Real Time Finger Recognition Based Announcement System

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Abstract – Our essential aim of developing finger recognition based announcement system is to create a natural interaction between human and computer where the recognized gestures can be used for conveying desired information. In our country around 2.94% of peoples are not able to speak (dumb) and old aged or disabled persons who can‘t speak or walk are properly most sensitive persons and they must be served in a systematic, quick, sophisticated and efficient manner by very little effort. The problem is that there is no anybody who is always with them for 24 hours daily routine life. This project can be used to serve these peoples and to provide a full control to them so that they may announce & perform any task with related to them. In this paper, we propose a new real time finger recognition method which will be very helpful to them for conveying their messages. We have developed a low-cost, reliable, efficient and secure finger operated announcement system especially for those persons with disabilities to do their work.

Index Terms – Real time voice announcement system, Human-Computer Interaction, Hand Gesture Recognition, Finger recognition, Disabled People, Speaker, MATLAB software, Webcam, Artificial intelligence application.

1. INTRODUCTION

Hand gesture recognition has always been a topic of discussion due to its wide applications based on artificial intelligence. Human hand and finger detection is an important role in human-computer interface. By using finger recognition we can use this system in Hospitals, Colleges etc. for voice announcement system. There are many related works of fingertip interaction with large screen display which utilize free hand/finger tracking in real time applications. We describe barehanded interaction between human and large screen display for Hand and Finger Detection. Barehanded means that no need to use many staffs.

User itself can control announcement of specified tasks. We found important applications for fingertip interaction with large screen display detection.

Hand gesture recognition is one of the important problems in vision-related fields such as human-machine interaction, communication, and robotic. There are two gesture types including static and dynamic ones. The application of each gesture type depends on the system objective and gesture definition. Static hand gestures are usually identified based on the hand appearance, e.g. contour and shape, while gestures of the other type are mostly recognized according to the change of hand pose and motion trajectory. In this paper, we focus on some recent methods that recognize static hand gestures. This paper presents a novel technique for hand gesture recognition through human–computer interaction based on shape analysis.

The goal of static hand gesture recognition is to classify the given hand gesture data represented by some features into some predefined finite number of gesture classes. The proposed system presents a recognition algorithm to recognize a set of six specific static hand gestures, namely: Open, Close, Cut, Paste, Maximize, and Minimize.

The hand gesture image is passed through three stages, preprocessing, feature extraction, and classification. In preprocessing stage some operations are applied to extract the hand gesture from its background and prepare the hand gesture image for the feature extraction stage. In the first method, the hand contour is used as a feature which treats scaling and translation of problems (in some cases). The complex moment algorithm is, however, used to describe the hand gesture and treat the rotation problem in addition to the scaling and translation.

The algorithm used in a multi-layer neural network classifier which uses back-propagation learning algorithm. The results show that the first method has a performance of 70.68% recognition, while the second method, proposed in this article, has a better performance of 85.28% recognition rate.

The process of hand gesture recognition composes mainly of four stages:

i. Hand gesture images collection

ii. Gesture image preprocessing using some techniques including edge-detection, filtering and normalization

iii. Capture the main characteristics of the gesture images using feature extraction algorithms, and

iv. The evaluation stage where the image is classified to its corresponding gesture class.

2. RELATED WORK

Recently, use of human movements, especially hand gesture, has become an important part of Human Computer Intelligent Interaction (HCII), which serves as a motivating force for research in modelling, analyzing and recognizing the hand

gestures. Many of the researchers have tried to use this HCI for different applications. Their work and approach can be summarized as below:-

i. Nitin J. Janwe,Kishor K. Bhoyar, "Video Key-Frame Extraction using Unsupervised Clustering and Mutual Comparison"- In this paper the authors describe key frame extraction technique based on intuition thathigher the motion more the key frames required for summarization.

ii. Mandeep Kaur Ahuja, Dr. Amardeep Singh," A Survey of Hand Gesture Recognition", International Journal of Advance Research in Computer Science and Management Studies, Volume 3, Issue 5, May 2015- Introduction of hand gesture recognition technique which utilizes an FPGA based smart camera for gesture analysis.

iii. Xing-fang, Huang, & Jiang-she Zhang, "Edge-Preserving Filtering for Grey and Color Image", In Proc. of the IEEE/Computer Science and Information Engineering - The detail study on the local adaptive noise reduction operator based on a location shifting procedure is done.

iv. Yunyu Shi, Haisheng Yang, Ming Gong, Xiang Liu, and Yongxiang Xia,"A Fast and Robust Key Frame Extraction Method for Video Copyright Protection", Journal of Electrical and Computer Engineering Volume 2017 (2017) A sequential search algorithm that bypasses the process of temporal video segmentation is proposed for key frame extraction in MPEG videos.

