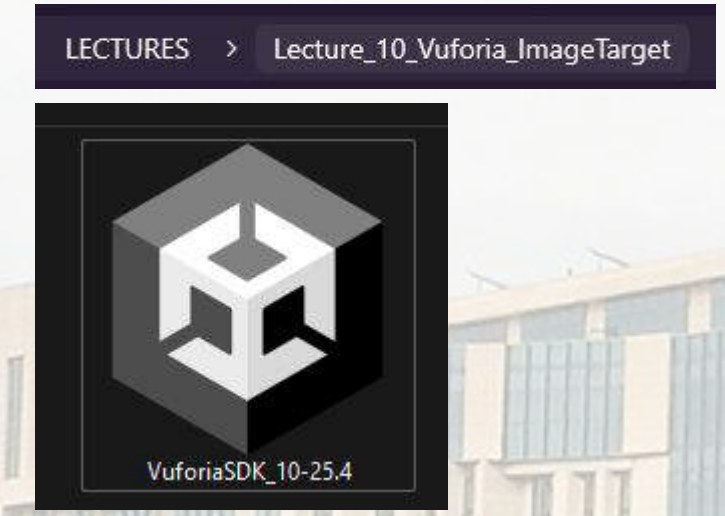
1. Install the latest version of Unity by checking the Android build support.



