WORKOUT GUIDE AND CLASSIFIER

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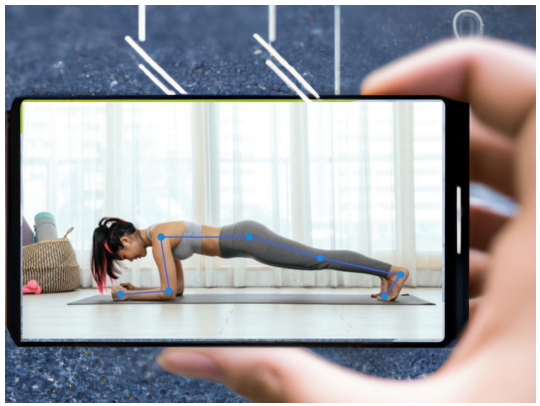
Introduction

- The project presents a comprehensive model that leverages computer vision and deep learning techniques to develop a CNN model for exercise classification and a model for performing exercise pose estimation.
- The project aims to assist individuals in achieving a healthy lifestyle by providing personalized exercise recommendations and real-time pose analysis.
- The project combines computer vision, deep learning, and user-specific information to create a powerful workout guide with potential applications in exercise tracking, fitness monitoring, workout classification and personalized workout guidance.



Motivation

- Plan and track their fitness goals.
- Personalized workout routine based on BMI index
- Quantifies physical workout
- Provides posture correction
- Effectively ulizes time by engaging in productive exercise routines.
- Classifies exercises into 4 classes

Literature Review

Authors	Title	Description
Rahul Ravikant Kanase et al.[1]	Pose Estimation and Correcting Exercise Posture	This project utilizes advanced pose estimation techniques to detect and analyze users' exercise poses, providing real-time feedback and suggestions for improved posture and injury prevention.
Alexander Toshev et al.[2]	DeepPose: Human pose estimation via deep neural networks	By leveraging recent advancements in Deep Learning, the authors aim to develop a powerful and efficient approach that provides high precision pose estimates.

Table 1: Literature Review

Literature Review

Abdulmajid Murad et al.[3]	Deep recurrent neural networks for human activity recognition	This paper proposes deep recurrent neural networks (DRNNs) based on LSTM architecture for human activity recognition.
Karen Simonyan et al. [4]	Two-stream convolutional networks for action recognition in videos	This research paper introduces a sports detection system that utilizes a deeper CNN model combined with fine-tuning

Table 2: Literature Review

Literature Review

Shakil Ahmed Reja et al.[5]	Sports Recognition using Convolutional Neural Network	This research study proposes a novel two-stream ConvNet architecture for action recognition in videos.
Hankil Kim et al.[6]	Human activity recognition by using convolutional neural network	This paper presents a human activity recognition (HAR) system that utilizes a time-based dataset captured by a thermal camera and a CNN structure to address the challenges of discomfort caused by acceleration-based methods and variability in vision-based systems.

Table 3: Literature Review

Gaps Identified

1. The system cannot generalize on popular exercises.
2. Limited in handling diverse poses.
3. Computationally expensive for training and execution.
4. A two-stream architecture that can handle videos with a lot of occlusions is hard to implement.
5. Poor lighting conditions negatively impact the accuracy of the model
6. The CNN may not be able to track the progress of activity over time.

Problem Statement

To develop a comprehensive workout guide that incorporates a workout classifier utilizing pose estimation to enhance the user's posture during exercises. This guide aims to help individuals achieve their personal fitness goals by considering their BMI. Additionally, the classifier categorizes the workout into four distinct classes.

Objectives

1. Help users achieve personal fitness goals based on BMI
2. Assist users in improving their posture during workouts using real-time feedback and pose estimation
3. Classify workouts into four distinct classes which helps in organizing and tracking the user's workout routines

Overall, the objectives of this workout guide and classifier model are to promote proper form, provide personalized recommendations, and facilitate progress tracking, thereby assisting individuals in achieving a healthy lifestyle and attaining their fitness objectives.

