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A Survey on Contactless Gesture based Interactions

K. Mary Sudha Rani[1], Dr. Y. Rama Devi[2], K.V.N Sairaam Reddy[3], Vishnu Gadam[4]
[1]Assistant Professor, [2]Professor, [3,4]Student, Department of CSE, CBIT, India

Abstract: Gesture Based Interaction is the mathematical interpretation of human motion by a computing device. Contactless Gesture Based Interaction with devices aims to offer new possibilities to interact with machines thereby enabling development and design of far more natural and intuitive interactions with computing machines. The system makes use of static and dynamic gestures in order to perform operations on a system. This paper provides a detailed review on contactless systems which facilitates a better means of interaction between humans and machines.
Index Terms : Contactless Gesture Based Interaction, finger segmentation, contours

I. INTRODUCTION TO CONTACTLESS SYSTEMS

One of the major ramifications of the Covid-19 crisis has been the increasing apprehension with regard to contact with foreign surfaces and by extension foreign objects. A wide range of routine utilities such as ATMs and groceries depend on contact for their successful operation, for instance when confirming transactions for the former and whilst generating bills for the later. This forms the gist of the problem which is proving to be a burden on a day to day basis. This impediment has led to uncertainty with regards to safety. Now more so than ever there is a strong emphasis on ensuring safety through minimal contact. This has led calls for systems that fulfill the specified requirements whilst ensuring safety and ease of use. This is where Contactless Gesture Based Interaction with Devices can be essential. It aims to simplify the mathematical interpretation of motion by a computing device and enable the gradual move away from peripheral devices to the use of dynamic interactive devices which eliminate the concept of touch from everyday tasks. Modern research is tending to move from standard peripheral devices such as mouse, keyboard, touch screens etc. to remotely commanding computers through speech, emotions, and body gestures. This project belongs to the domain of hand gesture recognition using video image processing and pattern recognition to interact with the device. In the existing system the users use peripheral devices such as keyboard, mouse, or touch screen to interact with the devices. This has sufficed for generations, but as mentioned earlier the apprehension regarding coronavirus has effectively made these redundant as people who would earlier operate these are dissuaded from the same due to risk of physical contact. Therefore, one would assume that voice-based systems are the future but there are certain inefficiencies in them too. There are quite a few voice based interaction systems although they leave much to be desired in terms of effectiveness and need improvement. We aim to further improve on these systems to provide a rich set of features for easy use. A prominent use of gesture-based interaction is using video game remote controllers to control various actions with gestures, although these aren't appropriate for day to day utilities as they would require a controller to control operation as well as being expensive.

II. RELATED WORKS

Various methods have been adopted for facilitating contactless interaction.

A. Hidden Markov Model based Dynamic Hand Gesture Recognition System using OpenCV

A novel and faster system for dynamic hand gesture recognition by using Intel's image processing library OpenCV. Many hand gesture recognition methods using visual analysis have been proposed: syntactical analysis, neural networks, the hidden Markov model (HMM). A HMM is proposed for hand gesture recognition. The whole system is divided into three stages: detection and tracking, feature extraction and training and recognition. The first stage uses a more non-conventional approach of application of Lαβ colour space for hand detection. While the process of feature extraction is the combination of Hu invariant moments and hand orientation. For the training, Baum-Welch algorithm using Left-Right Banded (LRB) topology is applied and recognition is achieved by Forward algorithm with an average recognition rate above 90% for isolated hand gestures. Because of the use of OpenCV's inbuilt functions, the system is easy to develop, its recognition rate is quite fast and so the system can be practically used for real-time applications.

B. Hand Gesture Detection and Recognition using Principal Component Analysis

A real time system, which includes detecting and tracking bare hands in a cluttered background using skin detection and hand postures contours comparison algorithm after face subtraction,and recognizing hand gestures using Principal Components

Analysis (PCA). In the training stage, a set of hand postures images with different scales, rotation and lighting conditions are trained. Then, the most eigenvectors of training images are determined, and the training weights are calculated by projecting each training image onto the most eigenvectors. In the testing stage, for every frame captured from a webcam, the hand gesture is detected using our algorithm, then the small image that contains the detected hand gesture is projected onto the most eigenvectors of training images to form its test weights. Finally, the minimum Euclidean distance is determined between the test weights and the training weights of each training image to recognize the hand gesture.

