

# **PROJECT REPORT**

**on**

**Motion Capture Using Computer Vision**

**for**

**Digipodium**

**towards partial fulfillment of the requirement**

**for the award of degree of**

**Bachelor of Computer Applications**

**from**

**Babu Banarasi Das University**

**Lucknow**



**Developed and Submitted by**

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**Under Guidance of**

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**Mrs. Aarti Rani Ma'am**

**Mr. Sarvesh Kumar Srivastava Sir**

**Academic Session 2021 - 22**

**School of Computer Applications**

# **CERTIFICATE**

**This is to certify that Project Report entitled  
Motion Capture Using computer Vision**

**being submitted by  
Komal Gautam**

**towards the partial fulfillment of the requirement  
for the award of the degree of**

**Bachelor of Computer Applications  
to  
Babu Banarasi Das University  
Lucknow**



**in the Academic Year 2021-22  
is a record of the student's own work carried out at  
Digipodium**

**and to the best of our knowledge the work reported herein does not form a part  
of any other thesis or work on the basis of which degree or award was conferred  
on an earlier occasion to this or any other candidate.**

**Dr. Prabhash Ch. Pathak  
HEAD (School of Computer Applications)**



## Certificate

This is to certify that **Komal Gautam** has successfully completed the project titled “**Motion Capture using Computer Vision**” as part of the internship program in our organization.

The project using Python Data Science was done under the guidance and supervision of Mr Zaid Kamil from Jan'22 – May'22.

The student has completed the assigned project well within the time frame and the performance and conduct during the project was found good.

A technically sound project has been developed for one of our clients.

Regards,

A handwritten signature in blue ink, appearing to be 'Zaid Kamil', is written over a faint, light blue circular watermark or background.

Director

Digipodium

9415082377

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Digipodium, Lower Ground Floor, Raja ram Kumar Plaza, Behind Motimahal Restaurant,  
Hazratganj, Lucknow-226001.

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## **ACKNOWLEDGEMENT**

On the very outset of this report, I would like to extend my sincere & heartfelt obligation towards all the personages who have helped me in this endeavor. Without their active guidance, help, cooperation & encouragement, I would not have made headway in the project.

I am Ineffably indebted to ZAID KAMIL for conscientious guidance and encouragement to accomplish this assignment.

I am highly indebted to DIGIPODIUM INSTITUTE for their guidance and constant supervision as well as for providing necessary information regarding the project & also for their support in completing the project.

I extend my gratitude to BABU BANARASI DAS UNIVERSITY for giving me this opportunity

I also acknowledge with a deep sense of reverence, my gratitude towards my parent and member of my family, who has always supported me morally as well as economically.

At last but not least gratitude goes to all of my friends who directly or indirectly helped me to complete this project report.

Any omission in this brief acknowledgement does not mean lack of gratitude.

**Thanking You**

**Komal Gautam**

## **DECLARATION**

I **KOMAL GAUTAM** here by declare that this project report entitled **MOTION CAPTURE USING COMPUTER VISION**, submitted by us, under the guidance of **Mr. ZAID KAMIL SIR** of **DIGIPODIUM INSTITUTE, LUCKNOW** is our own and has not been submitted to any other University or Institute or published earlier.

Signature of Student :

**Komal Gautam**  
**BCA VI Semester**

**Date: 1- June- 2019**

## **ABSTRACT**

Marker less tracking of human pose is a hard yet relevant problem. Recognition of human actions is one of the important tasks in various computer vision applications including video surveillance, human computer interaction etc. Traditionally RGB or depth cameras are utilized for this task.

In this work we propose an approach that utilizes motion capture data for recognizing actions. In this project, we derive an efficient system for tracking human pose using a computer vision technology with the help of webcam. Motion capture provides accurate motion information of joints of body in 3D space. The 3D skeleton joint co-ordinates of the user provided by motion capture system are saved in the database and used to the dynamics of the action being performed. Pose data is imported in unity which is cross platform used developing games and interactive content. After that we apply 3d model on the pose data and display the result.

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# INTRODUCTION OF THE PROJECT

## **INTRODUCTION OF THE PROJECT**

Motion capture (Mo-cap) refers to a group of technologies that records the movements of people and objects, and transfers the corresponding data to another application. It's been used for many purposes, from sports therapy, farming, and healthcare, to film and gaming. By mapping real-world movement on computer generated frames, motion capture allows for photorealistic dynamics in a virtual environment.

In motion capture sessions, movements of one or more actors are sampled many times per second. Whereas early techniques used images from multiple cameras to calculate 3D positions, often the purpose of motion capture is to record only the movements of the actor, not their visual appearance. This animation data is mapped to a 3D model so that the model performs the same actions as the actor. This process may be contrasted with the older technique of rotoscoping.

Computer vision is a field of artificial intelligence (AI) that enables computers and systems to derive meaningful information from digital images, videos and other visual inputs — and take actions or make recommendations based on that information.

Computer vision works much the same as human vision, except humans have a head start. Human sight has the advantage of lifetimes of context to train how to tell objects apart, how far away they are, whether they are moving and whether there is something wrong in an image.

Computer vision trains machines to perform these functions, but it has to do it in much less time with cameras, data and algorithms rather than retinas, optic nerves and a visual cortex. Because a system trained to inspect products or watch a production asset can analyze thousands of products or processes a minute, noticing imperceptible defects or issues, it can quickly surpass human capabilities.

Unity is a cross-platform game engine developed by Unity Technologies, first announced and released in June 2005 at Apple Inc.'s Worldwide Developers Conference as a Mac OS X-exclusive game engine. The engine has since been gradually extended to support a variety of desktop, mobile, console and virtual reality platforms. It is particularly popular for iOS and Android mobile game development and used for games such as Pokémon Go, Monument Valley, Call of Duty: Mobile, Beat Saber and Cuphead. It is considered easy to use for beginner developers and is popular for indie game development.

Unity gives users the ability to create games and experiences in both 2D and 3D, and the engine offers a primary scripting API in C# using Mono, for both the Unity editor in the form of plugins, and games themselves, as well as drag and drop functionality.[42] Prior to C# being the primary programming language used for the engine, it previously supported Boo, which was removed with the release of Unity 5,[43] and a Boo-based implementation of JavaScript called Unity Script, which was deprecated in August 2017, after the release of Unity 2017.1, in favor of C#

NEED  
OF  
IDENTIFICATION

## **Objective**

*Reducing the cost and making the process cost efficient*

### ***NO NEED OF STUDIO***

The main objective of this project is to help the creators by providing the facility the of capturing movements and objects managing a big studio.

### ***WHY COST EFFICIENT***

We will be using the single DV Camera and there is no need to manage the studio this will ultimately reduce the cost of the system.

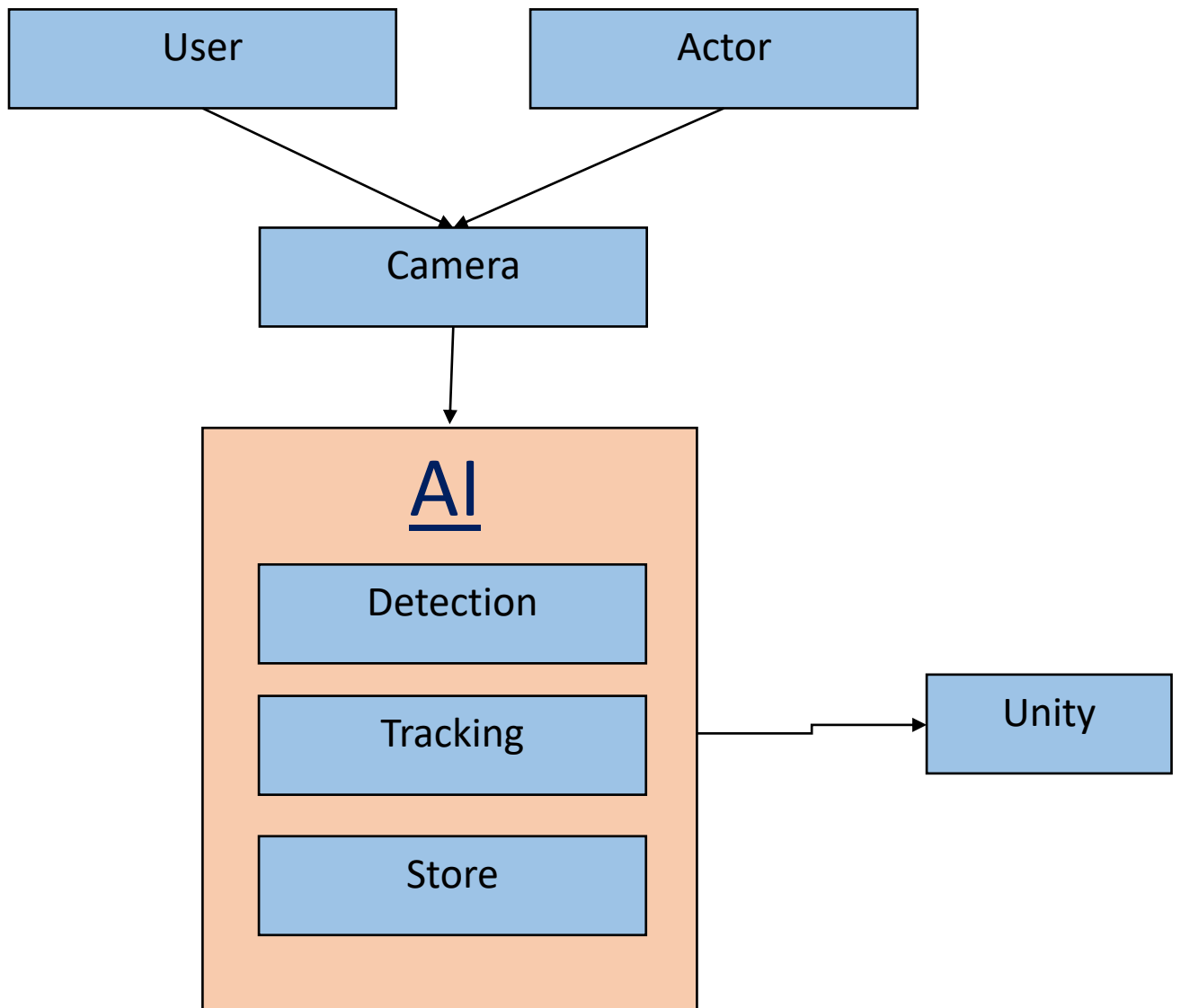
### ***WE WILL BE USING COMPUTER VISION CONCEPT***

We will be using the computer vision concept for capturing the data. Then we will be applying pose estimation and pose logic.

