



# **Implementation of Real Time Hand Gesture Recognition**

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**ABSTRACT:** Most common form of communication is by means of using gestures. Gestures play an important role in interaction that may be with human or non-human things. In this paper, the main objective is to count the number of fingers which are unfolded in real time. The real-time recognition process uses three main steps: they are background subtraction by using codebook algorithm, contour, convex hull and convexity defect calculation and final convexity defect calculation. Based upon the calculation of defect points, the number of fingers are counted. Background subtraction results in a background-subtracted image. Background-subtracted image results in hand as white color and background as black color. This paper implements recognition of hand gesture in real time and it is implemented using Intel Atom Processor using OpenCV.

**KEYWORDS:** Code book algorithm; background subtraction; foreground image; contour; convexity defects; convex hull

## **I. INTRODUCTION**

Recognizing the gestures in real time is the main objective of this paper. Different types of gestures are online gesture and offline gestures. Online gestures mean that a real-time gesture that is direct manipulation gestures and offline gestures means processing the gestures before user interaction. Different kinds of gesture recognition are face gesture recognition, sign language recognition and hand gesture recognition.

Many challenges like latency that is recognizing the different gestures in image processing applications is slow, lack of gesture language because different people have different gestures which is lack in recognition of different gesture language. Another important challenge is robustness means because of lighting conditions and background noise it is difficult to recognize the different postures of gestures.

## **II. RELATED WORK**

In Paper [4], for unobstructed surroundings real-time hand gesture appreciation is introduced in command to identify the hand gestures. In order to make out the hand gestures in genuine time three phases are introduced: they are real-time hand tracking, learning of gesture, via applying Hidden Markov models to identify the gesture. In charge to follow the hand in real time Kalman filter and furnish blobs analysis is used. Second phase is to educate the gestures and preserve the record. Third phase is to recognize the gesture shape based on the American Sign Language.

In paper [5], earlier to silent backgrounds, endless gestures are acknowledged. In this paper four phases are introduced to make out the endless gestures: they are tracking real-time in hand and extracting to locate the unremitting hand and region of hand extraction. Second phase is taking out of feature by means of Fourier Descriptor. Third phase teaching the hand gestures with hidden Markov model. And the last phase is to know the gesture.

In paper [3], vision-based hand gesture relations are discussed. To trigger hand detection a precise sign is required by means of tracking, afterwards based on the movement and colour cues hand is segmented.

In paper [7], for lively environments and real-time hand gratitude algorithm is discussed to cooperate with robots. By means of cascade of boosted classifiers the discussed algorithm detects hand based on hand positions, velocities and static gestures.

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Vol. 3, Issue 5, May 2015

## III. PROPOSED WORK

### A. Block Diagram

In this Paper the proposed block diagram consists of three stages which are shown in Figure 1.

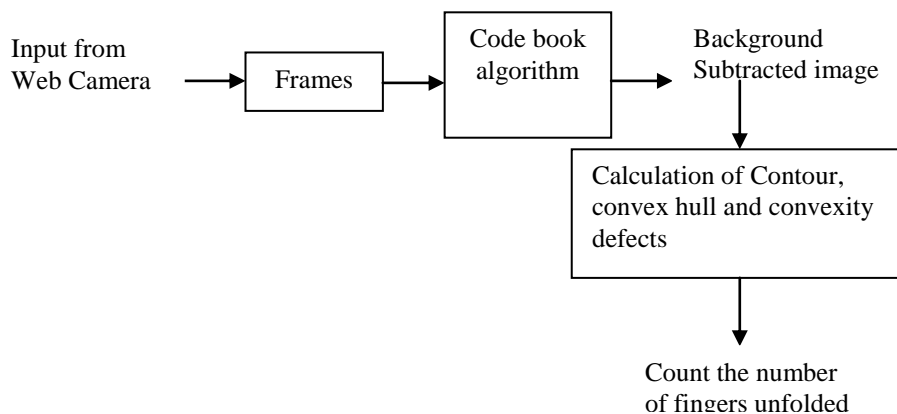


Figure 1. Block diagram of proposed hand gesture recognition system

From the above block diagram the input is taken from the web camera in real time. The real time video is converted into fixed number of number of frames. The frames are the input to the code book algorithm. The code book algorithm converts the color image which is three channel images to binary image which is single channel image. Background subtracted image is single channel image where hand image is white in color and background is black in color. The binary image is used for the calculation of contour, convex hull and convexity defects and finally depending upon the calculation of defect points the fingers which are unfolded are counted.