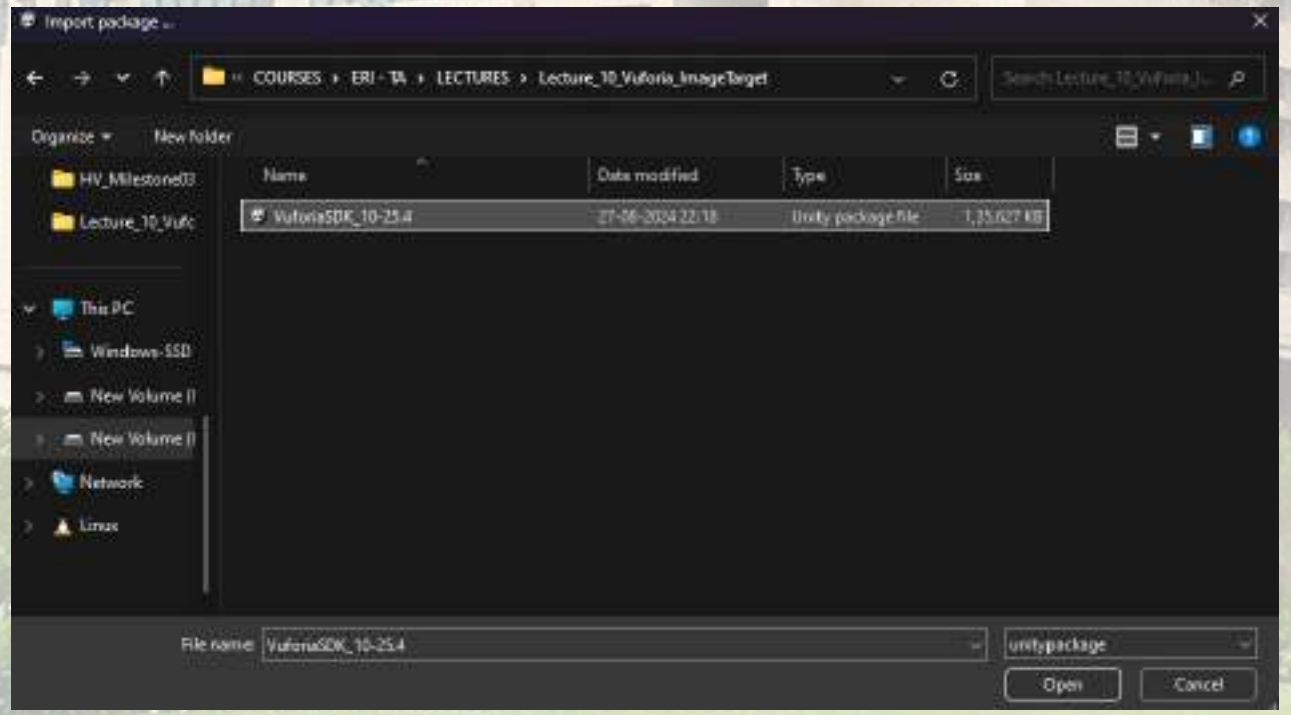


2. Find the option under Assets > Import Package > Custom Package.

3. Navigate to the location where you've downloaded the Vuforia SDK

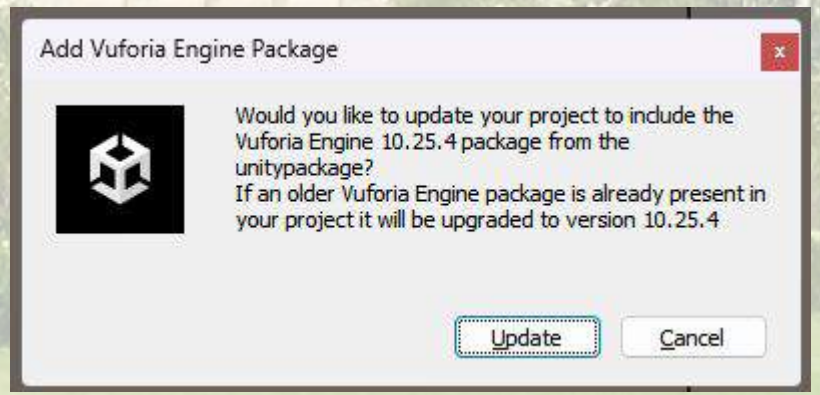


4. After you select and hit open.

