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A Comparative Study on Hand Segmentation techniques using colour models

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Abstract— This paper incorporates the dynamic study and the analysis of numerous varying colour models used for hand segmentation and analyse the (HCI) interfacing techniques under different environment conditions on different backgrounds. Interfacing evolves as in a form of Man – Machine Interaction performing hand segmentation based on colour models. A comparative study to observe and analyse techniques for skin colour based segmentation are performed. Morphological processing is used as one of the key technique for eliminating the background noise. Fast algorithms and Canny Edge Detection techniques are used for vision based hand gesture recognition used in robotic control and in various applications.
Keywords— Hand Gesture, Man-Machine Interaction (MMI), Canny Edge Detection, Segmentation, Interfacing.

I. INTRODUCTION

Hand gesture recognition system forms an integral part of Human Computer Interface (HCI). Segmentation and Hand Tracking are the two primary steps towards the functionality and implementation of Hand Gesture Recognition system. A gesture is mainly perceived to be of two types , Static gesture which is also known as a posture and a dynamic gesture which requires processing of a spatial – temporal image sequence where the actual length of the sequence varies with each instantiation of the gesture. It encapsulates a wide variety of applications including real time vision based hand recognition.

Segmentation refers to the process of dividing the image into its constituent parts. Several colour models such as the YCbCr colour model , the HSV (Hue Saturation Value) model wherein it denotes the hue with its dominant colour of an image, the RGB (Red , Green , Blue) which is known for its simplicity and ease to use where each of the respective components are closely related etc. are used for the segmentation process. Colour models form an important part in the domain of Hand Gesture Recognition.

Various grey level segmentation techniques are used for object segmentation. Some of them are Adaptive thresholding, P-tile method, Edge Pixel method and the use of fuzzy logic is also used . The conventional methods used for hand segmentation generally used a hand glove in Hand Gesture Recognition (HGR). It uses a novel approach where they considered to have a colour based image segmentation using HSV (Hue Saturation Value) colour model which is capable of discriminating luminance from chrominance whereas the recent technology allows us to have a direct contact with the skin enabling to use human skin colour complexion. However the skin colour tone varies therefore the colour excerpt plays a vital role in it. The segmentation process extensively uses the colour information which perceives to be invariant to rotation and geometric variation.

II. SEGMENTATION

Segmentation procedures partition an image into its constituent parts or objects. It is known that autonomous segmentation is known to be the most strenuous task in digital image processing. There are several methods of segmentation based on detecting sharp , local changes in intensity. Several algorithms are used for the purpose. Hand Tracking and Segmentation (HTS) is one of the algorithm which is known to give better results on hand glove as compared to skin when segmentation is performed. Segmentation is a pre-processing operation which is used by a wide variety of applications. The selection of segmentation algorithm depends on the kind of application it assembles and is measured in terms of recall and precision coefficients or by calculating the false and correct detection rates. Skin colour based statistical model is explained.

The segmented regions must have two properties – Homogenity (Similarity) & Connectivity and adjacent regions must have different properties. The homogeneity property is satisfied when the pixels of the same region share the factors such as colour , intensity , shape , size etc. The problems encountered in hand skin segmentation are different light conditions , low video quality , complex background.

There are several types of segmentation techniques, some of them are as follows :

A. Region based

It involves region growing techniques, region splitting and region merging techniques.

B. Edge based

It involves making use of Prewitt filter, Canny edge Detector , Hough Transforms etc.

C. Pixel based

It uses classifiers such as piecewise linear classifiers , Gaussian classifiers ,Bayesian classifiers, histogram based thresholding etc. It is the simplest segmentation technique. The various segmentation methods are :

1) Intensity Method
2) Discontinuity Method
3) Similarity Method
4) Partial Differential Equation Method
5) Clustering Method.
6) Hybrid Method
7) Graph based Method
8) Compression based Method
9) Pixon –based Method.

D. OTSU Thresholding Theorem

The segmentation of the images is performed using Otsu thresholding algorithm. It works on the principle that it divides the image into two parts – one is the hand and the other part is the background. In this paper a morphological method is used to remove and eliminate the background as well as the object noise. It also uses a Canny Edge detection technique to find the boundary of the image. A contour tracking algorithm is also used to track the contour in clockwise direction. Segmentation is done to convert the grey scale image into a binary image so that we have only two objects i.e. one is hand and the other is background.
Morphological filtering technique is used to remove the noise from the image. Morphological filtering consists of four techniques

1) Dilation
2) Erosion
3) Opening
4) Closing.

