Advanced User Interface

2018/19

Public speech in Virtual Reality

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Abstract

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1 Introduction

1.1 Purpose

The purpose of this document is to give information about the "WIVR games for stress relief" project developed for the Advanced User Interface course.
This document aims to explain:

- The needs, goals and requirements for the targeted users;
- Previous researches and projects on the same topic;
- The choices made throughout the development of the project;

1.2 Scope

"Public speech in Virtual Reality" is a VR application that tries to give an instrument to people that have fear of speaking in public to improve their ability to speak to an audience. The application offers to the user a virtual theatre where he/she can try a speech in front of an audience that can react based on his/her performance. The main functionality of the application is given by a biosensor (Empatica E4)that allows the tracking of the heart rate and the galvanic skin response of the user. These values are used to evaluate the state of mind of the subject and decide how the environment should change. In fact, based on the anxiety level, the amount of people that the user sees in the audience can be changed or, in case the application consider that the user is in a situation of high stress, block the test.

1.3 Definitions, acronyms and abbreviations

- VR: Virtual Reality
- HMD: Head Mounted Display
- WIVR: Wearable Immersive Virtual Reality
- HR: Heart Rate
- GSR: Galvanic Skin Response

2 NGR

2.1 Target

The main target of the project are people that have fear of speaking in public. This kind of fear can be categorized as part of social phobia, i.e. "persistent fears of situations involving social interaction or social performance or situations in which there is the potential for scrutiny by others" [1].

2.2 Context and Needs addressed

"In social/evaluative situations, the primary threat stimulus is an audience and the primary threatening outcome is negative evaluation from the audience" [1]. The idea of being evaluated by the audience is enough to start a loop that keeps fueling the anxiety of the subject as shown in figure 1.

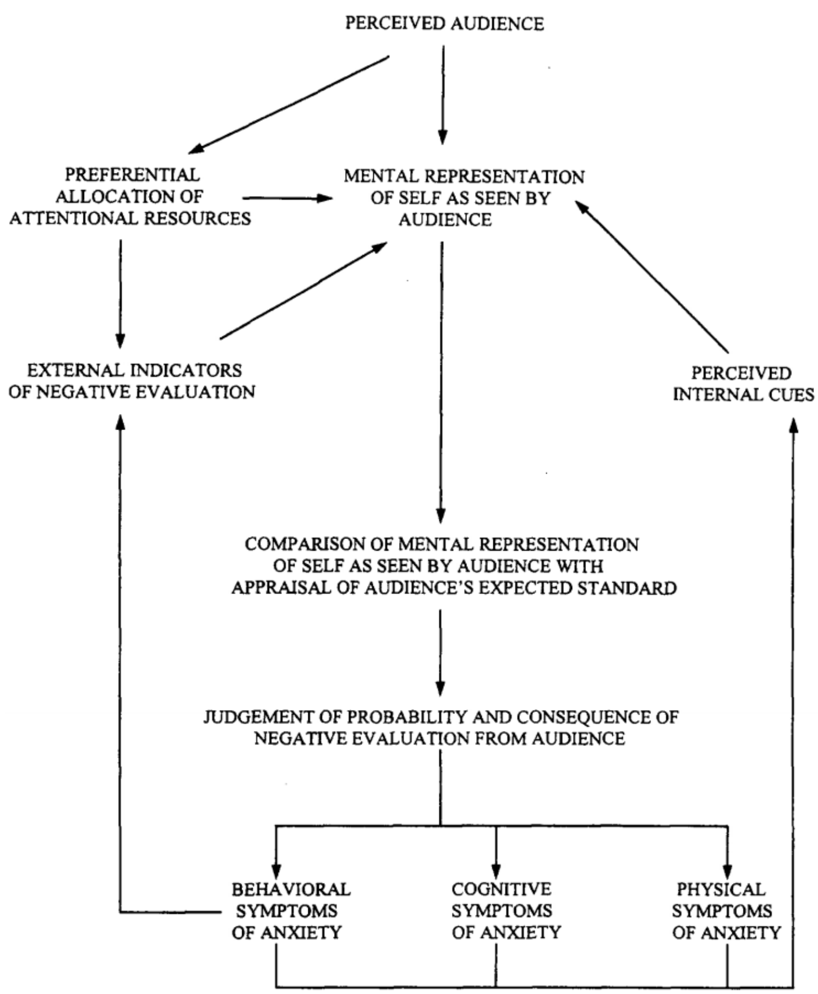

Figure 1: A model of the generation and maintenance of anxiety in social/evaluative situations [1].

For this reason the needs that were formulated are:

- Have more confidence around people during the speech
- Listen to the speech after the performance

2.3 Constraints

- HMD;
- A smartphone running Android Jellybean or higher (4.1.x+);
- Empatica E4;
- Microphone;
- Headphones;
- A pc (Windows 7 or higher) with Visual C++ Redistributable Package installed
- Bluegiga Bluetooth Smart Dongle
- Comfortable place where the user can sit down and rest the arm

2.4 Goals

- Improve the ability to speak in public
- Allow the subject to be less anxious before and during the speech

2.5 Requirements

- The applications should provide an environment where the subject can try his/her speech in front of a virtual audience.
- The application should progressively change the number of people that the user can see in the audience based on his/her state of mind.
- The application should calm the subject if needed.
- The application must stop the test in case the subject doesn't feel well.
- The application should reward the user on a good performance.
- The application should record the speech and play it if needed.

