

Hand Gesture Recognition: Survey Study

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Abstract— From the traditional age, gesture was the primary mode of communication, when the evolution of human civilization they developed the verbal communication, however still non-verbal communication is equally important. Such non-verbal communication isn't solely used for physically challenged person however additionally it is expeditiously used for numerous applications like 3D gambling, aviation, surveying, etc. this can be the simplest technique to act with pc with none peripheral devices. Several Researchers are still developing sturdy and economical new hand gesture recognition techniques. The most important steps associated whereas coming up with the system are: information acquisition, segmentation and following, feature extraction and gesture recognition. There are totally different methodologies related to many sub-steps gift at every step. A numerous segmentation and following, feature extraction and recognition techniques are studied and analyzed. This paper reviews the comparative study of varied hand gesture recognition techniques that are bestowed up-till currently.

Keywords: Segmentation & Tracking, Feature Extraction, Hand Gesture Recognition

I. INTRODUCTION

Gesture recognition is that the method of distinguishing the gestures by the pc that is formed by the user. Human will management the machine by the hand gesture is outline in [1]. There are primarily 2 strategies of hand gesture recognition. One is static hand gesture and another is dynamic hand gesture. Static hand gesture technique might solely acknowledge the predefined gesture. Whereas within the dynamic hand gesture it couldn't be like that, it might clear the that means of gesture by its movement. Dynamic gesture is a lot of sensible as compared to static gesture, although it's a lot of difficulties. Researchers have developed the range of techniques that are, Vision-based, depth-based gloved-based. Author has projected the comparative study of gloved and blank check gesture [2]. Gloved-based hand recognition is simply too embarrassing whereas creating the interface, whereas the Vision-based could be a snug expertise however it works laborious in unhealthy conditions. however within the depth-based it's advantageous; it's the 3D data regarding the hand dimension [3]. thus it ends up in high process speed and accuracy, however depth camera supported numerous technologies like time of flight [TOF], 3D optical maser scanning is simply too a lot of overpriced thus its utility is restricted. Now, Designers have an interest in Microsoft Kinect 3D camera that is a smaller amount pricey.

II. ABOUT HAND GESTURE

Hand gesture is high sensible visual communication which might be initiated through the middle of palm, finger position and form. Gestures are includes of static and dynamic hand gestures. because the name, it's obvious, static suggests that

the stable form of hand, and dynamic gesture composed of series of hand movements. Gesture has the variety in hand movement in keeping with time and background; it varies from person to person. Hand gesture suggests that all the mix of gestures and movements that is created by the hand. the most distinction between posture and gesture is that posture has a lot of stress on the form of hand whereas gesture has more emphasis on the hand movement [6][7].

III. BASIC THEORETICAL CONSIDERATION

A generalized block diagram of gesture recognition system is shown in fig 1.

