

MEDIA CONTROL AND HARDWARE CONTROL USING HAND GESTURE RECOGNITION

Nireeksha Shetty

Priyanka Vallakathi

Apurva Tupe

Anita Shirude

Abstract— In the field of image processing it is usually important to identify the human gestures for general life applications. Gestures are a major form of human interactions. Gesture recognition has a vast scope in the field of research among various human computer interactions and it eases the communication between human and machines. It provides a non verbal way for humans to communicate with the machines and therefore it is full of innovative approach. This approach is used to identify the basic hand gestures. The main feature used in this project is to detect the image through web camera and to process it dynamically. This approach can further be used in real time system as well. The project describes the schemes of capturing the image using image detection algorithm and processing the image to recognize the gestures as well as to give the result. This project aims to control the media player as well as hardware (i.e. toy car) using the hand gestures.

Keywords— Image Processing, Dynamic Gesture Recognition, Human Computer Interaction, Blurring, Noise reduction, RGB to HSV conversion, HSV Thresholding, Image Grab, Blob Detection, Vector calculation.

I. INTRODUCTION

Gesture Recognition is a study in computer science in order to interpret human gestures via various mathematical algorithms. Gestures can be any form of bodily movements, usually from the face or hands. The main goal of gesture recognition is to enable the machines to understand human body language and to communicate with them via gestures. Many techniques have been introduced to identify human gestures for the ease of communication between the various machines and humans. Gesture recognition thereby builds a richer bridge between the machines and humans. It enables humans to interact with the machines without any use of mechanical devices such as a keyboard or a mouse. Gesture Recognition can be implemented using a technique such as Image Processing.

Image Processing is a method which converts an actual image into a digital form and performs particular operations over it in order to get an enhanced image. It is a form of signal processing in which input is an image and output is the characteristics or parameters of that particular image. Image processing is also

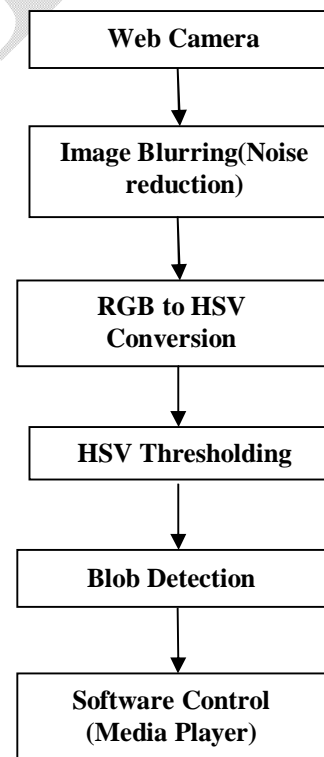
used for retrieving information from a particular image. Image Processing is a rapidly growing technology used these days.

1.1 Goal

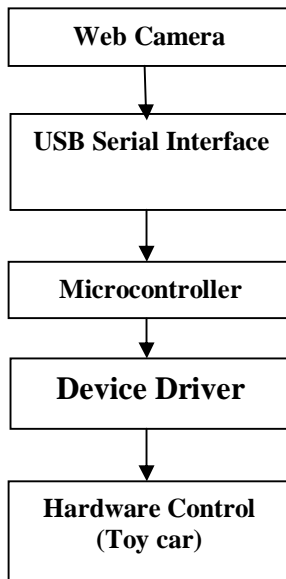
The goal of this project is to create a program to implement real time gesture recognition. At any point of time the user can use his hands in order to do a specific gesture in front of the web camera interfaced with the system. The program has to capture those gestures, analyze it and identify the sign. The identification of gestures would take place by detecting the colour pointers used by the user in the input picture.

II. PROPOSED SYSTEM

SOFTWARE SYSTEM



HARDWARE SYSTEM



movements. The video is then processed to extract the predefined colour pointer. After detecting the colour pointer on hands, the software or hardware system is controlled according to the gestures. In order to minimize the errors, the surrounding must not contain the same colour as colour pointer.

