Final Project Report

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***Abstract*—Virtual Reality (VR) Technology has been developing rapidly over the past decade. Current solutions such as Unity attempt to use old programming languages and paradigms to implement VR environments and thus limit developers' abilities to create new and unique environments. With every cutting edge technology, new paradigms and design patterns must be invented. In this paper, we discuss a new modular, immediate mode, promise-based application design philosophy (PBIM) suitable for implementing large virtual reality applications. We present a library which implements this design philosophy and a few case studies of this library in use.**

I. Introduction

The Virtual Reality (VR) market is growing rapidly. The International Data Corporation (IDC) projects that revenues for the combined Augmented Reality (AR) and Virtual Reality markets will grow from $5.2 billion in 2016 to more than $162 billion in 2020 [1]. This flourishing new industry has created an exciting new field of Software Engineering with great potential for revolutionary new design paradigms and program architectures.

Most current frameworks and libraries attempt to apply old design paradigms and program architectures that are well-suited for 2D user interfaces and rendering 3D environments to a flat screen to virtual reality. Although these endeavors have been successful, they do not fully explore potential new design paradigms and program architectures.

Our goal was to develop innovative environments with We wanted to use a modern, fast, and usable framework to create these virtual reality applications. After analyzing the current solutions, realized that the current methods had many drawbacks. We will examine them in turn.

A. Frame Rate

Virtual Reality requires a very high frame rate. A virtual reality program must be capable of generating 90 frames per second (fps). Because there are two eyes, and thus two screens to render to, the effective required frame rate is 180fps. Achieving this frame rate is resource intensive and requires highly efficient and optimized code. Additionally, multithreading is imperative so that long-running processes can occur without blocking the user interface. This is unlike a traditional desktop user interface where blocking the UI process for a second does not have a major affect on the usability of the program.

B. 3D Environment

C. Programmability

D. Open Source

We chose to take a step back from the predominant design philosophies and explore alternative architectures.

In this paper, we present a new program architecture and user interface design paradigm which builds on and combines concepts from many previous architectures.

II. Evolution PBIM

A. Entity Component System

B. React-Like Architecture

III. Promise-Based Immediate Mode (PBIM)

A. Promise-Based

B. Immediate Mode

IV. Flight

Flight is our implementation this new PBIM design philosophy. It is written in Rust and is designed to be highly modular. It implements the PBIM design philosophy using Rust `FnOnce` closures and resolves state using a *guru* system.

References

[1] IDC. *Worldwide Revenues for Augmented and Virtual Reality Forecast to Reach $162 Billion in 2020, According to IDC*. Aug. 15, 2016. URL: https://www.idc.com/getdoc.jsp?containerId=prUS41676216.