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HAND GESTURE RECOGNITION SYSTEM FOR BETTER HUMAN COMPUTER INTERACTION

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ABSTRACT

The recent progress on human- computer interface technology has enabled more intuitive and natural communications between human and sensor based devices in many fields such as games, e-learning and medical image processing. While traditional human-computer interface devices such as the keyboard and mouse still dominate in our daily life, the existing work consists of less accuracy and some external devices are used to communicate between them. This work proposes a real time hand gesture recognition system for human computer interaction (HCI) this proposed work can recognize two different hand gestures at faster rate with reasonable accuracy. The gestures are classified on the basis of shape based features. Using hand as a device can help people communicate with computers in a more efficient way. This system consists of three main modules like hand segmentation, hand tracking, and gesture recognition from hand features. This feature work focuses the users get the ability to interact with the application from a distance without any physical interaction with keyboard or mouse. The proposed work allows users to track their fingers moving in three-dimensional space

Keywords : Matlab 9; Web cam

1. INTRODUCTION

Since their first appearance, computers have become a key element of our society. Surfing the web, typing a letter, playing a video game or storing and retrieving data are just a few of the examples involving the use of computers. And due to the constant decrease in price of personal computers, they will even more influence our everyday life in the near future. To efficiently use them, most computer applications require more and more interaction. For that reason, human-computer interaction (HCI) has been a lively field of research these last few years. Firstly based in the past on punched cards, reserved to experts, the interaction has evolved to the graphical interface paradigm. The interaction consists of the direct manipulation of graphic objects such as icons and windows using a pointing device. Even if the invention of keyboard and mouse is a great progress, there are still situations in which these devices can be seen as dinosaurs of HCI. This is particularly the case for the interaction with 3D objects. The 2 degrees of freedom (DOFs) of the mouse cannot properly emulate the 3 dimensions of space. Furthermore, such interfaces are often not intuitive to use. To achieve natural and immersive human-computer interaction, the human hand could be used as an interface device. Hand gestures are a powerful human to- human communication channel, which forms a major part of information transfer in our everyday life. Hand gestures are an easy to use and natural way of interaction. Using hands as a device can help people communicate with computers in a more intuitive and natural way. When we interact with other people, our hand movements play an important role and the information they convey is very rich in many ways. We use our hands for pointing at a person or at an object, conveying information about space, shape and temporal characteristics. We constantly use our hands to interact with objects: move them, modify them, and transform them. In the same unconscious way, we gesticulate while speaking to communicate ideas ('stop', 'come closer', 'no', etc). Hand movements are thus a mean of non-verbal communication, ranging from simple actions (pointing at objects for example) to more complex ones (such as expressing feelings or communicating with others). In this sense, gestures are not only an ornament of spoken language, but are essential components of the language generation process itself.

2 HUMAN COMPUTER INTERFACE SYSTEMS

Computer is used by many people either at their work or in their spare-time. Special input and output devices have been designed over the years with the purpose of easing the communication between computers and humans, the two most known are the keyboard and mouse. Every new device can be seen as an attempt to make the computer more intelligent and making humans able to perform more complicated communication with the computer. This has been possible due to the result oriented efforts made by computer professionals for creating successful human computer interfaces. As the complexities of human needs have turned into many folds and continues to grow so, the need for Complex programming ability and intuitiveness are critical attributes of computer programmers to survive in a competitive environment. The computer programmers have been incredibly successful in easing the communication between computers and human. With the emergence of every new product in the market; it attempts to ease the complexity of jobs performed. For instance, it has helped in facilitating tele operating, robotic use, better human control over complex work systems like cars, planes and monitoring systems. Earlier, Computer programmers were avoiding such kind of complex programs as the focus was more on speed than other modifiable features. However, a shift towards a user friendly environment has driven them to revisit the focus area the idea is to make computers understand human language and develop a user friendly human computer interfaces (HCI). Making a computer understand speech, facial expressions and human gestures are some steps towards it. Gestures are the non-verbally exchanged information. A person can perform innumerable gestures at a time. Since human gestures are perceived through vision, it is a subject of great interest for computer vision researchers. The project aims to determine human gestures by creating an HCI. Coding of these gestures into machine language demands a complex programming algorithm. An overview of gesture recognition system is given to gain knowledge.