C. Real Time Finger Tracking and Contour Detection for Gesture Recognition using OpenCV

The objective of this method is to use one of the important modes of interaction i.e. hand gestures to control the robot or for offices and household applications. Hand gesture detection algorithms are based on various machine learning methods such as neural networks, support vector machines, and Adaptive Boosting (AdaBoost). Among these methods, AdaBoost based hand-pose detectors are trained with a reduced Haar-like feature set to make the detector robust. The corresponding context-free grammar based proposed method gives effective real time performance with great accuracy and robustness for more than four hand gestures. Rectangles are creating some problem due to that we have also implement the alternate representation method for same gestures i.e. fingertip detection using convex hull algorithm.

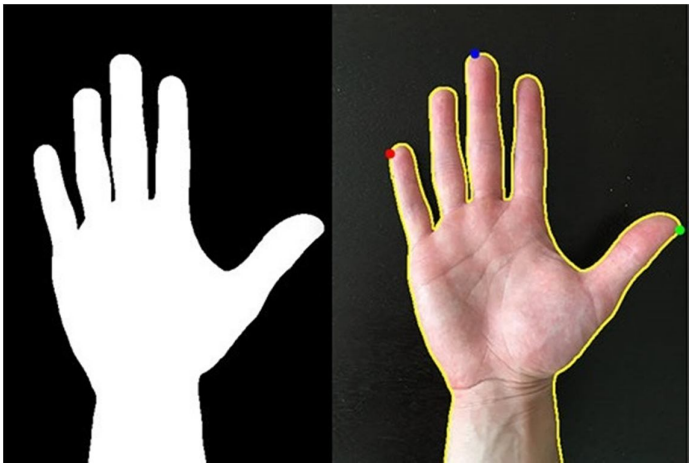

Fig. 1. Masked input

D. Hand Gesture Recognition for Human Computer Interaction

The use of a physical controller like mouse, keyboard for human computer interaction hinders natural interface as there is a strong barrier between the user and computer. In this paper, they have designed a robust marker- less hand gesture recognition system which can efficiently track both static and dynamic hand gestures. Their system translates the detected gesture into actions such as opening websites and launching applications like VLC Player and PowerPoint. The dynamic gesture is used to shuffle through the slides in presentation. Our results show that an intuitive HCI can be achieved with minimum hardware requirements.

E. An Elicitation Study on Gesture Preferences and Memorability Towards a Practical Hand-Gesture Vocabulary for Smart Televisions

With the introduction of new depth-sensing tech-nologies, interactive hand-gesture devices (such as smart televi-sions and displays) have been rapidly emerging. However, given the lack of a common vocabulary, most hand-gesture control commands are device-specific, burdening the user into learning different vocabularies for different devices. In order for hand-gestures to become a natural communication for users with interactive devices, a standardized interactive hand-gesture vo-cabulary is necessary. Recently, researchers have approached this issue by conducting studies that elicit gesture vocabularies based on users' preferences. Nonetheless, a universal vocabulary has yet to be proposed. In this paper, a thorough design methodology for achieving such a universal hand gesture vocabulary is presented.The methodology is derived from the work of Wobbrock et al. and includes four steps: (i) a preliminary survey eliciting users attitudes, (ii) a broader user survey in order to construct the universal vocabulary via results of the preliminary survey, (iii)an evaluation test to study the implementation of the vocabulary and finally (iv) a memory test to analyse the memorability of the vocabulary. The proposed vocabulary emerged from this methodology and achieves an agreement score exceeding those of existing studies. Moreover, the results of the memory test show that, within a 15-minute training session, the average accuracy of the proposed vocabulary is 90.71%. Despite the size of

the proposed gesture vocabulary being smaller than that of similar work, it shares the same functionality, is easier to remember and can be integrated with smart TVs, interactive digital displays,etc.

