

Robotic ARM using Computer Vision

M Sandeep, Lavanya Shivgonda, Rajeswari M, Kaushik S, Nikhil Tengli



Abstract— A Bot which pursues Human hand developments. Its unlimited authority lies with the client and doesn't have any knowledge of its own. Programmed robots having man-made brainpower are a danger to society and may cause hurt in certain situations. Subsequently, having full oversight over the robot is a protected method to work with such robots. In this paper, we have proposed a comparable arrangement of a robot. catching pictures from the PC web cam progressively condition and procedure them as we are required. By utilizing open source Computer vision library (OpenCV for short), a picture can be caught on the basis of its Hue saturation value (HSV) extend. The fundamental library capacities for picture dealing with and handling are utilized. Fundamental library capacities are utilized for stacking a picture, making windows to hold picture at run time, sparing pictures, and to separate pictures dependent on their shading values. I have additionally connected capacity to edge the yield picture so as to diminish the twisting in it. While handling, the pictures are changed over from their essential plain Red, Green, and Blue (RGB) to an increasingly reasonable one that is HSV.

I. INTRODUCTION

PC vision is an interdisciplinary field that manages how PCs can be made to pick up an abnormal state understanding from advanced pictures or videos. It depends on ongoing innovation of Computer vision. It doesn't require any gloves or other overwhelming contraption. This technique requires just web camera to remove the video outline. Today the greater part of the workstations have an incorporated webcam alongside it so it is an effectively accessible gadget

The thought here is to computerize assignments that the human visual frameworks can do. In this way, a PC ought to almost certainly perceive objects like the essence of an individual or even a statue. In this the camera input identifying and detecting a hand using various algorithms in OpenCV. The computer reads any image as a range of values between 0 and 255. For any color image, there are 3 primary channels — red, green and blue.

II. RELATED WORK

This segment quickly talks about a portion of the work done by different creators in the field of PC vision and mechanical arms.

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* Correspondence Author (s)

Mr. M Sandeep, School of C & I T, REVA University,
Ms. Lavanya Shivgonda, School of C & I T, REVA University,
Ms Rajeswari M, School of C & I T, REVA University,
Mr. Kaushik S, School of C & I T, REVA University,
Mr. Nikhil Tengli, School of C & I T, REVA University,

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The majority of the scientists arranged motion acknowledgment framework into primarily three stages subsequent to getting the info picture from camera. These are: Extraction Process, highlights estimation and grouping or acknowledgment as appeared in Figure 2.1

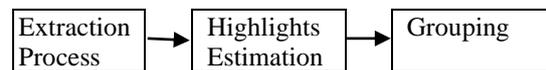


Fig 2.1: Data processing

- Extraction process and picture pre-handling

Division is the primary procedure for perceiving hand signals. It is the way toward isolating the information picture into Districts isolated by limits. The division procedure is relies upon the kind of motion, in the event that it is dynamic signal, at that point the hand motion should be found and followed however on the off chance that it is static motion, at that point input picture must be fragmented as it were. The hand ought to be found right off the bat so a jumping box is utilized to indicate the skin shading, since it is simple and invariant to scale, interpretation, and revolution changes. In division process the shading space is utilized yet shading spaces are delicate to lighting changes for these reason HSV shading models are utilized. This system focuses on the shades of the pixel used to standardized R-G shading space. Some pre-preparing tasks are connected, for example, foundation subtraction, edge discovery and standardization to upgrade the sectioned hand picture.

- Highlights Estimation

Great division process prompts impeccable highlights extraction procedure and it assume an essential job in an effective acknowledgment process. Highlights vector of the fragmented picture divided picture can be removed in various ways as indicated by specific application. Different techniques have been utilized for speaking to the highlights extraction. A few techniques utilized the state of the hand, for example, hand form recognition while others identify fingertips position or palm focus.

