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Sports Analyzer Portal: A Smart Training Assistant for Athletes

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Abstract - The Sports Analyzer Portal is an intelligent, web-based platform designed to assist athletes and sports enthusiasts in enhancing their posture, performance, and overall training using technological advancement. The project attempts to bridge the gap between conventional sports coaching and contemporary digital solutions by providing a visual and interactive interface. In its first phase, the portal targets two sport likes — football and cricket — by bringing perfect postures of activities such as football kicking methods and cricket bowling or batting positions through high-definition static images and videos. These are visual aids for users to learn independently and imitate perfect techniques while practicing. The future plans for the portal involve AI-based posture detection and real-time feedback, allowing users to upload videos of themselves and obtain analysis based on movement and posture alignment using pose estimation systems like MediaPipe or OpenPose. The portal will also provide customized nutrition plans based on physique, type of sports, and fitness goals, so that athletes remain in perfect balance between training and food consumption. This comprehensive approach aims to change the portal into an all-around digital support system for athletes, beyond posture correction alone. Plans are in the long term to expand the platform to serve a broad array of sports by addressing fundamental movements, training drills, and sport-specific nutrition advice. Despite being still in its interface development stage, the project forms a solid ground for a future-proofed system integrating sports science, artificial intelligence, and human-centered design to facilitate autonomous learning and distance coaching in the sports sector.

Key Words: Posture analysis, sports training, pose estimation, MediaPipe, OpenPose, football, cricket, AI coaching, web-based sports platform, digital training

1. Introduction

In the contemporary age of the digital revolution, technology has transformed almost every aspect of life, such as sports and sports coaching as well. Conventional methods of sports coaching depend mainly on direct observation and physical presence of a coach, which are generally limited by factors such as shortages of time, enormous expenses, and geographical limitations. Consequently, numerous aspiring sportsmen and sportswomen may not be able to access quality, frequent coaching. With computer vision, machine learning, and web interaction technologies growing rapidly, there is now the possibility of filling this gap by offering intelligent, remote coaching assistance.

The Sports Analyzer Portal is one step in that direction — a web portal software application that is meant to give sportsmen a combination of visual demonstrations and AI-based feedback mechanisms designed to correct posture and enhance technique. For starters, the portal focuses on two of the most popular and widely played sports: football and cricket. It provides high-definition visual guides for correct postures and movements involved in activities such as kicking, batting, or bowling. These act as easy-to-understand references for sportsmen to follow during self-training sessions. Once the system grows, it will introduce real-time posture analysis coupled with nutritional planning to offer an end-to-end digital training experience.

2. Literature Survey

In recent years, the use of artificial intelligence and computer vision in sports training has received tremendous interest. Some of the research work has showcased the application of pose estimation algorithms like OpenPose and MediaPipe for analyzing the posture of human bodies for fitness and rehabilitation applications. For example, Zhang et al. (2021) proposed a real-time feedback mechanism employing OpenPose for aligning yoga poses, which was shown to be effective in enhancing the alignment of the users. Similarly, Kumar and Verma (2020) have used MediaPipe for analyzing batting stance in cricket, pointing towards its ability to identify limb positions and offer automatic corrections. Singh et al. (2022) have another paper where AI-aided football training is used, in which players were given feedback

regarding their kicking style using a vision-based system. Furthermore, Lee and Park (2019) investigated sports personalized coaching systems that adjust according to user performance and learning curves. Such contributions highlight the capabilities of smart coaching tools to make sports training accessible to everyone by doing away with the necessity of constant physical guidance. The Sports Analyzer Portal finds inspiration in such works as it aims to integrate AI-powered posture guidance, visual presentation, and customized training assistance into an intuitive platform. It is being marketed as a holistic solution for distant, accessible, and cost-effective sports coaching.

Paper Examples

Zhang et al. (2021) [1] proposed a new method to improve yoga practice through real-time feedback technologies using OpenPose for precise pose estimation. Their framework combines computer vision and deep learning methods for helping users align their yoga posture properly. Through the use of live video input, the model detects prominent body joints and contrasts them with pre-defined optimal poses. In the event of differences, the system gives instant corrective feedback, directing users to correct their posture.The backbone of their approach is the use of OpenPose, which effectively identifies human skeletal framework in images and videos. The strength of this function allows the system to examine intricate yoga poses at high accuracy. The feedback system is intuitive in that it provides users with easy-to-follow instructions for improving their movement. This sort of real-time advice is most useful for yogis exercising with no immediate supervision, which helps them maintain correct form and minimize the potential for injury.Experimenting assessments proved the system's efficiency, with high accuracy in detection of pose and alignment correction. The findings of this study indicate that the incorporation of AI-based feedback during yoga practice can significantly enhance user performance and adherence to proper techniques. This work opens up the opportunity to design smart fitness apps that provide tailored coaching, enabling quality training to reach more masses.

