A Synopsis of Project on

An Application based Data-Driven AI Fitness Trainer integrating Deep Learning Algorithms and Computer Vision

Submitted in partial fulfillment of the requirements for the award
of the degree of

Bachelor of Engineering

in

Computer Science and Engineering(Data Science)

by

Riya Sawant(21107019)
Rutuja Patil(21107012)
Tanvi Panchal(21107006)
Sneha Sabat(22207008)

Under the Guidance of

Prof. Anagha Aher
Prof. Ashwini Rahude

Department of Computer Science and Engineering(Data Science)
NBA Accredited
A.P. Shah Institute of Technology
G.B.Road,Kasarvadavli, Thane(W)-400615

UNIVERSITY OF MUMBAI
Academic Year 2024-2025

Approval Sheet

This Project Synopsis Report entitled ***"An Application based Data-Driven AI Fitness Trainer integrating Deep Learning Algorithms and Computer Vision "*** Submitted by ***"Riya Sawant"(21107019),"Rutuja Patil"(21107012),"Tanvi Panchal"(21107006),"Sneha Sabat"(22207008)***is approved for the partial fulfillment of the requirenment for the award of the degree of ***Bachelor of Engineering*** in ***Computer Science and Engineering(Data Science)*** from ***University of Mumbai***.

(Prof. Ashwini Rahude)
Co-Guide

(Prof. Anagha Aher)
Guide

Prof. Anagha Aher
HOD, CSE(Data Science)

Place:A.P.Shah Institute of Technology, Thane
Date:

CERTIFICATE

This is to certify that the project entitled ***"An Application based Data-Driven AI Fitness Trainer integrating Deep Learning Algorithms and Computer Vision "*** submitted by ***"Riya Sawant" (21107019),"Rutuja Patil" (21107012),"Tanvi Panchal" (21107006),"Sneha Sabat" (22207008)*** for the partial fulfillment of the requirement for award of a degree ***Bachelor of Engineering*** in ***Computer Science and Engineering (Data Science)***,to the University of Mumbai,is a bonafide work carried out during academic year 2024-2025.

(Prof. Ashwini Rahude)
Co-Guide

(Prof. Anagha Aher)
Guide

Prof. Anagha Aher
HOD, CSE(DS)

Dr. Uttam D.Kolekar
Principal

External Examiner(s)

1.

2.

Internal Examiner(s)

1.

2.

Place:A.P.Shah Institute of Technology, Thane
Date:

Acknowledgement

We have great pleasure in presenting the synopsis report on **An Application based Data-Driven AI Fitness Trainer integrating Deep Learning Algorithms and Computer Vision.** We take this opportunity to express our sincere thanks towards our guide **Prof. Anagha Aher** & Co-Guide **Prof. Ashwini Rahude** for providing the technical guidelines and suggestions regarding line of work. We would like to express our gratitude towards his constant encouragement, support and guidance through the development of project.

We thank **Prof. Anagha Aher** Head of Department for his encouragement during the progress meeting and for providing guidelines to write this report.

We express our gratitude towards BE project co-ordinator **Prof. Poonam Pangarkar**, for being encouraging throughout the course and for their guidance.

We also thank the entire staff of APSIT for their invaluable help rendered during the course of this work. We wish to express our deep gratitude towards all our colleagues of APSIT for their encouragement.

Riya Sawant
(21107019)

Rutuja Patil
(21107012)

Tanvi Panchal
(21107006)

Sneha Sabat
(22207008)

Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, We have adequately cited and referenced the original sources. We also declare that We have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

(Signature)
Riya Sawant(21107019)

(Signature)
Rutuja Patil(21107012)

(Signature)
Tanvi Panchal(21107006)

(Signature)
Sneha Sabat(22207008)

Date:

