ARSCAPES Documentation plagiarism Report

by BATCH-5, PROJECT PHASE-2

Under the esteemed Guidance of

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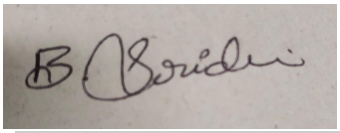


Submission date: 28-Mar-2024 01:28PM (UTC+0530)
Submission ID: 2333609256
File name: RemovePagesResult_2024_03_28_07_57_24.docx (745.05K)
Word count: 4295
Character count: 25906

ABSTRACT

ARSCAPES is leading the way, in innovation by spearheading an effort to make motion capture technology more accessible to all. This groundbreaking project focuses on ensuring that both cost and complexity are no barriers thus transforming the realms of education and tourism.

Traditionally motion capture technology has been costly and intricate limiting its use to industries and prestigious institutions. However, ARSCAPES is changing this narrative by utilizing camera systems and popular software like Unreal Engine 5 and Unity3D.

The educational sector is among those benefiting greatly from ARSCAPES. Through its methods students are transported to learning environments that were previously out of reach. With ARSCAPES enabling teaching educators can offer experiences that enhance student engagement and comprehension.

Furthermore, ARSCAPES expands its influence, into the field of tourism. Through providing captivating tours led by engaging companion travelers can set off on memorable adventures right from their mobile device. Whether discovering ruins, exploring terrains or immersing, in historical sites ARSCAPES enhances the travel experience by merging the real world with the virtual realm.

To sum up ARSCAPES symbolizes a change in how we interact with learning and travel. By making motion capture technology more accessible it not transforms methods but also sets the stage for a tomorrow where immersive adventures are achievable, for all.

INTRODUCTION

In a time when technology is continuously shaping our world there is a project that stands out for its goal of making education more accessible and transforming the tourism industry. ARSCAPES isn't, about technology; it's about sparking change removing barriers and creating a future where learning has no limits and exploration knows no boundaries.

At its core ARSCAPES has an impactful vision; to bring learning experiences and immersive travel to everyone regardless of where they are. Picture a classroom where students can go on adventures to places led by expert teachers who transcend physical limitations with the help of technology.

ARSCAPES stands out for its combination of technology and a strong focus, on inclusivity and accessibility. By harnessing software platforms such as Unreal Engine 5 and Unity3D ARSCAPES enables individuals of all backgrounds, not experts to craft experiences.

Our era of fast technology and links has seen ARSCAPES reshape how we learn and travel. This ground-breaking project blends advance•d tech with engaging experiences. But it's more it opens up worldwide knowledge and adve•nture access like never before.

ARSCAPES makes motion capture tech easy to use. Its goal is inclusion letting teachers, coders, and fans create immersive content. By sharing these tools, ARSCAPES helps everyone explore education and tourism. We gain new ways to learn and appreciate our world. Simple tools give complex understanding.

PROBLEM IDENTIFICATION

In the world of motion capture technology, the conventional methods have faced issues over time making it difficult for them to be widely accepted and efficient. When we examine the complexities of motion capture systems it becomes clear that they encounter problems related to expenses, intricacy and limitations in capturing movements. These obstacles not hinder the accessibility of motion capture technology. Also impact the precision and quality of recorded motions prompting a thorough investigation and evaluation.

The high costs associated with utilizing motion capture technology act, as a barrier for individuals and organizations looking to integrate it into their operations. The expenditures involved in acquiring equipment such as, top notch cameras, sensors and exclusive software present a financial challenge.

Apart from concerns the complex nature of motion capture systems poses a significant hurdle for users, with varying levels of expertise. The process of setting up and calibrating requires attention to detail and expertise, in operations. It often involves knowledge in configuring hardware and integrating software. Additionally resolving problems, like synchronization errors, marker obstructions and data discrepancies requires an understanding of motion capture principles and effective troubleshooting methods.

Moreover, traditional motion capture systems have limitations, in capturing details like facial expressions and intricate hand movements. Despite improvements in hardware and software these systems struggle to reproduce the nuances of human movement. Issues such as marker placement, lighting conditions and obstructions can lead to inaccuracies in captured data resulting in imperfections that affect the realism of motion captured performances.

OBJECTIVE

Our objective is to revolutionize motion capture technology by implementing an augmented reality solution that utilizes webcams and Python scripting, responding to the challenges of cost and complexity in traditional motion capture systems.

