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Development of a Virtual Pitching System in Screen Baseball Game

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Abstract

In recent years, indoor simulated sports have become widely used, and screen baseball system has emerged that can play baseball in indoor space. In this paper, we propose a virtual pitching system that can improve the realism of screen baseball game. This virtual pitching system is characterized in that it uses a transmissive screen in the form of a pitching machine without a pitching hole and installed on the back of the screen. Therefore, unlike existing systems where pitching holes are formed on the screen, it enhances the immersion feeling of displayed images. Also, in this pitching system, the synchronization algorithm between the pitching machine and the virtual pitcher is used to form a sense of unity between the virtual pitcher and the ball according to various types of virtual pitchers, thereby enhancing the reality of baseball games.

Keywords: *Screen Baseball System, Virtual Pitcher, Virtual Pitching System, Pitching Machine*

1. Introduction

Recently, simulation devices that can enjoy sports games without going to the field by using 3D stereoscopic image and computer simulating technology have been developed and widely spread. In the case of a screen baseball performed indoors, since the image of the baseball field is displayed through the screen, time and cost are saved compared to playing in an outdoor field while giving a feeling of playing a real baseball game outdoors. It is very popular among busy modern people who have difficulty in outdoor baseball play because of time and economical reasons. In addition, there is a limitation that a team must be formed in a real baseball game, but screen baseball play can be done alone, and a baseball game can be formed by virtually forming a team. There have been a lot of researches on virtual sports in the indoor environment, mainly screen golf[1,2,3,4], and recently, research on screen baseball is needed[5].

In a screen baseball system, a virtual pitcher is displayed on the screen, and when a ball is blown from the back of the screen, the user hits the ball. Therefore, the realization of virtual pitcher implementation and the integration of flying ball and pitcher are important factors for determining the quality of display simulation[6,7].

In current screen baseball systems, the pitching machine is provided on the back of the screen, so that the

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pitching ball from the pitching machine is blown to the user at the plate after passing through the screen. Therefore, a pitching hole is formed in the middle of the screen so that the ball can pass through the screen. The pitching hole of the screen is essential because of the mechanism of the current screen baseball system that is pitched from the back of the screen and is provided to the user of the plate after the ball passes through the screen. Since only the pitching hole portion is displayed in black while the baseball related image is displayed on the screen, the image should be omitted only in that portion of the screen. Therefore, it disturbs the feeling of immersion in the image displayed on the screen from the viewpoint of the user and reduces interest in the screen baseball game.

In this study, we propose a pitching system without pitching hole to enhance the realism of virtual pitcher in screen baseball system. The system uses a screen made of a transmissive type with which the pitched ball can pass without a pitching hole, so that the image displayed on the screen is not skipped. Thus, interest in the screen baseball game can be improved without detracting from the feeling of immersion in the image displayed on the screen.

This paper is composed as follows. Chapter 2 describes the components of the screen baseball system developed in this study. In Chapter 3, we propose a virtual pitching system in which there is no pitching hole and the virtual pitcher and the pitching machine operate synchronously. Chapter 4 concludes the paper.

2. Screen Baseball System

The components of the screen baseball system developed in this study is shown in Figure 1.

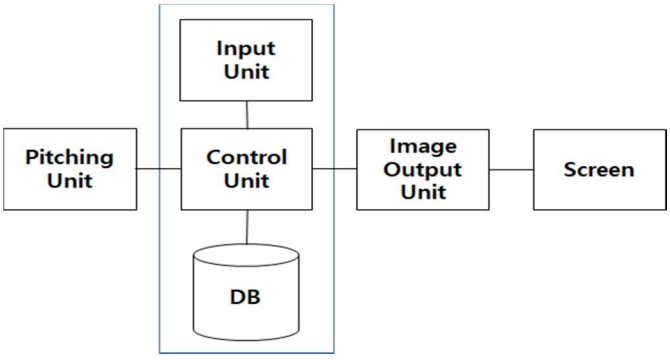

Figure 1. Components of Screen Baseball System

The screen baseball system includes a ball pitching unit, a control unit, an image output unit, and a screen. In addition, the screen baseball system is equipped with a striking plate on which the user is positioned to strike, and various sensing devices for sensing the ball hit by the user. The sensing device senses the movement of the hit ball by the user and transmits the overall physical state information of the hit ball to the control unit, which can be used for the operation of the control unit. Any device such as a camera or a sensor can be used as the sensing device. A camera or a sensor may be used alone or in combination, or may be used in multiple units.