Abstract

Generic workout routines, a lack of personalized advice, and challenges in time management often result in ineffective workouts and frustration in reaching fitness goals. This AI Fitness Trainer addresses these problems by offering highly personalized recommendations through Deep Neural Networks (MLP), ensuring guidance tailored to each user's unique fitness profile and goals. The AI trainer incorporates Mediapipe and Cvzone technologies along with a Convolutional Neural Network model for advanced pose estimation and real-time analysis. At the same time, a voice assistant provides instant feedback on posture. Additionally, users can view weekly progress through a detailed dashboard and keep track of performance on a dynamic leaderboard. This comprehensive system ensures a tailored fitness experience, combining precise recommendations, real-time feedback, and progress tracking to enhance user engagement and motivation

Contents

List of Figures

List of Tables

List of Abbreviations

AI:	Artificial Intelligence
AIFT:	AI Fitness Trainer
DNN:	Deep Neural Networks
CNN:	Convolutional Neural networks
MLP:	Multi-Layer Perceptron

Chapter 1

Introduction

In today's fast-paced world, achieving personal health and fitness goals requires more than just generic workout routines and static fitness plans. Modern fitness enthusiasts seek personalized guidance, something that adapts to their individual needs, goals, and limitations. However, traditional fitness programs often fail to meet these evolving expectations. Lacking the necessary flexibility, many existing solutions do not cater to unique user requirements, which ultimately leads to decreased motivation and inconsistent results. Most fitness solutions, such as mobile apps and wearable devices, offer generic workout plans and manual tracking. They lack real-time, personalized feedback, which is crucial for optimizing performance. Without immediate guidance on form and progress, users often experience inefficient workouts and struggle to stay on track. Inadequate personalization, lack of real-time feedback, and low user engagement remain key issues in current fitness technologies. A dynamic and interactive solution is needed to provide tailored guidance and keep users motivated while achieving their fitness goals.

1.1 Motivation

Traditional fitness programs often provide generic advice and rely on manual tracking, which fails to address the unique needs of individuals. These programs lack the personalization necessary to cater to specific health conditions, fitness goals, and user progress. The AI Fitness Trainer addresses these limitations by utilizing artificial intelligence to analyze real-time data and offer personalized workout recommendations tailored to each user. This allows for instant feedback on exercise form and progress, enabling users to make adjustments in real-time for better results. With this personalized approach, the AI Fitness Trainer enhances user engagement, motivation, and overall fitness outcomes. Ultimately, it provides a more effective and customized fitness experience compared to traditional methods.

1.2 Problem Statement

The challenge in achieving fitness goals often stems from the need for individuals to simultaneously focus on two demanding tasks: performing exercises with correct form and tracking progress or results. This dual-task requirement imposes cognitive load, dividing attention and increasing the likelihood of improper form, which can lead to injuries or inefficient work-

outs. Many fitness enthusiasts also lack access to personalized, real-time guidance, which limits their ability to correct mistakes in the moment and maximize the benefits of their workouts. Traditional fitness solutions, such as static workout plans, gym sessions without real-time feedback, and generic mobile applications, fail to cater to each individual's specific goals, fitness levels, and physical limitations. The absence of a tailored approach to fitness results in decreased motivation, inefficient workouts, and slow progress. Access to professional trainers for personalized advice can be financially burdensome, and conventional fitness programs lack the adaptability to accommodate diverse fitness goals and schedules. Without the ability to receive continuous, customized support, users often struggle to achieve their long-term health and fitness objectives.

1.3 Objectives

- To provide real-time feedback on exercise form, gesture, posture, and accuracy percentage, as well as to detect and track exercises performed, calculate calories burned, and address user slacking off during workouts using deep learning-powered human pose estimation, computer vision technologies and convolutional neural networks (CNNs).

- To provide personalized workout routines based on the user's health conditions, age, fitness based goals using a deep learning-based Multilayer Perceptron network.

- To create a dynamic and customizable diet plan tailored to the user's health conditions, age, preferences, height, weight, and allergies using a deep learning-based Multilayer Perceptron network.

- To generate comprehensive weekly performance reports by integrating data from workouts and diet recommendations using data aggregation, descriptive statistics, and data visualization techniques, and to enhance user engagement and motivation through a system that allows users to log their progress and participate in leaderboards.