In order to limit the need for specialized equipment and software, as well as optimizing accuracy and efficiency in movement analysis, we can use augmented reality. The primary devices for capturing are webcams which offer a cheaper alternative compared to highly-priced motion capture cameras.

In addition to addressing financial constraints that come with typical motional capture systems, the proposed solution simplifies setup and calibration procedures hence reducing complexity. With an interface that requires fewer technicalities not forgetting its simplicity, small studios can easily incorporate this tool into their production pipeline bringing about new ways of creation on top of improving their projects' quality.

The main objective of our work is to make motion capture technology affordable and easy to use by integrating it with augmented reality, python scripting and webcams. This will broaden the range of motion capture applications that can be used in different fields such as healthcare, sports analysis, telepresence and virtual training.

Employing augmented reality, we can produce immersive environments that cut across established limits; which means that users get to interact with motion-captured content live and within many places. Webcams are considered the ubiquitous capture devices that would help in wide adoption and integration with hardware infrastructure already existing.

Motion capture innovation now reaches out to various sectors due to its increased versatility. Motion Capture is a key element of physical therapy and rehabilitation in healthcare where patients can perform exercises under the guidance of virtual trainers

SYSTEM METHODOLOGIES

Research and Development:

This includes understanding its traditional drawbacks, expenses, and complexities. This research guides the development of ARSCAPES, informing decisions on the specific technology, software integration, and the overall project direction.

Technology Selection:

Based on the research, suitable camera systems and software like Unreal Engine 5 and Unity 3D are chosen for the ARSCAPES project. The focus is on affordability, accessibility, and compatibility with educational and tourism uses.

Software Development:

The Chosen software platforms are used to create the ARSCAPES application. The development team works on making user-friendly interfaces, smoothly integrating motion capture technology, and optimizing the app for different devices, including mobile phones.

Testing and Iteration:

Once the Initial development is done, thorough testing is carried out to make sure the ARSCAPES project works well, performs efficiently, and easy to use. Feedback from teachers, students, tourists, and other people involved is gathered and used to make continuous improvements and enhance the overall experience for users.

Educational Integration:

Collaborating with schools and colleges is key for successfully incorporating ARSCAPES into the classroom. We offer workshops, training, and learning materials to help teachers use ARSCAPES to increase student engagement and understanding across different subjects and grade levels.

Empowering Creativity:

ARSCAPES strives to empower artists, designers and developers to create captivating experiences. Workshops, tutorials and collaborative projects are organized to nurture creativity and innovation within the ARSCAPES community promoting inclusivity and diverse storytelling in entertainment.

Embracing Accessibility and Inclusivity:

Emphasis is placed on ensuring accessibility and inclusivity throughout the development process. This involves optimizing the ARSCAPES application for users with varying knowledge levels and addressing barriers like language differences or physical disabilities.

Continuous Feedback:

Monitoring the impact of ARSCAPES is done through evaluation processes. Data analytics, user surveys and feedback help assess its effectiveness in education, tourism and creative sectors. Insights gathered inform enhancements to the project.

Sharing Information and Encouraging Adoption:

Efforts are made towards spreading awareness, about ARSCAPES among target audiences for adoption. This involves advertising initiatives, special events and partnerships, with media platforms and influencers to increase awareness and spark curiosity in the impact of ARSCAPES, on enhancing travel adventures for everyone.

Building Partnerships in Tourism:

It's crucial to collaborate with tourism organizations and destinations to boost the use of ARSCAPES, in the tourism sector. Tailored tours and experiences are crafted to highlight how ARSCAPES can enhance travel draw in tourists and spark interest from stakeholders.

OVERVIEW OF TECHNOLOGIES

Technologies used:

* Machine Learning (Open CV)
* Machine Learning (Media Pipe)
* Unity (cs sharp)
* Unity (unity inbuilt scripts)
* Unity (Unreal engine 5.2)
* Live link
* Facemaker
* Unreal engine blue prints (C++)

Machine Learning OpenCV refers to the combination of machine learning algorithms and techniques with OpenCV library. OpenCV (Open Source Computer Vision Library) is an open-source software for computer vision and machine learning. It provides numerous functions for real-time computer vision applications, such as image processing, feature detection, object detection, tracking, and more.