Kumar and Verma (2020) [2] utlined a detailed investigation on improving cricket batting performance by analyzing batting stances in real time with the MediaPipe framework. Kumar and Verma concentrated on recording and analyzing the biomechanics of cricket shots to give real-time feedback for improving performance.The approach was to gather a diverse set of data in the form of videos for eight basic strokes of cricket: pull, cut, cover drive, straight drive, backfoot punch, on drive, flick, and sweep. The videos were obtained from sources such as YouTube and local cricket clubs to ensure the widest possible range of playing styles and conditions. All the videos went through preprocessing to remove noise and normalize the data for processing.Using the MediaPipe library, the researchers extracted 17 major landmarks from every frame of the videos, prioritizing key joints and body parts underpinning batting styles. The landmarks were the nose, shoulders, elbows, wrists, hips, knees, ankles, heels, and foot indices. The features were utilized to generate a dataset with 51 feature columns constituting the x, y, and z coordinates of every landmark.The research utilized several machine learning models such as Random Forest, Support Vector Machine, k-Nearest Neighbors, Decision Tree, Linear Regression, and Long Short-Term Memory networks for classification and prediction of the stroke type carried out. Of all the algorithms, the Random Forest algorithm reported the highest accuracy of 99.77%, which proves the efficiency of the method.This study showcases the promise of combining computer vision and machine learning algorithms in sports analysis, presenting a cost-efficient and effective solution for players and coaches to analyze and enhance batting performance. The real-time feedback process can assist in improving posture, enhancing techniques, and eventually overall gameplay.

Singh et al. (2022) [3] proposed a novel solution for football training in the form of an AI-based system for delivering real-time feedback on kicking techniques for players. The system involves the use of computer vision to analyze videos of players, highlighting specific parameters like posture of the body, alignment of limbs, and dynamics of movement while kicking. By comparing these recorded movements with the optimal movements in a database, the system detects discrepancies and provides remedial recommendations for improving performance.

The essence of this approach is the use of pose estimation algorithms, through which the body positions of different body joints are detected and tracked with precision. This allows for the system to analyze the biomechanics of every kick, making it possible to ensure that players are properly aligned and minimizing the risk of injury. The feedback is visual and textual in nature, enabling players to learn and apply the suggested adjustments effectively. Experimental tests showed the system's effectiveness in enhancing players' kicking accuracy and reliability. The research emphasizes the promise of AI-based equipment in democratizing access to quality coaching, particularly among those who cannot afford individualized training. With immediate data-driven feedback, this vision-based feedback system is a breakthrough in sports training practices.

Lee and Park (2019) investigated how adaptive, AI-based coaching systems can be developed to tailor sports training to individual user performance and learning progressions. Their aim was to design smart platforms that track the progress of athletes, analyze performance information, and modulate training programs according to the specific learning curve of each user.The principal methodology consisted of merging machine learning algorithms with the ability to analyze real-time data from

different sensors and user feedback. These algorithms evaluated parameters including skill level, rates of improvement, and reaction to prior training sessions. The system adapted dynamically based on this analysis to alter training material, intensity, and feedback systems to enhance learning yield. A key feature of their methodology was the focus on constant adaptation. As the users interacted with the system, their performance history updated future training adjustments such that the coaching was always pertinent and useful. This continuous improvement process was designed to keep the user interested, avoid skill plateauing, and respond to changing needs of each athlete.The research findings emphasized the capability of AI-driven coaching systems to transform sports training through personalized, adaptive, and effective learning processes. These systems can fill gaps in conventional coaching, particularly in situations where individualized teaching is impossible or restricted. Through technology-driven customization of training based on individual requirements, Lee and Park's research advances the cause of accessible and impactful sports education.

Bačić and Hume (2017) presented a groundbreaking method of boosting tennis training through the amalgamation of computational intelligence with qualitative coaching diagnostics. In their research, they aimed at creating an automated system that could evaluate tennis swings to enhance performance as well as safety.