3 State of the art

3.1 Applications

There are many application with the same objective that were developed and are nowadays available:

- Virtual Orator
- Speech Center VR
- VirtualSpeech
- #BeFearless
- Public Speaking Simulator VR

Some of them are available on smartphone other are only available on PC using a HDM (HTC Vive, Oculus Rift etc...). All of them offer similar features but they also offer unique options to differentiate from the others application.

	Multiple Environment	Upload documents	Record your performance	Question from the audience	Speech analysis	Distractions	Variable number of people during the speech	Biosensor	Lectures	Evaluation of the performance
Virtual Orator	X	X	X	X		X				
Speech Center VR	X	X	X			X			X	X
VirtualSpeech	X	X	X		X	X		X	X	X
#BeFearless	X	X	X		X			X		X
Public Speaking Simulator VR						X	X			

This project uses the same general idea as these applications and tries to expand it by introducing a biosensor as a mean to change the virtual environment the user is put in.

3.2 Research

There are many researches about public speech anxiety (and social phobia) but the most relevant for the sake of this project are:

- Slater, M., Pertaub, D. P., & Steed, A. (1999). Public speaking in virtual reality: Facing an audience of avatars. IEEE Computer Graphics and Applications, 19(2), 6-9.

  The focus of this paper is to analyze how people evaluate themselves while in front of an audience with different reactions using VR.

- Pertaub, D. P., Slater, M., & Barker, C. (2002). An experiment on public speaking anxiety in response to three different types of virtual audience. Presence: Teleoperators & Virtual Environments, 11(1), 68-78.

  This is an extension of the previous research.

- Chollet, M., Sratou, G., Shapiro, A., Morency, L. P., & Scherer, S. (2014, May). An interactive virtual audience platform for public speaking training. In Proceedings of the 2014 international conference on Autonomous agents and multi-agent systems (pp. 1657-1658). International Foundation for Autonomous Agents and Multiagent Systems.

  The focus of this research is to design a way to let people learn how to behave in front of a fake audience that reacts to the user actions. This research doesn't use VR but instead works with screens and audiovisual sensors to analyze the user behaviour.

- Poeschl, S., & Doering, N. (2012, March). Virtual training for Fear of Public Speaking—Design of an audience for immersive virtual environments. In Virtual Reality Short Papers and Posters (VRW), 2012 IEEE (pp. 101-102). IEEE.

  This research explains how to develop an audience that shows realistic behaviour.

- McKinney, M. E., Gatchel, R. J., & Paulus, P. B. (1983). The effects of audience size on high and low speech-anxious subjects during an actual speaking task. Basic and Applied Social Psychology, 4(1), 73-87.

  This research studies how people react during a speech in front of different amount of people hearing.

4 UX design

4.1 General

The application is divided into two modes: free talk and interview. The former is for whom have their own speech material, while the later without material will be interviewed by other users. The audience are divided in three different characters: kind classmates & colleagues, serious experts and indifferent people. Different character will give different feedback during the speech. The user could choose the number and composition of the audience.

4.2 Audience

- Kind classmates & colleagues: with causal wearing and friendly smile, they will listen with smile, nod and praise during the speech.
- Indifferent people: with strange wearing, they pay no attention to the speaker and will look around, speak to others and fall asleep during the speech.
- Serious experts: with formal suit and serious expression, they will listen without emotion, shake head and get angry during the speech.

