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"PYTHON PROJECT REPORT"
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ON
MOTION CAPTURE USING PYTHON

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CERTIFICATE

This is to certify that the **Seminar Work** entitled **"Motion Capture using python"** is a bonafied work carried out by **Saurov Ghosh, Pradum pal, Shivaraj V Awaradi, Subramanya M bearing USN 1EP20IS079, 1EP20IS071, 1EP20IS081, 1EP20IS087** respectively in partial fulfillment for the award of **Bachelor of Engineering in Information Science and Engineering** under **Visvesvaraya Technological University, Belgaum** during the year **2022-2023**. It is certified that all the corrections/suggestions indicated in the Internal Assessment have been incorporated in the report and submitted in the department library. This seminar report has been approved as it satisfies the academic requirements in respect of Seminar work prescribed for the award of the said degree.

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ABSTRACT

In this project, we developed a Python based Motion capture Platform that allows users to visualize and interact with various real time Application. The user performs a real world action the code analyses the action by the frame works through python libraries we used a combination of python libraries such as Mediapipe, CVZone, Numpy for the Frame works and Calculation of landmarks in form of lists. The action in captured and imported into a character developed in Unity. Over all, this project provides a useful educational tool for students and professionals to learn about and understand different Python open Source Libraries ,Game Development and Real time application, and how they behave in Various Scenarios.

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CHAPTER 01

INTRODUCTION

Motion capture or mo-cap, is the name for technology that records the movement of people or objects. The motion is captured by the tech and the data is transferred to a computer program to enable photorealism in a virtual environment.

Mo-cap has become increasingly popular in recent years, as a method of imbuing computer-generated 3D characters with the natural and often subtle movements/mannerisms of human actors.

Motion capture sessions involve the movements of actors many times per second. Only the movements are recorded - not their real visual appearance. The animation data is then mapped to a 3D model which is enabled to perform the actions that is captured.

Motion capture offers a way to record complicated stunts which would be impossible (or at least very dangerous) for an actor to perform repeatedly.

It was used extensively during the filming of "The Matrix."

Motion capture can also plan and animate difficult or dangerous scenes before filming them, minimizing risks to actors and crew.

There are two types of motion capture – image-based and body-based.

Image-based uses images from one or more cameras placed around the subject to track its movements.

Body-based uses markers attached to strategic points on the subject's body (e.g., hands, face)

Mocap, short for motion capture, is a technique used to record the movement of objects or people.

CHAPTER 02

PROJECT DESCRIPTION

The algorithm was implemented using the Python Open-Source libraries. The code consists of packages like CV ZONE, NUMPY, MATPLOTLIB etc.

These packages helps in various ways such as Image processing and AI Functioning , Frame works ,Operations on the array.

This project will basically start by running the python code on Visual studio editor, as the code run the object is detected in form of landmarks with the help of Media-Pipe package.

These image processing projects in Python work as a basic part of all computer vision playing an important role in assisting real-life examples such as cars that are self-driven, acrobatics as well as object detection through deep learning.

Once all the landmarks are captured it stores all the captured data in form of a list called as animation text file.These Animation text file is imported into the unity Software for each line and points drawn of the object.

Unity is a platform where we can create characters for games or any other purpose used, once the object is detected the action is being copied and processed to the character developed .

2.1 Technologies/tools used

The technologies/tools that are used:

- **Python**-Python is a versatile programming language that can be used for web development, machine learning, automation, and more.

- **Unity-**Unity is more than an engine – it's the world's leading platform for creating and operating interactive, real-time 3D (RT3D) content. Game developers, artists, architects, automotive designers, filmmakers, and more use Unity to bring their imaginations to life. Begin by downloading and installing the Unity Editor.

- **Media-pipe-** Media-Pipe **is an** open-source framework for building pipelines to perform computer vision inference over arbitrary sensory data such as video or audio

- **Numpy**-NumPy is a Python library used for working with arrays. It also has functions for working in domain of linear algebra, fourier transform, and matrices.

- **Open cv-**OpenCV (Open source computer vision) is a library of programming functions mainly aimed at real-time computer vision.