A fast algorithm is developed to recognize the hand gestures automatically as in a form of given manual commands. This fast algorithm does not have any effect of translations , rotation and the scale of hand. A new advanced computer vision technique is used that does not requires markers for markings in the hand glove. A new method known as the curvature space method is used for gesture recognition which involves the determination of boundary contours of the hand. This approach is translation invariant. This technique emphasizes not only on skin colour but also on size of the image.

III. COLOR MODELS

Four commonly used colour models are:

A. RGB model
B. YCbCr model
C. CIE Lab model
D. HSV model

The RGB colour model is the most commonly used model which is an additive colour model where the red, green , blue colours are known as the primary colours and are added in different combinations to be used for various purposes. Another one such model which is known as the CIE Lab colour model which has three dimensions , the first dimension for representing the lightness and the other two axis i.e. the ‘a’ axis and the ‘b’ axis which are also known as the colour opponent axis. This colour model is a well-known model and encapsulates almost all colour that are perceivable. One of the special features of the CIE Lab colour model is that it consists the gamut (subset of colours) of both RGB colour model as well as the CMYK colour model. CMYK (Cyan Yellow Magenta) model is a

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subtractive model which is known to introduce three inks respectively and a key colour (Black). The model helps in masking colours on a lighter background or usually a white background on a partial basis or on an entirely basis.

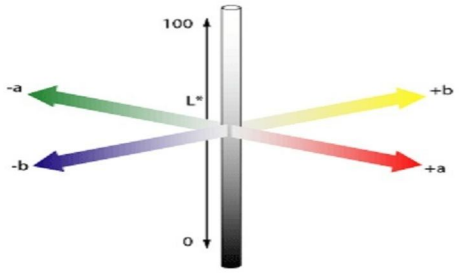

Figure 1 CIE Lab colour model

Other colour models such as the NTSC colour model are generally used for television systems. The Histogram based colour model represents number of pixels that have colours. A colour histogram focuses only on the proportion of the number of different types of colours. It helps to represent the statistical values of the colours and their respective essential tones of an image. The Hue Saturation Value (HSV) is also one such model which is closely related to the RGB (Red Green Blue) colour model.

The YCbCr colour model is another model which is used as a part of colour image pipeline and is widely used in digital video. It helps in understanding and distinguishing the luminance and the chrominance components. It provides a way of encoding the RGB information.

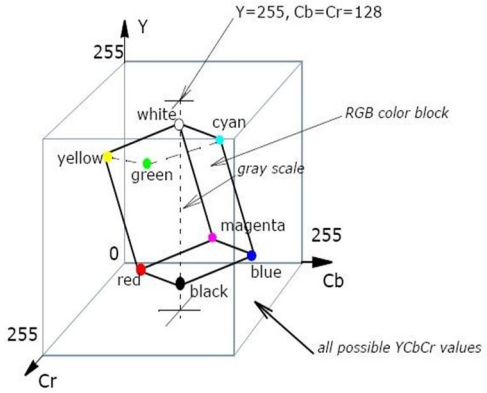

Figure 2. YCbCr colour model

In addition to all the above methods the Hybrid colour model is used combining different colour models for procuring better results. It replaces the conventional methods where hand gloves were used. The current techniques employ hybrid models and hybrid techniques where two or more colour models are integrated for prolific results under different environment conditions.

IV. CONCLUSION

It was observed that on testing the HTS algorithm on around 70 samples including hand glove and skin colour it was the hand glove which was known to give better and fast segmentation results as compared to skin colour segmentation due to different light conditions.

Canny Edge Detection technique is used to detect the edges of the hand and the segmentation technique was successful to partition the images. Morphological filtering operations were successful in reducing and eliminating the noise from the segmented image. The non-linear operators of morphological processing helps in setting the value pixels accordingly. Skeletonization helps to convert each and every component in a binary image to a single pixel wide skeleton.