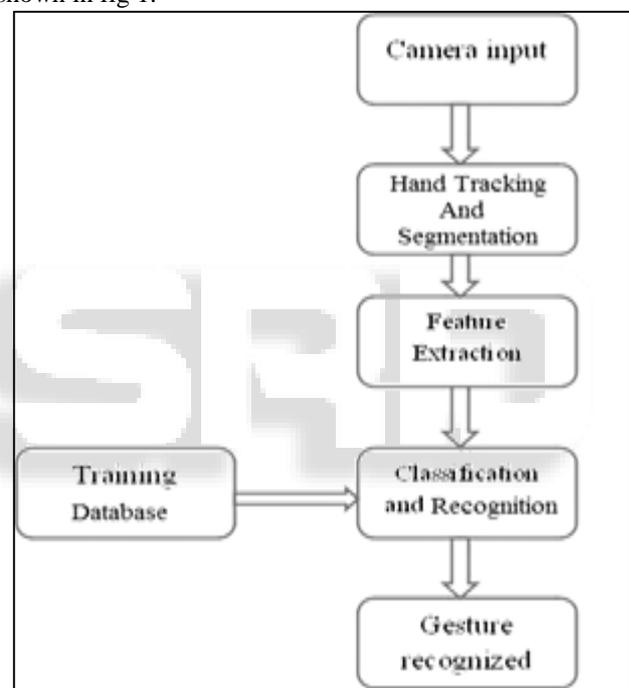


Fig. 1: Generalized Block Diagram

Image acquisition is that the primary step in gesture recognition system. a collection of image frames are captured by a less expensive camera. Segmentation of hand is that the needed to trace the movement of the hand. Segmentation partition the image into its objects and region of interest from the virtual surroundings. Autonomous segmentation is one to the foremost tough task in digital image process. Hand following could be a high resolution technique that's utilized to understand the consecutive position of hand. when the with following could be a high resolution technique that's utilized to understand the consecutive position of hand. when the with success hand following and segmentation is finished there's the requirement to extract the necessary feature points in this metameric image. when getting the extracted options of hand, classifier and recognizer plays a significant role in gesture recognition system. Classification and Recognition of the system wherever input options are compared with features of the trained information, which ends in gesture recognition.

IV. METHODS OF HAND GESTURE RECOGNITION SYSTEM

A. Pixel to Pixel Comparison:

This technique involves the pixel by pixel comparison of the frame captured and with the image information. This technique isn't thus correct however simple to implement. Pre-requisite to the comparison image ought to be mesmeric out from the virtual surroundings. this could be done by choosing the edge exploitation technique.[4]

B. Edges Method:

The target of this technique is to seek out the best gradient in a picture and this can be found by applying the edge within the gradients. Threshold can take away the low magnitude gradients. The magnitude of gradient is that the add of derivatives in x and y directions [4].

C. Using Orientation Histogram:

Orientation bar chart relies on the feature vectors, ends up in formation of bar chart supported the sides of image. initial the system is trained with the pictures. As pictures are captured by the digital camera because the input these images is regenerate to the gray scale and from this the bar chart is made that is employed as the coaching pattern. There forward the identical steps are followed for recognition i.e capture of image, conversion to gray scale and bar chart calculation. The advantage of this technique is that it's in no time, sturdy and translation invariant however the disadvantage relies on rotation. [4]

D. Thinning Method:

so as to seek out the bar chart of image the middle of image is taken because the reference. assumptive the window at the middle of the image, that is in RGB format has to be regenerate to YCbCr. there's a variety of Cb and chromium. If the constituent is within the nominal vary, then it ought to be regenerate to white constituent remainder of the pixel are turned to black. ends up in the output image as a grey scale image; next step is to convert this gray scale image to binary that is finished by choosing the edge exploitation the technique. so, the binary is then diluted [26]. whereas undergoing this procedure, noise and undesirable segments more to that. thus, those noise are ought to be removed.

V. HAND GESTURE TECHNOLOGIES

Gestures are most thought of because the most natural and overpriced manner of communications between pc and human in virtual surroundings and it's the sole a robust way of communication among humans. the most important constraint is interfacing of gesture movement with the pc. For initialing the system, start is to gather the gesture information so as to accomplish the particular application. For gesture recognition system and hand posture totally different technologies are discovered for deed the input file.

Vision based approaches: Recognition system only requires the camera to capture the image for natural interaction between human and computers. That is more useful in real time applications [23]. Although this technique is simple but there are lots of challenges while implementing such as complex background, lighting conditions and variations, and other skin color objects with the hand object.

Vision based technology deals with the characteristics of image such as texture and color that are required for the identification of gesture. There are many techniques evolved for detecting hand object after the image pre-processed image, these methods are divided into two parts.

A. Appearance Based Approaches:

During this approach, the visual look of the input hand image is shapely exploitation the feature extraction, that are then compared to the feature extracted of the keep image. This technique has the advantage of real time performance and easier as compared thereto of 3D model primarily based approach. the final technique of this approach is to find skin colored regions in a picture. Recently there's heap of analysis taken place that applies invariant options like Ada boost learning algorithmic rule. exploitation this invariant option that permits the identification of points and region on the hand, instead of modeling the entire hand. The positive purpose of this technique is it overcomes the matter of occlusion.