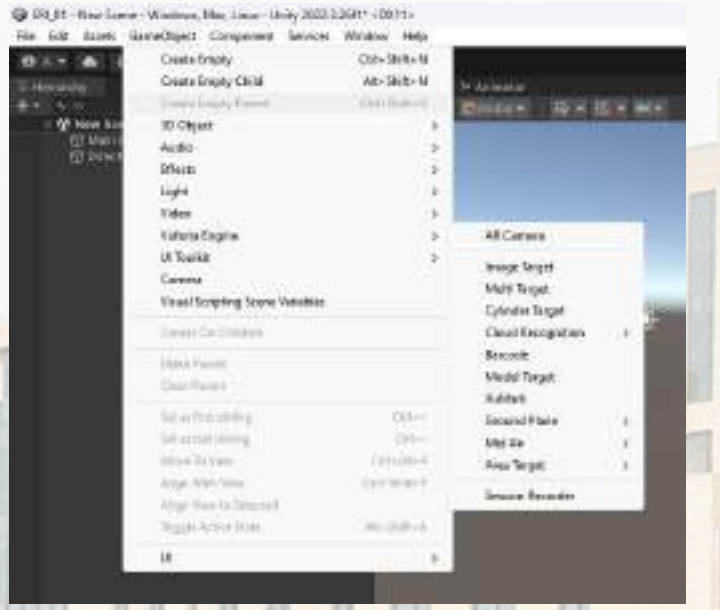


5. Click on “Import”.

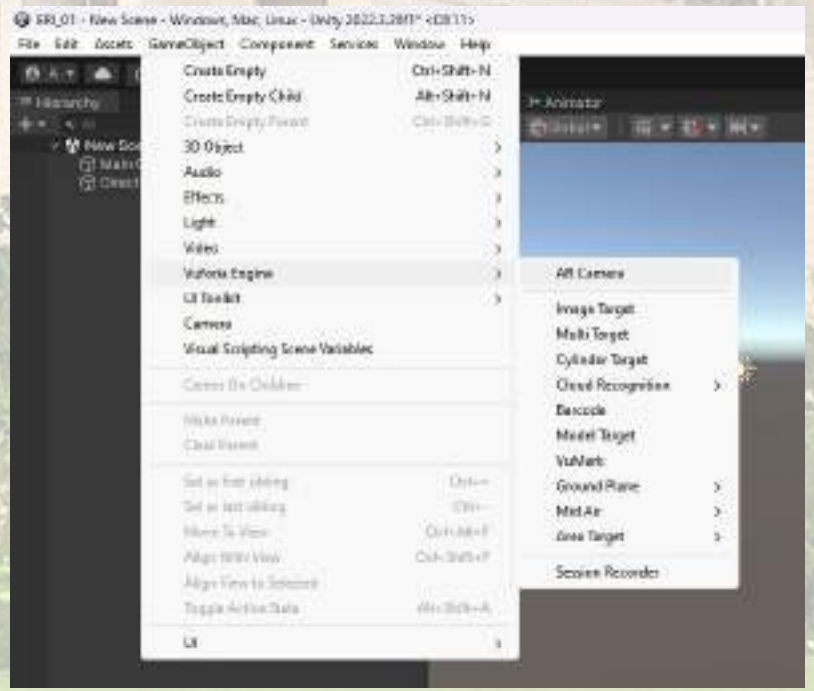
6. Select Update.



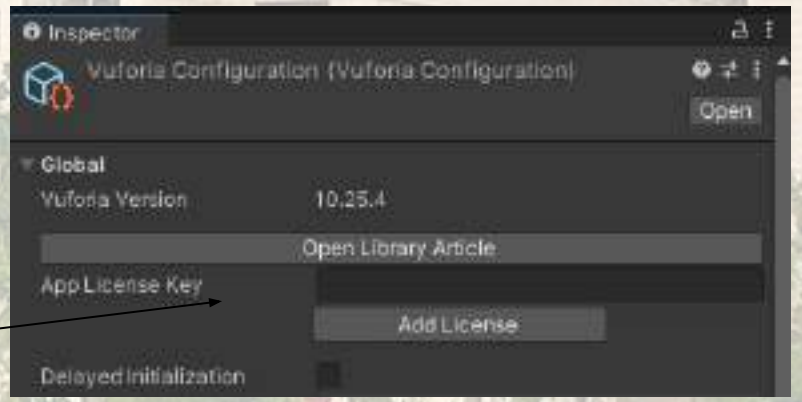
7. After importing Vuforia to Unity, find the Vuforia option in the “GameObject” menu.