The striking plate is a predetermined distance away from the screen. The distance between the pitcher and the catcher in the actual baseball is 18.44m, so that the distance between the batting plate and the screen can be set to about 18m in the screen baseball. However, in the case of a screen baseball, there is often a shortage of installation space, and the distance between the plate and the screen is often shorter than 18 m. The surface facing the striking plate on the screen is called the front. A ball pitching unit is provided on the back

of the screen. The ball pitching unit fires a ball so that a user on the striking plate can strike.

The control unit is responsible for various operations and controls necessary for the operation of the screen baseball system. When the user hits the pitching ball, the control unit receives the overall state information on the hit ball from the sensing device, and then calculates the batting result (ground ball, fly, hitter, home run, etc.) of the ball. The control unit is connected to an input unit and a database. The input unit is used for inputting various information such as a nickname of a team member or a team name from a user, and a keyboard or a mouse can be used. The database stores information necessary for the user to calculate the batting result of the hit ball or information about the baseball related image to be displayed on the screen.

The video image output device is for projecting images such as a shape of a pitcher, a virtual ball displayed on the screen corresponding to the ball hit by the user, and a defender who defends the virtual ball to be displayed on a screen. Imaging devices such as beam projectors may be used. The screen displays the projected image on the video output device and displays it to the user. When the image display device and the striking plate are disposed opposite each other with the screen therebetween, the screen is a 'transmissive' screen. In the transmissive screen, a user located on the striking plate sees the image projected from the image display device on the opposite side of the image display device. If the image display device and the striking plate are disposed on the same side with the screen therebetween, the screen may be a 'reflective' screen. The screen baseball system proposed in this study uses a transmissive screen.

3. Virtual Pitching System

3.1 Virtual Pitcher Type

Figure 2 shows a menu for selecting various types of virtual pitchers in a screen baseball system. The user can select a desired type of virtual pitcher to be displayed on the screen. For example, in a real baseball, there is a left-handed pitcher and a right-handed pitcher depending on which hand is used, and the power of the ball can vary according to the pitch of the pitcher, even if it is the same left-hander (or the same right-hander). Also, there are various pitching types such as overthrow, three-quarter, side arm, under-throw, etc., and the trajectory of the ball can be changed according to this pitching type. The user can also select an appropriate virtual pitcher according to his / her preferred pitching type. Then the selected type of pitcher are presented in the system.

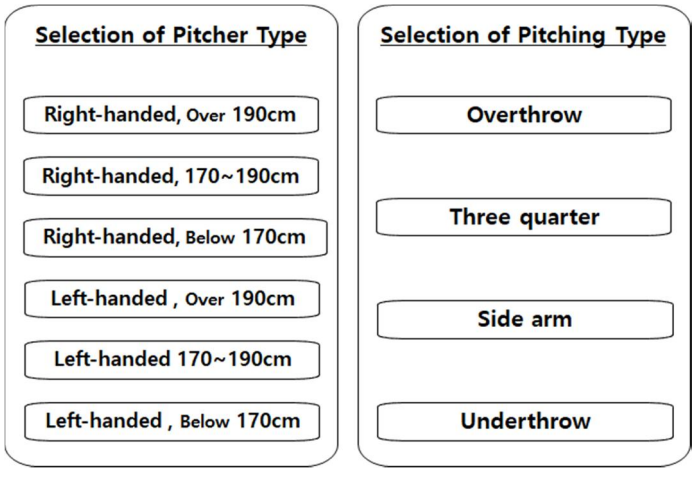

Figure 2. Selection of Virtual Pitcher

3.2 Synchronization of Virtual Pitcher and Pitching Ball

The feature of this virtual pitching system are that the operation of the virtual pitcher and the position of the ball coming from the pitching machine are synchronized and operate without pitching holes. In Figure 3, the virtual pitcher selected by the user is pitched on the screen, and the ball is configured to pitch in the pitching machine as soon as the ball is released in pitching of the virtual pitcher. Thus, the user is impressed that the ball is actually being pitched in the hands of the virtual pitcher being displayed on the screen. The position of the exit of the pitching machine can be adjusted by the position adjuster so that the exit from which the ball fires in the pitching machine corresponds to the position at which the ball is released by the virtual pitcher.

