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Depth-based hand gesture recognition

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Abstract: this project presents Hand Gesture recognition for Indian sign languages. The gesture recognition basically is designed for human machine interaction. The system consists of components such as pre-processors, feature extraction& recognition for static gesture recognition. In the first component background subtraction& detection of hand is obtained. Depth camera is used to extract the hand gesture recognition. In second component features such as contour & convex are computed & gesture is recognized for sign languages identifiably. The features of hand are extracted and the static hand posture is classified using the support vector machine (SVM). The result of convexity shows that there white regions which the convex hull comprises but not contained in the contour. These regions are the defects relative to the hull. The beginning point & end point are the points on the hull where the defect begins & ends. The farthest point indicates the point on the defect which is the farthest from the edge of the hull. Expect the beginning point, end point and farthest point, other useful information is the depth of the defect. The depth of the defect is the distance between the farthest point & edge of the hull. Otherwise, the beginning and the end point are used to determine the fingertips positions. The positions of fingertips are then used for the static hand posture classification and gesture recognition.

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I. INTRODUCTION

Gesture recognition can be seen as a way for computers to begin to understand human body language, thus building a richer bridge between machines and humans than primitive text user interfaces or even GUIs (graphical user interfaces),which still limit the majority of input to keyboard and mouse. Gesture recognition enables humans to interface with the machine (HMI) and interact naturally without any mechanical devices. Using the concept of gesture recognition, it is possible to point a finger at the computer screen so that the cursor will move accordingly. This could potentially make conventional input devices such as mouse, keyboards and even touch-screens redundant. In human communication, the use of speech and gestures is completely coordinated. Machine gesture and sign language recognition is about recognition of gestures and sign language using computers. A number of hardware techniques are used for gathering information about body positioning; typically either image-based (using cameras, moving lights etc) or device-based (using instrumented gloves, position trackers etc.), although hybrids are beginning to come about. Although this technology is still in its infancy, applications are beginning to appear. Mac/Windows computer and webcam to download an app that allows them to control Music & Video apps such as sportily, iTunes, Windows Media Player, QuickTime, and VLC using gestures. Gesture recognition can be conducted with techniques from computer vision and image Processing.

II. METHODOLOGY

In our project the proposed system will include 3D webcam for capturing the hand gestures & an algorithm that processes the acquired images & then classifies the hand gesture correctly. The work mainly emphasizes on the feature extraction from the hand gestures & use that features in the recognition algorithm. The system will contain setup procedure in which the algorithm is trained on the given training set based on significant feature extracted for different hand gestures. The system will be able to classify the given hand gestures based on the knowledge acquired during the training phase. The design of hand gesture recognition system is divided into two phases.

First phase is the pre-processing phase & second phase is the classification phase. The efficiency of the classification phase entirely depends on the pre-processing phase. In training phase the data base which consists of list of unique binary pattern for different hand gesture representing some specific number between 0-9 & alphabets A-Z is created & is represented in some form. design of a system shown in figure.