The resolution of the web camera is kept at 320*240 pixels for better quality of video. The image captured by web camera is in RGB colour model. The image is then converted to HSV colour model for better resolution. The hue, saturation and value is calculated for each pixel of grabbed image. The colour pointers on hands are represented using black colour and other regions are represented using white colour.

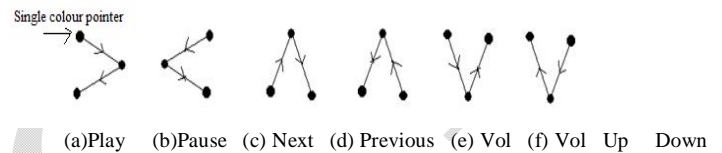


Fig 2 : shows the hand gestures for media player control (software control).

III. RELATED WORK

3.1 Web Camera

The use of a web camera is to capture human gestures. The package called JMyron is used to interface the web camera with the system.



Fig. 1 : Interaction among the components

3.2 Fetch Image Through Web Camera

The user makes hand movements using colour pointers as per the predefined gestures in the system and web camera captures these

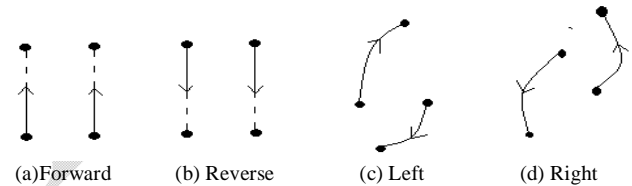


Fig 3 : shows gestures for controlling the hardware. It requires two colour pointers.

3.2 Image Blurring (Noise Reduction)

Blurring is technique in which image is processed and noise is removed to get a pure image. Blurring is very useful for generating Background images and Shadows .Blurring is done using filtering method.

Common types of noise:

- 1) **Salt and pepper noise:**
 This noise contains random occurrences of black and white pixels.
- 2) **Impulse noise:**
 This type of noise normally contains random occurrences of white pixels.
- 3) **Gaussian noise:**
 This type of noise usually contains variations in intensity drawn from Gaussian normal distribution.



Original

Salt and pepper noise

Impulse noise

Gaussian noise

There are three Blurring Techniques:

- 1) 3*3 Windowing Technique
 - 2) 5*5 Windowing Technique
 - 3) 7*7 Windowing Technique
- 5*5 Blurring Technique:

Since images usually contain noise, this noise should be removed as a part of pre-processing task. For the noise removal we are using 5*5 Gaussian filter. Gaussian filtering is more effective at smoothing images.

The average filter and its variations give an equal vote to all neighbours around the center of the rectangular filtered image. A better way is to give more power to near neighbours than to distant ones. A Gaussian distribution

clustered around the kernel centre is an intelligent way to distribute graded power to near and distant neighbours.

$$K = \frac{1}{25} \begin{bmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \end{bmatrix}$$

The above operation shows that add all the 25 pixels, take its average and replace the central pixel with the new average value and continue this operation for all the pixels in the image.

IV. RGB TO HSV CONVERSION

4.1 RGB Colour Model:

The RGB colour model approximates the way human vision encodes images by using three primary colour channels: red, green, and blue.

In RGB colour model red, green, and blue channels combine to create all the available colours in the system. When all three primary colour values are the same, the result is neutral, or greyscale.

Secondary colours are combinations of two primary colours: red mixed with green is yellow, green mixed with blue is cyan, and blue mixed with red is magenta.

V. HSV COLOUR MODEL

Hue:

Hue describes the actual colour itself, whether it's red or green or yellow. Hue is measured as an angle on a colour wheel.

Saturation:

Saturation describes the intensity of a colour, whether it's a bright red or a pale red. An image that is completely de-saturated has no colour at all and is a greyscale image. Saturation is also measured on a colour wheel, but as the distance from the centre of the wheel to the edge.