8. Delete the “Main Camera” from the scene and add “AR Camera” from the Vuforia menu.

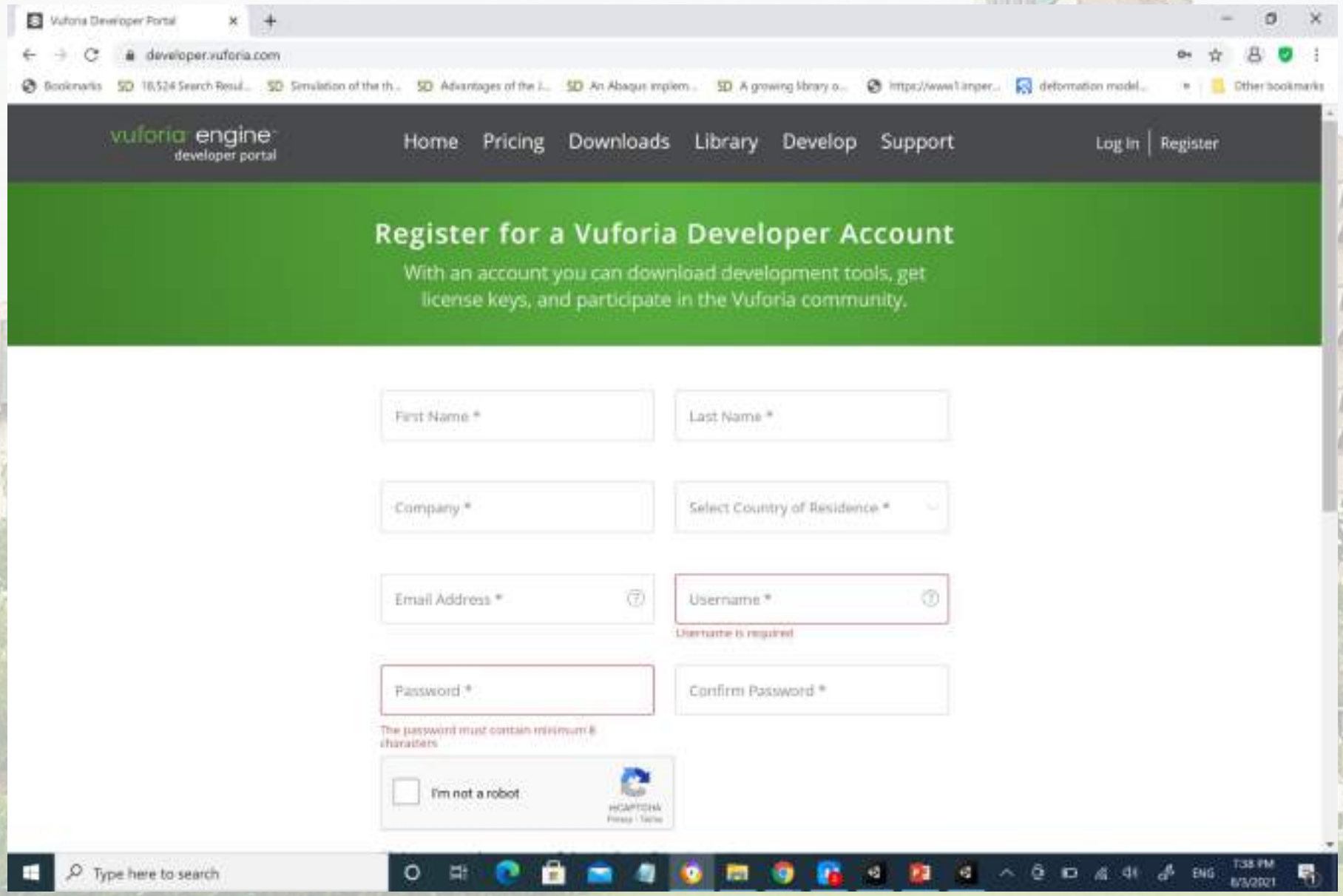


9. Click “Open Vuforia engine configuration” under the “AR camera” gameobject.

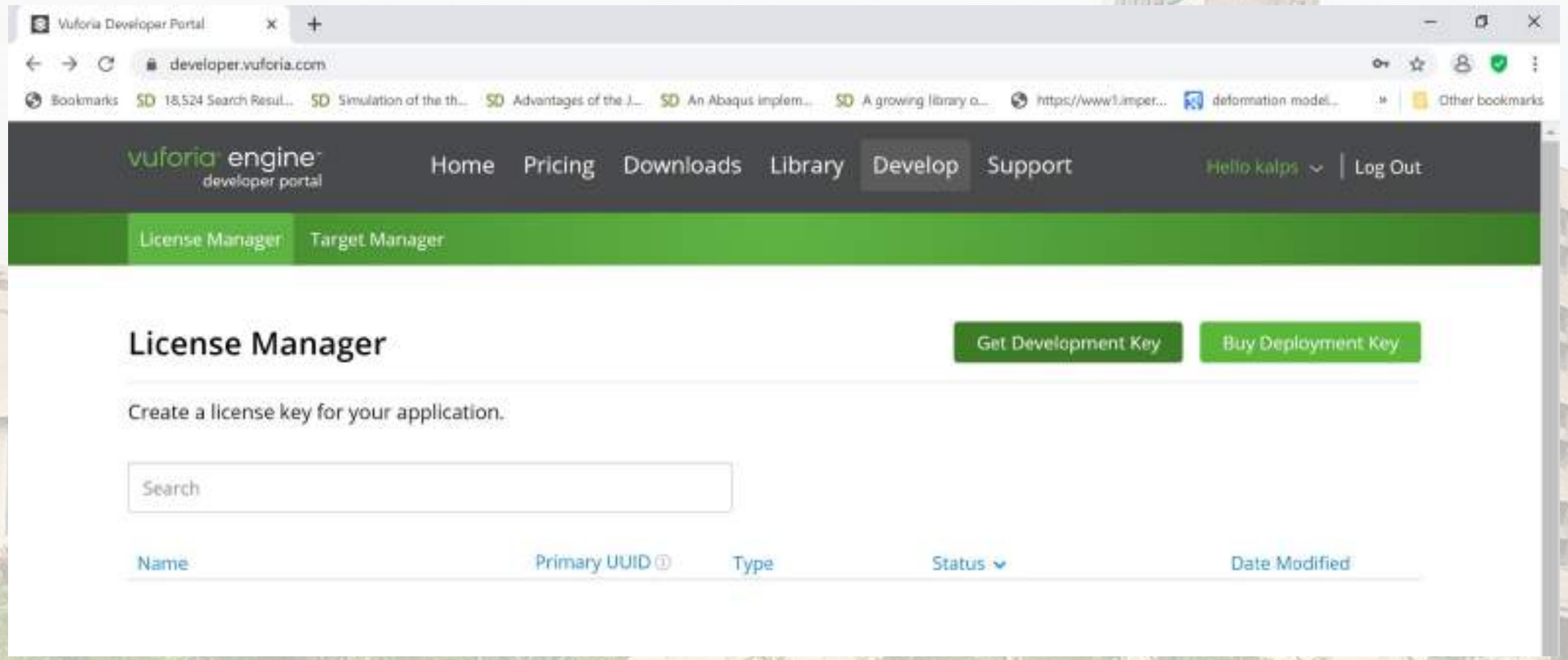


10. Click the “Add license” button.