3. PROPOSED MODELLING

By using finger we can use this application in Hospital, College etc. For voice announcement system. there are many related works of fingertip interaction with large screen display which utilize free hand/finger tracking: interface in VR environment. We describe barehanded interaction between human and large screen display for Hand and Finger Detection. Barehanded means that no need to many staff. User self-controls the speaker directly with the announcement of his/her hand. We identify essential services for fingertip interaction with large screen display detection, identification. There are basically two type of approaches to hand gesture recognition, Vision based and Non-Vision based approaches. The project work focuses on Vision based approach as it lies in an affordable range and is a non-tedious approach as compared to Non-Vision based approach. The Vision based approach uses camera as an input device, thus facilitating a natural interaction between users and computers. A video containing static hand gesture will be converted into frame and further steps will be applied to process it.

The aim of this project is to recognize static hand gestures. Due to strict time allocation and lack of knowledge on high level programming language, it was necessary to limit the scope of the project. Therefore, the scope of this project involves converting captured image via a vision based sensor (web-cam) and apply image processing techniques to analyze the image representing the hand gesture as well as converting a video of static hand gestures into frame and then selecting key frames based on skin color detection and then processing on the hand gesture to extract the feature representing number.

3.1. Static Hand Gesture Recognition

There are two basic approaches in static gesture recognition:

a) The top-down approach, where a previously created model of collected information about hand configurations is rendered to some feature in the image co-ordinates. Comparing the likelihood of the rendered image with the real gesture image is then used to decide whether the gesture of the real image corresponds to the rendered one.

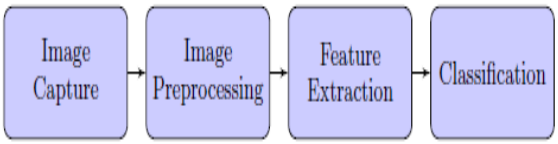

Figure 1- Schematic view of gesture recognition process

b) The bottom-up approach, which extracts features from an input image and uses them to query images from a database, where the result is based on a similarity measurement of the database image features and the input features.

The disadvantage of the first approach is that it seems to use a high computational effort in order to achieve robust recognition. The second approach however requires an adequate preprocessing in order to achieve a reliable segmentation. This report mainly keeps the focus on the latter approach since this seems to be the commonly used one. The whole process of static gesture recognition can be coarsely divided into four phases, as shown in Figure 1. Each phase performs a specific task, whose result is passed to the next phase. The commonly used techniques for each phase are described in the following subsections:-

i. Image capturing

The task of this phase is to aquire an image, or a sequence of images (video), which is then processed in the next phases. The capturing is mostly done using a single camera with a frontal view of the persons hand, which performs the gestures. However, there also exist systems that use two or more cameras in order to aquire more informations about the hand posture. The advantage of such a system is that it allows a recognition

of the gesture, even if the hand is occluded for example by the body of the person that per- forms the gesture, since the other camera captures the scene from another perspective.

ii) Image Preprocessing

The basic aim of this phase is to optimally prepare the image obtained from the previous phase in order to extract the features in the next phase. How an optimal result looks like depends mainly on the next step, since some approaches only need an approximate bounding box of the hand, whereas others need a properly segmented hand region in order to get the hand silhouette

The most commonly used technic to determine the regions of interest is skin color detection [7, 2, 8]. A previously created probabilistic model of skin-color is used to calculate the probability of each pixel to represent some skin. Thresholding then leads to the coarse regions of interest. Some further analysis could for example involve the size or perimeter of the located regions in order to exclude regions such as the face. Yet another interesting approach is to use a previously acquired image of the background, subtracting it from the image with the gesture, as proposed in [5]. Based on perimeter lengths, the hand region can then be extracted.

iii) Feature extraction

The aim of this phase is to find and extract features that can be used to determine the meaning of a given gesture. This is a simple approach which relies on the outline of a given hand region. Given a hand region the outline is extracted using for example some edge tracking algorithm. The local features are then represented by the local extrema of the outline, whereas there are two different kind of extrema: The peaks and the valleys. The peaks are usually found at the finger tips, whereas the valleys are rather found in the regions where two fingers join the palm of the hand. One advantage of such features is the quick exclusion of inappropriate gestures, using the number of peaks and valleys as indicators.

