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Hand Gesture Recognition for Indian Sign Language

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Abstract- **In this paper, we introduce a hand gesture recognition system to recognize the alphabets of Indian Sign Language. In our proposed system there are 4 modules: real time hand tracking, hand segmentation, feature extraction and gesture recognition. Camshift method and Hue, Saturation, Intensity (HSV) color model are used for hand tracking and segmentation. For gesture recognition, Genetic Algorithm is used. We propose an easy-to-use and inexpensive approach to recognize single handed as well as double handed gestures accurately. This system can definitely help millions of deaf people to communicate with other normal people.**

Keywords- Indian Sign Language, Hand Tracking, Segmentation, Feature Extraction, Gesture Recognition, Single handed Gestures, Double handed Gestures.

I. INTRODUCTION

Sign language is the most natural and expressive way for the hearing impaired. The Indian Sign Language was proposed by Government of India so that there is a uniform sign language that can be used by all the deaf and dumb people in the country. Till now very little work has been done to develop software that translates this sign language into corresponding text and voice. Automatic sign language recognition offers enhancement of communication capabilities for the speech and hearing impaired. It promises improved social opportunities and integration in the society to these people.

The idea of our project is to design a gesture recognition system that will automatically capture, recognize and translate the alphabets of Indian Sign Language into corresponding text and voice in a vision based setup. In our project we propose to recognize single handed as well as double handed gestures accurately with a single normal webcam using bare human hands. The aim of our project is to recognize the gestures with highest accuracy and in least possible time. To recognize the gestures, our system consists of 4 modules: Hand Tracking and Segmentation, Feature Extraction, Gesture Recognition, Application Interface.

II. LITERATURE SURVEY

In general there are 3 main categories of object tracking-point tracking, kernel tracking and silhouette tracking. A comparative study of different object tracking methods has been listed in [2]. The various state of art tracking methods and techniques has been discussed in [1]. From this paper it is seen that Camshift method has real time performance and it can track accurately in presence of distracters and noise. Kalman filter method has error classification rate of 86% [2].Speeded-Up-Robust-Features (SURF) is able to detect rotating object but it fails to detect highly scaled object. KLT is only for affine motion but not suitable for translational, rotational nor scaling motion [1]. There are other methods of tracking like robust multi-cue hand tracking achieved by velocity weighted features and color cue implemented by Zhigeng[3]. Liu [4] uses Viola-Jones method for hand detection. In [5], Tower method and skin color are used for hand gesture recognition tracking and control. From this literature survey we found out that Camshift method is best suited for our System since it is inexpensive i.e. it can be used with the in-built web camera and gives good result in terms of speed and accuracy.

For image segmentation there are various methods like The Adaptive Color Image Segmentation System (ACIS) [6] uses HSV color model and neural network for segmentation. The given method does not require a prior knowledge of the image and its performance is efficient on noisy images. The Automatic Seeded Region Growing Algorithm (ASRGC) [7] uses YCbCr model for image segmentation along with the techniques of automatic seed selection, region growing corresponding to each pixel and merging of similar regions. YCbCr model has been used in [8] to design a self adaptive skin color model and a Gaussian model classifier using BP neural network. Different region based and object based segmentation approaches have been discussed in [9]. The HSV, color space describes color with intuitive values. The intuitiveness of the color space components and explicit discrimination between luminance and chrominance properties works effectively for skin color segmentation [10]. So we have chosen HSV color model for hand segmentation.

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After segmentation, we have to search the input image in a database. The image has to be described or represented by certain features. Shape is an important visual feature of an image. There are various methods used in Feature Extraction. [20] describes those methods: Contour shape techniques only exploit shape boundary information. Methods based on the Hausdorff distance are useful for locating objects in an image or sub-image matching. The retrieval performance of the Generic Fourier descriptor (GFD) demonstrates it is a desirable solution to generic shape representations. If storage is a concern, Fourier Descriptor (FD) can be considered.

There have been varied approaches of gesture recognition ranging from statistical modeling such as Principal component Analysis (PCA)which is used to extract the features from the hand gesture's images, Hidden Markov Model (HMM)[11][12]which is a double stochastic process governed by a Markov chain and is used to model wide range of data, to approaches based on soft computing tools such as Artificial Neural Networks(ANN) [13][14]useful for complex pattern recognition and classification tasks, Genetic Algorithms (GA)[15][16] is used for feature selection problem. Techniques like Support Vector Machines (SVM)[18] employed for classification, particle filtering and condensation algorithm, Finite State Machine(FSM)[19] have been used for Gesture Recognition system. Genetic algorithms [15][16][17] are a class of parallel adaptive search algorithms based on the mechanics of natural selection and natural genetic system. Over the last twenty years, it has been used to solve a wide range of search, optimization, and machine learning. GA has great advantages over other techniques like it is easy to understand, it supports multi-objective optimization, it is good for "noisy" environments. GA is inherently parallel and easily distributed.