11. To obtain the license key, register on vuforia engine developer portal.

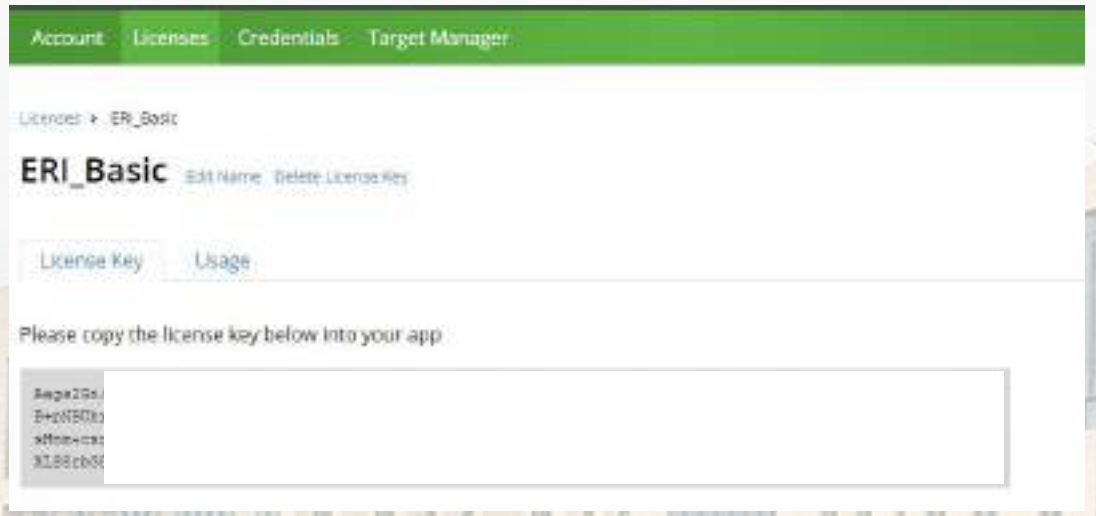


12. Log in to your vuforia account and click “Get Development Key”.



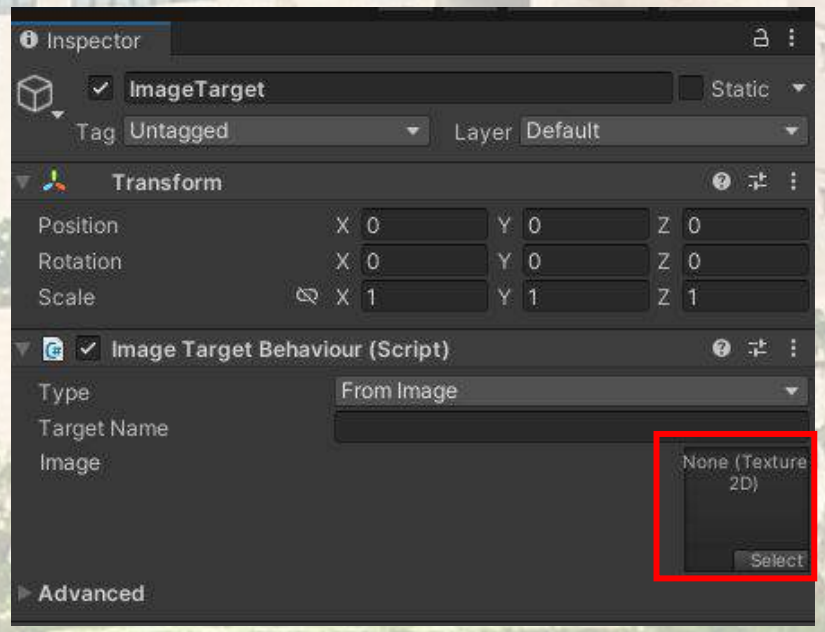