This refers to using machine learning techniques within the OpenCV framework to create computer vision applications. This allows developers to combine traditional computer vision algorithms with modern machine learning methods, unlocking powerful capabilities for their projects.

Machine learning techniques, when combined with OpenCV, can improve different parts of motion capture systems. This includes detecting movements, tracking them, estimating posture, recognizing gestures, filtering data, and predicting motion.

Machine Learning in MediaPipe usually involves using deep learning models that have been trained on large datasets. These models can perform tasks like analyzing images and videos, classifying them, detecting objects, tracking movements, and segmenting different parts.

The models are designed to process multimedia data quickly, in real-time, which makes them suitable for applications that need low latency, such as live streaming, video conferencing, and interactive experiences.

MediaPipe provides a collection of pre-trained models that developers can use right away for common tasks. It also has tools and API's that allow developers to customize and train models for specific use cases.

Additionally, MediaPipe offers optimized implementations for various hardware platforms, including CPU's, GPU's and specialized accelerators like Google's Edge TPU. This enables efficient deployment across a wide range of devices, from smartphones and tablets to edge and IoT devices.

MediaPipe simplifies the implementation of motion capture systems by offering pre-built components and tools powered by machine learning algorithms. Its versality and ease of integration make it a popular choice among developers working on motion capture applications across diverse domains.

Unity C# is the programming language used within the Unity game development platform. It's more commonly known as C#, but the term "Unity C#" is used to specify it use in the Unity environment. C# is a programming language developed by Microsoft. It's widely used for building different types of applications, including games. Unity, one of the leading game development platforms uses C# as its main scripting language.

Unity C# scripting lets developers easily work with motion capture data in their Unity projects. This helps them create engaging and lifelike animations and interactions.

Unity is a widely used game development platform that allows creators to build interactive 2D, 3D, virtual reality (VR), and augmented reality (AR) experiences. It offers a range of tools and features to streamline the game-making process, including a powerful rendering engine, physics simulation, audio system, animation tools, and more. Within the Unity environment, there are pre-written scripts that come built-in to the engine. These scripts cover a wide variety of functionalities, from basic movement and input handling to more complex systems like artificial intelligence and networking. Developers can utilize these scripts to add common behaviors and features to their games without having to write everything from scratch.

Key Components of Unity's Built-in scripts:

- MonoBehaviour
- Input Handling
- Physics
- Animation
- Audio
- User Interface (UI)
- Networking
- AI and Pathfinding

These built-in scripts act as building blocks that developers can use to rapidly create prototypes, implement key features, and build engaging experiences within Unity, without having to start from scratch.

Unity provides a versatile and robust platform for integrating motion capture into your projects, be it games, simulations, virtual reality experiences, or other interactive applications. By utilizing Unity's features and tools, developers can create captivating and realistic character animations that elevate the user experience.

Unity is a popular program used to create games, simulations, and other interactive experiences. It was developed by Unity Technologies and works on many different platforms, including computers, phones, game consoles, and virtual reality devices.

Unreal Engine, created by Epic Games, is a powerful game engine used to make engaging interactive experiences. It's famous for its advanced graphics, strong physics system, and extensive tools for game development. Unreal Engine is often preferred for making big-budget games, virtual productions, architectural visualizations, and more. Like Unity, it works on various platforms including Windows, macOS, Linux, Android, iOS, gaming consoles, VR/AR devices, and web browsers.

Unity and Unreal Engine are both popular game development platforms, each with its own set of features and tools. Let's focus on how motion capture can be used within Unity.

Unity's motion capture capabilities often involve integrating third-party tools or plugins, rather than having native support within the engine itself. Unity offers various tools and plugins to help developers incorporate motion capture into their game projects. By using these tools, developers can create realistic character animations and immersive experiences for players.

Livelink is a software tool developed by Unreal Engine, a popular game engine created by Epic Games. It allows real-time communication and data sharing between various devices, software programs, and Unreal Engine itself. Livelink is widely used in animation, virtual production, motion capture, and other real-time content creation workflows. Livelink is an essential part of real-time content creation pipelines. It enables smooth communication and data exchange between different devices, software applications, and Unreal Engine projects.

Livelink is often used in motion capture to make it easy to send real-time motion data from motion capture systems to animation software or game engines. Livelink is a key part of motion capture pipelines by allowing smooth connection between motion capture systems and animation software or game engines. This lets you see and use the captured motion data right away.