Methodology of the Workout Guide

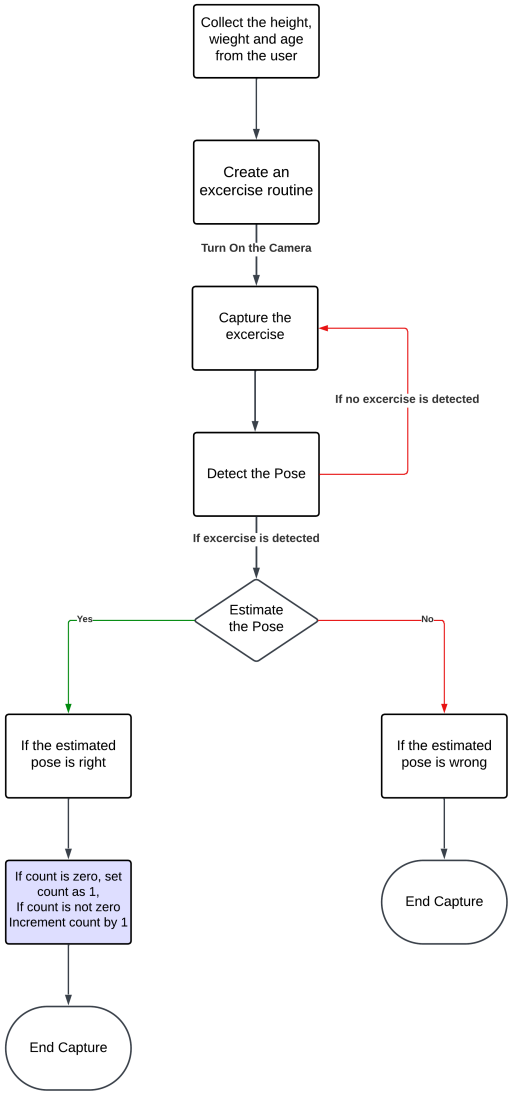


Figure 2: Working of the workout guide

Methodology of the Workout Guide

- Collect the user information including height, weight and age.
- Calculate the BMI index.
- Recommend exercises based on the calculated BMI index
- Pose Estimation is performed with the help of Mediapipe and OpenCV libraries.
- Real-Time Feedback is provided to the user which helps him to correct his posstures while performing the exercises.

