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Vision Tracking Realization of a Robotic Follow Spot System

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Abstract: In this paper, we described about the actor-tracking techniques of a robotic follow spot system. The robotic follow spot system contains Pan-Tilt actuator mechanism and infrared detectable camera. The infrared LED modules, as markers, are attached on the actor's head. The system detects the marker by the camera and actuates the follow spot to locate the marker be the center of the image. In order to improve the tracking speed, we used a very simple image processing algorithm, binarization and CG (center of gravity) calculation. The actor's relative location from the center of the image is regarded as error. Controlling the Pan-Tilt actuators, which move the follow spot and the camera, compensates the error. PD control and digital LPF (Low pass filter) algorithm is applied. The control command is transferred to the physical AC servomotors by CAN (Control area network) interface.

Keywords: Automatic Follow Spot System, infrared image detection, infrared image processing, PD control, LPF(Low Pass Filter), automatic tracking.

1. INTRODUCTION

Developed follow spot system contains AC servo-motors, high-precision harmonic drives, DSP (Digital signal processor) board, Embedded PC and CMOS camera [1]. The infrared image is captured by a camera, which is connected with the PC by USB (Universal serial bus). The location of the marker attached on the actor is calculated, and the PC generates the control command. The command is transferred by CAN interface card to the DSP processor board and it converts the information format between the Embedded PC and actuators.

The infrared light-emitting device, marker, is attached on the actor's head and the camera with the infrared pass filter [2] captures the marker's image. We converted the received image in black and white by binarization with an appropriate threshold [3].

In this case, global coordinate origin is the center of the captured image frame. The location of CG (center of gravity) from the origin is calculated. The point is regarded as an error, which is to be compensated through PD control. Finally, pan-tilt actuator is driven after the smoothing process by applying the LPF on the PD control command, which can make the follow spot following an actor [4,5].

We does not use visible but infrared ray band, because we need to secure the robustness and light image-processing burden. In order to minimize the image processing computation burden, we used simple algorithms [6], which is explained above.

In this paper, we realized an actor following algorithm on the previously published system [1] with the speed of 16 frames per second in real time.

2. ALGORITHM DESCRIPTION

Fig. 1 shows the control algorithm structure and related hardware. Marker modules are attached on actor's head. The camera, which contains infrared pass filter, detects the marker modules. The filter changes the color image into mono image but removes visible ray spill lights. It is an important issue, because we need to get the actor's location keeping the robustness.

The generated gray image passes binarization, which simplifies data processing with predefined threshold value. The value can adjust the sensitivity. With a narrow field of view, high sensitivity is not required. But in wide field of view, sensitivity adjustment process is required, because the possible spill light can decrease the robustness performance. In this case, in order to obtain the appropriate binarization image, adjusting the threshold process is required but the overall computation burden does not changes very much.

We used PD control to compensate the error, and smooth motion is achieved through LPF. Through CAN interface, the control command is delivered to the DSP board, which controls the AC servomotor. Through this process, fast tracking speed and precise motion of the follow spot system is realized.

