STATIC HAND GESTURE RECOGNITION SYSTEM FOR DEVICE CONTROL

[1]CHETHANA N S, [2]DIVYA PRABHA, [3]M Z KURIAN

[1] M.Tech student (Digital Electronics), SSIT, Tumkur, Karnataka
[2]Associate Professor, Dept of ECE, SSIT, Tumkur, Karnataka
[3]H.O.D, Dept of ECE, SSIT, Tumkur, Karnataka
Email: chethana.ns@gmail.com, dpssit@gmail.com, mzkurianvc@yahoo.in

Abstract: The primary goal of Gesture Recognition is to create a system which can recognize specific human gestures and can be used to convey information or for device control. This paper aims at development of a Hand Gesture Recognition (HGR) system captured from a webcam in real time. The system consists of three stages: image acquisition, feature extraction, and recognition. In the first stage input image of hand gestures are acquiesced by digital camera in approximate frame rate. In second stage a rotation, scaling and orientation invariant feature extraction method has been introduced to extract the feature of the input image. Finally, edge detection is used and K-Curvature algorithm is applied to recognize the hand gestures.

Keywords: Hand Gesture Recognition, Static HGR

I. INTRODUCTION

Gesture is a form of nonverbal communication or non vocal communication in which visible bodily movement communicate particular messages. Gesture includes movement of hands, face or other parts of the body.

A Gesture is categorized into two distinctive categories Dynamic and Static. Dynamic gesture is intended to change over a period of time where as a static gesture is observed at the spurt time. Static (posture or certain pose) requires less computational complexity. Dynamic (Sequence of postures) are more complex but suitable for real time environments.

Two approaches are commonly used for acquiring information necessary for gesture recognition system.

1. Methods which use Data gloves: mechanical or optical sensors are attached to a glove that transduces finger flexions into electrical signals for determining the hand posture. This approach forces the user to carry a load of cables which are connected to the computer and hinders the ease and naturalness of the user interaction.
2. Methods which are Vision Based: This method is based on the appearance of hand using skin color to segment the hand and extract necessary features. This is easy, natural, non invasive and less cost compared to other method.

Figure 1: Block diagram of HGR System

Image acquisition is followed by pre processing and then feature extraction succeeded finally by the classification stage. In image acquisition, the input image of the hand gesture is acquiesced by camera. Pre processing includes noise filtering, RGB to Gray scale conversion, etc. feature extraction includes background separation, image enhancement, converting to binary image, edge detection etc. depending on the algorithm used for classification, features of the image is extracted. Recognition or classification is a process of identifying the gesture, for which different algorithms like k-curvature, SVM, HMM etc algorithms can be used depending on the application.

After the recognition of the gesture, the command signal is generated according to the sign and it can be passed to the device for controlling.

The main applications are Robot control, Television control, 3D modelling, Virtual Environments, Graphic Editor Control etc.

The goal of this paper is to create a system which can identify specific hand gestures and use them for device control by overcoming few constraints which occur in the existing methods.