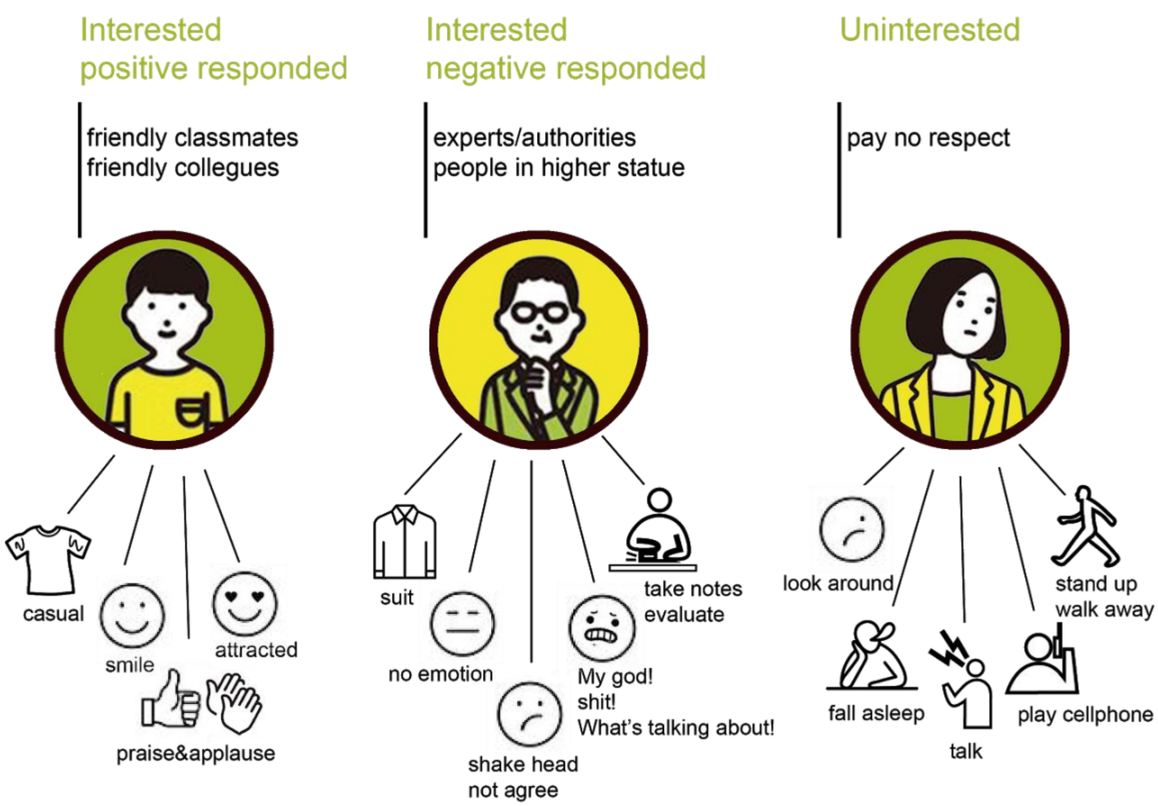

Figure 2: Audience characteristics

4.3 Audience number and composition

- Number: the number of audience will be changed by the light in the theater. More audience will come into view with bigger light.
- Composition: the users can choose different compositions of audience in different characters, which will help them to meet their own level.