### B. Frames

As shown in figure 1. The input from web camera is real time video. The video is divided into number of frames. In this proposed paper the number of frames is in range from 30 to 300. The web camera used in this proposed paper is Tag web camera with 16 mega pixel camera.

### C. Code book algorithm

Consider  $M$  be a sequence of trained  $N$  RGB vectors for single pixel.

$$M = \{m_1, m_2, m_3 \dots m_N\}$$

For  $X$  code words codebook  $B$  is given as

$$B = \{b_1, b_2, b_3 \dots b_x\}$$

Each code word  $b_i$ ,  $i = 1, 2, \dots, X$  with RGB vectors  $U_i = \{\vec{R}_i, \vec{G}_i, \vec{B}_i\}$  and having six key values like

$$aux_n = \{\check{I}, \hat{I}, f_i, \lambda_i, m_i, n_i\}$$

Where  $\check{I}, \hat{I}$  represents brightness factors like minimum and maximum.

$f_i$  Represents Frequency of codeword occurrence.

$\lambda_i$  Codeword not occurred during the training period of longest interval that is Maximum Negative Run length (MNRL).

$m_i, n_i$  Access time of 1<sup>st</sup>  $n$  last codeword.

The algorithm Construction is shown below.

- I.  $X \leftarrow 0$  ( $\leftarrow$  means assignment),  $B \leftarrow \emptyset$ ; (empty set)
- II. for  $t=1$  to  $N$  do
  - i.  $B_t = (R, G, B)$ ,  $I \leftarrow R + G + B$

# International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 5, May 2015

- ii. Find the code word  $b_m$  in  $B = \{b_i | 1 \leq i \leq X\}$  matching to  $X_i$  based on two conditions  $\text{colordist}(M_t, U_m) \leq \epsilon$  and  $\text{brightness}(I, (\hat{I}_m, \hat{I}_m)) = \text{true}$ .
- iii. If  $C = \emptyset$  or there is no match, then  $L \leftarrow L + 1$  create a new code word  $B_L$  by setting  $U_L \leftarrow (R, G, B)$  and  $\text{aux}_L \leftarrow (I, I, 1, t - 1, t, t)$ .
- iv. Otherwise, update the matched code word  $c_m$  consisting of  $V_m = (\vec{R}_m, \vec{G}_m, \vec{B}_m)$  and  $\text{aux}_m = (\hat{I}_m, \hat{I}_m, f_m, \lambda_m, p_m, q_m)$  by setting

$$U_m \leftarrow \left( \frac{f_m \cdot \vec{R}_m + R}{f_m + 1}, \left( \frac{f_m \cdot \vec{G}_m + G}{f_m + 1} \right), \left( \frac{f_m \cdot \vec{B}_m + B}{f_m + 1} \right) \right) \text{ and}$$

$$\text{aux}_m \leftarrow \langle \min\{I, \hat{I}_m\}, \max\{I, \hat{I}_m\}, f_m + 1, \max\{I, \lambda_m t - q_m, p_m, t\} \rangle$$

end for.

- III. For each code word  $b_i, i = 1, 2, \dots, X$ , wrap around  $\lambda_i$  by setting

$$\lambda_i \leftarrow \max\{\lambda_i, (N - q_i + p_i - 1)\}$$

## D. Contour, Convex hull and Convexity defect calculation

Contour means the exact boundary of an hand image which mean the boundary pixel an hand image. Contour forms the recognition of hand image. Convex hull fits the area within the contour of a hand image. Convex defect points means between the corresponding fingers the defect points will be calculated.

## IV. EXPERIMENTAL RESULTS

In real time by using web camera the input video is taken and converted into frames than some of the steps are carried out as shown in the figure 1 to count the number of fingers. The experimental results are shown below.