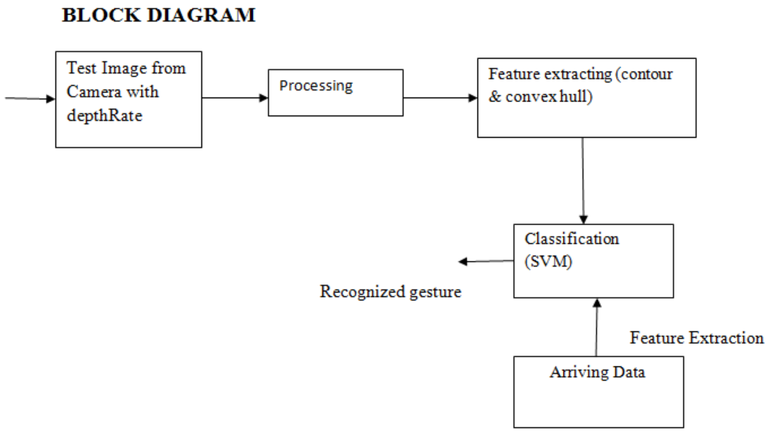

Fig 1. General Methodology

The system mainly focuses on support vector machine (SVM) which is machine learning algorithm. Initially traditional methods will be followed in pre-processing steps for preparing an image for feature extraction. Once the prepare image (noise free image) is successfully achieved, the significant features representing different hand gestures are extracted & represented to include in classification algorithm. This is because the more features include in the algorithm the more will be the accuracy of classification. The initially we are using simple test image from camera. Image from camera is processed with pre-processing phase consisting of background subtraction and colour space transformation. Features like convex & contour are extracted from original image.SVM is used for image classification.SVM is machine learning Algorithm Extracted Features & Recognized gestures compared with each other to achieve desired accuracy, precision & recall. In our project the proposed system will include 3D webcam for capturing the hand gestures & an algorithm that processes the acquired images & then classifies the hand gesture correctly. The work mainly emphasizes on the feature extraction from the hand gestures & use that features in the recognition algorithm. The system will contain setup procedure in which the algorithm is trained on the given training set based on significant feature extracted for different hand gestures. The system will be able to classify the given hand gestures based on the knowledge acquired during the training phase. The design of hand gesture recognition system is divided into two phases. First phase is the pre-processing phase & second phase is the classification phase. The efficiency of the classification phase entirely depends on the pre-processing phase.

In Second phase the data base which consists of list of unique binary pattern for different hand gesture representing some specific number between 0-9 & alphabets A-Z is created & is represented in some form. The overall implementation process is described as follows

1) **Human Generated Gesture**

As a first step of implementation user will show one gesture. The gesture should be constant for some period of time, which is necessary for Static processing. These gestures should be already defined as valid gesture for processing.

2) **Web Camera**

The purpose of web camera is to capture the human generated hand gesture and store it in memory. The matlab tool is used for storing image in memory and again calling the same program after particular interval.

3) **Image Processing Algorithm**

This carries the major portion of implementation. First the captured image is pre-processed by techniques like making binary, zooming, cropping and standard resizing. Such pre-processed image is given to the image-processing algorithm. The algorithm will count the number of fingers shown by user, which will work as input for next processing

4) **Event Handling**

Once the gesture is identified the appropriate command for it will be executed.. Shortcut for applications like notepad, WordPad are also provided. Other control commands include shutdown and restart facilities using gestures

5) **Back To Capturing Gestures**

Gesture recognition is a dynamic process so once particular gesture is identified and appropriate control command is executed it will again go to capture next image and process it accordingly

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III. SYSTEM DESCRIPTION

1) Collecting the pictures

Collect pictures of all the gestures that will be supported by the Gesture recognition system. Every gesture is associated a particular task through which the user can control the computer.

2) Finding the hand

We need then to analyze the picture, and to find the relevant part of the picture. Indeed the user will never put his hand in the same area of the picture. In any cases, the user expects the program to count same no of fingers. So it is necessary to find the hand in the picture that is to say to zoom on the hand, and to pick it up.

3) Zooming on the Hand

A) Finding the hand in the picture

According to the requirements, the web camera is not supposed to move. This piece of information gives a huge advantage that allows simplifying the zooming process. Indeed, it implies that the background is more or less always the same. In all what follows, it will be supposed that in the picture, we can just find the hand and the background: no other object should be present. Please note that all correct sign are suppose to include thumb finger, which is used as a reference for zooming on the hand. After processing noise removal, the resulting picture will be black almost everywhere except where the hand is. So, zooming can then be easily realized by cropping areas whose pixel values are close to 0.

B) - Creating a Binary Picture

To make all the pre-processing easier, it is better to create a binary picture. To do so, it is necessary to choose a threshold: pixels with value lower than this threshold will be set to 0 (black) and others will be set to 1. The choice of this threshold depends on the web camera properties. Then it is necessary to execute noise-removal functions, else every noisy pixel that its value is too high may be considered as part of the hand and will be included in the zoom-in picture.

C) Zooming in the Binary Picture

Let's suppose that the picture is completely black (0), except in the area of the hand in which it is completely white (1), according to the previous few examples. The problem now is how to crop the area completely black. The fastest method is to compute a line vector in which the i-th element is the sum of the elements of the i-th column of the picture, and a column vector in which the i-th element is the sum of the elements of the i-th line of the picture

4) Recognize the gesture (Convex & contour)

Once region of hand is obtained, the next step is to extract the features of hand. One useful way of realizing the shape of hand is to compute a convex hull for the hand and then compute its convexity defects before computing the convex hull, pixels with depth value farther than the hand depth are removed from the region of hand. The contour of hand which contains the largest contour area is then evaluated from the remaining pixels. The contour is then simplified by the polygonal approximation. The convex hull covers a given nonempty set of hand contour points. Once the contour and the convex hull are computed, the next step is to compute the convexity defects for finger identification. A result of convexity defects is shown in Fig. 4 & 5It is clear that there are four White regions which the convex hull comprises but not contained in the contour. These regions are the Defects relative to the hull. The beginning point and end point are the points on the hull where the defect begins and ends. The farthest point indicates the point on the defect which is the farthest from the edge of the hull. Except the beginning point, end point and the farthest point, other useful information is the depth of the defect. The depth of the defect is the distance between the farthest point and the edge of the hull. Otherwise, the beginning and the end point are used to determine the fingertip's position. The positions of fingertips are then used for the static hand posture classification

