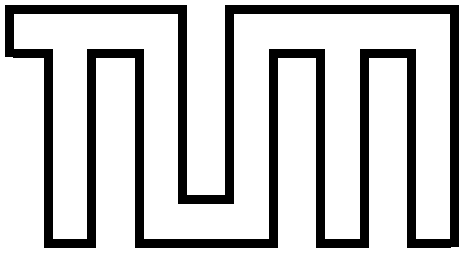


Technische Universität München

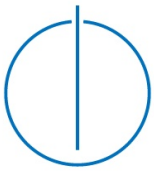
Department of Informatics

Master Practical Course Games Engineering
Augmented Reality

Rune TD

Serious Celtic Augmented Reality Tower Defense Game

Summer term 2018



Authors

Stefan Stark, Florian Hösch

Dennis-Florian Herr and Michael Felleisen

Supervisors

Prof. Gudrun Klinker, Ph.D.

Dipl.-Inf. David A. Plecher, M.A.

Contents

1 Introduction

"The year is 50 B.C. Gaul is entirely occupied by the Romans. Well, not entirely... One small village of indomitable Gauls still holds out against the invadors. And life is not easy for the Roman legionaries who g garrison the fortified camps of Totorum, Aquarium, Laudanum and Compendium...", Robert Steven Caron. [1]

Similar to the famous opening quote from the Asterix comics, our game is set in the middle of the last century before Christ. The Celtic culture is at its peak and shaped central Europe and the British Isles during the last centuries. [2] But conflict arises between the Celts and the Romans when Gaius Julius Caesar is leading his military campaigns northwards to conquer Gaul, known as the *'bello Gallico'*.

During his campaigns, Caesar encounters several *'oppidum'*, fortified Celtic villages or cities. [3] The player is taking control over the defenses of a small Celtic *'oppidum'* and has to defend the village using powerful Celtic runes. After the village is fortified enough to fend of wildlife, the player has to fend of wave after wave of the Roman campaign to conquer his village. Who will come out on top? The organized roman empire or the naturalistic Celts with exceeding knowledge in ancient runes?

The game is supposed to teach players the meaning of ancient Celtic runes in a playful and engaging way. While playing the campaign players gradually unlock runes, that they must use with physical, printed markers[1] to control the augmented reality world. When a rune is unlocked the player gets educational information about the rune and an explanation of its effect in-game. The original meaning of the rune is related to their in-game effect to improve the learning experience by creating coherence between the educational information and the game experience.

The following chapters are meant as a documentation for our prototype implementation. We start with describing the game design choices, followed by an explanation of the mechanics used to play the game. Afterwards we discuss problems during development, especially in regard to augmented reality and present a short user study of our prototype as presented at the TUM Demo Day of the summer semester 2018. Finally we discuss future work that was out of scope of the practical course.

[1] Our rune markers are explained in Chapter 2

2 Game Design

[4]

2.1 Basic Concept

The priority of this serious game is to convey knowledge of celtic runes and culture. Since the raw learning of plain foreign symbols is not very exciting, our game tries to weaken the less interesting parts of learning by offering a classical Tower Defense Game.

2.2 Runes

Almost every rune out of the 26 letter rune alphabet has a special meaning in the game itself, very close to the traditional meaning of the rune in ancient times.
To name but one, the *Kenaun* rune, also called *Kenaz* has the traditional meaning *torch* and in-game upgrades standard towers to fire towers.

2.3 Tower Defense

The Tower Defense concepts we are using are very basic. Towers can be manually placed and upgraded in various ways, using gold, to kill monsters that are walking on a specific path towards the players base. If a monster reaches the base alive, it does damage to the players health and if the health drops to zero the player looses and has to start over. The distinguishing feature of our tower defense is that the player does not earn gold by killing monsters, but by planting and harvesting different farms.