Convolutional Neural Network (CNN) Architecture

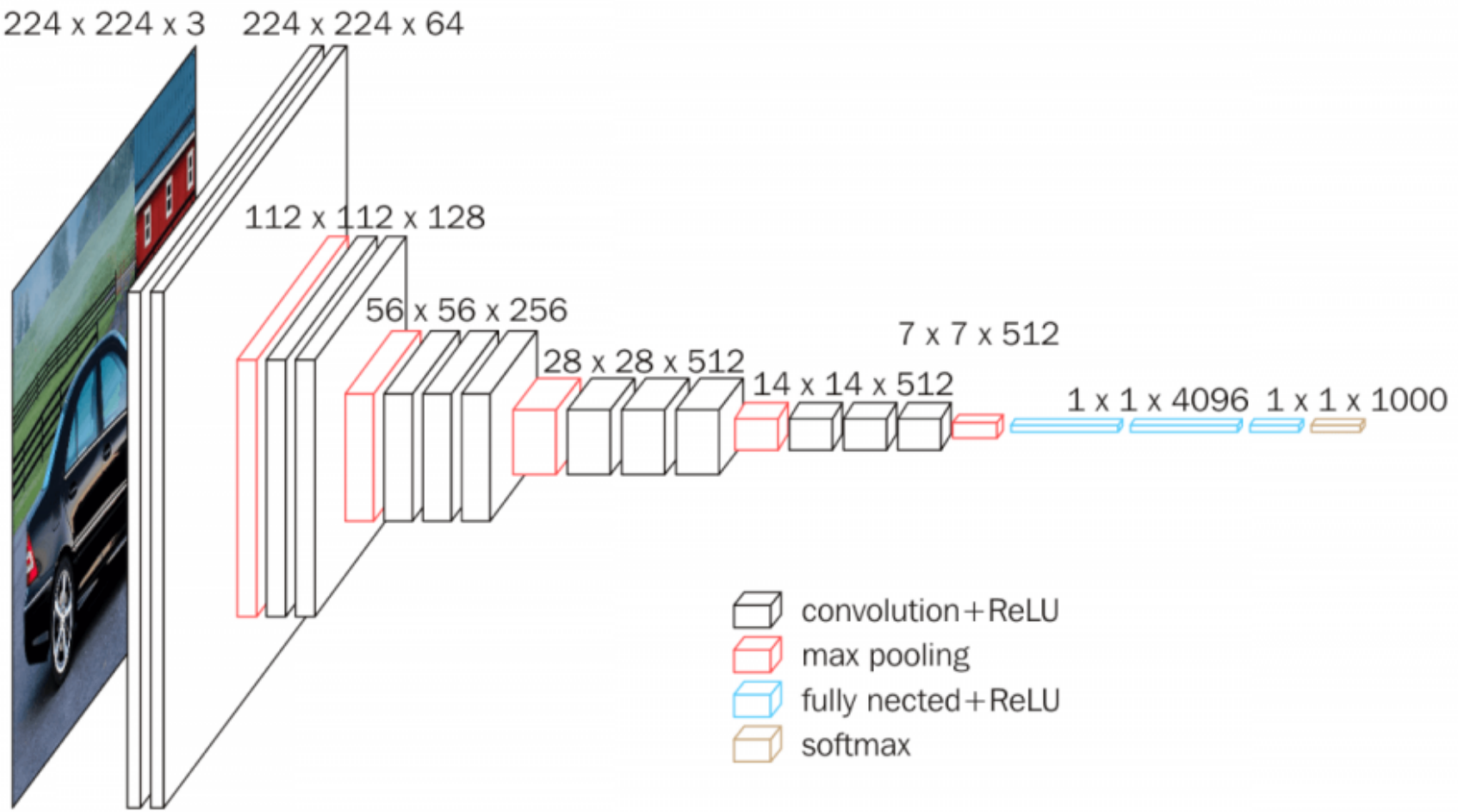


Figure 3: Architecture of VGG16

Network Architecture

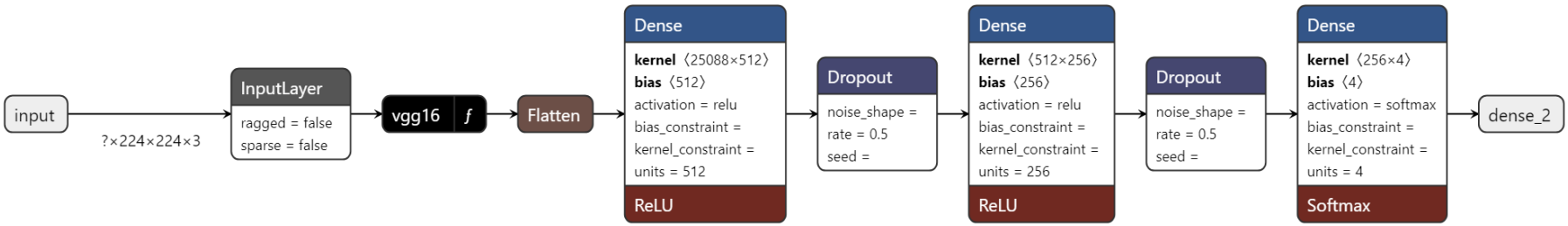


Figure 4: Network Architecture

Methodology of the Workout Classifier

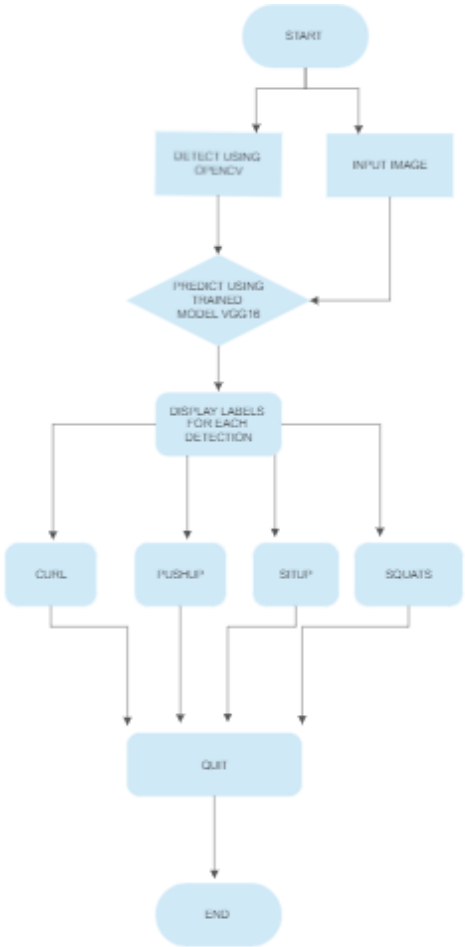


Figure 5: Working of Workout Classifier

Methodology of the Workout Classifier

- The data for training and testing the model are collected which belongs to 4 distinct classes, namely Squat, Curls, Situps and Pushups.
- Perform Data Preprocessing ,where resizing, normalization, feature extraction etc is done.
- Perform Data Augmentation and transform the available data
- Split the available data into training,testing and validation sets.
- Train the model to classify the entire data into 4 exercises and identify them.
- Analyze the results of the model and evaluate its performance.

Dataset

- The provided data set comprises a collection of images encompassing four distinct exercises, namely Squats, Curls, Sit-ups, and Push-ups.
- Each exercise category is represented by a total of 500 images.
- The images adhere to jpg, png, bmp and jpeg file formats.
- The images have been sourced from repositories such as Google and Kaggle.