### ***POSE DATA PROVIDING BONE ARCHITECTURE***

That pose data will provide us the bone architecture, points. After that this 3-D track data will be converted and then passed to unity

## PROPOSED SYSTEM



# Problem Statement



## Problem Statement

As we have described above there already exist several motion capture systems that are used in many different fields where the entertainment sector is the largest. However, a drawback with existing motion capture systems are that they tend to be very expensive and require advanced hardware that makes the process complex. The question we raise is if it is possible to develop a cheap, simplified version of a motion capture system. With price and simplicity in mind we believe an optical motion capture system is best fitted since it uses to us accessible equipment to a reasonable cost.

The main reason why existing optical motion capture systems are so expensive is because of their choice of hardware. Generally, expensive high performance cameras with very high frame rate are used. We will examine whether or not it is sufficient to use only a single DV camera to record a three dimensional motion. To do this we will use a low end DV camera with the ability to capture only 25 frames per second, compared to other systems on the market that uses cameras with up to 2000 frames per second.

Another drawback with existing optical motion capture systems, except the high costs, is the complicated setup of the capturing environment that is needed. This is usually so complex that you need a special studio for all the hardware setup and careful calibration.

To keep costs down and simplicity high our solution also must include an easy set up that can be done in any dim room rigged with a DV camera. To make this possible our system will use fluorescent markers that reflect the light of a UV light tube.

Due to the camera restrictions we also need to examine the best placements for the markers. They cannot be too many because they then will get mixed up, and they cannot be too few or we will loose vital information about the body movements. Normally only one color, white, is used on the markers. A way to make it easier to keep the markers separated would be to use more colors and give markers close to each other different colors.

There were two major problem in the existing Motion Capture System

**GADGETS**

Marker motion capture system is the technology of motion tracking where special equipment is used. A person wears a suit with built-in reflective markers. While actor's moving or taking postures, the markers' positions are fixed by cameras and get to the computer, where it is summarized in a single three-dimensional model that accurately reproduces the movements of the actor in real time. – Marker motion capture system allows reproducing the facial expression of the actor. In this case markers on the face that allow recognizing the main mimic activity are needed.

### *Mocap suit*

a mocap suit is a device that an actor wears in order to help record each move they make. It is fitted to the actor which helps in properly placing the markers like dots or LEDs. The more updated versions are now using sensors rather than just markers to track the movements of the actor.

These markers are tracked by specialized cameras where the movements are being sent to a computer using motion capture software. The more cameras used for motion tracking, the more precise the outcome will be. A "skeleton" is generated in the computer which moves in real-time and the actions recorded will be used on a 3D character.

Once the movements are recorded and transmitted into the computer, VFX artists will then "clean up" the shots for any anomalies, bumps, or jitters due to occlusion, reflections, or glitches.

Aside from the mocap suit, a head-mounted gear is also essential for a full motion capture experience. This technique is called "facial capture" where it records the actor's exact expressions and reactions by using markers or dots on their faces. Though there are some that don't require markers anymore.

### *The Studio*

The capture space is called the 'Volume'. This is essentially a studio stage over which is mounted around approx 60 motion capture cameras which will capture every detail of the performance, translating it to a character avatar in real-time. As with green screen work, the volume will be as bare as possible, with essential props or scenery represented by physical mock-ups. The floor is then divided by tape into a grid and will have visible position reference points marked out on the floor.

Shooting Motion Capture can often feel strange or unusual if you are not familiar with it, even for seasoned professionals. Most actors and directors are used to

working with large set pieces and complicated props. The minimalist nature of Motion Capture strikes a large contrast to traditional film methods.

Appearance isn't everything however, and despite not looking like a traditional set the scenes in Motion Capture can be performed largely as they would in conventional shooting. An advantage of motion capture is the ability to shoot scenes in their entirety, due to the cameras capturing from every angle. This gives the added benefit of removing the need to turn around and re-set for other angles – if the actors and directors are happy with the take then we have every angle and framing that anyone could need.

# System Analysis

## **System Analysis**

### ***Computer vision life cycle model***

Machine learning projects are on everyone's lips, but from customer projects we know that the implementation of AI projects is a mystery to many. That's why we will show you how the life cycle of our machine learning projects looks like in a series of blog posts. Our target audience for this series are project managers, engineers, decision makers, and everyone else planning an AI project

In this first part of our series we're going to briefly touch upon the single project phases. We're also going to discuss special challenges we face in the field of computer vision. In later blog posts we will take a closer look at each project phase.

Machine learning projects start like any other technology project. There is a problem or a need, and we begin to explore the task and discuss possible approaches to solve it. However, the execution of AI projects is fundamentally different from traditional technology ventures, because they are of more iterative and explorative nature. This is why every machine learning project is carried out in a life cycle process.

### ***1. Data Collection***

Machine learning models should solve a given problem on the basis of data. Therefore everything starts with collecting enough samples with proper metadata.

Quality, quantity, and the balance of the data are the decisive points in data collection. The more data we have and the better the quality and balancing is, the better the model will learn and predict accurately.

### ***2. Data Preparation***

Let's say we have collected enough data, then we need to create a structure we can feed the model with.

We clean the data by identifying noise, false or misleading data and correct or remove it from the training set. Additionally, we preprocess the data to normalize it.

In our cases this mostly mean scaling or cropping images, converting them into a relevant format and creating a folder structure we can use for training

### ***3. Model Evaluation and Training***

During model evaluation we take a closer look at different models and model architectures in order to find out which architectures work well with certain data and certain problems.

There are models that work well with text, e.g. translation, term classification. Other models work well with images, e.g. classification models, detection models, or localization models. Our experience, best practice orientation, and scientific research lead us to the appropriate model for our current project.

### ***4. Model Validation***

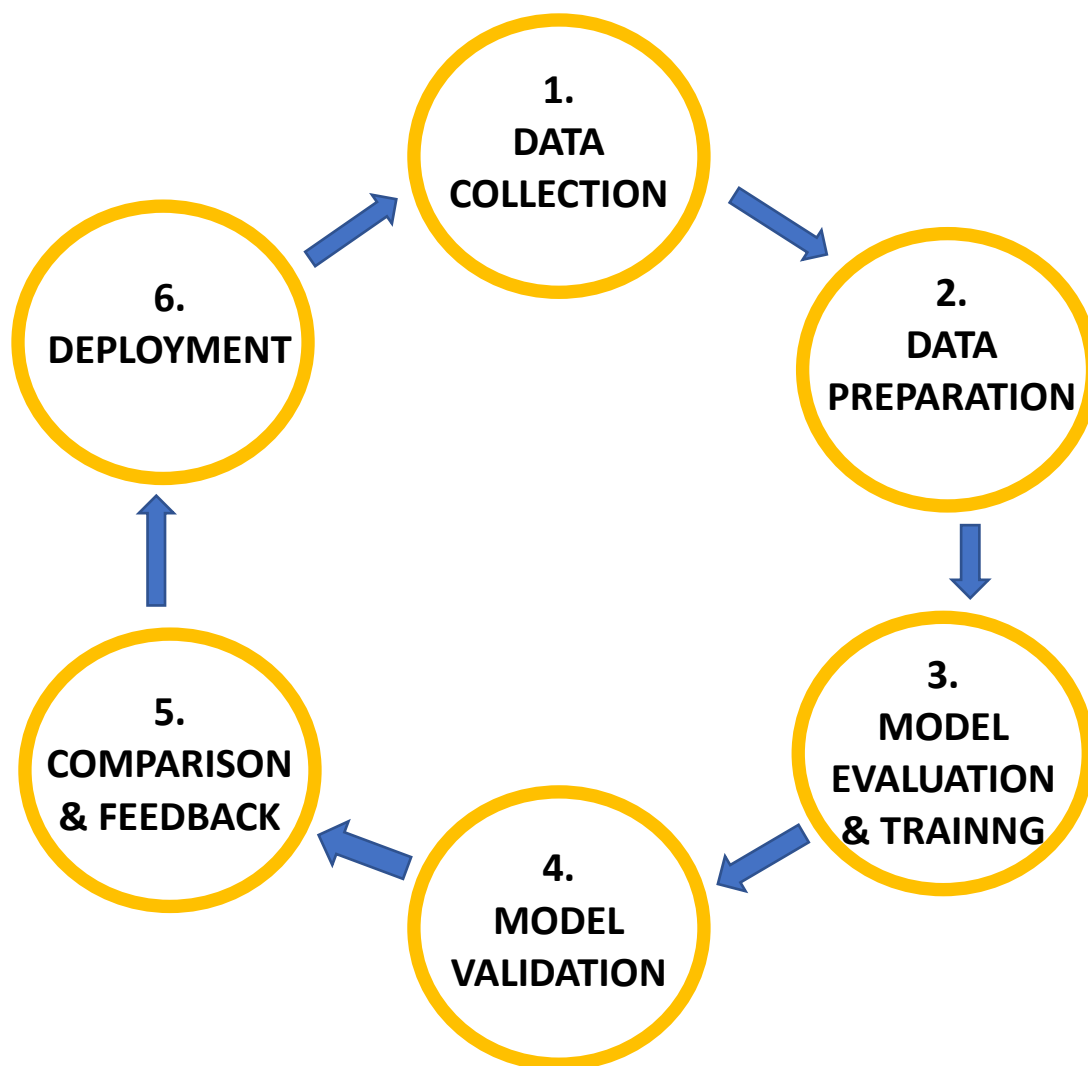
After finishing the training as described above, we assess the quality of the model. We work with the model to understand its behavior: which aspects are already solved very well, and which are not. By inspecting the visual data we interpret necessary changes to the training set in order to optimize result quality. An adjustment could be for example to collect or synthesize more data from a specific category.