Value:

Value represents Brightness of Colour.

Advantages of HSV colour model over RGB colour model

- Strong model than RGB because it offers a more intuitive representation of the relationship between colours.
- HSV select more specific colour.
- In HSV model value of 'H' and 'S' remain constant if the value of 'V' changes, but value of RGB changes with the change in 'V'

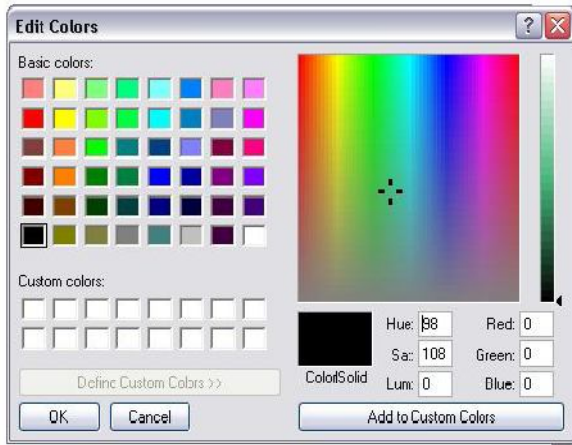
5.1 Conversion from RGB to HSV:

• Algorithm:-

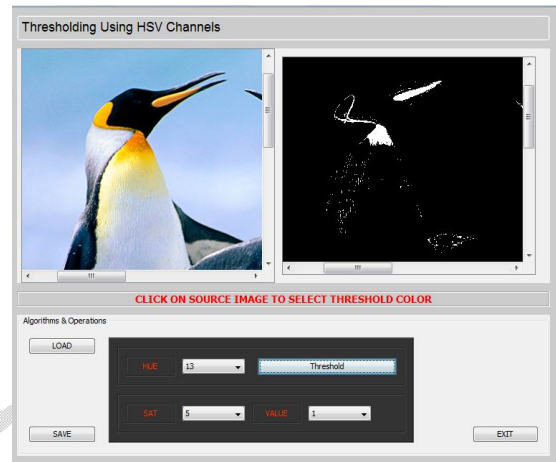
1. Load image.
2. Read each pixel from image
3. Separate RGB color for each pixel.
R = col & 0xff;
G = (col >> 8) & 0xff;
B = (col >> 16) & 0xff;
4. Find min value and max value from R,G,B.
5. Assign max to value.
6. If value equal to zero the
assign hue=saturation =0.
set pixel in image again.

As seen in the above image if value(Lum)=0 then output color is black i.e there is no brightness in the colour hence Hue and Saturation will be zero.

7. Else



range. We can use it to enhance a black and white image or to create selection masks.



```
//Formula for finding Saturation.
Find saturation= 255 * (Max-Min)/value.
if saturation is zero then
assign hue is zero.
set pixel
end if
Else
if max equal to R then
```

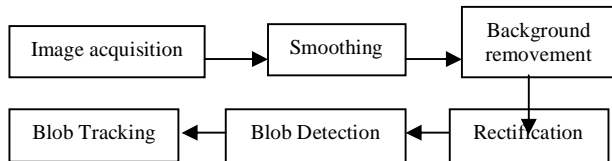
```
//Formula for finding Hue.
hue = 0 + 43*(G-B)/(max-min).
End if.
If max is equal to G then
hue = 85 + 43*(B-R)/(max-min).
End if
If max is equal to B then
hue = 171 + 43*(B-R)/(max-min).
End if.
If hue<0 then
hue=hue+255.
End if.
End if.
8.Set each pixel again on image.
End.
```

Algorithm for HSV Thresholding:

- i. Decide Threshold value.
- ii. Compare the value.
- iii. Calculate the binary output pixel value (black or white) based on current threshold.
- iv. Store the new value at same location in output image.

Blob Detection
1. Blob Analysis

In image processing blob is defined as region of connected pixels. Blob detection is the identification of these regions in an image.