B. 3D Model-Based Approaches:

In this approach for modeling and analysis of hand shape the 3D model is used. While doing the 2D projection some data is lost, so intended a depth parameter is added in 3D model to make it more accurate [3]. 3D model is classified into volumetric and skeletal models. These two models have the constraints while designing. Volumetric model is used in real time application as it deals with the 3D model base appearance of human hand. The main constraint while designing this system is, it has the huge dimensionality parameters which cause the designer to work in 3 dimensional. Skeletal model overcome the volumetric model by limiting the parameters which are going to model the hand shape from 3D structure [5]. Sparse coding is a complex feature optimization which will provide the high efficiency for high dimension description. It is a new technique which has first-tier precision as compared to HOG-DTF and DSR descriptors

[8]. After the sparse signal compressive sensing is obtained. Compressive sensing is used to recover the sparse signal from few observations. Because of this the resource consumption is reduced [9].

C. Gloved based approaches:

Glove approach uses the sensors for capturing the hand position and motion. Detection of hand is done by the sensors on hand and the correct coordinates of location of palm and fingers is to be find out using the sensors on the gloves. This approach is cumbersome as the user need to be connected to the computer physically. Even though the sensors required for this interaction are expensive [2].

D. Marked Colored Glove Approach:

In this approach the glove which is to be worn by the human hand are made marked by the colors to direct the process of tracking the hand and locating the palm and fingers, which will provide the exact geometric features resulting in formation of hand shape.

VI. DIFFERENT HAND SEGMENTATION, FEATURE EXTRACTION AND RECOGNITION TECHNIQUES

Techniques/ Methods	Literature Availability	Remarks & Accuracy
HSI, YCbCr and morphological operations[10]	Different luminance conditions and complex backgrounds	Provides better performance, accuracy, compared to the HSI and YCbCr methods
Free Hand Tracking [2]	Complex background and other body parts	RGB to HSV, RGB to YCbCr. Parallel conversion
Gloved Hand Tracking[2]	Complex background and other body parts	RGB to HSV and the selecting the Hue.
Depth and RGB image alignment for segmentation using Kinect[11]	Simple and complex background.	Genetic algorithm to extract the key points with both depth and RGB.

Table1: Segmentation and Tracking Techniques:

Camshift algorithm for Tracking[32]	Simple background	Faster than mean shift algorithm
Tower method for tracking[12]	Simple background	2-5times faster than Camshift algorithm
Haar-like feature and adaptive skin color model for two hand segmentation[13]	Complex background	Accuracy:89% to 98% For limited hand movement
Industrial CT image segmentation algorithm [14]	Any type of background	Accuracy: 95% High precision can detect the fracture of industrial tools
Tracking by Viola jones method [15]	Simple background and different lighting conditions	Accurate and fast learning-based method for object detection
Color based segmentation using HSV, La*b* color spaces[16]	Simple as well as complex background	Camshift tracking using HSV gives better results.

TABLE 2: Feature Extraction Techniques

Techniques/ Methods	Literature Availability	Remarks & Accuracy
Distance and angle from the endpoint of hand[17]	Complex background	Accuracy:92.13% Gestures used:10
Angle, location, velocity and motion pattern P2DHMMs[18]	Complex background	Accuracy:98% Gesture used:36
Orientation Histogram[19]	Complex background	Accuracy:90% Gesture used:33
Finger tracking by laser tracking used HMM [20]	Complex background	Accuracy:95% Gesture used:5
Finger angle characteristics[21]	Static gesture	Accuracy:96.8% Gesture used:9
Curvelet	Different	Accuracy: upto

characteristics [22]	backgrounds	100%
Hu invariants & moments on the template matching[23]	Different backgrounds	Seven values of moments on the hand
K-Curvature algorithm[24]	Different background	Accuracy: 92%
HOG3D descriptor and a dense	Different background	Accuracy: 97%

Table 2: Feature Extraction Techniques

Techniques/ Methods	Learning theory	Remarks & Accuracy
MRS-CRF algorithm[27]	Probabilistic models	Accuracy:90.45% Efficient for dynamic hand gesture recognition system. Accurate as compared to CRF algorithm (85.3%)
Superpixel Earth movers distance (SP-EMD)[28]	Novel distance metric to overcome the partial matching problem	Accuracy:98.8% Distance measurement between two hand gestures based on shape and texture
Random Forest[29]	Machine learning model	Accuracy: 94.33% Decision making trees for training samples of the training sets
Fusing frame images[30]	Hierarchical identification model	Accuracy: 90% Rough hand gesture recognition
Non-linear SVM and Bag-of-features(BOF)[25]	Statistical learning theory	Accuracy:97% Does not need hand segmentation and tracking.
Support vector machine[7]	Statistical learning theory	Accuracy:99.2%
Self-organizing Maps[31]	Automatic learning theory	----
Hidden Markov model[20]	Machine learning	Accuracy:93.7%

