Software Requirement Specifications

For
Virtual Tour of
Department of Computer Science and Engineering

Version 1.0.2

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SRS Revision History

Date	Version	Remarks
6th Feb 2018	1.0.1	First Draft
18th April 2018	1.0.2(After 1st Cycle)	Revised Functional requirements,Contextual Inquiry redone etc.

1 Introduction

This SRS document aims at developing Mobile App that gives users the Virtual Tour of the CSE Department.This aims at familiarising new students and visitors with our Department.

1.1 Purpose

This app is being developed as a software project for the software engineering course of Indian Institute of Technology Guwahati.The intended audience of this Virtual Reality (VR) app is Users who want a comprehensive virtual tour of the Department of Computer Science and Engineering , IIT Guwahati and can use an Android device.

1.2 Scope

Project- Virtual Department
Features:

1. Comprehensive 3D map of the CSE Department
2. Control the first person character with your head movements only.
3. Immersive Environment

The VR App when completed can be used by all users who know how to operate an Android application and a VR headset to get an immersive tour of the Department. Most of the gestures to roam around in the virtual world are kept intuitive which makes it easy to operate.

1.3 Definitions, Acronyms, and Abbreviations

SDK : Software Development Kit
VR: Virtual Reality
AR: Live direct or indirect view of a physical, real-world environment
Unity: cross-platform game development engine

1.4 References

IEEE. IEEE Std 830-1998 IEEE Recommended Practice for Software Requirements Specifications. IEEE Computer Society, 1998.

1.5 Overview

Other parts of the SRS :-

1. Functional Analysis: contains the modular structure of the whole software
2. Softwares/Resources Requirements: Function required to construct the product
3. Interface Description
4. Contextual Inquiry

2.The Overall Description

This section presents the overall view of specific requirement which will form the background of section 3.

2.1 Product Perspective

Apart from giving the virtual tour of our department,this Android app has the potential of motivating all the country's bright students.When they see themselves standing in one of the best colleges in the country,they will be motivated to opt for it.This app will also form the base for AR/VR tour of entire IIT.

2.1.1 System Interfaces

The software can be directly launched on Mobile supporting Android without the need for installing external APIs.

2.1.2 Interfaces

This software uses the following Software-User interfaces :

1. This app is based completely on Android Platform using Unity engine and can be used by any device supporting Android 4.0+.
2. The software will be GUI accessible and will use Accelerometer of the device to move around.
3. User will be immerse himself and be able to control his movements using his head positioning.

2.1.3 Hardware Interface

1. The final version of the software can be used by any smartphone with at least:
    a. Android 4.4+ (KitKat)
    b. Processing Power: Dual Core 1.2GHz
    c. Accelerometer Sensor
2. VR headset compatible with Google Cardboard SDK

2.1.4 Communications Interface

Map will be Offline without the need for a Server side application.Environmental sensor data will be sent by the Android as sensor information packages through Java's ObjectOutputStream.

Authentication and data encryption should be considered to disallow unauthorized users from logging in to the App, but is outside the scope of this project.

2.1.5 Memory Constraints

Minimum Memory Space:500 MB (due to extensive detailing of the map)

2.2 Product Functions

Functions to be included in final product are as follows :
1. Movement in Virtual Space through head movements
2. Description popup about a section or room in department

2.3 User Characteristics

The intended users for the product will have the following characteristics :-
1. Able to afford and use an Android device (Version 4.4+)
2. Able to understand the functioning and operation of the software on a basic level.
3.Able to move the head without any restriction
4.Should know how to control a VR headset and how to move in the virtual Space.

2.4 Assumptions and Dependencies

1. OS used on the device :- Android 4.4 (KitKat) or higher
2. Device must have a minimum of 500 MB storage space for storing the application and also some minimal data generated whilst operation.
3. Device must have a minimum 2GB RAM and 1.2GHz Processing Power.
4. Device must have support for Virtual Reality Apps
5. Must have ARM architecture based hardware design

3.Specific Requirements

The inputs and outputs of the Application related to External Environment. We conducted Contextual Inquiry of around 50 people belonging to our target audience about various functional and non-functional requirements. Results of this are attached at the end of this document.

3.1 External Interfaces

Inputs

1. Head Movements of User detected via Accelerometer of Smartphone
2. Map of the Department through Memory of Device.

Outputs

1. Movement in Virtual Space:
    a. Forward
    b. Backward
    c. Left
    d. Right
2. Rotation of Character in Virtual Space:
    a. Look Up/Down
    b. Turn Left/Right
3. Details Pop-up of a particular Office/Lab

3.2 Functional Requirements

3.2.1 Navigation

- Input: User's Head Movement

- Output: Change both the location inside the virtual world and orientation of camera of augmented user.
- Description: This function handles the Movement of the User through the Virtual Space and the orientation of the Camera attached to the Augmented user. User moves by turning his head in the direction he wants to move and starts movement by turning his head down by a threshold angle.

