FIT-AI

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Abstract: FitAI is an AI-powered fitness assistant that uses computer view to track and count push-ups in real time. The system utilizes a camera to capture the user's movements, processes the footage using AI-based pose recognition, and accurately counts each push-up. The goal of FitAI is to provide users with an automated and structured way to monitor their workout progress without the need for manual counting. This project aims to enhance fitness tracking through technology, making workouts more engaging and effective.

Keywords: efficiency , counting algorithm , CNN model , intensity.

1.INTRODUCTION

With artificial intelligence (AI) integrated into the fitness industry, it has developed some great solutions for improving the efficiency of your workouts, as well as tracking them. In this project, we will build an AI-based push up counter using computer vision to detect and analyze body movements in real-time. Using a webcam, the system tracks the user's motion, automatically counting the number of push-ups they concede without requiring any tracking on their part.

Most tracking methods rely on wearable devices or manual input, creating a hassle and an opportunity for human error. Instead, this AI-based method enables a seamless, automated experience with immediate feedback and accurate rep tracking. Using pose estimation, the system then identifies all of the relevant body landmarks to see if the push-up is performed correctly and determines if push-ups are repetitions or not.

This project aims to contribute to the growing field of AI-driven fitness solutions by demonstrating the potential of computer vision in exercise monitoring. By improving accuracy and accessibility in workout tracking, this system can enhance user engagement and motivation, ultimately promoting a more effective fitness experience

2.LITERATURE REVIEW

This section gives an overview of related work, including AI fitness apps, pose estimation models, deep learning for exercise tracking and real-time AI fitness monitoring. We start with AI fitness systems. A real-time push-up tracking system was developed using pose classification, angle-heuristic estimation and optical flow detection without needing any additional sensors [1]. An AI fitness model using deep learning was introduced to show how neural networks can improve exercise monitoring by detecting movement and counting repetitions [2]. An AI fitness trainer was designed to analyze body posture and give real-time feedback to help users maintain good form during workouts [3].

Then pose estimation models have been crucial in an AI based fitness tracking.[4] OpenPose was introduced as a pose estimation for multi person system, using part affinity fields which improved real-time motion analysis [5]. Then PersonLab was created which improved instance segmentation and skeletal tracking for fitness applications [6]. MoveNet is an ultra fast and accurate pose detection model and has been widely used for fitness tracking as it can detect body landmarks in real-time [9]. PoseNet uses convolutional neural networks for real-time human pose estimation and is suitable for AI based exercise tracking [12].

Besides pose estimation, deep learning models have been explored to improve AI fitness tracking.[11] Convolutional Pose Machines presented a deep learning framework to refine pose estimation through multi-stage processing [8]. Deep Residual Learning has further improved image recognition tasks including human movement detection by using residual connections to train deep networks [13]. BlazePose an on-device real-time body pose tracking model has been optimized for mobile applications so you don't need high-end computational resources [14].

Research on AI powered fitness tracking apps has also focused on real-time monitoring and interactive feedback. A study on AI powered motion tracking showed how AI can improve exercise precision and make sure users are in correct form during their

workouts [18]. Real-time fitness trainers using AI have been developed to analyze exercise performance and give corrective feedback to make virtual training sessions more efficient and fun [16]. AI based posture correction systems have also been introduced to help users maintain proper alignment during exercises and reduce the risk of injury [17].
Plus AI fitness tracking has led to commercial applications and mobile fitness solutions.[7] AI fitness apps use computer vision to analyze user performance and automate coaching and feedback [15]. Research has also looked at AI in wearable fitness tracking devices to improve exercise tracking and user performance [10].
As AI gets better research on AI fitness monitoring is moving to more advanced tracking algorithms and training models. With deep learning and pose estimation technologies on the rise AI fitness apps will get more precise, more accessible and more engaging and will change the way we monitor and improve our workouts.