III. CONCLUSION

The system mask's camera input based on skin area detection, contours and various deformities and uses this masked input to detect static and dynamic gestures in a fixed portion of the screen and perform basic actions depending on the gesture detected. With the current scenario in the world leaning towards the ushering of digital applications the immediate future will be all about contactless applications.

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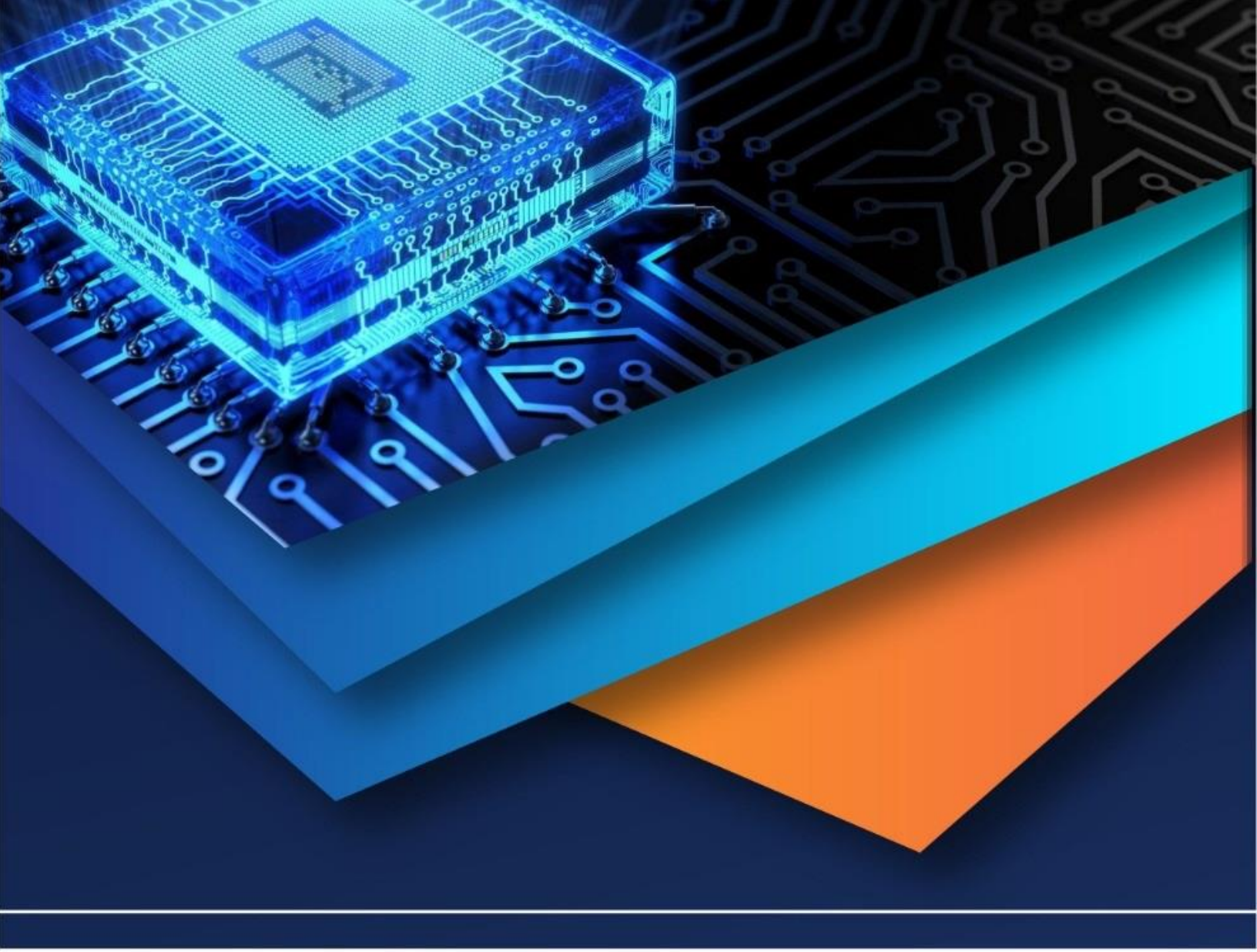

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