13. Create the development key with any License name and uncheck the box for terms and conditions. Then click confirm.

14. Copy the License key as below and paste to the Unity.



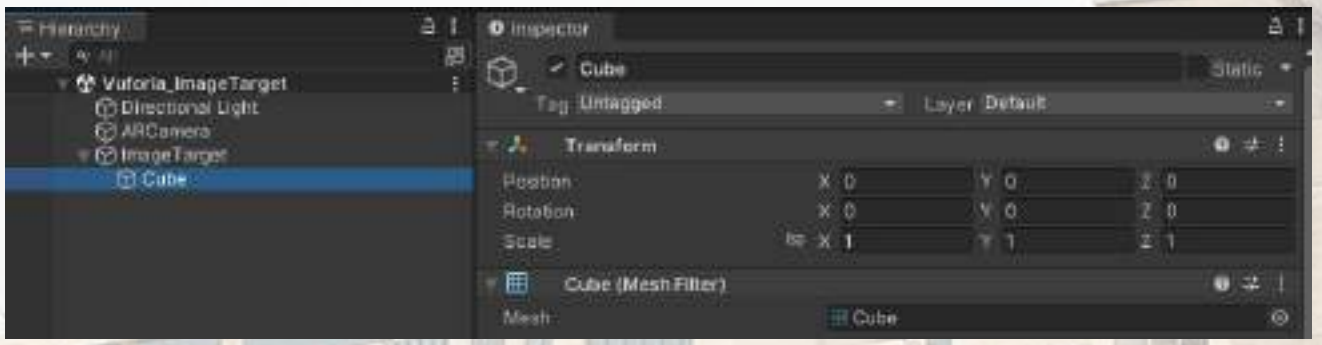
15. Add “Image target” –> Marker_Vuforia to the Assets >Resources under Project.

