

Yulin Khoo

AR-tificial Perception

The camera lens is the entrance into your
desired world



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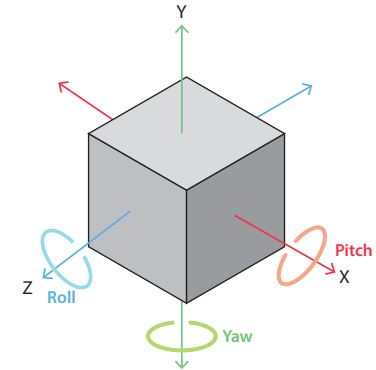
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An individual's creative imagination can be brought to life through the power of **Augmented Reality (AR)**. With a simple touch of the screen and movement of the camera, an entrance into a simulated environment will open. Apple has created the opportunity for individuals to gain easy access into the works of AR just within the palm of their hands. However, the creation of virtual objects is more than what meets the eye, lying within lies complex combinations of data and softwares. So how does this augmented world truly come to life?

ARKit is a development software introduced with iOS 11 (2017), easily enabling developers to incorporate AR experiences into apps. It is a fundamental framework that processes mathematical calculations to detect movement and the environment. ARKit utilises **Visual Inertial Odometry (VIO)** as a system to obtain real-time motion measurements. Accurate measurements are detected through a combination of motion and video data. Through the iPhone's **camera, gyroscope and accelerometer**, the VIO software performs enhanced

depth mapping of the physical surfaces (walls, floors, furniture, etc), in conjunction with the data from the inertial sensors. Accurate location awareness is achieved through **anchor points**, used to optimise world tracking. Anchor points are updated across video frames captured through the camera, allowing virtual objects to remain in the same position whilst maintaining its proportions.

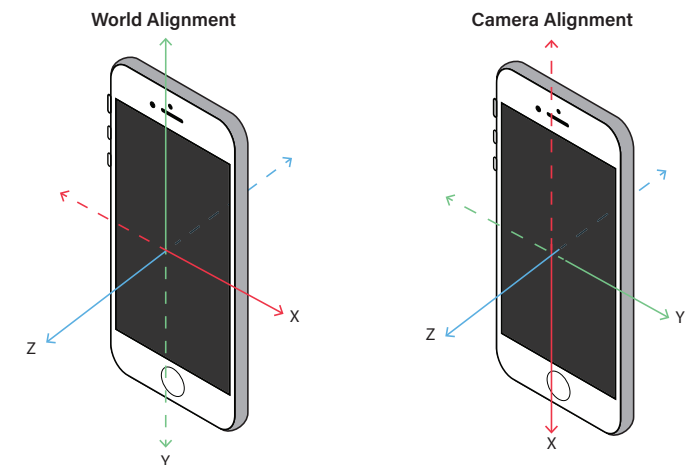
The 3D space is tracked with the **6 Degrees of Freedom (6DOF)**, where an object's position is defined with 3 coordinates of **y, x and z** and the orientation is defined with parameters of **roll, pitch and yaw**. There's a few alternatives that ARKit can base off, such as **world and camera alignment**. With **world alignment**, the y-axis is set in the opposite direction of gravity, thus the camera is placed and stays in the initial position of the device. The camera coordinate is always fixed and the origin of the 3D space remains at the device's starting position. The 3D space in **camera alignment** is dependent on the direction of the camera, unlike world alignment, it provides the ability for the user to walk



6 Degrees of Freedom (6DOF)

Movement (x, y, z) = up/down, left/right, forwards/backwards

Orientation = roll, yaw, pitch



around. With different configurations, AR can be experienced in different ways.

Virtual objects must be refined with **RealityKit**, a high-performance 3D rendering program. This is the process where the virtual objects come to life, implementing **rendering, animation, physics, and audio engine**. Rendering involves the practice of adding shading, colour and effects. RealityKit offers various textures and realistic materials that can be applied to virtual objects, forming realistic displays. To create a more immersive experience, interactive animations and audio added by RealityKit can adjust in accordance with the movement of the user and environment. For example, **spatial audio** is adjusted to follow in the direction that the user is facing, the volume of the sound changes according to the user's distance from the virtual object. As a result of RealityKit, virtual objects are seamlessly overlaid and enhanced into the physical world.

The latest version of ARKit introduces several new and improved features.

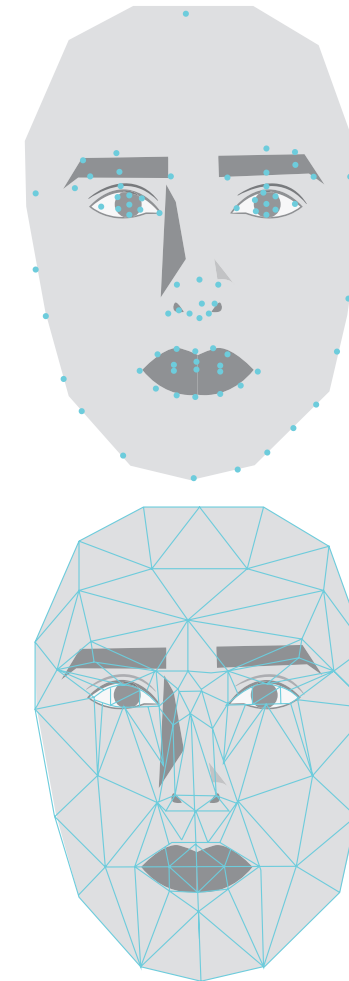
References:

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Location anchors allow augmentations to be experienced on certain sites, positioned with specific measurements of latitude, longitude and altitude. Customised AR creations can be placed on famous landmarks and cities, fully immersing the user in all views and angles. For example, an anchored 3D label is scaled the same size as the Ferry Building in San Francisco. **Face tracking** for AR is available to the front camera, facial feature points are detected to create a mesh on the face. With this feature, users can have a fun and interactive experience with animated facial filters and avatars. Memoji enables users to create a personalised 3D avatar that accurately tracks movements of facial features.