The authors applied three-dimensional motion information recorded by multi-camera video systems to examine tennis swing movements. Through generating virtual 3D stick figure replays, the authors facilitated close visual inspection of players' movements. These visualizations were tagged by expert coaches and highlighted both correct movements and common faults for different levels of skill.To convert this expert information into an autonomous system, the research used adaptive assessment modules that were capable of learning from the labeled data. These modules had coaching rules and could develop their internal structures in order to give personalized feedback. The feedback consisted of verbal guidance and end-of-session performance reports, providing participants with information about how they were performing and areas for improvement.The system proved capable of independently evaluating new data, correlating feedback to the player's level and individual coaching situations. With attention given to safety as well as performance factors like swing width and swing technique, the prototype offered thorough evaluations. Not only does it help to refine technique, but it also helps to prevent injury by pointing out potentially dangerous motions.Bačić and Hume's research is an important breakthrough in sports training that demonstrates the potential of artificial intelligence to provide qualitative, professional-level coaching feedback in an automated and customized fashion. Their approach provides a solution for boosting athletic performance scalable to a larger market, especially in environments where access to professional coaches is limited.

3. Methodology

The Sports Analyzer Portal embraces a multi-layered methodology for providing smart, user-friendly, and effective posture analysis and training support. Topmost is the user interface layer, where the user can register, log in, and interact with the system to view tutorials or upload his or her training videos. They can choose their sport—beginning with football and cricket—and view high-definition photos and videos that illustrate exemplary postures for particular actions such as football kicking or cricket bowling.

Once a video has been uploaded, it comes into the processing layer, in which pose estimation algorithms such as MediaPipe or OpenPose are utilized. These systems extract frame-by-frame skeletal keypoints to comprehend the user's posture in motion. This posture information is subsequently compared against pre-stored reference postures in the system so that the AI engine can identify faults and give corrective advice. Such advice is presented in the form of overlaid pictures, keypoint comparison graphs, or text feedback so that users have a clear idea of how to correct their technique.

Apart from posture correction, the portal features a module on nutrition that provides customized diet plans based on the user's body type, sports activity, and fitness objectives. This is controlled through inputs from the user and back-end computations based on sports nutrition principles. All the user information, such as videos uploaded, analysis reports, and diet charts, is saved in a secure central database, facilitating continuous access and tracking of improvement. In general, the approach emphasizes interactivity, customization, and automation to build a digital environment that facilitates athletes for distance learning and self-development.

