

ÇANKAYA UNIVERSITY

Software Requirements Specification

**Simulacrum: Simulated Virtual Reality for Emergency Medical
Intervention in Battle Field Conditions**

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1. INTRODUCTION

1.1 Purpose

The purpose of this document is describing the simulation which is called Simulacrum: Simulated Virtual Reality for Emergency Medical Intervention in Battle Field Conditions. This simulation aims to educate military personnel about principles of medical interventions in battlefield conditions. This document includes detailed information about requirements of the project. It reflects the identified constraints and proposed software functionalities. Moreover, the SRS document explains how participants interact with the simulation. This document explains how concerns of the stakeholders are met.

1.2 Scope of Project

Most of the military personnel do not have enough knowledge and experience about medical intervention techniques. In addition to this, the personnel, who has the knowledge about medical intervention techniques, might be ineffective because they are not familiar with the battlefield conditions and this causes increasing level of anxiety or stress. There are not enough efficient and low cost training programs that addresses this problem. The project has become necessary to develop due to lack of these training programs.

The purpose of Simulacrum project is to design “Immediate Medical Intervention During Combat” both as a standalone application and a VR system, which shall include realistic scenarios, by taking account of the experience gained by Turkish Armed Forces personnel and their inventories (e.g. tools, materials) that are used for medical intervention. To increase the level of immersion in this project, HTC Vive is going to be used. This technology allows the participants to interact with virtual environment. This interaction occurs by walking around in virtual world and touching the objects in the virtual world using controllers. Apart from having medical intervention situations in battlefield conditions, this simulation also includes first-aid trainings. This project creates opportunities such as frequent repeating, easier access, efficient cost, etc.

There are two actors in the simulation which are participant and admin. NPCs (Non-player Character) have roles such as trainer, victim, etc. During the simulation, participant can interact with these NPCs and get specific information from NPCs related to situation. Training of the first-aid and medical intervention technique shall be divided into two different modes. First mode is Training Mode and traditional education technique is used in this mode. Participant will be debriefed about first-aid and medical intervention techniques. After the debriefing, participant shall take a quiz about these techniques. If the result of the test is satisfactory, the participant shall be able to practice the techniques. The other type of mode is Battlefield Mode and interactive education technique is used in this mode. Training of the first-aid or medical intervention technique shall be given to the participant in battlefield conditions. Second type of actor is admin and admins have the authority of making changes in simulation. Users will be able to enter the simulation as admin using password which are granted to admins.

1.3 Glossary

Term	Definition
Participant	The user who interacts with the simulation environment. Generally Medical Aid Man, Privates Sergeants, Militant Lifesaver, Commissioned Officer in Turkish Armed Forces
Haptic Feedback	Creating sense of touch by applying vibrations and forces to the user
HTC Vive	It is head-mounted virtual reality glasses which has gaze driven technology and provides haptic feedback through controllers
Stakeholders	Any person who has contribution in the project.
Virtual Environment	Computer generated 3D modelled environment which has the resemblances of the real world
Virtual Reality	It is computer-simulated environment which the user interacts with this environment
NPC (Non-player Character)	Characters in the simulation who cannot be controlled by the participant [1]

1.4 References

[1] T. Petrenko and O. Tymchuk, "Adaptive Behavior Control Model of Non Player Character", 2013 UKSim 15th International Conference on Computer Modelling and Simulation, 2013.

1.5 Overview of the Document

The second part of the document describes functionalities of the Simulacrum: Simulated Virtual Reality for Emergency Medical Intervention in Battle Field Conditions. Informal requirements are described and it is a context for technical requirement specification in the Requirement Specification chapter.

Requirement Specification chapter is written for software developers and details of the functionality of the simulation are described in technical terms.

Both of the sections describe the functionalities of the same product. However, it is described differently because they are intended for different audiences.

2. OVERALL DESCRIPTION

2.1 Product Perspective

Simulacrum: Simulated Virtual Reality for Emergency Medical Intervention in Battle Field Conditions is a virtual reality simulation project that has the purpose of training first aid and medical intervention techniques in battlefield conditions. The project divided into two parts: training mode and battlefield conditions mode.

Training mode includes three parts which are education about first-aid and medical intervention techniques, quiz about related topics and practice of the technique part. Battlefield condition mode has different scenarios about applying medical intervention techniques in battlefield conditions.