2.4 Campaign

Because of the sheer number of runes the player has to learn before he is able to actually play the game, we slowly introduce the runes step by step in a campaign/ tutorial mode. That way, no one is overwhelmed by too many different rune symbols, their meanings and their meanings in-game, but is able to learn in small manageable steps.

After playing the campaign, a free-play mode is unlocked to offer a challenge for more experienced players without playing the campaign again.

2.5 History

Manching nachempfunden

3 Mechanics

3.1 Runes

3.2 Rune Combining

a

4 Encountered Problems

4.1 Markertracking

Since we were creating our project in Unity we decided to use Vuforia as our Augmented Reality tracking library, but the performance was not sufficient in the beginning.
The tracking was not stable enough for the amount of markers we intended to use, so we had to change a few aspects of our game.

The first thing we scraped were the enemy path markers. Instead the path spawns relative to the base rune. This solved stability issues as well as problems with very efficient path patterns made by the players. By removing this player variable we had an easier time creating a balanced campaign mode.

The second thing we improved was the markers themselves. The first hand-drawn markers did not bring the image recognition performance we needed.
Therefore all the markers we used in our project were generated by a script. In the center of each marker is the central rune the marker is representing and the outlines of the marker consists of the whole rune alphabet in a random order. Because of that, we could have multiple different instances of the same rune markers without using e.g. plain numbers.

4.2 Marker printing

The first time we printed all of the close to 100 markers, we used a very simple printer and very basic printing paper. This resulted in white vertical lines across most of the markers, which was very bad for the image tracking. Moreover, after using the markers a few times, they started to bend which made the tracking even worse. After that we used an industrial printer with very thick paper and got much better results.

5 Userstudy

a

6 Future Work

6.1 Free Play Mode

The Free Play Mode was supposed to be played after completing the campaign. It would be designed to test and strengthen the knowledge gained about runes, their meaning and how to use them most efficiently.
To achieve this, the player would fend off randomly generated waves of enemies with all runes unlocked. Before each wave starts, information about the type of attackers is displayed in form of rune symbols and/or names. If the player was shown the runes "Ehwaz" (speed) and "Kenaz" (torch) for example, he would know to expect a wave of fast enemies with fire element and could adjust his strategies accordingly.
This mode could easily be implemented as a two player mode as well, with one player creating the waves of attackers using markers and the other fending them off.

6.2 Wearables

For a game like this, wearable Head Mounted Displays (HMD) could enhance the player experience quite a bit. HMDs like the Oculus Rift, the HTC Vive or Google Cardboard in combination with the Unity engine are quite easy to implement. Player input on the other hand would be more difficult.
Using a simple mouse would break the immersion a lot. Using a controller would be acceptable, but the game requires the player to use their hands to place runes so the player would have to put down and pick up the controller constantly. Gesture recognition would be the optimal solution but is very difficult and time consuming.

References

[1] Robert Steven Caron. *Beginning of most Asterix comics*. URL: `http://comedix.de/lexikon/db/vorwort.php` (visited on Mar. 13, 2018).

[2] Bernd Liermann. *Herkunft der Kelten und Lage des keltischen Kulturkreis*. URL: `http://www.antikefan.de/kulturen/kelten.html` (visited on Mar. 13, 2018).

[3] John Collis. "Die Oppidazivilisation". German. In: *Das keltische Jahrtausend*. Ed. by Hermann Dannheimer and Rupert Gebhard. 2., erweiterte Auflage. Vol. 23. ausgeliehen TU München Universitätsbibliothek 94 A 484. Prähistorische Staatssammlung München und Verlag Philipp von Zabern, Mainz, 1993, p. 102. ISBN: 3-8053-1514-7.

[4] Sabine Rieckhoff and Jörg Biel. *Die Kelten in Deutschland*. German. ausgeliehen TUM TB Stammgelände GES 410f 06.2004 A 159. Stuttgart: Theiss Verlag, Sept. 2001. ISBN: 9783806213676.

Appendix

A Appendix A