2.1 SIGN LANGUAGE

Sign languages are the most raw and natural form of languages could be dated back to as early as the advent of the human civilization, when the first theories of sign languages appeared in history. It has started even before the emergence of spoken languages. Since then the sign language has evolved and been adopted as an integral part of our day to day communication process. Now, sign languages are being used extensively in international sign use of deaf and dumb, in the world of sports, for religious practices and also at work places. Gestures are one of the first forms of communication when a child learns to express its need for food, warmth and comfort. It enhances the emphasis of spoken language and helps in expressing thoughts and feelings effectively. A simple gesture with one hand has the same meaning all over the world and means either 'hi' or 'goodbye'. Many people travel to foreign countries without knowing the official language of the visited country and still manage to perform communication using gestures and sign language. These examples show that gestures can be considered international and used almost all over the world. In a number of jobs around the world gestures are means of communication. In airports, a predefined set of gestures makes people on the ground able to communicate with the pilots and thereby give directions to the pilots of how to get off and on the run-way and the 5 referee in almost any sport uses gestures to communicate his decisions. In the world of sports gestures are common. The pitcher in baseball receives a series of gestures from the coach to help him in deciding the type of throw he is about to give. Hearing impaired people have over the years developed a gestural language where all defined gestures have an assigned meaning. The language allows them to communicate with each other and the world they live in.

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2.2 SIGN LANGUAGE

The recognition of gestures representing words and sentences as they do in American and Danish sign language undoubtedly represents the most difficult recognition problem of those applications mentioned before. A functioning sign language recognition system could provide an opportunity for the deaf to communicate with non-signing people without the need for an interpreter. It could be used to generate speech or text making the deaf more independent. Unfortunately there has not been any system with these capabilities so far. In this project our aim is to develop a system which can classify sign language accurately

3 DATABASE DESCRIPTION

In this project all operations are performed on gray scale image .The hand gesture database. The database consists of 25 hand gesture of International sign language. The letter j,z and have been discard for their dynamic content. Gesture a,e is produced as it is a static gesture .The system works offline recognition i.e. The test image as input to the system and system tells us which gesture image I have given as input. The system is purely data dependent.

I take gray scale image here for ease of segmentation problem. A uniform black background is placed behind the performer to cover all of the workspace. The user is required to wear a black bandage around the arm reaching from the wrist to the shoulder. By covering the arm in a color similar to the background the segmentation process is fairly straight forward.

A low-cost black and white camera is used to capture the hand gesture performed by performer .it produces 8-bit gray level image. The resolution of grabbed image is 256*248. Each of the gestures/signs is performed in front of a dark background and the user's arm is covered with a similar black piece of cloth, hence easy segmentation of the hand is possible. Each gesture is performed at various scales, translations, and a rotation in the plane parallel to the image-plane. There are total 1000 images, 40 images per gesture

4 PRE PROCESSING

Preprocessing is very much required task to be done in hand gesture recognition system. I have taken prima database which is standard database in gesture recognition. I have taken total 25 signs each sign with 40 images. Preprocessing is applied to images before we can extract features from hand images. Preprocessing consist of two steps

4.1 SEGMENTATION

Segmentation is done to convert gray scale image into binary image so that i can have only two object in image one is hand and other is background. Otsu algorithm is used for segmentation purpose and gray scale images are

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converted into binary image consisting hand or background. After converting gray scale image into binary image i have to make sure that there is no noise in image so i use morphological filter technique. Morphological techniques consist of four operations: dilation, erosion, opening and closing.

A very good segmentation is needed to select a adequate threshold of gray level for extract hand from background .*i.e.* there is no part of hand should have background and background also shouldn't have any part of hand. In general, the selection of an appropriate segmentation algorithm depends largely on the type of images and the application areas. The Otsu segmentation algorithm was tested and found to give good segmentation results for the hand gestures and was, therefore, selected .Otsu algorithm is nonparametric and unsupervised method of automatic threshold selection

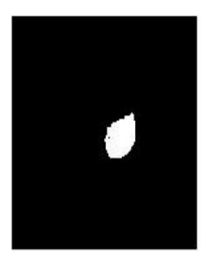
4.2 MORPHOLOGICAL FILTERING

If take close look to the segmented image after applying the Otsu algorithm on the original gray scale image i found that the segmentation is not perfectly done. Background may have some 1s which is known as background noise and hand gesture mat have some 0s that is known is gesture noise. These errors can lead to a problem in contour detection of hand gesture so we need to remove these errors. A morphological filtering approach has been applied using sequence of dilation and erosion to obtain a smooth, closed, and complete contour of a gesture. In the morphological dilation and erosion we apply a rule on a binary image. The value of any given pixel of any given pixel in output image is obtained by allying set of rules on the neighbors in the input image.

