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A PATH FOR HORIZING YOUR INNOVATIVE WORK

HAND GESTURE RECOGNITION SYSTEM USING IMAGE PROCESSING

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Abstract: Image processing has a very big potential to do virtually anything. But in real life, worse come to worst when the development of particular interest is not being done properly. The complexness and configurable in so many way of today's entertainment has brought us back to basic of safety. It is worthless to have complete system that can do almost anything but compromises human life. To cope up on par to today technological achievement, this project will try to bring sophisticated ways of using image processing as a solution to deliver command in the other way. The hardware is being interfaced by using Software Development Kit (SDK) from the supplier of the hardware, in this case. Proper data channeling between hardware and software ensure smooth transaction that increase performance and capability. The method of backlighting is used to give proper exposure to the subject so that the further processing and blob (binary large object) analysis can be done on it.

Keywords: About Four Key Words Or Phrases In Alphabetical Order, Separated By Commas.

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INTRODUCTION

Image processing is a branch of knowledge that tries to reach the same goal as human vision does. The process will not be the same but the objective is. The concept may or may not differ, depends on what sub task of the whole system is to be accomplished first. Machine look on something trough segregated details to do matching based on system's hardware capability. Human on the other hand, used as much information as possible and will decide at that instance, fulfilling directly to the objective of the vision task itself. That is why trying to have the same par with human capability especially from the recognition accuracy perspective is impossible with current technology advancement available.

Humans communicate mainly by vision and sound, therefore, a man-machine interface would be more intuitive if it made greater use of vision and audio recognition. Another advantage is that the user not only can communicate from a distance, but need have no physical contact with the computer. However, unlike audio commands, a visual system would be preferable in noisy environments or in situations where sound would cause a disturbance.

Many hand gesture recognition methods using visual analysis have been proposed: syntactical analysis, neural network based approaches, and the HMM-based recognition [3,4]. Since gesture consists of continuous motion in sequential time, an HMM must be an e!ective recognition tool.

In Real-time Vision based Hand Gesture recognition system**,** hand tracking and segmentation are most important and challenging steps towards gesture recognition. Uncontrolled environment, lighting condition, skin color detection, rapid hand motion and self-occlusions are the challenges need to be considered while capturing and tracking the hand gesture [6]. Various researchers are working on hand tracking and segmentation to make it robust to achieve natural interface with machine. Bao *et al.* [7] introduced a new robust algorithm called Tower method for hand tracking module where**,** skin color was considered for hand gesture tracking and recognition recognition strategy.

Direct Method Based Strategy.

Knowing that the hand is made up of bones of fixed width connected by joints which can only flex in certain directions and by limited angles it would be possible to calculate the silhouettes for a large number of hand gestures. Thus, it would be possible to take the silhouette information provided by the detection method and find the most likely gesture that corresponds to it by direct comparison. The advantages of this method are that it would require very little training and would be easy to extend to any number of gestures as required. However, the model for calculating the silhouette for any given gesture would be hard to

construct and in order to attain a high degree of accuracy it would be necessary to model the effect of all light sources in the room on the shadows cast on the hand by itself.

Learning Method.

With this method the gesture set to be recognised would be "taught" to the system beforehand. Any given gesture could then be compared with the stored gestures and a match score calculated. The highest scoring gesture could then be displayed if its score was greater than some match quality threshold. The advantage of this system is that no prior information is required about the lighting conditions or the geometry of the hand for the system to work, as this information would be encoded into the system during training. The system would be faster than the above method if the gesture set was kept small. The disadvantage with this system is that each gesture would need to be trained at least once and for any degree of accuracy, several times. The gesture set is also likely to be user specific. It was decided to proceed with the learning method for reasons of computation speed and ease of implementation.

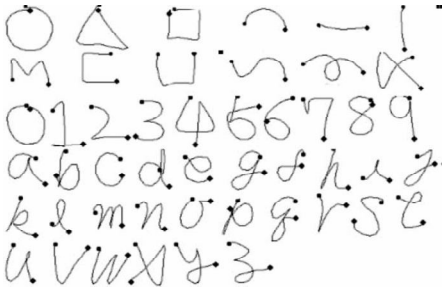

Fig.1 Gesture shapes used in the system

One type of gesture is the graphic gesture consisting of six drawing elements (circle, triangle, rectangle, arc, horizontal line, and vertical line), and six edit commands (move, copy, undo, swap, remove, and close). The other type consists of the 10 Arabic numerals from 0 to 9 and the 26 characters of alphabet. Fig. 1 shows the gesture shapes used in this system. preprocessing algorithm using image processing

A) Hand location algorithm using color analysis

Hand detection is the "frst step in visual image-based gesture recognition, and therefore directly in#uences the recognition rate. Our research exploits such a priori knowledge as skin-color, hand size, and positional information through the following steps:

Step 1: Color system conversion from RGB to YIQ.

