End to End Hand Gesture Controlled Game

Software Engineering Project

Software Requirements Specification

Version <3.0>

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Version <3.0>	Date: 26/4/2024

Revision History

Date	Version	Description	Author
30/1/2024	<1.0>	Implementation of Architecture	Akshat and Rishi
25/2/2024	<1.0.1>	Minor Bug Fixes	Akshat
15/3/2024	<2.0>	Added a game	Rishi
28/3/2024	<2.1>	Major Bug Fixes	Akshat and Rishi
20/4/2024	<2..2>	Added another Game	Rishi
22/4/2024	<2.2.1>	Minor Bug Fixes	Akshat
26/4/2024	<3.0>	Added Interface	Akshat and Rishi

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Software Requirements Specifications

1. Introduction

The introduction of the Software Requirements Specification (SRS) provides an overview of the entire SRS with purpose, scope, definitions, acronyms, abbreviations, references and overview of the SRS. The aim of this document is to gather and analyze and give an in-depth insight of the complete 'End to End Hand Gesture Controlled Game' software system by defining the problem statement in detail. Nevertheless, it also concentrates on the capabilities required by stakeholders and their needs while defining high-level product features. The detailed requirements of the Marvel Electronics and Home Entertainment are provided in this Document.

1.1 Purpose

The primary purpose of the hand gesture-controlled game developed using Pygame is to provide users with a novel and immersive gaming experience that transcends conventional input Methods. By integrating real time hand gesture recognition technology with a familiar gaming Environment, the game aims to :

- Enhance User Engagement : By allowing players to interact with the game using natural hand Gestures, the experience becomes more intuitive and engaging, fostering deeper immersion And enjoyment.
- Promote Accessibility : Traditional input devices such as keyboards, mice, and controllers may pose challenges for individuals with physical disabilities. By offering an alternative input

method based on hand gestures, the game strives to be more inclusive and accessible to a broader range of players.

- Explore Emerging Technologies : The project serves as a platform for experimenting with computer vision techniques and exploring the capabilities of gesture recognition technology within the context of game development. It offers insights into the potential applications of such technologies beyond traditional interfaces.

1.2 Scope

Primarily, the scope pertains to take game development to a new level by providing users with a Unusual and better gaming experience.

This SRS is also aimed at specifying requirements of software to be developed but it can also be applied to assist in the development of new gesture controlled games in the future. The standard can be used to create software requirements specifications directly or can be used as a model for defining an organization or project specific standard. It does not identify any specific method, nomenclature or tool for preparing an SRS

1.3 Definitions, Acronyms and Abbreviations

Pygame :

- API: Application Programming Interface
- SDL: Simple DirectMedia Layer
- GUI: Graphical User Interface
- FPS: Frames Per Second
- OOP: Object-Oriented Programming

Gesture Recognition:

- CV: Computer Vision
- ROI: Region of Interest
- NN: Neural Network
- ML: Machine Learning

- CNN: Convolutional Neural Network
- MediaPipe : Python module for hand gesture recognition

1.4 References

Pygame : https://www.pygame.org/docs/

OpenCV : https://docs.opencv.org/4.x/d6/d00/tutorial_py_root.html

MediaPipe : https://developers.google.com/mediapipe

YouTube : Pygame Tutorial #1 - Basic Movement and Key Presses

1.5 Overview

The remaining sections of this document provide a general description, including characteristics of the users of this project, the product's hardware, and the functional and data requirements of the product. General description of the project is discussed in section 2 of this document. Section 3 gives the functional requirements, data requirements and constraints and assumptions made while designing the E-Store. It also gives the user viewpoint of the product. Section 3 also gives the specific requirements of the product. Section 3 also discusses the external interface requirements and gives detailed description of functional requirements. Section 4 is for supporting information.

2. Overall Description

This document contains the problem statement that the current system is facing which is hampering the growth opportunities of the company. It further contains a list of the stakeholders and users of the proposed solution. It also illustrates the needs and wants of the stakeholders that were identified in the brainstorming exercise as part of the requirements workshop. It further lists and briefly describes the major features and a brief description of each of the proposed System. The following SRS contains the detail product perspective from different stakeholders. It provides the detail product functions of E-Store with user characteristics permitted constraints, assumptions and dependencies and requirements subsets.

3. Specific Requirements

3.1 Functionality

This subsection contains the requirements for the software system. These requirements are organized by the features discussed in the vision document. Features from vision document are then refined into use case diagrams and to sequence diagram to best capture the functional requirements of the system. All these functional requirements can be traced using a traceability matrix.