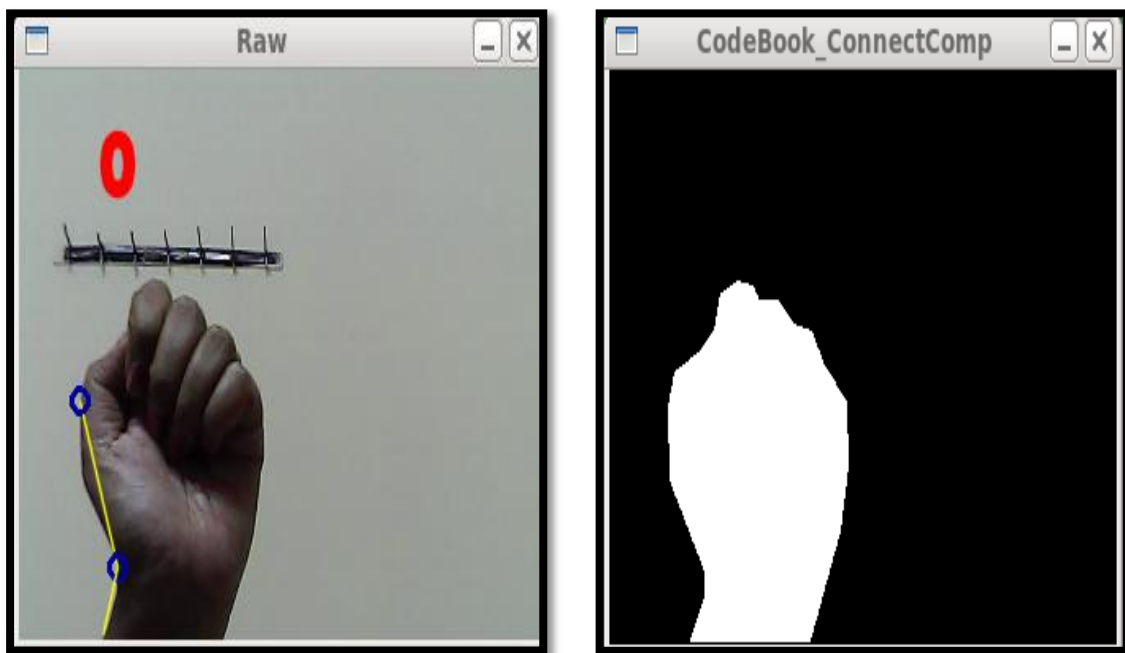


Figure 2. Input frame count 0 and background subtracted Image.

Figure 2 shows the count zero of raw hand image with the back ground subtracted image. Raw image from the real time web cam with the count zero. In the raw image the back ground with some extra objected is subtracted and results in the back ground subtracted image shown.

# International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 5, May 2015

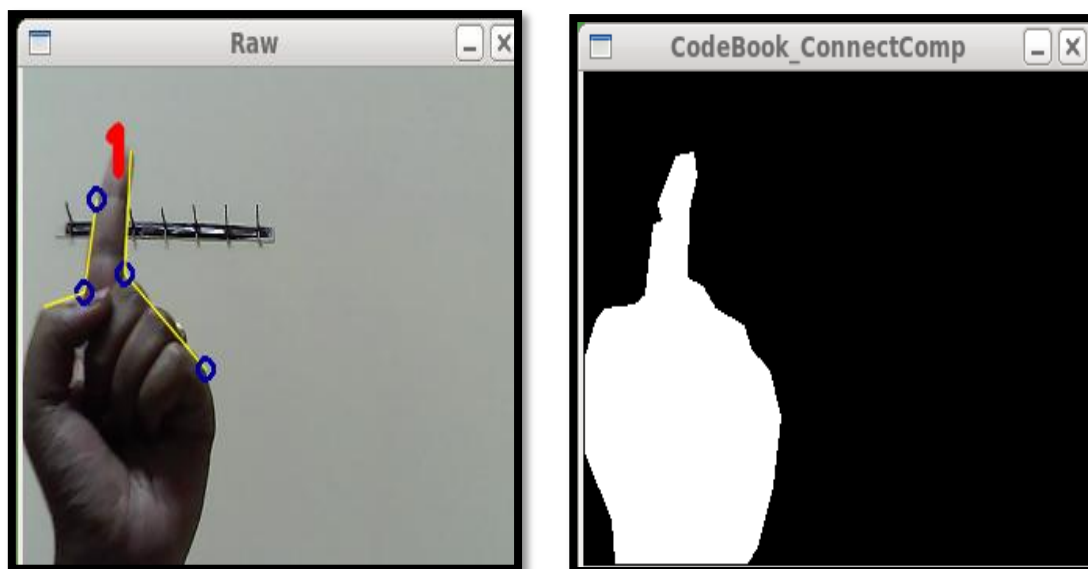


Figure 3. Input frame count 1 and background Subtracted Image

Figure 3 shows the count one of raw hand image with the back ground subtracted image. Raw image from the real time web cam with the count one.