Dataset

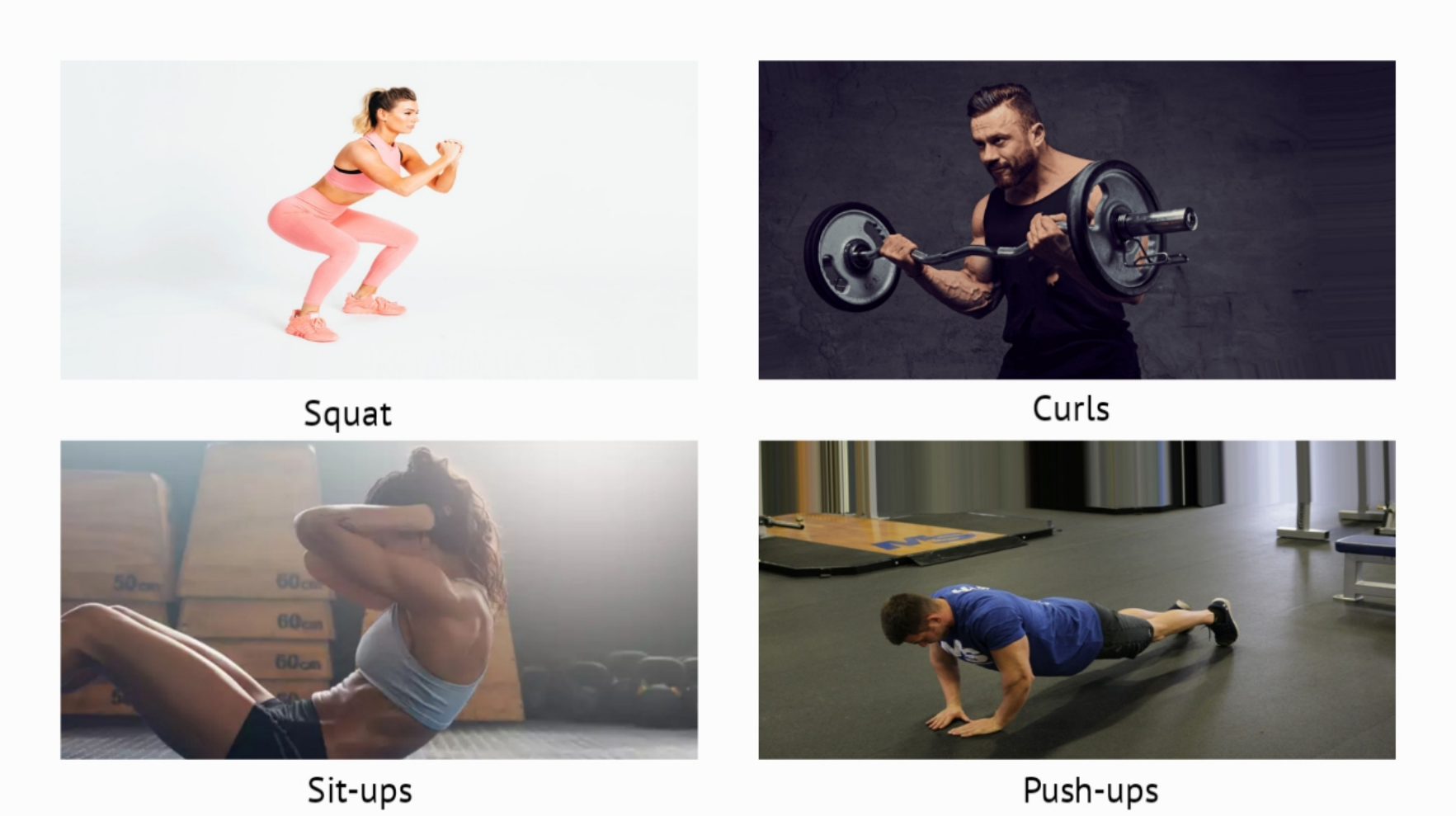


Figure 6: Dataset

Hardware and Software Requirements

- **Hardware Requirements**
  1. Webcam:

     Cameras with at least 720p resolution are recommended.
  2. Computer:

     The Computers require High-performance CPU,GPU and Sufficient RAM.
- **Software Requirements**
  1. Operating System:

     Windows is the preferred operating system
  2. Integrated Development Environment (IDE) :

     Jupyter Notebook is the IDE used in the project
  3. Python:

     Python 3.10.11 Programming Language with Libraries OS, Shutil, Pandas, Seaborn, Collections, Sklearn, Matplotlib,OpenCV, TensorFlow, Keras, Numpy, Tkinter and Mediapipe installed.