1.4 Scope

- The Data-Driven AI Fitness Trainer (AIFT) can be applied in various areas such as fitness centers, home workouts, corporate wellness programs, and more, providing a comprehensive solution for personalized fitness training, workout plans, and nutrition guidance.

- AIFT caters to a wide range of users, including fitness enthusiasts, beginners, professional athletes, and individuals with specific health needs, offering tailored workout and diet plans for each.

- The recommendation engines within AIFT are highly customizable, allowing seamless integration with other platforms and ensuring flexibility for different fitness applications and use cases.

- With its adaptive workout plans, real-time feedback, and personalized recommendations, AIFT enhances the fitness experience, making it a valuable tool for users looking to achieve their fitness goals efficiently and effectively.

Chapter 2

Literature Review

In recent years, the intersection of artificial intelligence and fitness has become a focal point of research, reflecting a growing demand for personalized training solutions. As fitness enthusiasts increasingly seek tailored guidance to achieve their health goals, various studies have explored innovative approaches to enhance user experience and effectiveness in workout routines. This literature review examines the key findings and contributions of notable research in the field, highlighting the challenges and opportunities for developing advanced AI-driven fitness solutions.

2.1 Comparative Analysis of Recent Study

Robust Intelligent Posture Estimation for an AI Gym Trainer (2023): Venkata Sai P. Bhamidipati et al. proposed a posture estimation system using Mediapipe and OpenCV, focusing on real-time video processing and keypoint detection. Although it offers accurate posture estimation for specific exercises, its limitations include dependency on predefined datasets and environmental factors such as lighting and camera quality. This study highlights the importance of environment in posture estimation, an aspect that the AI Fitness Trainer addresses by integrating robust algorithms that can work in diverse conditions.

AI Trainer: Autoencoder-Based Approach for Squat Analysis and Correction (2023): Mukundan Chariar et al. developed a system to classify squat types and provide feedback on correct form using Mediapipe. The approach is effective for squat exercises but lacks generalizability across other workout types. While this method works for specific exercises, the AI Fitness Trainer aims for a more comprehensive solution, capable of recognizing and providing feedback for a wide range of exercises.

Real-Time Short-Range Human Posture Estimation Using mmWave Radars and Neural Networks (2022): Han Cui and Naim Dahnoun introduced a real-time human posture estimation system utilizing mmWave radar and neural networks, achieving accurate posture estimates at 20 frames per second with minimal localization error. However, the reliance on specialized hardware raises concerns about accessibility for consumer-grade applications.While this study demonstrates impressive accuracy, the AI Fitness Trainer aims to provide similar posture estimation capabilities using standard camera systems, enhancing accessibility and usability for a broader audience without the need for specialized equipment.

A Framework for Recognition and Prediction of Human Motions in Human-Robot Collaboration (2020): Thomas Callens et al. introduced a motion prediction framework used in human-robot collaboration. The model struggles with phase speed estimation, limiting its

real-time effectiveness in dynamic environments. This framework highlights the challenge of real-time feedback in motion-based applications. The proposed system enhances real-time feedback for human posture and performance, ensuring continuous monitoring during workouts.

An Efficient Hybrid Recommendation Model with Deep Neural Networks (2019): Zhenhua Huang et al. proposed a hybrid recommendation model combining deep learning and metric learning to generate personalized recommendations. The system, however, faces challenges in handling sparse datasets, reducing its effectiveness in real-time applications. The hybrid recommendation method aligns with the approach of using deep neural networks, but the AI Fitness Trainer focuses on optimizing real-time performance and enhancing user engagement through dynamic feedback.

A Hybrid Recommender System Using Multi-Layer Perceptron Neural Networks (2018): Didar Divani Sanandaj et al. combined collaborative and content-based filtering using an artificial neural network to address the cold-start problem in recommendation systems. While it improves recommendation accuracy, the system struggles with accuracy when handling complex or sparse data. The approach of AIFT expands on this by focusing on dynamic, real-time personalization for each user's unique workout goals, without relying heavily on collaborative filtering.