Table 3: Recognition Techniques

VII. CONCLUSION

Hand gesture recognition system is applicable to the general person and physically challenged persons, 3D gaming, non-verbal communication between computer and human or between human to human. Because of increasing application of hand gesture recognition system, there is a need of research. A comparative study of various techniques used now a day is reviewed here. Generic important components and methodology used in hand gesture recognition system is described. Brief comparison of various techniques used for segmentation, tracking, feature extraction and gesture recognition is shown. High precision segmentation algorithms are required to be designed for hand gesture recognition system. However the rate

of recognition is trade-off with the time rate. Therefore the emphasis should be focused on to improve the time rate. Along with the gesture recognition the simultaneous process of speech recognition is also another area of research.

REFERENCES

- [1] Siddharth S. Rautaray and Anupam Agrawal: "Interaction with Virtual Game through Hand Gesture Recognition" International Conference on Multimedia, Signal Processing and Communication Technologies; IEEE 2011
- [2] Dharani Mazumdar, Anjan Kumar Talukdar, Kandarpa Kumar Sarma; "Gloved and Free Hand Tracking based Hand Gesture Recognition" ICETACS IEEE 2013
- [3] Sethu Janaki V M, Satish Babu, Sreekanth S S; "Real Time Recognition of 3D Gestures in Mobile Devices"; Recent Advances in Intelligent Computational Systems (RAICS); 2013 IEEE
- [4] Kamalpreet Sharma, Naresh Kumar Garg; "Hand Gestures Recognition For Deaf And Dumb" International Journal of Computer Application and Technology (s), May - 2014, pp. 10-13
- [5] Ra'eelah Mangera; "Static gesture recognition using features extracted from skeletal data"; IEEE 2013.
- [6] FANG Zhi-gang. "Computer Gesture Input And Its Application in Human Computer Interaction", Published by the small micro computer system, 1999.
- [7] S. Mitra, T. Acharya. "Gesture Recognition: A Survey", IEEE Transactions on Systems, Man, and Cybernetics, Part C: Applications and Reviews, pp. 311-324, 2007
- [8] S.M. Yoon, T. Schreck and G.J. Yoon; "Sparse coding based feature optimization for robust 3D object retrieval"; Electronics Letters, IEEE 2012.
- [9] Lei Zhang, Yanning Zhang, Wei Wei, Fei Li; "3D Total Variation Hyperspectral Compressive Sensing Using Unmixing"; Foundation for Fundamental Research; IEEE 2014.
- [10] Avinash Babu.D, Dipak Kumar Ghosh, Samit Ari; "Color Hand Gesture Segmentation for Images with Complex Background"; International Conference on Circuits, Power and Computing Technologies; IEEE 2013.
- [11] Zhaojie Ju, Yuehui Wang, Wei Zeng, Shengyong Chen , Honghai Liu; "Depth And RGB Image Alignment For Hand Gesture Segmentation Using Kinect"; International Conference on Machine Learning and Cybernetics, Tianjin; IEEE 2013.
- [12] Pham, Nguyen, TuKhoa, "A New Approach to Hand Tracking and Gesture Recognition by a New Feature Type and HMM", Sixth International Conference on Fuzzy Systems and Knowledge Discovery, IEEE Computer Society, 2009, pp. 3-6.
- [13] Chueh-Wei, Chun-Hao, "A Two-Hand Multi-Point Gesture Recognition System Based on Adaptive Skin Color Model", IEEE, 2011.
- [14] Xiaohong Hu; "Image Segmentation Algorithm for Fracture Tracking Trajectory in Industrial CT image management system"; International Conference on Measuring Technology and Mechatronics Automation; IEEE 2014.