### ***5. Comparison and Feedback***

In this step it is time to share the progress we've made so far with our customer. We present our findings on the quality and condition of the model, we show what worked and what did not work. A good teamwork with our customer is significant here. Together, we discuss possible improvements of the model, for example gathering more data and where to get this data from. In close cooperation, we plan the next iteration of model training.

### ***6. Deployment***

The deployment of our current model version acts as the quality base line for the following training iteration. If the model already adds value for the customer, it can be integrated in his prototype or even in production. Meanwhile, we begin the next iteration of training, the life cycle starts again.



## **FEASIBILITY** **STUDY**

All projects are feasible given unlimited resources and infinite time. Unfortunately the development of computer-based system in many cases is more likely to be plagued by scarcity of resources and delivery date. Hence, we have made use the concept of reusability that is what Object Oriented Programming (OOP) is all about.

The feasibility report of the project holds the advantages and flexibility of the project.

This is divided into three sections:-

1. Economic Feasibility
2. Technical Feasibility
3. Behavioral Feasibility
4. Operational Feasibility

### ***Technical Feasibility -***

In Technical Feasibility current resources both hardware software along with required technology are analyzed/assessed to develop project. This technical feasibility study gives report whether there exists correct required resources and technologies which will be used for project development. Along with this, feasibility study also analyzes technical skills and capabilities of technical team, existing technology can be used or not, maintenance and up-gradation is easy or not for chosen technology etc.

By using the libraries of python, and python programming language this system can be easily constructed. Hence our system is technically feasible

### ***Operational Feasibility -***

In Operational Feasibility degree of providing service to requirements is analyzed along with how much easy product will be to operate and maintenance after deployment. Along with this other operational scopes are determining usability of product, Determining suggested solution by software development team is acceptable or not etc.



By using the interactive user interface user can easily interact with the system and can perform their desired operations very easily. Hence, our system is operationally feasible.

### ***Economic Feasibility -***

In Economic Feasibility study cost and benefit of the project is analyzed. Means under this feasibility study a detail analysis is carried out what will be cost of the project for development which includes all required cost for final development like hardware and software resource required, design and development cost and operational cost and so on. After that it is analyzed whether project will be beneficial in terms of finance for organization or not.

Our motion capture system does not require any external gadgets and cross platform subscription ,we can easily upload our 3-d track to unity (i.e. freely available)

### ***Behavioral Feasibility***

People are inherently resistant to change, and computers have been known to facilitate change. An estimate should be made of how strong a reaction the user staff is likely to have toward the development of a computerized system. [t is common knowledge that computer installations have something to do with turnover, transfers, retraining, and changes in employee job status. Therefore, it is understandable that the introduction of a candidate system requires special effort to educate, sell, and train the staff on new ways of conducting business.

## **DATABASE**

Database is critical for all businesses. A good database does not allow any form of anomalies and stores only relevant information in an ordered manner. If a database has anomalies, it is affecting the efficiency and data integrity. For example, delete anomaly arise upon the deletion of a row which also forces other useful data to be lost. As such, the tables need to be normalized. This fulfils the last objective of ensuring data are accurate and retrieved correctly. Database files are the key source of information into the system. It is the process of designing database files, which are the key source of information to the system. The files should be properly designed and planned for collection, accumulation, editing and retrieving the required information. The organization of data in database aims to achieve three major objectives: -

- Data integration
- Data integrity
- Data independence

## Modules

1. Video camera handler
2. Image frame extraction
3. Image conversion system
4. Pose estimation AI loader
5. Bone rendering system
6. Pose detection and frame creation
7. Tracking and capture
8. Database Handler
9. Dashboard system
10. Motion capture file creator
11. Unity integration
12. 3D wireframe maker
13. Human body extraction and segmentation
14. Mocap manager
15. View display manager

**In this project, three members are involved and so, we have divided the whole project into three groups:-**

The following modules are handled by Ravi Sharma :

Module 1: Video camera handler

Module 2: Image frame extraction

Module 3: Image conversion system

Module 4: Pose estimation AI loader

Module 5: Bone rendering system

The following modules are handled by Naushad Ahmed :

Module 6: Pose detection and frame creation

Module 7: Tracking and capture

Module 8: Database Handler

Module 9: Dashboard system

Module 10: Motion capture file creator

The following modules are handled by Komal Gautam :

Module 11: Unity integration

Module 12: 3D wireframe maker

Module 13: Human body extraction and segmentation

Module 14: Mocap manager

Module 15: View display manager

## Process Description

1. **Video camera handle** : Video camera handle purpose is to check whether the webcam is present or not. It select the source of camera if multiple camera are present. It check whether video is recording or not. It read the data from the video.
2. **Image frame extraction** : In image frame extraction we extract the images from video and compress it and then store data in numerical matrix format .
3. **Image conversion system** : If one specific point can be observed by any two cameras, the point's position can be located in a 3-D space based on triangulation principle. By continuing to capture the frames with high speed camaras, the points are tracked with post-data-processing procedures (e.g. 2-D to 3-D visual human motion conversion)
4. **Pose estimation AI loader** : this will load the particular pose model and then this model will be applied to the image and it will make the user bone frame
5. **Bone rendering system** : This module helps in drawing the bone outline from each pose points.
6. **Pose detection and Frame creation** : this module will display the user bone frame and detect the pose .
7. **Tracking and capture** : in this we track the movement of the points from their location and capture in the form of x axis ,y axis and z axis .
8. **Database Handler** : This model manages the database of user's previous work using SQLite/SQL Alchemy database software. We use SQL Alchemy for writing the database coding and for performing the operation like CRUD(create, read, update, delete).
9. **Dashboard system** : This module manages the code which provides the user interface better view to user. We allow the camera to be start or not and start the recording and give the title to the video and it also show the previous recording It's is basically the front end for displaying the user interface.

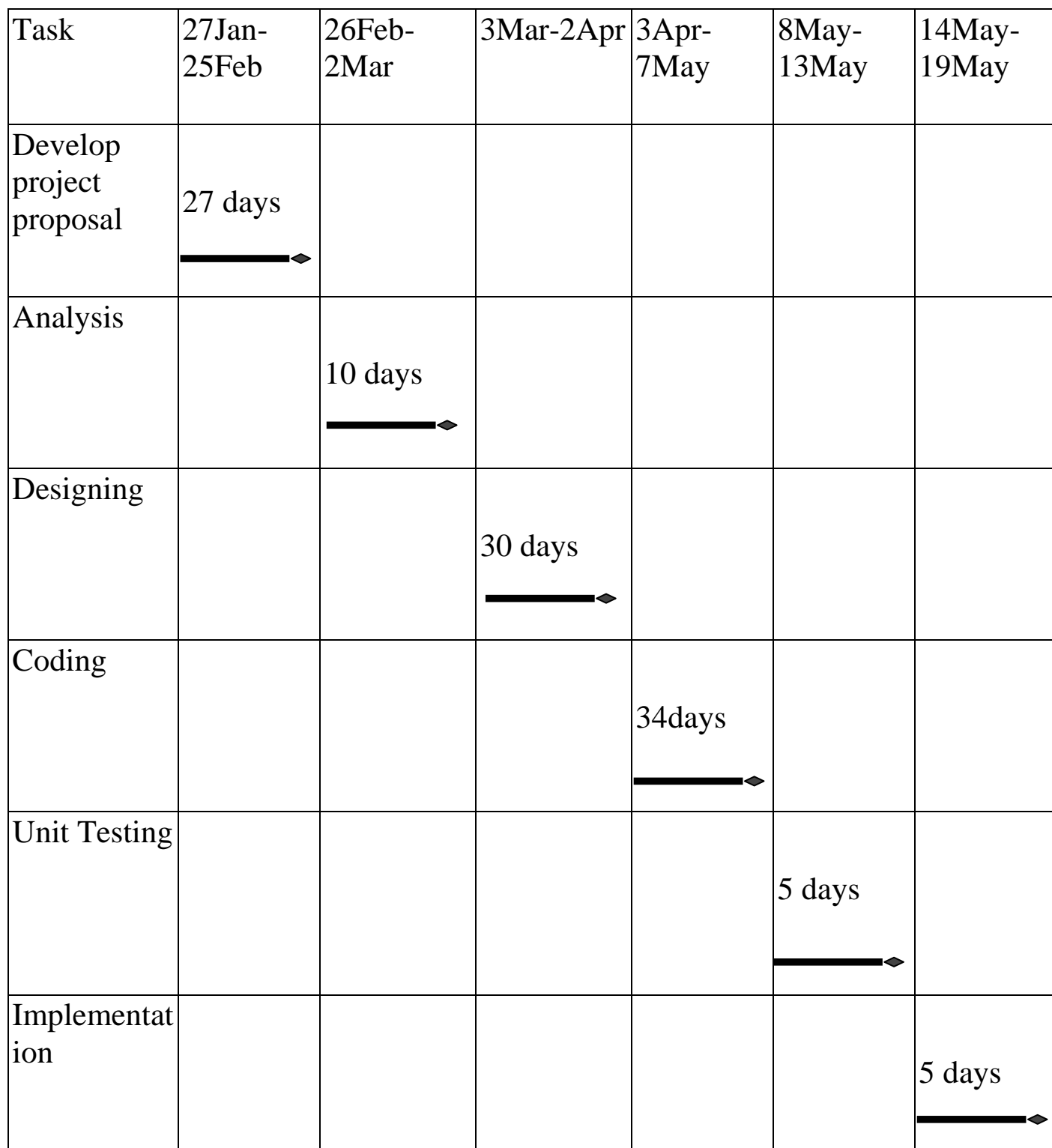
10. **Motion capture file creator** : this module will help in creating a file which fetch the data from database.
11. **Unity integration** : In this module we upload the data in unity and apply the 3 D Model on the data .
12. **3D wireframe maker** : In this module we create line and sphere which will displays the output in the form of stick figure.
13. **Human body extraction and segmentation** : This module helps in identifying the human body from the image and removes the background of the image.
14. **Mocap manager** : Mocap manager is used for managing the files and folders and also allow us for the creation and deletion of logics
15. **View display Manager** : All the codes related to the font-end and input output of the project are managed by this module.

