# Virtual Production and Live Performance Capture

Authors Tucker Burke

Location Artist Community Performance Arts Studio

Market Apartments at Corpus Christi

Rochester, NY 14605

Date 5.22.20

Executive Summary

I'm a fourth year Game Design and Development student. I transferred into the program after completing an AS in Computer Science. I studied 3D animation at SUNY Alfred for a couple of years after completing high school. I have professional experience in various graphic arts and a history of success in unsupervised positions. The proposed project makes use of this combined skillset. I would like to do this project because it will allow me to showcase this combination of skills in a way that is applicable in a number of industries including: video games, film, television, and advertising.

Virtual production is a means of creating film or game cinematics where the physical and digital worlds combine to create a heightened sense of reality. During this project is to assemble and implement a DIY virtual production toolset to create a short cinematic. **The goal of this project is to create a resource to compare entry level hardware and software performance to aspiring virtual producers.** A few of the tools that will be utilized are: motion capture, facial capture, real-time virtual cameras, and live compositing. Implementing these technologies will require ingenuity. Multiple solutions will be explored such as: repurposing and modifying hardware, creating custom software interfaces or plugins, utilization of Arduino, along with the testing of various virtual reality sensors. Ultimately, the tools will have to perform at a speed that allows for real-time recording in Unreal Engine.

Note that a successful "product" in this project is twofold. The cinematic will be used as marketing material to help with additional, future fundraising. The other half being the toolset itself. The research will help determine the most cost effective, consumer grade, DIY solutions for inspiring indie game developers and film makers. The process of selecting components, building this toolset, and putting it all together to create a showcase demo will be documented and uploaded as a resource for those interested in replicating the results.

I live in a state subsidized artist's community with a large, live performance studio perfect for testing. I have fortunately, already received the minimum funding required for this project and am able to operate under my freelancing DBA, Brand New Creative, LLC. Additional funding

would allow for much higher visual quality. The project would begin June 15th and would span twelve weeks.

Table of Contents

# 1 Introduction and Project Goals

The objective of this project is to create DIY virtual production solutions within budget that perform the following functions:

- **Motion Capture** – process of recording the *movements* of live performance actors
- **Facial Capture** – process of recording the *movements* of a person's face
- **Virtual Camera** – process of recording the *movements* of a physical representation of a camera.
- **Live Compositing** - process of combining real world actors and sets with computer generated graphics via virtual cameras in *real-time*. Live compositing is a stretch goal because it appears to be too costly for obtainable budget but still warrants consideration.
- **Custom Tools** – creation of custom hardware and software solutions to improve the capabilities and usability of the toolset

All of these features will have to be utilized in tandem to create a demo cinematic that showcases the capabilities and limitations of the toolset along with how the toolset can be improved and expanded. The project does not hinge on the success of any one project function. So if perhaps I'm unable to find a viable affordable solution within the twelve week project, the remaining functions will be able to continue through the demos production.

# 2 Project Team

The creation of the toolset along with the production of the demo cinematic are solo projects. There are a number of actors and dancers in my building who expressed interest in performing for motion capture. However, at this point these are just leads, no one has committed, and this is not required for successful completion of the project.

## 2.1 Full-time/Part-time

Team members that want co-op credit: Tucker Burke
IGM courses completed for eligibility: pending
Career services co-op orientation completed: pending

## 2.2 Primary Mentor/Supervisor

pending

# 3 Project/Product Concept

## 3.1 High Concept

Assembling a DIY consumer grade, virtual production and performance capture toolset by combing affordable hardware and software solutions to achieve the highest possible production quality.

## 3.2 Abstract

Assembling a DIY consumer grade, virtual production and performance capture toolset by combing affordable hardware and software solutions to achieve the highest possible production quality. This is a toolset to be used by aspiring indie game developers and film makers to add realistic animation and motion to digital characters, their faces, and the cameras in their scenes. This will be accomplished by capturing real world motion from actors and a director operating the virtual camera. The ready-made, out of box solutions to these functions come at a premium. Making these technologies accessible to independent creators via a comprehensive presentation and guide is something I have yet to find. The process of selecting components, building this toolset, and putting it all together to create a showcase demo will be documented and uploaded as a resource for those interested in replicating the results.

## 3.3 Overview

These products are used to capture real life motion in a way that can then be attached to 3d digital models and cameras in order to animate them in an incredibly realistic manner. The purpose of the project is to develop these products and lower the barrier to entry by greatly reducing equipment costs. Here is an overview of how I intend to approach each of the functions I will implement in the toolset. A more detailed breakdown is available in the appendix. All of these are subject to change as some of these solutions will likely prove problematic and more research will have to be conducted during the duration of the project.

Motion Capture – To capture humanoid, bipedal motion I will test using camera systems that are capable of sensing depth information in real-time as well as virtual reality style sensors. There is several different software to try pairing with each of these units as well. The results I have seen documented with these solutions have been somewhat subpar for professional use. I will determine how these can be improved with additional effort or programming. The costliest pair of these solutions would net under $400. Meanwhile, the least expensive professional mocap solution I was able to find is priced $1,800 not including software. I will test utilizing the data in both real-time and offline environments. However, the demo will use offline data for mocap.

Facial Capture – Over the past few years we have seen great advances in facial motion capture on mobile devices in software such as Snapchat. I intend to test this hardware as well more

powerful desktop camera capture systems. I will have to build a makeshift helmet as well in attempt to capture facial motion while also capturing body motion. I may discover doing them separately results in higher quality. The highest cost pairing I will be testing again is below $400 unless I am able to obtain a GoPro camera which would be an additional $200 or so. The greatest cost for testing DIY facial capture will be shaving my beard for better accuracy! Low end professional hardware solutions start in the $2,000 range. I will test utilizing the data in both real-time and offline environments. However, the demo will use offline data for facial capture.

