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A Survey on Ai Based Workout Tracking System

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ABSTRACT : The purpose of the "Ai-Based Workout Tracking System" is to track exercise routines in order to enhance physical health. The advantages of exercise are universal and apply to people of all physical and health conditions. Research emphasizes the risks associated with sedentary lifestyles. Fast-paced lifestyles favor self-learning over traditional workout tools like personal tutors and training centers. Self-learning, however, carries the risk of improper postures, which could result in both immediate discomfort and long-term health problems.The goal of this project is to create a fitness tracker that tracks and analyzes user postures and actions, with an emphasis on weightlifting activities. Weights such as barbells, dumbbells, or one's own body weight are used in coordinated movements during exercise to promote the development of muscle, strength, endurance, and power. For both amateur and professional gymnasts, poor posture is a frequent problem.

This project combines object detection and recognition using Computer Vision (CV), a branch of computer science that aims to give computers the ability to process digital images similarly to human vision.

Based on posture analysis, the system uses a KNN classifier trained on angles between joint key points to identify different sorts of workouts. Testing has been done on the ability to identify and detect different workout types from input films in a variety of environments and routines.

Keywords: body movement analysis, convolutional neural networks (CNNs), angles calculation, workout type recognition, and deep learning approaches.

I.INTRODUCTION

The execution of exercises in the context of artificial intelligence (AI)-based fitness coaching entails a sequential flow of bodily movements arranged to cause muscle contraction under tension. This is accomplished by using weights, such as barbells, dumbbells, or one's own body weight, with the goals of promoting power, endurance, growth, and strength. While exercising has a favorable impact on one's health, if done incorrectly, there may be hazards and inefficiencies. For both amateur and professional gymnasts, poor posture is a common problem. This is mostly because performing complex motions in weightlifting exercises can be difficult. When exercising, adopting the wrong posture can cause a number of health issues, such as knee, shoulder, back, or neck pain.

In order to minimize physical strain on the human body and maintain a balanced relationship between the skeleton and muscles, it is important to maintain proper posture. Maintaining this balance is essential to protecting the body's supporting structures from additional damage or progressive deformations that may occur during weightlifting training. As a result, it is critical to emphasize posture when completing workouts in order to preserve body balance, align supporting structures, and promote efficient physiological functioning. Advances in Computer Vision (CV) provide the basis and motivation for solving posture-related difficulties in weightlifting training. The field of computer science known as CV is concerned with creating methods that let computers recognize, analyze, and interpret digital images in a way that is similar to human vision, then produce the necessary results.Notably, object recognition and detection are essential CV technologies that are used to build the best possible posture detection system. Object detection, a common problem in CV, involves classifying images and drawing bounding boxes around things. It finds significant use in many industries and facets of human life, such as object tracking and facial recognition. In

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order to identify and assess exercises during a workout, object detection technology is used in this research.

II.LITERATURE REVIEW

The main focus of the study was a comprehensive examination of the efficacy of different approaches in the field. Examining relevant research papers allowed for the assessment of various methods and strategies used in these fields. This procedure aimed to highlight the subtle nuances and developments in the sector.

Shakir Khan, Kashif Zafar, LulwahAISuwaidan, Abdul Rauf Baig, Afzaal Hussain, Riyad Almakki, et al.[1] Exercise tracking and quantification software is essential for improving general health and inspiring people. Although there are great trackers for aerobic workouts, manually recording free weight exercises—especially in weight training—remains difficult. It's widely known that a well-rounded workout routine must include weight training. In addition to presenting a novel technique for identifying a wide variety of gym-based free weight workouts using Long Short-Term Memory (LSTM) neural networks, this study focuses on the utilization of a single chest-mounted tri-axial accelerometer for data collecting. The study describes the methods used to collect the data, with a focus on the application of a tri-axial accelerometer put on the chest.This apparatus is essential to the study's methodology for automatically identifying free weight exercises performed in a gym. LSTM neural networks aid in the recognition process, demonstrating the viability of this creative strategy. LSTM-based gym exercise recognition models are trained and tested through a series of studies. Notably, the study investigates the efficacy of distinct models tailored to certain muscle groups as well as a general model intended to identify every activity. The positive results of the trials are discussed in the study's conclusion, highlighting the potential use of the suggested strategy in developing an automated system for thorough tracking and analysis of gym-based workouts. The ultimate goal is to free people from the tedious manual record-keeping that comes with working out at the gym, thereby revolutionizing the experience of exercising.In addition to increasing motivation, the use of automated exercise tracking is in line with the overarching objective of enhancing health conditions through successful and efficient exercise regimens.

