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Electronic Poll Counter of Crowd Using Image Processing

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ABSTRACT: Image Processing has become a major part of industry whether it is Gaming Industry, IT industry, Day to Day lives etc. Everywhere there has been thousands of applications of Image Processing. It's very amusing that just playing with certain images and performing some operations gives you tons of information about them. Image processing technology is used in various medical field, remote sensing, and robot vision, tracking movements and Gestures, Surveillance etc. With such applications we are proposing an idea as an Image Processing Application for counting the number of people helpful during rush hours in Railways or Shopping centres etc. Our system, by capturing real life videos and images make appropriate detection and provide an accurate count of people present at any instant of time. We have implemented two methods to count. Firstly based on an image and then based on video. In image based counting method, pre-processing operations like grey scaling ,frame differencing, morphology operations are performed on single image, whereas in video based counting method pre-processing operations are performed similar to that of image based method. Since we are working with video we have implemented object tracking and data association algorithms to count people.

KEYWORDS: Image processing, grey scaling, frame difference, morphology operations, object tracking, data association algorthim, image based counting, video based counting.

I. INTRODUCTION

In imaging science, image processing is any form of signal processing for which the input is an image, such as a photograph or video frame; the output of image processing may be either an image or a set of characteristics or parameters related to the image. The image is processed by adjusting hue, saturation, brightness etc. People counting has been an important component in video surveillance systems. For example, different levels of attention could be based on crowd of different density. To track and count moving people is considered important for the security or the marketing research. Many of such information are extracted manually. Therefore it is necessary to develop the automated system which will count the number people. There are different approaches for counting the number of people from acrowded scene. One of the approaches is to detect humans using Image Processing techniques from an image or videos. There has been a vast amount of work done in the area of human detection and it usually performs well in scenes that are not very crowded.

In our real-time people counting system we have a single fixed position camera. The camera is hung from the ceiling, so the top view of the camera feed is obtained and the image data of the passing people are not fully overlapped.We have implemented two methods to count. Firstly based on an image and then based on video. In image based counting method, pre-processing operations like grey scaling ,frame differencing, morphology operations are performed on single image and then applying canny edge detection algorithm[1] to form contours or blobs. The size of the contours are compared with pre-defined level, if the condition is satisfied, that contour marked and counted. In video based counting method pre-processing operations are performed similar to that of image based method. Since we are working with sequence of frames we have implemented object tracking and data association algorithms to track and assign a

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identity to the detected object. This identity act as our counter.To track people, we have used Kalmanfilter[4] and for data association we have executed Hungarian algorithm[3].
We have implemented our project using java as our frontend language and MySQL as our backend database. To perform image processing we have used OpenCV 3.1.0.

II. RELATED WORK

Authors like Lin SF, Chao HX[7], T. Zhao, and R. Nevatia[8] addressed issue of people counting. They proposed methods such as fitting method, object detection method. Fitting method is easy to use method, but as it has skipped single object tracking process, it results into difficulty to acquire correct counting information. Objecttracking method has high precision because it detects directly object. This method acquires people counting information by tracking moving point, then applying analysis for point tracking. But though this method is insusceptible of camera angle, but has lower accuracy.
Duan-Yu Chen, Chih-Wen Su, Yi-Chong Zeng, Hong –Yuan Mark Liao[9] proposed a system "An Online People Counting System for Electronic Advertising Machine" for counting the number of people watching a TV-wall advertisement or electronic billboard without counting repetitions by using stationary camera. In this firstly detect face and filtering of face is done, in which, SVM based face detector is used. Filtering is used to filter out false positive face. Then an online classifier trained by Fisher's Linear discriminate strategy is developed. Several attempts have been made to track pedestrians.

III. PROPOSED SYSTEM

In this paper, we are introducing a method for counting the number of people at any instant.Our system as two different methods for people counting
1) Image based counting.
2) Video based counting.
3.1 Image Based Counting
Image based counting modules are as follows:
a)Image Acquisition Module:
Image are first required in RGB and it is resized to 640x480 pixels. Firstly, background image needs to be captured and then foreground image which consists of people (objects).Fig2.a shows the acquired background and fig2.b shows foreground.
b)Background subtraction and segmentation module:
In this module we have sub-modules as follows:
i)Grey scaling& Frame Difference:
In this module, both images are pre-processed by converting it to a grey-scaled image to remove noise. The resulting image after grey scaling of both background and foreground is shown in fig2.c and fig.2.d.Frame Difference step is very important and consists of Pixel by Pixel absolute difference between two consecutive frames(in our case background and foreground). The result of this operation is a new image that shows all the differences between this 2frames. Fig.2.d shows the frame difference output.
ii)OTSU Thresholding and Blurring:
We used thresholding and blurring to decide the existence of motion.Otsu[6]is global thresholding method. We have usedthis type of thresholding because we wanted threshold level to be adaptive rather than fixed level which we used earlier for binary thresholding. We have used blurring to remove noise. Fig2.f shows output after applying thresholding and blurring on frame difference output.