3.2.1.1 checkDirectionalMovement

- Input: User's Head Movement ,Threshold Angle
- Output: bool Walking
- Description: This function converts the user's head movement data into sensor data and checks whether the angle is below threshold angle and correspondingly outputs whether user should move or not.

3.2.1.2 moveFront

- Input: bool Walking
- Output: Change the location inside the virtual world.
- Description: This function moves the Augmented User forward in the direction of Line of Sight with a constant speed.

3.2.1.3 checkRotationalMovement:

- Input: User's head Movement
- Output: Sensor Data (Gyroscope)
- Description:This function detects changes in the orientation of user's head by detecting change in Gyroscope Matrix i.e Sensor Data

3.2.1.4 Up rotation by W degrees.

- Input: Sensor Data (Gyroscope)
- Output: Change the camera orientation up by W degrees of line of sight inside the virtual world.
- Description :This function changes the camera orientation of augmented user up by W degrees to the Line of Sight

Similarly defined are:

3.2.1.5 Down rotation by X degrees.

3.2.1.6 Right rotation by Y degrees.

3.2.1.7 Left rotation by Z degrees.

3.2.2 viewDetails

- Input: Gaze of the User
- Output: Details of the Current Section (Pop Up)
- Description: This function allows the user to view the details of the Professor or a Section of a Department just by gazing at the door of that room.

Note : Gaze is a technique which uses the centre point of the screen as the point where the user is currently looking at.User can change the gaze by moving his head to point at the Object he wants the details of .

3.2.2.1 checkInteraction

- Input: Gaze of the User
- Output: Game Object which the user is gazing(looking at),bool HasDetails
- Description : Function to monitor Gaze of User constantly return the GameObject which is currently looked at and whether it has details associated.

3.2.2.2 displayDetails

- Input : GameObject , bool HasDetails
- Output: Details of the Current Section (Pop Up)
- Description : Function to display details of the Current Section of the Department.

3.2.3 Initialisation

- Input : Start of the App
- Output: Call the 3D visualisation to create the 3D world from the Map
- Description : This function initialises the 3D World around the user and initialises the coordinates to the entrance of the Department.

3.2.4 3D Visualisation

- Input: Call from Initialisation function(4)
- Output: Initialise and Update the surroundings according to the position of the augmented user.
- Description: This function is responsible for building and updating the Virtual World as the Augmented User moves/looks around.These functions come pre-built in Unity3D Software.

3.2.4.1 Build 3D Visualisation

- Input: Call from Initialisation function(4)
- Output: Create the 3D Virtual World around the user
- Description :Function which sets up the 3-D visualization around the augmented user.

3.2.4.2 Update 3D Visualisation

- Input: 3D Virtual World,Current user position.
- Output: Changes surroundings according to the position of the augmented user.
- Description :Since the surroundings change whenever the user moves, this function is needed to constantly calculate the 3D surrounding setup for each and every position and orientation of the user's view.

3.3 Non Functional Requirement

3.3.1 Contextual Inquiry Report

Problem and Solution Overview

The Aim of the app is to give an immersive Virtual tour of the Department of Computer Science and Engineering , IIT Guwahati.Apart from being Entertaining , this app helps people navigate and find places such as Professor's offices and Labs. etc within the department.Most of the VR tour apps are either static 360 images or 360 Videos with no control over movement.Our product aims to create a virtual department where users can move around freely as intuitively as possible.

Target Users

Rationale behind choice of users

We sought users who are representative of the target market for our application.In particular we sought out people who need to visit the department at least once be it either a student (Dept/Non-Dept) or a Professor. We also searched for people who represented different ages, careers and degrees of proficiency with technology.

Backgrounds of Users

We conducted four interviews, two with undergraduate students(CSE and Non CSE), one with a graduate student, and one with a professor.

One undergraduate is a sophomore in the CSE department.She is an average student (GPA ~ 7)with her needing to visit the department at least once every day for classes and labs.She has quiet good knowledge about the department.She sometimes wants to know where she needs to go before a class or a meeting with a professor.

The other undergraduate is a freshmen from the EEE Department and is good is his studies (GPA ~ 9).He currently doesn't visits the CSE Dept. but wants to take Minor in CS and wants to know the exact place to go before physically going there .

The graduate student is getting a master's degree in Computer Science and also works part time doing research.He is in his 1st Semester and has Computer Systems and Robotics lab in next semester.He wants to reach the lab on time on 1st day to make good expression.

The professor is from the another Department in his 2nd year with IIT Guwahati.With his busy schedule,he sometimes needs to visit other professors for academic and administrative affairs.He wants to get familiar with the department as soon as possible.

Contextual Inquiry

Process and Environment

All of our interviews were conducted in the homes of the users, often at their desks using our prototype developed after the 1st cycle of software development.Users had access to a smartphone with app installed and VR headset for immersive tour.

Our interviews were typically conducted by two team members, although on one occasion there was only one available. One interviewer typically focused on asking questions, while the other concentrated on taking notes and making sure that everything was covered.