Juan Jesús García Domínguez, Ana Jiménez-Martín, David Casillas-Pérez, Sara García-de-Villa, et al.[2] Precise performance of recommended exercises is essential for home-based physical therapy, and patient adherence is especially important for older persons who may have trouble remembering their therapists' instructions. Inertial Measurement Units (IMUs) are commonly utilized for monitoring the performance of exercises, offering crucial motion data. This study suggests collecting data from four IMUs mounted on the limbs to simultaneously identify and evaluate proper workout performance by utilizing machine learning algorithms. This innovative method overcomes the lack of a single, comprehensive answer for both tasks, which is necessary for a thorough description of physical therapy performance. Six machine learning classifiers are evaluated in three different scenarios: one classifier for evaluation and recognition, one classifier for identifying correct workouts while rejecting incorrect ones, and a two-stage method for identifying exercises and evaluating them. Using four IMUs to track the mobility of thirty participants, the suggested methodology is applied to eight upper- and lower-limb workouts intended to maintain the health of senior adults. The results show high accuracy rates: 88.4% to 91.4% for exercise detection and 93.6% to 100.0% for exercise evaluation in the first three scenarios, respectively. This study lays the groundwork for the creation of virtual coaching systems by demonstrating the viability of IMUs in complete monitoring of physical therapy and providing insights into the executed exercises and their quality... In the realm of physical therapy administered at home, it is imperative that recommended exercises be performed precisely, particularly for elderly patients who can find it difficult to remember their therapists' instructions. IMUs, or inertial measurement units, are frequently used to monitor workout movements and provide useful motion data. Using information from four IMUs mounted on the limbs, this study presents a novel method for concurrently identifying and assessing the correct performance of workouts. This integrated approach tackles an issue that hasn't been studied before but is essential to comprehending physical therapy performance in its whole. Six machine learning classifiers are evaluated in three different scenarios in this study: one classifier for both recognition and assessment combined, one classifier for identifying proper exercises while eliminating erroneous ones, and a two-stage method for exercise recognition and evaluation.

Thirty volunteers with four IMUs are used to track the motion of the suggested methodology during eight distinct upper- and lower-limb

workouts intended to maintain the health of the elderly. The results show that exercise recognition had high accuracy, ranging from 88.4% to 91.4% in the first situations and 96.2% in the third. Exercise evaluation accuracy varied from 93.6% to 100.0% in the third scenario. This study highlights the potential of IMUs for thorough physical therapy monitoring, offering perceptions into the effectiveness and caliber of exercise, and opening the door for the creation of virtual coaching programs.

Chuan, Wentong Zhang, Caixia Su, et al.[3] Many people agree that exercise therapy is essential to a patient's recovery, and there is increasing focus on incorporating contemporary technology like virtual reality (VR) and augmented reality (AR) into therapeutic regimens. When it comes to computer-assisted physical rehabilitation training, movement data gathered from sensory systems during prescribed rehabilitation exercises is analyzed to assess performance. A major problem is the complex field of human activity recognition, especially when considering machine learning. Sensitive activity detection is predicated on deep learning from multiple low-level sensor measurements associated with human actions.Using a deep learning architecture, the research presents the Smart Sensor-based Rehabilitation Exercise Recognition (SSRER) system as a solution to this problem. The system analyzes sensory data related to body motions during physical rehabilitation activities using a Convolutional Neural Network (CNN) on a dynamic platform (D-CNN) with Gaussian Mixture Models (GMM). Multiple CNN pathways are formed by segmenting the input signals and GMMs into different forms. In order to ascertain the state transition likelihood of hidden states, the Sensor (S-CNN) component uses an algorithm for enhanced lossless information compression. To evaluate rehabilitation exercises at various levels, a hybridized CNN combines the D-CNN and S-CNN components with a deep learning classifier. By applying deep learning techniques that make use of the best-learned characteristics for every exercise, the suggested SSRER system performs better when it comes to classifying rehabilitative activities. The mathematical study of the discrepancy between test scores and the best attribute utilizing gathered data and different activity recognition datasets is highlighted in the text. By combining D-CNN and S-CNN components in a deep learning framework, improved performance in identifying and classifying various rehabilitation activities is demonstrated, offering significant contributions to the field of computer-assisted rehabilitation training.