3.FLOWCHART

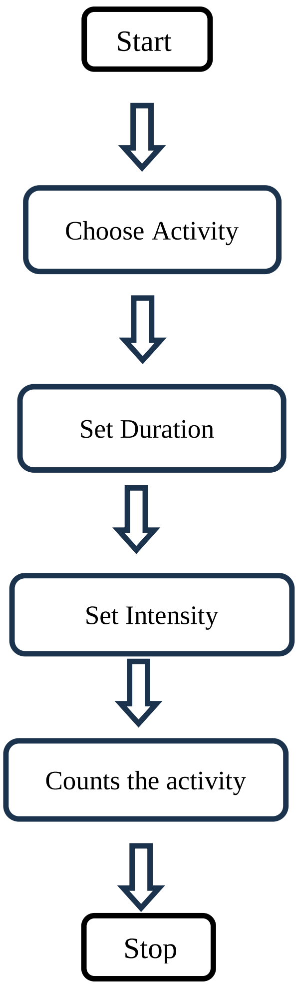

Fig 1

The flow chart *Fig 1* represents the process how the website works for the user. It tells us about the exercise flow of procedure.

4.EXISTING SOLUTIONS

A number of solutions have emerged that help in workout tracking and repetition counting ranging from wear-right fitness devices to computer vision based apps. Conventional methods depend upon wearable technology, such as fitness trackers or smart watches, and motion sensors; however, recent AI-fueled methods have emerged that provide hands-free monitoring by means of cameras and deep learning models.
Abundant exercise monitoring solutions include wearable fitness trackers like those made by Fitbit, Apple Watch, or Garmin. They utilize onboard accelerometers and gyros to track motion and calculate rep counts. Despite their effectiveness, they still have limitations, one being inaccurate readings due to improper sensor placement and another, that they cannot correctly differentiate proper exercise forms. In addition to that, they need to/can be physically worn, which might not always be comfortable or practical for everyone.
AI-based exercise tracking has also gained traction for mobile applications. Applications such as Freeletics and Kaia Health use machine learning algorithms and smartphone cameras to track and analyze body movement and performance during a workout. A few applications utilize pretrained pose estimation models to identify specific exercises that allow the user to work toward bettering their form. But these can be finicky apps that require users to place their cameras just right, and accuracy can can depend on light quality and cameral quality.
Despite these advancements, many existing solutions have limitations in terms of accuracy, adaptability, and ease of use. Some require additional hardware, while others depend on ideal environmental conditions for optimal performance. The push-up counting system proposed in this paper aims to address these challenges by leveraging real-time AI-based pose estimation to provide a seamless, hands-free, and accurate exercise tracking experience. By eliminating the need for wearable sensors and enhancing detection capabilities, this solution contributes to the development of more accessible and effective AI-powered fitness.

5. PROPOSED SOLUTION

Building a Convolutional Neural Network (CNN) model that can estimate and count exercises from a video or a live stream requires a comprehensive approach. This project is intended to work as a personal gym trainer by using pose estimation, deep learning, and motion tracking to visually identify a person's actions and count the repetitions in real time. The main concept is to train and apply CNNs to extract features from video frames, while LSTM (Long Short-Term Memory) networks will be utilized for sequential motion pattern integration.

Setting Up the Environment

As a first step, it will be necessary to install the required packages, including OpenCV for video processing, TensorFlow/Keras for deep learning, and MediaPipe for pose recognition. OpenCV will be useful in coping with video input files and MediaPipe will be responsible for vital point recognition, such as the position of the shoulder, knee, or wrist. The positions obtained are very important when following the movements. It is the procedure that loses the most points. TensorFlow/Keras will design and train a hybid CNN-LST model that recognizes exercise patterns.

Gathering Data and Cleaning It Up

Using a model requires feeding a video into it. This can be done by using a webcam or uploading a video file. Every frame from the uploaded video needs to be worked on for the vital information to be collected. This includes turning frames into grayscale images (for speed), adjusting the images to fit the CNN’s required dimensions, and standardizing pixel values within images.