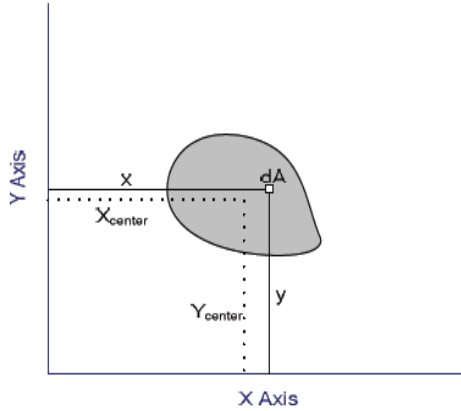


First the image is captured by web camera. Noise is then removed from the image to get blurred image in smoothing process. Then the background is subtracted from an image only an colour pointer area's information remained. The rectification process is used to detect existence of blobs. If blob exists, the size, coordinate value of centre of each bob can be calculated respectively.

Blob detection is used to detect contact area from an image. In typical applications of using blob analysis, blob's area, shape, diameter, perimeter and location are important features required to be calculated. In processing, blob detection function is required to identify same gray level pixels from the image. And these pixels are separated into different blobs based on relationship of inter-connection.

Blob coordinate calculation

After blob detection, contact blobs are separated from the whole image. A centroid calculation algorithm is used in the study to calculate the coordinate value of center point of the blob. Figure 4 shows the position of centroid. (X_{center}, Y_{center}) is the coordinate values of centroid of the object.

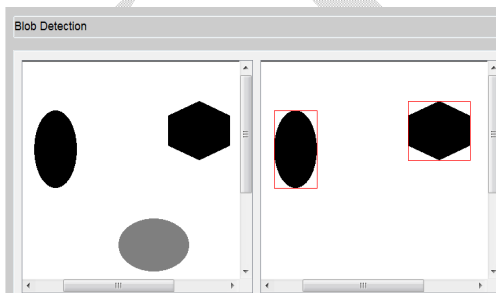
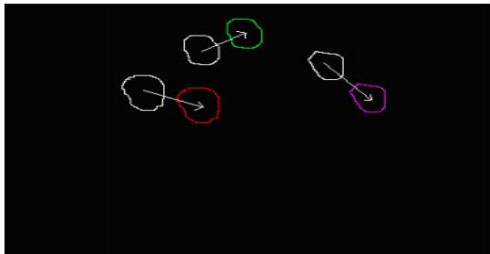


Equation 1 is used for centroid coordinate calculation. x_{center}, y_{center} are the centroid coordinates of the blob

$$x_{center} = \int_A x dA / A, y_{center} = \int_A y dA / A \quad (1)$$

Blob Tracking:

Blob tracking is important task of gesture recognition. This task includes the recognition of the corresponding blobs for detecting of touch events.



Blob tracking helps to identify the finger's actions and movements. To recognize corresponding blobs from many blobs in a series of images, we use Minimum Distance First algorithm (MDF).

Consider there are P blobs in the first image and Q blobs in the second image, in the first image, all blobs' coordinate values are

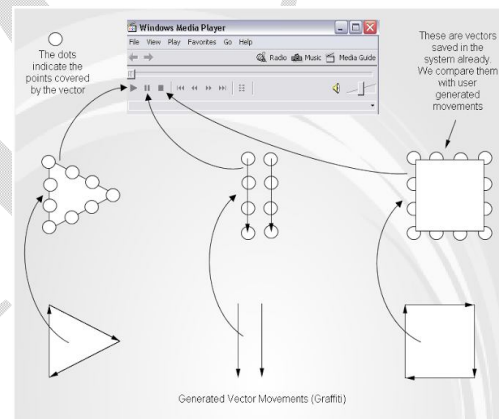
stored in two array variables (x_{oldi}, y_{oldi}) , where $1 \leq i \leq P$ and in second image, blobs' coordinate values are stored in two array variables (x_{newj}, y_{newj}) , where $1 \leq j \leq Q$. A dynamic two-dimension array $D(i,j)$ is considered for storing the distance values of each blob. The distance between two blobs can be calculated through equation 2.

$$D(i, j) = \sqrt{(x_{oldi} - x_{newj})^2 + (y_{oldi} - y_{newj})^2} \quad (2)$$

The blobs with minimum distance are usually treated as the corresponding blobs, depends on the distance calculated between two blobs. And then, a recursive method is applied to qualify the validation of the corresponding blobs.

