Gesture Determination for Hand Recognition

Taher KHADHRAOUI
LSTS Laboratory
National School of Engineers of Tunis (ENIT), Tunisia
khadhra.th@gmail.com

Fouazi BENZARTI
LSTS Laboratory
National School of Engineers of Tunis (ENIT), Tunisia
benzartif@yahoo.fr

Abdulrahman ALARIFI
KACST, CRI
aarifi@kacst.edu.sa

Hamid AMIRI
LSTS Laboratory
National School of Engineers of Tunis (ENIT), Tunisia
hamidlamiri@yahoo.com

***Abstract*—Gestures are the dynamic movements of hands within a certain time interval, which are of practical importance in many areas, such as human–computer interaction, computer vision, and computer graphics.**
This paper demonstrates the feasibility of a new method of hand-geometry recognition based on parameters derived from the contour of the hand. The contour can be modelled by parameters, or features, that can capture more details of the shape of the hand than what is possible with the standard geometrical features used in hand-geometry recognition. The set of features considered in this paper consists of the spatial coordinates of certain landmarks on the contour.

Keywords-component; hand recognition; feature extraction; gesture determination

I. INTRODUCTION

Hand is a natural and powerful means of communication that conveys information very effectively. Hand gesture recognition is an important aspect in Human-Computer interaction, and can be used in various applications, such as virtual reality and computer games.
Research on hand gestures can be classified into three categories: sensor-glove-based analysis, vision-based analysis, and analysis of drawing gestures [1].
Pattern recognition consists of 1) identifying the pixels in the image that constitute the hand we're interested in, 2) extracting features from those identified pixels in order to classify the hand into one of a set of predefined poses, and 3) recognizing the occurrence of specific pose sequences as gestures [1]. In this paper we focus our attention to vision based shape extraction of hand first part. After second part we propose a real time hand gesture recognition system.
Experiments have been conducted to validate the performance of the proposed system. As it is easy to develop other hand gestures, the proposed system has good potential in many applications.

II. RELATED WORK

Many methods for hand gesture recognition using visual analysis have been proposed for hand gesture recognition. Before we can perform gesture recognition, we need to identify roughly where the hand is located in our images. Previous work was done to classify a hand into one of a set of signed words (sign language) [2]. Matthew Tang has proposed the hand gesture recognition using Microsoft's Kinect [1]. Computer vision and pattern recognition techniques [3], involving feature extraction, object detection, and classification, have been successfully used for many gesture recognition systems. Xia Liu and Kikuo Fujimura have proposed the hand gesture recognition using depth data [7]. There is another efficient technique which uses Fast Multi-Scale Analysis for the recognition of hand gestures as suggested by Yikai Fang, Jian Cheng, Kongqiao Wang and Hanqing Lu [6].
The principles and background of some of these popular tools used in gesture recognition are discussed in [8].

III. PROPOSED METHOD

The proposed method is summarized in figure 1. It uses four main steps:

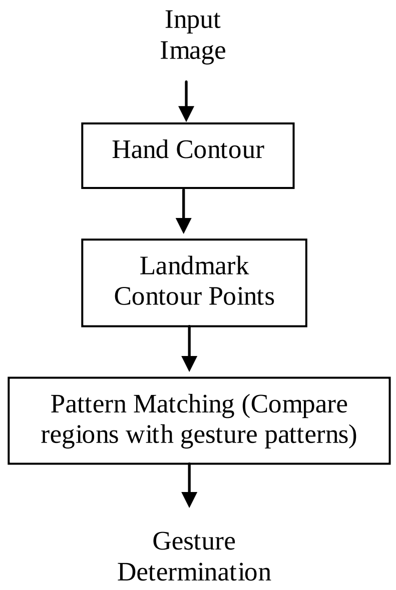

Figure 1. Framework of gesture recognition

Typical image analysis and in particular gesture recognition usually consists of several steps:

A. Hand Contour

This step is also known as hand detection. It involves detecting and extracting hand region from background and segmentation of hand image. Hand model features (see Figure 1) are extracted from the segmented hand region represented by its boundary contour.