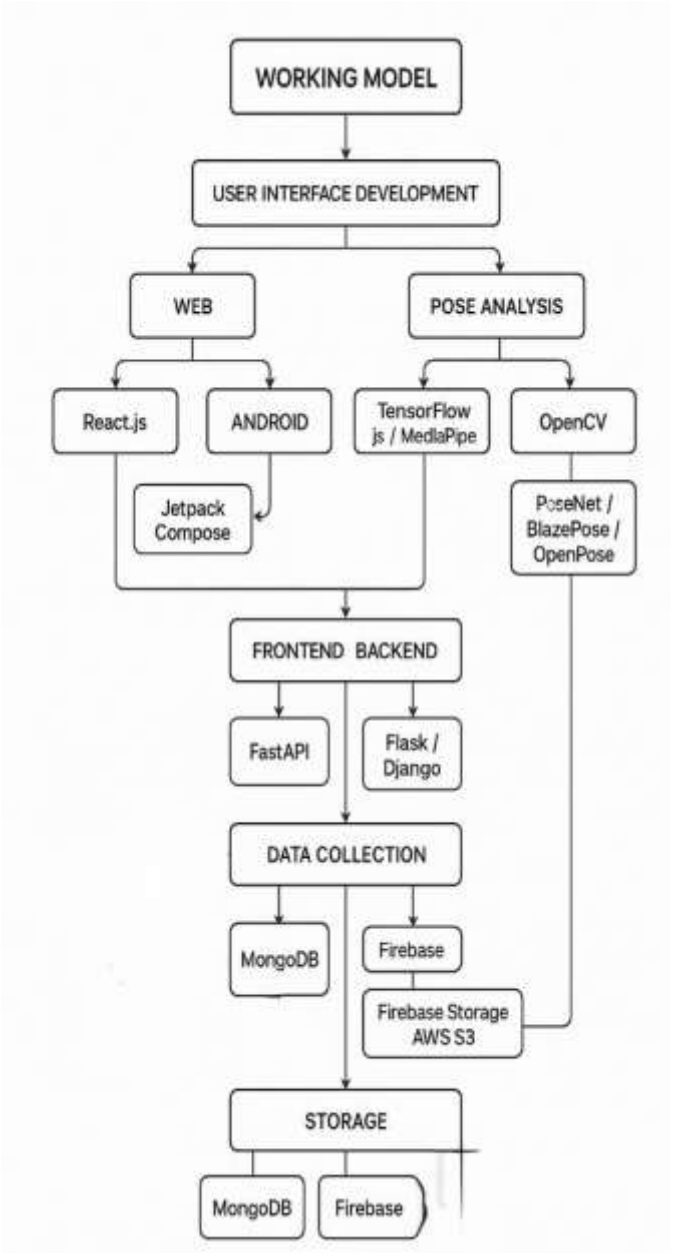

Fig 1: Block diagram

In addition, the system includes tracking of user progress through the storage of a record of posture analysis and nutrition plan histories. This enables users to track progress over time and make training adjustments accordingly. The portal is scalable, with upcoming releases to include more sports and also integrate more advanced AI methodologies like real-time video streaming and motion prediction. Security and privacy are ensured through the adoption of encrypted data transmission and secure user authentication methods, thus safe usage.

4. Flowchart

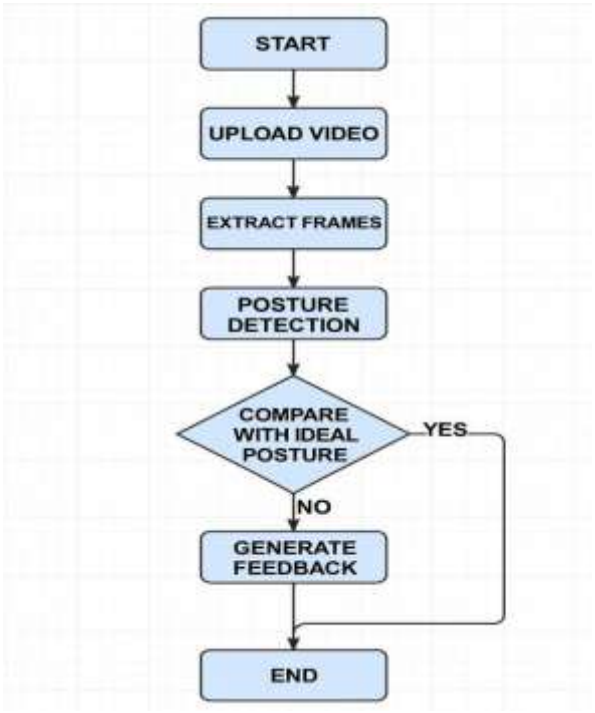

Fig 2: Flow chart of the proposed system

The flowchart depicts the sport-by-sport process of the Sports Analyzer Portal's functioning. It starts with user login, where users register or log in. Users then choose their sport of choice and either watch instructional videos or upload training videos of their own. Videos uploaded are then subjected to AI-based pose estimation to obtain key posture information. The data is analyzed relative to reference postures to detect deviations and provide corrective feedback. Users are provided with visual and text cues to enhance technique. Lastly, the system saves the results of analysis and user information in a database to track progress and retrieve it in the future, finally completing the loop of interactive sport training.

5. Output

The frontpage of the Sports Analyzer Portal includes a modern, interactive layout with a sporty tagline and sport-type cards such as Football, Cricket, Basketball, Tennis, and Baseball. These cards have a photo and "My Game" button for fast accessibility. A navigation bar is displayed at the top with menu choices for training, contact, and user signup/login.

Fig 3: Home page of the web page

By clicking on the "My Game" button within the Football option, this dynamic page is opened. The users are asked to upload their training video, which is then analyzed with AI/ML and gives feedback on body stance, shot angles, and style. It has support for .mp4 and .mov file types of up to 100MB.

Fig 4: My game page(Football)

Upon uploading the training video, the system carries out pose analysis based on AI/ML processes. It visually maps the body posture of the player and gives specific feedback. In this case, the player is instructed to hold his/her present posture during the entire kick so as to execute it at the best.

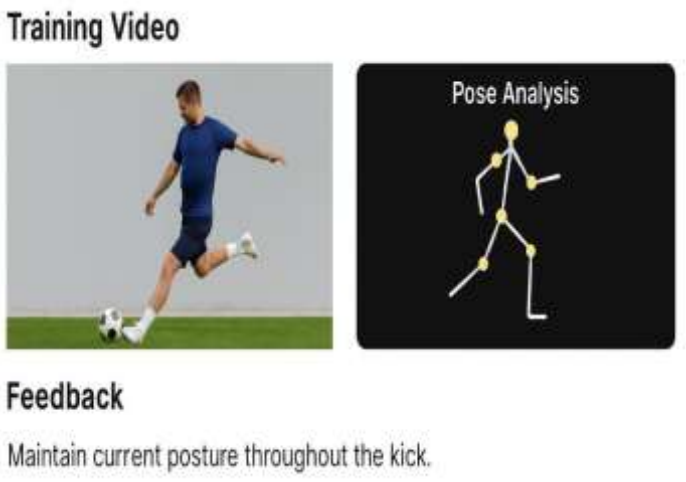

Fig 5: Feedback

The Training & Diet feature of the STATPULSE platform is a personalized way of fitness and diet. It integrates organized workout regimens with customized diet regimes to ensure that users reach their targets efficiently. Users are able to monitor calorie burn, maintain regularity with routines, and gain the advantage of expert-approved advice to enhance overall health and performance. The feature caters to beginners and intermediate users alike in terms of guiding them on their fitness path.