# Gantt Chart

The objective of Software Planning is to provide a framework that enables the manager to make reasonable estimates of resources, cost, and schedule. These estimates are made within a limited time frame at the beginning of a software project and should be updated regularly as the project progresses. In addition, estimates should attempt to define best case and worst case scenario so that project outcomes can be bounded.

A Gantt chart is a popular type of chart that illustrates a project schedule. Gantt Chart illustrates the start and finish dates of the terminal elements and summary elements of a project. Terminal element and summary comprise the work breakdown structure of the project





**Figure : Gantt Chart**

# Software Requirement Specification (SRS)

## Resources (Hardware & Software)

### **1. Hardware Requirements :**

#### Client Side

Processor	Dual Core or above
RAM	1 GB
Disk space	500 GB
Monitor	15"
Others	Keyboard, mouse, Internet Connection

#### Server Side

Processor	Dual Core or above
RAM	1 GB
Disk space	500 GB
Monitor	15"
Others	Keyboard, mouse, Internet Connection

## **Software Requirements**

### **Client Side**

- \* Web Browser (Google Chrome, Firefox, IE9 or above)
- \* Unity Software

### **Server Side**

- \* Web Browser (Google Chrome, Firefox, IE9 or above)
- \* Windows 10 or above / Linux
- \* VS code
- \* SQLite Manager
- \* Python 3.7

## **Functional Requirements**

### **CAMERA :**

By using the camera we will be capturing the video & images

### **BACKGROUND LIGHTENING :**

Maintaining the lightening service of the environment

### **SYSTEM :**

A computer system is required in which software will be installed

### **UNITY :**

Unity is used for developing 2-D & 3-D content and show output in the form of 3d model

# High -Level Design

## **USE CASE DIAGRAM**

Use case diagrams consists of actors, use cases and their relationships. The diagram is used to model the system/subsystem of an application. A single use case diagram captures a particular functionality of a system.

Hence to model the entire system, a number of use case diagrams are used.

### *Purpose of Use Case Diagrams:-*

The purpose of use case diagram is to capture the dynamic aspect of a system. However, this definition is too generic to describe the purpose, as other four diagrams (activity, sequence, collaboration, and Statechart) also have the same purpose. We will look into some specific purpose, which will distinguish it from other four diagrams.

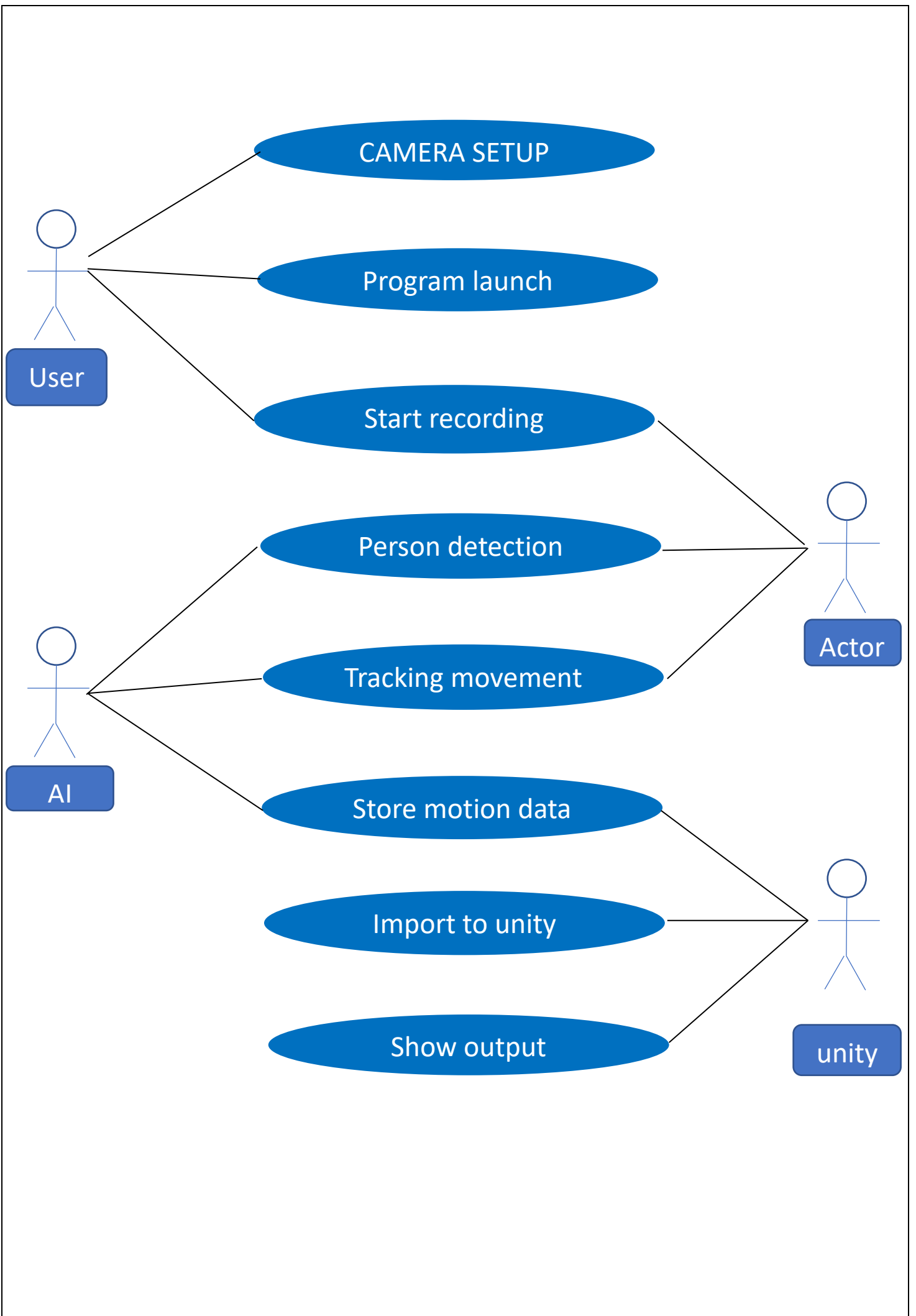
Use case diagrams are used to gather the requirements of a system including internal and external influences. These requirements are mostly design requirements. Hence, when a system is analyzed to gather its functionalities, use cases are prepared and actors are identified.

When the initial task is complete, use case diagrams are modelled to present the outside view.

In brief, the purposes of use case diagrams can be said to be as follows –

- Used to gather the requirements of a system.
- Used to get an outside view of a system.
- Identify the external and internal factors influencing the system.
- Show the interaction among the requirements and actors.





## **CLASS DIAGRAM**

Class diagram is a static diagram. It represents the static view of an application. Class diagram is not only used for visualizing, describing, and documenting different aspects of a system but also for constructing executable code of the software application.

Class diagram describes the attributes and operations of a class and also the constraints imposed on the system. The class diagrams are widely used in the modeling of object oriented systems because they are the only UML diagrams, which can be mapped directly with object-oriented languages.

Class diagram shows a collection of classes, interfaces, associations, collaborations, and constraints. It is also known as a structural diagram.

