Florida International University
Knight Foundation School of Computing and Information Sciences

Software Engineering Focus

Final Deliverable

Project Title: LEADER

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Abstract

This document is necessary in understanding the usage of LEADER. LEADER is a VR law enforcement de-escalation simulation in which players are placed in situations where they are tasked with de-escalating a variety of situations. The point of these situations is to help train law enforcement with de-escalation tactics in differently generated situations.

LEADER uses AI to generate conversations with the player. The goal of using AI is to generate different situations with different levels of unpredictability. The game allows the player to speak into the game, and receive a verbal response back from the actor. The end goal of these situations is to make the actor agree to perform some sort of action which signifies that the actor has calmed down and the situation is de-escalated.

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Introduction

In the ever-evolving landscape of law enforcement, the ability to effectively de-escalate potentially volatile situations is paramount. Traditional training methods, while valuable, often lack the immersive and interactive elements necessary to fully prepare officers for the complexities they face in the real world. Recognizing this gap, the LEADER project embarked on a groundbreaking endeavor to develop an AI-based police de-escalation training simulator.

Current System

Current police de-escalation training methods primarily rely on classroom instruction, role-playing scenarios, and video simulations. While these methods provide a foundation for

understanding de-escalation principles, they often fall short in replicating the dynamic and unpredictable nature of real-world encounters. Officers may struggle to translate classroom knowledge into effective action when faced with the heightened emotions, split-second decisions, and unpredictable interactions that characterize real-world de-escalation scenarios.

Purpose of New System

The LEADER simulator addresses the limitations of traditional de-escalation training methods by providing officers with an immersive and interactive training experience that mimics the challenges and complexities of real-world encounters. Through the use of AI-powered actors, and advanced natural language processing, the simulator creates realistic scenarios that demand officers to apply their de-escalation skills in real time.

User Stories

- User Story 1: Background and research
- User Story 2: API implementation & development
- User Story 3: AI development & implementation
- User Story 4: Asset development & implementation
- User Story 5: Situation assessment
- User Story 6: Modification of AI difficulty or unpredictability
- User Story 7: Deployment

Implemented User Stories

- User Story 1: Background and research
- User Story 2: API implementation & development
- User Story 3: AI development & implementation
- User Story 4: Asset development & implementation

Pending User Stories

- User Story 5: Situation assessment
- User Story 6: Modification of AI difficulty or unpredictability
- User Story 7: Deployment

Project Plan

The LEADER project succeeded through a meticulous planning phase that involved extensive research, agile development, and rigorous testing. The project team evaluated game engines, VR hardware, and text-to-speech APIs to determine the most effective combination for their VR-based police de-escalation training simulator. Agile development techniques were utilized to organize the project into sprints with defined goals and deliverables, promoting efficient collaboration and task completion. Clear roles and responsibilities were assigned to team members, fostering effective communication and issue resolution. This thorough planning established the groundwork for subsequent development, testing, and deployment phases.

Hardware and Software Resources

The following is a list of all hardware and software resources that were used in this project:

Hardware Resources:

- Oculus Quest 2 VR headsets
- High-performance workstations with powerful GPUs
- Software Resources:

Unity game engine
- Hugging Face SDK for speech-to-text conversion
- Llama 2 for natural language processing
- Amazon Polly for text-to-speech conversion
- 3D modeling software
- Audio editing software
- Version control system

Sprints Plan

Sprint 1

- Research and understanding of police de-escalation tactics and situations.

Sprint 2

- Research and capability testing of different AI conversational models.

Sprint 3

- Development of Unity environment and VR implementations.

Sprint 4

- Development of the main workflow mechanic involving text-to-speech pipeline.

Sprint 5

- Development of realistic assets involving Actor models and setting models.

Sprint 6

- More testing of AI conversational abilities and inclusion of realistic animations and elements of Unity environment.

System Design

This section contains information on the design decisions that went into this project. The architecture patterns are outlined and explained. The entire system is shown in a package diagram and the subsystems are explained. Finally, the design patterns used in the project are discussed.

Architectural Patterns

The LEADER project utilized a pipeline architecture to streamline data processing and interactions between its components. This architecture enabled the efficient flow of user inputs, AI actor behavior determination, and simulation updates, contributing to a smooth and immersive VR training experience. The pipeline's modular design ensured ease of development, maintenance, and scalability.