III.PROPOSED SYSTEM

The Gesture Recognition System takes the input hand gestures through the in-built web camera. Hand tracking is done using Camshift method. Then the Segmentation of hands is carried out by using HSV color model. The segmented hand image is represented using certain features. These features are used for gesture recognition using the Genetic Algorithm which gives optimized results. The final result obtained is converted into corresponding text and voice.

Our system consists of 4 modules: Hand Tracking, Segmentation, Feature Extraction and Gesture Recognition.

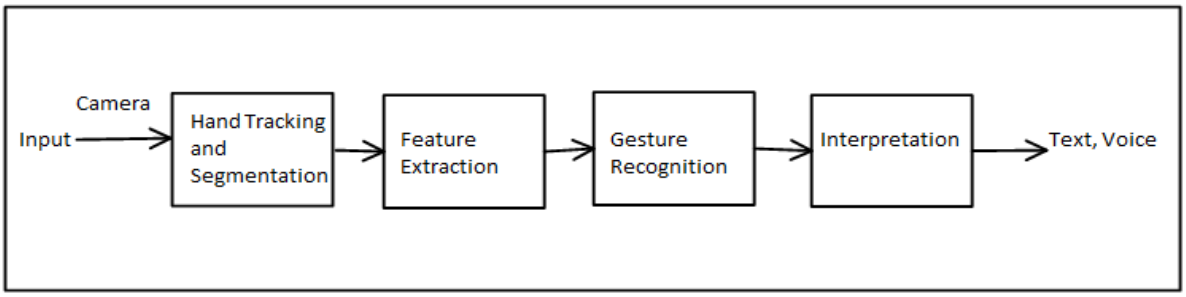

Figure 1.System Overview

A. Hand Tracking

For hand tracking from the captured image, we have chosen the general Camshift algorithm which is summarized in following steps:

1. Chose the initial region of interest which contain the hands we want to track
2. Make a color histogram of that region as the object model.
3. Make a probability distribution of frame using the color histogram.
4. Based on the probability distribution image find the center mass of the search window using mean-shift method.
5. Center the search window to the point taken from step 4 and iterate step 4 until convergence.
6. Process the next frame with the search window position from the step 5.

B. Segmentation

After tracking the hands, our next step is to segment the hands from the background. The HSV color model is used for this purpose.

C. Feature Extraction

In feature extraction several general purpose features are extracted and the relationship between features and classes is inferred by an appropriate classifier. These features have been selected from shape representation proposed in [20] and are listed below: Hausdoff Distance, Fourier Descriptor.

D. Gesture Recognition

After extracting features of the input character, we search its features into the database and consider the most similar features as the result.

Genetic Algorithm is a good option for managing the randomness of natural samples, and seems to be suitable for Hand gestures analysis. Genetic Algorithm [7][8] is summarized in following steps:-

1. Initialize: create an initial population.
2. Evaluate: calculate the fitness of each individuals in the population.
3. Choice parents: select individuals that have fitness between a given ranges from the population to be the parents.
4. Cross2x: perform 2-point crossover (2x) on the parents to create new individuals.
5. Mutation: it takes the new individuals created by cross2x procedure and randomly changes some genes from it.
6. Replacement: it takes five elements randomly from the population, choose worst one and then replace it with a new individuals.
7. Check stop: stop the system if best solution found.

III.MATHEMATICAL MODEL

The mathematical model of our system is:
Let G be a hand gesture recognition system that recognizes hand gesture; such that
G = {I, SG, DG, F, O | □s}
where
I is a set of input hand gestures;
I = {I1, I2…}
SG represents a set of single-handed gestures of manual alphabets;
SG ⊆ I
SG ={*C, I, J, L, O, U, V*};
DG represents a set of double-handed gestures of manual alphabets;
DG ⊆ I
DG ={*A,B,D,E,F,G,H,K,M,N,P,Q,R,S,T,W,X,Y,Z*};
F represents Feature Set ;
F = {*f1, f2…f26*}
O is a set of output alphabets in form of text;
O = {*A…Z* |□ }
Initialization: We initialize the feature set consisting of features of 26 alphabets.
F = {*f1, f2…f26*}
The output set is initialized to NULL.
O= { □□
The success state of the system is:
Ii=Fj where Ii € I
Fj € F where 1 <= j <=26
The failure state of the system is:
1. Ii≠Fj where Ii € I
Fj € F where 1 <= j <=26
2. Ii=Fj and Ii=Fk where Ii € I
Fj € F where 1 <= j <=26 and
Fk € F where 1 <= k <=26

Following functions can be mapped onto the elements of the set:
1. Let *fe* be a rule of I to O such that for given input; it returns output text.
fe(I) |□O.
For example,
fe(I*0*) |□{B} □O.

IV. CONCLUSION

In this paper a real time hand gesture recognition system is proposed by means of Camshift method, HSV color model and Genetic algorithm. The proposed gesture recognition system can handle different types of hand gestures in a common vision based platform. The system is suitable for both single handed and double handed gestures.

The system makes use of bare hands for interacting with the computer and is inexpensive, therefore facilitating the deaf-dumb people to use it. The proposed system is effective in recognizing the alphabets of Indian Sign Language. This system can definitely help millions of deaf people to communicate with other normal people.

