**5. Finger Detection for Sign Language Recognition**

Language. Finger Detection is accomplished based on the concept of Boundary Tracing and Finger Tip Detection. The system does not require the hand to be perfectly aligned to the camera or use any special markers or input gloves on the hand. Our project aims to bridge this gap by introducing an inexpensive computer in the communication path so that the sign language can be automatically captured, recognized and translated to speech for the benefit of blind people.  
  
**This paper presents a special-purpose image processing algorithm that we have developed to recognize signs from the**  
  
American Sign Language with high accuracy. In recent years, there has been a tremendous amount of research on hand gesture recognition.  
  
**Authors are with the Department of Computer Science, PES Institute of**  
  
Many previous gesture based systems have the common element of markers on the hand , data gloves or colored gloves worn by the user to allow the gesture and pose to be derived. This system achieves the objective of detecting the number of open fingers using the concept of boundary tracing combined with finger tip detection. It handles breaks, if any, during boundary tracing by rejoining the trace at an appropriate position. There have been many previous works which extracted certain features of the hand for finger detection.  
  
**Finger Detection for Sign Language Recognition**  
  
The final phase traces the boundary of the image and in the process detects finger tips which aid in finger detection.  
  
**Finger Detection Flowchart**  
  
Edge detection is a phenomenon of identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities. The Canny algorithm uses an optimal edge detector based on a set of criteria which include finding the most edges by minimizing the error rate, marking edges as closely as possible to the actual edges to maximize localization, and marking edges only once when a single edge exists for minimal response . Instead of using a single static threshold value for the entire image, the Canny algorithm introduced hysteresis thresholding, which has some adaptivity to the local content of the image. While the results are desirable, the hysteresis stage slows the overall algorithm down considerably.  
  
The performance of the Canny algorithm depends heavily on the adjustable parameters, , which is the standard deviation for the Gaussian filter, and the threshold values, th and tl.  
  
**The bigger the value for , the larger the size of the**  
  
Gaussian filter becomes. Smaller values of imply a smaller Gaussian filter which limits the amount of blurring, maintaining finer edges in the image. The user can tailor the algorithm by adjusting these parameters to adapt to different environments with different noise levels. The threshold values and the standard deviation for the Gaussian filter are specified as 4.5, 4.7 and for the above used input source and background environment.  
  
The edge detected image contains portions which are unnecessary for further analysis. The first technique examines pixels from the bottommost y level and at each level checks if there are three or more consecutive white pixels. The second technique exploits the fact that most of the edge detected images of hand gestures have the wrist portion which has a constant difference between the either ends on the same y-level.  
 **Now we choose the maximum of Rejoining the trace on encountering breaks**  
  
In the first technique we trace downwards from the finger tip position to the optimal y-level, then from that position we increment the x-coordinate until we find a white pixel, this serves as the starting point for processing the next finger. The second technique is employed when the fingers are adjoined. In this technique we check if a white pixel exists towards the right/left of the current downward trace pixel, if found, this serves as the starting point of processing next finger. In this section we describe the accuracy of our algorithm.  
  
The images have been captured using a 6 Mega Pixel Canon PowerShot S3 IS. Figure 6 shows a subset of American Sign Language gestures which have fingers open. Language corresponding to alphabets. 7, the finger recognition works accurately for 95% of the cases.  
  
**American Sign Language Gestures**  
  
A boundary-trace based finger detection technique is presented and cusp detection analysis is done to locate the finger tip. Language which have fingers open. The accuracy obtained in this work is sufficient for the purposes of converting sign language to text and speech since a dictionary can be used to correct any spelling errors resulting from the 5% error in our gesture recognition algorithm. In future work, sensor based contour analysis can be employed to detect which fingers in particular are open.  
  
In particular, we will focus on translating the recognized sequences of signs to continuous text and then to render the text in speech that can be heard by blind people.