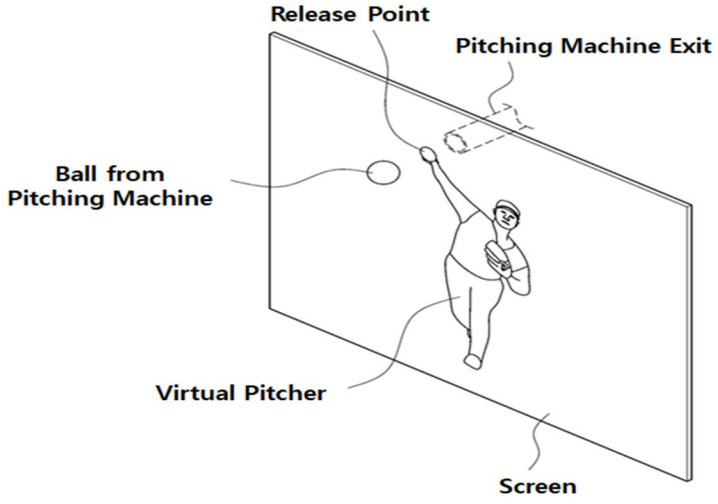

Figure 3. Virtual Pitcher and Pitching Ball

In this virtual pitching system, one of the plural types of virtual pitchers is determined by the user's choice, and depending on which pitcher is selected, the release point (the position of the hand of the pitcher's hand at the moment of leaving the baseball) is changed in the virtual pitcher. For example, in Figure 2, there are six different types of pitchers depending on whether they are left-handed or right-handed, and according to the distinction of pitchers, and there are four different types of pitchers depending on the pitching type. When combined, there are 24 different pitchers. If they are all different release points, the exit of the pitching machine must be able to be positioned at 24 different positions, in order for the ball to be fired corresponding to their release point location.

However, since the screen baseball system up to now has no position controller, the position of the exit of the pitching machine cannot be changed. Also, in existing systems, a pitching hole must be formed on the screen for a ball to be ejected from the pitching machine to pass through the screen. If the pitching hole is formed in 24 positions, the pitching holes will occupy most of the screen. Therefore, with the conventional techniques, it was practically impossible to cause the ball to be fired in correspondence with the release point positions of the respective pitchers for the various types of pitchers. However, this system solves this problem by the synchronization algorithm between the pitching machine and the virtual pitcher.

3.3 Virtual Pitching Flow

This section shows the pitching flow of the implemented virtual pitching system. The pitching flow is as follows.

1) Create data in advance in the release point control tool of the virtual pitcher. The screen of the developed system is shown in Figure 4.

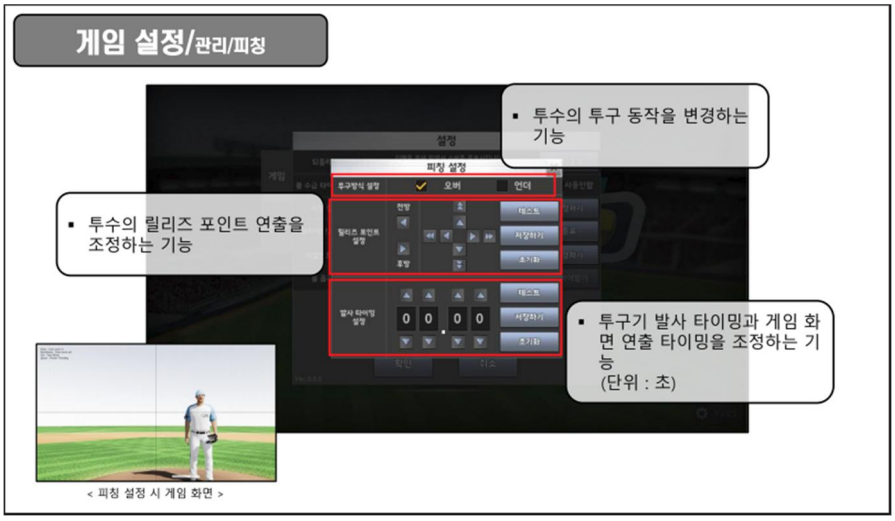

Figure 4. Virtual Pitching System Setup

2) Place a virtual pitcher on a previously placed pitcher pivot in the starting scene. The implementation result is shown in Figure 5.