A typical interview would begin by asking the user whether they knew how to operate a VR headset and use Gaze in VR.We would then have the user demonstrate to us how they used each tool.The users were then told the technique for navigation i.e In the virtual space look at an angle of more the 30 degrees below the line of sight to start walking.Also to turn the camera , they were told to turn their head by the same angle.
Users were also demonstrated on how to use Gaze VR to find the details of the Room(Office/Lab) they were looking at .
Users were then asked to navigate from entrance to the B.Tech 2nd year Lab and find details about the lab.To remove the knowledge bias they were told the path to reach their destination.He or she would then go through the navigation to reach the target, and explain what sort of thoughts led to each

decision made. We would observe how they moved inside the virtual world and on completion of the task ask questions about anything that we did not understand or found particularly interesting.

We typically concluded our interviews by thanking our users and presenting to them the idea of a Virtual Reality based tour app. We would gather the users' impressions of the idea and ask for suggestions.

Common Tasks and Themes

We observed that users once put headset on were completely engrossed in the virtual world.In order to move forward users had to dip their head by 30 degrees which the users found to be unintuitive.They also had to stop moving to look around themselves. The head turning to look around was used with ease . Users had to make some turns to get onto stairs or change lanes. While doing this, users bumped into the corner wall initially but later could adapted to the system.

We observed that users sometimes stopped moving unintentionally since they forgot their head had to be tilted downwards.This led to some frustration initially but users later adapted to this technique.

It was also observed that since the turning was based on rotation of the head , to take a U-turn in VR , users had to turn their body by 180 degrees.

Upon reaching the destination , users focussed Gaze on the door of the lab for 3 seconds to activate the viewDetails function.They were then shown a popup of information about the door they were looking at.

Task Analysis Questions

We have interviewed 2 undergraduates , 1 graduate and 1 professor from IIT Guwahati.The response has been analysed in the answers itself.

Q:Who is going to use the system ?

A: The system i.e VR based tour app will be primarily used by students and professors of IIT Guwahati who need information of CSE Department.It can be used for recreational purposes as well.

Q:What steps do they now perform for finding information in CSE Department?
A:Presently users physically have to go the department and ask people around to give information which is a time taking and painful process .

Q:What tasks are desired?
A:Users would like the system to be able to immerse them in the virtual world and allow continuous and intuitive navigation around the department.Users would also like to find details about Labs or Professors using the app itself.

Q:How is Navigation technique learnt by the users?
A:Users learn the technique by trial and error and experimentation with the application.They found the technique quite intuitive since while moving forward in real life, people tend to lean their head forward. Hence the technique was found to be reasonably intuitive.

Q:Would users like a Background audio while performing the task ? If yes,then what would you like it to be ?
A:Users wanted the background audio to be either immersive game music or Ambient noises (like footsteps etc).Both options are reasonable as Game Music would immerse the user more and Footsteps sound will make walking in virtual world even more intuitive.

Q: How often do users use VR apps (Tour apps specifically) ?
A:Users are more and more drawn toward VR apps specifically VR gaming.With the growing popularity of Google's StreetView, VR Touring is also gaining popularity among the users.

Q:What are users' reviews about the Navigation technique ?
A:Users found the technique quite intuitive since while moving forward in real life, people tend to lean their head forward.However users found the leaning angle to be too much to consistently maintain while moving forward.

Q:What are users' reviews about the Rotation technique ?

A:Since head movement are completely identical to the Camera movement in VR , Users found this to be intuitive and had no complaints regarding rotation.

Q:What are the time constraints on the task?
A:Users want to reach the required destination as fast as possible but at the same time do not want to lose control over navigation and rotation.Normal Walking Speed (1.4 m/sec) sufficed users' requirement for both criteria.

Conclusion
After thorough analysis of questions and observing users' activities,following decisions were taken.
1.The Threshold angle has been reduced to 15° since users' view area while walking was covering ground mostly.
2.Footstep Noises have been added since users wanted some ambient background audio

Distribution of Work
• Student 1 - interviewed two users, wrote up contextual inquiries and task analysis
• Student 2 - interviewed 1 user, wrote up task analysis and functional summary
• Student 3 - interviewed one user and expanded inquiries

3.4 Software System Attributes

3.4.1 Reliability

MTBF (Mean Time Between Failures) : Minimum value - 30 Seconds The software is supposed to work properly while running any applications while providing user with probable suggestions to change their operation method whenever required.

3.4.2 Availability

The system will be available for use whenever the user deems necessary 24/7. The system shall allow users to restart the application with User starting the Tour from the Entrance of the CSE Department.

3.4.3 Security

Being a tour app it would not need any type of Authentication.The Map files will be DRM encrypted by Unity itself to prevent unauthorized changes .

3.4.4 Maintainability

The system will be updatable from software patches available through the Google Play Store. Any discrepancies will be addressable by any developer as the coding will be done according to the coding standards of IEEE.

3.4.4 Portability

The software will be easily transferable to any Android device satisfying the minimum software dependency requirements as specified in this SRS Document. The software can be installed on an Android using the same method as any other Android App via the Android App Manager.