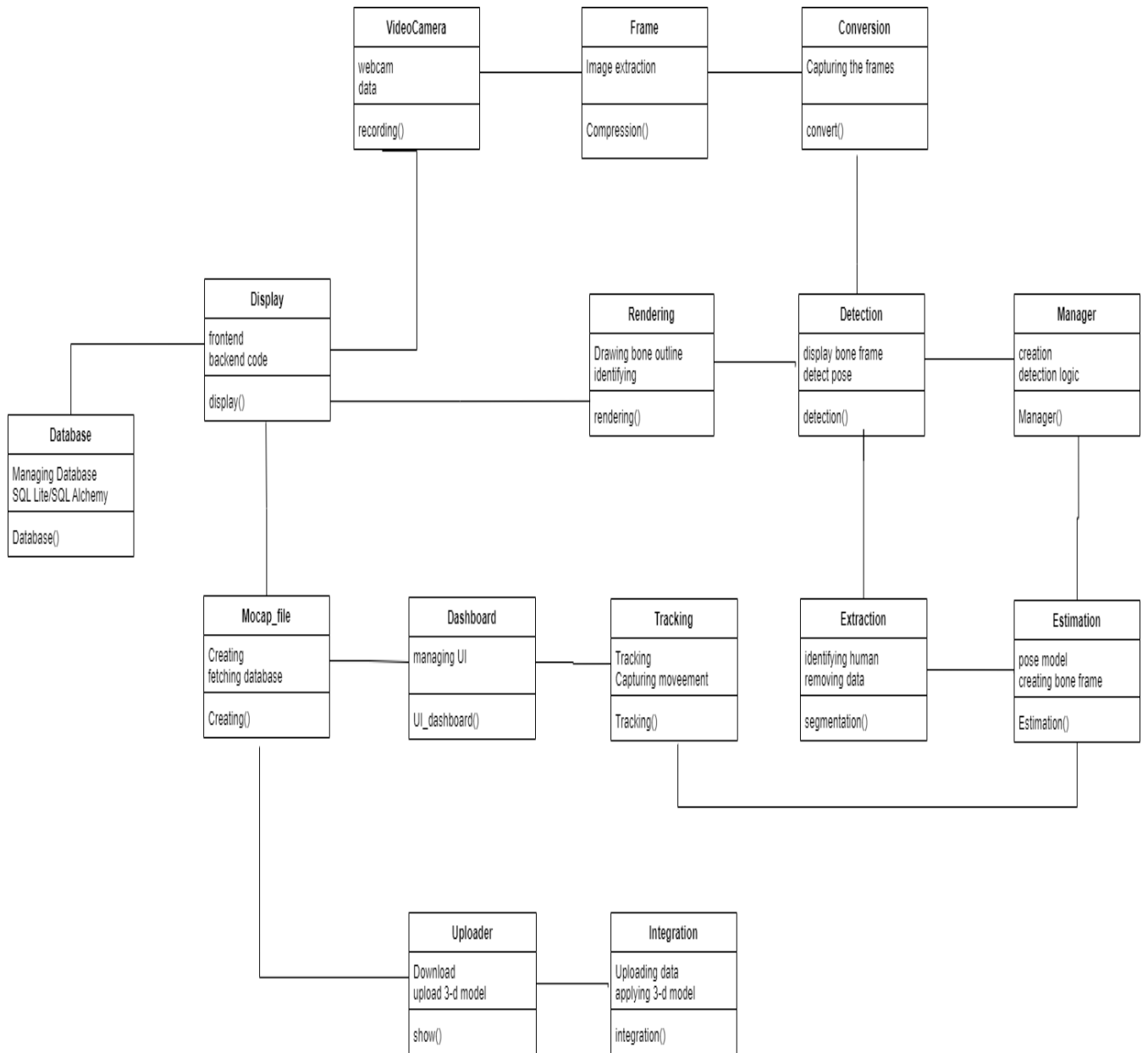
### ***Purpose of Class Diagrams:-***

The purpose of class diagram is to model the static view of an application. Class diagrams are the only diagrams which can be directly mapped with object-oriented languages and thus widely used at the time of construction.

UML diagrams like activity diagram, sequence diagram can only give the sequence flow of the application, however class diagram is a bit different. It is the most popular UML diagram in the coder community.

The purpose of the class diagram can be summarized as –

- Analysis and design of the static view of an application.
- Describe responsibilities of a system.
- Base for component and deployment diagrams.
- Forward and reverse engineering.



# Tools & Technologies

## Document convention

### *Font Family:*

Book Antiqua

### *Font Size:*

Main Heading (Section) : 14 font Bold  
Subsection Heading 12 font, bold, italic

### *Font Color:*

Content-black

### *The operating system :*

The operating system used is windows 10, because it is the latest windows operating system. The software can also run on windows 8 or 8.1 as well as Linux system.

### *Python:*

Python is a powerful general-purpose programming language. It is used in web development, data science, creating software prototypes, and so on. Fortunately for beginners, Python has simple easy-to-use syntax. This makes Python an excellent language to learn to program for beginners.

### *Sqllalchemy :*

SQLAlchemy is the Python SQL toolkit and Object Relational Mapper that gives application developers the full power and flexibility of SQL. SQLAlchemy provides

a full suite of well known enterprise-level persistence patterns, designed for efficient and high-performing database access, adapted into a simple and Pythonic domain language.

### *VS Code:*

Visual Studio Code is a lightweight but powerful source code editor which runs on your desktop and is available for Windows, macOS and Linux. It comes with built in support for JavaScript, TypeScript and Node.js and has a rich ecosystem of extensions for other languages.

### PyQt Designer

The PyQt installer comes with a GUI builder tool called Qt Designer. Using its simple drag and drop interface, a GUI interface can be quickly built without having to write the code. It is however, not an IDE such as Visual Studio. Hence, Qt Designer does not have the facility to debug and build the application.

### *Unity*

Unity is a cross-platform game engine developed by Unity Technologies, first announced and released in June 2005 at Apple Worldwide Developers Conference as a Mac OS X game engine. The engine has since been gradually extended to support a variety of desktop, mobile, console and virtual reality platforms

## TESTING PHASE

One of the purposes of the testing is to validate and verify the system. Verification means checking the system to ensure that it is doing what the function is supposed to do and Validation means checking to ensure that system is doing what the user wants it to do. No program or system design is perfect; communication between the user and the designer is not always complete or clear, and time is usually short. The result is errors and more errors. Theoretically, a newly design Lal system should have all the pieces in working order, but in reality, each piece works independently. Now is the time to put all the pieces into one system and

### **LEVELS OF TESTING**

The different types of testing are as follow:

1. Unit Testing
2. Integration Testing
3. Acceptance testing

#### **1. Unit Testing:**

This is the smallest testable unit of a computer system and is normally tested using the white box testing. The author of the programs usually carries out unit tests.

#### **2. Integration Testing:**

In integration testing, the different units of the system are integrated together to form the complete system and this type of testing checks the system as whole to ensure that it is doing what is supposed to do. The testing of an integrated system can be carried out top- down, bottom-up, or big-bang. In this type of testing, some parts will be tested with white box testing and some with black hox testing technlques. This type of testing plays very important role in increasing the systems productivity. We have checked our system by using the integration testing techniques.

#### **3. Acceptance testing:**

The user to ensure that the system functions, as the user actually wanted performs this testing. With prototyping techniques, this stage becomes very much a formality to check the accuracy and completeness of processing- The screen layouts and

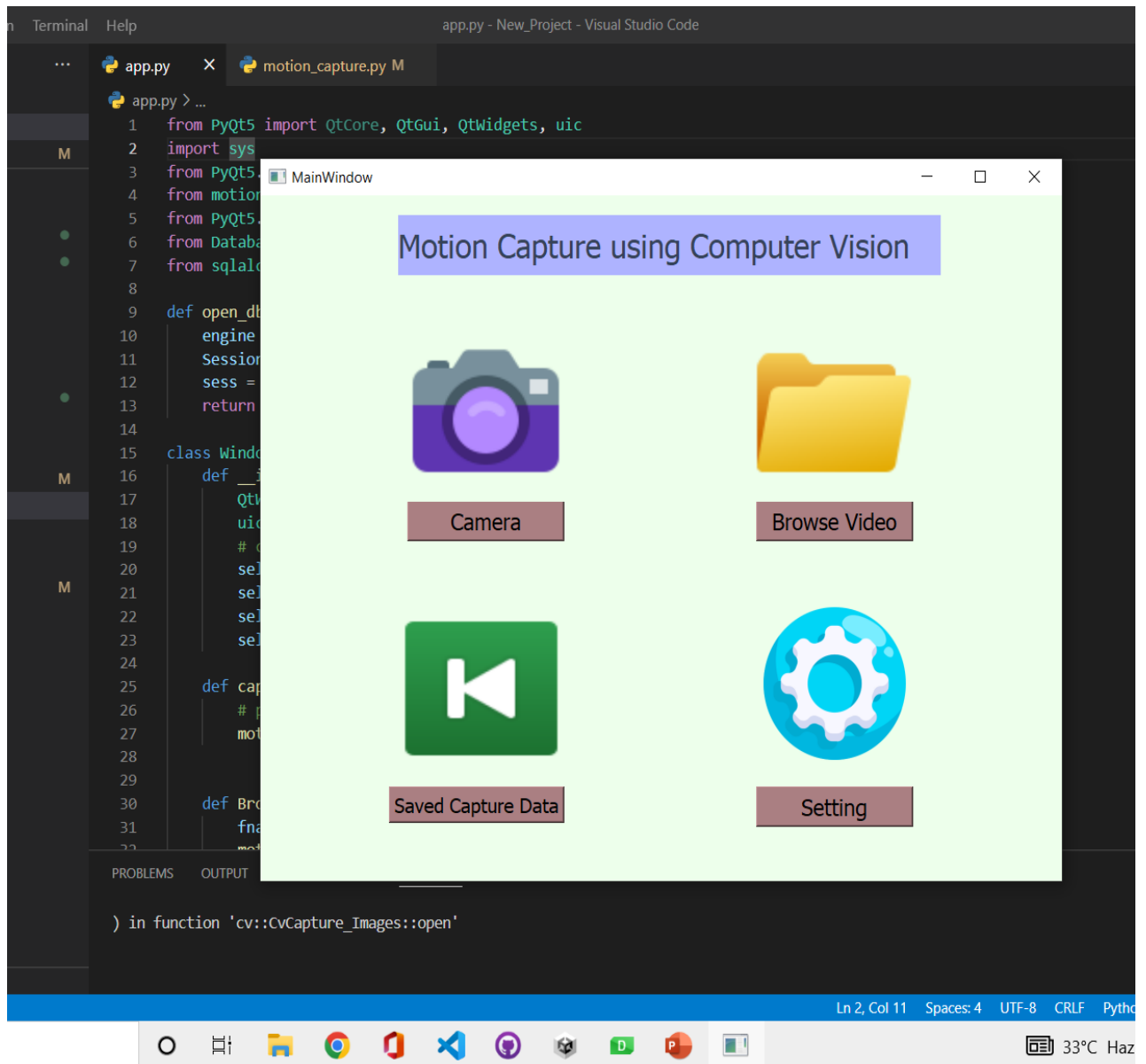
output should already have been tested during the prototyping phase. An error in the program code can remain undetected indefinitely. To prevent this from happening the code was tested at various levels. To successfully test a system, each condition, and combinations of conditions had to be tested. Each program was tested and linked to other programs. This unit of program is tested and linked to other units and so on until the complete system has been tested. The purpose of testing is to ensure that each program is fully tested. To do so a test plan had to be created. The test plan consists of a number of test runs such as the valid paths through the code, and the exception and error handling paths. For each test run there is list of conditions tested, the test data used and the result expected. The test plan was then reviewed to check that each path through the code is tested correctly. It is the responsibility of the programmer to collect the data that will produce the required test condition

