Leveraging the Image Processing Tools and Techniques in Enhancing the Efficiency of Hand Gesture and Digital Recognition System

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ABSTRACT

The ability to bridge the communication gap between people with speech and hearing impairments is a benefit of sign language. Gestures and postures are combined to create sign language. The natural method of communication is gestures, which are signs made with or without an object. People with disabilities could communicate their feelings without an interpreter, thanks to the sign language system. A novel webcam-based hand gesture recognition system for two-digit classification is proposed in this paper. This system's basic concept is to convert gestures from digital images or devices that capture images into text. Due to individual variations in hand colour, size, and shape, gesture-based communication is very complicated. The data glove-based method and hand-attached motion sensors are two examples of various approaches to gesture recognition. The hand's position and movement are tracked by these sensors. An appropriate set of equipment is required for the sensor-based method. It is expensive and may impede the hand's natural movement. A rapid and dependable vision-based method should be developed to overcome the limitations of data glove-relied approaches. The proposed system utilized the live feed of image processing and machine learning's learning capabilities to solve the recognition problem.

INTRODUCTION

Sign recognition nowadays typically consists of three fundamental steps.

A. Segmentation, also known as a region of interest,

B. Feature Extraction, and

C. Classification

The segmentation procedure is used to divide the hand part. The hand position must be in the centre of the image, and these two conditions should be necessary [1]. Various algorithms have high efficiency depending on whether the background is flat or uniform.

Extracting features reduces the resources required to explain a large set of data accurately. Before feature extraction, it is crucial to distinguish between gestured frames and not gestured frames. The hand makes intermediate movements between the two gestures in the sequence of static hand gestures. When the gesture boundaries are known, they can match reference patterns with all input signal segments. An input to the system for dynamic gesture recognition is a video sequence. Speed of hand movement and pose may vary from time to time. The effectiveness of recognition is affected by signing speed [2]. After matching or relating the information in the target image to the trained image samples, classification is used to get accurate results. The best match for the intended image is found through this method.

Due to their simplicity, hand gestures are a very effective way to express thoughts and satisfy human interaction's fundamental requirements. Additionally, hand gestures offer an appealing alternative to cumbersome interface devices for human-computer interaction (HCI). Most gestures used in sign language must be linked to a specific thought interpretation [3]. The ability to bridge the communication gap between people with speech and hearing impairments is a benefit of sign language. Gestures and postures are combined to create sign language. The natural method of communication is gestures, which are signs made with or without an object. It can be used in robotics, augmented reality, electronic gadgets, and many other areas worldwide. People with disabilities could communicate their feelings without an interpreter, thanks to the sign language system. This system's fundamental concept is to convert gestures from images or devices that capture images into text. Due to individual variations in hand colour, size, and shape, gesture-based communication is extremely complex [4].

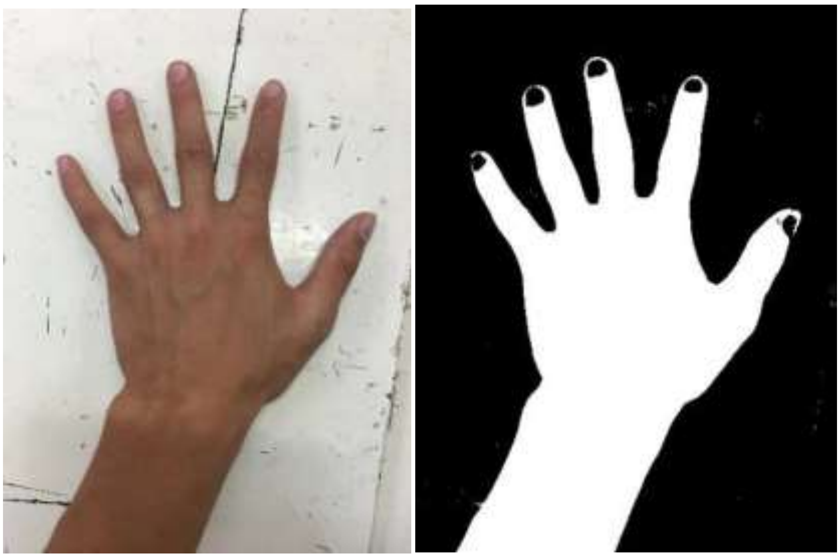

Fig 1: Hand Gesture and Threshold

Data glove-based methods are among the various gesture recognition methods; The hand is connected to motion sensors. The hand's position and movement are tracked by these sensors. An appropriate set of equipment is required for the sensor-based method.

The term "noisy gestures" refers to good gestures that contain some additive noise because of problems with the device, the user's unfamiliarity with the recognition system, or temporary or permanent behavioural characteristics like anxiety, trembling hands, or movement limitations [5]. It is expensive and may impede the hand's natural movement. A vision-based approach is developed to circumvent the limitations of the data glove-based method. Cameras are used in the vision-based method to record hand gestures. There are two types of vision-based techniques: appearance-based and 3-D hand model-based techniques. Four different kinds of cameras are used in the 3-D hand model-based method: stereo, monocular, angle-of-view, time-of-flight, infrared, and other types to produce three-dimensional hand models for gesture recognition.