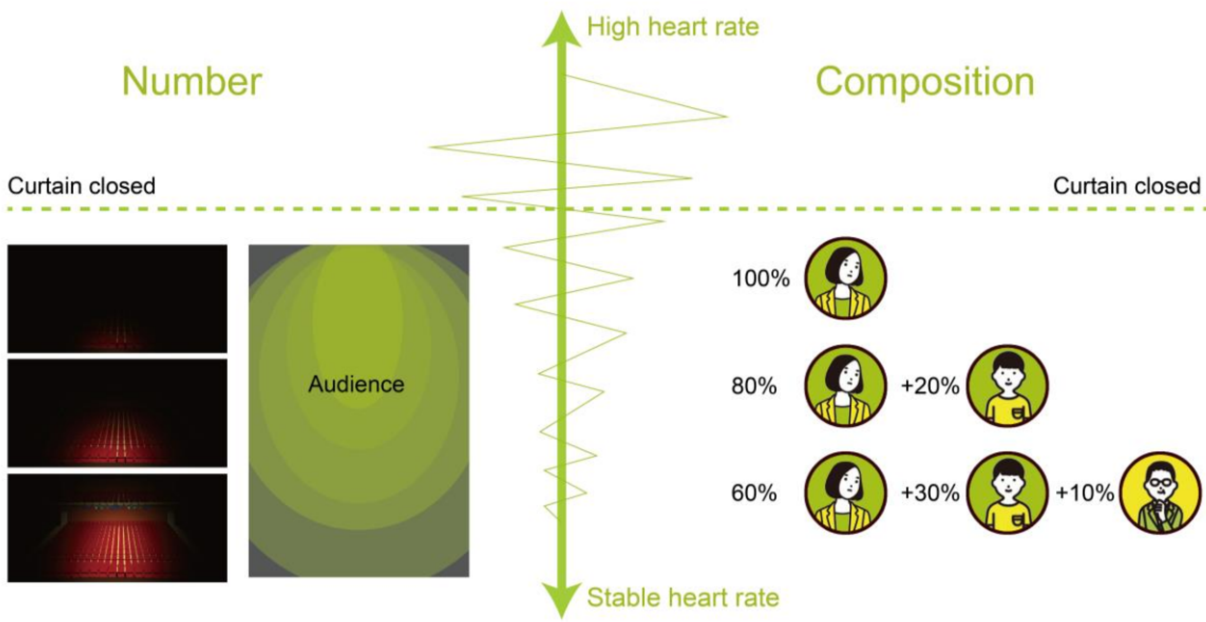

Figure 3: Number and Composition

4.4 Process

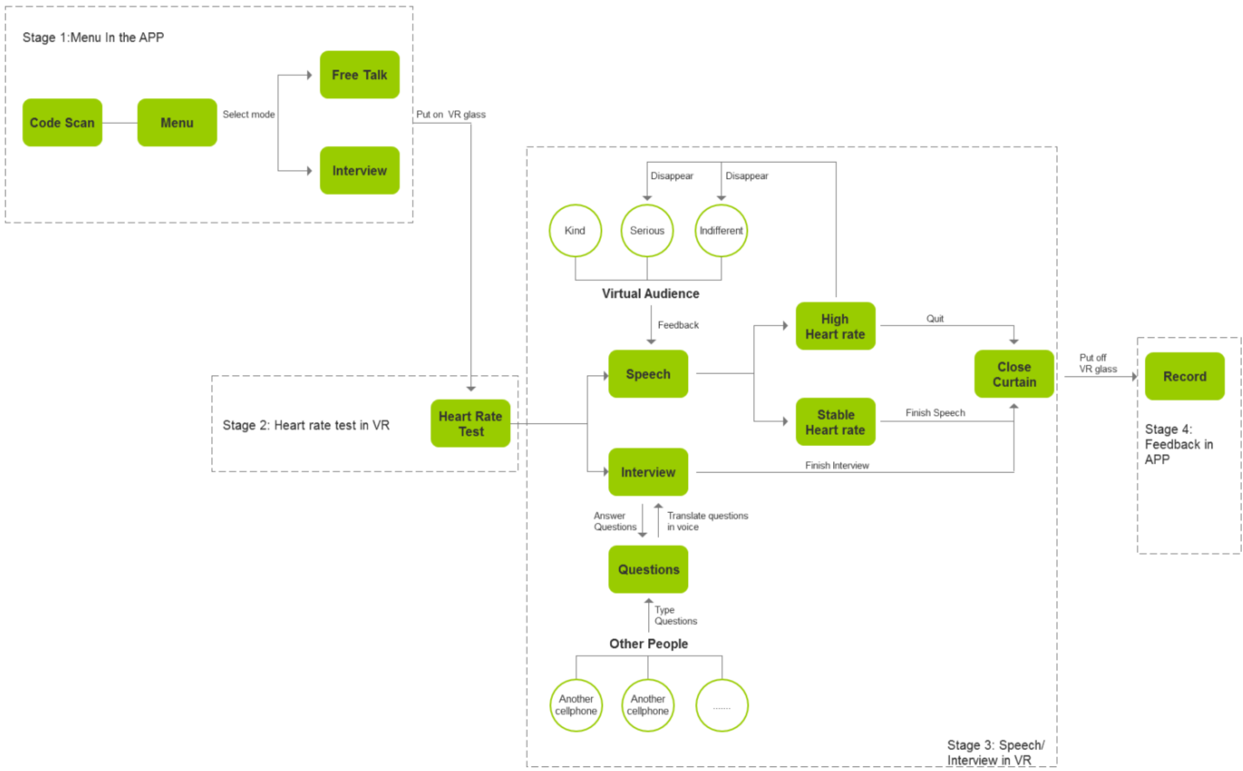

Figure 4: Flow of the application

4.5 Interface

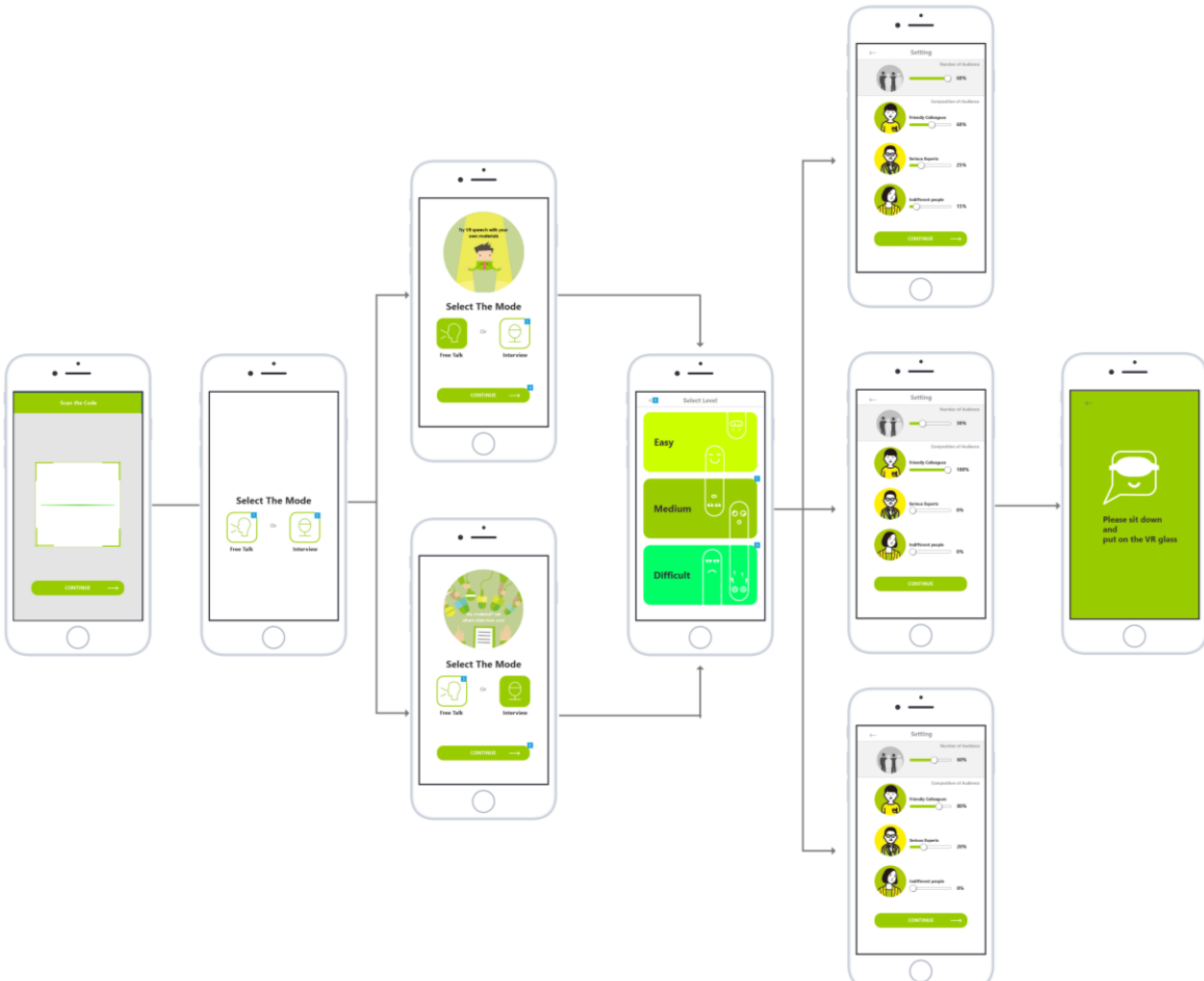

Figure 5: Stage 1: App

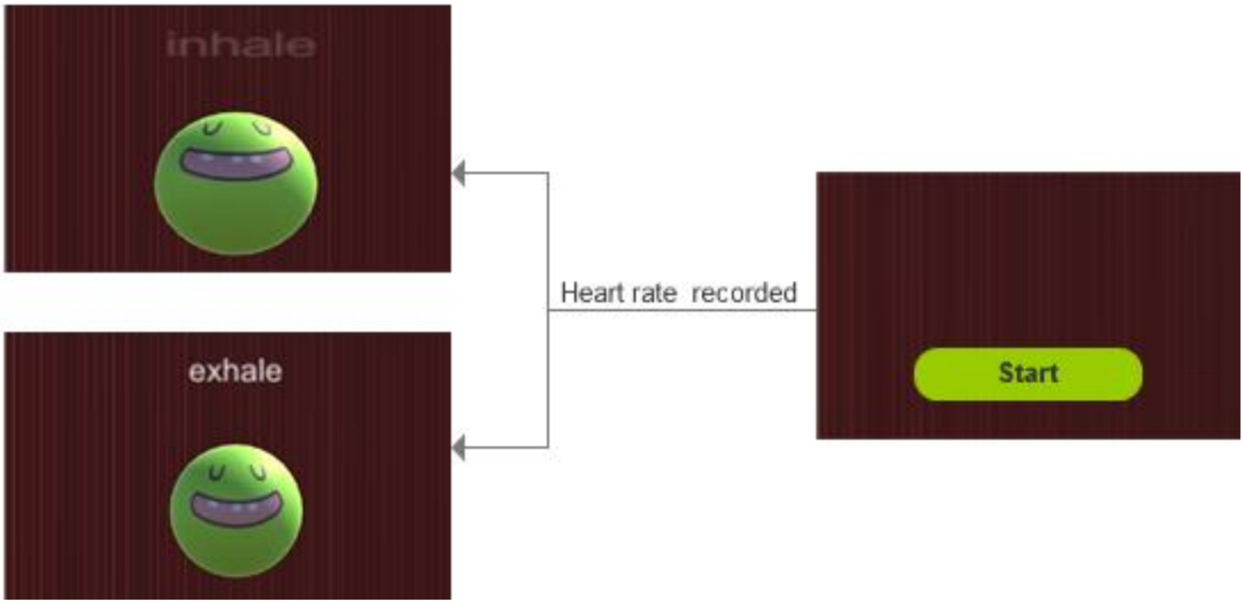

Figure 6: Stage 2: Heart rate test

5 Implementation

5.1 Introduction

The main application of the project is an Android app built on Unity. This allows the creation of a VR environment with ease. The only problem that arises from this choice is that it isn't possible to retrieve the data from the biosensor and send them to the smartphone directly as Unity doesn't allow a direct communication. As shown in figure 7 the information from the biosensor are read first by a Computer and then sent to a Firebase server that stores the values. This values are then read by the Android application using HTTP requests.