V. FUTURE WORK

In our work, we showed that our proposed gesture recognition system can recognize only the alphabets of Indian Sign Language. The future work includes recognizing different other gestures in Indian Sign Language.

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REFERENCES

[1]. Alper Yilmaz, Omar Javed, Mubarak Shah, "Object Tracking: A Survey", ACM Computing Surveys, Vol. 38, No. 4, Article 13, December 2006.
[2]. Fariborz Mahmoudi, Mehdi Parviz, "Visual Hand Tracking Algorithms," Proceedings of the Geometric Modeling and Imaging – New Trends (GMAI'06), 2006.
[3]. Zhigeng Pan, Yang Li, Mingmin Zhang, Chao Sun, Kangde Guo, Xing Tang, Steven Zhiying Zhou, "A Real-time Multi-cue Hand Tracking Algorithm Based on Computer Vision," IEEE Virtual Reality 2010, 20-24 March, Waltham, Massachusetts, USA.
[4]. Liu Yun, Zhang Peng, "An Automatic Hand Gesture Recognition System Based on Viola-Jones Method and SVMs". 2009 Second International Workshop on Computer Science and Engineering.
[5]. Pham The Bao, Nguyen Thanh Binh, "A New Approach To Hand Tracking and Gesture Recognition by a new feature type and HMM", 2009 Sixth International Conference on Fuzzy Systems and Knowledge Discovery.

[6]. Deshmukh K.S., Shinde G. N, "An Adaptive Color Image Segmentation", Electronic Letters on Computer Vision and Image Analysis 5(4):12-23, 2005.

[7]. Frank Y. Shih, Shouxian Cheng, "Automatic seeded region growing for color image segmentation", Image and Vision Computing 23(2005) 877-886.

[8]. Guoliang Yang, Huan Li, Li Zhang and Yue Cao,"Research On a Skin Color Detection Algorithm Based on Self-adaptive Skin Color Model", 2010 International Conference On Communications And Intelligence Information Security.

[9]. Noel O'Connor, Sorin Sav, Tomasz Adamek, Vasileios Mezaris, Ioannis Kompatsiaris,

[10]. Tsz Ying Lui, Ebroul Izquierdo, Christian Ferran Bennström, Josep R Casas," Region and Object Segmentation Algorithms in the Qimera Segmentation Platform".

[11]. Ryzard S. Choras, "Hand Shape and Hand Gesture Recognition", 2009 IEEE Symposium on Industrial Electronics and Applications (ISIEA 2009), October 4-6, 2009.

[12]. Nguyen Dang Binh, Toshiaki Ejima, "Real-Time Hand Gesture Recognition using Pseudo 3-D Hidden Markov Model", Proc. 5th IEEE Int. Conf. on Cognitive Informatics (ICCI'06), 2006.

[13]. Assoc Prof Abd Manan Ahmad, Dr Abdullah Bade, et al. "Using Principal Component Analysis And Hidden Markov Model For Hand Recognition Systems", 2009 International Conference on Information and Multimedia Technology.

[14]. Stefan Oniga, Alin Tisan, Daniel Mic, Attila Buchman and Andrei Vida-Ratiu, "Hand Postures Recognition System Using Artificial Neural Networks Implemented in FPGA", 30th ISSE 2007.

[15]. Md. Rezwanul Ahsan, Muhammad Ibn Ibrahimy, Othman O. Khalifa, "Electromygraphy (EMG) Signal based Hand Gesture Recognition using Artificial Neural Network (ANN)", 2011 4th International Conference on Mechatronics (ICOM), 17-19 May 2011.

[16]. Ho-Duck Kim, Chang-Hyun Park, Hyun-Chang Yang, and Kwee-Bo Sim," Genetic Algorithm Based Feature Selection Method Development for Pattern Recognition", SICE-ICASE International Joint Conference 2006 Oct. 18-2 1, 2006.

[17]. Angel Dacal-Nieto1,2, Esteban Vázquez-Fernández1,3, Arno Formella2, Fernando Martin3, Soledad Torres-Guijarro1, Higinio González-Jorge1,"A genetic algorithm approach for feature selection in potatoes classification by computer vision", 2009 IEEE.

[18]. Majida Ali Abed , Ahmad Nasser Ismail and Zubadi Matiz Hazi," Pattern recognition Using Genetic Algorithm", International Journal of Computer and Electrical Engineering, Vol. 2, No. 3, June, 2010

[19]. Yu Yuan and Kenneth Barner, "Hybrid Feature Selection for Gesture Recognition using Support Vector Machines", ICASSP 2008.

[20]. Sushmita Mitra and Tinku Acharya, "Gesture Recognition: A Survey", IEEE Transactions on Systems, MAN, and Cybernetics—Part C: Applications and Reviews, Vol. 37, No. 3, May 2007.

[21]. Dengsheng Zhang, Guojun Lu,"Review of shape representation and description techniques" 2003 Pattern Recognition Society. Pattern Recognition 37 (2004) 1 – 19.