Camera System for Interaction in Golf Game

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Abstract. We propose the camera system for user interaction through flight data measurement of the golf ball by using line-scan camera and high-speed cameras in the golf game. And then line-scan camera is checked the fly or no of the golf ball and flight status of the golf ball takes image by using the high-speed camera. Therefore, we can confirm the progressive direction and spin of the golf ball through the image processing.

1 INTRODUCTION

As golf games become more popular, technology that recognises the operation of the real user has also advanced. The more commonly used system is the optical sensor, however optical sensors are expensive. In addition, measurement errors can easily result depending on the flight of the ball and judgement errors due to minute dust or humidity. In order to overcome these limitations, we propose the camera system for flight data measurement of the golf ball by using a line-scan camera and high-speed cameras in the golf game. Through the camera system, we can more accurately measure the progressive direction and spin of the golf ball.

2 CAMERA SYSTEM IN THE GOLF GAME

Our system consisted of one line-scan camera, an image capture board and two high-speed cameras in which several exposures are possible when one image is taken.

Figure 1. Camera System

In our system, we use the line-scan camera to check whether the golf ball has passed or not. By controlling the illumination we set up an environment that makes the flying golf ball well seen. After the captured image rapidly judges whether the ball has passed or not, it sends a trigger signal to the high-speed camera to take a photograph. The image received in the high-speed camera measures the flight data of the golf ball through image processing. This image is equivalent to an image captured by a high-speed camera of more than 1,000fps. After the location information of the golf ball is measured, the speed and a direction are calculated using the physical formula. This information is then applied to the golf game.

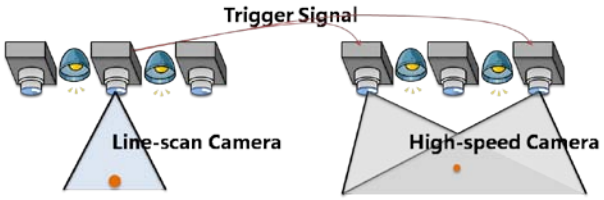

Figure 2. Principle of the Camera System

2.1 The Line Scan Camera

We use the line-scan camera for checking whether the golf ball passed or not. The line-scan camera that spec is resolution of 1024×200, gray image and frame rate of 25 KHz, is able to capture the golf ball although it is fast. Figure 3 is the image which the golf ball passes in the line scan camera. After the captured image rapidly judges the weather passed or not, it has to send the trigger signal to the high-speed CCD camera for it taking a photograph. Therefore, image processing of the line-scan camera's image has to be simple. So, if the bigger value of line-scan camera's image than 40 was 300, it determined that the golf ball passed and the trigger signal was transmitted to the high-speed CCD camera.

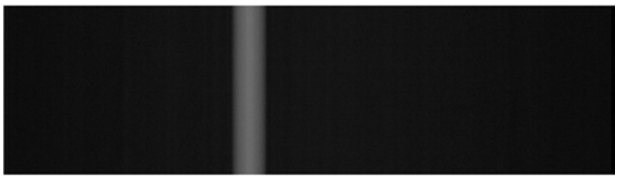

Figure 3. The golf ball passes in the line-scan camera

2.2 The high-speed camera

The high-speed CCD camera overlaps the image of many cuts on the image of the leaf, because it can acquire the image with the fast speed. The high-speed CCD camera acquires image when, it received trigger signal from the line-scan camera. At this time, the Sensor Exposure value is defined by the Exposure Numbers, the Exposure Duration, and the Exposure Interval. Exposure Numbers; the exposure number definition of the camera lens the Trigger signal once received. Exposure Duration; the defining

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the exposure time of a camera. Exposure Interval; duration of the next exposure of a camera. (Figure 4. reference)

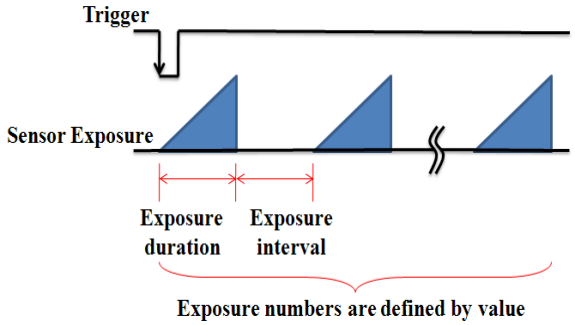
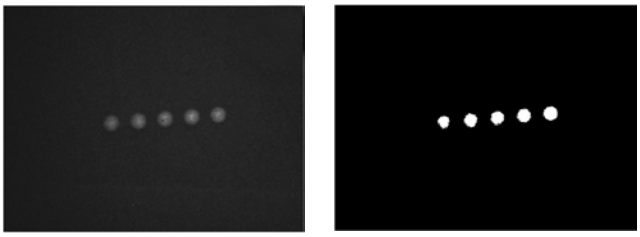


Figure 4. The photographing method of the high-speed camera

The obtained image one by one classifies five balls after performing the image processing. At this time, in the result image, because it is not successively enumerated from the right, by using the selection sort, the indexing of the golf ball enumerates as the order of a left from the right (Figure 5. reference).

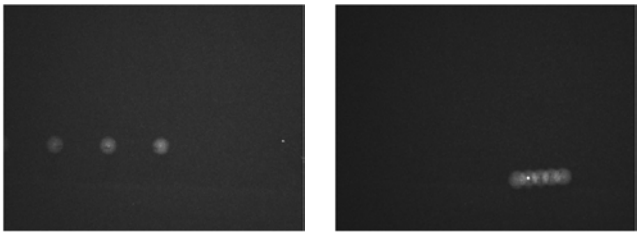


(a)Before image processing (b)After image processing

Figure 5. The captured image by the high-speed camera

2.3 The exception handling of captured image

It is faster than the Sensor Exposure set value of the high speed CCD camera or there is the slow case in the image acquisition according to the Sensor Exposure set value of the high speed CCD camera. The golf club and method of the golfer hitting a golf ball are mistaken according to a distance between the golf ball and a hall, a location. At this time, an affect is caused in the speed of the golf ball.



(a) The fast case (b) The slow case

Figure 6. The difference of The Sensor Exposure set value of the high-speed CCD camera.

In case the first, the shapes of five balls aren't photographed because the golf ball are faster than the Sensor Exposure set value of the high speed CCD camera (Figure 6(a) reference). Because this kind of case calculates by using the difference of the time and distance between the golf ball of first and the second (based on the right), it is able to make a speed and angle with calculation. In the second case, the golf ball are slower than the Sensor Exposure set value of the high speed CCD camera, the overlapped image of the golf ball is obtained (Figure 6(b) reference).

In such case, since knowing the set value of the Exposure Numbers, it can do in the size of one blob with assumption whether several golf balls are overlapped or not. Here, we can calculate Y Coordinate at the right and left of a blob and by using the Y-axis projection technique. We cannot be known about the progressive direction of the golf ball in the case of one blob. However, because a distance is known about the diagonal line element of the golf ball, we can calculate a speed of golf ball. At this time, the first value in the Y-axis projection sets as the canter of the golf ball at the Y-axis. By using the trigonometrical function and the physical formula of S=VT, the coordinate of a ball obtained through this kind of process makes a speed and angle with calculation.

3 CONCLUSIONS

We proposed the camera system for measuring flight data of the golf ball on the screen golf game system. We were also able to see the appearance of the flying ball through direct application of the physical simulator to our data. Our camera system can be applied to various sports games that use a ball, such as baseball.

Figure 7. Playing the Golf Game

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