Facemaker is a term that can have different meanings depending on the context. In the context of motion capture and animation, "Facemaker" typically refers to software or techniques used to capture and animate facial expressions. It involves creating a digital representation of a person's face, which can then be manipulated to mimic various expressions, emotions, and movements. This digital representation is often used in animation, video games, virtual reality, and other forms of digital media to create realistic characters and performances. Facemaker technology is crucial for achieving lifelike and expressive facial animation in these mediums.

Unreal Engine's Blueprint system is a visual way of creating code. It lets developers build gameplay elements, interactions, and even complex systems without writing traditional code. With Blueprints, you can visually construct logic graphs by connecting nodes that represent different actions, events, conditions, and variables. Blueprints are great for quickly testing ideas, designing gameplay mechanics, and creating content like levels and videos directly in the Unreal Engine editor.

C++ is a very popular programming language. It is known for being fast and flexible. Unreal Engine, a game engine, is built using C++. This means developers can expand and customize Unreal Engine by writing their own C++ code. Blueprints offer an easy way to create game logic, but C++ is often used for more critical performance tasks, making changes deep in the engine, and connecting with outside libraries and systems.

In Unreal Engine, you can use Blueprints, C++, or a combination of both. Many developers find Blueprints useful for quick changes and testing, while C++ provides more control, optimization, and integration with other systems.

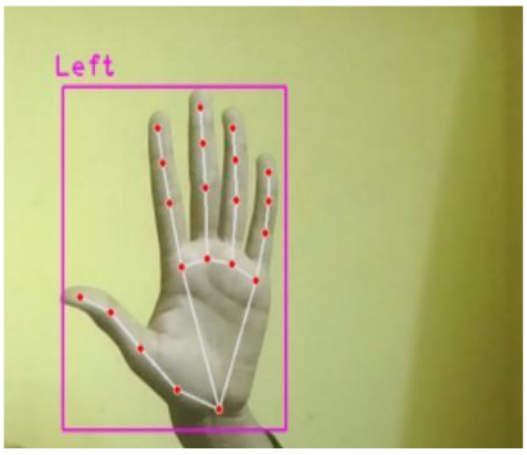
IMPLEMENTATION

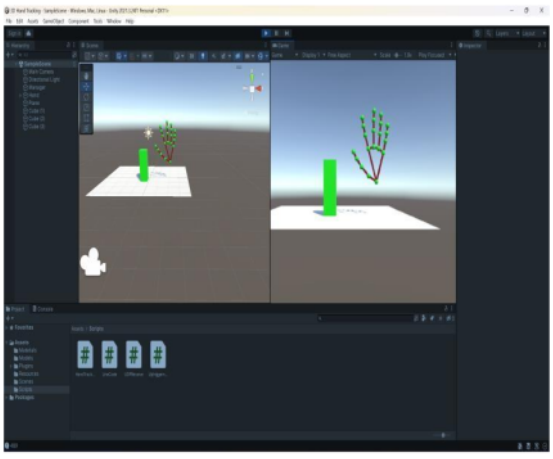
EXPERIMENTATION PHASE- 1

To make virtual objects interactable using their hand gestures, augmented reality (AR) **Hand tracking** involves identifying and analysing real-time movements of the hand in a digital environment. This is where we create a Python based hand tracking solution that ensures accurate and captivating identification of hand motion for AR experience.

Python, the primary programming language used to implement this hand tracking solution, is widely known for its versatility and user-friendliness. Media Pipe boasts powerful machine learning-based system features for strong hand tracking, providing reliable real time detection and tracking of both hands. In this mini-project, we combine powers of Media pipe and python to guarantee accurate as well as responsive recognition of hand gestures – which are key to creating immersive AR experiences

Unity integration is another important feature for advancing hand tracking capabilities. Unity, a widely used game development platform, allows users to create augmented reality experiences with interactive objects that can be controlled by hand motion.





