Hong Kong University of Science and Technology  Final Year Project (2006-2007)
Department of Electronic and Computer Engineering

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Visual Monitoring System
Introduction

**Background**
Engineering is the application of scientific and technical knowledge to solve human problems. We observed our daily lives to find out inconveniences and problems. For example, the tutor wants to write something on the PowerPoint or PDF document, he is forced to write slowly and carefully using the computer mouse. The tutor can write and draw on the screen directly, it will be more efficient.

**Abstract**
The project will use the CMOS camera to capture the motion and hand gesture in front of the projector screen and implement the computer control functions by developing a real time image processing program.

**Aims**
The main aim of the project is to design a visual monitor system, which uses a Webcam to capture the hand gestures and trace the hand movement, in order to perform the mouse functions by different gestures and update the pointer location.

**Methodology**

**Extraction of the Projected Screen Area**
This is the first stage of the system. At this stage, the projected screen area will be extracted from the image. The simplest method is that color format conversion, thresholding, dilation and erosion are done sequentially on the image.

**Producing Transformation**
Our objective in this part is mapping the projector screen image to the computer geometry. The transformation was used to update the computer mouse cursor after we obtain the coordinate of hand from the captured image.

**Body Extraction**
The body is extracted by background subtraction and then thresholding body image to white. Lastly, the background noise is removed in the image.

![Background(RGB)](image1)
![Input Image(RGB)](image2)
![Background(V layer of HSV)](image3)
![Input image(V layer of HSV)](image4)

![Subtracted image](image5)
![Threshold image](image6)
![Extracted body](image7)
Motion Detection
Motion Detection is the most important part in this project. The new hand coordinates in the next frame will be calculated by motion detection. The algorithm must be fast and accurate, as it is used to update the mouse cursor coordinates. Three-step searching was used here.

Mouse Location Update
After finding the position of hand, the mouse pointer was set to this position from pervious position for drawing a line. The assumption was both positions were very close because the intervals were very short. This step was repeated continuously. Lastly, the curves are formed.

Flow Chart
Results

Moving Right

The system was not very sensitive to the movement of hand because the mouse does not move with the hand all the time. Also, there were errors about the mouse movement although the mouse moved almost in the same direction of hand movement.

Conclusion

There are two main parts in this project, they are hand gesture recognition and motion detection. At the end of this project, we finished the second part: motion detection. When the coordinates of hand image is found, our program will trace the new coordinates of hand image in the subsequent frames. The hand coordinates were used to update the coordinates of the mouse cursor system. On this stage, human hand can be traced and used to perform some simple drawings on the computer screen.

Further Work

1. We need to improve the accuracy and speed of the program. If we want to do more controlling functions, Hand recognition must be done in the future.

2. Those fundamental requirements are prepared well in this project. Such as the body extraction and end point searching from skeleton image. It will be easier for us to develop the hand recognition base on these results.