### **VERIFICATION AND VALIDATION (V&V)**

The objectives of verification, validity activities are to assess and improve the quality of the work products generated during development and modification of the software. Quality depends upon the various attributes like correctness, completeness, consistency, reliability, usefulness, usability, efficiency and conformance standards. The terms verification and validation are used synonymously. These are defined as: Verification: "Are we building the product right?" Validation: "Are we building the right product?" Verification activities include proving, testing, and reviews. Validation is the process of evaluating software at the end of the software development to ensure compliance with the software requirements. Testing is a common method of validation. Clearly, for high reliability we need to perform both activities. Together, they are often called V&V activities. The major V&V activities for software development are inspection, reviews, and testing (both static and dynamic). The V&V plan identifies the different V&V tasks for the different phases and specifies how these tasks contribute to the project V&V goals. The methods to be used for performing these V&V activities, the responsibilities and milestones for each of these activities, inputs and outputs for each V&V task, and criteria for evaluating the outputs are also specified. The two major V&V approaches are testing and inspections. Testing is an activity that can be generally performed only on code. It is an important activity and is discussed in detail in a later chapter. Inspection is a more general activity that can be applied to any work product, including code. Many of the V&V tasks are such that for them, an inspection type of activity is the only possible way to perform the tasks (e.g. traceability and document evaluation). Due to this, inspections play a significant role in verification.



# Screenshots



Terminal Help app.py - New\_Project - Visual Studio Code

app.py x motion\_capture.py M

app.py > Window

```
1 from PyQt5 import QtCore, QtGui, QtWidgets, uic
2 import sys
```

M

s 's' to save the recording

MainWindow

Motion Capture using

Camera

Saved Capture Data

```
25 def capture_live(self):
26     # print("clicked")
27     motion_capture()
28
29
30 def Browse_File(self):
31     fname, ftype = QFileDialog.getOpenFileName(self, 'Select a video', './', 'Video (*.mp4 *.avi)')
32     motion_capture_video(fname)
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