Different features such as skin colour [4], shape, motion and anatomical models of hand are used in different methods. Different methods for hand detection are summarized in this paper. Some of them are.

Colour: Different colour models can be used for hand detection such as YCbCr, RGB, YUV, etc.

Shape: The characteristics of hand shape such as topological features could be used for hand detection.

Learning detectors from pixel values: Hands can be found from their appearance and structure such as Adaboost algorithm. 3D model based detection: Using multiple 3D hand models multiple hand postures can be estimated.

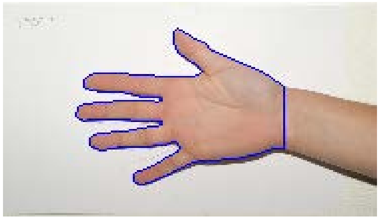

Figure 2. Hand Contour

B. Landmarks Contour Points

The next important step is hand tracking and feature extraction. Tracking means finding frame to frame correspondence of the segmented hand image to understand the hand movement. Following are some of the techniques for hand tracking.

1) Template based tracking

If images are acquired frequently enough hand can be tracked. It uses correlation based template matching. By comparing and correlating hand in different pictures it could be tracked.

2) Optimal estimation technique

Hands are tracked from multiple cameras to obtain a 3D hand image.

3) Tracking based on mean shift algorithm

To characterize the object of interest it uses color distribution and spatial gradient. Mean shift algorithm is used to track skin color area of human hand.

Two types of features are there first one is global statistical features such as centre of gravity and second one is contour based feature that is local feature that includes fingertips and finger-roots. Both of these features are used to increase the robustness of the system.

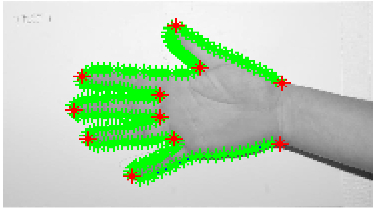

Figure 3. Landmark Contour Points

The ASM searching algorithm uses an iteration process to find the best landmarks which can be summarized as follows:

- Initialise the shape parameters b to zero (the mean shape)
- Generate the shape model point using

$$x = \bar{X} + Pb \qquad (1)$$

- Find the best landmark z by using the feature model
- Calculate the parameters b' as

$$b' = P^T(z - \bar{X}) \qquad (2)$$

- Restrict parameter b' to be within $\pm 3\sqrt{\lambda_i}$

If |b' - b| is less than a threshold value, then the matching process is completed;

else b = b', and return to step 2

C. Pattern Matching

Using SIFT features for object matching is very popular, and seems to be a reliable choice for solving the problem of illumination and pose variability. The SIFT descriptor is highly distinctive and partially invariant to variations. In order to make the ASM shape model rotation invariant, the gradient orientations of the descriptor are always computed relative to the edge normal vector at the landmark point which could be obtained by interpolation of neighboring landmarks.

There are a two main advantages of the SIFT feature descriptor [5]. The first advantage is that SIFT descriptors encode the internal gradient information of a patch around the landmark. The SIFT descriptors have a more discriminative likelihood model which is distinctive enough to differentiate between landmarks.

The second advantage of the SIFT descriptors is that they are more stable to changes that occur due to changes of pose, that can occur when dealing with hands.

D. Gesture Determination

In order to test any comparison metric devised it is important to have a constant set of easily reproducible gestures. It is also important to ensure that the gestures are not chosen to be as dissimilar as possible. Sign language gestures are an excellent test, but sign language normally involves both hands with one hand regularly occluding the other. However, there is an American one-handed sign language alphabet, which, with slight modification, can be used.

IV. EXPERIMENTS RESULTS

In our preliminary experiments, we have obtained some promising results for different gesture recognition. Experimental results are given to demonstrate the viability of the proposed Hand Gesture Recognition method.

V. CONCLUSION

We have proposed an efficient 2D Hand Detection for Gestures Recognition. The approach is definitely robust, simple, and easy and fast to implement compared to other algorithms. It provides a practical solution to the reconstruction problem. Future work includes applying the 3D model to hand animation and recognition, and using robust multi-view hand alignment to automate the reconstruction.