Vector Calculation

Vector calculation relates to a hand gesture recognition system and in this method collection of images, wherein a hand is represented, is received in real time dynamically and is processed to represent the colour pointer region in each image as a vector, and then the vectors are processed to identify hand gestures.



VI. SOFTWARE CONTROL

In this project the software considered is the Media Player. Once all the above methods and algorithms have been performed the vector patterns are matched and then the Media player can be controlled to perform various operations such as Play, Pause, Change tracks(i.e. Next, Previous) and can also control the Volume accordingly.

VII. HARDWARE CONRTOL

MICROCONTROLLER

In our project we are using 89C51 Microcontroller. The AT89C51 is a CMOS 8-bit microcomputer with 4K bytes of

Flash programmable and erasable read only memory (PEROM). The on-chip Flash allows the program memory to be reprogrammed in-system. Atmel AT89C51 is an efficient microcontroller (as they are used inter-changeably) which provides a highly-flexible and cost-effective solution to many embedded control applications.

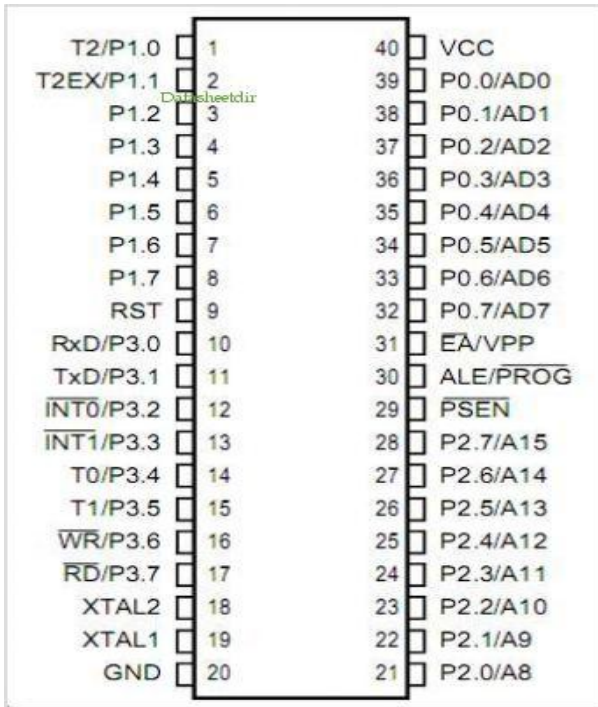
This **RF module** contains of an **RF Transmitter** and **Receiver**. An RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected at pin4. The transmitter/receiver (Tx/Rx) pair operates at a frequency of **434 MHz**. The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter. The transmission occurs at the rate of 1Kbps to 10Kbps.

VIII. CONCLUSION AND FUTURE SCOPE

This system is helpful for communicating with a deaf and dumb person. The system takes less time for pattern recognition. The recognition rate of all gestures is in between 70-80% which is an acceptable range. Every user can get information from the system by hand gestures and cost will be cheaper than touchpad. In project presentation, the slides can be controlled using hand gestures. Thus Hand Gesture Recognition can be extended to be used for various real time applications such as Interactive Gaming Platforms, Industrial Applications, AC Control, Television Control.