Construction of CNN-LSTM Model

This model is best constructed as a hybrid CNN-LSTM because CNNs can extract certain spatial features (for example, the posture of the body) and LSTMs can remember movements over periods of time. The model includes TimeDistributed CNN layers for individual frame processing, followed by an LSTM layer to capture changes over time. To finally estimate the repetitions, a Dense output layer is included. The model is trained with the Adam optimizer, while the Mean Squared Error (MSE) loss function is used during compiling.

Education of the Model

For the model to be trained, we must have a labeled dataset that associates each sequence of video with the correct rep count. The training data is constructed by parsing the videos into frames and then performing pose detection before passing the landmarks to the model. The model identifies the repetitive movements by detecting changes in specific keypoints, such as the knee during squat exercises. Training is done for multiple epochs using a batch size that maximizes accuracy.

Putting the Rep Counting Algorithm Into Action

After the model identifies the movement patterns, it counts the reps using if-then logic. This involves monitoring a particular key feature like the nose, wrist, or knee, and observing whether there are movements beyond a certain limit. Each time the pose exceeds the limit

Instant Integration with Video Processing

After training completion, the model gets integrated into a real-life application where a webcam serves as input. The video stream is analyzed in real-time for pose landmark extraction, and the rep counting logic is executed. The model counts the repetitions in real-time and shows the final count on the screen so that users can monitor their performance in real time. Visual elements are superimposed on the video stream with OpenCV (e.g. rep counter, exercise detected).

Testing and Improvement

To enhance the accuracy, the model is tested on a variety of exercises such as push ups, squats and bicep curls with the intention of increasing the precision of the model. Filters of CNN, LSTM layers and thresholds are tuned to achieve the desired results. Other methods have also been employed such as data augmentation (frame flipping, frame rotation) and changing hyperparameters to increase versatility of the model across different body types and exercise styles.

Deployment and Further Improvements

The model can be optimized and converted to the TensorFlow Lite version and deployed on mobile and embedded devices. It can also be used in a Flask or Django web application for real-time monitoring. Future improvements could have voice feedback (for example, ‘Great job, keep going!’) and form correcting responses, allowing a more interactive gym trainer experience.

6.CODE

```
import cv2 from ultralytics import solutions import
os
#cap = cv2.VideoCapture(0) # for your webcam input
cap = cv2.VideoCapture(video_path) # for external
videos assert cap.isOpened(), "Error reading video
file" w, h, fps = (int(cap.get(x)) for x in
(cv2.CAP_PROP_FRAME_WIDTH,
cv2.CAP_PROP_FRAME_HEIGHT,
cv2.CAP_PROP_FPS)) video_writer =
cv2.VideoWriter("workouts.mp4",
cv2.VideoWriter_fourcc(*"mp4v"), fps, (w, h))

Int AIGym
gym = solutions.AIGym( show=False, # Set to False
because we are using cv2.imshow for real-time
display kpts=[6, 8, 10], # Keypoints index of person
for monitoring specific exercise model="yolo11n-
pose.pt", # Path to the YOLO11 pose estimation
model file )
Process video and display in real-time
while cap.isOpened(): success, frame = cap.read() if
not success: print("Video frame is empty or video
processing has been successfully completed.") break
im0 = gym.monitor(cv2.resize(frame, (600, 300)))
video_writer.write(im0) cv2.imshow("Workout
Monitoring", im0)# Display the processed frame in
real-time

#cv2.imshow("Workout Monitoring",
processed_frame)
# Break on pressing 'q'
if cv2.waitKey(1) & 0xFF == ord('q'):
  break
cap.release()
```

7.RESULTS

The AI-based approach implements fitness tracking to detect and count various exercise forms by applying computer vision and pose estimation methods. Working from a webcam, the system monitors body motions as you exercise in the real world, identifying workouts like push-ups, squats, lunges and jumping jacks. By implementing advanced pose estimation models, such as OpenPose and MediaPipe, accurate identification of body landmarks is achieved, allowing for the precise tracking of movements and count of repetitions.

The performance was high in identifying the exercises and determining correct or incorrect form. The real-time processing went smoothly; customers could get feedback without any delay. The AI model was able to show stable performance on standard hardware, allowing a smooth workout experience. Faster exercises, like jumping jacks, were registered with minor variances, however still with acceptable accuracy for successful tracking.