2.2 ADVANTAGES AND DISADVANTAGES

Motion capture is very different from traditional computer animation of a 3D model. First, have a look at the advantages of motion capture.

- It gives instant and real time results.
- It reduces the overall cost of keyframe-based animation in entertainment industry. One of the notable examples of this is Hand Over technique.
- Motion capture allows many tests to be done with different deliveries or styles. It gives an artist different personalities that are limited by the natural talent of that actor.
- It is capable of recreating complex movement and realistic physical interactions in a physically accurate manner. These movements and interactions may include weight, secondary motions and exchange of forces.
- It is capable of producing extremely large animation data within a given time. This ability of motion capture makes it ideal solution to both cost requirements and deadlines of a production.
- It can be used with third party and free software, which makes it cost effective.

Disadvantages of Motion Capture

Like any other system or technology, motion capture has some drawbacks. However, the advantages of this technology far outweigh its drawbacks. Let's have a look at the disadvantages of motion capture.

- It requires particular hardware and special software program in order to produce and process data.
- It is an expensive system and the cost of the equipment, software and personnel required can limit the use of this system to only large productions.
- It may have particular requirements for the space this system is operating in. The requirement of space mainly depends upon the magnetic distortion or camera field of view.
- It cannot capture those movements that do not follow the laws of physics.

2.3 APPLICATIONS

- **Healthcare** Motion capture devices will become much more popular as they become more accessible, with the ability to offer significant benefits in fields like disease prevention. Local hospitals and medical professionals will be able to use mocap technology to provide patients with tests that can forecast the risk of an injury deteriorating over time as more reliable systems become available. They assist in the diagnosis and treatment of physical conditions in healthcare and clinical environments, for instance, by evaluating a patient's motor activity or analyzing prior records to see if a therapeutic strategy had the intended outcomes.

- **Sports** A motion capture system is used in sports to evaluate all of the players' activities. Sportsmen, trainers, academics, and clinicians are all intrigued by physical limits and movement optimization. They can learn more about injury processes and prevention by using motion capture.

- **Entertainment** Filmmaking is a medium that heavily depends on human activity, such as facial expressions and various body movements. As a result, the benefits of motion capture aren't surprising, particularly in animated films. When it comes to communicating human motion, animators aspire to be as authentic as possible. It is likely to obtain even the tiniest facial expression or hand gesture using motion capture. Motion capture is also used in the making of video games. Every time a new version of your favorite game is released, you can see how this process has progressed; the characters are smoother and their action is more natural. That's how easily this phase progresses.

- **Biomechanics** Motion capture is a technique that uses mechanisms to analyze the form and composition of biological processes such as humans, animals, plants, organs, and tissues.

IMPLEMENTATION AND EXECUTION

3.1 Python Snippet Code

```python
import cv2
from cvzone.PoseModule import PoseDetector

cap = cv2.VideoCapture('Video.mp4')

detector = PoseDetector()
posList = []
while True:
    success, img = cap.read()
    img = detector.findPose(img)
    lmList, bboxInfo = detector.findPosition(img)

    if bboxInfo:
        lmString = ''
        for lm in lmList:
            lmString += f'{lm[1]},{img.shape[0] - lm[2]},{lm[3]},'
        posList.append(lmString)

    print(len(posList))

    cv2.imshow("Image", img)
    key = cv2.waitKey(1)
    if key == ord('s'):
        with open("AnimationFile.txt", 'w') as f:
            f.writelines(["%s\n" % item for item in posList])
```

3.2 Unity C# Code

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

public class AnimationCode : MonoBehaviour
{

    public GameObject[] Body;
    List<string> lines;
    int counter = 0;
    // Start is called before the first frame update
    void Start()
    {
        lines = System.IO.File.ReadLines("Assets/AnimationFile.txt").ToList();
    }