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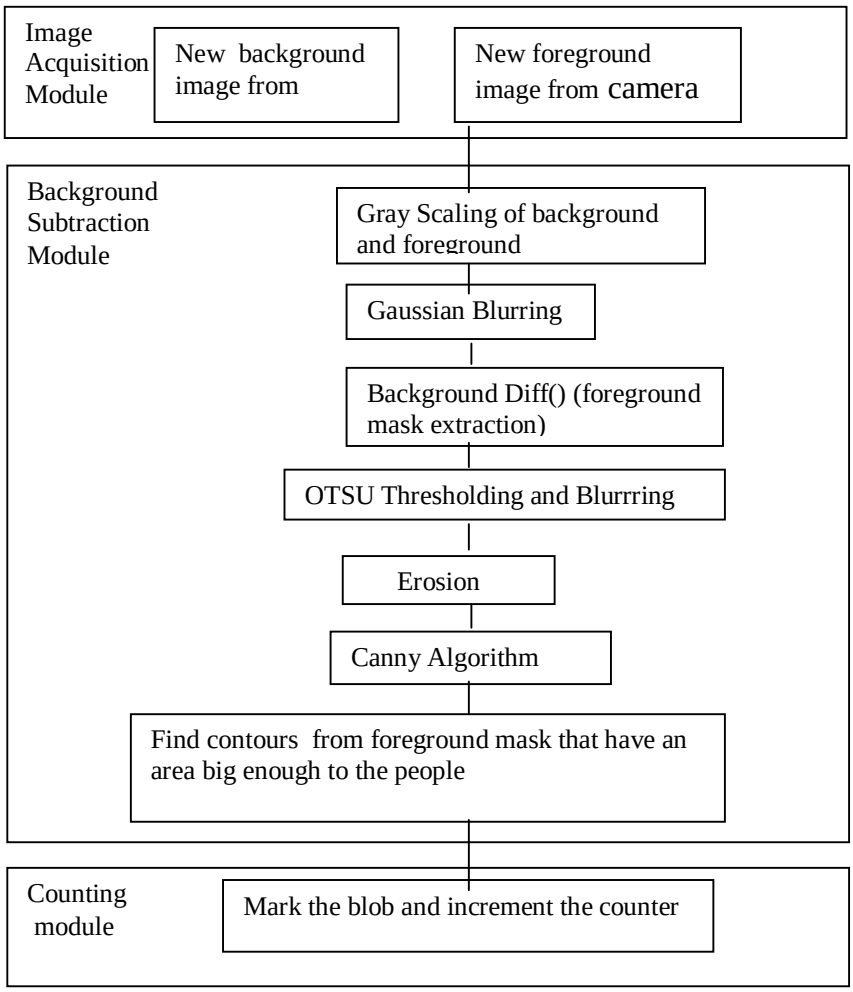

Fig 1: Image Based Counting

iii)Erosion:
Threshold will not eliminate all the "wrong" Pixels (Pixels which are in the background of the scene). The second step of this algorithm, is to make a morphology erosion in the binary image.We have given an option to set the mask and rate of erosion in application interface as shown in fig 3.Fig2.g shows the output after applying erosion.

iv)Canny Edge Detection
We have used Canny Edge algorithm in the beginning of the project while we were testing to get correct count on a handmade image of circles. We tested Canny Edge[1][2], Laplacian[2], and Sobel[2] operator on our test image out of which canny Edge algorithm gave us the best result.Fig2.h is the resulting image after canny edge detection.

v)Blob Analysis and Counting:
The step to identify all the objects on the scene and calculate all their features is called a Blob Analysis . We have set a condition to detect and mark good blobs.
If(Size_of_blob> min and Size_of_blob<= max) mark that blob

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Fig 2:Output at each step ofimage based counting method

We have provided an option to change maximum and minimum blob size at application interface as shown in fig 3.Counting module counts the number of marked good blobs. Count value is displayed on application interface as shown in fig 3.

2.2) Video based counting

Video based counting modules are as follows:

a)Frame acquisition:
Images (frames) are continuously fed from camera or the video sequence.Fig5.a shows input video. We have provided an option to select existing video file at application interface shown in fig 6.

b)Background subtraction module:
We have used BackgroundSubtractionMOG2[5] for background subtraction. Fig5.b shows the result after applying background subtraction and morphological operation.

