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New People Counting System with Reflective Markers

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Abstract. People counting is a problem applicable to various area. We propose a method to perform people counting using calibrated stereo camera & produced reflective marker. The proposed method easily recognizes the markers in the indoor environment without complicate preprocessing because it employs the infrared camera. The proposed method has been currently developed only for the use of people counting, & is planned to be extended later into the area of distinguishing ID's of people.

Keyword; People counting; Reflective fabric marker; Stereo Vision

1. Introduction

The business of counting the number of people in fab or plant is very important. Normally, such operation involves counting & guessing of the number of people coming in & going out at the gate of the plant. Although manual operations are accurate, the costs are high, while the method using a machine employing shaft or fingerprint, card, & face recognition takes a long time making it inconvenient. On the other hand, the method using cameras operates without the passersby taking action as in the manual method, it has an aspect of being relatively inaccurate due to overlapping problem & noise problem [1]. Therefore, we propose a method of accurately picking out a person passing by in passive & yet accurate way using the reflective marker.

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2. Methods

The proposed method counts people more accurately by using stereo cameras & a reflective marker. For this purpose, the present system employs infrared stereo cameras & an infrared reflective camera. Figure 1 & Figure 2 shows the marker & the stereo camera in use, respectively, there the infrared reflective marker is attached to person's cloth or cap.

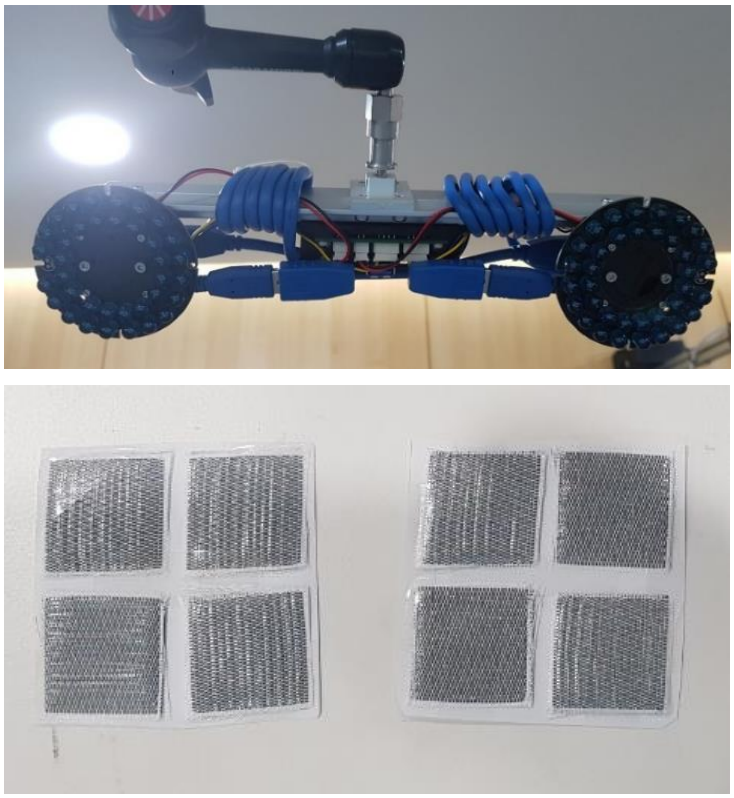

Fig. 1. Stereo camera used (left), Infrared reflective marker used(right)

The stereo camera consists of 2 units of calibrated cameras with the pose relationships between each camera. To outside of each camera, an infrared LED is attached to emit infrared rays. The irradiated infrared rays are reflected onto the marker to enter the camera sensor. To the front of the camera, an infrared filter is attached to shut off all lights other than that in infrared domain. Therefore, images entering the infrared stereo camera can easily distinguish the marker by simple thresholding operation.

And, 2D images obtained by the stereo camera can be reconfigured in 3D by using camera parameters calculated beforehand. Therefore, 3D position information of the marker can be found without separate image processing by using the proposed system.

3. Result

We have proposed a people counting system using a marker. The proposed method has been tested while 5 people are moving arbitrarily. Upon testing, 3D position information of the marker obtained from the camera for people counting was tracked after clustering [2]. Passing by the door of the people in the test was implemented to be a total of 87 times, with 2 times among them failing to be measured. Errors of each time involved the case where camera lighting was not sufficiently bright & the case where the marker broke away from camera's angle of view.

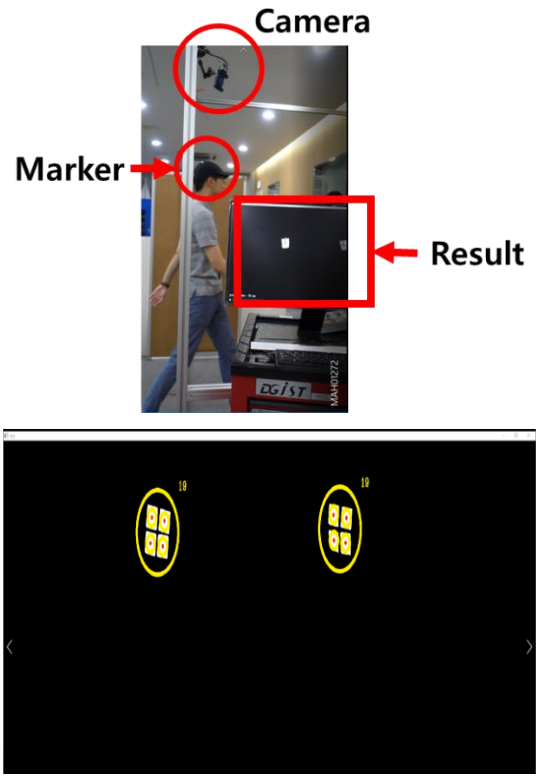

Fig. 2. Experimental environment(left), Imaging result of the proposed camera system(right)

4. Conclusions

The proposed method has wonderfully solved overlapping problems in 2D by using stereo cameras, & is relatively tough for using only lights of the particular wavelength band. However, a problem remains where much difference in reflection ratio of infrared rays occurs as a function of attached position of the marker. To solve such problem, a marker in the form capable of inferring ID's by reading only a part is planned to be developed in the future.

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