- Gestures Grouping

In the wake of demonstrating and examination of the information picture, signal arrangement technique is utilized to perceive the motion. Acknowledgment process is influenced by appropriate choice of highlights parameters and reasonable order calculation. For instance edge identification or shape administrators can't be utilized for motion acknowledgment since many hand stances are created and could deliver misclassification. The measurable instruments utilized for motion characterization are Hidden Markov

Show (HMM), Finite State Machine (FSM), Principal Component Analysis (PCA) and Neural system has been generally connected for extraction the hand shape. Other delicate processing instruments are Fuzzy C Means grouping (FCM),

Hereditary Algorithms GAs. In vision based methodology, we study of every accessible strategy utilized for hand identification, motion acknowledgment. From that we chose HSV for Pre-handling, AdaBoost for hand discovery and Haar classifier for preparing and redesign reason which has quick identification with great precision.

The paper "Continuous Finger Tracking and Contour Detection for Gesture Recognition utilizing OpenCV" by Ruchi Manish Gaurav and Premanand K. Kadbe [1] recommends that these days new advancements of Human Computer Interaction (HCI) are being created to convey client's direction to the robots. Clients can interface with machines through hand, head, outward appearances, voice and contact. The goal of their paper is to utilize one of the critical methods of association for example hand signals to control the robot or for workplaces and family unit applications.

The straightforward Haar-like highlights (which are processed correspondingly to the coefficients in the Haar wavelet change) are utilized in the Viola and Jones calculation. The Haar-like highlights are strong to clamor and different lighting condition since they register the dim dimension contrast between the white and dark territory of square shapes. The clamor and lighting varieties influence the pixel esteems all in all component territory. The fundamental picture at the area of pixel $[x, y]$ contains the whole of the pixel power esteems found straightforwardly over the pixel area $[x,y]$ and at the left half of this pixel. So $A[x,y]$ is the first picture and $AI[x,y]$ is the indispensable picture that is determined by a condition.

The AdaBoost based learning calculation improves organize by stage generally speaking exactness, by utilizing a straight blend of these independently frail classifiers [4]. The AdaBoost learning calculation at first relegates an equivalent load to each preparation test. We begin with the choice of a Haar-like element based classifier for the principal organize and showed signs of improvement than half grouping precision. In following stage this classifier is added to 975 the straight mix with the quality that is relative to the subsequent exactness. So the preparation test loads are refreshed for example preparing tests that are missed by the past classifier are supported in understanding. The following grouping stage must accomplish better exactness for these misclassified preparing tests so the mistake can be decreased. By this methodology we can improve the general order exactness at further stage. The emphasis goes on by adding new classifiers to the direct mix until the general exactness meets to the required dimension. At the last dimension the outcome is a solid classifier made out of a course of the chose weak classifiers.

we select skin-shading to get normal for hand. The skin-shading is an unmistakable signal of hands and it is invariant to scale and turn. In the subsequent stage we utilize the assessed hand state to separate a few hand highlights to characterize a deterministic procedure of finger acknowledgment. After the hand is divided from the foundation, a counter is extricated. The counter vector contains the arrangement of directions of edges of hand. At

that point the handling of counter vector gives the area of the fingertip.

As indicated by another paper titled "Vision Based Hand Gesture Recognition for Human Computer Interaction" by X. Zabulis, H. Baltzakisy and A. Argyroszy [3], they concentrate to vision-based acknowledgment of hand signals. The initial segment of the paper gives a diagram of the present best in class with respect to the acknowledgment of hand motions as these are watched and recorded by regular camcorders.

As per another paper titled "Hearty Real-Time Tracking of Non-unbending Objects" by Richard Y. D. Xu, John G. Allen and Jesse S. Jin Video Object Tracking assumes an essential job in numerous vision applications. Aside from applications customarily for video observation, object acknowledgment, and video division and ordering, ongoing article following is currently widely utilized in broad media discourse acknowledgment (Liu 2002), human signal acknowledgment, and item based video compressions, for example, MPEG-4. Their paper, then again, examines object following utilizing data from a client chose area of the underlying edge, which contains objects of enthusiasm without priori data. A solid focal point of this paper is execution. Powerful continuous following of non-unbending items is required in numerous applications.

tracks key purposes of the form subsequent to portioning each casing utilizing Canny channel and combining them by separation testing. The key focuses utilized in following are the neighborhood maxima or the defining moments of the shapes.