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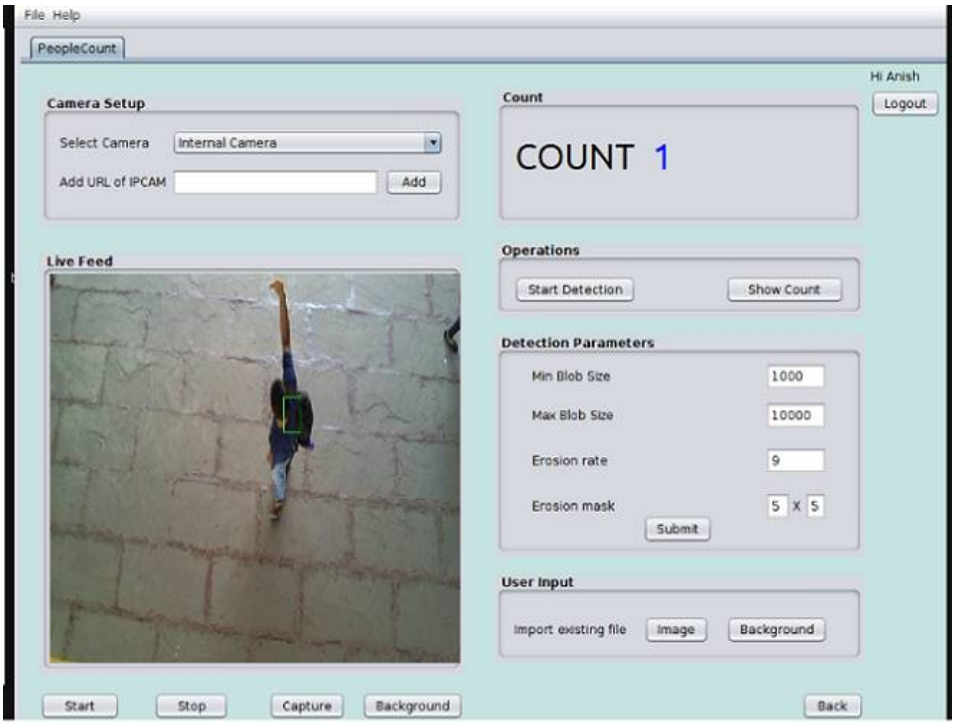

Fig 3: Image Based Counting GUI

c)Background Segmentation module:
Sub-modules are as follows:
i)Morphological operations:
We have used erosion ,dilation, open, close morphological operation. This operation performed on the binary output which is obtained after background subtraction mog2. Fig 5.b shows the output after morphological operation. We have also provided as option to set the parameters of this operation at application interface as shown in fig 6.
ii)Blob Detection
Blob analysis plays an important role in both image based counting and video based counting. The blobs which satisfies the blob area constraint are considered and the centroid of the detected blob is obtained. This centroid co-ordinates are passed to the kalman filter[4] tracking algorithm.

d)Tracking and counting module:
i)Kalman Filter:
Object tracking play an important part in our project. There are three important steps in our project, moving objects detection, tracking of such moving objects from frame to frame, and analysis of object tracks to understand their behaviours. We have used this algorithm to estimate the state of the target objects. First step in kalman is to find the centre of objects and predict its position in the next frame. The Kalman filter [4] takes the input as they arrive that is why it is an real time process. We have implemented multi-object tracking algorithm using kalman i.e applied kalman filter to each object. Object tracking output is shown in fig 5.c.