Chapter 3

Project Design

3.1 Proposed System Architecture

3.2 Data Flow Diagrams(DFD)

3.3 Use Case Diagrams

In Chapter 3 which is Project Design Project Groups should have System Architecture, and UML Diagrams like Activity/Use Case/Class. Don't just include diagrams. Write a brief about why Theoretically These diagrams are important in Design & also write in brief how they represent your project

Chapter 4

Project Implementation

In Chapter 4 which is Project Implementation Project Groups should add at Max 6 snippets of your code or Screenshots which you feel are major & Technically critical along with its brief description.

4.1 Timeline Sem VII

In this section, Students need to show the timeline of their project milestone and how they have reached this stage of the project in graphical representation.

Chapter 5

Summary

This will be the final chapter of the report. A brief report of the work carried out shall form the first part of the Chapter. Conclusions derived from the logical analysis presented in the Results and Discussions Chapter shall be presented and clearly enumerated, each point stated separately. Scope for future work should be stated lucidly in the last part of the chapter.

Bibliography

[1] Abror Abduvaliyev, Al-Sakib Khan Pathan, Jianying Zhou, Rodrigo Roman and Wai-Choong Wong ,"On the vital Areas of Intrusion Detection Systems in Wireless Sensor networks",IEEE Communications Surveys & Tutorials, Accepted For Publications, 2013-in press.

[2] H.H. Soliman, et al,"A comparative performance evaluation of intrusion detection techniques for hierarchical wireless sensor networks", Egyptian Informatics Journal (2012) 13, 225–238.

[3] Giannetsos Athanasios, "Intrusion Detection in Wireless Sensor Networks", Master THESIS, Carnegie Mellon University, April 8, 2008.

[4] K.Fall and K.Varadhan,"The NS Manual", http://www.isi.edu/nsnam/ns/doc/ns_doc.pdf., Accessed on 1 Feb 2014., 10am.

[5] Jae Chung and Mark Claypool,"NS by Example-Tutorial", http://nile.wpi.edu/NS/overview.html ,Accessed on 1 Feb 2014., 10am.

[6] Network Simulator blog, http://Mohittahilani.blogspot.com , Accessed on 1 Feb 2014., 10am.

[7] AWK Script for NS2, http://mohit.ueuo.com/AWK-Scripts.html , Accessed on 1 Feb 2014., 10am.

Appendices

Detailed information, lengthy derivations, raw experimental observations etc. are to be presented in the separate appendices, which shall be numbered in Roman Capitals (e.g. "Appendix I"). Since reference can be drawn to published/unpublished literature in the appendices these should precede the "Literature Cited" section.

Appendix-A: NS2 Download and Installation

1. Download ns-allinone-2.35.tar.gz from http://sourceforge.net/projects/nsnam/

2. Place ns-allinone-2.35.tar in your desired directory; like /home/vishal.

3. Go to terminal and do as following commands
sudo apt-get update
sudo apt-get install automake autoconf libxmu-dev build-essential

4. Extract ns-allinone-2.35 and after extracting go to folder ns-allinone-2.35 from Terminal as
$cd ns-allinone-2.35
$./install

5. Path Setting
$ gedit .bashrc

This command will open an existing file in editor. Just put the following path which is given bellow. [Remember that our ns-allinone path is /home/vishal. we will change this path according to our ns-allinone folder's path]

export PATH=$PATH:/home/vishal/ns-allinone-2.35/bin:/home/vishal/ns-allinone-2.35/tcl8.5.10/unix/home/vishal/ns-allinone-2.35/tk8.5.10/unix

export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:/home/vishal/ns-allinone- 2.35/otcl-1.14:/home/vishal/ns-allinone-2.35/lib

export TCL_LIRARY_PATH=$TCL_LIBRARY_PATH:/home/vishal/ns-allinone-2.35/tcl8.5.10/library

After this save and exit.

6. Now type in terminal to check that, is all command we entered in .bashrc is correct or not? And To take the effect immediately
$source .bashrc

7. Then perform the validation test using this command.
$ ./validate

8. Run ns2 using this command
$ns

We will get % prompt in our terminal. Now ns2 has been installed.