Human Computer Interaction System

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Abstract: A real-time dynamic hand gesture recognition system is performed in this paper. Vision-based hand gesture recognition enabling computers to understand hand gestures as humans do is an important technology for intelligent human computer interaction. In this paper, a recognition system for dynamic hand gestures is proposed. In dynamic hand gesture recognition, hand is segmented by using background subtraction method. The images are trained using neural network. The accuracy is to be calculated based on confusion matrix is 96%.

Index Terms: Neural network, background subtraction, Feature extraction.

I. Introduction

Gesture recognition is a vital space of analysis in the field of computer vision. Gesture recognition pertains to recognizing meaning expressions of motion by a person’s, involving the hands, arms, face, head or body with the intention of conveying meaning full information or interacting with the environment. In addition to the theoretical aspects, any practical implementation of gesture recognition typically requires the use of different imaging and tracking devices or gadgets. Gestures can be static (the user assumes a certain pose) or dynamic (with pre-stroke, stroke, and post-stroke phases). Direct use of the hand as an input device is an attractive method for providing natural human computer interaction (HCI) (Pavlovic et al., 1997). Vision-based techniques, while overcoming this constraint, need to contend with other problems related to occlusion of parts of the user’s body. Vision-based devices can handle properties such as texture and color for analyzing a gesture, while tracking devices cannot. Vision-based techniques can also vary among themselves in: the number of cameras used, their speed and latency, the structure of environment (restrictions such as lighting or speed of movement), any user requirements (whether user must wear anything special), the low-level features used (edges, regions, silhouettes, moments, Histograms), whether 2-D or 3-D representation is used. Gesture recognition has wide-ranging applications in human-computer interaction, sign-language communication, video surveillance, dance/video annotations, forensic identification and the likes. Since the introduction of the foremost common input devices not a lot have changed. This is probably because the existing devices are adequate. It is also now that computers have been so tightly integrated with everyday life, that new applications and hardware are constantly introduced. The means of communicating with computers at the instat square measure restricted to keyboards, mice, light pen, trackball, keypads etc. These devices have grown to be familiar however inherently limit the speed and naturalness with which we interact with the computer. In recent years there has been a great deal of studies aimed at the inconvenience of human computer intercommunication tools such as keyboard & mouse. As one of the alternative gesture recognition methods have been developed by which a variety of commands can be used naturally. Since conventional input devices need a great deal of technical education, many researchers feel a great interest in & attach importance to hand gesture recognition. In the present day, framework of interactive, intelligent computing, an efficient human–computer interaction is assuming utmost importance in our daily life. Gestures are physical positions or movements of a person’s fingers, hands, arms or body accustomed convey information. Hand gestures, i.e., gestures performed by hand. Gesture recognition is the process by which gestures formed by a user square measure created renowned to the system.
A pattern recognition system are employing a remodel that converts a picture into a feature vector, which will then be compared with the feature vectors of a coaching set of gestures. The final system will be implemented with a neural network. As the computer industry follows Moore’s Law since middle 1960s, powerful machines are built equipped with more peripherals. Vision-based interfaces are feasible at the current moment the PC is in a position to “see”. Hence users are allowed for richer and user-friendly man-machine interaction. This can lead to new interfaces that will enable the readying of recent commands that aren’t possible with the current input devices. Plenty of time will be saved as well.

Recently, there has been a surge in interest in recognizing human hand gestures. Hand gesture recognition has varied applications like laptop games, machinery control (e.g. crane), and thorough mouse replacement. One of the most structured sets of gestures belongs to sign language. In sign language, each gesture has an assigned meaning (or meanings).

Computer recognition of hand gestures may provide a more natural-computer interface, allowing people to purpose, or rotate a CAD model by rotating their hands. Hand gestures will be classified in 2 categories: static and dynamic. A static gesture is a particular hand configuration and create, represented by a single image. Dynamic gesture may be a moving gesture, represented by a sequence of images. We will focus on the recognition of static images. Interactive applications pose particular challenges. The interval ought to be in no time. The user ought to sense no considerable delay between once he or she makes a gesture or motion and once the computer responds. The computer vision algorithms should be reliable and work for different people. There are also economic constraints: the vision-based interfaces will be replacing existing ones, which are often very low cost. A hand-held video game controller and a television remote control each cost about $40. Even for added functionality, consumers may not want to spend more. When additional hardware is needed the cost is considerably higher.

Academic and industrial researchers have recently been focusing on analyzing images of people. While researchers are creating progress, the matter is difficult and lots of gift day algorithms are complex, slow or unreliable. The algorithms that do run near real-time on computers those are very expensive relative to the existing hand-held interface devices.

2.1 Skin color detection:

![Figure 2 The flow chart of dynamic gesture recognition algorithm](image-url)
The image obtained from the camera is RGB imagewhere skin color region clusters together. So we use the skin color model to remove the background according to the easily distinguishable from non-skin area. The differences of skin color of image are mainly caused by light, so we obtain region of hand to avoid the effect of light. In HSV space each uniform color area of color image corresponds to a relatively consistent tone, therefore the tone is able to as a rule of color segmentation.

2.2 Hand detection:
Hand detection is the most important part of the whole algorithm, which is made up of three parts: median filter, hand connections and hand detection. Median filter and hand connections are mainly to filter out the noise, preparation for next hand segmentation. In skin color region, the area of hand and face are large, while there are many smaller blocks in the binary image to greatly affect the efficiency of hand detection. So we set area threshold to filter out the smaller blocks. After the skin color detection, we can see that face is the main skin color blocks, which are filtered out to obtain hand. According to the contour feature of hand and face, the obvious difference of them is that the gravity of hand is below the half of the height of the hand contour.

2.3 Dynamic hand gesture recognition:
Dynamic hand gestures recognition is composed of three parts: movement detection, the trajectory of palm gravity and direction recognition. As the camera takes time to open, so we record the movement of image from the 15th frame as a start. Movement detection is mainly to track hand and information, record the coordinates of hand gravity, as is shown in formulas.

\[
x = \frac{x f(x, y)}{\sum f(x, y)}
\]

\[
y = \frac{y f(x, y)}{\sum f(x, y)}
\] … (1)

2.4 Picture of the difference with the background:
The difference with the background can be done using the Matlab function “imabsdiff”. After that, to make all the preprocessing 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 video camera properties: if we consider that the camera provides pixels coded on bytes, pixel values will be from 0 to 255. Some measurements have proven that in this case, the presence of the hand will imply a variation of pixel values bigger than 20 units. Of course, the optimal threshold depends on the background; nevertheless, this threshold can be correct in most of cases. 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. For example if we suppose that the hand is in one corner of the picture and that there is a noisy pixel in the opposite corner of the picture of the differences, so the zooming function will keep it and the resulting picture, after zooming, will not be very different of the initial picture.

2.5 Classification and Recognition
For classification and recognition neural network with spatial feature are used. Feature which are extracted are perimeter, area, coefficient are calculated after skin detection, background removal then contour detection. The training of total 203 images are given and 3 output are classified. It takes 58 iteration and total 1.08 second time. The training of neural network is shown in figure.
II. Conclusion

The algorithm is tested on database as well as on camera. Firstly, the RGB image is converted to a skin colour model. The contour detected is done then the feature are extracted and trained using neural network. The skin image is called hand region. The hand region is moved and direction is to be shown according to the requirement.

References