Result

The Test Accuracy = 91.5%

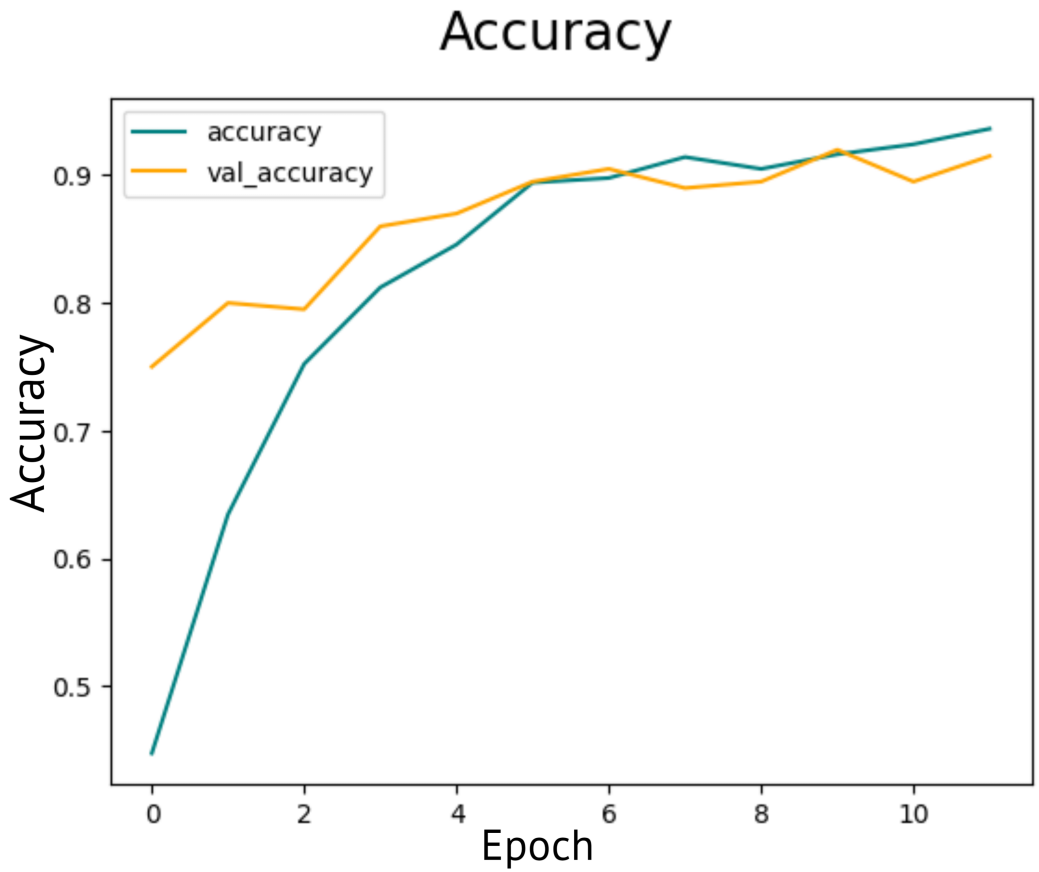


Figure 7: Model Training Accuracy

Result

The Test Loss = 0.2872

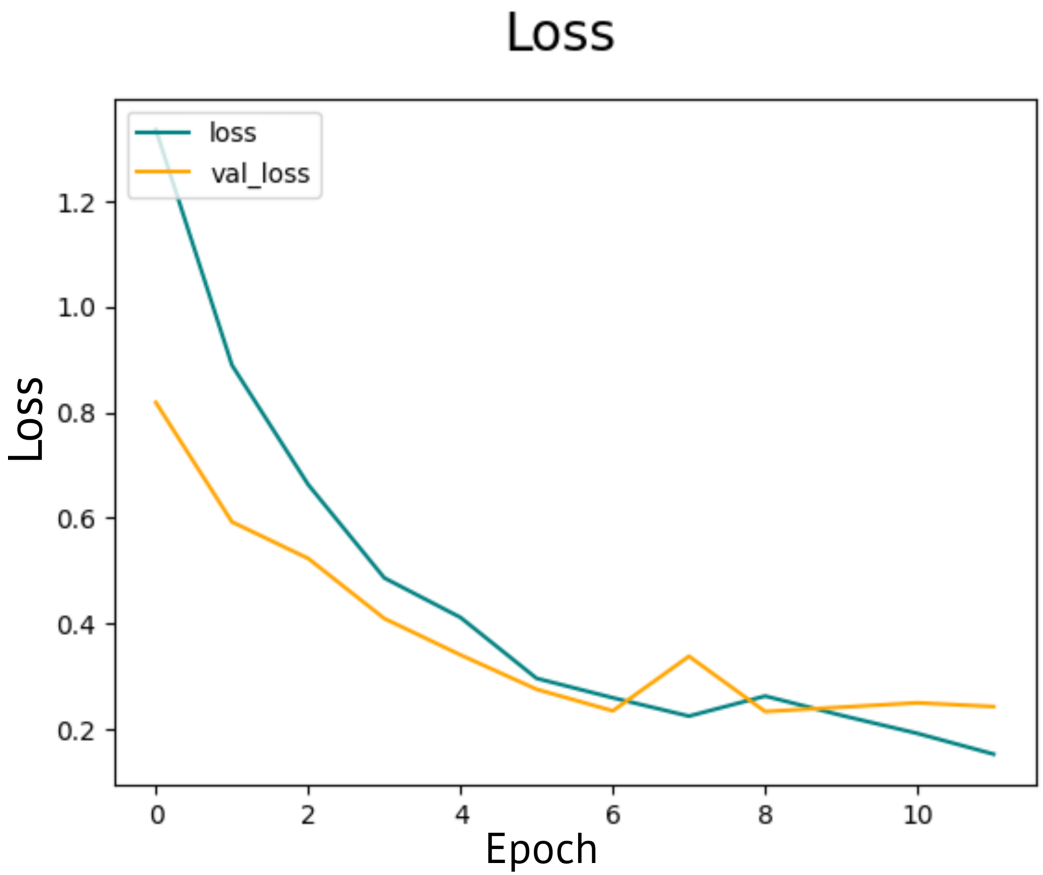


Figure 8: Model Training Loss

Result

Class	Precision	Recall	F1-score	Support
Curl	0.98	0.86	0.92	109
Pushup	0.92	0.94	0.93	99
Situp	0.93	0.87	0.9	86
Squats	0.85	0.98	0.91	106
Accuracy			0.92	400
Macro Avg	0.92	0.91	0.91	400
Weighted Avg	0.92	0.92	0.91	400

