3.2 Feature Extraction

After contour formation the fingertips are identified by considering the X , Y positions of the hand. The highest X, Y position is the middle finger tip. Depending upon the angle and the distance between the fingers the other fingertips are calculated. To extract the good features or patterns these contour image and the fingertips which are recognized are calculated by the convex hull [17] identify the concave points after obtaining the hull to detect the exact fingers.

3.3 Gesture Recognition

After getting the convex hull and detecting the concave points the features extracted should be handled by the events. For the recognition of the gestures and for the handling of the events Finite state machine[1] was used.

To have the region of the hand the bounding box and total line length is calculated. The four mouse events are handled through the five recognized gestures. By determining the counter as numbers to the events these four mouse events are handled. For the mouse move we set the counter as 4. If any of the four fingers are up then the mouse move event is activated. If the counter is 2, two fingers are up then the right click is activated. In the same way for the left click counter value one is activated and if counter value is three then double click is activated. Again in the mouse move the ordered sequence of states should be handled to move mouse move right, mouse move left, mouse move up, mouse move down. For the mouse move left a counter of 1 is set in the mouse move operation.

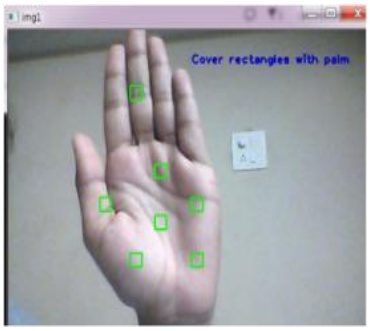

Figure 2: Image of Hand Detection

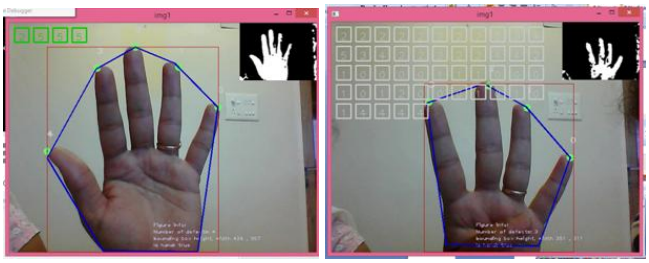

Figure 3: Results For the Hand Gesture for Reset and Mouse Move

Figure 2 and 3 shows the hand gesture results obtained using the proposed system. In Fig 2 the seven patches of the hand takes the range of skin color . In Fig 3 the binary image is shown and the events are handled for the "Reset " and "Mouse move". The contour formed with the blue lines is shown and the green dots shows the finger tips formed by the convex hull. The bounded box area of hand region is shown with red box.

3.4 Input Video

After handling the events through the hand gestures these events are applied for the extraction and replacement of the object in a frame of video so the input video is given for the present system. The system can take any type such as .JPEG, .MPG or .avi of the video file. Then the input video is extracted into frames to do the operations of the video inpainting.

3.5 Video Inpainting

The video inpainting is the most enhancement technique in the video processing. The proposed system is able to select the constant object and extract it from the current frame and track in the remaining frames and inpaint that object with the background. Using the key frame as a reference model, the system is able to handle the static elements. The main steps in the Video inpainting technique in this system are 1. Object selection 2. Object tracking 3. Video pipelining.

3.5.1 Object selection

For a selection of the object the frame should be selected from a video through the hand gesture events which are detected. Many of the methods for the selection of the object include painting based technique[18] gives the results slower for video streams for segmentation. The combination of mean-shift and graph is the other method for the segmentation. In the current system for selecting the object need to form the contour i.e., shape of the object , a contour algorithm [19] is used. The fingerprint application of [20] is applied to find the binary mask. This binary mask is formed by considering all the pixels of the object. After selecting the object by forming the contour, the clustering technique with Nearest Neighbor Field(NNF) is used to find the exact boundaries of the object, and to match the nearest pixel with highest probability. Many methods of clustering techniques have been studied like k-means and hierarchical in this the main drawback is the number of clusters should be defined at the initial stage of the clustering algorithm. The segmentation method along with the multi resolution approach[20] is used to fine the object borders. This approach begin from the core layer and forward to the next layer. At this stage of finer layer the object border pixels are investigated.