One of the significant advantages of morphological filters is that it does not pose a problem of blurring the images during its image enhancement. Therefore the morphological filtering comes out to be an indispensable feature for hand segmentation. The Fast algorithm works well on images with complex background but not too well with too many pixels. The positions of the hand and the distance from the hand also do not pose a problem in this technique. The conventional methods of converting the RGB (Red Green

Blue) colour space into HSV (Hue Saturation Value) colour space is often time consuming which is why it was crucial to propose new models based on YUV and RGB colour spaces.

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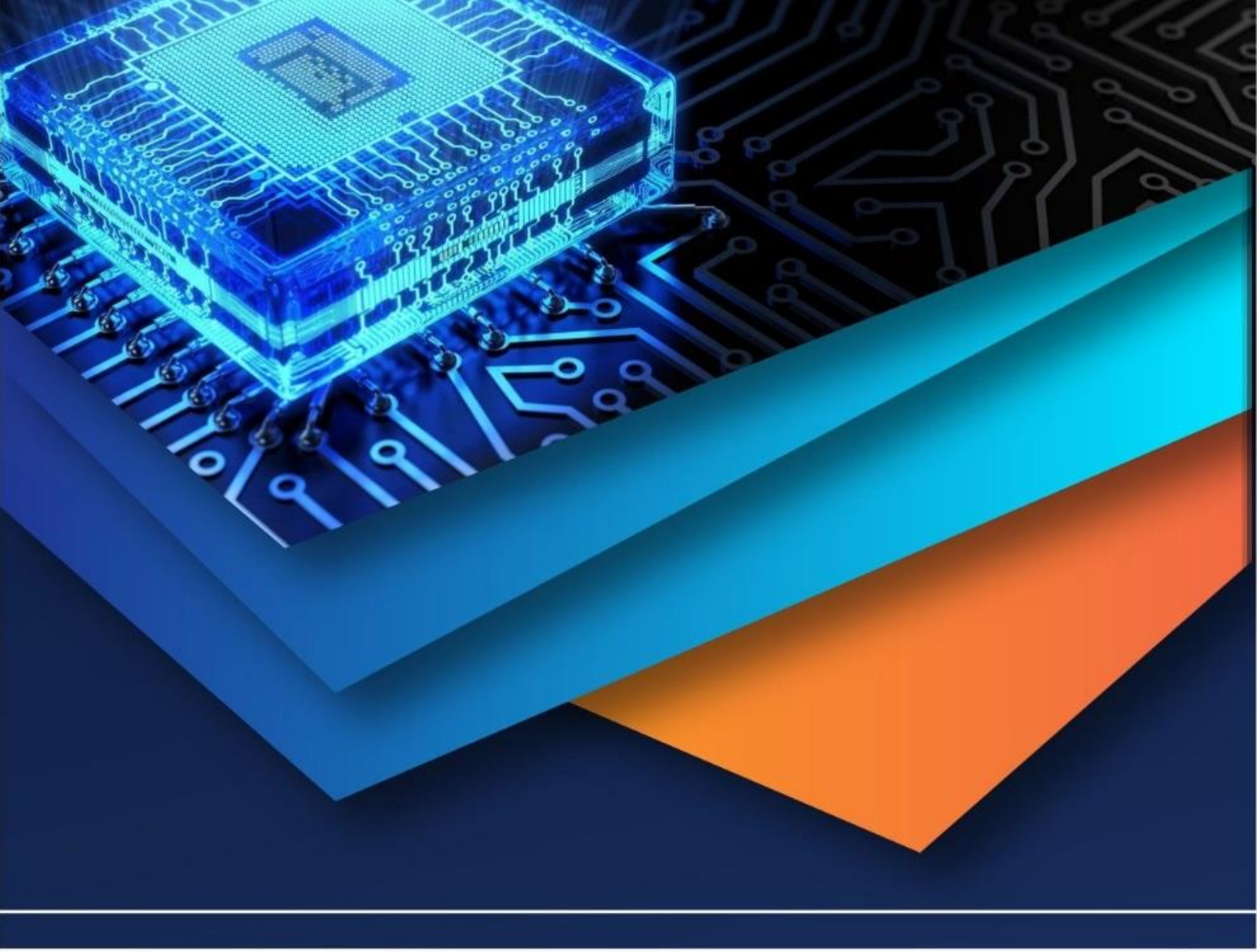

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