Table 4: Classification Report

Result

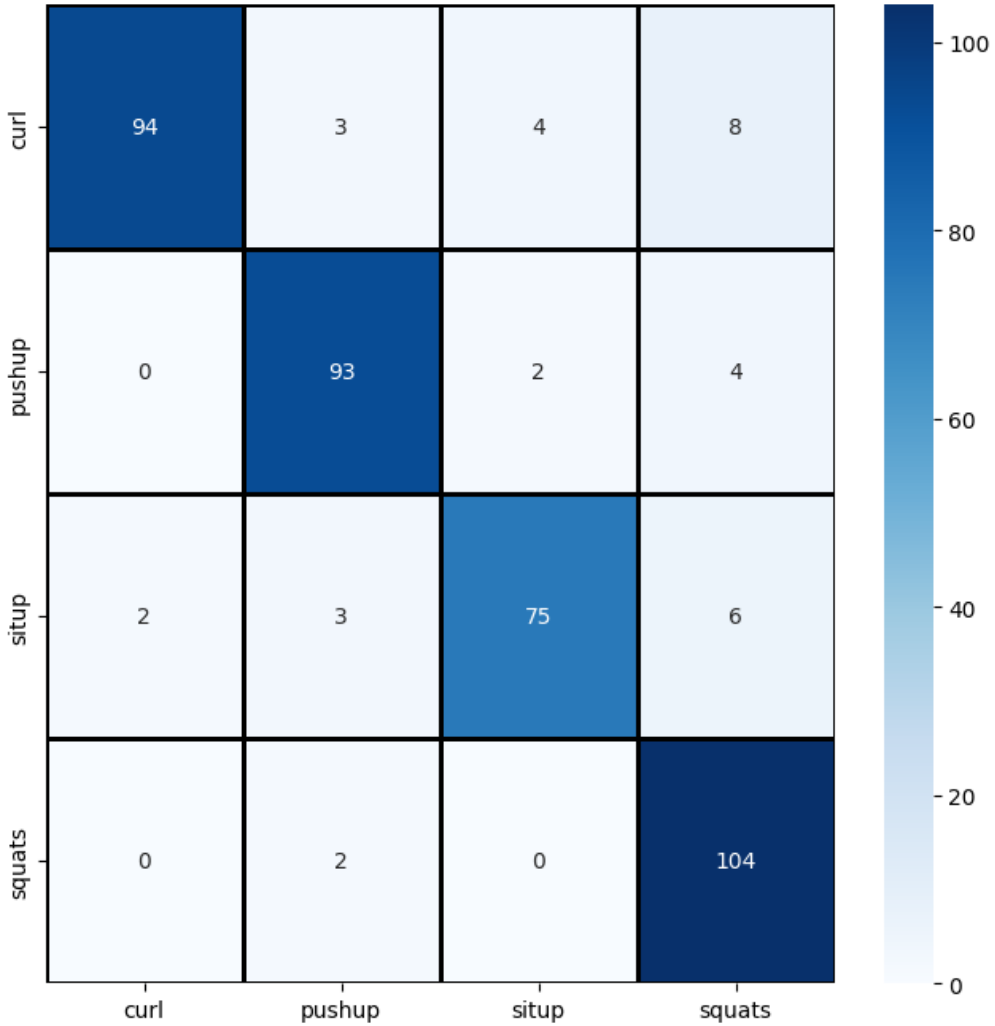
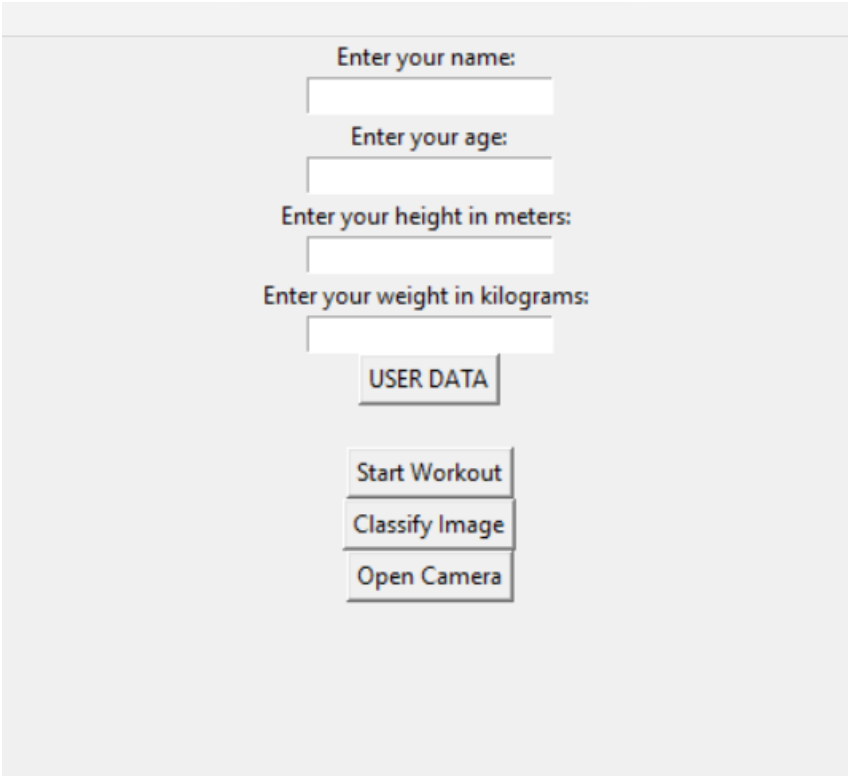
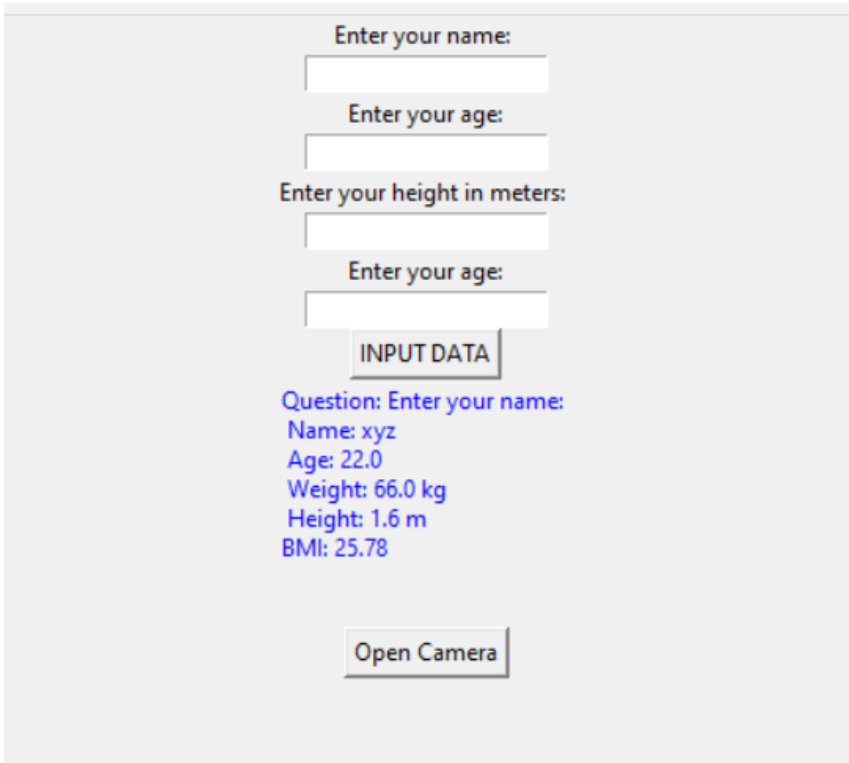


