International Journal of Engineering and Technical Research (IJETR)
ISSN: 2321-0869, Volume-3, Issue-6, June 2015

Object Detection and Tracking for Surveillance System

Payal Patoliya, Prof. Md. Salman R. Bombaywala

***Abstract*— Over the last few years, the surveillance system is extremely active research area due to increasing levels of terrorist activity and social problems. The design of an advanced automatic video surveillance system requires the application of many important functions including, but not limited to, object detection, classification, tracking, behavior, activity analysis, and identification. Object detection is the first step in video surveillance that aims to detect the moving objects to be classified and tracked. For object detection method processing time and accuracy rate are two important factors. This paper presents a method which is combination of background modelling and subtraction using local Thresholding method for object detection. This method requires less processing time and also gives good accuracy rate. After successful detection of all the objects, detected objects have been tracked using Kalman filter based method. This method successfully tracks single and multiple objects. And this method also able tracks the object in occlusion condition.**

***Index Terms*— Surveillance system, Detection, Tracking, Background Subtraction, Kalman Filter.**

I. INTRODUCTION

Over the last few years, the surveillance system is extremely active research area due to increasing levels of terrorist activity and social problems[1]. Video surveillance system is one of the current challenging research topic in computer vision specially for humans and vehicles. It is a important technology to fight against terrorism, public safety, crime and for traffic management[2]. Now a day's Automated security video surveillance systems have become an important topic because of increasing demand for such systems in public areas such as airports, underground stations and mass events[1]. In video surveillance, detection of moving objects from a video is the first initial and necessary step for object tracking and for the behaviour understanding[4].

The surveillance system includes fixed camera and static background which gives a clue for the object detection from videos by background subtraction technique[1]. The design of an automatic video surveillance system requires the application of many important functions including, object detection, classification, tracking, behaviour, activity analysis, and identification [3].

Payal Patoliya, Post Graduate student, E&C., S.N.P.I.T / GTU, Umrakh / Bardoli, Gujarat, India.

Prof. Md. Salman R. Bombaywala, Assistant Professor, E&C., S.N.P.I.T./ GTU, Umrakh/Bardoli, Gujarat, India.

Object Detection:- Object detection is to locate objects in the every frame of a video streams[1]. It is the first step in video surveillance and it detects the moving objects after that objects are classified and tracked. There are challenges in moving object detection such as noise, lighting changes, dynamic background, occlusions and shadows[2]. Object detection has many applications in many areas of computer vision, including image retrieval; pose estimation, and video surveillance etc[5]. For object detection processing time and accuracy rate are two very important factors.

Object Tracking:- Tracking is defined as, "Locating a moving object or multiple objects over a period of time" and it shows the trajectory or path of an object in image sequence over time by locating its position in every image"[1]. There are two major components of a tracking system target representation and localization[10]. So, for tracking the objects in video the first step is to detect the objects. Object tracking can be applied in many areas like automated surveillance, traffic monitoring, human computer interaction etc. Challenges in the tracking include noise in frames, complex object motion and shape, occlusion, change in illumination etc[12].

The remainder of this paper is organized as follows: Section II includes literature review of various Object Detection and Object Tracking methods. Section III presents Algorithm for Detection of Objects and Algorithm for Tracking of Objects which are Detected by Detection Algorithm. Experimental results which include Qualitative analysis and Quantitative analysis of Algorithm for both Object Detection and Object Tracking are presented in Section IV. Our conclusions are made in Section V.

II. SYSTEM MODEL

Here, aim is to build the video surveillance system for object detection and object tracking. So, first Object is detected using Background Subtraction based method. After successfully detection of all the moving objects, Morphology operations are applied on detected result and then tracking algorithm is applied to track the all detected objects using Kalman filter method. So, detected objects are taking as measurements for Kalman filter in Object tracking. Below figure shows the flow of proposed algorithm.

