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| **Virtual Buzz:**  **Simulating visual Influences of Alcohol in an Augmented-Reality App** |

**Term Project**

Department of Computer Science

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Student Research Project Thesis:

VirtuallyUnderInfluence



Simulating visual Influences of Alcohol in an Augmented-Reality App

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# Abstract

## Introduction

The industrial partner ASN (which roughly translates to “Never behind the wheel”) primarily provides information as well as experiences in regard to the influence of alcohol and other drugs. Until now, they have used a variety of different tools such as (drunk) driving simulators and a couple of different kinds of glasses, which come with very individual, visual impairments, to provide such experiences.

Due to the continuous desire to appeal to their young target audience by providing an immersive and realistic experience in combination with the rising popularity of technologies related to virtual reality, this project was mostly set out to be research oriented and give a good idea about the currently available capabilities as well as their limitations with a chance to result in an actual augmented reality (AR) app.

## Approach

The target device for this project was the smartphone powered Google Cardboard headset and the Vuforia software development kit (SDK) was suggested to be used for the augmented reality development for the Android platform. As a first step, we decided on using the Vuforia SDK for the game engine Unity and began to experiment with the various tools at our disposal in order to get a better understanding of what we could achieve.

After developing a first prototype of an AR app, which simply used the ‘blur’ component provided by Unity on the running smartphone camera, and thereby proofing the plausibility of the project idea, we went on to attempt implementing the other visual effects described by ASN.

Based on the research nature of this project, the whole development process as well as the information gathered on the topic of both Unity and AR capabilities is supposed to be documented in a manner to not just give a good insight on the project itself, but the topic and used tools as well. It is aimed at both potential future contributors to this project as well as developers interested in testing the water of augmented reality with the tools used here.

## Results

This project resulted in a functional app that serves as a proof of concept for the initially uncertain idea to simulate the visual effects caused by substances like alcohol, but also identified the currently still severe limitations of the processing power of smartphones regarding the used technologies.

The documentation serves as introduction to the world of AR and Unity while also giving insight on the project itself, the encountered limitations and possible extensions or future projects this could lead to.

# Management Summary

# Introduction

This chapter covers an overview of the project as well as the underlying idea and the goals and objectives contained therein.

## Overview

This project was set out to be primarily for research purposes regarding the available technologies and features regarding the uprising “Google Cardboard”-device since neither of the participating parties had any previous experiences with this new area of development. The company “Am Steuer Nie” (ASN) has provided the basic idea for the project, which is to create a new mobile app replacement for the actual glasses with built-in sight impairments they use for demonstration purposes of the influences of substances like alcohol to the human sight (and driving) and possibly use those in a sort of a game to catch the attention of their target audience. The app is not (yet) planned to be released in any app-stores, since that is not essential to the project even though it could be an option for future versions so they can be used in other companies similar to ASN or simply educational purposes in general.

The documentation of our findings and development experiences regarding the new technologies is also an essential part of this project since it is supposed to provide an inexperienced developer the needed insight into the area of virtual and augmented reality as well as game development with the Unity game engine.

## Goals and Objectives

The goals and objectives of this project initially were very vague and partially had to be determined further over the course of the project as we acquired a greater insight on the available tools and possibilities we had. The basic goal laid out was to simply develop some kind of app to simulate the visual impairments caused by the influence of substances such as alcohol while providing a good documentation for all the gained knowledge over this new area of programming as well as all the technologies that had to be used to achieve that.

|  |  |
| --- | --- |
| Initial Requirements | Fulfillment status |
| Working app for simulating substances |  |
| App for Android-OS |  |
| Usage of “Google Cardboard” |  |
| Developing concrete Game Ideas |  |
| Extensive Documentation |  |

In addition to the basic objectives, we were able to split up to whole project further as we went on and identified the following goals along the way:

|  |  |
| --- | --- |
| Identified Goals and Objectives | Fulfillment status |
| Implementing visual effects (split up further) |  |
| Ability to configure Settings |  |
| Configuration Management |  |
| Understanding used Features & Shaders |  |
| Implementing a custom Shader |  |
| Performance Optimization |  |
| Including virtual Objects |  |
| External Controller |  |
| User Manual |  |

## Content Overview? (Mini summary per Chapter)

# Background

This chapter is intended to give a slight insight into the background of both the students as well as the industrial partner involved in this project.

## Fachstelle Am Steuer Nie (ASN)

The industrial partner Am Steuer Nie, ASN for short, (which roughly translates to: “Never behind the wheel”) is a rather small company with the goal to teach people between the ages of around 14 and 22 about the negative influences of substances like alcohol and drugs on the human capabilities especially regarding driving. The focus regarding substances thereby lies on alcohol and they have a variety of tools at their disposal in order to provide a somewhat realistic and immersive experience.