Zhou Wenting et al. [4] Modern and widely used, wireless sensors are a popular tool for exploration, especially when it comes to monitoring and locating the human body. In this regard, research on using smart sensors to improve movement coordination and flexibility has been prompted by the popularity of aerobics as a sport. This work uses motion analysis techniques, software and hardware architectural methods, and sensor design methodologies to explore the possible function of wireless smart sensors in tracking and detecting aerobics exercise postures. To develop a complete sensor model and system for posture monitoring and recognition, the research entails sample gathering, sensor analysis, and algorithm streamlining.One of the most important parts of this investigation is figuring out where to put the sensors. The study's methodical testing determines that, while preserving upper arm stability, positioning the sensor 2.5 cm from the wrist section and in the middle of the lower arm allows for efficient tracking of lower arm contraction and stretching movements. The findings show that, with an average error of less than 0.9 cm, the measured junction curve at a distance of 2.5 cm nearly matches the real winding curve. This accuracy in sensor positioning adds to the suggested model's accuracy in detecting and identifying aerobic posture. Data collection from eight participants who maintained their typical postures for roughly six seconds during the trial will be used to further validate the suggested algorithm and system design. The experiment's statistical accuracy rate, which is 90.6%, shows that the algorithm and system created for this investigation have an exceptionally high degree of accuracy. Overall, a system model appropriate for posture tracking and recognition in the context of aerobics is designed with successful application of the theoretical underpinnings of wireless sensor networks.

Shun Ishii, Mika Luimula, Guillaume Lopez, Anna Yokokubo, and others et al.[5] In the field of measuring fitness, wearable technology has become increasingly popular. Nevertheless, the tracking capabilities of these widely used gadgets are usually restricted to a predetermined set of activities. In order to overcome this restriction, a prior study presented ExerSense, a system that can segment, classify, and count several physical workouts in real-time. ExerSense is made to handle both user-specified exercises and predefined workouts with just a single motion given ahead of time, thanks to the correlation mechanism. As a

continuation of the previously mentioned work, the present research assesses ExerSense's functionality on a range of wearable technologies. In this study, four different wearable sensors were used to gather acceleration data for five popular activities.

Finding the most precise tool and the best location for identifying various activities was the main goal. The researchers executed 50 random validations to test resilience, and the results showed how well ExerSense functions with a variety of devices. The smartphone attached on the upper arm was found to be somewhat more effective than the chest-mounted sensor for the focused activities among the general usage devices that were examined. The ear-mounted sensor showed the least efficacy, while the wrist-mounted watch came in third.

Samiksha Mohite, Lalita Borkar, Ashwini Jadhav, Nikita Sambari, and Pratiksha Shinde, among others.[6] The utilization of artificial intelligence (AI) and machine learning in daily life has rapidly increased in the modern era characterized by technology breakthroughs. Notably, the field of human pose identification and assessment has seen frequent uses of AI. The launch of "AI Fitness Genie" is a significant step forward in utilizing AI's ability to monitor users' workout positions, calculate the number of repetitions needed, and provide personalized, comprehensive evaluations for improving body posture. This AI-powered tool, which doubles as a workout companion and fitness guide, attempts to reduce the risk of both acute and chronic injuries by assisting users in executing exercises correctly.

Its AI capability is similar to face recognition, but it can recognize the full body, which highlights how revolutionary it may be for workout regimens.

The main feature of the program is face recognition technology modified for wholebody position estimation. This fits in with the larger context of AI applications for predicting human pose, where methods like 3D body volume modeling and skeleton or contour modeling are used to carefully examine how the human body is positioned. Interestingly, the research uses the YOLO technique, which was used to investigate various classification strategies. Underscoring the project's dedication to enhancing the comprehension and use of AI in human pose evaluation is the focus on classification techniques.The research combines computer vision algorithms with an open-source toolkit called the Open Pose framework to evaluate yoga poses specifically. With the use of these technologies, the system is able to provide a thorough evaluation of an individual's yoga poses by precisely measuring human posture. By guaranteeing correct exercise execution and posture maintenance, this multifaceted approach combines artificial intelligence (AI), computer vision, and open-source frameworks to create a sophisticated tool that goes beyond simple exercise tracking and aims to significantly enhance individuals' overall fitness.