3.4.2. Tracking the object

The median filter is used to remove the noise and small or tiny gaps . The calculated object contour should be tracked in neighboring frames of the video after selecting the object. A contour tracking approach[20] of two phase is used in this system. In the first phase homography based contour tracking approach is used while in second phase a counter is refined and adjusted with undesired object area. For the homography determination[19] the strongest contour points are tracked in two frames by pyramid base motion detection. The homography is calculated on the strongest points between the contour point whereas the mask is based on the object contour.

3.4.3 Video Pipelining

A contour is formed through the selection of object and the mask synthesize is invoked. The object of the frame I is a combination of the source region (S) and the target region (T) and is given by the equation

$$I=TUS \quad (1)$$

All pixels defined in source region are replaced from the target region. F denote the mapping between the target and the source region and is given by the equation

$$F=T\rightarrow S \quad (2)$$

F has been determined by the equation 2. To create the final image the target pixels are replaced by the source pixels. The key frame K_f is stored as the synthesize frame. A reference model R_f is defined by calculated homogrophy with binary synthesis Mask M_n for each new frame F_n. The desired pixels $(M_n(p)=1)$ the current frame pixels are copied for undesired pixels $(M_n(p)=0)$ and are replaced by the key frame F K_{kf} interpolation information. The method of mapping forwarding by homography H_k [20] for the reference model is given by the equation 3

$$R_f(P) = \begin{cases} F_n(P), & M_n(P)=1 \\ K_f(H_k.P), & M_n(P)=0 \end{cases} \quad (3)$$

To find a transformation for the new frame the H_k is used to find the number of iterations. After filling the gap with the source region the new object is replaced. The selection of object and replacement of object is done through the real time hand gestures with which events are handled.

4. Results

The results of hand detection compared with the other papers are shown in table 1.

Table 1: Comparision of Hand Detection Accuracy

Sr no	Algorithm used in Papers	Static/dynamic	Accuracy
1	PCA[11]	dynamic	93.1%
2	Finger Earth Movers classification[10]	Dynamic/ black belt	93.2%
3	HMM[8]	dynamic	93.84%
4	SVM [12]	dynamic	92.5%
5	FSM	dynamic	94-96%

For the hand gesture detection , each event is tested by the five persons for the 10 times and the accuracy for the each event is shown in table 2. and the Overall percentage for the events handled ranges from 94% to 96%.

Table 2: Results for the Hand gesture Recognition

Events Detected	No .of Persons	Input Images	Output Images	% of accuracy
Left click	3	50	47	94%
Right click	3	50	46	92%
Mouse move	3	50	47	94%
Reset	3	50	48	96%

The results for video Inpainting through this events are shown in the figure 4

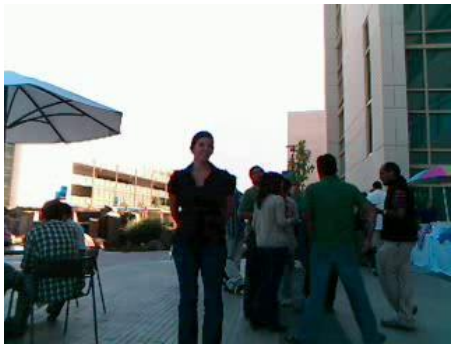

Figure 4.1: Frame before Inpainting

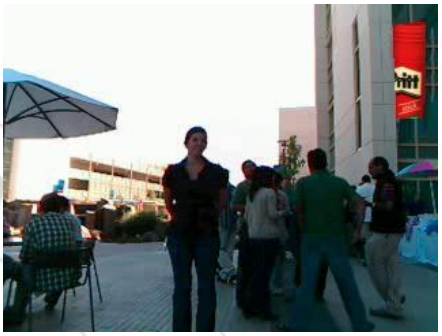

Figure 4.2: Frame after Inpainting

The fig 4.1.shows the frame of video in this the half of the mirror is replaced with the other object of red color as it is shown in the fig 4.2 i.e., after replacement of object.

The input videos are taken from different locations for testing the accuracy ranges from 92% to 95% the time required for the larger number of frames of video is greater compared to less frames of video

5. Conclusion

Dynamic hand gesture recognition system is proposed whose aim is to identify human generated gestures for device control and for video inpainting technique. Gestures are identifies and recognized by the Finite State Machine. . We use a Pix-Mix algorithm for the video inpainting and is a pixel based approach. This system can be used in multimedia applications, robot applications, and healthcare e.t.c very useful for the physically disabled users who lack the strength and precision used to operate the traditional input devices. This paper works well with minimal hardware requirements but under some constraints of light and background when detecting the hand through the camera.

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