MSc - Önálló laboratórium 1

Augmenteted reality using ARKit

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Contents

Chapter 1

Introduction

Smartphones have become a defining part of our days. By now we can't even imagine our everyday life without them. We read e-mails, browse the Internet or monitor daily exchange rates. Now we can do all important things with our phones. Listening to music and watching series, but in terms of photography and video capabilities, they are not far behind cameras designed for professional purposes. Their computing capacity has grown exponentially over the years. The quality of camera systems is also undergoing significant progress every year.Perhaps this is why many people say that the development of telephones is starting to slow down. This industry has reached its peak.

At the time, in 2007, the iPhone was considered a huge world sensation and now we know it was a world-changing announcement. At the time of writing this report, there are several reports that Apple is working on the introduction of a similarly large and decisive new product line. The so-called Apple AR/VR glasses. Only time will tell if this really happened until then I thought that it would be a great advance if I started familiarising with this technology. If this will be the next ”touchscreen phone era”, I thought it would be worthwhile to start dealing with it in time. Regardless, I have long been interested in the technology's operating principle and scope of use. From the consumer side, what kind of application possibilities does augmented reality technology have? At that time, I wanted to implement a similar augmented reality-like navigation system in my own high school navigation application. Unfortunately, I did not know about the existence of these technologies at the time.

As I mentioned in the first paragraph, today's phones have a huge computing capacity. This is also why it is possible for such augmented reality applications to run on our phones. Based on the 1 or better case 2 or 3 lenses placed in the phone, it can measure the 3D depth of each scenario. There are phones, such as the iPhone 13 Pro, which have a laser LiDAR sensor placed specifically for this purpose. In the 2010s, many devices with similar technology came out, such as Microsoft's Kinect developed for the X-Box 360 console. It is also worth mentioning Google Glass developed by Google or HoloLens and HoloLens 2 marketed by Microsoft. Unfortunately, the former mentioned Google Glass was not an undivided success and in 2023 the sale of the glasses was discontinued.

Last but not least, it is important to mention the Oculus Quest 2 VR headset introduced by Meta and the computer use and games based on it. In addition, the Metaverse, announced by Meta 2 years ago, is also an important milestone in the life of virtual reality and therefore also in the life of augmented reality.

As the examples above clearly reflect, it will be an important and presumably defining technology in the future. In light of this, during my self-lab, I got to know the ARKit and RealityKit developed and used by Apple. And with the help of the frameworks, I developed an augmented reality application displaying economic metrics. And during the report I used LaTex, because I felt it was time to familiarize myself with this kind of documentation language.

Chapter 2

Current techologies

Before I started the development of the application I have done a research period to have a better overview of the current market. There are several frameworks to choose from to start developing augmented reality applications. The most used AR frameworks are Google ARCore, Apple ARKit and RealityKit, Simple CV and Unity AR Foundation. I ended up using Apple ARKit to build my app. I've been working with iOS development for several years and I'm sure with the Swift language as well.

2.1 Unity

One of the main frameworks that we can use if we want to develope augmented reality application is Unity. Unity is a purpose-build framework for augmented reality development. It's key feature is that with the framework developer can easily deploy it's product across multiple mobile and wearable AR devices. It includes core features from ARKit(Apple), ARCore(Google) and HoloLens(Microsoft) as well unique features.

AR Foundation which is the recommended framework for Unity development there are several features what the developers can use like:

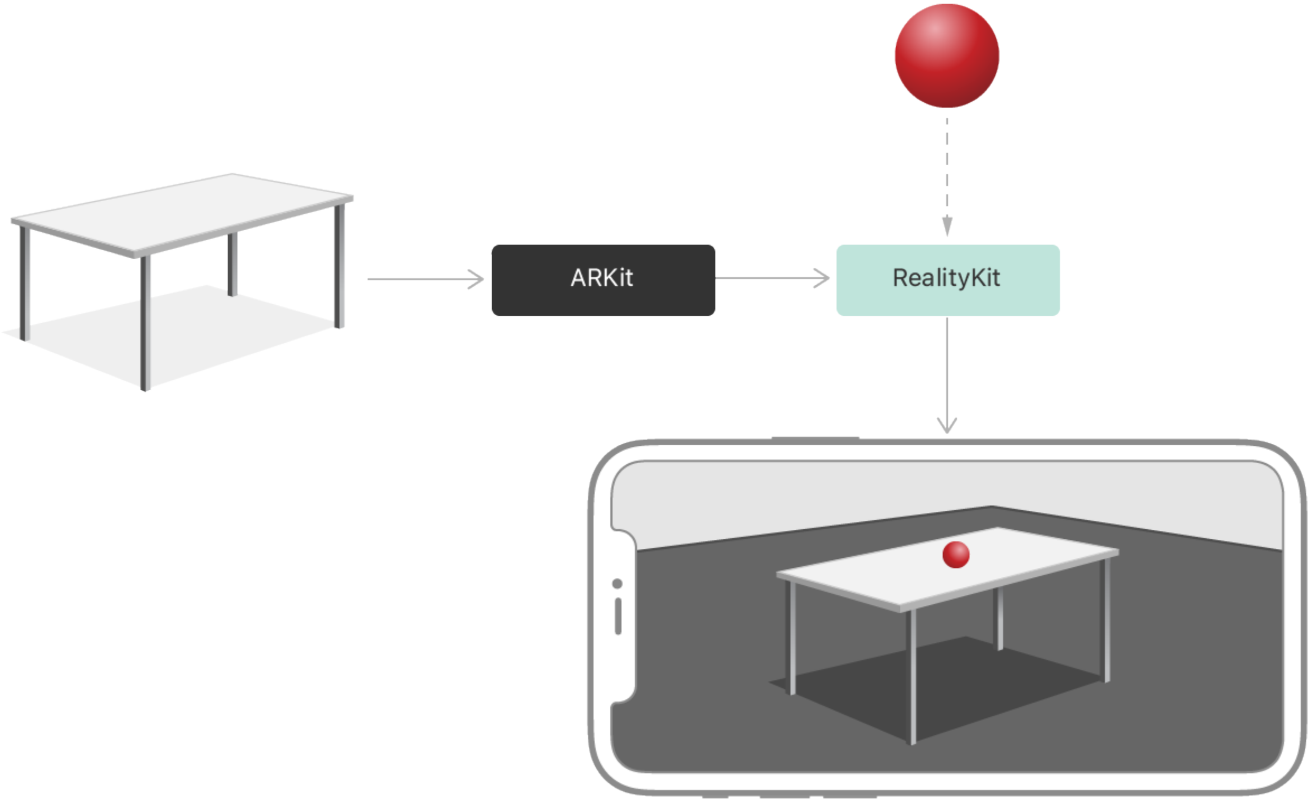
- Device tracking
- Raycast
- Plane detection
- Gestures
- Face tracking