2.1.1. Development Methodology

For developing the project, we have planned to use Scrum which is an agile software development methodology. Scrum is incremental and iterative. In scrum, main work is divided into sprints which should be completed within a certain period of time which could be 30 days on average. Iteration length of every sprint must be equal, because scrum is an agile development methodology. Every Sprint includes tasks which has own story points and risk points. Development team should have a daily meeting every morning which should be maximum 15 minutes. Scrum has three main roles which are product owner, scrum master and development team. Product owner is the person who delivers the requirements, scrum master is the person who manages the development team. Development team is the group of developers who work on the project according to schedule. There are some advantages of Scrum. First advantage is that it is easier to cope with changes because of short sprints and constant feedback. Another advantage is problems can be handled swiftly due to morning meetings. Also, it makes it possible to create quality products in scheduled time [1]. *Figure 1* represents four sprints of the project on the lab board. Sprint is one of the most important feature for Scrum methodology. At the end of each sprint, a part of project has been completed and it has been presented to customer for validation. By taking into consideration of these facts, Scrum is the most suitable methodology for the project.

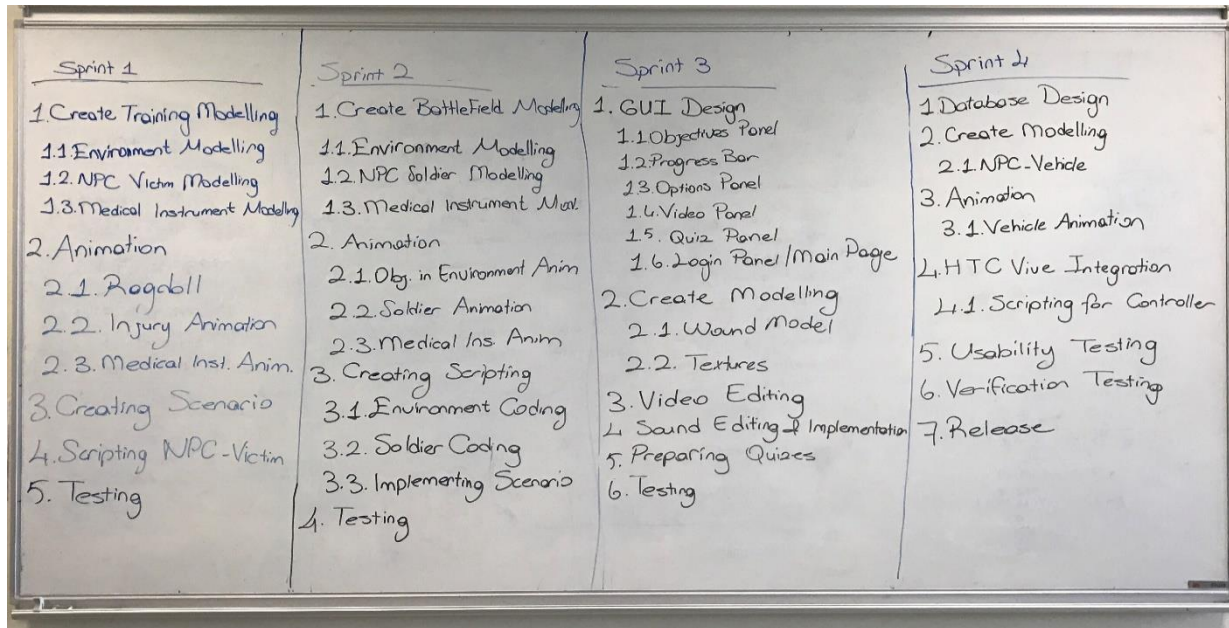


Figure 1 All Sprints of the Project on the Board

We have also used Scrum Board (see Figure 2) in order to complete tasks that are in the current sprint iteratively. Each tasks are written on the story cards which include their own risk points. Scrum board that includes six different phases. “Project Backlog” phase contains all processes within the sprint. “To Do” phase includes which is need to be done with priority. “In Progress” phase contains tasks that are currently being constructed. “In Review” phase represent processes that are being reviewed. “To Deploy” phase includes modules that are ready to be integrated within the main system. “Done” phase indicates processes that are successfully working within the system.