    // Update is called once per frame
    void Update()
    {
        string[] points = lines[counter].Split(',');

        for (int i =0; i<=32;i++)
        {
            float x = float.Parse(points[0 + (i * 3)]) / 100;
            float y = float.Parse(points[1 + (i * 3)]) / 100;
            float z = float.Parse(points[2 + (i * 3)]) / 300;
            Body[i].transform.localPosition = new Vector3(x, y, z);
        }


        counter += 1;
        if (counter == lines.Count) { counter = 0; }
        Thread.Sleep(30);
    }
}
```

3.3 Line code

```
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);
    }
}
```

CHAPTER-04
RESULTS

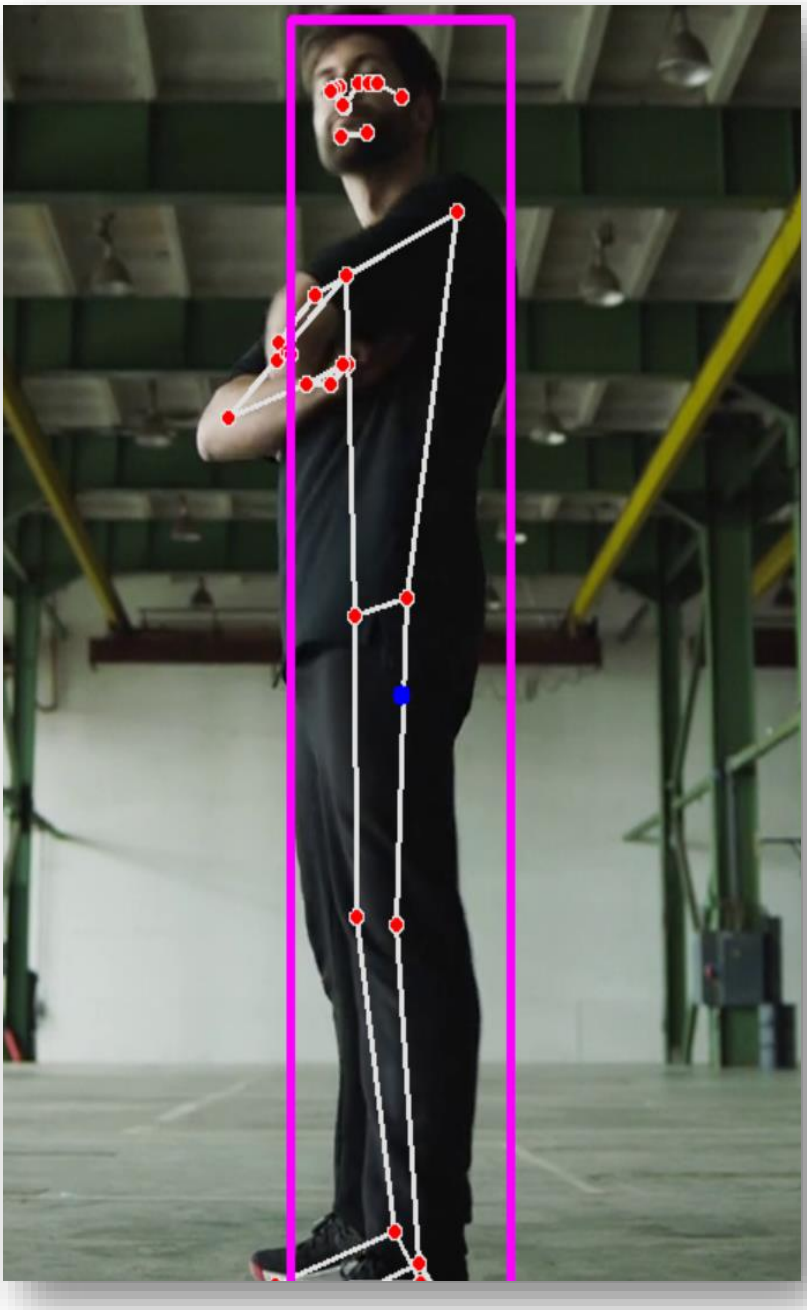

FIGURE 4.1: Python source Code Output

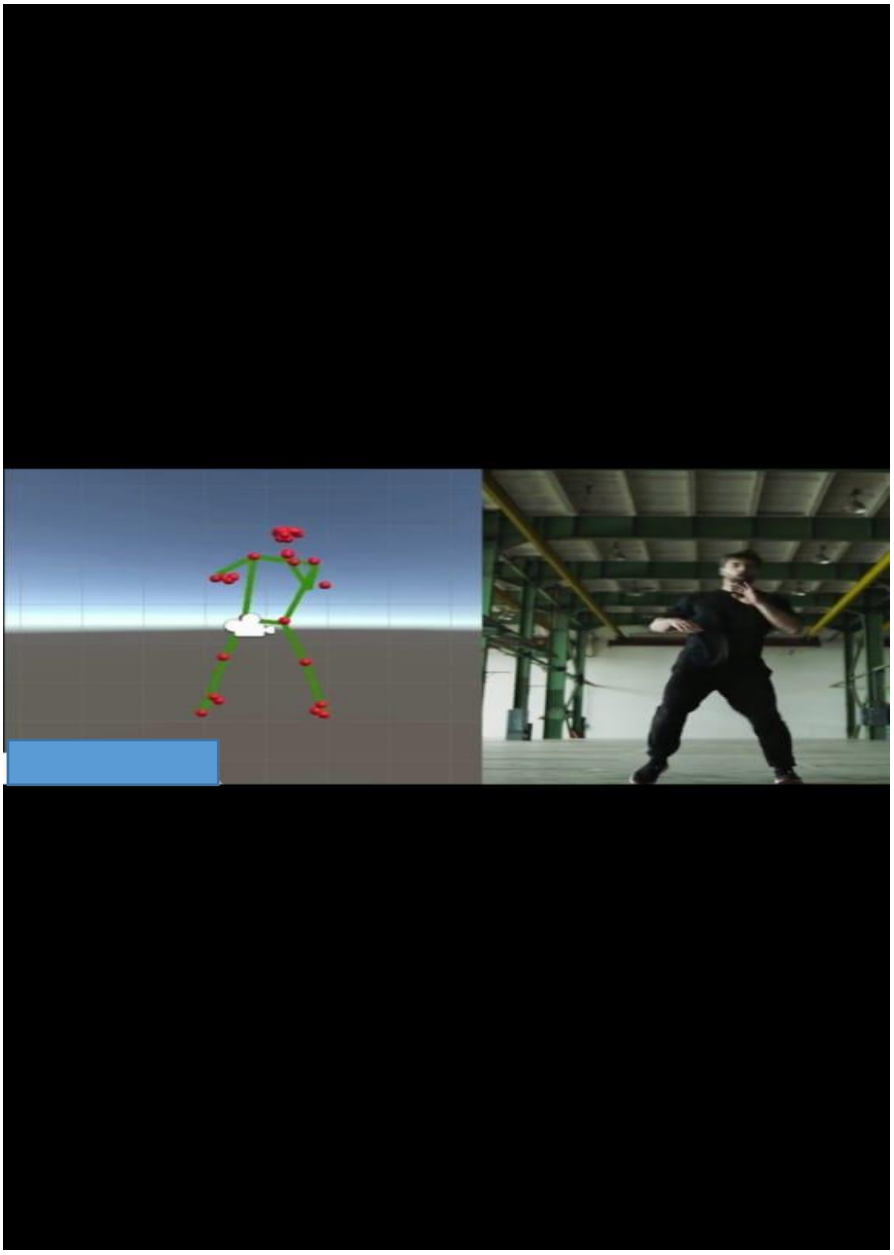

FIGURE 4.2: FINAL OUTPUT WITH UNITY PLATFORM

CONCLUSION

Motion capture is not a new technology, but it is still not completely evolved in the field of performance animation. There are now better tools to deal with the data, but it is still necessary to have specialized technical people to deal with it.
Because of the proliferation of performance capture projects, there are more and more people using motion capture on a regular basis. The bad reputation that used to surround motion capture in the computer animation industry is virtually gone and, although it isn't liked by everyone, it is a valuable tool in the visual effects arsenal and it will remain so for time to come.

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