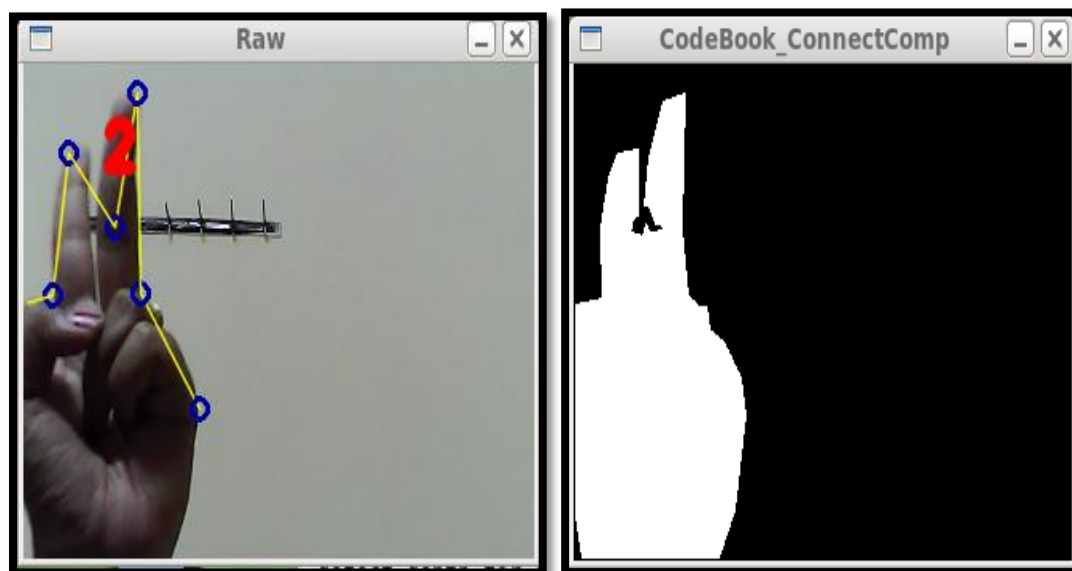


Figure 4. Input frame count 2 and background subtracted image

Figure 4 shows the count two of raw hand image with the back ground subtracted image. Raw image from the real time web cam with the count two.

Figure 5 shows the count three of raw hand image with the back ground subtracted image. Raw image from the real time web cam with the count three.

# International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 5, May 2015

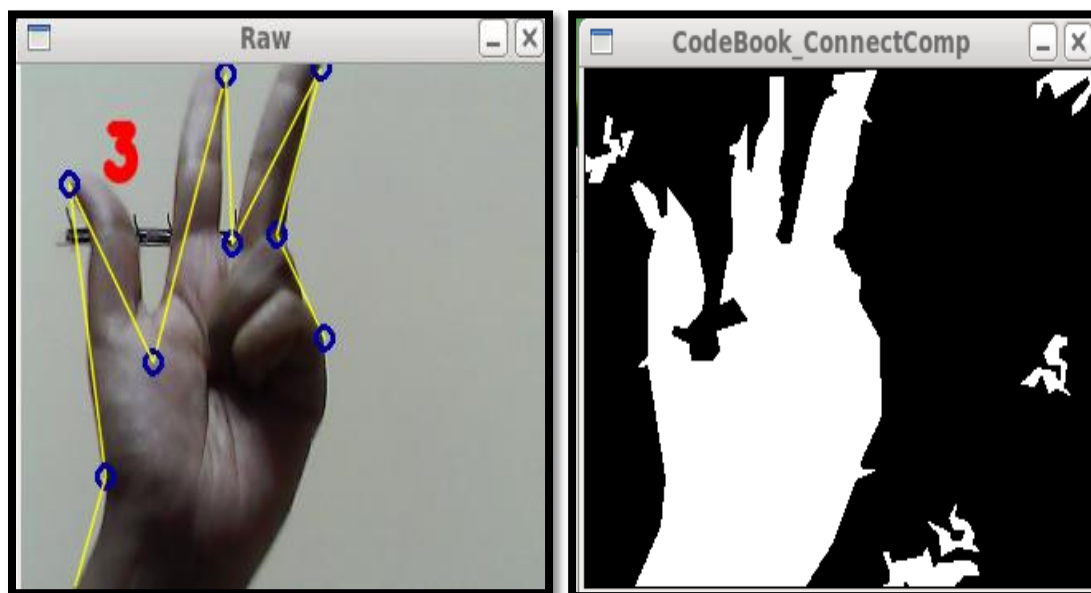


Figure 5. Input frame count 3 and background subtracted image

Blue color in the raw hand image shows the convex defect points. Count three of raw image and back ground subtracted image is shown in figure 5.