7.1 Coding

Code for Machine Learning:

```
from cvzone.HandTrackingModule import HandDetector
import cv2
import socket

cap = cv2.VideoCapture(0)
cap.set(3, 1280)
cap.set(4, 720)
success, img = cap.read()
h, w, _ = img.shape
detector = HandDetector(detectionCon=0.8, maxHands=2)

sock = socket.socket(socket.AF_INET, socket.SOCK_DGRAM)
serverAddressPort = ("127.0.0.1", 5052)

while True:
    # Get image frame
    success, img = cap.read()
    # Find the hand and its landmarks
    hands, img = detector.findHands(img)  # with draw
    # hands = detector.findHands(img, draw=False)  # without draw
    data = []

    if hands:
        # Hand 1
        hand = hands[0]
        lmList = hand["lmList"]  # List of 21 Landmark points
        for lm in lmList:
            data.extend([lm[0], h - lm[1], lm[2]])

        sock.sendto(str.encode(str(data)), serverAddressPort)

    # Display
    img = cv2.resize(img, (0, 0), None, 0.5, 0.5)
    cv2.imshow("Image", img)
    cv2.waitKey(1)
```

Unity Code for Hand Tracking

Code #1

```
using System.Collections;
using System.Collections.Generic;
using UnityEngine;

public class HandTracking : MonoBehaviour
{
    // Start is called before the first frame update
    public UDPReceive udpReceive;
    public GameObject[] handPoints;
    void Start()
    {

    }

    // Update is called once per frame
    void Update()
    {
        string data = udpReceive.data;

        data = data.Remove(0, 1);
        data = data.Remove(data.Length - 1, 1);
        print(data);
        string[] points = data.Split(',');
        print(points[0]);

//0       1*3      2*3
        //x1,y1,z1,x2,y2,z2,x3,y3,z3

        for (int i = 0; i < 21; i++)
        {

            float x = 7 - float.Parse(points[i * 3]) / 100;
            float y = float.Parse(points[i * 3 + 1]) / 100;
            float z = float.Parse(points[i * 3 + 2]) / 100;

            handPoints[i].transform.localPosition = new Vector3(x, y, z);

        }


    }
}
```

Code #2

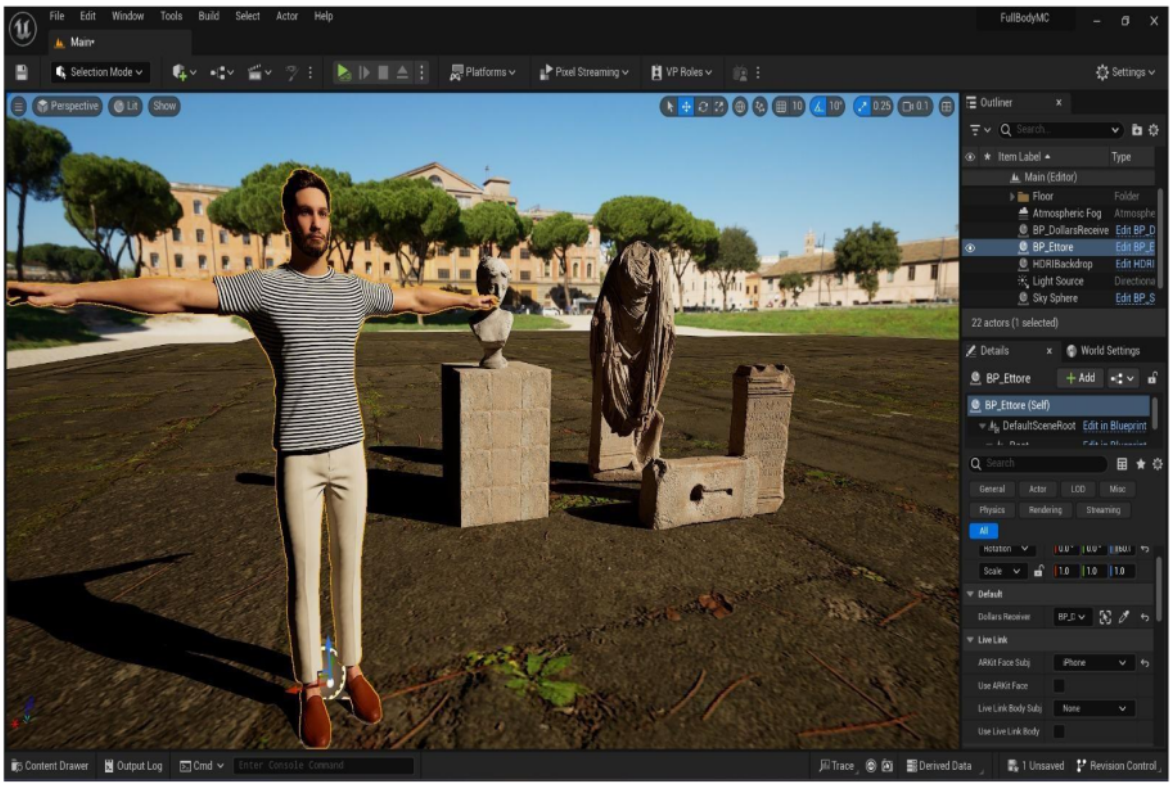
```
using System.Collections;
using System.Collections.Generic;
using UnityEngine;

public class LineCode : MonoBehaviour
{

    LineRenderer lineRenderer;

    public Transform origin;
    public Transform destination;

    // Start is called before the first frame update
    void Start()
    {
        lineRenderer = GetComponent<LineRenderer>();
        lineRenderer.startWidth = 0.1f;
        lineRenderer.endWidth = 0.1f;
    }

    // Update is called once per frame
    void Update()
    {
        lineRenderer.SetPosition(0, origin.position);
        lineRenderer.SetPosition(1, destination.position);
    }
}
```