Beneath the creation of a virtual object lies many layers of mathematical calculations and mapping. Softwares like ARKit and RealityKit make this creation process more simple yet high in quality. The digital age is continuing to rapidly grow, the future for ARKit has great potential to become even more advanced.



Face Tracking

Facial characteristics (eyes, nose, lips, etc) detected with points. These features can be identified with the help of shadows and light that shapes the face.

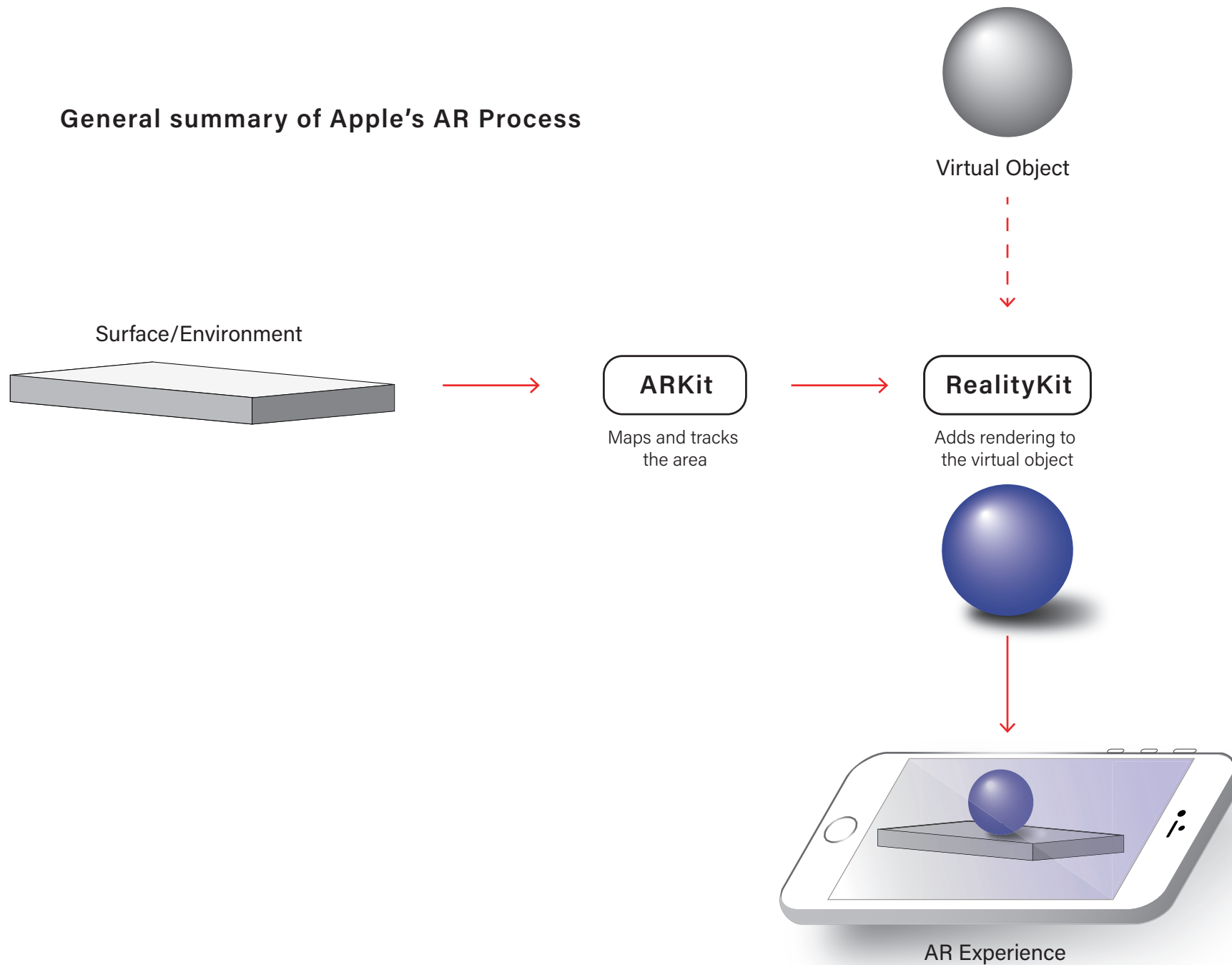
From these points, a mesh can construct the face. With this, the camera is able to track changes in facial expression and head rotation.

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General summary of Apple's AR Process



Anchor Points

Anchor points are added throughout the 3D mapped world. Virtual items placed near the anchor point will be effectively tracked and updated as the camera changes positions.