II. RELATED WORK AND CONTRIBUTIONS

Jean-Francois collumeau et al. introduced the simulation of gesture based remote control interface intended for operating rooms. A complete vision-based surgeon-computer interaction simulator has been introduced in this paper. System consists of a software image processing chain coupled with a virtual surgical lighting arm and a graphical interface[1]. Harish Kumar Kaura et al. implemented a system through which the user can give command to a wireless robot using gestures. Through this method, the user can control or navigate the robot by using gestures of his/her palm, there by interacting
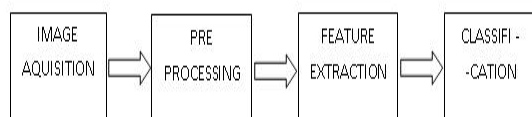
with the robotic system. Technologies used are C++ with Open CV and Arduino Duemilanove. After pre processing, the Convex Hull method is used for recognition. Wi-Fi shield connects Arduino to a Wi-Fi connection. Implementation makes use of periodic polling from WiFly to the web server to access the command signal in real time. This method of periodic polling may overload the server [2]. Asanterabi Malima et al. developed an algorithm for recognizing a limited set of gestures from hand images for a robot control application. It involves segmenting the hand based on skin color statistics as well as size constraints. Then centroid or Centre Of Gravity (COG) of hand and farthest point from the COG is found. Circle with radius 0.7 of farthest distance from the COG is drawn. 1D binary signal is extracted by tracking the circle. By counting number of zero to one transition in this 1D signal and subtracting one leads to the estimated number of fingers active in the gesture. This technique does not require the storage of a hand gesture database in the robot's memory [3]. Nancy et al. has done the analysis of Hand Gesture recognition technique using finger movement detection based on color marker. This approach is based on red color marker detection. Red color marker on fingertip of user's hand wearing white cloth glove is used. The system would only detect the red color marker and it makes possible to point a finger having red color marker. In this paper, they have used a pointed gesture with the help of red color marker, only the finger wearing red color marker is detected and it us used for pointing on the computer screen. The inconvenience of placing markers on the user's hand makes this approach infeasible in practice [4]. Yikai Fang et al. proposed a real time hand gesture recognition method. In this method, they reduced the computation expense by detect multi-scale feature across binary image and make hand gesture interface more practical by combine this feature detection with hand tracking and segmentation. Altogether this method combines fast hand tracking, hand segmentation and multi-scale feature extraction to develop an accurate and robust hand gesture recognition method [5]. Tasnuva Ahmed presented a neural network based real time hand gesture recognition system. They have explained the whole system of hand gesture recognition in four phases. Image acquisition; Image processing, Feature Extraction and HGR. Feature of input image based on moment feature extraction method is used. So that the system can recognize hand gestures captured in different angle or orientation or size. As Artificial Neural Network is used to recognize the hand gesture, even it is rotation, translation, scaling and orientation independent, the delay occurs due to training needed for artificial neural network and switching delay between the nodes [6]. Mithun G Jacob et al. presented a method for surgical instrument handling and retrieval in Operating Room with a multimodal Robotic assistant. They have used

a Microsoft Kinect sensor to acquire depth information used to segment the hand and localize the fingertips. 3D trajectory of the fingertips is used to classify the dynamic gesture, smoothened with Kalman filters and then quantized for classification with a set of Hidden Morkov Models (HMM) and they have used a microphone with the CMU Sphnix to recognize speech commands. The command is sent to robotic arm across the network to deliver the instrument [7]. Amiraj Dhawan & Vipul Honrao introduced methods for Human Computer Interaction using the user's hand. They have compared the different methods for all the preprocessing tasks required and then created a pipeline of these preprocessing tasks and then used the detected hand as an interaction device for HCI applications. They have explained two types of hand segmentation, with background constraint and relaxed background constraint.

With background constraint includes the methods static threshold value, incremental thresholding value, thresholding using Ostu's method, and dynamic thresholding using color at real time. Relaxed background constraints include the methods color based thresholding, background subtraction. They explained hand detection can be done by drawing contours, convex hull method and convexity defect is found. They proposed three techniques for interaction finger counting, hand orientation, and finger tracking [8]. shwetha k. yewale et al. presented an overview of different methods for recognizing the hand gestures using MATLAB. They explained edge detection using canny edge detection algorithm and skin detection using hue and saturation values of various possible skin tones can be used for hand gesture recognition. ANN algorithm is used to train the system and concluded that edge detection and ANN provides good solution for hand gesture recognition using MATLAB [9].

III. SYSTEM ARCHITECTURE

The proposed system in this paper is designed to recognize hand gesture in real-time. The technique used to recognize hand gesture is based on Computer Vision. The Basic flow of the system is shown in the figure 2.

- Collect the picture of gesture taken through the video camera.
- Image frame is processed using image processing
- Processed image is used to extract features for gesture recognition.
- Counting number of fingers using the features extracted.
- Command signal is generated and passed to the device
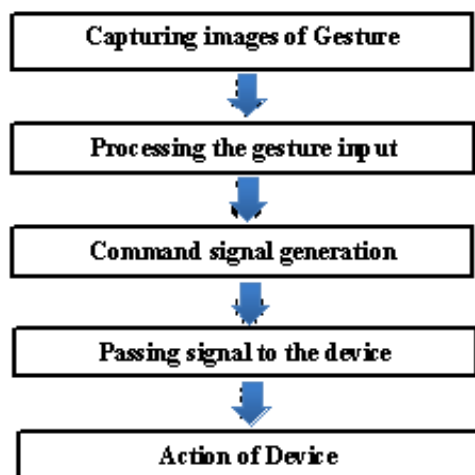- According to the command, the device action takes place.