References

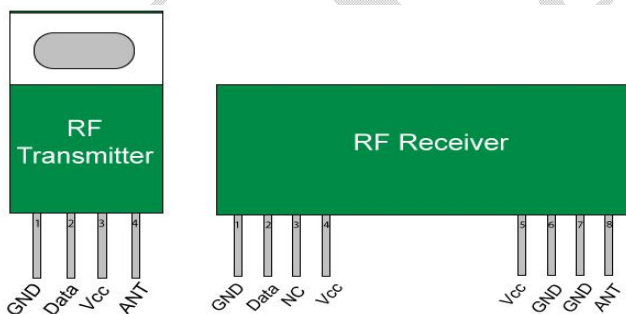
- [1] Ankita Saxena,Deepak Kumar Jain,Ananya Singhal Central Electronics Engineering Research Institute, Pilani 333031, Rajasthan, “Hand Gesture Recognition using an Android Device”, in Central Electronics Engineering Research Institute, Pilani 333031,Rajasthan.
- [2] Zhou Ren, Junsong Yuan, *Member, IEEE*, Jingjing Meng, *Member, IEEE*, and Zhengyou Zhang, *Fellow, IEEE*, ” Robust Part-Based Hand Gesture Recognition Using Kinect Sensor”, in IEEE TRANSACTIONS ON MULTIMEDIA, VOL. 15, NO. 5, AUGUST 2013.
- [3] Chen-Chiung Hsieh and Dung-Hua Liou Dept. of Computer Science and Engineering, Tatung University Taipei, Taiwan and David Lee Reallusion Inc.2F, No. 126, Lane 235, Pao-Chiao Rd. Hsintien, Taipei County 231, Taiwan.” A Real Time Hand Gesture Recognition System Using Motion History Image”, in 2010 2nd International Conference on Signal Processing Systems (ICSPS).
- [4] C. Keskin, A. Erkan, L. Akarun ,” Real Time Hand Tracking and 3D Gesture Recognition For Interactive Interfaces Using HMM”, in Computer Engineering Dept. Boğaziçi University.
- [5] Jagdish Lal Raheja, Radhey Shyam, G. Arun Rajsekhar and P. Bhanu Prasad ,”Real-Time Robotic Hand Control Using Hand Gestures”, in Digital Systems Group, Central Electronics Engineering Research Institute(CEERI)/Council of Scientific & Industrial Research (CSIR), Pilani, Rajasthan, India.
- [6] Lindeberg, Tony ,”Evaluation of HMM Training Algorithms for Letter Hand Gesture Recognition”, in Hazewinkel, Michiel, Encyclopedia of Mathematics, Springer, ISBN 978-1-55608-010-4.
- [7] am Rajesh J Nagarjunan D Arunachalam RM and Aarthi R Department of Information Technology, Amrita VishwaVidyaapeetham, Coimbatore,



DEVICE DRIVER

RF transmitter and receiver:

Pin diagram



Signals through RF travel through larger distances making it suitable for long range applications. RF signals can travel even in case of obstruction between transmitter & receiver. RF transmission is more reliable and strong . RF communication uses a specific frequency .

India and Assistant Professor Department of Information Technology, Amrita VishwaVidyapeetham, Coimbatore, India, "Distance Transform Based Hand Gesture Recognition For PowerPoint Presentation Navigation", in *Advanced Computing: An International Journal (ACIJ)*, Vol.3, No.3, May 2012.

- [8] Sheng-Yu Peng CSIE, Tamkang University Taiwan, Kanoksak Wattanachote CSIE, Asia University Taiwan, Hwei-Jen Lin CSIE, Tamkang University Taiwan, Kuan-Ching Li CSIE, Providence University Taiwan, "A Real-Time Hand Gesture Recognition System for Daily Information Retrieval From Internet", in *Fourth International Conference on Ubi-Media Computing*.
- [9] Asanterabi Malima, Erol Özgür, and Müjdat Çetin (2010), "A Fast Algorithm For Vision-Based Hand Gesture Recognition For Robot Control", in *Faculty of Engineering and Natural Sciences, Sabancı University, Tuzla, İstanbul, Turkey*.