5 SEGMENTATION ANALYSIS

Segmentation in our proposed hand gesture recognition system is done by Otsu algorithm. The algorithm treats the segmentation of a gray scale image into a binary image as a classification problem in which the two classes (in this case, hand and background) are generated from the set of pixels within the gray scale image. There are total L levels in ray scale image (0-255) Using a threshold T for an image with L gray levels, the image is segmented in two classes$\Omega 0$=(1,2…..k) and $\Omega 0$=(k+1,k+2L) The optimum threshold $k*$ is determined as that value of k which maximizes the ratio of the between-class variance $\sigma B2$ …..B to the total variance $\sigma k2$.after finding the threshold value k hand pixels were assigned "1" and the background pixels were assigned "0".Segmentation results are shown below

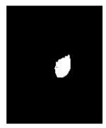
Unsegmented image of gesture "a"



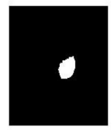
Segmented image of gesture "a"

MORPHOLOGICAL FILTERING ANALYSIS

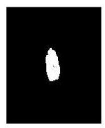
After finding the segmented image i found that it has some noise so for reduction noise i used morphological filtering operations .Results after morphological operations is given below



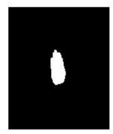
Segmented image of gesture "a"



Morphlogical Filtered image of gesture "a"



Segmented image of gesture "b"



Morphological Filtered image of gesture "b"

6.1 LINEAR CLASSIFIER

Here dissimilarity between reference gesture and test gesture i computed taking every gesture as a reference and test all the gesture with reference gesture. It's computed for every gesture.
The test gesture is tends to belong to each gesture class to compute Dm,m=1,2,….M; and the test gesture is assigned to class given by the minimum distance rule =argmi
In confusion table total 500 gesture were tested (20 each gesture).Confusion matrix is given below

	TEST GESTURE																								
	a	ae	b	c	d	e	f	g	h	i	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y
a	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ae	0	18	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
b	0	1	17	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
c	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
d	0	0	0	0	18	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
e	0	0	1	0	0	18	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
f	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
g	0	0	0	0	0	0	0	19	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
h	0	0	0	0	0	0	0	0	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i	0	0	0	0	0	0	0	0	0	17	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0
k	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
l	0	0	0	0	0	0	0	0	1	0	0	19	0	0	0	0	0	0	0	0	0	0	0	0	0
m	0	0	0	0	0	0	0	0	0	0	0	0	19	0	0	0	0	1	0	0	0	0	0	0	0
n	0	0	0	0	0	0	0	0	0	1	0	0	0	18	1	0	0	0	0	0	0	0	0	0	0
o	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0
p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0
q	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	18	1	0	0	0	0	0	0	0
r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0
s	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0
t	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	18	1	0	0	0	0
u	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0
v	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0
w	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	18	1	0
x	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	0
y	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	18

Table 1 confusion matrix of linear classifier

Gesture classified correctly=473

Total gesture=500

Accuracy=(473/500)×100=94.6%

6.2 MULTI CLASS SUPPORT VECTOR MACHINE

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	TEST GESTURE																								
	a	ae	b	c	d	e	f	g	h	i	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y
a	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
æ	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
b	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
c	0	0	0	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
d	0	0	0	0	18	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
e	0	0	1	0	0	18	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
f	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
g	0	0	0	0	0	0	0	19	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
h	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
i	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
k	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
l	0	0	0	0	0	0	0	0	1	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0
m	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0
n	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0
o	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0
p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0
q	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0
r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0
s	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0
t	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0
u	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0
v	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0
w	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0
x	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	0
y	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20