### Motivation

A part of the motivation to develop a new AR-App simply comes from making use of the newest technologies available and expanding the tools available to continue making the simulation of the big variety of effects, which alcohol and other substances can have on our well-being, more realistic. Along with that aspect also comes the ‘hype-factor’ that these still relatively new kinds of technologies typically have on the younger generations and therefor possibly improves the reception of both marketing and the actual demonstrations.

### Existing Tools

Driving Simulation

Drunkenness Glasses

Documentation and Visualizations

## Personal Motives

### Konrad Höpli

Aside from the opportunity to really get into some of the newest technologies on the market, I also have been enthusiastic about gaming and its connection to the real world, which really is what AR tries to tie together on a new level. I think in most games the primary goal is to either create a really immersive and fictional experience (e.g. Life is Strange, Ori and the blind Forest) or being as realistic as possible (e.g. various kinds of simulations and even war-games like Battlefield 1). In the future I strongly believe, that the first kind will move over to virtual reality and the second kind has potential to be continued in augmented reality. However, looking at the current experiences available and the first impression of the limitation currently still out there, I will definitely hold on to the statement, that this is still futuristically speaking.

The other part of my motivation for this project comes from my personal lifestyle that really values both healthiness and responsibility. The responsibility aspect has basically always been important to me and surely has a relation to how I was raised on the farm of my father. Although I do drink some alcohol from time to time and consider a good, cold beer one of the best drinks available, I am heavily against all kinds of excessive substance consumptions with a negative impact on our ability to, well, function especially if it also potentially effects not just ourselves but other living beings.

# Different Realities[[1]](#footnote-1)

Interesting links:

<http://electronicdesign.com/embedded/6-things-know-about-augmented-reality?utm_source=twitter.com%20Free&utm_medium=social&utm_campaign=blog>

<https://medium.com/@Khullani/the-reality-virtuality-continuum-db166a704c01#.m2ymzc5um>

One of the goals of this project is the development of an app that should be used to visualize the negative visual effects that substances just like alcohol can have and this is best done by creating an experience as immersive as possible. One of the current trends regarding immersion definitely is the usage of virtual or augmented realities with the help of some of the newest tools available such as Google Cardboard and the HTC Vive or Oculus Rift.

Before we go into the specific options available, the following image provides a quick overview about the relationship of the available options using a simplified version of the reality-virtuality continuum described in published papers as early as 1994. While those terms may already have been introduced at that time, the impact and availability of these technologies has only been surging during the latest years and at the time of writing this document, there is not yet an end in sight, although the processing power appears to be one of the most limiting factors.

AR

Figure 1: Simplified Reality-Virtuality Continuum

On the left side of the relationship, there is what we consider the real world as itself (or seen through a display) including existing objects and visuals, but also the constraining laws of physics that apply to them etc. On the right side is the virtual reality, which stands for a completely synthetic manifestation of a world, where its creator is in full charge of the objects existent therein as well as the governing laws they are bound to (or not).

In between the two extrema of this continuum, there is a whole range of possible implementations originally defined as mixed reality (MR), but nowadays mostly referred to as augmented reality (AR). Depending on where exactly on this relationship an application or game intends to be, it will typically find itself somewhere in between with a focus on either the real world or the virtual reality. In the paper used as a source for this chapter, the points closer to the real world are defined as augmented reality whereas the points closer to the virtual reality are called augmented virtuality, which has still not established itself as a common term or application, but may still be to come using the newest technologies we now have at our disposal. A good example for the latter would be a completely constructed, virtual reality where a couple of real objects such as bottles are integrated into and may even be interacted with.

A key factor about this formulation is, that the point on the continuum is defined by the extent to which the human perception is being altered instead of the mechanism through which the modification is achieved.

In our project’s case, we will try to primarily integrate the real environment using smartphone cameras as an optical see-through-device and image altering technologies to modify the real-world-experience captured and generate a simulation of drunkenness. As such, this project fits perfectly into the original definition of AR since we stay relatively close to the left side of the continuum.

# Vuforia

Vuforia is a software development kit (SDK) aimed at making AR development more accessible and it provides individual versions for Android, XCode (iOS) as well as Unity.

In the beginning stages of this project we had to choose one of the versions provided and since the one for Unity comes with additional features and even though we have no previous experience with the popular game engine we quickly decided to go for that one and use the opportunity to further expand our developer horizon.

During the development of our project a new partnership between Unity Technologies and PTC Inc. was announced[[2]](#footnote-2) with the goal to make AR-development more accessible by integrating the Vuforia toolset into the Unity IDE. Needless to say, this also makes it very likely that the already convenient toolset provided will continue to be improved and expanded in the future.