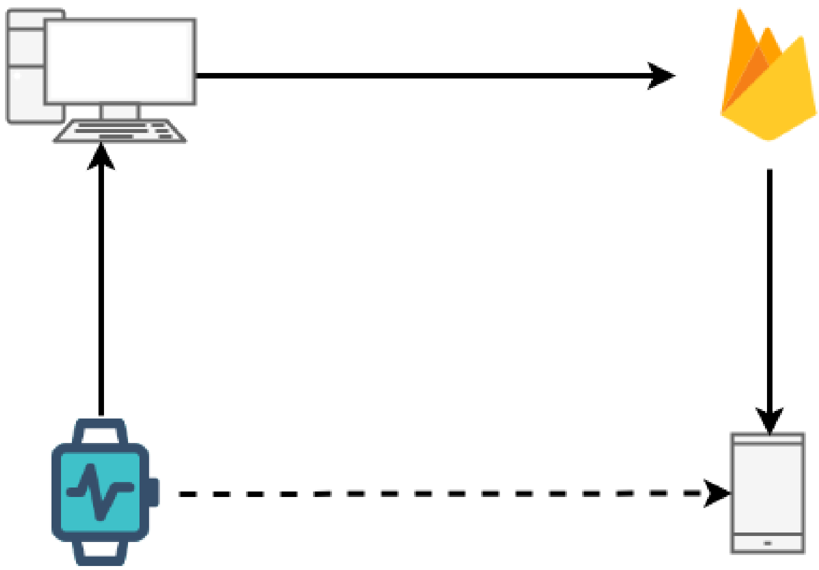

Figure 7: Diagram that shows how the communication from the biosensor to the smartphone works.

The problem that arises with this choice is the need for authentication so that a smartphone is always connected to the right biosensor.
To solve this problem, the authentication is done by using QR codes so that, whenever a biosensor is connected, the computer application generates a QR code that allows a smartphone to "connect" to it.
This solution works with the assumption that the user is near the computer that displays the QR code. This is a safe assumption as the biosensor is connected by bluetooth to the computer and so it can't be too far from it.