16. Add the Image Target from GameObject > Vuforia Engine > Image Target

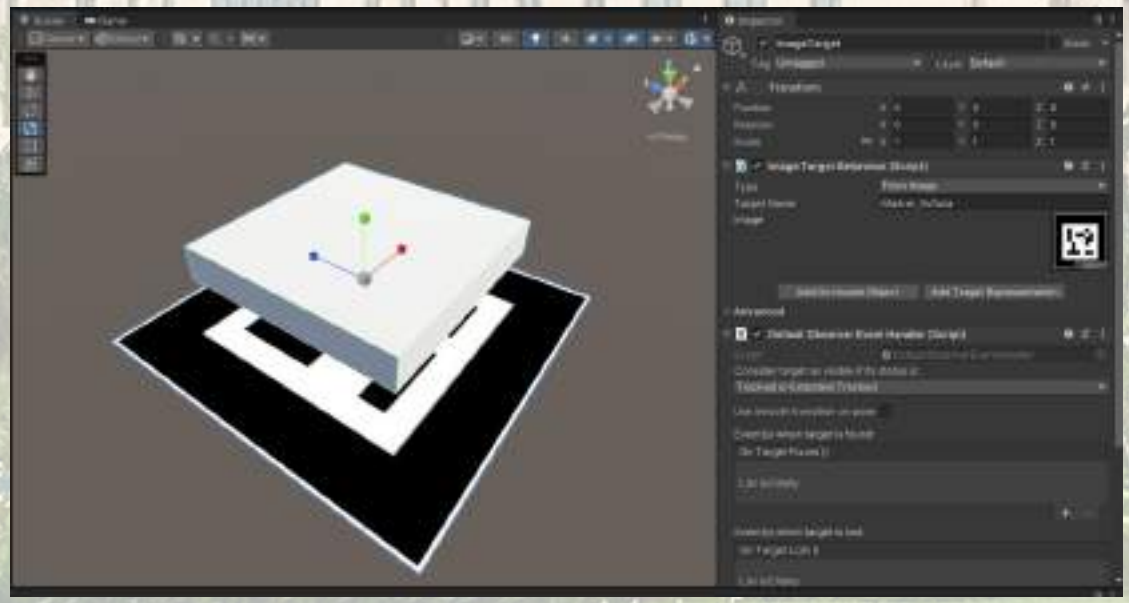


17. Choose ”Marker_Vuforia” or any other marker image and drop to the Image.

18. Create a gameobject “Cube” and make it as a child of “Image Target”.

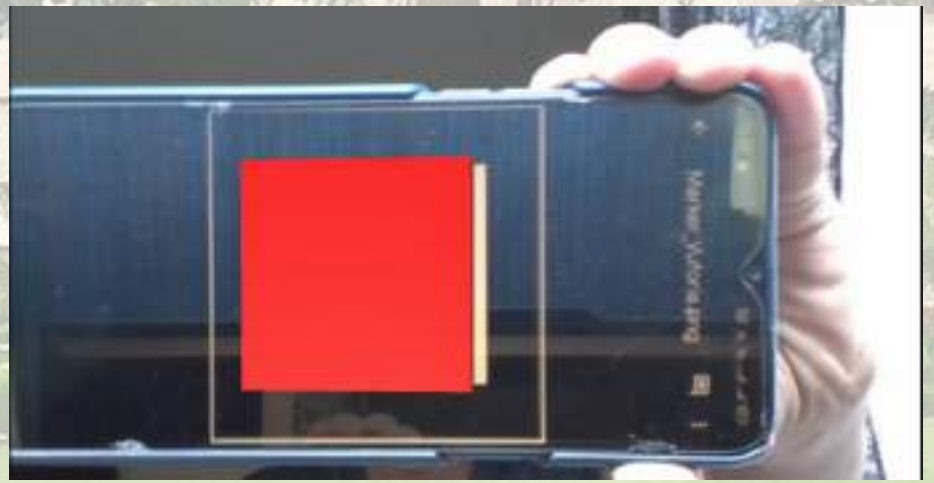


19. Change the Transform values of the “Cube” to adjust the marker borders.

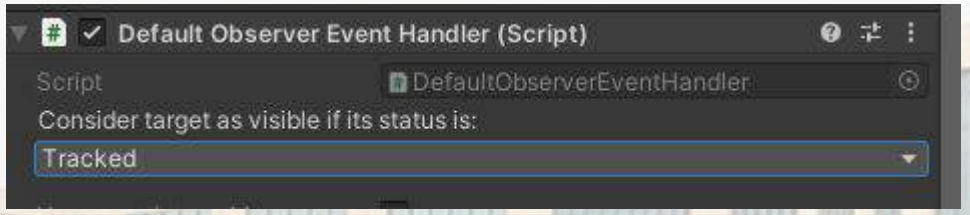


20. Use the printed marker or download the marker image on cellphone.