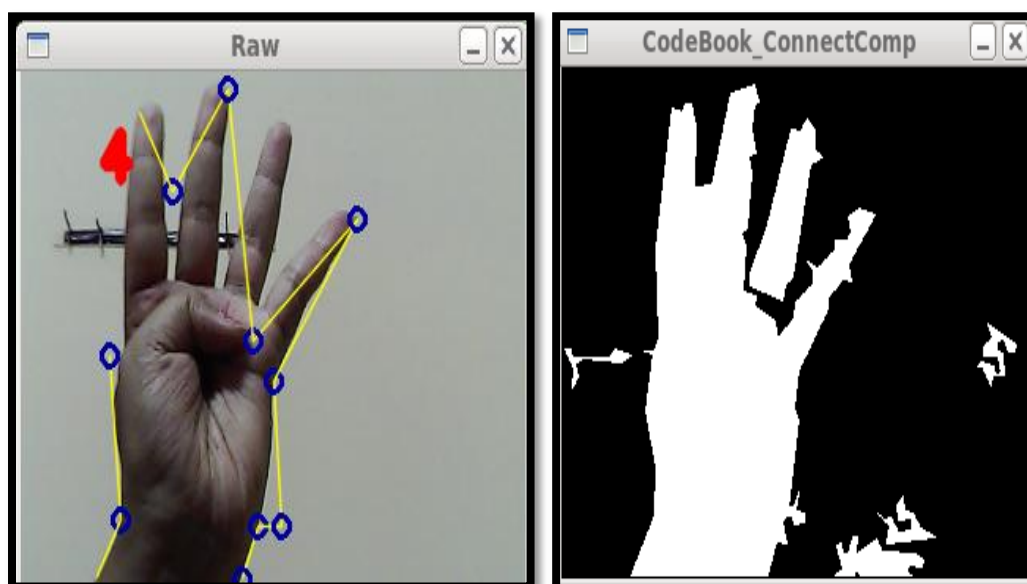


Figure 6. Input frame count 4 and background subtracted image

Yellow color in the all figures shows the convex hull of hand image. Count 4 of an hand raw image is shown in the figure 6 and also back ground subtracted image.

Figure 7 shows the count five of raw hand image with the back ground subtracted image. Red color in the below image indicates the count of number of fingers unfolded.

# International Journal of Innovative Research in Computer and Communication Engineering

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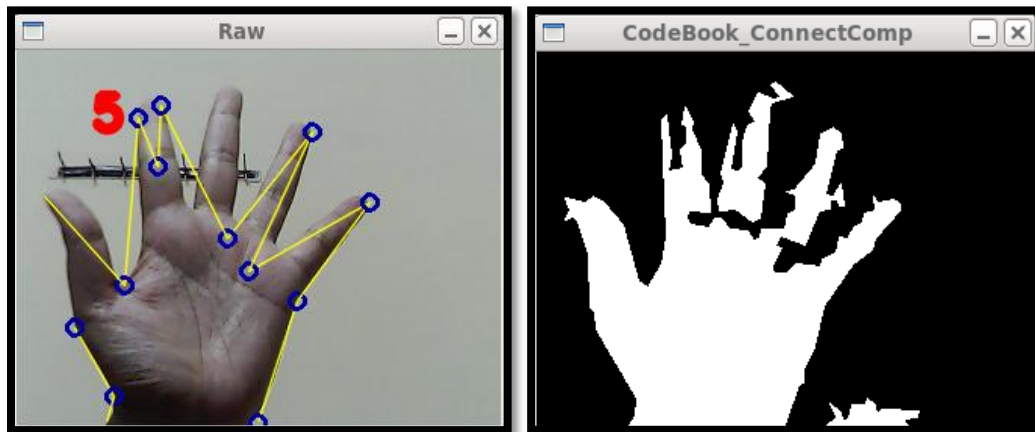


Figure 7. Input frame count 5 and background subtracted image

## V. CONCLUSION

The core of the proposed project is to find the number of fingers unfolded by using Intel atom processor and OpenCV. Depending upon the requirement of applications the proposed paper results are used like for examples physically challenged persons the different gestures makes the movement of wheel chair and for operating robots and many more. Future scope is to recognise both the hand gestures and count the unfolded fingers.

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