Zernike moments. Zernike moments (ZM) and pseudo Zernike moments (PZM) are in general used to describe shapes, whereas ZMs are usually better for describing shapes than PZMs. On the other hand, PZMs are known to be less affected by noise. In order to use ZMs for hand features description, the hand is represented as a set of ZMs rather than using a single ZM. In [3], they proposed to first separate the hand into two sub-regions, where one region contains the finger part, and the other consists of the palm. The ZMs and PZMs are then calculated for each finger and for the palm, using the center of the minimum bounding circle of the hand silhouette, which has the advantage of translation invariance, making this feature more reliable.

Another important technique, that is presented in [3], uses a different weight for the palm and the finger features. Since most gestures depend more on the actual positions of the fingers and less on the palm position, the weight for the fingers should be bigger than weight for the palm region. Empirical tests lead to a weight of 0.7 for the finger features and 0.3 for the palm feature, for which the best results were obtained. Local Orientation Histogram. In [8], the utilization of so called Local Orientation Histogram features is proposed.

3.2 System Specifications

Some of the system requirements include both software and hardware.

i) Hardware Requirements

System Requirement : Intel Core i5 2.60 GHz

Installed Memory (RAM) : 4GB

Mouse : Logitech

Webcam : HD Webcam

ii) Software Requirements

Operating System: Windows XP/7

Coding Language: MATLAB

3.3 Problem Analysis

By analyzing the problem we observe that the main task is to find the feature points and the frames.The main issue is to select proper image format for recognition of features from a set of recorded frames and proper video format for triggering frame for identification purpose such that processing is efficient and fast enough.

- To identify the hand gesture irrespective of background and proper lighting condition is the main issue to be dealt with.
- The next task is to track the gesture for feature identification purpose from the manually triggered frame.
- The videos are taken from a low quality capture device, which consists of heavy noise due to low price image sensor. The next issue is to reduce the noise from the image such that minimum data loss can be achieved.
- When we have segmented the image consisting of human hands only, the next issue is to find the useful feature points from the image.
- Finally, the last task is to pass a set of frame database from all the basic stages of image processing.

4. DESIGN STRATEGY

In figure 1, frames will be created after selecting an existing video of type .avi file. The video folder needs to be of the required format .avi only and if some other formats exists then

it will display folder doesn't exists. If camera is not initialized or is not able to capture a video the user will be required to restart the program. Then the extracted frames from the video will be stored in a folder in the extension .png.

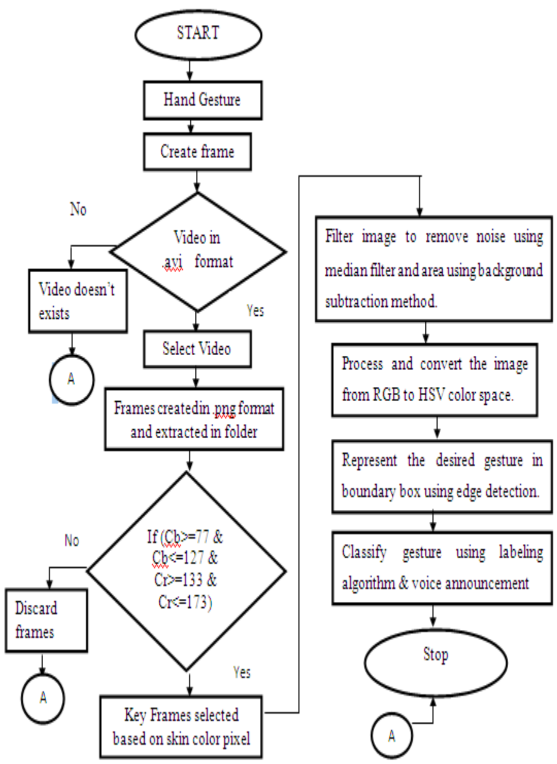

Figure 2- Flowchart for the proposed system

From the extracted frames, the key frames will be extracted based on the range of skin color pixel as discussed in fig 1. Once the key frames are extracted from a sequential shots of scenes it becomes easier to process the image and represent the area of the respected static hand gesture.