Step 2: Estimation of similarity measures between model and input regions.

Step 3: Thresholding similarity measures.

Step 4. Noise removal and dilation.

Step 5: Detection of hand candidate regions.

Step 6: Selection of hand region

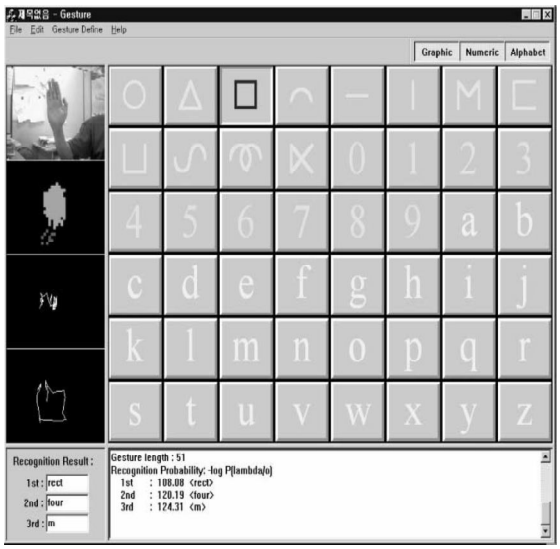

Fig. 2. Human computer interaction by hand gesture.

Color is one of the most distinctive clues in "nding objects and is generally input as RGB information via a CCD or a video camera. The RGB color system is known to be sensitive to lighting conditions and has a high computing cost, since the RGB system includes the mixed information of color and intensity. Therefore, the YIQ color system, which is known to be less sensitive to lighting than the RGB, is adopted. In YIQ, Y refers to intensity, while I and Q represent color information.

To reduce the e!ect of lighting and processing cost, only I and Q values are used to construct a skin-color model and to extract hand areas from input images by calculating the similarity between the model and the input image.

B) Spotting algorithm

The last preprocessing step is pure gesture detection. One gesture in our system is generated while the hand region is still on the screen. Therefore, the garbage movements that come

before and after a pure gesture are included in the input gesture. To remove these garbage gestures, we use a time-varying-based spotting algorithm.

This approach uses a spotting rule with user stops for a while (2 or 3 s) before the meaningful gesture starts and after it ends. Using this rule, the standstill area corresponds to the spotting area and the gesture between two spotting areas is pure gesture. In a gesture trace which consists of a sequence of (*x*, *y*) positions, the spotting area is detected by the state transition rules .

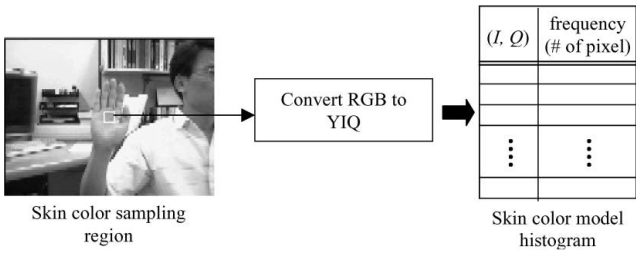

Fig. 3. Skin color model histogram on I-Q space.

SELECTION OF SENSORS

Since the hand is by nature a three dimensional object the first optical data collection method considered was a stereographic multiple camera system. Alternatively, using prior information about the anatomy of the hand it would be possible to garner the same gesture information using either a single camera or multiple two dimensional views provided by several cameras. These three options are considered below:

Stereographic system: The stereographic system would provide pixellated depth information for any point in the fields of view of the cameras. This would provide a great deal of information about the hand. Features that would otherwise be hard to distinguish using a 2D system, such as a finger against a background of skin, would be differentiable since the finger would be closer to camera than the background. However the 3D data would require a great deal of processor time to calculate and reliable real-time stereo algorithms are not easily obtained or implemented.