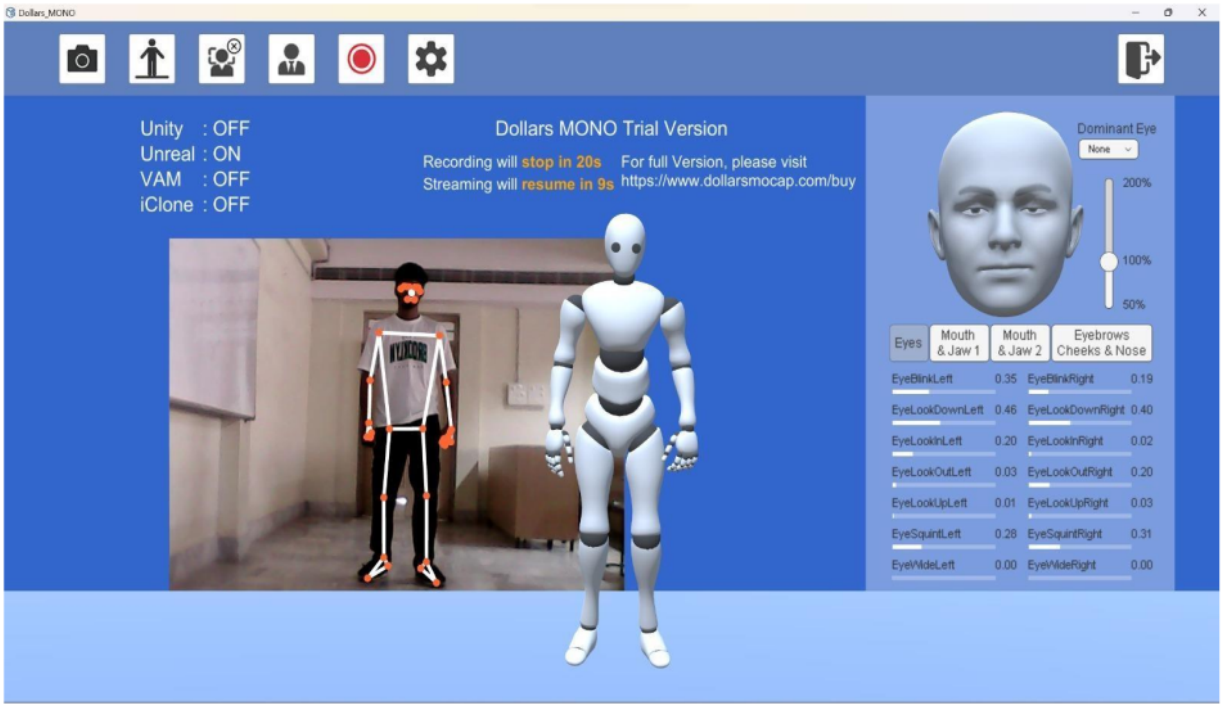
7.2 Testing

Phase I of Implementation:

This second phase is aimed at creating a **entire body motion capture system** with webcam based input interface using Unreal Engine 5 and integrating it to Metahuman.

