A Training and Support System for Three-Point Shooting for Basketball Beginners

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Basketball has become one of the most popular sports worldwide in recent years. Among all offensive techniques, the three-point shot has gained significant importance. In the NBA, teams attempted over 30 three-point shots per game on average during the 2023-2024 season, making up nearly one-third of all field goal attempts. Despite its popularity, the three-point shot remains a difficult skill. The long shooting distance leads to a lower success rate than other shots. Even elite NBA teams struggle to exceed a 40% success percentage. Mastering this technique is even more challenging for amateur players and beginners due to a lack of proper training, physical conditioning, and expert guidance.

Traditional training methods include online video instructions and camp-style offline instruction. While these methods provide learning opportunities, they have clear limitations. Online instructions often feature professional players whose shooting mechanics and physical attributes differ significantly from those of beginners. Beginners may attempt to mimic these movements without considering their own physical limitations, leading to ineffective results. In-person training programs, such as basketball camps, focus on repetitive drills. These drills may improve technique but can become monotonous, reducing motivation. Many beginners struggle to stay engaged in such training and may abandon practice before making meaningful progress.

To address these challenges, this research proposes a three-point shooting training and support system specifically designed for basketball beginners. The system leverages computer vision technology, particularly YOLOPose, to analyze and visualize shooting motions. Unlike conventional training methods that only examine the side view of a player's movement, this system analyzes both frontal and lateral perspectives. A multi-perspective approach provides a more comprehensive assessment of shooting form and allows for more precise feedback. The system also includes a personalized matching mechanism that pairs beginners with skilled players who share similar physical characteristics and shooting styles. This customized learning experience ensures that beginners follow shooting models suited to their own bodies. To enhance engagement, the system incorporates a reward subsystem, where participants earn points based on their shooting percentage and adherence to optimal form. These points allow access to higher-quality basketball, motivating beginners to continue training.

A controlled experiment was conducted to evaluate the effectiveness of the proposed system. The study involved 30 participants, including 10 skilled players and 20 beginners. The experiment followed the NBA Three-Point Contest format, in which participants attempted shots from five designated positions on the court. The 20 beginners were divided into two groups. The control group received traditional training, in which lateral only feedback was provided. The experimental group received feedback from both frontal and lateral perspectives through the proposed system. The results showed that beginners in the experimental group improved shooting accuracy more than those in the control group. Furthermore, beginners in the experimental group reported higher levels of motivation and engagement, demonstrating the system’s ability to enhance both

performance and training experience.

This research highlights the potential of integrating pose estimation technologies into sports education. The system offers visually intuitive feedback, bridging the gap between professional training methods and amateur development. Traditional coaching often fails to address key biomechanical issues. Many beginners struggle with improper elbow positioning, misalignment of the knee, and inefficient shot release. These issues are difficult to detect through side-view analysis alone. The proposed system overcomes this limitation by incorporating frontal-perspective analysis. This allows for identifying common shooting errors that might otherwise go unnoticed. By correcting these mistakes, the system improves shooting accuracy, optimizes biomechanics, and reduces the risk of injury.

The experimental results emphasize the importance of a multi-perspective approach to basketball training. The frontal perspective revealed critical shooting errors that were not evident from the lateral only. For instance, some beginners positioned the ball too far to one side before releasing their shot. This issue could not have been detected through lateral only analysis. Correcting such mistakes significantly improved shot consistency. The statistical analysis further confirmed that the experimental group improved shooting accuracy significantly more than the control group.

The study also provides insights into gender differences in three-point shooting training. Female participants faced additional challenges due to differences in body strength, which affected their shooting mechanics. To address this, the system introduced a metric for "correct shots" within the restricted area. This allowed for a more equitable assessment of progress. The experimental results showed that female beginners in the experimental group made significant improvements in shot placement compared to the control group.

The reward subsystem proved to be a strong motivator for beginners. Beginners showed enthusiasm for earning points and unlocking access to higher-quality basketballs. This gamified approach increased engagement and encouraged consistent practice. Sustained training is essential for percentage improvement, and the system’s ability to maintain user motivation represents a key advantage over conventional training methods.

In conclusion, this research presents an innovative and technology-enhanced approach to learning three-point shooting. By combining pose estimation, personalized feedback, and gamification, the proposed system provides a more effective and engaging learning experience for beginners. The proposed system overcomes these limitations by offering real-time feedback, customized learning, and interactive motivation. As the system continues to evolve, it has the potential to transform basketball training for players at all levels. By making high-quality training accessible and engaging, this system could significantly improve skill development in basketball and other sports.

This study makes several important contributions. First, it introduces a matching subsystem that matches beginners with skilled players based on physical characteristics. This ensures that beginners train from models suited to their own characteristics, increasing the likelihood of successful skill acquisition. Secondly, it improves upon existing motion analysis techniques by incorporating both frontal and lateral perspectives. Traditional lateral-only analysis often fails to detect frontal perspectives, such as improper ball positioning relative to the face. Thirdly, the research integrates gamification through a reward subsystem. This approach makes training more engaging by allowing beginners to earn points and unlock rewards, fostering long-term motivation.

Despite its promising results, this study has some limitations. The sample size was relatively

small, which may limit the generalizability of the results. Future work should expand the participant pool to include a more diverse range of skill levels, genders, and playing styles. Additionally, the database of skilled players did not include female skilled players. This may have impacted the effectiveness of the matching subsystem for female beginners. Future work should incorporate female skilled players to improve inclusivity and effectiveness.

Several areas for future work could further enhance the system. Integrating real-time video analysis would allow for more dynamic training. Instead of analyzing keyframes from videos, the system could provide immediate feedback while a player is shooting. This would enable real-time corrections, improving the training process. The system could also be expanded to include other basketball skills, such as dribbling and defensive maneuvers. Analyzing movement patterns in these areas could provide additional training benefits. Finally, long-term training should be conducted to assess the system's impact over extended training periods. Understanding how the system influences skill development over months or years would provide valuable insights into its effectiveness and sustainability.