Training Assistant : Strengthen Your Tactical Nous with Proficient Virtual Basketball Players

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Figure 1: (a) A trainee practices tactics by using the proposed system. (b) Tactic content that a trainee experiences in the viewing perspective of the power forward.

ABSTRACT

Tactic training plays a crucial role in basketball offensive plays. With the aid of virtual reality, we propose a framework to improve the effectiveness and experience of tactic learning. The framework consists of a tactic input device and a wireless VR interaction system, which allows the user to conveniently input target tactic and practice in a high-fidelity circumstance. By the assistance of our VR training system, the user can vividly experience how the tactics are executed by viewing from the a specific player's viewing direction. Additionally, tactic movement guidance, action hint of how to offense aggressively, and virtual defenders are rendered in our system to make the training more realistic. By using the proposed framework, players can strengthen their tactical nous and improve the efficiency of tactic training.

CCS CONCEPTS

• **Human-centered computing** → **Virtual reality**;

KEYWORDS

virtual reality, basketball tactics, streaming technology, motion capture, sports, training

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1 INTRODUCTION

Tactic training is important for basketball teams, and it requires a lot of training and practice to improve both the fluency and efficiency of executing an offensive tactic. However, if some players in the basketball team are unfamiliar with target tactic(s), it will be very difficult for the team members to realize/practice tactic(s) correctly. More importantly, the timing of running, ball-passing, and exact motion of pump fake or cross entry have a great influence on the successful execution of tactics.

Virtual reality (VR) technology has been widely applied to sports area [Covaci et al. 2015; Neumann et al. [n. d.]]. Compared with training in the real world, VR-based training offers a fully controllable environment, allowing feasible training systems to help athletes improve skills for playing in high-pressure situations. For example, in the virtual circumstance, trainees can interact with simulated opponents controlled by the coaches. With the tracking of the head-mounted display (HMD) and the poses of the trainees, coaches can monitor and analyze players' behavior while training in the designed virtual scenario.

To improve the effectiveness of conventional basketball tactic training, we propose a VR-based framework which allows players to practice in a high-fidelity environment and be trained through a more effective way. The proposed framework is composed of an easy-to-use tactic input device (e.g. tablet) and a wireless VR interaction system that enables sports training with fast movements. By using virtual reality technology, our system has high controllability of the rendered content, including additional guide and various competitive situations. Besides, motion sensors are applied during the training procedure to analyze the trainees' body pose and provide correct action hints (e.g. pump fake or ball-passing).

2 OUR APPROACHES

In our work, a tactics input tablet is essential for the user to input target training tactics (cf. Section 2.1). To offer a real-time interactive training process, a wireless virtual reality system with human motion tracking technology is presented in Section 2.2.

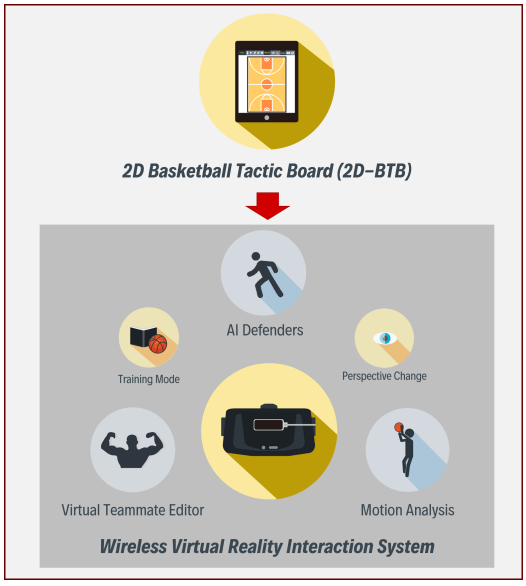

Figure 2: System framework.

Based on the target tactic trajectory input through the tablet, a computing server will establish corresponding three-dimensional virtual training scene with players running on the virtual court. Virtual defenders with artificial intelligence will also be generated to make the training more realistic. When the user learns tactics with the virtual reality system, the information such as the user's trajectory, head pose, and skeleton will be sent to the computing server, and the server will supply proper tactic guidance (e.g. viewing direction and offensive fake move) to the trainee. Also, we provide a virtual teammate editor [Chang et al. 2018] for the trainee to create teammate avatars resemble his/her real teammates by simply uploading a 2D face image for each teammate. Using avatars resembling the appearance of the trainee's real teammates makes it more nature and easy to recognize virtual players of different positions.

2.1 Tactic Input

Compared with conventional physical basketball tactic board (BTB), electronic tactics board can provide more comprehensive assistance for tactic training. On the 2D tactics input tablet, users can input players' offensive trajectories and orientations for the target tactic. In addition, correct timing for running and ball-passing is one of the important parts for a successful execution of a basketball tactic. With our BTB, users are able to modify each player's travel time intuitively, especially when multiple players have to move simultaneously. Furthermore, coaches can control virtual players immediately in an intuitive way, which makes it possible for the coach to build their own training scenario and demonstrate concrete tactic execution easily even when there is only few players participating in the training.

2.2 Wireless Virtual Reality Interaction

Free movement is necessary for the trainees to perform tactics during training. To offer users wireless and highly immersive experience, low-latency and high-throughput capabilities are needed to handle the demands of VR content and make the human brain perceive the virtual environment as real as possible. Benefited from fully immersive virtual reality system, the user can experience how the tactics are executed by viewing from a specific player's viewing direction. Also, a step-by-step learning mode is provided by considering the user's orientation to check whether he/she looks at the correct direction. Our VR system improves the training experience by the following three features: (1) virtual teammate editing (2) motion analysis, and (3) virtual defenders with AI.

2.2.1 Virtual Teammate Editing. The virtual teammate editor allows the user to create their own teammate avatars by inputting the 2D face photos of their real teammates and adjusting the body shape, hairs, and clothing of each teammate via a well designed GUI. Practicing with virtual players resemble the desired teammates can help the trainees to recognize different offensive players at a glance, which creates a more personalized training environment for the trainee.

2.2.2 Motion Analysis. Offensive aggressiveness and fake move are important for achieving a successful tactic execution. Benefited from the IMU-based human motion capture device, user's incorrect movements could be detected by motion analysis. The guidance will give proper motion hints to remind the user to perform fake action or ball-passing. Also, the target trajectory is rendered on the virtual court to show the exact paths the trainee should follow.

2.2.3 Artificial Intelligence Defenders. Defenders play important roles in the practice of tactic execution. They not only influence the trajectories and ball-passing type of the offensive team but also narrow the view of offensive players. Thus, in our framework, the trajectory and animation of the virtual defenders will be automatically generated according to the movements of offensive players. Practicing with simulated AI defenders can exponentially increase the vividness of the training process. Machine/deep learning methods [Chen et al. 2018; Franks et al. 2015] can be applied to generate the trajectories of defenders.

3 CONCLUSION

We propose a framework for basketball tactics training via VR technology. With the help of high-immersive VR interaction system and beneficial virtual training assistants (movement guidance and virtual defender), tactic(s) training can be much more interesting and effective. Please refer to the demo video (https://youtu.be/-9uvrFCxy8Y) for more details.

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