5.2 Android Application

Language used: C#
Plugins:

- ZXing
- Android Runtime Permissions

5.2.1 Description

The core of the project is the Android application. It is split in three parts:

1. QR code reader
2. Main menu
3. VR application

5.2.2 Algorithm design

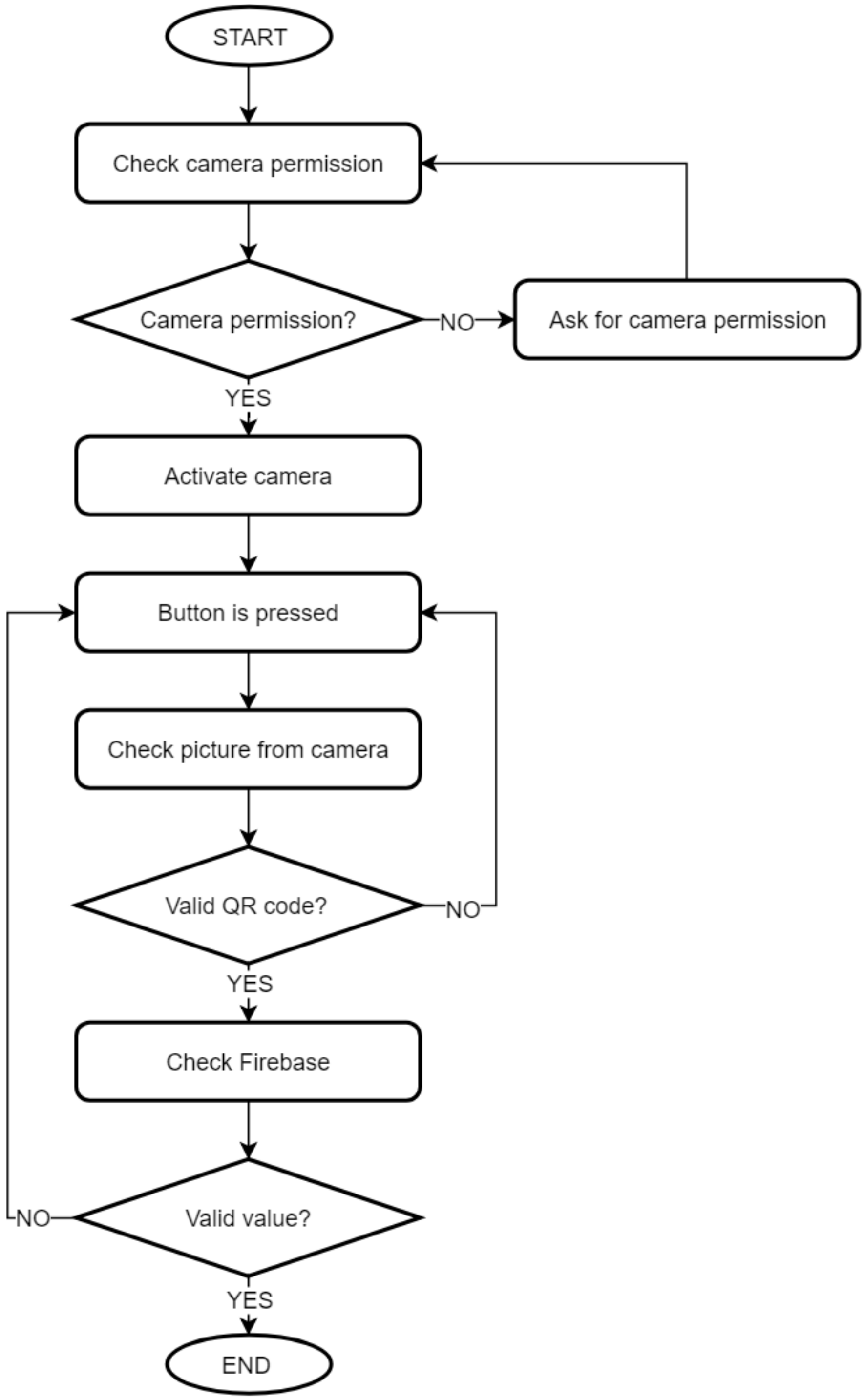

Figure 8: Flowchart that describes how the connection to the right "room" in the Firebase server works

5.3 Computer Client

Language used: Java
Plugins:

- ZXing
- JavaFX

5.3.1 Description

The computer client main task is to retrieve data from the Empatica E4 and send the values to the Firebase server. In order to do this, it communicates with E4 streaming server, an application that allows to forward realtime data of multiple Empatica E4 devices to multiple TCP socket connections.
The E4 Streaming server works through a message protocol where client request are in the following format:

COMMAND ARGUMENT_LIST

Messages from server containing responses to commands are in the following format

COMMAND ARGUMENT_LIST

Messages from server containing data from device are in the following format

STREAM_TYPE TIMESTAMP DATA

The commands used from the client are:

- device_list
  requests the list of Empatica E4 devices to the E4 Streaming server
- device_connect DEVICE_ID
  sends a connection request to a specific device
- device_subscribe STREAM STATUS
  start or stop receiving data from a given stream.
- device_disconnect
  sends a device disconnection request