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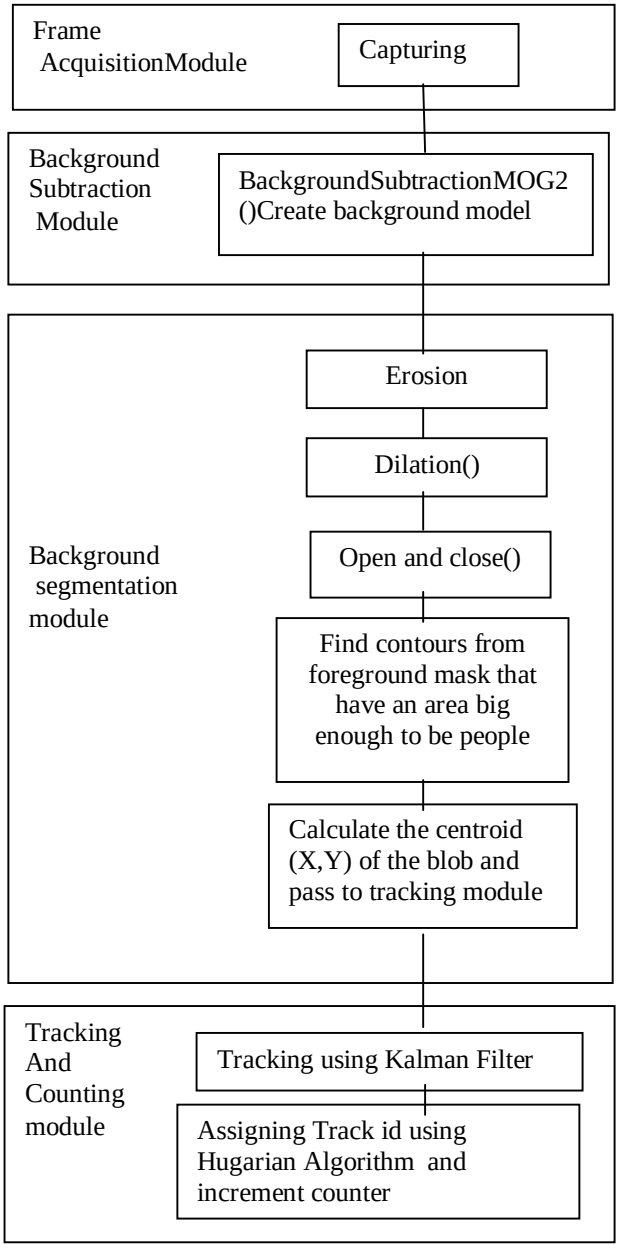

Fig 4:Video Based Counting

ii)Counting:
When the blobs are tracked, for each tracked blob we assign a track identity to each tracks using the Hungarian algorithm[3]. This track id gives the real time count. We have displayed count value at application interface as shown in fig 6 which gets incremented each time a track id is incremented.

iii)Hungarian Algorithm:
Hungarian algorithm[3] is used for solving an assignment problem[3]. Consider an example where we have four jobs say J1, J2, J3, and J4which is need to be carried out by four workers say W1, W2, W3, and W4, one job per

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worker.The algorithm will assign a worker to job which will result into minimum cost. Cost matrix shows the cost of assigning a certain worker to a certain job. In our project we are considering tracks as workers and jobs as the detections. The objective is to minimize the total cost of the assignment.