This paper examines following articles utilizing quick shading thresholding as shading data gives a productive element. They are powerful to fractional impediment and geometry invariant, and computationally productive.

Following Using Colour Clustering

- i. Colour Space
- ii. Colour Representation
- iii. Region Grouping and Noise Filtering
- iv. Foreground Object Extraction
 - a. Colour Clusters Determination
 - b. Foreground Extraction Mask
- v. Contour Extraction
- vi. Alpha Blending with Edge Map
- vii.

III. METHODOLOGY

The algorithms in the OpenCV library are used in order to identify a user's hand through camera and is tracked in real time.

The BGR camera input is converted into a HSV (Hue, Saturation, Value) space and a specific colour is detected using the mentioned HSV values.

The detected colour entity is tracked in real time frame by frame. All these data are processed and the signals are sent to the robotic arm through an Arduino Uno board.

The system majorly consists of three modules:

- i. Data Acquisition Module
- ii. Data Processing Module
- iii. Hardware Module

Data Acquisition Module: This module deals with the acquisition of data from the user through a camera input by identifying and detecting a hand using various algorithms in OpenCV. This acquired data is forwarded to the processing module.

Data processing Module: This module processes the data received from the acquisition module. The data includes the shape of the hand being distinctly identified from the background using the Convex Hull algorithm and is processed by the Arduino Uno Microcontroller.

Hardware Module: The processed data is received from the processing module through the microcontroller and is implemented on the hardware robotic arm.

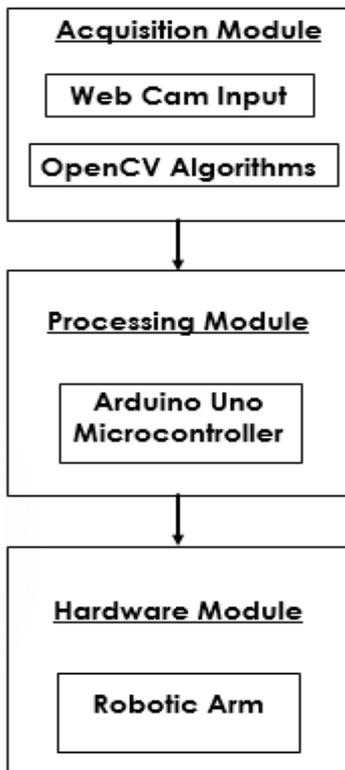


Fig 3.1: System Architecture

1. Colour Detection

To detect colour, the BGR colour space is converted into an HSV colour space.

The tint of a pixel is an edge from 0 to 359 the estimation of each point chooses the shade of the pixel the request of the shading is same yet in turn around as the request in rainbow request from red to violet and again back to red. The Saturation is essentially how soaked the shading is, and the Value is the manner by which splendid or dull the shading is.

So the scope of these are as per the following:

- Hue is mapped – $>0^{\circ}$ - 359° as [0-179]
- Saturation is map - $>0\%$ - 100% as [0-255]
- Value is 0-255 (there is no mapping)

So as to identify a shading, we have to choose a range for HSV esteem for that specific shading as there are loads of variety of the shading.

Presently we make another paired picture of same size as unique picture called a veil and we'll ensure just those pixels that are in this HSV range will be permitted to be in the cover. That way just that shading items will be in the veil.

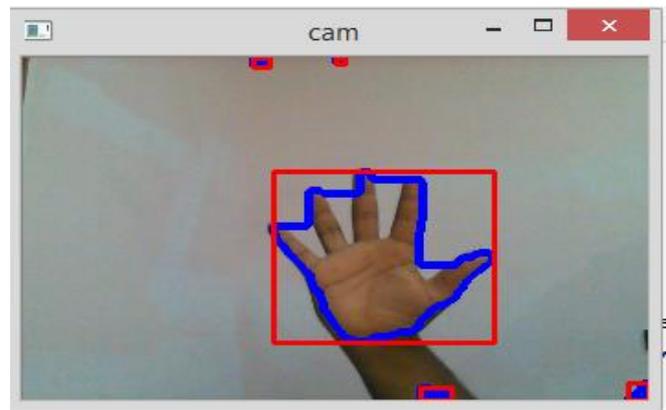


Fig 3.2 BGR Colour Space



Fig 3.3 Raw Mask Output (HSV Colour space)

2. Filtering the Mask

In the above mask, the colour is detected but it has some false positives called noise which may affect the efficient tracking of the hand.