Table 2 Multiclass support vector machine

Number of gesture per class=20

Total class=25

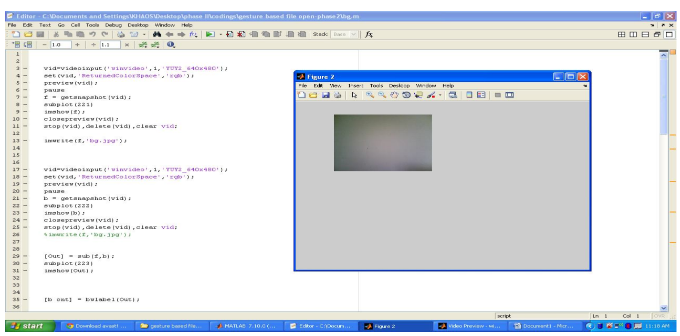
Total no. gesture=20*25=500

Correctly classified gesture =493

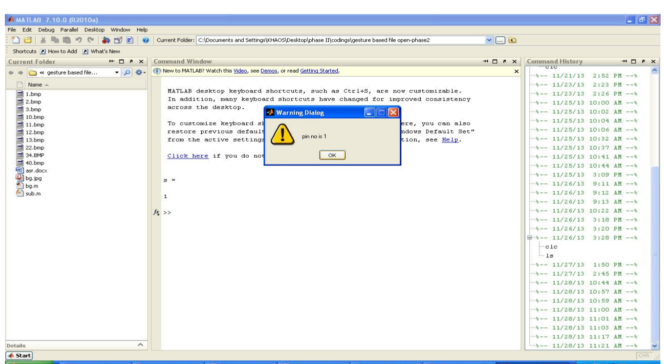
Misclassified gesture=7

Accuracy = (493/500) ×100=98.6%

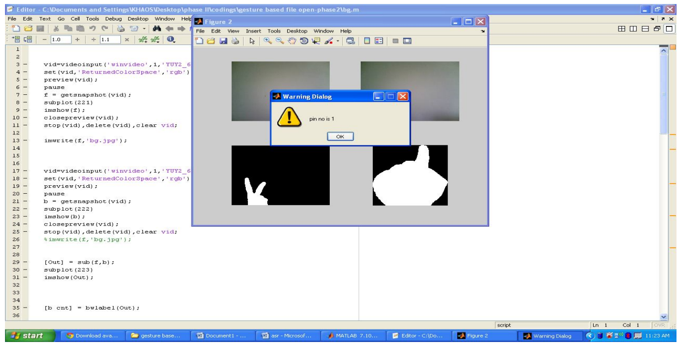
7. RESULTS



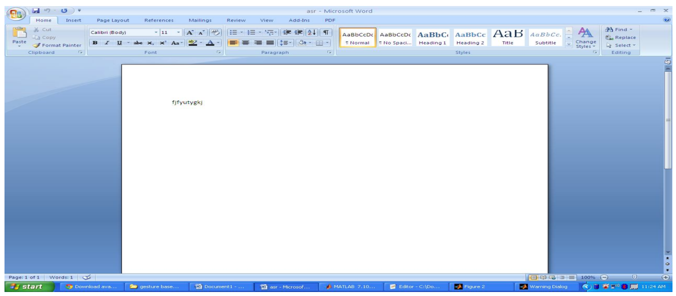
Analysis 1: Getting background image



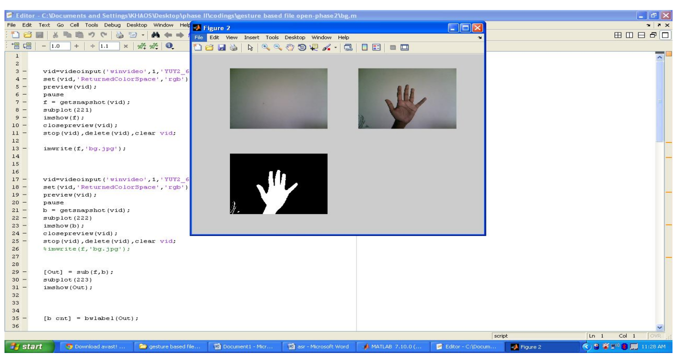
Analysis: 2 getting gesture image



Analysis: 3 Input pincode gesture



Analysis: 4 Browse word document by input gesture



Analysis: 5 Comparison of Mismatched gesture images

8. CONCLUSION

Gesture based interfaces allow human computer interaction to be in a natural as well as intuitive manner. It makes the interaction device free which makes it useful for dynamic environment It is though unfortunate that with the ever increasing interaction in dynamic environments and Corresponding input technologies still not many applications are available which are controlled using current and smart facility of providing input which is by hand gesture. The most important advantage of the usage of hand gesture based input modes is that using this method the users get that ability to interact with the application from a distance without any physical interaction with the keyboard or mouse. This paper implements a hand gesture recognition system which is used for browsing images in the image browser and provides a fruitful solution towards a user friendly interface between human and computer using hand gestures. The proposed research work could be very efficiently used in a varied domain of applications where the human computer interaction is the regular requirements. Also the gesture vocabulary designed can be further extended for controlling different applications like game control etc. The vocabulary designed also gives flexibility to define gestures based on the user interest for specific command which make the gesture recognition system more user friendly .As the system provides the flexibility to the users and specifically physically challenged users to define the gesture according to their feasibility and ease of use.

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