IV. RESULTS

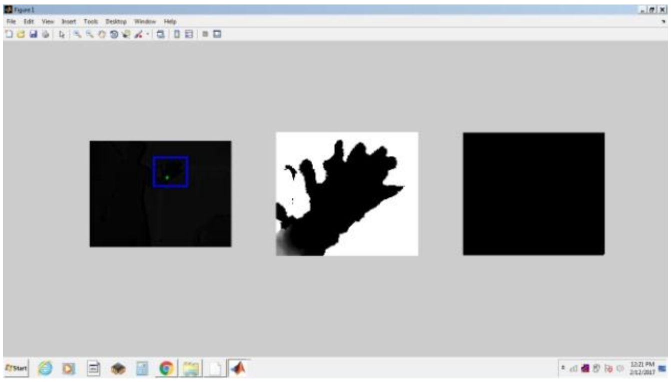
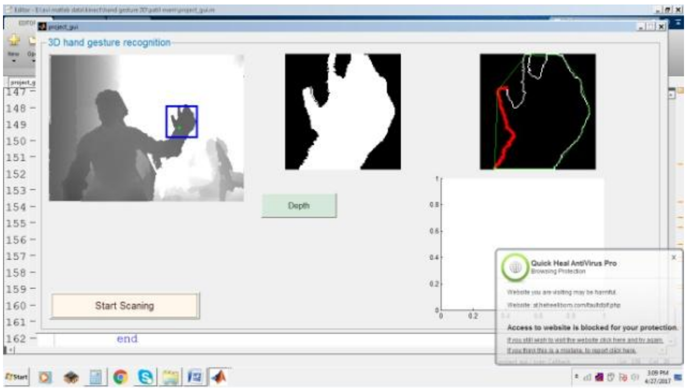


Fig 2. Hand Region Extraction & contour evaluation



Quick Heal AntiVirus Pro
Browsing Protection
Website you are visiting may be harmful.
Access to website is blocked for your protection.
If you still wish to visit the website click here and try again.
If you think this is a mistake, to report click here.

Fig. 3. Polygonal Approximation

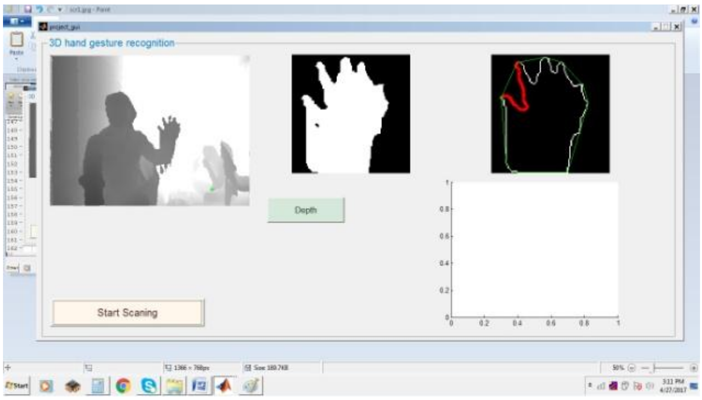


Fig.4 Convex Hull copmutation

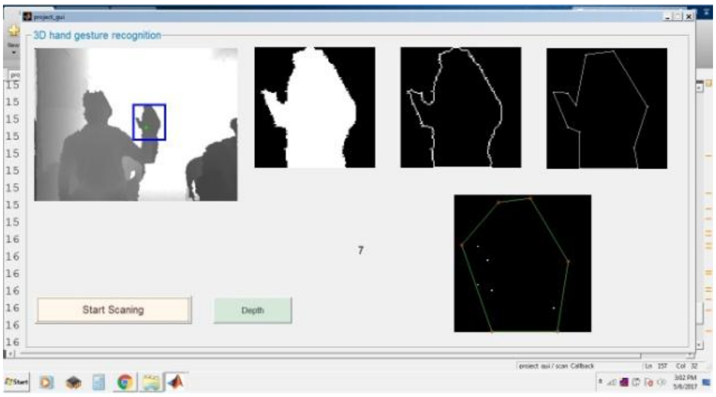


Fig. 5 Convexity Defects computation

V. CANCLUSION

The proposed system can recognize nine commonly used static hand gestures for embedded systems. These Static hand gestures can be recognized according to static hand posture based methods, and Fingertip based methods. The proposed system can accurately detect the static hand gestures with an average recognition rate of 87.6 %, which is good for controlling the embedded systems

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