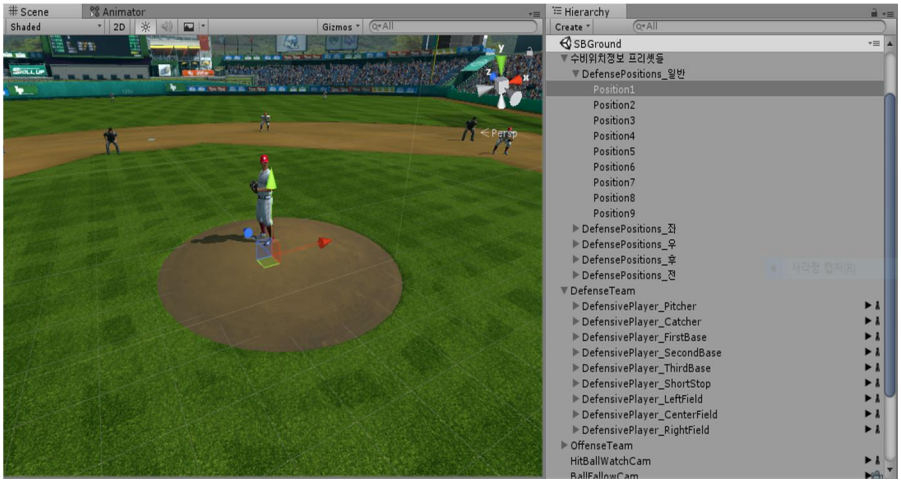

Figure 5. Virtual Pitcher Placement

3) When the batter enters the striking plate, zoom in the pitcher using the stored data. The result screen is shown in Figure 6.

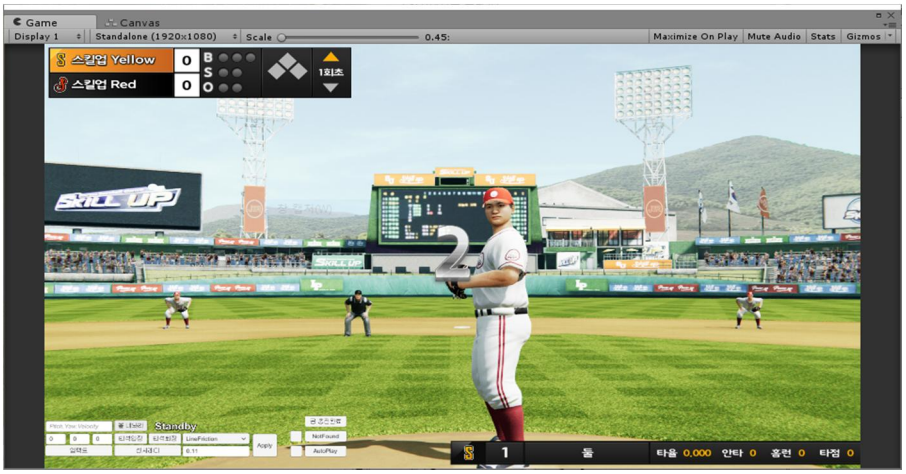

Figure 6. Example of Virtual Pitcher

4) When the count is over, play the pitching animation. Example of animation is shown in Figure 7.

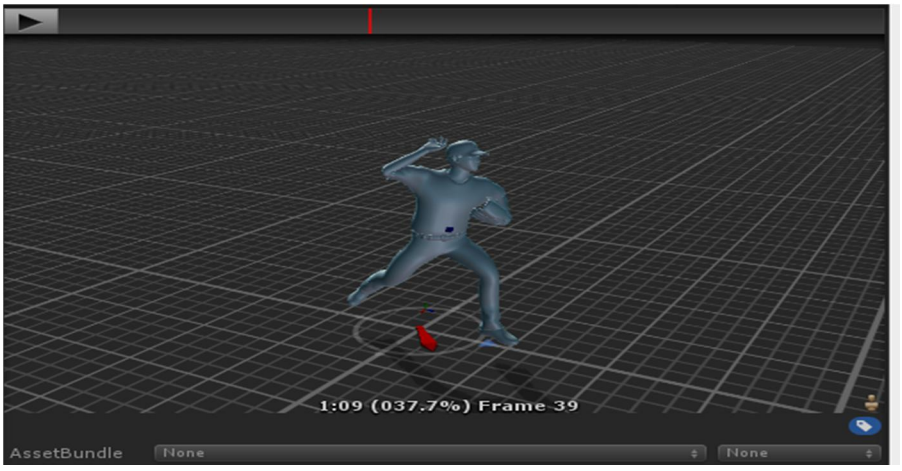

Figure 7. Virtual Pitcher Animation

4. Conclusion

In this study, we developed a screen baseball system and a virtual pitching system that works in this screen baseball system. The screen baseball system consists of a pitching unit, a control unit, a video output unit, a screen, and a sensing unit. The screen implemented in this system is a transmissive screen with which the pitched ball can pass without pitching holes, and the image displayed on the screen is not skipped. Thus, interest in the screen baseball game can be improved without detracting from the feeling of immersion in the image displayed on the screen.

In addition, the proposed virtual pitching system synchronizes the motion of the virtual pitcher with the position of the ball coming from the pitching machine. The position of the exit of the pitching machine is adjusted by the position adjuster so that the exit from which the ball is fired at the pitching machine corresponds to the position at which the ball is released by the virtual pitcher depending on the pitcher type.

Therefore, the user has the advantage of enhancing the reality of the game because he or she is impressed that the ball is actually being pitched in the hands of the virtual pitcher displayed on the screen.

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