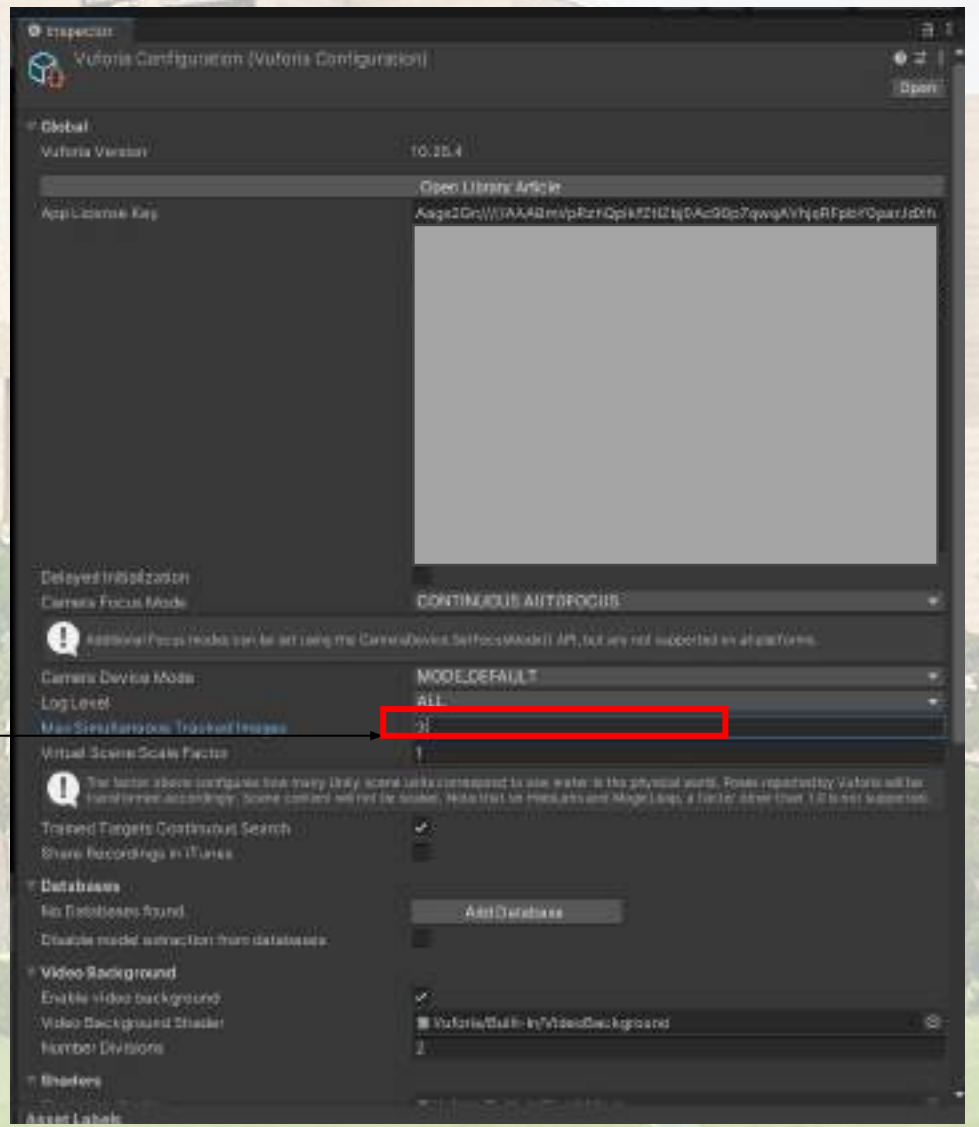
21. Hit the play button and put the marker in front of the camera of your device to track the virtual gameobject (Cube).



22. To disable the “Extending tracking,” check the “Tracked” from the “Image Target.”



23. For multiple object tracking, enter the number Of Image targets in “Max Simultaneous Tracked Images” section of “Vuforia Configuration”.



Example 01: AR application for Engineering Machinery.