Darshan Rao, Tejas Shelke, Kaustubh Utturwar, Anuj Patil, and Ekta Sarda, among others[7] Exercise is extremely important in our daily lives, especially for patients undergoing medical procedures, where it is essential to hasten the body's healing process. Owing to its essential function, there is a growing focus on using Artificial Intelligence (AI) and Image Processing to augment and improve the workout routine, doing away with the need for ongoing expert supervision. One important approach is to include a software-based motion tracker, which can be used to track exercises, give real-time feedback on posture during workouts, and maximize the effectiveness of positive results by computing and analyzingdata. Interestingly, the MediaPipe framework is suggested for this application, which makes use of a machine learning model that maps points across different human joints in order to track, record, and evaluate movement. With the MediaPipe architecture, the use of AI and image processing in exercise tracking is extended to a thorough examination of body position. This technology-driven strategy creates opportunities for the implementation of an application made especially to track registered users' medical workouts. The software, which is predicated on complex bodily tracking, may be improved further to enable communication between a registered user and a verified medical professional.Thanks to secure databases, this novel method would enable the physician to view detailed diagnosis reports and the mapped patient's exercise history. Essentially, the idea of incorporating AI and image processing into exercise tracking is in line with the more general realization that technology may significantly increase the efficacy of physical activity, especially when it comes to a patient's recuperation. The focus on postural feedback in real-time and the possibility of mapping consumers to medical specialists underscores the adaptability and potential significance of these technological interventions in the field of fitness and health.

Reza Farahbakhsh, Javad Rezazadeh, Roberto Minerva, Alireza Farrokhi, et al.[8] The Internet of Things (IoT) is having a huge impact on many parts of daily life, and one of the most important application domains within IoT is well-

being. In particular, the emphasis on smart fitness has gained popularity, signifying an IoT technology convergence aimed at delivering cutting-edge personal services. This article explores the field of smart fitness in the context of the Internet of Things, focusing on three main areas: movement analysis, fitness applications, and fitness trackers, which comprise wearable and non-wearable sensors. Notably, by utilizing data gathered from IoT-based smart fitness solutions, artificial intelligence (AI) integration significantly improves training performance.The potential for this IoT and AI junction to transform how people approach and profit from fitness activities is enormous.The link between sensors is crucial to the smart fitness landscape that is based on the Internet of Things. The complex network of connections between sensors is an interesting subject, and socialIoT shows up as a major facilitator in this context. Social-IoT makes it easier for users in many places and at different times to share data, information, and experiences pertaining to their training activities. The social and collaborative elements of smart fitness are strengthened by this interconnection, which creates a dynamic environment where users may benefit from one another's experiences and build a feeling of community while pursuing fitness objectives. The objective of this research is to present a thorough analysis of different fitness trackers and applications, and then investigate AI algorithms used in intelligent fitness scenarios. The literature study provides insight into the present level of technology in this field by examining the wide range of fitness trackers and applications. The study then explores how AI algorithms create intelligent fitness situations, highlighting how they help to maximize training efficiency. The study concludes with a thorough examination of the advantages and possible drawbacks of smart fitness. In order to link technology improvements with people's holistic well-being, the article aims to contribute to the ongoing evolution of IoT-based smart fitness by identifying existing gaps and suggesting viable pathways for future research.