Virtual Camera – To capture camera motion I will test VR sensors, headset, and wands as well as mobile device gyroscopes. There will likely be some 3d mathematic required here. This will be mounted to a camera shoulder rig with an optional screen mounted as a viewport. This could potentially be a mobile device if Wi-Fi performance proves of quality. This solution is intended to be done in real-time via Unreal Engine, but I will explore exporting the data to an offline render engine for educational purposes as well.

Live Compositing – As mentioned above this is a stretch goal because research has already shown that it will be difficult to create viable quality without additional funding. There are however, many ways to approach this function. In addition to a camera which captures live film at production quality, there is the choice between green screen, projectors, and LCD walls. Additionally, without a very expensive LCD enclosure there is the challenge of syncing real-world lights with digital scene lights in real-time. I do have access to a couple of cameras and may acquire a GoPro for some level of educational experimentation in this area.

# 4 Proposed Schedule

See Appendix for additional information

| Week | Tasks(s) |
|---|---|
| 1 | Build physical hardware |
| 2 | Scenes, assets, and data |

| | |
|---|---|
| 3 | Virtual Camera |
| 4 | Virtual Camera 2 |
| 5 | Motion Capture |
| 6 | Motion Capture 2 |
| 7 | Facial Capture |
| 8 | Facial Capture 2 |
| 9 | Demo Testing and Planning |
| 10 | Demo Capture |
| 11 | Demo Assembly |
| 12 | Polish, Post Mortem, Resources |

# 5

## 5.1 RIT Resources

## 5.2 Funding/Overhead

Funding for this project falls into two categories: the first being the capture devices and the software required to operate them, the other being the computer which will process this real-time data. Being that this is aimed at analyze consumer level DIY solutions, I am trying to keep the budget as low as possible, while attaining the best visual fidelity available to the assembled hardware. This build is based off of upgrading my current rig (i-3 cpu, 1080 gpu, and 24 gig ram) to something capable of producing viable professional results. Some features, as seen below, that are pay gated beyond the entry tier. In addition, I already owned a couple of the capture devices. This, along with a generous product tester, is reflected in the discounted cost. Fortunately, I have attained funding for the minimum viable product, which is also detailed below.

**Legend**

| | |
|---|---|
| Minimal Viable Product | xxxxxx |
| Additional Capture Methods | xxxxxx |
| For Quality Increase | xxxxxx |

| **Capture Hardware** | **Retail cost** | **Discounted cost** |
|---|---|---|
| HTC VIVE Cosmos Elite | $899 | $600 |
| VIVE Tracker x 3 | $99 x 3 | $99 x 3 |
| Valve Knuckles | $279 | $279 |
| Additional VIVE straps | $70 | $70 |
| Xbox Kinnect x 2 | $95 x 2 | $20 |
| Kinect PC adapter x 2 | $28 x 2 | $28 x 2 |
| Logitech HD Pro C920 | $80 | $0 |
| GoPro Hero 7 | $330 | $330 |
| Shoulder Rig | $50 - $100 | $50 - $100 |
| DIY Head Rig | $80 | $80 |
| | | |
| **Capture Software** | | |
| iClone Studio | in contact | in contact |
| Unreal Engine 4.5 | free | free |
| | | |
| **PC Rig** | | |
| Gigabye X570 AUROS Elite | $199 | $199 |
| AMD Ryzen 3700X | $275 | $275 |
| Cooler Master NR600 | $70 | $70 |

| | | |
|---|---|---|
| Gigabyte RTX 2080 Windforce | $720 | $720 |
| Gigabyte AOURUS 500gb NVMe | $119 | $70 |
| Viper Steel DDR4 RAM 16gb x 2 | $70 + $90 | $165 |
| Massdrop Vast Ultrawide 100hz | $500 | $225 |
| ASUS ROG Ryujin 360mm AIO | $360 | $100 |
| Misc Wiring | $50 - $100 | $50 – 100 |
| | | |
| **Total** | $4814 | $3661 |
| Total Discount Donated | $1153 | |
| Minimum Viable Total | $1865 | |
| Personal Contribution | $1650 | |
| Additional Funds Raised | | |

## 5.3 Marketing/Distribution

## 5.4 Competitive Analysis

## 5.5 Focus Groups

## 5.6 Feedback

## 5.7 Distribution

# 6 Justification

## 6.1 Team Merits

## 6.2 Co-op Equivalency

| | |
|---|---|
| Qualifications | |

| | |
|---|---|
| Minimum hours | |
| Industry experience gained | |
| Job search process | |
| Mentoring | |
| Compensation | |
| Skill development | |

# 7

## 7.1 Licensing

# 8 Post-mortem

# 9 References

# 10 Acknowledgements

# 11 Appendices

Project Title: _____

Project Supervisor: _____

Supervisor approval (signature): _____ Date: _____

**IGM Department Approval***

Approved by:

Elouise Oyzon (IGM Undergraduate Program Coordinator):

_____ Date: _____

*The IGM Undergraduate Program Coordinator is the final arbiter of the number of hours of co-op credit (if any) that will be allowed for each team member of the project (at least 10 – 12 weeks & 350+ hours are required for a full co-op). This will be determined upon the completion of both the project and the post-mortem report.

Updated 04/01/2020