Figure 2 Scrum Board with Tasks

2.2 User Characteristic

2.2.1. Participants

2.2.1.1. Participant must be an employee of Turkish Armed Forces.

2.2.1.2. Participant must read and understand Turkish language due to simulation language is Turkish.

2.2.1.3. Participant must have knowledge of first-aid and medical intervention techniques.

2.2.2. Admin

2.2.2.1. Admin must be an employee of Turkish Armed Forces.

2.2.2.2. Admin must read and understand Turkish language due to simulation language is Turkish.

2.2.2.3. Admin must know how to use a computer.

2.2.2.4. Admin must have knowledge of first-aid and medical intervention techniques.

3. REQUIREMENTS SPECIFICATION

3.1 External Interface Requirements

3.1.1. User interfaces

The user interface will be worked on Windows.

3.1.2. Hardware interfaces

The simulation requires HTC Vive. HTC Vive requires necessary drivers installed within the operating system. Also, it requires 1 USB and HDMI port on the PC.

3.1.3. Software interfaces

There are no external software interface requirements.

3.1.4. Communications interfaces

There are no external communications interface requirements.

3.2 Functional Requirements

3.2.1. Profile Management Use Case

Use Case:

- Start
- Login as Admin
- Exit

Diagram:

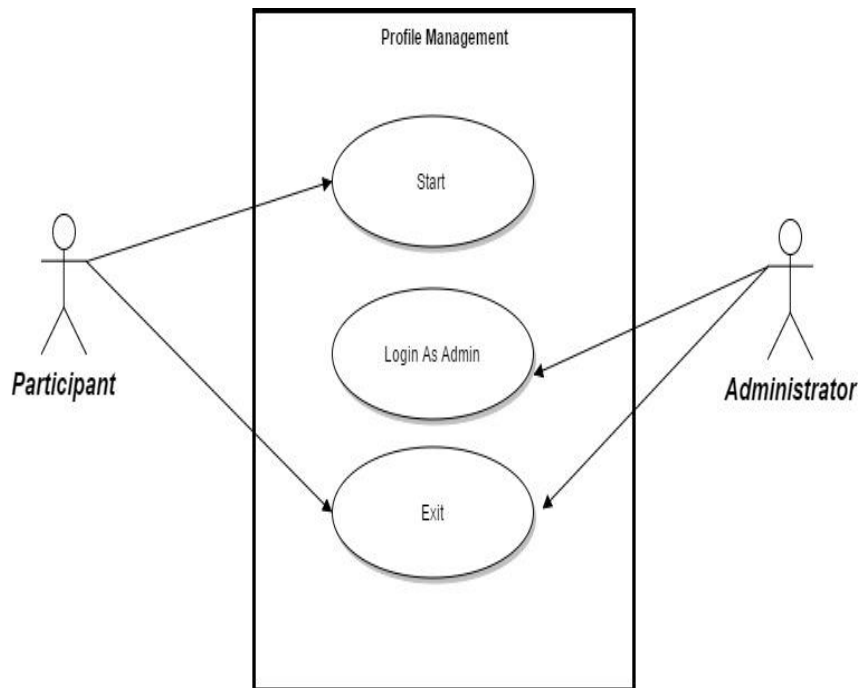


Figure 3 Profile Management Use Case

Brief Description:

In Profile Management diagram (*Figure 3*) explains the basic operations which is related to entering system of participant and admin. Participant and admin are able to use the following function: Exit. Apart from these, participant can also use the Start function and Admin can use the Login as Admin functions.

Initial Step by Step Description:

1. Participant shall start system without login.
2. Admin shall login to the system using password.
 - 2.1. If the password is invalid for the admin name, admin should re-login.
3. Admin and Participant can exit from the system.

3.2.2. Options Menu Use Case for Setting

Use Case:

- Pause
- Continue
- Change Volume Settings
- Display Instructions
- Exit

Diagram:

