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Finger Gesture Recognition Using Laser Line Generator and Camera

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Abstract – *This paper presents the information about finger gesture recognition using laser line generator and camera. Gesture recognition relates to perceiving important aspect of movement by a human, including the hands, arms, face, head, as well as body. It is of most extreme significance in designing an insightful and efficient human– computer interface. Gesture based interactions are becoming more and more popular in today's world. The project intends to develop a system that can recognize gestures which can be used as an input command to interact with the PC/laptop which can be applied to certain applications on that system. The method involves following steps, namely-image acquisition, image pre- processing, gesture detection, and gesture recognition.*

Keywords **-**Gesture, Human-Machine interaction, Laser line, Image acquisition, Feature extraction, Gesture matching.

1. INTRODUCTION

Today's era technology is developing rapidly and new innovations are done, the need for human and machines interaction also increases. So to meet the need of interaction between human and machines gesture recognition systems are developed. Innovation of such system have eliminated the use of mouse for interacting with computer.

Gesture is a form of nonverbal communication which involves movement of a part of the body, especially the hand usually to express an idea. While communicating with each other, we make use of speech, gestures and body movements to convey information[2].Likewise while communicating with computers we make use of input devices such as mouse or keyboard. But this way of communication is not natural. So in order to make the interaction natural gesture recognition systems are developed. Driven by this subtle objective of making hand one of the main modal for interaction between human and computer huge amount of activities have been given to hand gesture recognition. So far, the greater part of research work is highlighted on recognition from images and videos due to popularity of cameras .The ongoing advancement in depth sensors such as Microsoft's Kinect device has created another dimension of energy in hand gesture recognition. In computer vision, the hand gesture recognition can be treated as a combination of three sub parts hand. detection, tracking the hand and gesture recognition[1]. For deaf and mute people hands are important for communication, so hand gestures are vital for communication in sign language. The existing real life applications of gesture based human-machine interaction are: in controlling robots, in gaming sector, translation of body and sign language and in controlling machines.

The proposed system has been emphasized on developing an efficient scheme that can accomplish hand gesture recognition without introducing any training related overheads. This system will work as one of the futuristic of Artificial intelligence and computer vision with user interface. The main priority of the system is to be simple, easy and user friendly without making any special hardware. All computation will occur on single PC or workstation. Only special hardware will be used to digitize the image-Web camera and Laser line.

2. RELATED WORK

There are many gesture recognition techniques developed for recognizing various gestures performed by user. Following works has been analyzed by us for developing our gesture recognition system.

In 2017, Athiya Marium et.al [1] presented a Hand Gesture Recognition using Webcam which uses built in functions for every gesture provided by the PyAutoGUI module. It is coded in Python and uses OpenCV library. The image pre-processing techniques involved are color filtering, smoothing, and thresholding. The algorithm implemented in this paper detects the gesture based on the number of contours that are visible and thereby performs the necessary operation related to gesture.

Ann Abraham Babu et al. [7] proposed another gesture recognition technique using contour analysis In the first phase, the input image is acquired with the help of a camera. In the second phase, the skin color of hand region is detected using HSV color space and morphological operations such as erosion and dilation are performed to remove noise followed by smoothing and thresholding of hand image. In Feature extraction phase, contours of hand image are detected. Finally, Gesture recognition phase includes recognizing hand gestures using contour analysis by comparing Auto-Correlation Function (ACF) amongst the contours and if they are close, then calculate Inter-Correlation Function (ICF) to truly determine similarity. Each recognized gesture is assigned with the corresponding action.

A. Kurakin et al.[8] proposed a system which is evaluated on a challenging dataset of twelve dynamic American Sign Language(ASL) gestures .In this a method called action graph is used for back-end classifier.

3. METHODOLOGY

The following figure mentions a basic idea of the system we have proposed.

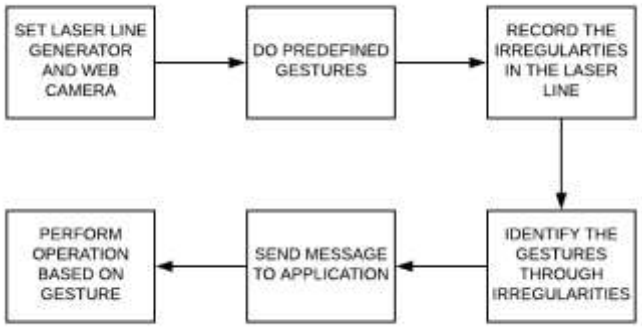

Figure 1: Block diagram of proposed system.