Fig 6: Training and diet page

The Player Comparison function presents the side-by-side comparison of two players on the basis of major performance indicators: Acceleration, Speed, Ball Control, and Passing. Each property is illustrated with radar charts and progress bars for quick strength and area of improvement identification. This tool assists coaches and players in analyzing differences in performance so they can plan targeted training and make strategic decisions.

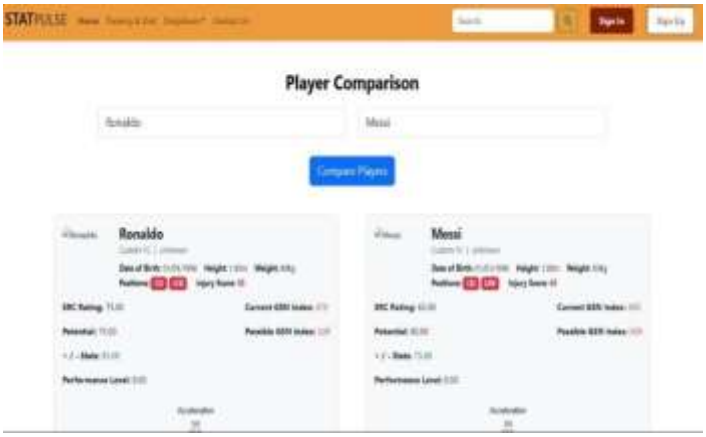

Fig 7: Player comparison

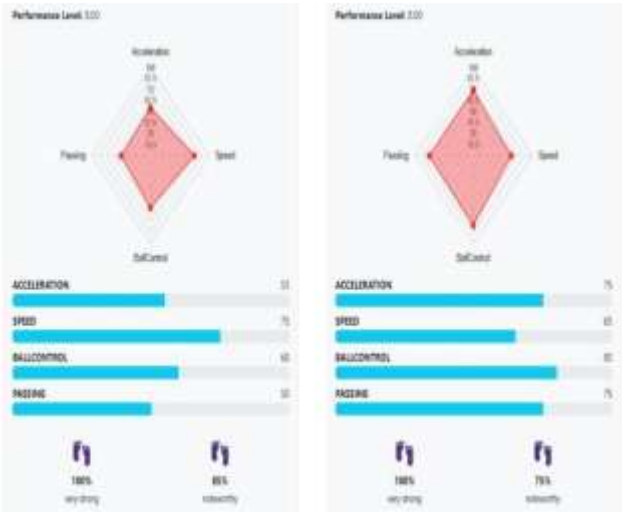

Fig 8: Performance comparison

6. Conclusion and Future scope

The project satisfactorily illustrates an AI-driven sports performance analysis system that relies on computer vision and machine learning to evaluate and improve athletic abilities. The system, through the analysis of live training videos and pose estimation extraction, gives athletes specific feedback to enhance their technique with accuracy. The incorporation of features like pose comparison, scoring of performances, and statistics visualization for players enhances its usability in multiple training sessions. The incorporation of an easy-to-use interface, full training and diet counseling, and comparative performance monitoring guarantees a complete fitness experience for users. The findings indicate that individualized feedback from biomechanical posture analysis can significantly aid coach and athlete development. Nevertheless, although the existing system performs well in controlled settings, difficulties exist in managing real-world issues like differences in lighting, background noise, and dynamic sporting environments. In the future, the system can be extended to support additional sport disciplines such as basketball, tennis, or swimming. Support for more sophisticated deep learning models such as 3D pose estimation and action recognition can also be added to improve accuracy and context understanding. Integration of wearable sensors can also enhance the collection of data for more detailed feedback. Moreover, the use of a recommendation engine that proposes personalized drills or workouts in line with performance deficiencies can increase the adaptability and personalization of the system. With improving technology in the field of fitness, this solution has great potential to become a useful tool for not only elite athletes and coaches but also for fitness enthusiasts who wish to have systematic improvement and injury prevention.

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