5. RESULTS AND DISCUSSIONS

We performed various tests to match our desired outcome with the actual outcome. The tests we did contains following steps such as :

i. Extract Frame

ii. Camera initialization

iii. Conversion of image from RGB to Gray.

iv. Filtering the noise in the image

v. Removing the background of the image and keeping only the image which is desired

vi. Skin detection from the remaining image.

vii. Finally, finger detection process.

Test	Description	Desired and Actual Outcome
1.	Extract Frames	Extracted frames from a video in a folder and chosen key frames from those frames based on skin color detection condition
2.	Initialize Camera	Displayed user original image in new window
3.	Image Conversion	Displayed HSV image in new window
4.	Filtering	Smooth out image
5.	Background Subtraction	Unwanted areas are subtracted based on simple morphology
6.	Skin detection	Displayed skin regions as white with background removed
7.	Finger detection	Red outline drawn along outline of the skin region detected
8.	Exit	Exists when ESC button is clicked by user

Table 1- Results obtained

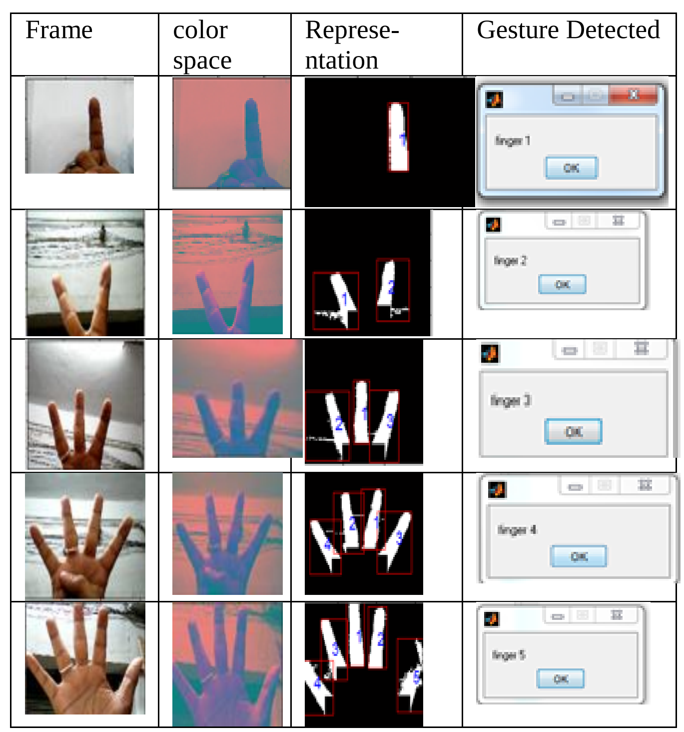

Figure 3-Table representing gestures

6. CONCLUSION

A static hand gesture recognition system was successfully implemented. In this project we explored the area of hand-gesture recognition for applications in human-computer interaction interface. After the completion of this project work it can be concluded that a few set of static gestures images can successfully undergo certain steps of preprocessing to display the number of fingers in the gesture. In real time static gesture recognition the two algorithms mainly Median Filter Algorithm and Contour Detection Algorithm was used for feature Extraction. Altogether the vision based method combines fast hand tracking, hand segmentation, region extraction and feature extraction to develop an accurate and robust hand gesture recognition method.

7. FUTURE SCOPE

This is an effective hand gesture recognition system to address the problem of extracting frames from a video and processing it. In the future scope, various hand gestures can be recognized and applied as input to the computer. The hand gestures representing numbers can also be converted into commands to perform related tasks in real time. Enhancing the recognition capability for various lightning conditions, which is encountered as a challenge in this project can be worked upon in future.

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