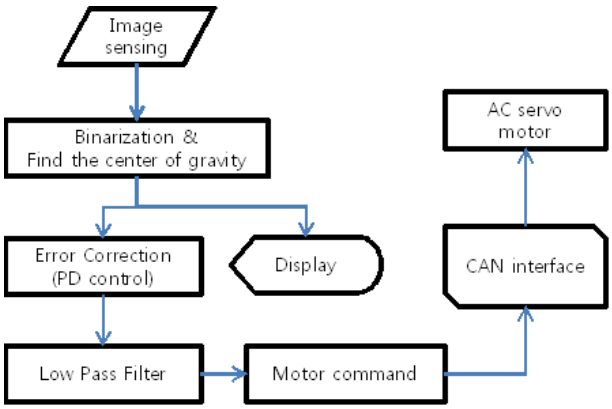

Fig. 1 Configuration of the follow spot system

3. EXPERIMENTAL RESULT

As shown in Fig. 2, the follow spot system keeps

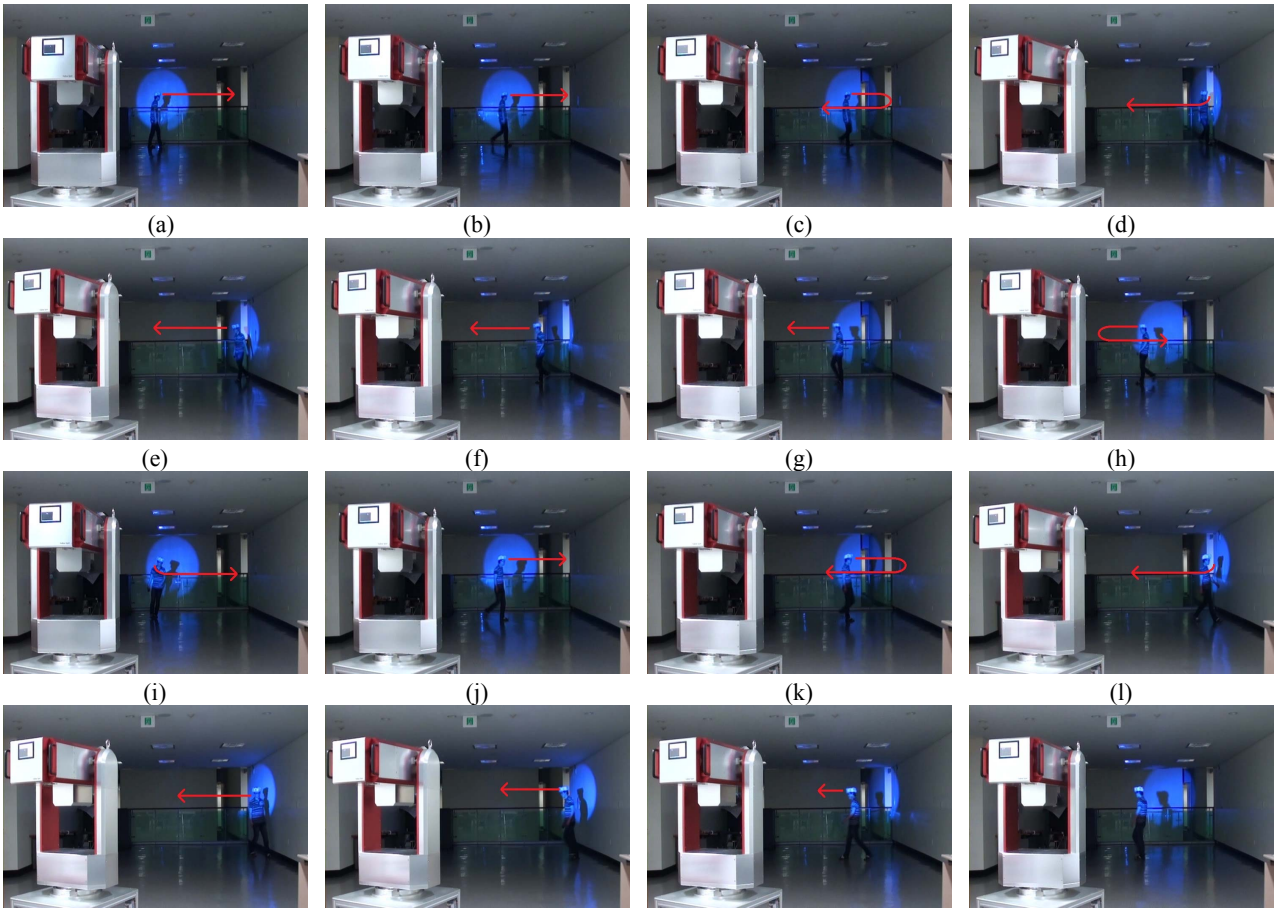

Fig. 2 Experimental result

track of the marker. Also, precise and rapid movements of the follow spot system are shown. The actor's location is calculated with 16 frames per second.

4. CONCLUSION

We realized actor tracking follow spot system with simple vision sensor. We verified the system performance with experiments.

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