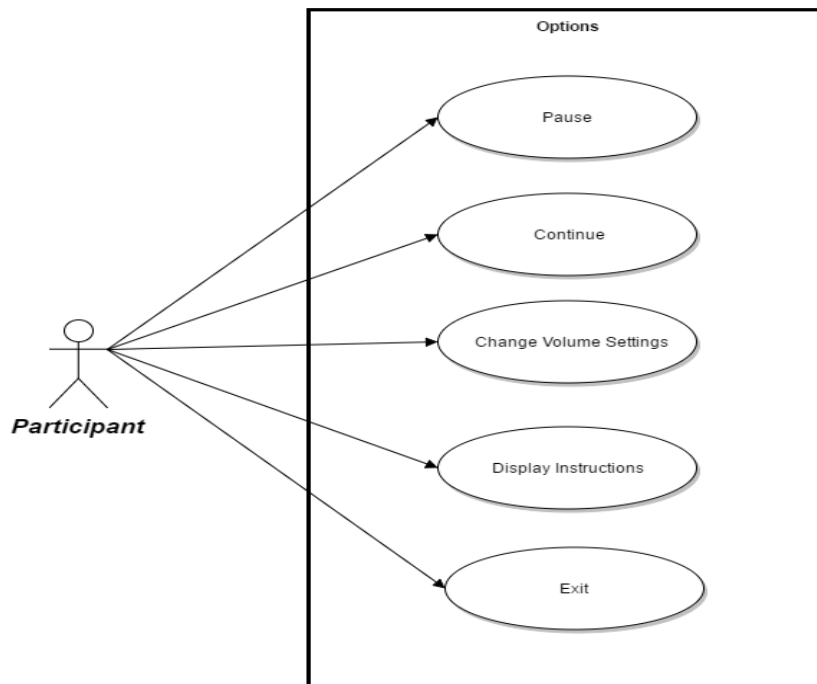


Figure 4 Participant Option Menu Use Case for Settings

Brief Description:

Figure 4 shows participant option menu use case diagram. When participant entered training and battlefield simulation within the system, he/she can display the options menu. Participant can execute functions of Pause, Continue, Change Volume Settings, Display Instructions and Exit in options menu.

Initial Step-By-Step Description:

1. If participant selects Pause button, the simulation stops.
2. If participant selects Continue button, the simulation continues from where it is left.
3. If participant selects Change Volume Settings button, a panel is displayed on the screen.
 - 3.1. Participant can increase volume of the simulation by selecting “+” button.
 - 3.2. Participant can decrease volume of the simulation by selecting “-” button.
4. If participant selects Display Instructions button, a panel which presents the instructions of the simulation is displayed.
5. If participant selects Exit button, simulation ends and main menu is displayed.

3.2.3. Training Mode Use Case

Use Case:

- Select Technique
- Display Score
- Display Options
- Take Quiz
- Answer Questions
- Attend Practice Technique
- Hold Object
- Drop Object
- Add Question
- Delete Question
- Update Question

Diagram:



Figure 5 Training Mode Use Case

Brief Description:

Figure 5 is a training mode use case diagram. In this use case diagram, when participant enters training mode, he/she can select a technique related to first-aid and medical intervention and he/she can display his/her previous scores. After selecting a technique, the participant shall finish educating part of the simulation. Then, participant shall take a quiz related to the technique and he/she shall answer the questions which are multiple choices in the quiz. After quiz, participant shall be able to attend to practice part and he/she can hold and drop objects in the simulation. Admin is able to manage text files related to quizzes.

Initial Step by Step Description:

1. When participant selects a technique, a panel which includes a list of techniques which are related to first-aid shall be displayed.
2. During education part of training, participant shall take information from NPC.
3. When education part of training is completed, participant shall take a quiz related to the education.
 - 3.1. When quiz part of training occurs, a panel which includes list of questions which are multiple choices shall be displayed.
 - 3.2. Participant should answer questions by selecting one of the choices.
 - 3.3. At the end of the quiz, correct answers and score shall be displayed.
 - 3.4. If the participant has given correct answers to 80% of the questions, quiz part shall end and participant shall attend practice part.
 - 3.5. If the participant fails, participant shall return to education part.
4. When participant attends practice technique, participant shall be able to interact with objects.
 - 4.1. Participant shall interact with objects by holding and dropping them.
 - 4.1.1. If participant hold down the trigger button, participant hold the objects on the virtual environment.
 - 4.1.2. If participant stops holding down the trigger button, participant drop the objects on the virtual environment.
 - 4.2. Participant shall gain score by performing techniques correctly.
5. Admin can manage questions which are on the quizzes.
 - 5.1. When admin selects the add question button, a panel which admin can add multiple choice questions on will be displayed.
 - 5.2. When admin selects the delete question button, a panel which admin can delete multiple choice questions on will be displayed.
 - 5.3. When admin selects the update question button, a panel which admin can update multiple choice questions on will be displayed.
6. If participant selects options button, a panel which includes option properties shall be displayed.