5.3.2 Algorithm design

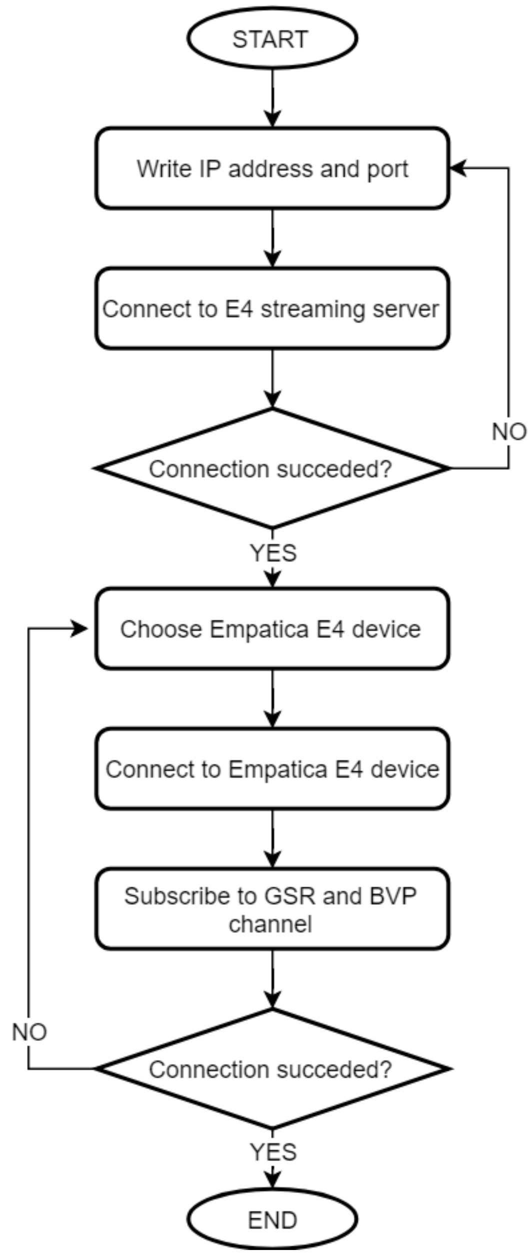

Figure 9: Flowchart that describes how the connection to the Empatica E4 device works

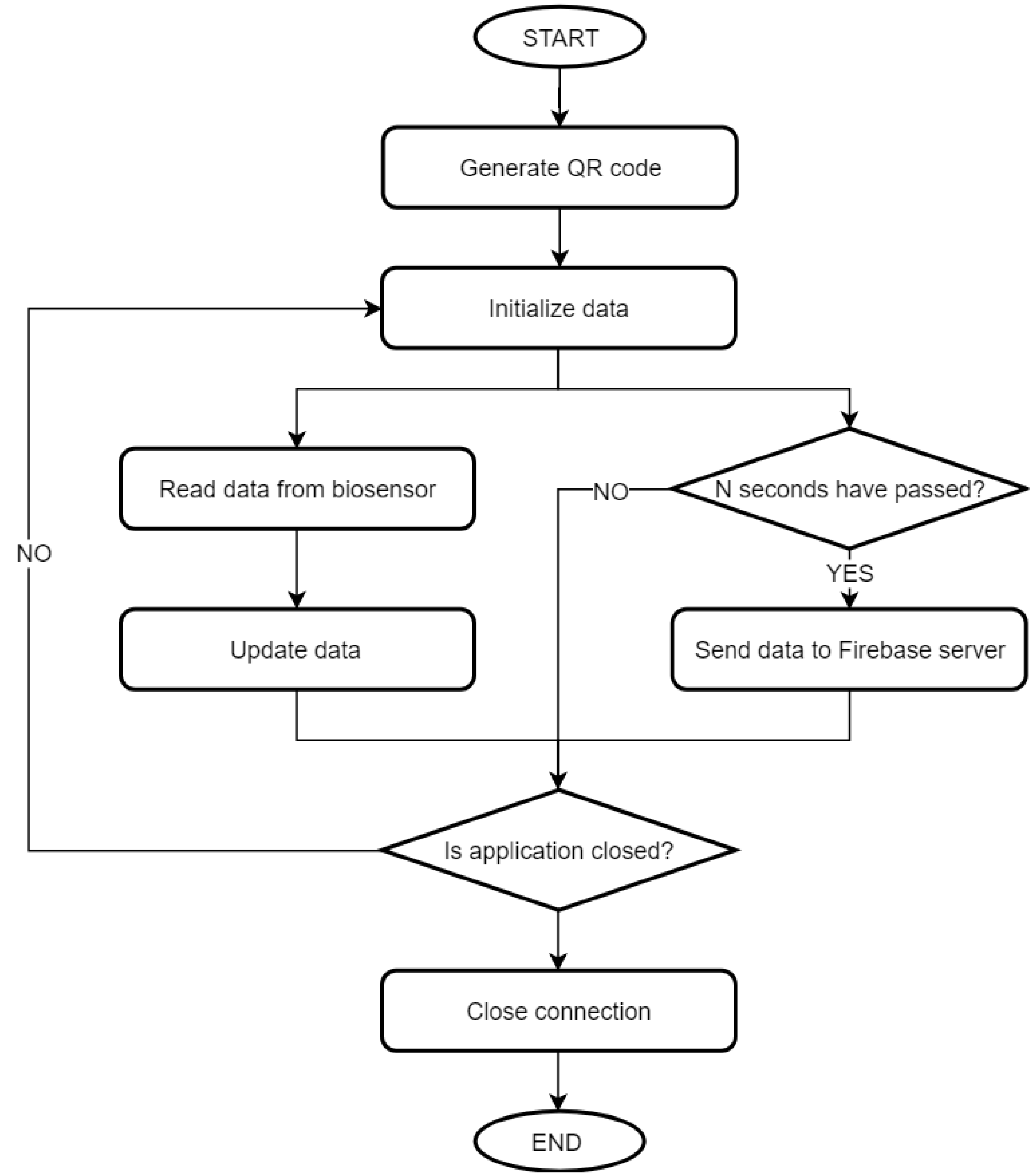

Figure 10: Flowchart that describes how the client retrieve data from the Empatica E4