2.2 Apple ARKit and RealityKit

Apple ARKit and RealityKit are two powerful technologies developed by Apple that enable the creation of immersive augmented reality experiences on iOS devices. ARKit is a software framework that provides developers with the tools and resources they need to build augmented reality apps for iPhones and iPads. It allows developers to easily place virtual objects in the real world, track the user's position and orientation, and integrate real-time camera data to create realistic and interactive experiences.

On the other hand, RealityKit is a high-level framework that makes it easy for developers to create 3D content and build AR experiences without requiring extensive knowledge of 3D graphics or game engine programming. RealityKit includes features such as physics simulations, animations, and spatial audio, which can be used to create highly immersive AR experiences.

Together, ARKit and RealityKit provide developers with a comprehensive set of tools for building augmented reality experiences on iOS devices. With these technologies, developers can create innovative and engaging apps that allow users to interact with virtual objects in the real world, opening up new possibilities for gaming, education, and more.



RealityKit's features:

- Rendering: RealityKit offers a powerful new physically-based renderer built on top of Metal, which is fully optimized for all Apple devices.
- Animation: It has built-in support for Skeletal animation and Transform-based animation. So, if you want, you can animate anithing or you can move, scale and rotate objects with various easing functions.
- Physics: With a powerful physics engine, RealityKit lets you adjust real-world physics properties like mass, drag and restitution, allowing you to fine-tune collisions.

- Audio: Spacial audio understanding and automatic listener configuration let you attach sound effects to 3D objects. You can then track those sounds, making them sound realistic based on their position in the real world.

- ECS: From a coding perspective, RealityKit enforces the Entity Component System design pattern to build objects within the world.

- Synchronization: The framework has built-in support for networking, designed for collaborative experiences. It even offers automatic synchronization of entities between multiple clients.

Chapter 3

Development

3.1 Overview

For the development phase of the project I used Apple's XCode integrated developer environment(IDE) as the main developer platform for iOS and ARKit development. For testing I used an iPhone 11 with dual camera system. I have also version controled the whole development process using git and publishing it on GitHub. Not only the source code can be found there but also the documentation of this project as I have writen it using LaTeX.

3.2 Yahoo Rest API

For retriving the displayed informations I used Yahoo's open and available for free financial API.

```
{
    ”success”: true,
    ”query”: {
        ”from”: ”EUR”,
        ”to”: ”HUF”,
        ”amount”: 1
    },
    ”info”: {
        ”timestamp”: 1682930463,
        ”rate”: 373.180303
    },
    ”date”: ”2023−05−01”,
    ”result”: 373.180303
}
```

3.3 SwiftUI

3.4 ARKit and RealityKit

Chapter 4

Presentation of finished work

In this section I will present and showcase my finished appliction. I will include screenshots to have a better representation and understanding for the reader.

Chapter 5

Sources

Below I list the external links and sources used during the project and the report.

5.1 External Links

Microsoft - What is Augmenteted Reality

Apple - Augmented Reality

Apple - RealityKit

Kodeco - RalityKit tutorials

Rövid leírás - https://developer.apple.com/forums/thread/658300

Apple - Adding procedural assets to a scene

Medium - Adding 3D text to scene

BetterProgramming - Taking AR view snapshot

YouTube - Placing models

GitHub - FocusEntity

BetterProgramming - Update model entity

RapidAPI

Yahoo Financial API Guide

APILayer REST API

RealityGeometries - Kúpinsta

YouTube - RealitySchool: Place, Interact with, and Remove AR Objects in RealityKit