Radha G, Varsha Jituri, Abhinand G, Mohammed Anas, Naveen Kumar B, and others[9] After the COVID-19 epidemic, working out at home has become increasingly popular. However, this has made it difficult to get competent trainers to validate exercise postures. Innovative solutions have been spurred by this paradigm change, including the use of technologies like Mediapipe and BlazePose. The machine learning and computer vision tool Mediapipe offers a flexible framework for examining many facets of human movement. When combined with BlazePose, a real-time pose estimation algorithm, these technologies allow users to receive real-time feedback as their workout actions are being evaluated.The urgent demand for remote posture validation during at-home workouts is met by this integration, which guarantees that people get precise instruction even when there isn't direct supervision from certified trainers. The suggested strategy improves the security and efficacy of at-home exercise regimens by utilizing Mediapipe and BlazePose. The model serves as a virtual fitness companion by verifying exercise postures and delivering real-time correction suggestions, giving users the assistance they need to do exercises correctly. This lessens dependency on personal trainers, which not only increases the safety of people working out at home but also advances the democratization of fitness. This approach's potential cost reductions add to its allure, making it a desirable option for people looking for economical and efficient substitutes for conventional in-person training. This study showcases the potential of technology-driven ways to revolutionize workout regimens, making a substantial contribution to the developing field of home-based fitness solutions. Through the utilization of machine learning and computer vision, the suggested model not only tackles the difficulties brought about by the pandemic but also establishes the groundwork for a revolutionary change in the way individuals approach and participate in at-home exercises. The creative application of these technologies is a significant breakthrough in the field of at-home workout programs since it not only helps with posture validation but also creates new opportunities for individualized and accessible training experiences.

Sebastian Baumbach, Arun Bhatt, Sheraz Ahmed, Andreas Dengel et al.[10] Sheraz Ahmed, Andreas Dengel, Arun Bhatt, Sebastian Baumbach, et al.[10] Advances in mobile and wearable devices with multiple sensors have led to a surge in interest in human activity recognition in recent years. These sensors, which are widely found in modern electronics, make it possible to gather a lot of information about people's daily activities. The field of study has studied lifestyle activities in great detail, with an increasing emphasis on identifying a wide variety of sport workouts. This paper's analysis focuses on nine distinct sports and fitness routines that are frequently used in gym environments with specialized equipment. The study advances our knowledge of how to accurately identify and analyze these activities using sensor data from

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smartphones and smartwatches. 23 individuals in the study will have their sensor data collected while they perform the designated sport and fitness activities. The studies use deep learning and conventional machine learning algorithms to assess how well various methods perform using the collected dataset. Notably, the 80% accuracy of linear Support Vector Machines (SVM) and Naive Bayes with Gaussian kernel is impressive.

The study does, however, show that deep learning models outperform these conventional methods of machine learning, obtaining an astounding 92% accuracy rate. This study provides insights into the potential of deep learning for increased accuracy in human activity detection tasks by illuminating the effectiveness of various algorithmic approaches in the context of sport exercise recognition. The research's conclusions add to the continuing conversation on human activity recognition, especially as it relates to sports and fitness activities. The contrast between deep learning algorithms and conventional machine learning highlights how recognition methods are always changing.

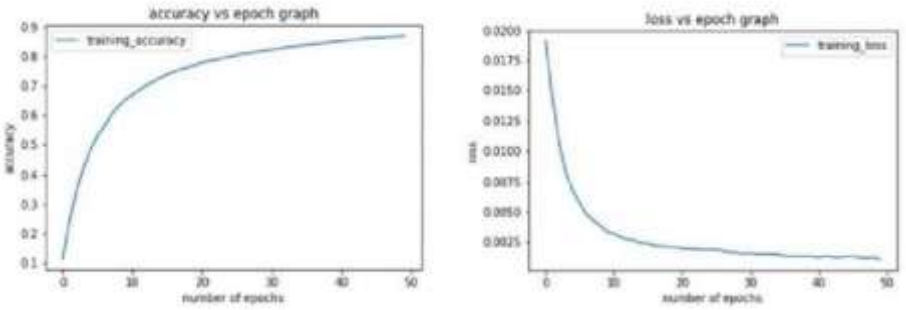
The study's emphasis on particular activities and use of cellphones and smartwatches as data collection tools improve the research's relevance in real-world situations. With the ongoing growth in sensor technology and machine learning, the knowledge gained from this work offers a useful starting point for investigating and improving human activity identification systems.