```
2022-06-01 09:36:07,617 INFO sqlalchemy.engine.Engine [raw sql] ()
2022-06-01 09:36:07,622 INFO sqlalchemy.engine.Engine COMMIT
INFO: Created TensorFlow Lite XNNPACK delegate for CPU.
```

Ln 28, Col 1 Spaces: 4 UTF-8 CRLF Python

33°C Haz

Press 's' to save the recording



TerminalHelp

app.pyX

app.py > ...

1 from

2 import

3 from

4 from

5 from

6 from

7 from

8

9 def op

10 en

11 Se

12 se

13 re

14

15 class

16 de

17

18

19

20

21

22

23

24

25 de

26

27

28

29

30 def Bro

31 fnar


32 mot-

PROBLEMSOUTPUT


) in function 'cv::CvCapture\_Images::open'

MainWindow

Motion Capture using Computer Vision



Camera



Browse Video

Select a video

« New\_Project » samples

Search samples

OrganizeNew folder

OneDrive - Person

Documents


Pictures


This PC

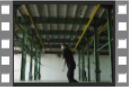
3D Objects

Desktop

Documents

Video 3.mp4

Video.mp4

Video2.mp4


File name:

Video (\*.mp4 \*.avi)

Open

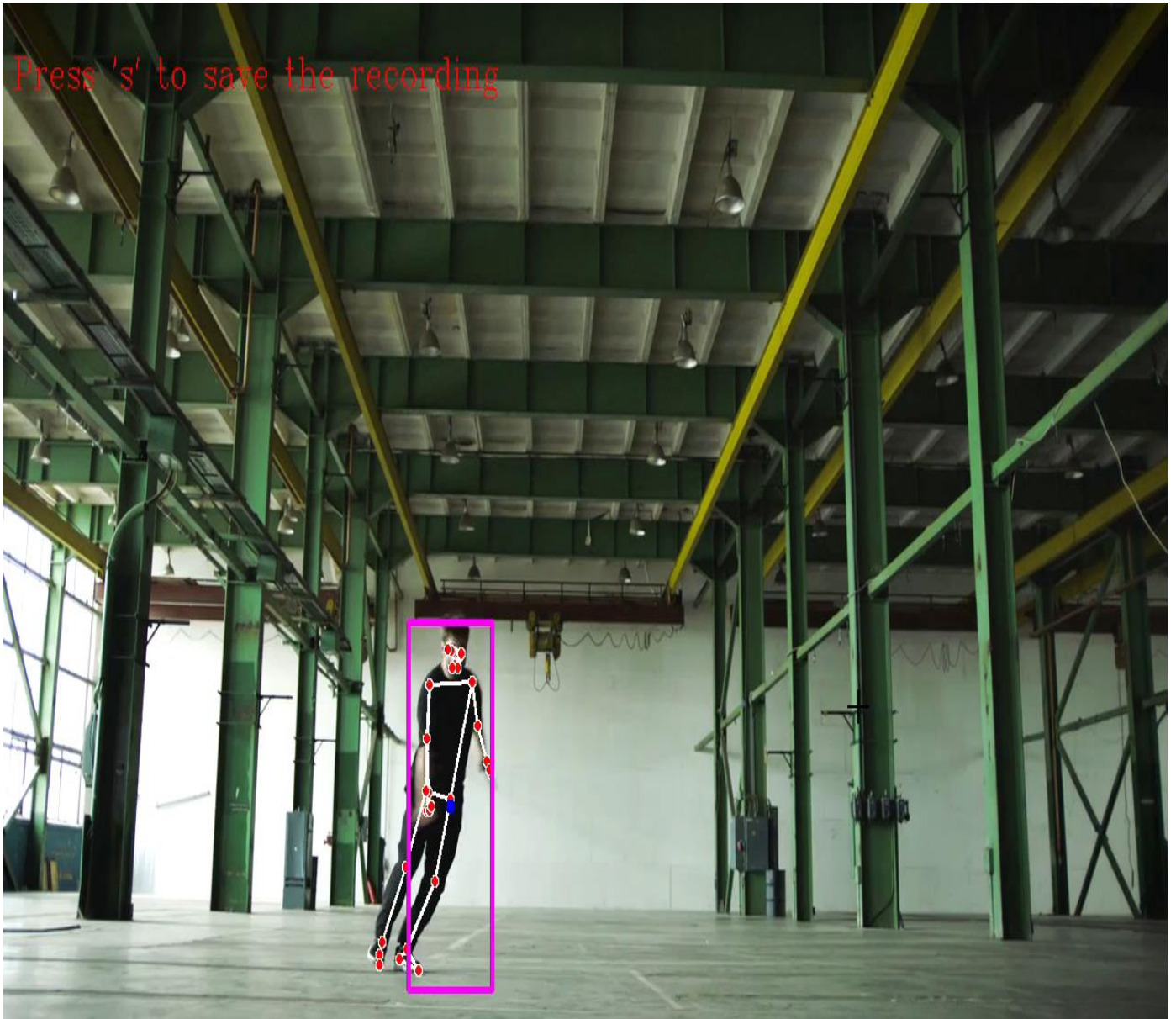
Cancel

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TerminalHelpanimation.sqlite3 - New\_Project - Visual Studio Code

...

app.pyanimation.sqlite3 M Xmotion\_capture.py M

animation.sqlite3

Search tables...Reset FiltersRecords: 20

Tables (1)

Capture

	id	filename	date
	Search column...	Search column...	Search column...
1	1	motion_data/Video2_...	2022-06-01 10:00:45...
2	2	motion_data/Video_c...	2022-06-01 10:01:38...
3	3	motion_data/Video 3...	2022-06-01 10:02:51...
4	4	motion_data/_captur...	2022-06-01 11:06:46...
5	5	motion_data/Video2_...	2022-06-01 11:07:21...
6	6	motion_data/Video_c...	2022-06-01 11:07:54...
7	7	motion_data/Video 3...	2022-06-01 11:08:15...
8	8	motion_data/Video_c...	2022-06-01 11:08:56...
9	9	motion_data/Video2_...	2022-06-01 11:09:01...
10	10	motion_data/Video_c...	2022-06-01 11:09:07...
11	11	motion_data/Video 3...	2022-06-01 11:09:12...
