Preface

In the past few decades, hand gesture recognition has been considered to be an easy and natural technique for human–machine interaction. Many applications have been developed and enhanced based on hand gesture recognition. These applications range from mobile phones to advanced robotics and from gaming to medical science. In most of the existing commercial and research applications, recognition of hand gestures has been performed by employing sensor-based wired embedded gloves or by using vision-based techniques where colors, chemicals, or paperclips are used on the hand. However, it is desirable to have hand gesture recognition techniques that are applicable to a natural and bare hand, which is normally used for depicting gestures in verbal communication. Another important issue involved in vision-based techniques is their variance to light conditions. As the light conditions change, the threshold used for the segmentation also has to be changed. Bare hand gesture-based applications where no external device or color is used, do not work for different light intensities. In the case of human skin, different user's skin color appears different in the same light intensity while same user's skin color varies in different light conditions.

The prime aim of this book is to enhance the current state of the art of bare hand gesture recognition and present a model for controlling an electromechanical robotic hand. The focus is on the development of intelligent techniques applicable to the spatial domain for processing where the user has no limitation on hand direction and will not use any extra material. The light and direction invariant methods for hand gesture recognition were investigated, which provide natural comfort to the user. Also, the controlling of robotic hand using natural hand gives a feeling of virtual hand to the user and it is much better way than entering the values of finger bending angles. Such a robotic hand has real-life applications in commercial, military, or emergency operations, where human life cannot be risked.

The research problems are discussed in Chap. 1. It gives a brief about the gesture recognition process and its effectiveness with real-time constraints. The goals are defined in Chap. 2. Current state of art in the context of natural computing is reviewed in Chap. 3, where different intelligent and soft computing-based HGR techniques are described. The latest results in real-time performance are also given.

It is also shown that current method detects only open fingers efficiently while bent fingers are either not counted or methods ignore them.

The preprocessing is discussed in Chap. 4, where ROI is extracted from the image frame and image would be cropped. The reduced size image would make the further process faster than before. ROI segmentation is also shown using the specialized device MS KINECT®, where depth information is used for gesture detection. The hand gesture recognition is explained in Chap. 5, which demonstrates light-invariant gesture recognition. Few gestures were already selected for the system and their OH was compared with the test image ROI to classify the gesture. The results are encouraging as in two very different lighting conditions, gestures were identified correctly. Gesture classification was perfomed using Euclidean distance and using ANN.

Chapter 6 explains the process of HGP detections using webcam and KINECT. The fingertip detection is direction invariant in both conditions, the user is free to show the hand in any direction. Chapter 7 describes the calculation of bent fingers' angle first using a geometrical method and later using ANN implementation. The performance analysis is also given for both approaches. Chapter 8 discusses what if both hands are shown by the user. A new concurrent fingertip method was applied to reduce computational time.

Further investigations in this area would include closed finger detections and motion-invariant methods. Although, KINECT is able to detect closed finger positions with few constraints using simple devices it can still be achieved. This work is focused on spatial domain analysis, someone can also investigate these issues in frequency domain- or model-based approaches. The performance on real-time embedded system is still a big issue as the cameras are going to have high resolution, more pixels are needed to process in a spatial domain. The processing power and memory is increasing with camera resolution, but methods to minimize these latencies should be investigated.

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