Multiple two dimensional view system: This system would provide less information than the stereographic system and if the number of cameras used was not great, would also use less processor time. With this system two or more 2D views of the same hand, provided by separate cameras, could be combined after gesture recognition. Although each view would suffer from

similar problems to that of the "finger" example above, the combined views of enough cameras would reveal sufficient data to approximate any gesture.

Single camera system: This system would provide considerably less information about the hand. Some features (such as the finger against a background of skin in the example above) would be very hard to distinguish since no depth information would be recoverable. Essentially only "silhouette" information (see Glossary) could be accurately extracted. The silhouette data would be relatively noise free (given a background sufficiently distinguishable from the hand) and would require considerably less processor time to compute than either multiple camera system. It is possible to detect a large subset of gestures using silhouette information alone and the single camera system is less noisy, expensive and processor hungry. Although the system exhibits more ambiguity than either of the other systems, this disadvantage is more than outweighed by the advantages mentioned above. Therefore, it was decided to use the single camera system.

Helpful Hints Choice of visual data format

Colour or black and white: The camera and video card available permitted the detection of colour information. Although using intensity alone (black and white) reduces the amount of data to analyse and therefore decreases processor load it also makes differentiating skin and markers from the background much harder (since black and white data exhibits less variation than colour data). Therefore it was decided to use colour differentiation.

RGB or HSL: The raw data provided by the video card was in the RGB (red, green, blue) format. However, since the detection system relies on changes in colour (or hue), it could be an advantage to use HSL (hue, saturation, luminosity- see Glossary) to permit the separation of the hue from luminosity (light level). To test this the maximum and minimum HSL pixel colour values of a small test area of skin were manually calculated. These HSL ranges were then used to detect skin pixels in a subsequent frame (detection was indicated by a change of pixel colour to white). The test was carried out three times using either hue, saturation or luminosity colour ranges to detect the skin pixels. Next, histograms were drawn of the number of skin pixels of each value of hue, saturation and luminosity within the test area.

Hand Segmentation.

The segmentation purpose color information was used**,** which is invariant to rotation and geometric variation of the hand [18]. Human perceives characteristics of color component such as brightness, saturation and hue component than the percentage of primary color red, green, and blue. Color models are useful for to specify a particular color in standard way. It is space-coordinated system within which any specified color represented by single point. Here**,** three

techniques were introduced using different color spaces for robust hand detection and segmentation**.** Hand tracking and segmentation (HTS) technique using HSV color space is identified for the preprocessing of HGR system.

Anticipated Static Gesture Set

Static gesture is a specific posture assigned with meaning. Following are the static gesture set specified for the proposed system with the specific meaning. Application interface will be provided after recognition of specified posture for action. Simplicity and user frendliness were taken into consideration for the design of anticipated posture set. For the mouse cursor movement the center of the hand gesture window was passed as a mouse cursor.



a) Open notepad b)Open Paint c)Log-Off

HSL Algorithm

i) Capture the Image

ii) Read the input image

iii) Convert RGB image into lab color space

iv) Convert the color values in I into color structure specified in cform

v) Compute the threshold value.

vi) Convert Intensity image into binary image

vii) Performing morphological operations such as erosion.

HTS Algorithm

i) Capture the image frames from camera.

ii) Process odd frames, tracked the hand using CamShift function by providing skin color samples at the run time.

iii) HSV histogram is created and the experimented threshold value is passed to the CamShift function for tracking required hand portion.

iv) Segment the required hand portion from Image

v) Find the edges by using Canny edge detection.

vi) Dilate the image

vii) Erode the image.

viii) Apply edge traversal algorithm to get final contour.

ix) Stop

CONCLUSION

We do not expect that the technology will directly replace the mouse, but it is likely that some part of the next-generation user interface will employ some form of hand gesture recognition using an image sensor.The final system developed recognised gestures using silhouette information alone. Although this was sufficient for the number of trained gestures, the accuracy would doubtless suffer if the number of gestures were increased. In order to remedy this, extra information about the test gesture would have to be gathered, such as edge information.

HTS algorithm was tested on four users for five gestures. Instances of three to five gestures on same users were tested. Algorithm was tested on green color glove and skin color on 70 samples. It was observed that using green color glove segmentation process is faster than using skin color due the varying lighting condition

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