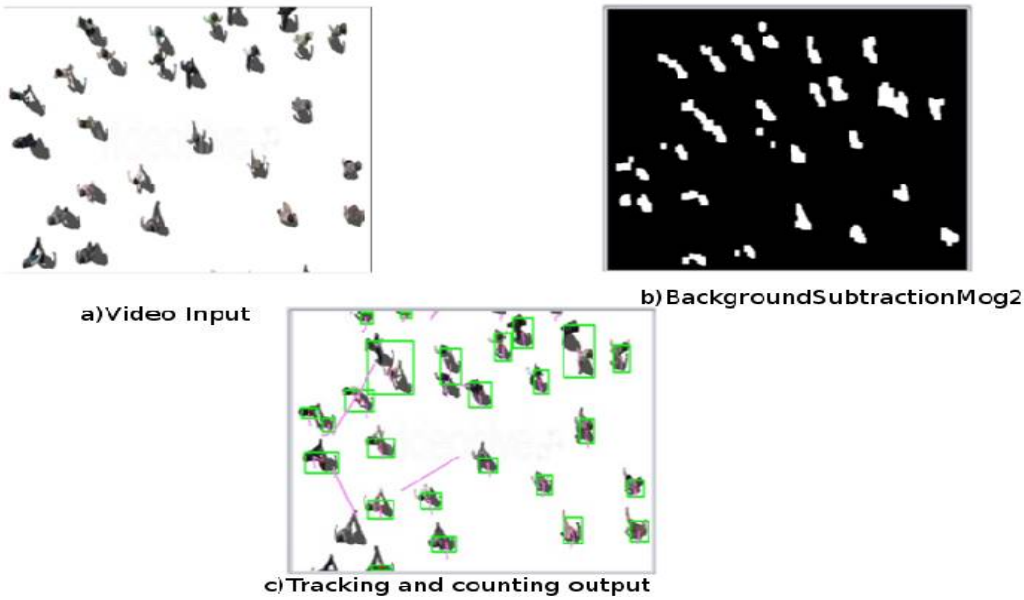

Fig 5: Video Based Counting Output

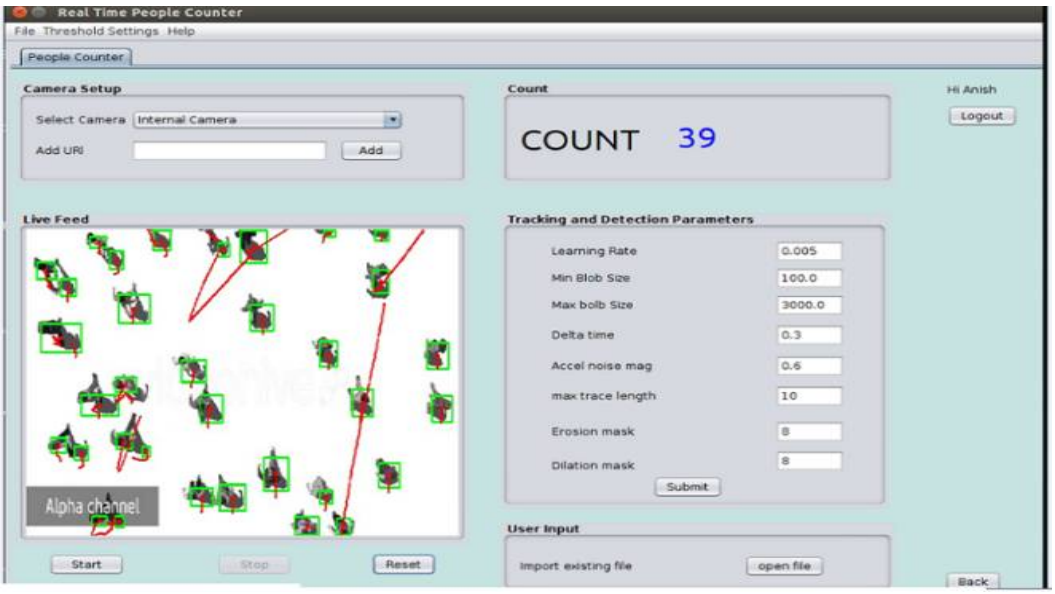

Fig 6: Video Based Counting GUI

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IV. PERFORMANCE ANALYSIS

We observe the performance of the algorithms under various conditions on image and video dataset which was captured in both outdoor and indoor environment. In the context of tracking, the accuracy can be defined as

Accuracy= (actual count/resulting count).

Performance analysis of image based counting method and video based counting methods shown in Fig: 7 and Fig: 8

Data Sets	Actual Count	Resulting Count	Accuracy
Test 1	3	3	100%
Test 2	14	14	100%
Test 3	21	21	100%
Test 4	25	25	100%
Test 5	48	48	100%
Total Count	111	111	100%

Table 1: Output analysis of image based count

Figure 3 shows image based system user interface. We need to click the start button to start live feed, then we need to capture background and foreground either by exporting the existing file or by taking it in real time.Figure 6 shows video based system interface. We can start live feed by clicking start button or we can export video file. Table 1 shows the results that we obtained for image based counting. We have performed various test cases at different environment to test our system. Test cases like test 1,test2 and test3 was performed in real time, by capturing images from live feed while test 4 and test 5 were existing image. Figure 2 shows the output at each stage of test case1.In this figure we can observer that the person is marked properly.We got 100% accuracy for all test cases respectively.

Table 2 depicts test cases based on video based system. Here we took test1,test2,test3,test4 test cases were under indoor environment whereas test 5 and test 6 were performed under outdoor environment. For test case 1 to test case 4 we set up our camera on top of a door which feeds us top view, whenever people passed through that door our system was able to track and count each person. Output of the test case 4 is showed in figure5 which was performed under outdoor environment and it shows each step of video based system processing.The accuracy factor is depended upon various factors like how dense is the crowd, brightness, light intensity variation.

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Data Sets	Actual Count	Resulting Count	Accuracy
Test 1	10	10	100%
Test 2	33	31	93.93%
Test 3	40	39	97.5%
Test 4	80	76	95%
Test 5	150	146	97.33%
Test 6	180	173	96.11%
Total Count	493	475	96.34%

Table2 : Output analysis of video based count

V. CONCLUSION

Thus we have presented a method for counting the number of people in a crowd using Image processing. The People counting system has several applications such as:
i)Security applications.
ii)Economic purposes like crowd Management.
In case of Shopping centres this poll can give us a bright scenario,when the trading hours are high andthe shopkeepers may have the sales in those hours. Our system can be also used as security application such as, if there is scenario of an evacuation, it is very important and useful to know how many people have been evacuated.We can count the number of people in a crowd with reports for further analysis. Thus introducing this new method we can reduce the error rate for the counting purpose.

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BIOGRAPHY

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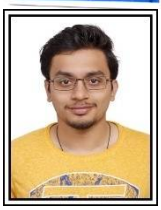

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