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Unsupervised Hand Detection in Class Room Using Combination of Skin Detection and Hough Transform

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Abstract

A large number of dataset can take a lot of effort in order to annotate the object that we observe, in this work is hand object. Therefore, we introduce an image processing method in order to perform unsupervised hand detection. The algorithm does not require any annotation data in order to do hand detection. Image processing step starts from skin detection in order to differentiate skin and non-skin region respectively. Subsequently, the border elimination was performed by specifying coordinates of each categories in dataset. Hand detection was performed by applying canny edge detector combined with hough transform in order to the hand coordinate. The proposed pipeline is validated by three categories of dataset. The result allows good accuracy rates of up to 97,677%.

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Keywords: Interactive Presentation; Skin Detection; Unsupervised Hand Detection; Class Room Multimedia Tool

1. Introduction

Bina Nusantara University implements an interaction between lecturers and students through the class presentation. Usually, during the presentation session, the lecturers or assistants require a wired mouse in order to control the slide. This process may interfere the interaction during the class due to the time required for the lecturer go back to the desk where the computer located. In addition to the presentation tool, some lecturers use wireless pointer that still require it to be carried.

The needs of the system that brings an improvement of the interaction that happened in the class, as well as applying an integrated system that is installed in the class are the objective of our activities. Sutoyo et al. [1] had implemented

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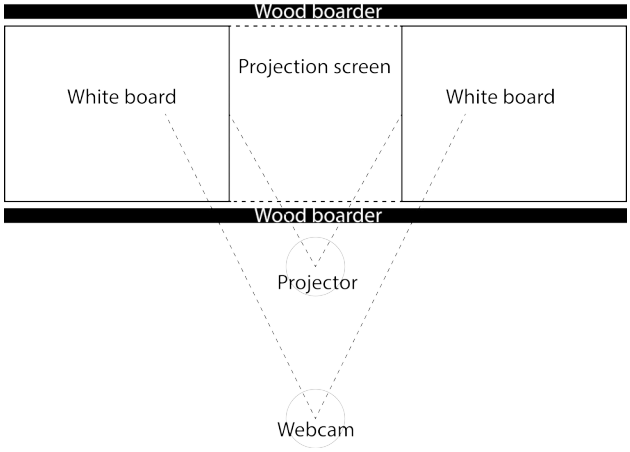
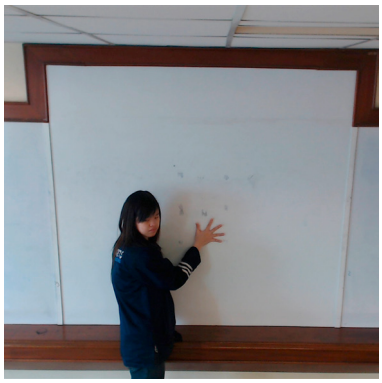
such system, however their proposed pipeline required a big annotation data that contains hand coordinates by manually segmenting them. In addition to that, the more annotated data given, the more reliable results produced. The disadvantage of their work [1] is consumes a lot of effort and time to annotate all the data. Hence, this work proposed an unsupervised hand detection in Binus classroom that does not require any annotation at all.



(a) Computer Vision system proposed in the class



(b) The image captured by proposed vision setup

Fig. 1: The vision system in the class room

2. Previous Works

Lee and Lee [2] presented a novel approach to recognize finger actions for electronic appliance interfaces. This method allows to detect and track fingertips with high performance and low-cost. In addition to that, the proposed method were robust to scale-invariant angle detection and recognize interface actions by contour analysis. In hand region detection part, they developed skin regions detection by subtracting background and redness of the skin. The input images were acquired from a web camera with a resolution of 320x240. The images used, showed a constant illumination through all the tested frame and the simple environment background was used in this work. Moreover, the collision model were implemented in order to sense the collision of virtual objects and the hand area.There were no details number of images/frames were used in order to evaluate their proposed methods, however the results showed a promising results around 98% in order to recognize fingertips.

Lee and Park [3] proposed a vision based remote control system by motion detection and open finger counting. A camera was mounted on the ceiling towards the user. An office environment were used as their environment setup. Lee and Park used his previous work [2] to implement skin detection. By using this pre-processing step, it could produce high recognition rate about 99% in finger counting recognition. The images used were acquired using LifeCam VX-600 web with resolution of 320x240 pixels. In addition to the experiments, there were no experiments conducted on illumination variance, only a constant illumination were tested in their dataset. However, the proposed method showed that it can work on a complex environment setup, in this case an office environment that contained a lot of objects in a frame.

Lee and Lee [4] developed motion-based first person by introducing interactive mode thorough face and hand movements. The author said that human faces and hands are easily distinguished by skin color. The method was to compute color difference in the red tone. The output produced a skin detection image using a defined threshold value. The images were produced using Microsoft LifeCam VX-1000. However, there were no details about how many images were evaluated using their proposed algorithms. The experiments conducted using two different illuminations