'92 KACC 1992. 10. 19~21

Recognition and Tracking System of Moving Objects based on Artificial Neural Network and PWM Control

M. Sugisaka
Oita University, Oita 870-11 Japan

Abstract: We developed a recognition and tracking system of moving objects. The system consists of one CCD video camera, two DC motors in horizontal and vertical axies with encoders, pluse width modulation(PWM) driving unit, 16 bit NEC 9801 microcomputer, and their interfaces. The recognition and tracking system is able to recognize shape and size of a moving object and is able to track the object within a certain range of errors. This paper presents the brief introduction of the recognition and tracking system developed in our laboratory.

1. INTRODUCTION

Development of a system which is able to recognize the shape and size of a moving object and is able to track the object is necessary for constructing intelligent robots that assist human beings. Recently, we developed a recognition and tracking system of moving objects which is able to recognize the patterns from the image data obtained from CCD video camera(visual equipment) and is able to track the object within a certain range of errors and performed the PWM control experiments[1]. In addition, we discussed how to implement artificial neural network system in the tracking system. This paper explains briefly the method and results obtained in the experiments.

2. CONFIGULATION OF RECOGNITION AND TRACKING SYSTEM

The configulation of recognition and tracking system develped in our laboratory is shown in Fig.1 and the general view of the system is shown in Fig.2. As shown in Fig.2 the system cosists of two DC motors with two encorders, a CCD video camera for taking the picture of a moving object. One DC motor with encoder which moves in up and down directions is located in the upper sphere. The other DC moter with encorder which moves in right and left directions is located in lower box.

The horizontal and vertical DC motors are driven by the PWM controller of electric circuits[2] and the velocity of tracking is selected appropriately by considering both the hardware limitations and the velocity of an object to be tracked. Namely, the duty ratio of the amerture current is changed.

The CCD video camera is able to move 60 degrees in right and left directions from the center and is able to move 45 degrees in up and down directions from the center. The movement of DC motors is locked from hardware in the outside of the region stated above even if the PWM controller received on-signal from the microcomputer.

The image data of a picture with 16×12 (low× column)=192 pixels is taken by the CCD video camera at one sampling and has values of six bits, namely, 64 degrees of intensity. The value of the image data is expressed as hexadecimal digit.

3. PROCESSING OF IMAGE DATA FROM CCD CAMERA

3.1 *Data Processing for Tracking*

The image data of a moving object with 16×12 pixels is taken into the NEC PC 9801 microcomputer through the video I/F interface and is stored in the memory. Thereafter, the image data is read from the memory and is printed on the CRT. This processing time is approximately less than 30 ms and therefore the sampling period(timer) is chosen as 30ms in the experiment. For the purpose of tracking, the highest degree of intensity is selected.

3.2 *Neuro-Logic Comuting for Pattern Recognition*

Neuro-logic computing method[3] is an approach in order to recognize the patterns of image data of picture of a moving object. In the following, the idea how to recognize the patterns of a moving object is shown based on the artificial neural network system.

The image data of the moving object is transfotrmed into the binary image using a threshold

value in order to recognize the pattern. The patterns of binary images of various moving objects are learned by a three-layers neural network system using the back propergation method beforehand.

The numbers of units in hidden and output layers in the artificial neural network system depend on the number of patterns to be recognized. In our case, the neural network system has 7 units in the input layer and has few units in the output layer.

4. TRACKING CONTROL USING PWM

As to tracking of visual system the following procedures are repeated:

1. The image data of picture of a moving object is taken into the microcomputer from the CCD video camera.
2. The position (i,j) of the hightest degree of intensity of the image is detected.
3. The current position of the CCD video camera is read and taken into the microcomputer. The camera is moved in order for the current position to become the center of the image. In other words, the deviation between the position (i,j) stated above and the center of the image is calculated. Thereafter the position of camera to be moved is calculated and the camera is moved to this position.
4. Approximately, time less than 1/30 seconds is necessary for taking the image into the microcomputer and a timer of 30ms in the microcomputer is used in the experiments.
5. The above procedures are performed repeatedly in order to track the moving object in a certain range of errors.

5. CONCLUSION

In this paper the recognition and tracking system of moving objects developed in our laboratory is introduced and is explained briefly. The idea of the artificial neural network system is presented in order to recognize the pattern of the moving object. The method how to track an moving object is also shown. It is seen from the fundamental experiments performed that the system developed is able to track the moving object of slow speed quite satisfactory at this stage and works at a certain degree of satisfaction.

REFERENCES

[1] M. Sugisaka and H. Kaita, "PWM Control of Recognition and Tracking System for Moving objects," The 31th SICE Annual Conference, , Kumamoto, July 22-24, 1992.

[2] K. Tanikoshi, "DC Moter no Seigyokairosekkei," in Japanese, CQ Syuppansya, 1985.

[3] M. Sugisaka, Y. Kodama, S. Sagara, S. Ueno and H. H. Kagiwada, "Characters Recognition via Artificial Neural Network Systems," Proceedings of the International Conference on Fuzzy Logic and Neural Networks, pp. 311-314, Iizuka, Japan, July 20-24, 1990.

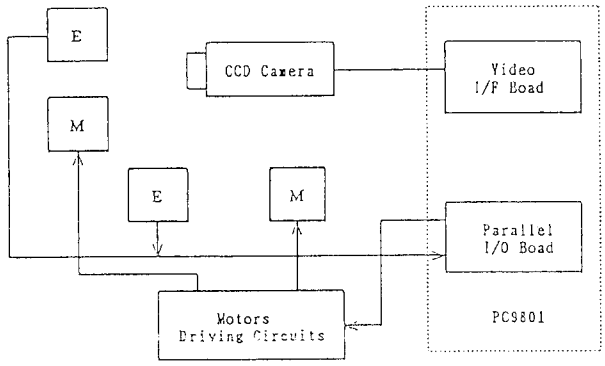

Fig.1 Configulation of Recognition and Tracking System of Moving Objects Developed

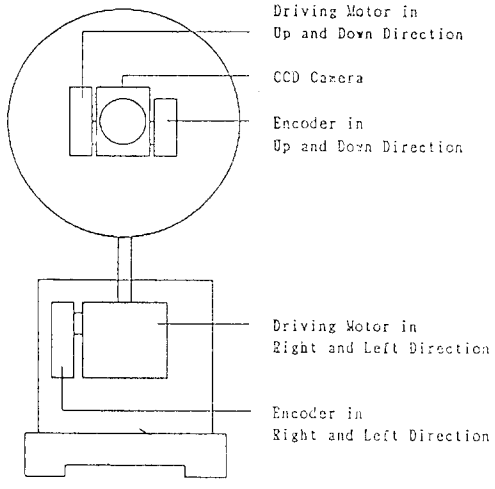

Fig.2 General View of the System