?Licensing?

# Unity

Unity is the most popular game engine currently available next to the Unreal Engine, which is the primary competitor used in many commercial games including a lot of AAA-titles and even in its free version can be used to create very impressive projects even with the free version of it.

Unity is one of the most popular cross platform game development tools, also referred to as game engine, used to create video games. It consists of an IDE as well as a visual editor which can be extended by the use of plugins, mostly referred to as assets. Unity itself has a quite low learning curve which is most likely one of the reasons why it became so popular recently. Other reasons are it being very well documented and free, which makes it very user friendly and attractive for users without prior programming knowledge. Besides its good documentation, it has a strong community behind it which allows new users to access the Unity forums to solve their programming issues with the assistance of more experienced programmers, or to discuss solutions and share acquired knowledge.

## Basics

As already indicated, Unity is more than a simple tool and comes in separate parts, which individually contribute to both the toolset available as well as the overall user experience. It is one of the most popular game-engines available today and thanks to its licensing model especially popular among indie- as well as hobby developers. The following graph puts into perspective, how many of the most popular free mobile games in the first quarter of 2016 have been made with the individual game engines available:

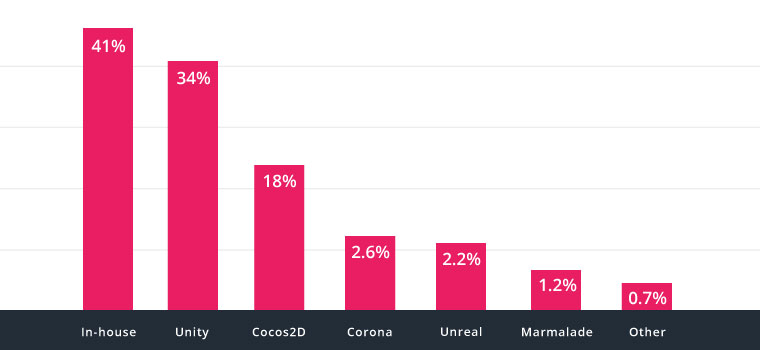


Abbildung 1: top 1000 free mobile games by engine[[3]](#footnote-3)

While this graph provides a decent idea of the popularity of Unity, it certainly does not show what the engine is actually capable of putting out and in order to get a better idea of that, it is recommended to have a look at the platform[[4]](#footnote-4) available to promote games made with Unity.

**Game Engine**

The game engine is what makes sure the created games can be run on a specific platform or environment, and in the case of Unity this is possible for basically all popular gaming-platforms such as PC, Android, Xbox as well as PlayStation.

**Integrated Development Environment (IDE)**

The IDE provided and developed by Unity Technologies really embraces a convenient concept that is not just for professional developers, but also easily understandable for users without a programming background even though games are generally seen as one of the most complex technical challenges available.

One of the primary reasons it does not require a development background is the separation of concerns used by Unity. The IDE itself is not intended to write a single line of code, but uses a very component based approach set in hierarchical scenes and customized using the configurable properties in the inspector window. The components are also referred to as “assets” and are one of the aspects, where the unity-developer-community really shines thanks to the integrated asset store, where anyone can share their developed assets (e.g. images, 3D models, animations, sounds and toolkits like the Vuforia SDK) with others at a price or completely for free. The amount of user collaborations is really impressive, but depending on the search term you may also struggle with finding what you are looking for since the description as well as the actual quality is of course very individual.

These components are one of the core concepts used by Unity and are really great for (but not limited to) making games due to the possibility to make each individual model used reusable as well as extendable. So, in case your game contains two humans, you are free to choose between two completely individual models, or the usage of a so called “prefab”, where you assign specific properties upon each instantiation, and can add components such as behaviors to both of them as you desire. This can lead to cases where using a simple cube as an obstacle is as simple as using a car- or plane-model for the same purpose.

**Code Editor**

The Coding IDE that comes with Unity is called MonoDevelop and provides a rather simple, straightforward experience. It is listed as a separate part of the IDE here, since it is rather loosely coupled to the Unity IDE in that it only opens when the user wants to edit a script component and developers are actually free to choose any other coding environment such as VisualStudio.

Unity allows scripting in C# (Version 4.0), Unity Script (JavaScript for Unity) as well as Boo. Due to the low usage of Boo, the scripting manuals and documentation are as of the version 5 of Unity only focused on the other languages available.

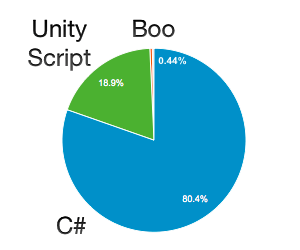


Abbildung 2: Distribution of Scripts created by language[[5]](#footnote-5)

The individual scripts you may or may not implement throughout the development of your project will then simply be used just like any other component with a few minor tweaks. For example, any public properties in your C# script as well as the ones manually marked with the attribute “FieldSerializable” will show up in the properties window and be configurable. Individual methods defined with your script can also be assigned to the respective events such as a button-click and will then be delegated once triggered.

