Development of the high-speed image recognition for an autonomous mobile robot.

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In Japan, the robot boom was arised by entertaiment robots such as AIBO, which spread through ordinary homes, in the end of 1990s, and it have been continuing now. The most of entertaiment robots for ordinary homes interact with a human through sound recognition or special remote controllar. A few entertaiment robots interact with a human through poor image recognition. but it is not satisfied. The development of image recognition for individual and gesture is attracting our attention as more natural interaction method with human. There are enough image recognition, which mounted in industrial robot, for individual and gesture. But it is very difficult to mount in ordinary home robots, because that needs special expensive hardware, and that's system is very complicated. By such reason, We request strongly that the structure of image recognition for a home robot turn out simple, and the image recognition, which using inexpensive image equipment, take enough high-speed processing.

This paper proposes a high-speed image recognition modules for face and hand recognition of an autonomous robot by using inexpensive image equipment. Target conditions of high-speed image recognition modules are, (I) processing speed is more than 20frames/s, (II) It is not dependent on a

background, (III) It is able to get coordinates of target in a picture, (IV) It take high rate of discernment.

I have chosen "Higher order local autocorrelation(HLAC) features of PARCOR images for gesture recognition"[kurita 1997] for method of this research as what fills target conditions mostly. They take three processes for gesture recognition. At first, make the PARCOR images from a sequence of images to extract domain of subject. Second, extract HLAC features from the PARCOR images, At last, discriminate HLAC features by linear discriminant analysis. The processing speed of this image recognition is about 30 frames/s, and the rate of discernment is around 100%. HLAC features are inherently shift-invariant and computationally inexpensive. This is why they take high-speed processing. If we employ this method of image recognition, we will need expensive image equipment to make the PARCOR images in the real-time. It is out of target conditions in this research. Then, I adopt human skin color domain extraction instead of the PARCOR images to extract domain of subject. It is possible to extract domain of human skin color by threshold method of YUV, YIQ color image format. I make the high-speed image recognition module, which consists of 3 processes as follow. (a) human skin color domain extraction, (b) HLAC features of subject domain, (c) linear discriminant analysis.

There were two experiments to the performance of image recognition module. The purpose of first experiment is to measure the rate of discernment by leave-one-out method from 1000 pictures. Sample pictures were taken at 6 places. The contents of sample pictures are 4 people and the hand of 3 form. As a result, by the use of Laplacian edge image to extract HLAC features, which rate of discernment was 93%.

The purpose of second experiment is to measure processing speed and the rate of discernment from 2 kinds of video images. The contents of these video image are as flow, (1) 3 people, who kept fixed distance from the camera, in other background, (2) 3 people, who moved the range of 1 to 3 meters from the camera. As results, the processing speed of image recognition modules is 16 frames/s. and the rate of discernment using (1) is about 88%, and using (2) is about 20 %.

From the results of experiments, the image recognition modules are effective in an autonomous mobile robot, which keep fixed distance from target.

Because this modules is filling target conditions of this research.

In this research, I developed an autonomous mobile robot with image recognition modules. This robot is able to recognize individuals, who keep fixed distance, by image recognition and make reaction for individual, who was recognized. In the future, this robot is applicated as Navigator, etc.

The method of human skin color domain extraction, which was devised in this research, offen makes noize at results, because that is created as having high-speed processing. This case reduces the rate of discernment in the background of the color similar to human's skin. As a future works, we will devise color domain extraction, which keeps high-speed processing and takes good accuracy more than this reaserch method.