Figure 9: Confusion Matrix

User Interface



(a) UI Before entering user details.



(b) UI After entering user details.

Figure 10: User Interface

User Interface

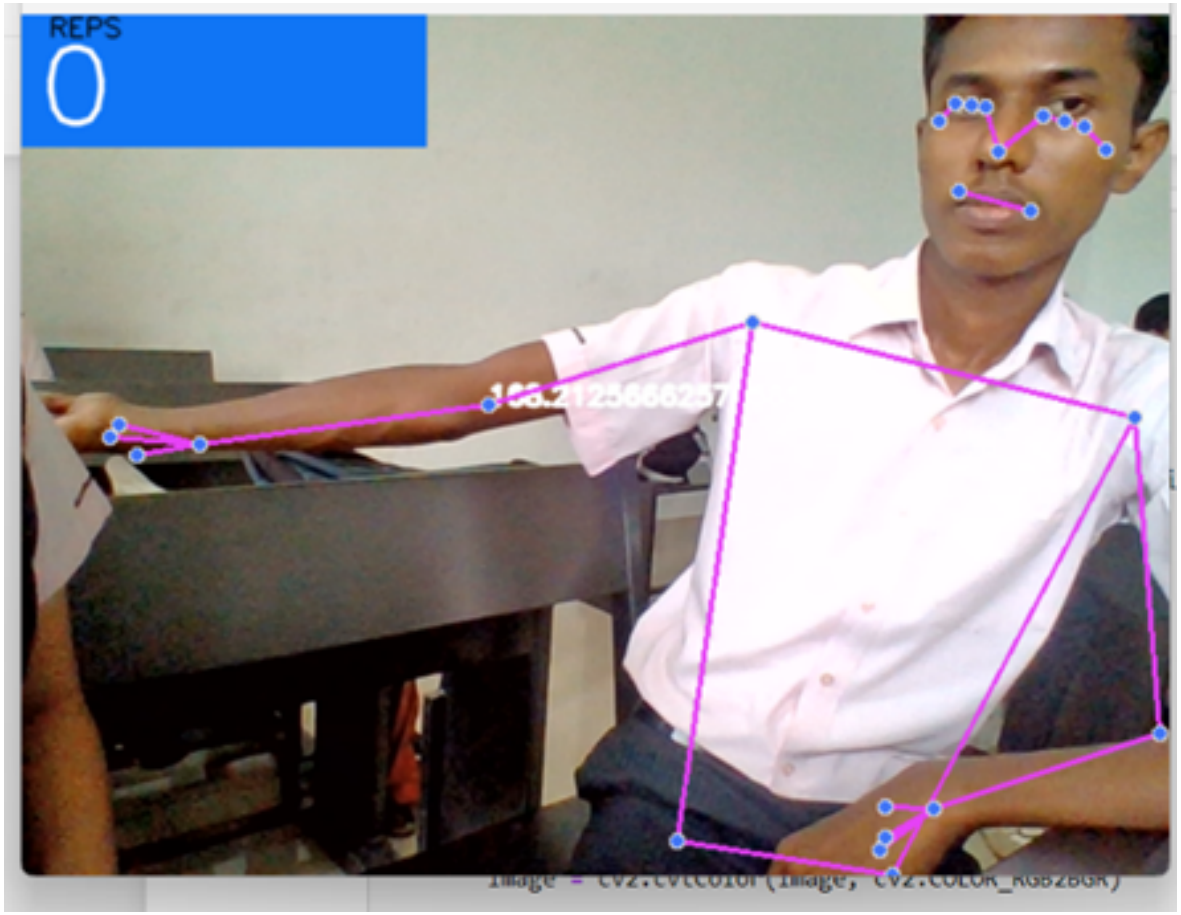


Figure 11: Camera Popup

Use Case Diagram

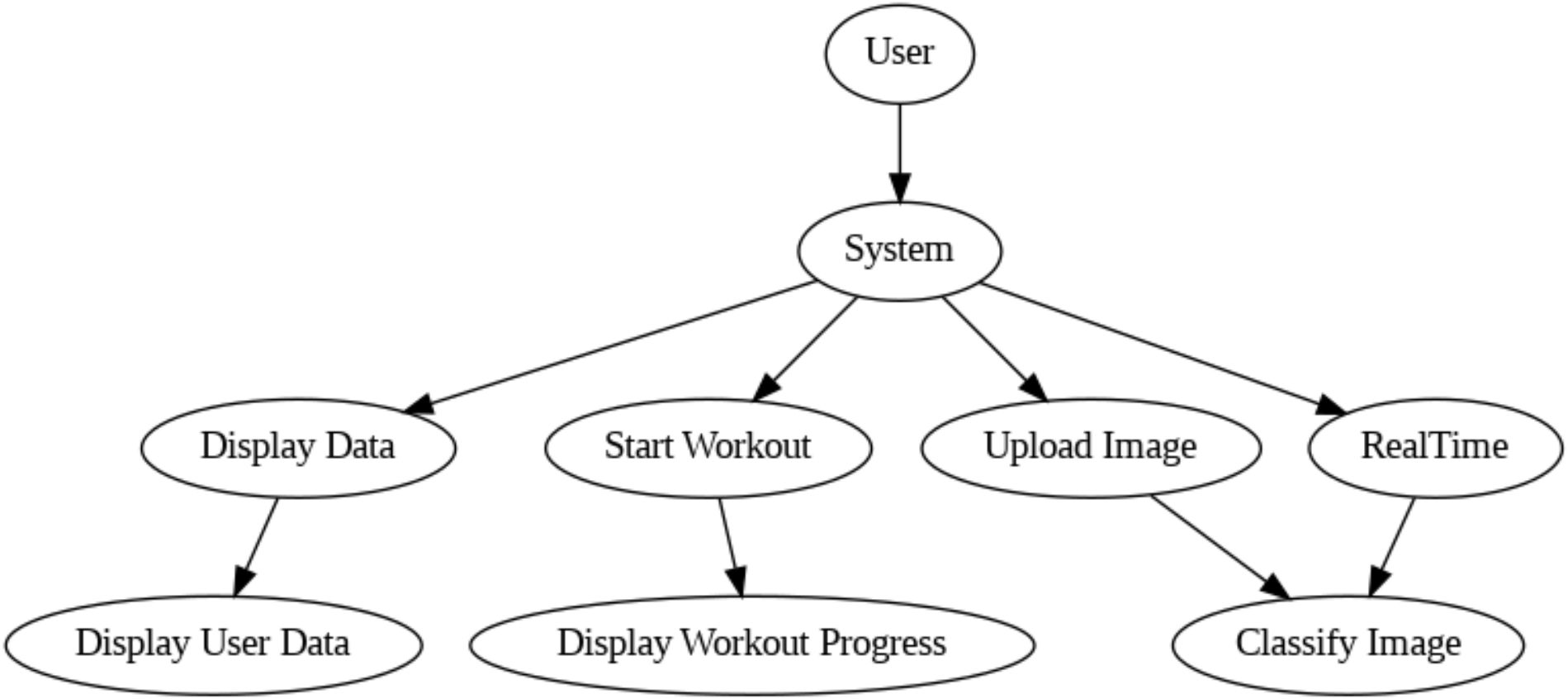


Figure 12: Use Case Diagram

Conclusion

- The Workout Guide is an effective tool for individuals who want to create and maintain a healthy lifestyle.
- Using computer vision techniques effectiveness of workout is evaluated
- The app calculates BMI index and suggests a workout based on the same.
- Users can optimize their workout experience and achieve their goals more efficiently with the model's features.
- The proposed system architecture is designed to provide a scalable and user-friendly experience.

Future Scope

- Physical therapy and rehabilitation settings
- Integration into smart gym equipment or home fitness systems
- Wearable technology and sensors
- Sports training and coaching
- Potential applications in fields related to health, wellness, rehabilitation, and sports performance enhancement.

References I

[1] R. R. Kanase, A. Pawar, S. Shedge, A. Jadhav, and A. Patil, "Pose estimation and correcting exercise posture," vol. 40, p. 03031, 2021.

[2] A. Toshev and C. Szegedy, "Deeppose: Human pose estimation via deep neural networks," *arXiv preprint arXiv:1406.2715*, 2014.

[3] A. Murad, J.-W. Kwak, Y.-B. Hong, and D.-H. Kim, "Deep recurrent neural networks for human activity recognition," *IEEE Access*, vol. 5, pp. 16861–16871, 2017.

[4] K. Simonyan and A. Zisserman, "Two-stream convolutional networks for action recognition in videos," *IEEE Transactions on Pattern Analysis and Machine Intelligence*, vol. 36, no. 9, pp. 1921–1933, 2014.

[5] S. A. Reja and M. M. Rahman, "Sports recognition using convolutional neural network," *IEEE Access*, vol. 8, pp. 12491–12498, 2020.

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[6] H. Kim, J. Kim, and J. Lee, "Human activity recognition by using convolutional neural network," *International Journal of Electrical and Computer Engineering (IJECE)*, vol. 9, no. 6, pp. 5251–5258, 2019.

THANK YOU