Our project has primarily been focused on C# scripting as well as the usage of a couple of the provided image filters and shaders (which are typically made in C Graphics or Cg in short).

## Features

Game Preview & Runtime changes

Profiler

Debugging

## Assets

Assets, which are mostly community built, are ranging from simple textures and models to complex editor extensions as well as scripts and can be acquired from the asset store within the engine.

## Shaders

A shader is a pre-compiled program for one of the number of stages of the graphics pipeline used in three-dimensional graphics to determine the final parameters of the object or image. It may include a description of arbitrary complexity absorption and scattering of light, texture mapping, reflection and refraction, shading, surface displacement, and postprocessing effects.

Programmable shaders are flexible and effective. Seemingly complex surfaces can be visualized with simple geometric forms. For example, the shaders can be used to draw a three-dimensional surface of the ceramic tiles on a completely flat surface. In Unity, shaders are divided into three types: vertex , geometry , and fragment (pixel).

# Visual Effects

A crucial goal of this project is the implementation of a realistic simulation of what it means to be drunk or under the influence of other drugs using the technological toolset available at the time.

## Information about Alcohol Effects on Vision Capabilities

Our industrial Partner ASN has provided us with information on the most essential visual effects of alcohol as well as other drug related substances. This information served this project as a basic element as we tried to implement as many of those effects as possible while also trying to keep the simulation as realistic as possible.

* **Tunnel View**:

The human field of vision encloses usually 180 degrees. But in fact, you can only see really sharp in a smaller field of view than that. Even though the peripherical vision is very important, because so you can react to warning colors or unexpected movements. Under alcohol influence these 180 degrees reduce steadily, being this of course especially dangerous in overtake actions, spotting pedestrians, etc.

* **Bright-/Dark-Blindness**:

Human pupils change their size based on the lighting circumstances. The time needed by the pupils adapt to changes thereof is typically longer under alcoholic influence and can lead to a sort of blindness for up to multiple seconds. Time that easily can lead to a crash.

* **Red light weakness**:

You are not able to differentiate red shades, what is trouble when you must pay attention to brake lights.

* **Blurred view**: The eyes can not display fast and sharp the context.
* **Double view**: each eye takes an image, and both images combined build a 3D image. Because of this, under alcohol influence you are able see double or triple things.
* **Inconstancy**: it is important to know that these restrictions are not present in the same way. It can happen that, if you are sitting, all is more or less sharp. But, as soon as you raise and move, your brain must process the inputs faster. Then the alcohol influence manifest.

Apart from visual restrictions, there are more like balance problems, delay in the reactions and motor functions, alll of them playing an important function in traffic.

# Solution/Implementation

# Challenges/Conclusion

Hardware Limitations and Optimization

# Game Ideas

# Table of Figures

**No table of figures entries found.**

# Images

[Abbildung 1: Distribution of Scripts created by language 12](#_Toc469576377)

# References

(kein Datum). Von Fachstelle ASN: Logo: http://www.fachstelle-asn.ch/images/asn-logo-de.png abgerufen

(12. 9 2014). Von Unity3d-Blog: Documentation Unity scripting Languages and you: https://blogs.unity3d.com/2014/09/03/documentation-unity-scripting-languages-and-you/ abgerufen

(11. 10 2016). Von Businesswire: PTC Unity Collaboration Announcement: http://www.businesswire.com/news/home/20161101006531/en/PTC-Unity-Announce-Strategic-Collaboration-Accelerate-Augmented abgerufen

Milgram, P., & Haruo, T. (1994). Von Augmented Reality: A class of displays on the reality-virtuality continuum: http://etclab.mie.utoronto.ca/publication/1994/Milgram\_Takemura\_SPIE1994.pdf abgerufen

Qualcomm Vuforia. (14. 12 2016). Von Vuforia.com: https://www.vuforia.com/-/media/Vuforia/Homepage/Singles/Vuforia%20Logo%20OLx2.png abgerufen

1. (Milgram & Haruo, 1994) [↑](#footnote-ref-1)
2. (Businesswire: PTC Unity Collaboration Announcement, 2016) [↑](#footnote-ref-2)
3. (Unity Technologies, 2016) [↑](#footnote-ref-3)
4. (Unity Technologies, 2016) [↑](#footnote-ref-4)
5. (Unity3d-Blog: Documentation Unity scripting Languages and you, 2014) [↑](#footnote-ref-5)