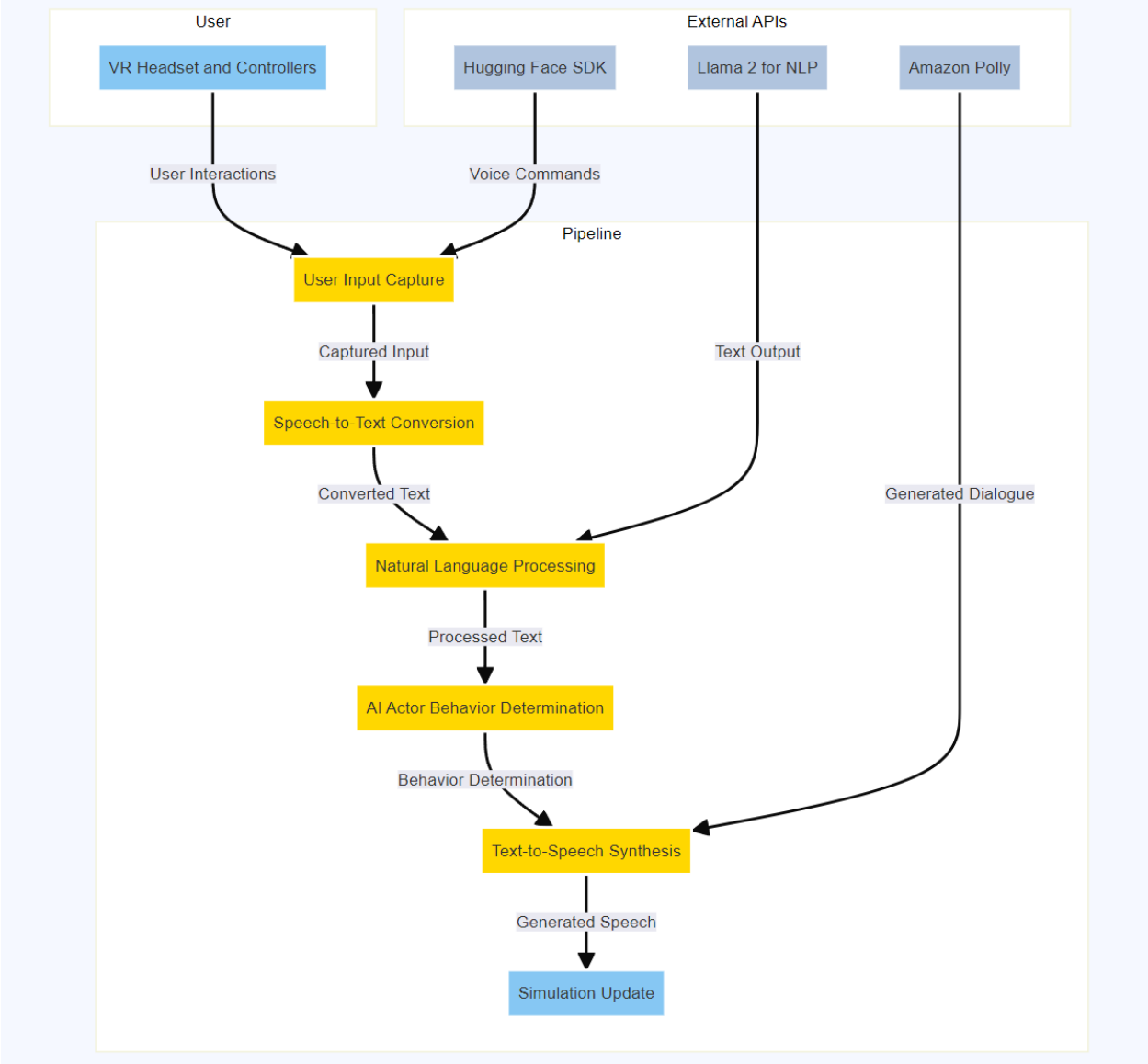
System and Subsystem Decomposition

The LEADER project can be decomposed into the following subsystems:

AI Actor Subsystem: Responsible for controlling and animating AI actors, including their movements, dialogue, and interactions with the environment and the user.

Speech and Text Processing Subsystem: Utilizes Hugging Face SDK, Llama 2, and Amazon Polly to enable real-time speech-to-text conversion, natural language processing, and text-to-speech generation.

Deployment Diagram



Design Patterns

Dependency Injection Pattern: Facilitated loose coupling between components, allowing for easy testing and replacement of dependencies without modifying the dependent code.

Observer Pattern: Enabled components to subscribe to events generated by other components, enabling efficient communication and data synchronization.

Singleton Pattern: Ensured that only one instance of certain critical components, such as the scenario manager, existed, guaranteeing consistent data access and behavior.

System Validation

Alpha Testing:

Conducted by the project team to identify and rectify internal bugs, usability issues, and performance bottlenecks.

GLOSSARY

AI Actor: A non-player character controlled by artificial intelligence that interacts with the user within the VR simulation.

De-escalation: A set of techniques and strategies used to reduce tension and avoid conflict in potentially volatile situations.

Natural Language Processing (NLP): The field of computer science concerned with enabling computers to understand, interpret, and generate human language.

Speech-to-Text Conversion: The process of converting spoken language into text format.

Text-to-Speech Synthesis: The process of converting written text into synthesized speech.

VR Headset: A wearable device that provides a virtual reality experience.

APPENDIX

Appendix A - User Interface Design

Appendix B - Sprint Review Reports

Appendix C - User Manuals, Installation/Maintenance Document, Shortcomings/Wishlist Document and other documents

References

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