5.4 Firebase server

Language used: javascript

5.4.1 Description

Firebase is a platform that offers the possibility develop web application easily. It was chosen as the backend for this project because of its ease of use.
The main objective of the Firebase application is to store the data retrieved from the biosensor and then send them when requested.
The services used on Firebase are:

- Realtime Database.
- Cloud functions;

The Realtime Database is a NoSQL database were data is stored as JSON. It is used to store the value read by the biosensor and the questions that have to be sent to the mobile application.

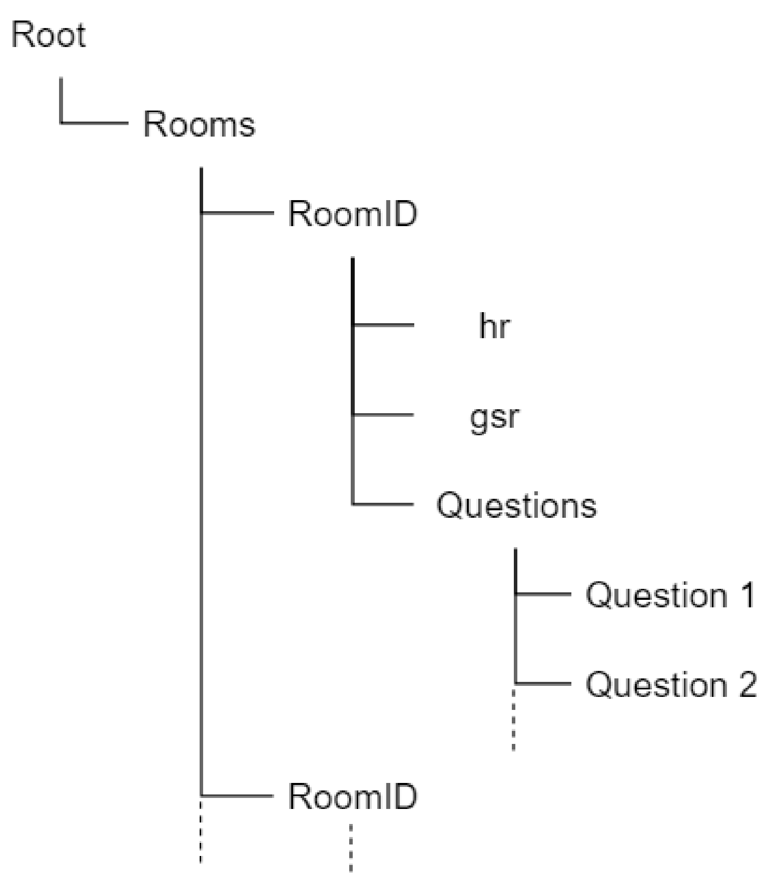

Figure 11: Structure of the Realtime Database

Cloud functions are used in order to let the PC client access the database. The Cloud functions are tasks that can be triggered by HTTP requests. The values required are sent as a JSON string in the body of the request.

- createRoom: creates a room with the given room code;
- updateValues: update the values of the hr and gsr stored in the given room;
- addQuestion: add a question to the list in the given room;
- removeRoom: Closes the room with the given room code.

6 Value proposition

6.1 Challenge

The main challenge that came up during the development of the project were:

- finding a way to put the subject in a ”controlled” stressful situation without leaving him/her in an anxious state;
- give instruction to the user so that he/she won't stay silent while in front of the virtual audience.

6.2 Main difficulties

The main difficulty of this project is given by the platform used. Even though Android devices are able to run VR application, they have really limited resources.In fact, they can be used to display simple scenery or games with a limited amount of polygons or 360° videos. Because of this limitation, some choices had to adjusted making the development harder.
Also, the biosensor used (Empatica E4) isn't the best fit for the purpose of this project. It can track the necessary data but it wasn't intended as a device to track parameters in real time and so noise and other problems were introduced.

7 Future work

In the future this project could be extended in many different ways:

- The Empatica E4 biosensor could be changed with a more specialized one that could track parameters in a more precise way while introducing new one. One option could be the usage of smart clothing that offer the possibility to track both HR and GSR while also allowing the tracking of the breathing activity. The last one can be used as a anxiety level tracker (like the other two parameters) but also as a mean to introduce breathing exercise to calm down the subject if needed;

- The whole project could be changed to use a different kind of VR device. The usage of devices as HTC Vive or Oculus Rift can improve the performance of the application while also increasing the number of people used in the audience so to make it a little more challenging for the user. The fact that Unity was used to develop this project could make the transition to a different device a little bit more easy to do as most of the scripts are not specific on the Android platform and the build settings can be easily changed.

References

[1] Rapee, R. M., & Heimberg, R. G. (1997). A cognitive-behavioral model of anxiety in social phobia. Behaviour research and therapy, 35(8), 741-756.