- [15] L. Yun, Z. Peng, "An Automatic Hand Gesture Recognition System based on Viola-Jones Method and SVMs", International workshop on Computer Science and Engineering, IEEE Computer Society, 2009, pp. 72-76.
- [16] S. Ghotkar , G. K. Kharate, "Hand Segmentation Techniques to Hand Gesture Recognition for Natural Human Computer Interaction", International Journal of Human Computer Interaction (IJHCI), Computer Science Journal, Malaysia, Volume 3, no. 1, ISSN 2180 -1347, April 2012, pp. 15-25.
- [17] U. Rokade, D. Doye, M. Kokare, "Hand Gesture Recognition Using Object Based Key Frame Selection", International Conference on digital Image Processing, IEEE Computer Society, 2009, pp. 228-291.
- [18] N. D. Binh, E. Shuichi, T. Ejima, "Real time Hand Tracking and Gesture Recognition System", ICGST International Conference on Graphics, Vision and Image Processing, GVIP 05 Conference, Egypt, Dec- 2005, pp. 362-368.
- [19] T. Maung, "Real-Time Hand Tracking and Gesture Recognition System Using Neural Networks", PWASET, Volume 38, 2009, pp. 470-474.
- [20] Feng-Sheng Chen, Chih-Ming Fu, Chung-Lin Huang; "Hand gesture recognition using a real-time tracking method and hidden Markov models"; Image and Vision Computing; Science Direct 2003
- [21] Yu Bo, Chen Yong Qiang, Huang Ying Shu, Xia Chenji; "Static hand gesture recognition algorithm based on finger angle characteristics"; Proceedings of the 33rd Chinese Control Conference July 28-30, 2014, Nanjing, China
- [22] Palvi Singh, Dr. Munish Rattan; "Hand Gesture Recognition Using Statistical Analysis of Curvelet Coefficients"; International Conference on Machine Intelligence Research and Advancement, IEEE 2013
- [23] Liu Yun, Zhang Lifeng, Zhang Shujun; "A Hand Gesture Recognition Method Based on Multi-Feature Fusion and Template Matching"; International Workshop on Information and Electronics Engineering (IWIEE); Science Direct 2012.
- [24] Marek Vaneo, Ivan Minarik, Gregor Rozinaj; "Evaluation of Static Hand Gesture Algorithms"; International Conference on Systems, Signals and Image Processing; IWSSIP IEEE 2014.
- [25] Muhammad R. Abid, Philippe E. Meszaros, Ricardo F. d. Silva , Emil M. Petriu; "Dynamic Hand Gesture Recognition for Human Robot and Inter-Robot Communication"; IEEE 2014.
- [26] U. Rokade, D. Doye, M. Kokare, "Hand Gesture Recognition by thinning method" International Conference on digital Image Processing, IEEE Computer Society, 2009, pp. 284-287.
- [27] Liling Ma, Jing Zhang, Junzheng Wang ; "Modified CRF Algorithm for Dynamic Hand Gesture Recognition"; Proceedings of the 33rd Chinese Control Conference; IEEE 2014.
- [28] Wang and S. C. Chan; "A new hand gesture recognition algorithm based on joint color-depth Super-pixel Earth Mover's Distance"; International Workshop on Cognitive Information Processing; IEEE 2014.

- [29] Weihua Liu, Yangyu Fan, TaoLei, ZhongZhang; "Human Gesture Recognition Using Orientation Segmentation Feature on Random Forest"; IEEE 2014.
- [30] Tingfang Zhang, Zhiquan Feng; "Dynamic Gesture Recognition Based on Fusing Frame Images"; International Conference on Intelligent Systems Design and Engineering Applications; IEEE 2013.
- [31] Deepika Tewari, Sanjay Kumar Srivastava, "A Visual Recognition of Static Hand Gestures in Indian Sign Language based on Kohonen Self Organizing Map Algorithm", International Journal of Engineering and Advanced Technology (IJEAT), Vol.2, Dec 2012, pp. 165-170.
- [32] Rajat Shrivastava; "A Hidden Markov Model based Dynamic Hnad Gesture Recognition System using OpenCV"; International Advance Computing Conference (IACC); IEEE 2013.