Under the Phase I, they sought to develop a complete motion capture system in the Unreal Engine 5 environment. This system combines the most advanced Metahuman technologies and can be synchronized with a webcam-based input interface for tracking full-body movements on the fly. Through this interface, users can manipulate virtual worlds by their hands and receive updates instantly as well. In the utilization of Unreal Engine 5 capabilities and Metahuman integration, this phase establishes building blocks for a robust motion capture that offers unequalled realism and interactivity.





An entire body motion capture system involves a combination of hardware, software, and calibration techniques to accurately capture and process the movements of a human body for various applications.

Full-body motion capture is extensively employed across numerous sectors such as film industry, animation and video games, sports science, biomechanics, virtual reality and augmented reality.

Through this technology, it is possible to create realistic character animations, analyse human movement for sports training and rehabilitation and create immersive virtual environments.

Phase II of Implementation:

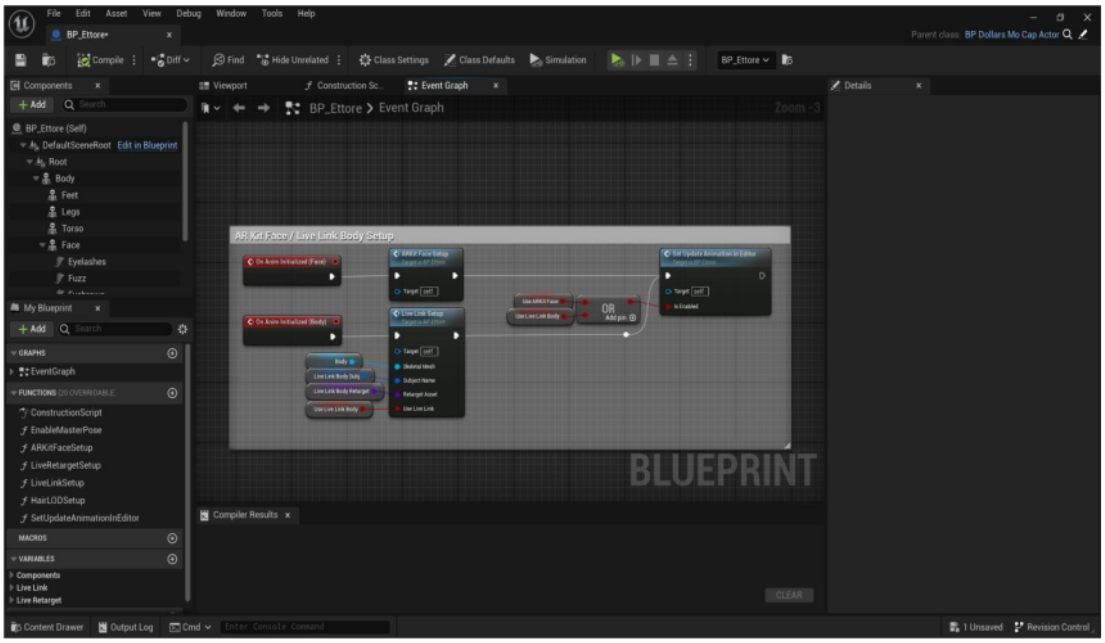
Goal: Improve the move record system to contain face recording using iPhone live link.

Description: Building on what was laid in Phase I, Phase II introduces more advanced facial capture capabilities. Through the use of iPhone Livelink app, it is possible for this system to get high quality faces and make virtual avatars to be more real and detailed. This now enables fine facial movements captured and thus enhances engaging with immersive as well as expressive interactions within virtual environments.

This part of the article tries to rely on Unreal Engine 5, RealFacetime and iPhone (for camera input) in order to capture facial expressions as well as movements.

RealFacetime is equipped with up-to-the-minute technology for tracking faces, which makes it possible for identification and scrutiny of different parts of human face.

The project seeks to integrate RealFacetime with Unreal Engine 5 by utilizing input from iPhone cameras and thus creates a lifelike digital avatar that can mimic human-like facial expressions.



RESULTS & DISCUSSIONS

Face Recognition:

By utilizing Live Link on a smartphone to capture features and expressions ARScapes face recognition technology allows for expressive facial animations to be applied to virtual characters. Through detection of reinforced expressions and movements users can interact with characters that display authentic emotional reactions and subtle facial movements enhancing the overall immersive experience. The precision of these expressions is achieved through data input, from the camera making it easier to replicate behavior in real time.