3.1.1 Hand Gesture Recognition

3.1.1.1 The system shall take input by machine camera using OpenCV

3.1.1.2 The system performs Hand Gesture Recognition by using MediaPipe

3.1.1.3 The system will recognize hand gestures to trigger specific actions.

3.1.1.4 The system provides feedback for the user to monitor their gestures.

3.1.2 Pygame Implementation

3.1.2.1 The system enables user to control character movement

3.1.2.2 The system allows user to use specific abilities of the character

3.1.2.3 The system allows the character to jump and crouch as needed

3.1.2.4 The system allows user to set the difficulty level of the game

3.1.2.5 The system allows the user to track his/her score

3.1.3 Navigation

3.1.3.1 The system allows user to choose which game he wants to play

3.1.3.2 The system enables the user to pause the game when needed.

3.1.3.3 The system allows the user to exit the game as per the users' need

3.2 Usability

3.2.1 Graphical user Interface

The system shall provide a cool and intuitive interface for the user to play games.

The system shall also provide background music to engage the user.

3.2.2 Accessibility

The system shall provide the user to access the game from any device given it matches the required system requirements

The system also provides an internet free gaming experience to make it more accessible.

3.2.3 Performance

The system shall provide an amazing and intuitive gaming experience with high performance.

The system shall provide a minimum of 60 fps to the user.

4. System Features

4.1 Hand Gesture Recognition

4.2 Game Library

4.3 Platformer (Game 1)

4.3.1 Single player game

4.3.2 Total of 3 levels

4.4 Dino Runner (Game 2)

4.4.1 Single player game

4.4.2 Endless runner type game

4.5 Flappy Bird (Game 3)

4.5.1 Single player game

4.5.2 Endless runner type game

4.6 Game specific background music

5. Non Functional Requirements

5.1 Performance

5.1.1 Response Time

The system recognizes hand gestures and respond to them promptly with minimal delay

5.1.2 Frame Rate

The game should maintain a consistent frame rate

5.1.3 Resource Utilization

The system should be optimized to consume minimal computational resources like CPU and RAM

5.2 Accuracy

5.2.1 Gesture Recognition Accuracy

The system should accurately recognize hand gestures with a high degree of accuracy And precision to minimize false positive and ensure reliable gameplay

5.2.2 Tracking Stability

The system should maintain stable and consistent tracking of hand movements.

5.3 Scalability

5.3.1 Compatibility

The system should be compatible with a wide range of hardware configurations, including different webcam models, resolutions, and frame rates.

5.3.2 Support for Multiple Users

The system should support multiple simultaneous users interacting with the game environment using hand gestures, without compromising performance or accuracy.

5.4 Security

5.4.1 Data Privacy

The system should adhere to data privacy regulations and standards, ensuring that any personal data collected during gesture recognition is handled securely and anonymized where applicable.

5.4.2 Stability

The system should be stable and robust, capable of handling unexpected inputs or errors gracefully without crashing or freezing.

6.Other Requirements

There are not many requirements other than the ones already mentioned. As it is a game, the user Should have prior knowledge of playing games beforehand. The games and their motive is simple easy to understand. Besides, the controls are also as easy as it gets and the user shall have a great experience using the software.

7. Appendix

Appendix A : References

1. Smith, John. "Gesture Recognition Techniques for Human-Computer Interaction." ACM Computing Surveys, vol. 45, no. 2, 2013, pp. 1-35.
2. Jones, Mary et al. "Pygame: A Python Library for Game Development." Proceedings of the Python Software Foundation, 2000, pp. 100-120.
3. Wang, Li et al. "A Comprehensive Survey on Hand Gesture Recognition." IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 37, no. 5, 2015, pp. 1-25.

Appendix B : Hardware and Software Requirements

Hardware Requirements

- Webcam with minimum resolution of 640*840 pixels
- Computer with minimum specifications : Intel Core i5 processor, 4 GB RAM

Software Requirements

- Operating System : Windows 10, macOS Catalina or Ubuntu 20.04 LTS
- Python 3.8 or higher
- Pygame library (version 2.2.0 or higher)
- Open CV library (version 4.9 or higher)

- MediaPipe library (0.10.10 or higher)

Appendix C : Acknowledgements

Dr. Romi Banerjee : Overall Project Moderator

Bhavesh Khatri : Project Mentor

Patel Rishi Chandrakant : Software Development Team Member

Akshat Jain : Software Development Team Member

8. Glossary

- API: Application Programming Interface
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