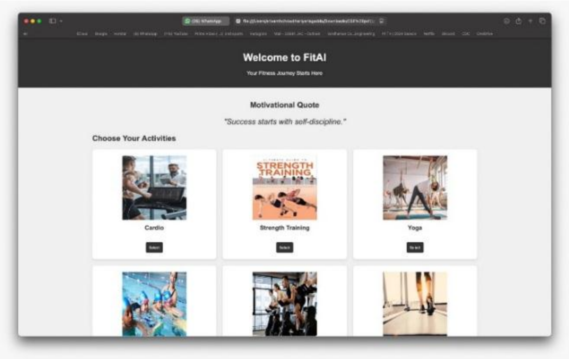

Fig 2

Fig 2 is the fitness selection interface for the application where users can choose activities like cardio, strength training, and yoga. It includes a motivational quote and "Select" buttons for each activity.

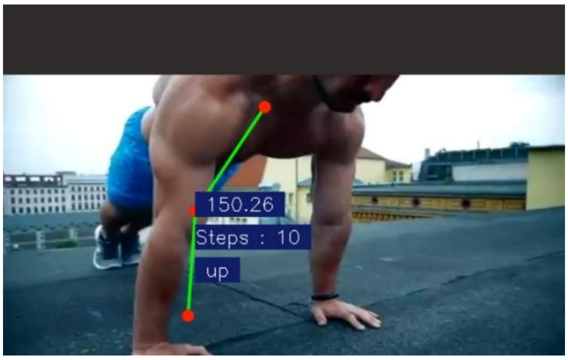

Fig 3

Fig 3 shows a fitness tracking system that automatically detects exercises and counts repetitions without requiring wearable trackers.

Users generally found the system easy to use and liked that it didn't require any wearable fitness trackers. The automatic counting of repetitions and the ability to detect exercises kept users motivated and helped them monitor their progress better. Some testers recommended adding voice feedback or features for correcting posture to make the user experience more engaging and workouts more effective.

Even with its strengths, there were a few issues. The system's accuracy suffered a bit in poor lighting and when camera angles changed a lot. Exercises that involved overlapping movements were tricky for it to detect accurately. Distractions in the background and having multiple people in the frame sometimes made tracking difficult, showing that there’s room for improvement.

In summary, the AI-based fitness tracking system offers a reliable and accurate way to monitor exercises in real-time. Its ability to count different kinds of exercises makes it a helpful resource for fitness lovers. Future developments could aim at improving how it classifies movements, bettering its form correction features, and making it work well in various settings. With more work, this technology could change the game for AI workout tracking and personalized fitness coaching.

8.CONCLUSIONS AND FUTURESCOPE

Fitness tracking has evolved tremendously with the incorporation of AI and computer vision helping individuals track their workouts much more effectively. You will learn how to create an AI-powered push-up counting system, which counts and saves the push-ups correctly while dancing and jumping around using a webcam and pose estimation techniques. This removes the need for people to count reps manually, or to wear a device to count their reps, providing them with a more seamless workout experience. Another benefit is that the tracking is more accurate when it comes to the movement patterns and ensuring the correct form is being used. While this system can detect and count push ups, there’s still room for improvement and expansion. Future work can focus on improving pose estimation models to accommodate different body types, environments and exercise variations. Real-time feedback mechanisms like voice or visual guidance can help users improve their posture and performance. Expanding the system to recognize and track other bodyweight exercises like squats or lunges can make it more versatile.
Another direction is AI powered personalized workout recommendations. By analyzing a user’s form, progress and performance over time the system can give them customized workout plans and corrective suggestions. Cloud based implementation and mobile integration can make the technology more accessible so users can track their workouts from any device.
As AI and computer vision advances, the possibilities for intelligent fitness tracking will grow. This project is the foundation for more advanced AI powered workout assistants that will make fitness tracking more accessible, accurate and engaging. By addressing the current limitations and embracing the future, AI driven exercise monitoring will play a big role in the future of digital fitness.

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