Accurate Full Body Motion Capture:

Using a camera-based motion capture system ARScapes achieves full body tracking that translates users' movements into natural and realistic animations. This enables incorporation of character movements in virtual environments facilitating interactive simulations training scenarios and captivating storytelling experiences driven by genuine human motion.

Natural Hand Gesture Recognition:

ARScapes hand gesture recognition feature empowers users to interact with objects and environments using hand gestures and motions. This user-friendly interface eliminates the need, for input devices enhancing immersion and providing a user experience.

Cost Efficiency:

By utilizing camera-based motion capture systems and open-source software like Python and MediaPipe, ARScapes significantly reduces the costs associated with traditional motion capture setups, making it more accessible to a wider audience.

Immersive Learning Experiences:

With full-body motion capture capabilities using Unreal Engine 5, ARScapes provides students with immersive learning experiences, allowing them to visualize concepts in three dimensions and engage with the material in a more interactive and dynamic manner.

Enhanced Tourism Experiences:

ARScapes enhances tourism experiences by offering virtual tours guided by interactive virtual guides with face tracking capture technology.

Real-Time Interaction:

ARScapes enables real-time interaction with virtual environments and characters, providing users with immediate feedback and a more engaging experience.

Traditional Motion Capture:

It is a technique used to record the movements of objects or people, often humans, for various purposes like animation, biomechanics, sports analysis, and virtual reality.

Accessibility in Education:

ARScapes facilitates remote learning by enabling advanced lessons through hand tracking motion, allowing students to interact with virtual objects and environments even when the teacher is not physically present.

Key Aspects of Traditional Motion Capture:

* Markers and suits
* Synchronization
* Post Processing
* Limitations

Traditional motion capture systems rely on markers placed on the subject's body and special cameras to record movement data. While these systems have been crucial in motion capture technology, recent improvements like markerless tracking and real-time processing have expanded the possibilities for capturing motion with greater accuracy, flexibility, and efficiency.

Traditional motion capture techniques have been used for a long time in various industries like movies, cartoons, and biomechanics research. These methods usually involve attaching reflective markers to specific points on the subject's body. Multiple cameras placed around the capture area track the movement of these markers, allowing the reconstruction of the subject's motions in 3D space.

However, traditional motion capture systems often require extensive setup and calibration, and they may have issues when markers are hidden from the cameras' view. Additionally, the data processing can take a lot of time, especially for large volumes of captured data, limiting the real-time use of these systems.

In recent years, motion capture technology has seen significant advancements, improving accuracy, efficiency, and versatility. Markerless motion capture systems, for example, use computer vision algorithms to track a person's movements without the need for physical markers.

Markerless systems also often provide real-time feedback, making them ideal for applications such as virtual reality, live performances, and interactive gaming. Another emerging technology is the use of inertial sensors and IMUs (Inertial Measurement Units) for motion capture.

This approach eliminates the setup time and reduces the risk of occlusion, enabling more natural and unrestricted movements to be captured. These sensor-based systems can be used in both indoor and outdoor settings. They are especially well-suited for motion tracking in sports, healthcare, and biomechanical research.

CONCLUSION

To sum up, motion capture technology has made a huge step forward with ARSCAPES which is being seen as more accessible, affordable and innovative in many industries. This made motion capture achievable for wider audiences since it integrated cost-effective camera systems and compatibility with top software platforms such as Unity and the Unreal Engine 5.

ARSCAPES is a landmark development in education. By aiding distance learning and offering immersive teaching experiences, ARSCAPES has redefined the ways students relate to educational materials. Students are enabled to explore difficult issues through realistic simulation and interactive lessons that go beyond traditional classrooms.

Also, ARSCAPES has changed the idea of travelling by providing visitors personalized virtual tours that are interactive enough to make them feel like they are right there. Such journeys can now be taken because ARSCAPES merges the real world with cyberspace so tourists have someone or something they can interact with on their trips.

The entertainment industry has seen a wealth of innovation brought forth by AR SCAPES allowing creators to produce animations that are realistic and experiences that consumers from all parts of the globe have fallen for.

In summary, AR CAPES serves as an agile tool, which could revolutionize our ways of learning, exploring and amusing ourselves in this digital era. In this manner, ARSCAPES acted as a facilitator for motion capture technology to be accessible across professional fields leading towards a future without boundaries to interaction and participation; thus, encouraging innovation, invention and human association.

ARSCAPES Documentation plagiarism Report

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