METHODOLOGY AND FORMULATION OF THE PROBLEM

Sign language use posture and gestures. The natural method of communication is gestures, which are signs made with or without an object. The ability to bridge the communication gap between people with speech and hearing impairments is a benefit of sign language.

People with disabilities could communicate without an interpreter thanks to the sign language system. This system's fundamental concept is to convert gestures from images or devices that capture images into text. Due to individual variations in hand colour, size, and shape, gesture-based communication is extremely complex.

Data glove-based methods are among the various gesture recognition methods; The hand is connected to motion sensors. The hand's position and movement are tracked by these sensors. An appropriate set of equipment is required for the sensor-based method. It is expensive and may impede the hand's natural movement. It is necessary

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to develop a vision-based method that is both rapid and dependable to circumvent the limitations imposed by the data glove-based approach.

A. Goals: The focus of this study will be on achieving the following goals:

1) Create, investigate, and implement a two-digit sign recognition framework.

2) The framework needs to be quick and dependable.

3) ought to apply the proposed framework to various datasets.

4) The primary goal is to speed up the digit recognition system when there is noise.

5) To gain knowledge from the design process, identify and resolve potential bottlenecks in the detection process, and recognize hand gestures and digits in a way that improves the overall quality of recognition.

B. To finish this research project, the methodology will carry out the following steps:

1) Develop a system that first detects the individual's hand and then the system's fingers.

2) Train the system to recognize left-handed or right-handed hands.

3) To identify the gesture's shape, perform opening and closing morphological operations.

4) For gesture matching, create or use an available database.

5) Align the recognition result with the database.

6) Perform various operations to verify the system's authenticity or dependability.

C. The Proposed Algorithm: Training and image segmentation detection are part of the proposed algorithm. The procedure in detail is as follows:

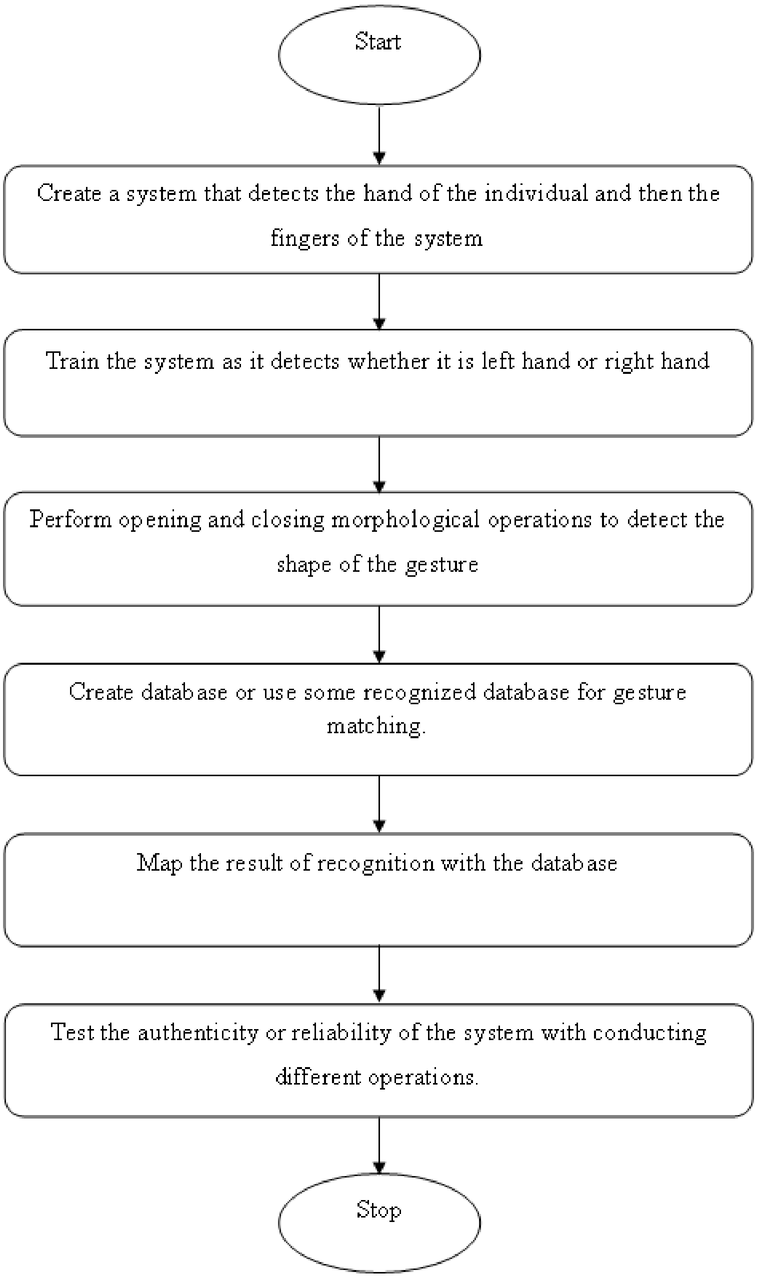
1) Identify the individual's left and right hands;

2) Prepare the model for digits 1 through 5.