In order to filter it out, we need to do some morphological activity called opening and shutting.

Opening the cover will clear every one of the dabs haphazardly showing up out of sight.

Shutting will fill the little gaps present inside the genuine item (hand).

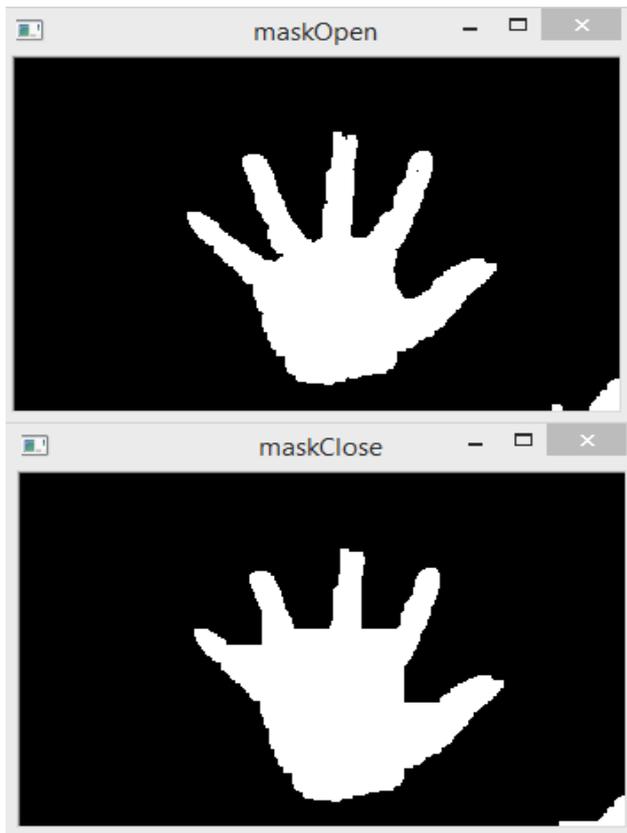


Fig 3.4 Mask Open and Mask Close

3. Processing

The coordinates of the detected hand are then sent to an Arduino Uno board in real time and the data is processed and the servo motors of the robotic arm rotate accordingly moving the hand in the desired direction.

IV. RESULTS AND DISCUSSION

The robotic arm built receives signals from the Arduino uno board and performs actions based on the inputs received by web cam using OpenCV library.

Even though the system is a robot capable of doing various tasks in different fields, it can only work when a trained user is operating it minimizing the risks of accidents due to self-aware robots.

V. CONCLUSION AND FUTURE SCOPE

PC vision speaks to the "product sensor" of things to come. PC vision exchanges interesting equipment for programming.

Robots help individuals with assignments that would be troublesome, dangerous, or exhausting for a genuine individual to do alone.

This robot is a step for the near future, giving complete control to robots may be a threat to mankind.

Thus, this Robot is a machine which has no artificial intelligence, but still can perform numerous tasks with human control.

We can exhibit that this Hand motion location and acknowledgment, joined with different advances, can deliver successful and ground-breaking applications.

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Authors Profile

Mr. M Sandeep pursuing Bachelor's of Computer Science & Information Technology from REVA University, Bangalore since 2015.

Ms. Lavanya Shivgonda pursuing Bachelor's of Computer Science & Information Technology from REVA University, Bangalore since 2015.

Ms Rajeswari M pursuing Bachelor's of Computer Science & Information Technology from REVA University, Bangalore since 2015.

Mr. Kaushik S pursuing Bachelor's of Computer Science & Information Technology from REVA University, Bangalore since 2015.

Mr.NikhilTengli Assistant Professor, School of Computing & Information Technology, REVA University, Bangalore.