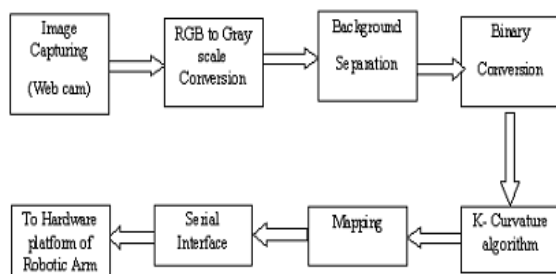**Figure 2: Basic flow of the System**

Figure 3: Architecture of the Hand gesture recognition system

Overall system architecture is shown in the figure3.

- Capture the image through the web camera or camera.
- Convert the image from RGB to Gray Scale.
- Background is separated by subtracting image from the captured background.
- Binary conversion is done to apply edge detection.
- Then K-Curvature algorithm is applied for hand gesture recognition.
- The recognized gesture command is sent through serial interfacing and device controlling (Robotic arm) is done.

IV. ADVANTAGES OVER EXISTING SYSTEMS

- Web cameras of PC's or Laptops can be used for capturing gesture inputs
- Provides flexibility to the user and system is portable
- It does not involve template matching to identify the finger count. Rather, each image frame is processed and the command is generated in real

time.
- It is rotation, scaling and orientation invariant

V. APPLICATIONS

- It can be used in Operating Room to pick and place the surgical instruments.
- It can be used to control Robotic arm.
- Industrial application.
- Security and Surveillance.
- Search and rescue operations.

CONCLUSION

This paper describes a brief study of the recent developments in Hand gesture recognition system for device. K-Curvature algorithm is applied for HGR and which can have few advantages over the existing system are observed.
In addition system can be improved to work compatible under different light conditions.

REFERENCE

[1] Jean-Francois Collmeau, Elyse Nespoulous, Helene Laurent and Benoit Magnanain "Simulation interface for gesture based remote control of a surgical lighting arm" IEEE International Conference on Systems, Man, and Cybernetics 2013.

[2] Harish Kumar Kaura1, Vipul Honrao2, Sayali Patil3, Pravish Shetty4, "Gesture Controlled Robot using Image Processing" (IJARAI) International Journal of Advanced Research in Artificial Intelligence, Vol. 2, No. 5, 2013.

[3] Asanterabi Malima, Erol Ozgur, and Mujdat Cetin "A Fast Algorithm for vision-based Hand Gesture Recognition for Robot Control" IEEE International conference on Computer Vision, 2006.

[4] Nancy and Gianetan singh sekhon "An Analysis of Hand Gesture Recognition Technique using Finger Movement Detection Based on Color Marker" Vol 3, No.1, January-June 2012, pp,129-133.

[5] Yikai Fang, Kongquiao wang, Jian Cheng and Hanquing Lu "A Real Time Hand Gesture Recognition Method" ICME, IEEE 2007

[6] Tasnuva Ahmed "A Neural Network based Real Time Hand Gesture Recognition System" International Journal of Computer Applications (0975 – 8887) Volume 59– No.4, December 2012.

[7] Mithun G. Jacob, Yu-Ting Li, Juan P. Wachs "Surgical Instrument Handling and Retrieval in the Operating Room with a Multimodal Robotic Assistant" IEEE International Conference on Robotics and Automation (ICRA) Karlsruhe, Germany, May 6-10, 2013.

[8] Amiraj Dhawan, Vipul Honrao, "Implementation of Hand Detection based Techniques for Human Computer Interaction" International Journal of Computer Applications (0975 – 8887) Volume 72– No.17, June 2013.

[9] Shweta. K. Yewale, Pankaj. K. Bharne "Hand Gesture Recognition Using Different Algorithms Based on Artificial Neural Network" International Journal of Electronic signals and systems 2011.

★ ★ ★