3.2.4. Battlefield Mode Use Case

Use Case:

- Select Injury Scenario
- Select Medical Interventions Technique
- Display Option
- View Objective Panel
- View Inventory Panel
- Movement
- Hold Object
- Drop Object
- Display Score

Diagram:

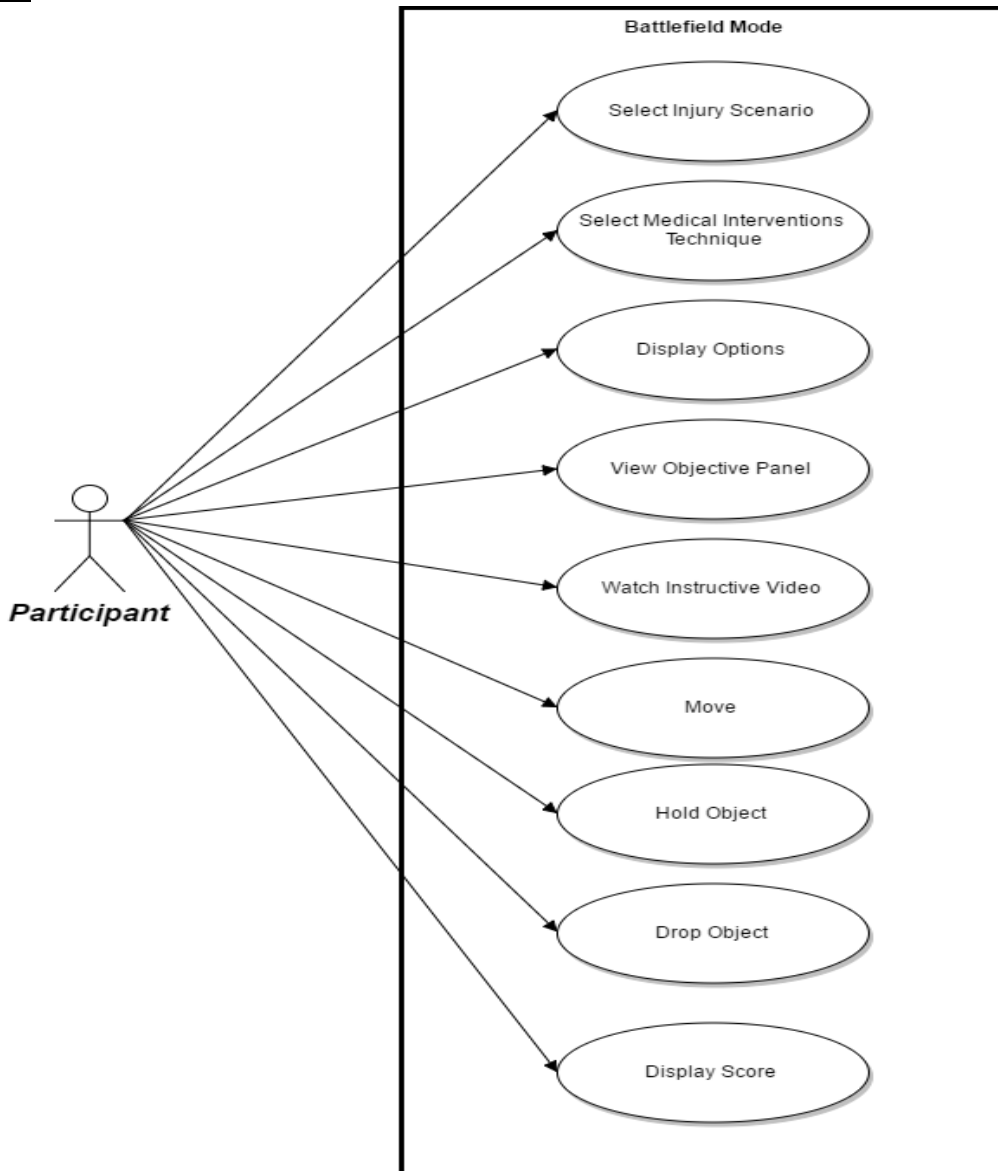


Figure 6 Battlefield Mode Use Case

Brief Description:

Figure 6 is a battlefield mode use case diagram. In this diagram, when participant enters battlefield mode, he/she can select an injury scenario which includes different scenarios of a NPC to get injured. After that, participant shall select medical intervention technique. Then, participant shall finish his/her duty in specific time. Participant can display his/her progress in simulation. Moreover, participant can move on the virtual environment and interact with objects by holding and dropping objects. These objects will be selected by the participant from inventory panel. Also, Participant can display scores on the battlefield environment.