3) To locate the boundaries of the samples and perform opening and closing operations.

4) Take the trained images and extract their features.

5) Correlate the trained data by classifying the target image using a segmentation method.



The proposed system's overall accuracy, which was found to be 91.5 per cent after 250 rounds of testing for digits from 1 to 5, was very good.

RESULTS

Fig 2: Classified image of both hands

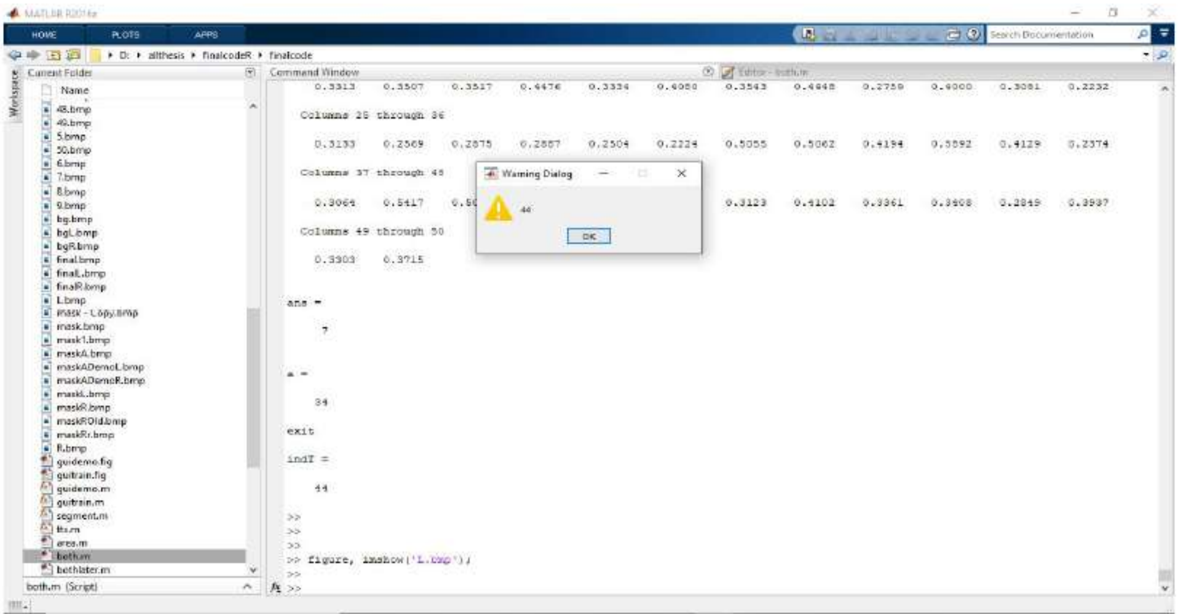


Fig. 3 Final output displayed with value '44'

Table I: Overall performance matrices of the sign recognize system

Hand Activity Serial No.	No. of Hands Used	Digits displayed by left Hand	Digits displayed by right Hand	Digits recognized for left Hand	Digits recognized for right Hand	Quantity of test performed	Accuracy of proposed system
1	2	1,2	3,5	1,2,3	3,4,5	25	96
2	2	1,3	4,1	1,3	4,1,3	25	94
3	2	1,4	2,4	1,4,5	2,4	25	92
4	2	1,5	2,3.4	1,5	2,3,4	25	90
5	2	2,5	3,4	2,3,5	3,4	25	88
6	2	2.4	1,2	2,4	1,2	25	92
7	2	2,3	1,3,5	2,3,4	1,3,5	25	93
8	2	3,1	3,4,5	3,4,1	3,4,5	25	90
9	2	3,4	1,2	3,4,5	1,2,3	25	95
10	2	5,2	1,3,5	5,2,3	1,3,5	25	85

CONCLUSIONS

It is evident from the results that the proposed algorithm tries to classify the segmented images with the trained images based on the amount of correlation data between the two images before attempting to determine the precise boundary of both left- and right-hand segmented images. Both the left and right hands have extremely refined and smooth edges due to the proposed method, and there is no loss of image detail. As a result, the proposed method yields positive outcomes and demonstrates the system's value. Could practice working with the digits 6 through 9 and 0 to produce different results. Additionally, it can improve the system's accuracy by using additional trained data from various individuals of varying ages.

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