WORKOUT TRACKING SYSTEM BASED ON AI

The first stage of the system is gathering datasets, which is an essential part of training the model. Depending on the type of exercise, users are asked to film their workouts from different angles, such side or front views. The recognition model is trained using this dataset as a base. A thorough video analysis is then carried out to obtain crucial information for model training. WrnchAI and OpenPose are examples of pre-trained models that make it easier to identify joint keypoints in recorded workout videos. These keypoints are then subjected to operations to create a feature vector, which serves as the foundation for training the recognition model.After training, the model is prepared for implementation, able to anticipate the kinds of workouts based on the feature vectors that are produced. The posture evaluation phase is an important component of the system. The next stage is to assess if the posture being done is correct or inappropriate, given the anticipated sort of workout. This assessment is essential for giving users feedback that is relevant to the exercise they are performing and how accurately they are executing their posture. By incorporating posture evaluation, the system's usefulness is increased. It can now identify the type of workout a user is doing and provides insightful information on their form and execution.

Paper	Year	Technique/Methodology	Pros	Cons
[1]	2022	Chest-mounted accelerometer & LSTM neural networks	Automated tracking of gymbased free weight exercises	Limited discussion on real-world deployment challenges.
[2]	2022	IMUs and Machine Learning	High accuracies in recognizing correct exercises.	Dependency on wearable IMUs for data collection.
[3]	2020	Smart Sensor-based Rehabilitation Exercise Recognition (SSRER)	Deep learning framework (DCNN with GMM) for exercise recognition.	Complexity in the integration of multiple components.

[4]	2021	Wireless smart sensors for aerobics	Integration of wireless sensors for posture tracking.	Limited discussion on algorithm robustness.
[5]	2021	ExerSense with acceleration data from wearables	Versatility in working with diverse wearables.	Dependency on acceleration data from wearables.
[6]	2022	AI Fitness Genie with computer vision and YOLO algorithm	AI-based tracking of exercise poses and repetitions.	Dependency on computer vision algorithms.
[7]	2023	MediaPipe framework for exercise tracking	Real-time feedback on exercise posture.	Dependency on MediaPipe framework.
[8]	2021	IoT-based smart fitness with AI	Integration of AI for enhancing training performance.	Broad categorization without in-depth focus on specific algorithms.
[9]	2023	Mediapipe and BlazePose for home workouts	Potential cost savings and reduced reliance on professional trainers.	Limited discussion on user feedback.
[10]	2018	Smartphone and smartwatch data for sport exercises	Analysis of sensor data for recognizing sport exercises.	Dependency on participant engagement for data collection.



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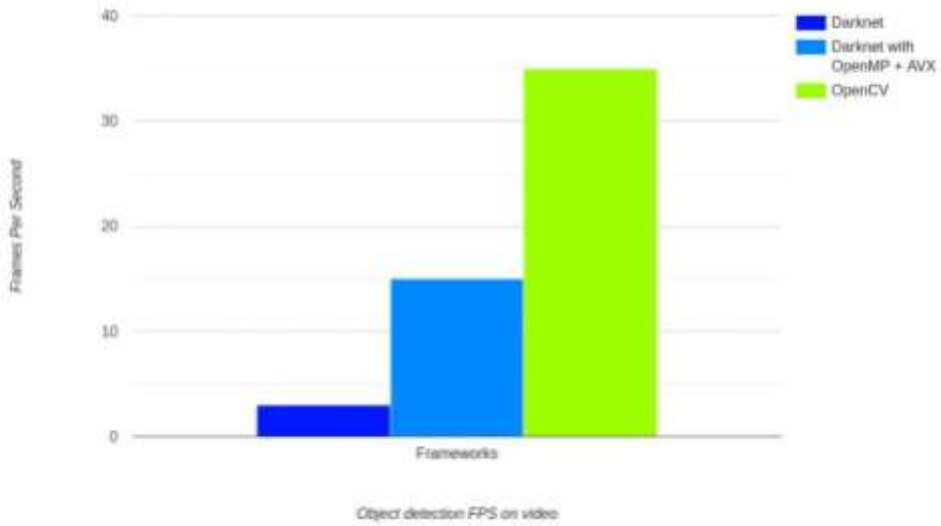

III.CONCLUSION

In summary, deep learning-based artificial intelligence (AI) workout monitoring has advanced significantly, demonstrating its potential to transform exercise identification analysis. Research is still being done with an eye toward solving problems, enhancing generalization on a variety of datasets, and incorporating deep learning models into workflows for practical applications. The accuracy and effectiveness of tracking exercises should increase as the area develops thanks to developments in deep learning techniques.

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