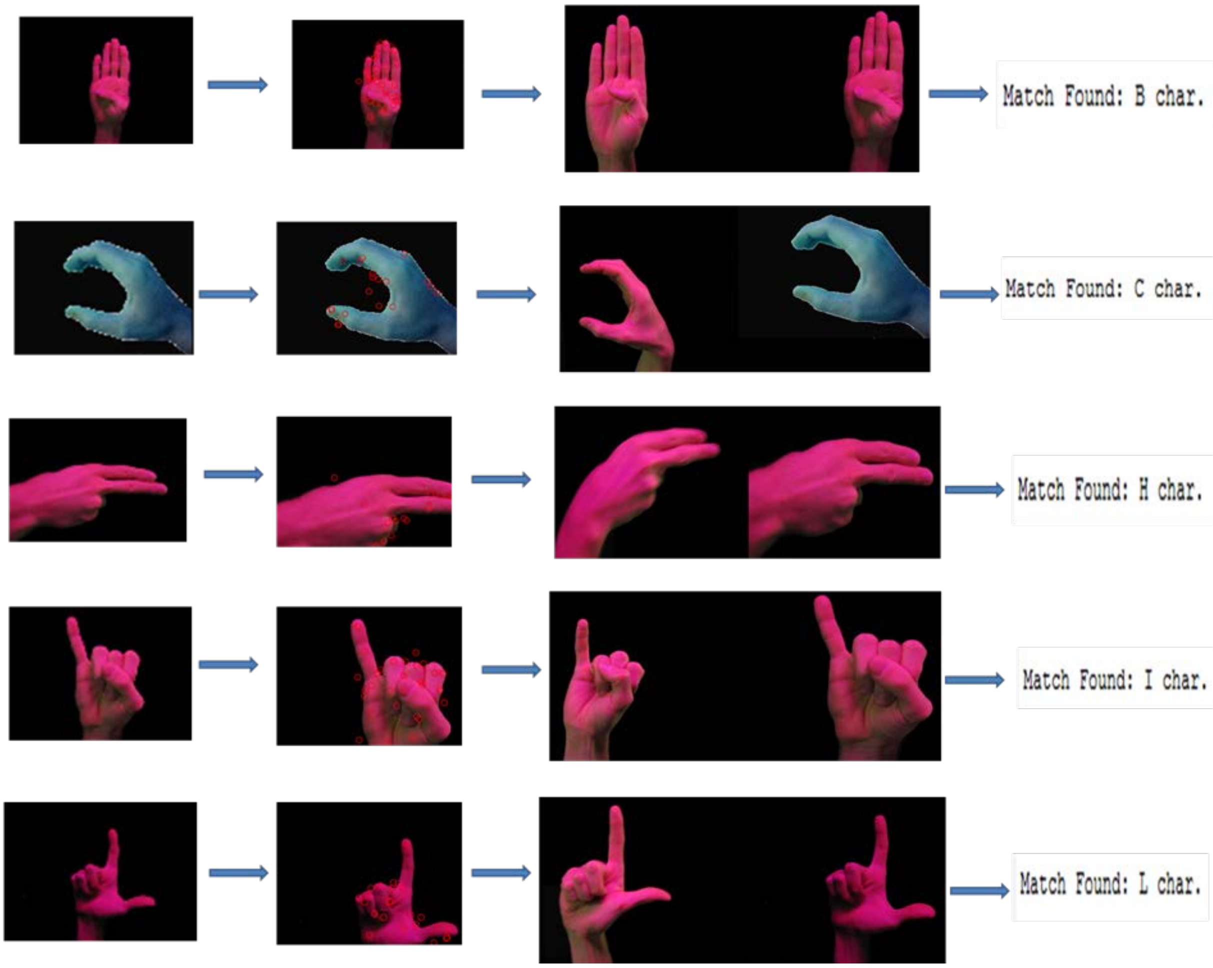

Figure 4. Gesture Determination

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