Our gesture recognition system includes the following steps:

1) Image acquisition: This step involves capturing images frame by frame using a webcam.
2) Image pre-processing: In this the images which are captured by webcam go through some image pre-processing process which involves color filtering, smoothing and thresholding.
3) Gesture detection: This step involves method which extracts the feature from the image. A laser line is used
4) on which finger gesture is performed and the irregularities in the laser line are detected. Using the irregularities features are extracted.

5) Gesture recognition: This step involves recognition of the finger gesture with the help of extracted features. After recognition related operation which is assigned to the action is performed.

4. TECHNIQUES

Step 1: Read and write bitmap images.

In this step, we have developed an algorithm which reads the bitmap images along with their header and also writes the data to another file to create the exact copy of the bitmap image. This will be useful for capturing the gestures provided by the user and then doing image preprocessing on that image and then returning the output to the user.

Step 2: Implement a routine which detects the presence of fingers based on color.

In this task, we have developed an algorithm to detect whether a finger is present or not in an image. This will help us to identify if the hand is present and if present it will perform the further functions.

1) Implement algorithm to covert rgb image into gray scale image.

Conversion formula used is
gray[i][j]=(pixel[i][j].b*0.3)+(pixel[i][j].g*0.59)+(pixel[i][j].rr*0.11);

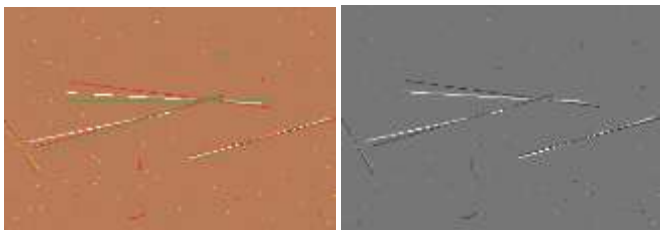

Figure 2: input-output

2) Implement a routine which removes unwanted objects from the image.

Here we used technique similar to Grassfire transform to remove the noise and to keep only that data which we want for recognition purpose. The algorithm checks the neighbouring 8 pixel of a pixel which we have implemented using recursion. If the number of pixels are less than a threshold count we consider it as noise and then convert it value to white. The lines which are hidden i.e observable from down are considered.

Figure 3: input-output

3) The discontinuity in the lines in output image indicates the finger.

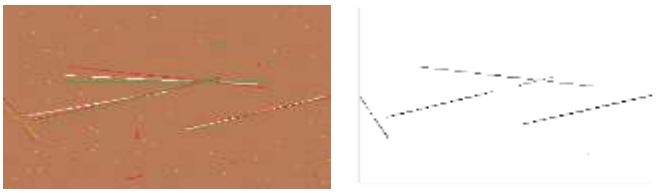

Figure 4: input-output

Step 3: Implement a routine which detects the presence of laser line and finds it's orientation.

In this, we have developed an algorithm to detect the presence of laser line and it's orientation in the image. The algorithm first converts the RGB image into grayscale and then checks for pixels with value 0.Then that pixels are saved which indicates the presence of laser line.

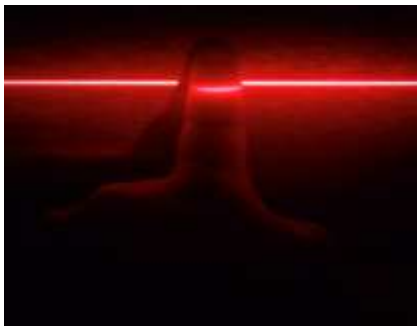

Figure 5: Laser Line

Task 4: Interface a webcam and perform the finger detection only along the laser line.

In this , we have developed an algorithm in which alignment of finger along the laser line will be detected. If the finger is not aligned properly then the gesture recognition will not begin.

Task 5: Based on the Lookup Table (LUT) react to the user's gesture.

After this, an algorithm to react to the extracted gesture is developed. Related operation will be performed.

5. EXAMPLE

Figure 6: Input gesture

If this is the gesture done by user then the opera browser will be opened on your laptop/desktop.

Figure7: Output

6. CONCLUSION

The proposed system will control the computer application with the help of finger gestures. The method proposed here will successfully create a finger gesture recognition system using laser line generator and camera, which will be able to recognize gesture performed by user and accurately perform the respective function. Our system will eliminate the use of mouse and make the human-machine interaction simpler through gestures.

7. HARDWARE

Figure 8: Laser line generator

Figure 9: Webcamera

8. REFERENCES

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