Initial Step-By-Step Description:

1. Participant can select an injury scenario from the list of scenarios.
2. Participant shall select a medical interventions technique related to the injury scenario.
3. Participant can select generate simulation button which chooses an injury scenario from the list of scenarios and a medical intervention technique which is related to the chosen scenario randomly.
4. Participant can move on the battlefield.
 - 4.1. When participant presses the trackpad up button on the HTC Vive controller, the participant shall move forward.
 - 4.2. When participant presses the trackpad down button on the HTC Vive controller, the participant shall move backward.
 - 4.3. When participant presses the trackpad right button on the HTC Vive controller, the participant shall move to the right side.
 - 4.4. When participant presses the trackpad left button on the HTC Vive controller, the participant shall move to the left side.
5. Participant shall interact with objects which are selected from objective panel by holding and dropping them.
 - 5.1. If participant hold down the trigger button, participant hold the objects on the virtual environment.
 - 5.2. If participant stops holding down the trigger button, participant drop the objects on the virtual environment.
6. If participant selects options button, a panel which includes option properties shall be displayed.
7. Participant can display objective panel to display the remaining tasks during the battlefield simulation.
8. When participant accomplishes or fails the given objectives, a new panel shall be displayed which includes the result of the simulation and score of the participant.
 - 8.1. If the participant accomplishes the given objectives in a certain amount of time, the displayed panel shall include the finish time and score of the participant.
 - 8.2. If the participant fails the given objectives, the displayed panel shall include the reason of failure and the score of the participant.

8.3. The displayed panel shall also include two buttons which allows the participant to restart the current simulation and return to main menu.

9. Participant can display scores on the battlefield environment.

10. Participant shall watch instruction video by pressing specific button.

3.3 Performance Requirement

Simulation's visual must run smoothly without any latency to keep the level of immersion high. This requirement is depended on many aspects of the user pc. Minimum requirements [2] for running HTC Vive are:

1. GPU: NVIDIA GeForce GTX 970, AMD Radeon R9 290 equivalent or better
2. CPU: Intel i5-4590/AMD FX 8350 equivalent or better
3. RAM: 4 GB or more
4. Video output: HDMI 1.4, DisplayPort 1.2 or newer
5. USB port: 1x USB 2.0 or better port
6. Operating system: Windows 7 SP1, Windows 8.1 or later, Windows 10

3.4 Software System attributes

3.4.1. Portability

- Simulacrum is designed for HTC Vive using Unity 3D.
- The project can mainly be used with HTC Vive but other virtual reality glasses like Oculus Rift, Sony PlayStation VR, Samsung Gear VR, etc. can be integrated into the project with basic adjustments since the project is developed by using unity 3D.

3.4.2. Performance

- Objects, which are not seen by participant, should not be rendered unless the participant sees the object.
- Animations of objects should not be played unless the participant sees the object.
- Level of detail of objects should be changed according to distance between object and the participant.
- Quizzes in training mode should be completed in 5 minutes.

3.4.3. Usability

- Each quiz in training mode has 5 questions.
- Each question in the quizzes has 4 choices.
- When the participant fails, an error message, which explains the reason that why the participant failed, should be displayed.

3.4.4. Adaptability

- Since no data is acquired and saved from the run time, there is no adaptability requirement.

3.4.5. Scalability

- Since only one participant uses the system at a time, there is no scalability requirement.

3.5 Safety Requirement

HTC Vive requires at least 2 meters square area. This area should not include any object which might be an obstacle to the user. These obstacles might cause the injury of the user or it could be harmful to the HTC Vive controller or the glasses.

Using HTC Vive for a long period of time and brain-body conflict might cause nausea and dizziness on the user. Brain-body conflict can be caused in simulation by changing position or rotation of the user in the simulation while the user stands still in real life.

4. REFERENCES

[1] H. Lei, F. Ganjeizadeh, P. Jayachandran and P. Ozcan, "A statistical analysis of the effects of Scrum and Kanban on software development projects", 2016.

[2] "HOW-TOS - What are the minimum system requirements?", *Vive.com*, 2016. [Online]. Available: https://www.vive.com/eu/support/category_howto/839576.html. [Accessed: 18-Nov- 2016].