12	12	motion_data/webca...	2022-06-01 11:09:41...
13	13	motion_data/webca...	2022-06-01 11:09:43...
14	14	motion_data/webca...	2022-06-01 11:09:44...
15	15	motion_data/webca...	2022-06-01 11:09:44...
16	16	motion_data/webca...	2022-06-01 11:09:44...
17	17	motion_data/Video_c...	2022-06-01 11:10:33...

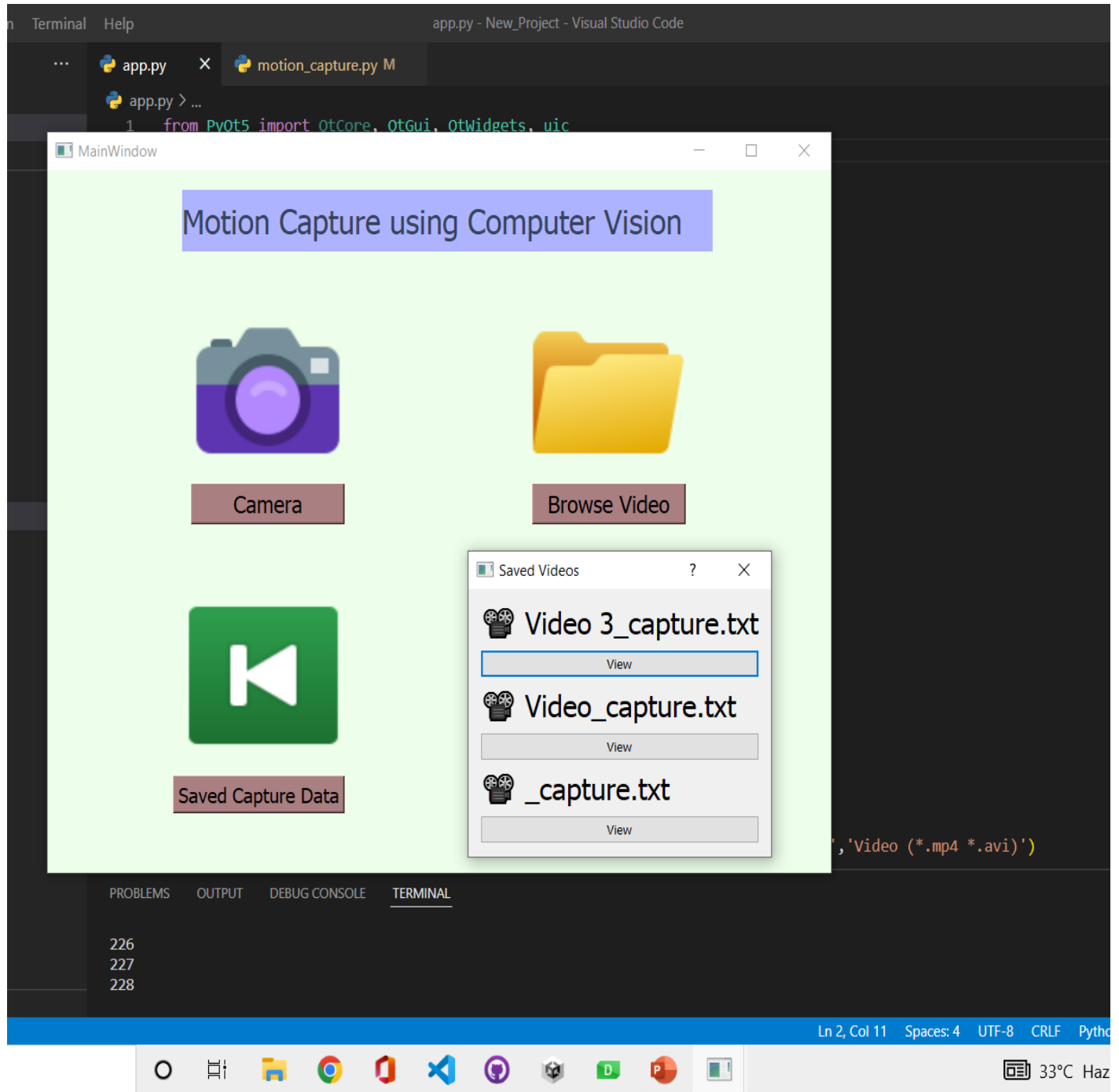
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PROBLEMSOUTPUTDEBUG CONSOLETERMINAL

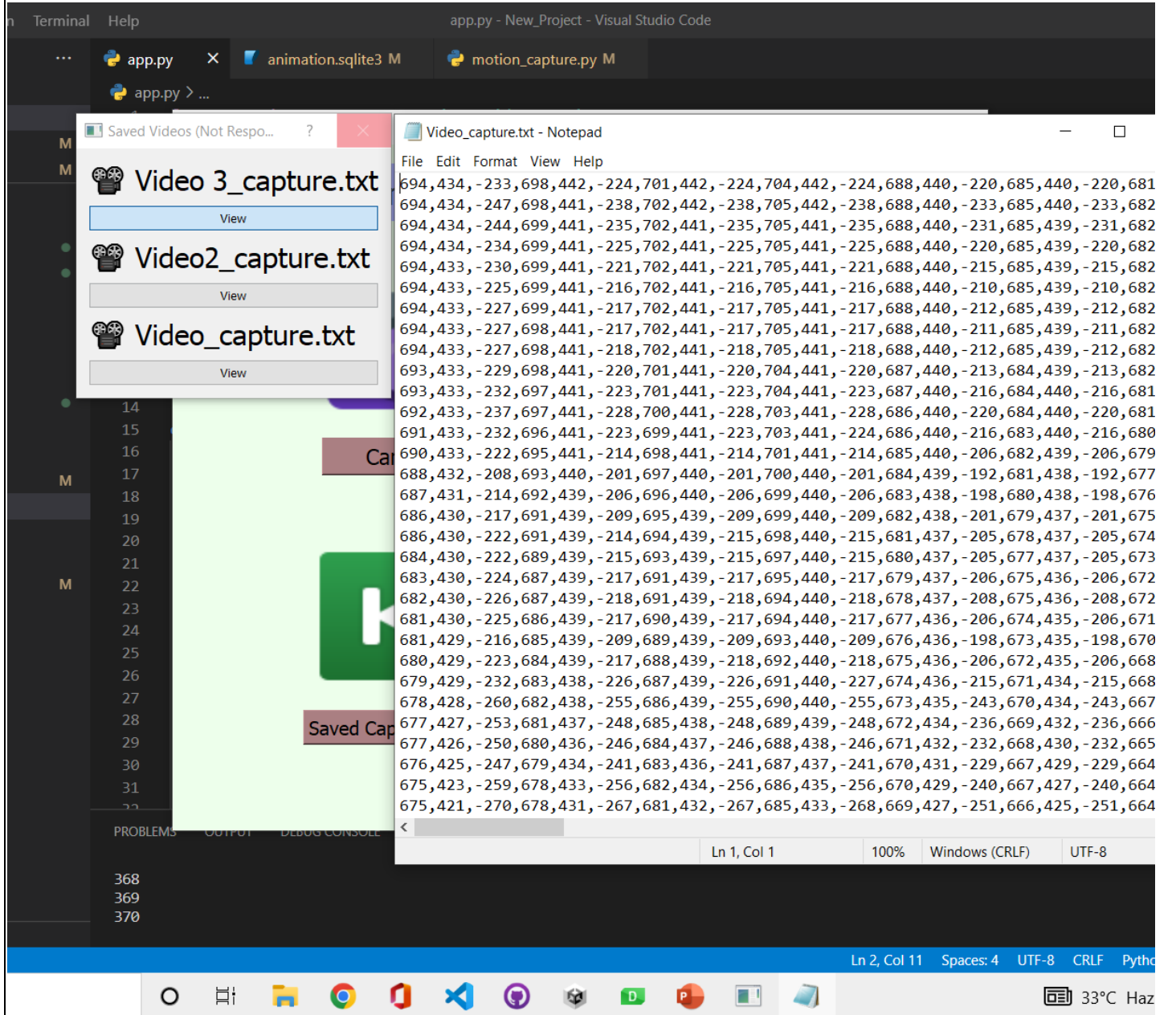
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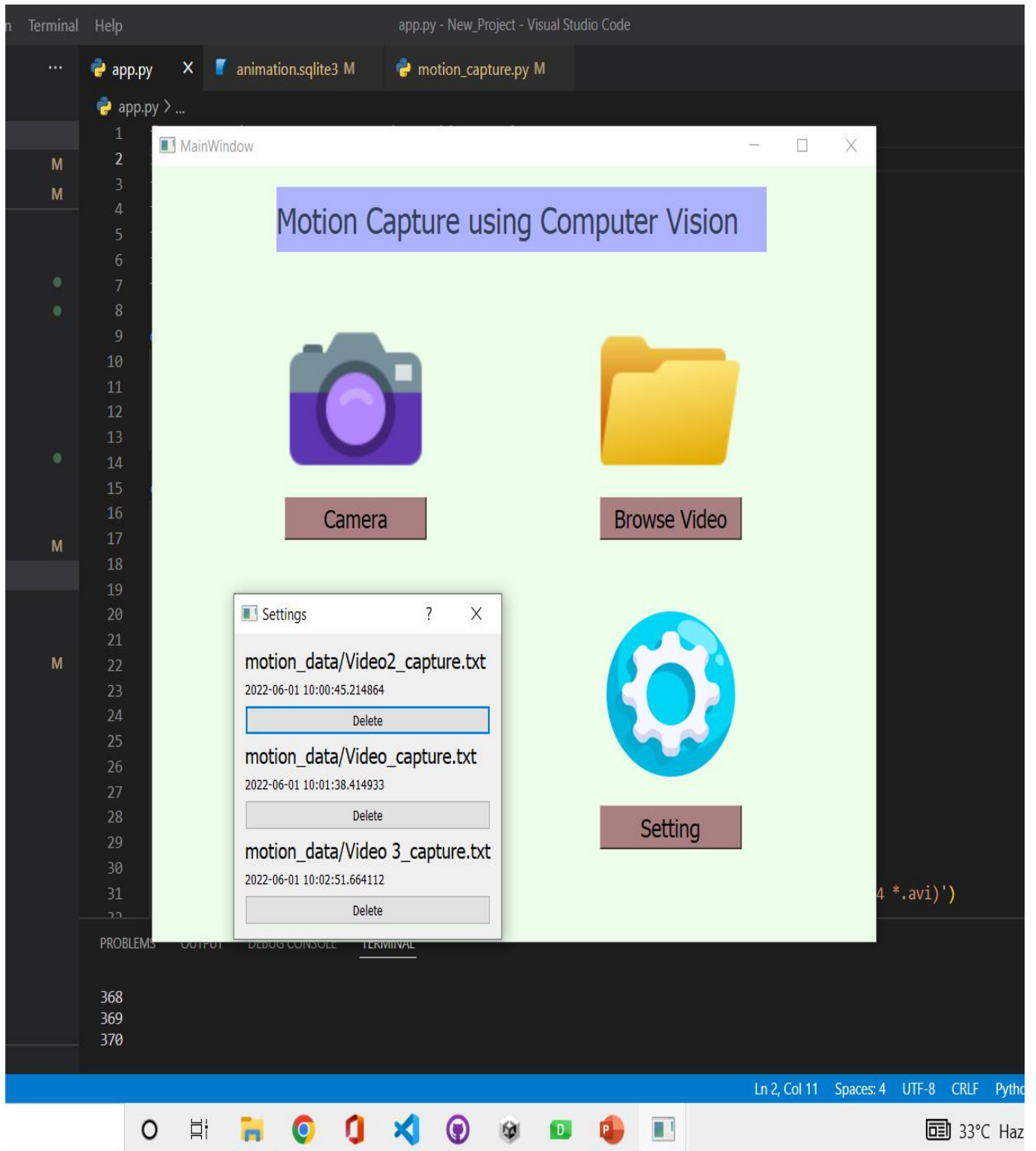




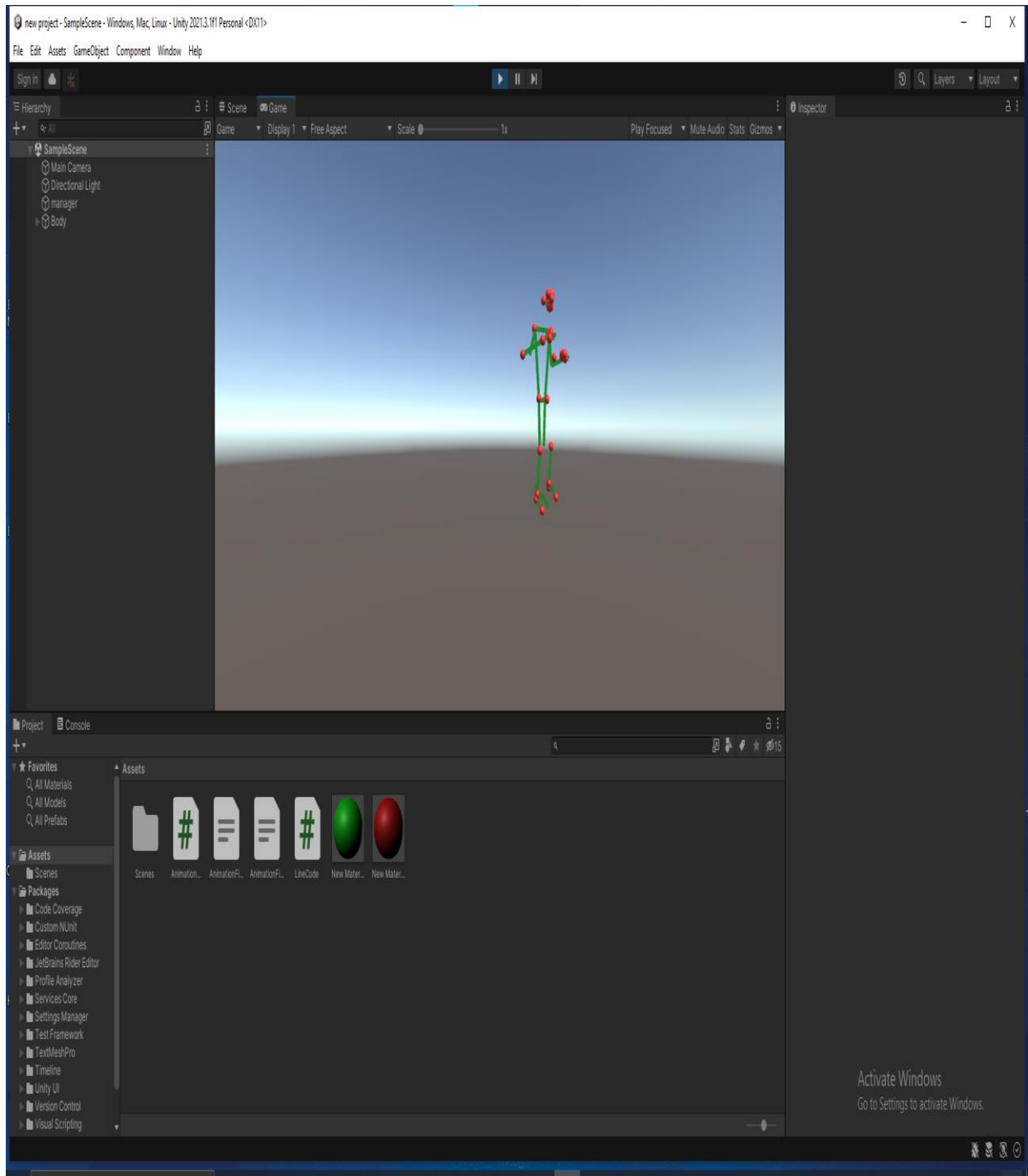








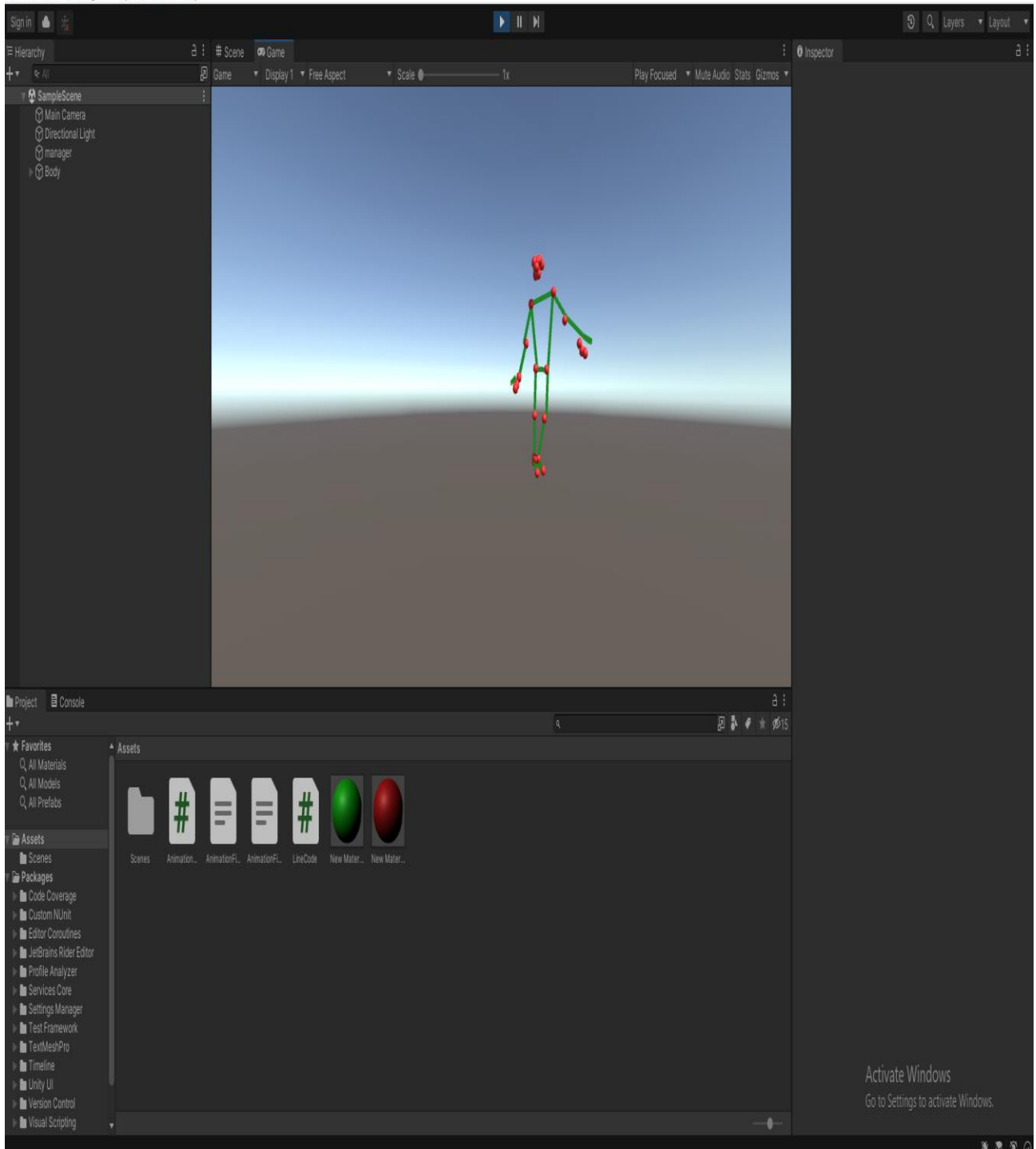




new project - SampleScene - Windows, Mac, Linux - Unity 2021.3.11f1 Personal <DX11>



File Edit Assets GameObject Component Window Help



# Conclusion

## Conclusion

This project will help new developers and independence artist to create movies, games with 3D-engine like – Unity without the needs of big studio and our project will be very helpful to these.

We wanted to see if it would be possible to build a system with a cheap, easy accessible camera, and a standard home computer. We have found that an optical motion capture system is very complex and it is hard to produce as a low budget system. Our attempt did not live up to our expectations in terms of accuracy and usability. The idea with using only one DV camera was to simplify the system since it would require no calibration or synchronization. It would also make the system cost efficient and more available to the general public. The single camera solution unfortunately created a number of problems in our system.

# Bibliography

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- [https://en.wikipedia.org/wiki/Main\\_Page](https://en.wikipedia.org/wiki/Main_Page)
- <https://mediapipe.dev/>