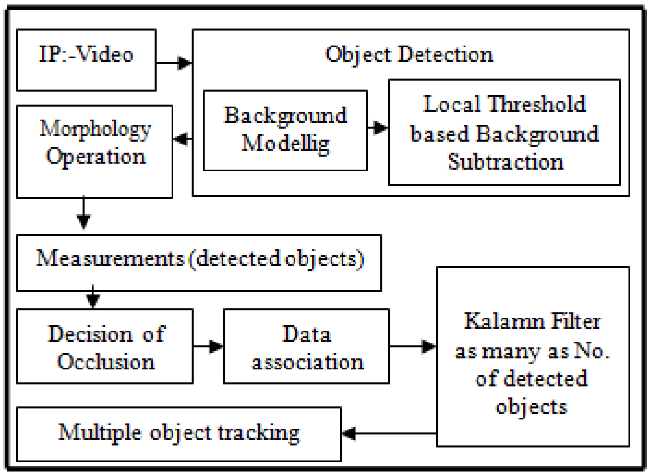


Fig. Flow of Proposed algorithm

III. PREVIOUS WORK

For object detection in surveillance system, Ying Li Tian et al.[13] propose a method for abandoned and removed object detection. This method gives the false positive rate 53% without tracking information while using tracking information this method reduces false positive rate from 53% to 16% for abandoned object detection and for removed object detection with tracking information this method reduces the false positive rate from 23% to 4%[13]. Shih-Chia Huang, propose the method for object detection which involves three modules: a background modelling (BM) module, an Alarm Trgigger (AT) module, and an object extraction (OE) module[3]. This method generate an accurate background with production of neither noise pixels nor artificial "ghost" trails and reduce the computational time but this method require little computational cost by the necessary operations in the proposed AT chain. This method gives the accuracy rate up to 53.43%[3]. Reza Oji[14] proposes a method for object detection based on ASIFT Key-points. If more key points are obtained and more accurate, the results will be better and more acceptable because the key points give the best information of objects. This method gives accuracy rate up to 85%[14]. Vikas Reddy et al.[9] propose a method for object detection via Block-based Classifier Cascade with Probabilistic Decision Integration. This method gives accuracy rate up to 71%[9]. Dina M.Rashed et al. propose a algorithm for moving object detection based on adaptive background subtraction[2]. This method Reduce Computational Complexity and Processing Time and also it solves the Problem of Sudden Changes and residual ghost that exists in video sequences[2]. This method gives accuracy rate up to 89%[2]. Muhammad Nawaz et al. propose an algorithm for Object detection which is based on Motion Estimation[6]. This method gives accuracy rate up to 93.46%[6]. Kalyan Kumar Hati et al.[5] propose a method for object detection which based on intensity range and it consist two steps: Development of Background model and Extraction of foreground object. This method defines an intensity range for each pixel location in the background to accommodate illumination variation as well as motion in the background. This method gives accuracy rate up to 98%[5]. Bo-Hao Chen and Shih-Chia Huang[7] propose a Moving Object Detection Algorithm which based on PCA based RBF network. This method gives accuracy rate up to 89.88% & 86.38%[7]. Shih-Chia Huang and Bo-Hao Chen[8] propose Automatic Moving Object Extraction Algorithm which based on FLD based RBF network. This method achieves accuracy rate up to 92.23% & 88.24%[8]. Elham Kermani and Davud Baseman[15] propose a method for moving object detection which is combination of adaptive filtering and Bayesian change detection algorithm. This method gives the accuracy rate up to 70%[15].

For object tracking in surveillance system, Axel Beaugendre et al.[16], propose a particle filter method for object tracking for automatic surveillance system. This algorithm can track single object but not be able to track multiple objects[16]. But this algorithm is robust to occlusion and also give the accurate result, when two target have similar color[16]. C. Beyan and A. Temizel[17] propose a adaptive mean shift based tracking method. This method is able to track the multiple objects. And also able to handle the occlusion problem[17]. But this method fail to track the object when two objects have similar color[17]. Qiang Chen et al.[18], propose a two-stage method for object tracking in which first stage is region-based method and second stage contour based method. This method can track only single object and also this method is time consuming method[18]. But this method is robust to scale changes[18]. Mahesh Kumar Chouhan et al.[19] propose a method for moving object tracking using Mean Shift method with Adjusted Background HistogramThe advantages of this method are faster convergence and correct location of object as compare to mean shift. This method is able to track only single object[19]. But this method is not able to handle the occlusion problem[19]. Shao-Yi Chien et al.[20] propose a method for object tracking using particle filter With Diffusion Distance. This method is not be able to handle the occlusion problem. This method can tracks only single object[20]. Lingfeng Wang et al.[21] propose Forward–Backward mean-Shift for Object Tracking using Local-Background-Weighted Histogram. This method is able to track short time occluded object but this method is not suitable for long time occlusion[21]. G. Mallikarjuna Rao and Dr.Ch.Satyanarayana[22], propose a method for tracking based on Kalman filter and template matching. In this method as the object has been detected, the same is tracked by kalman filter along with Template Matching algorithm which is more accurate. This method can track object under the light changing condition[22]. Intaek Kim et al.[23] propose a particle filter based object tracking method. This method has disadvantage that when two targets have same color this method cannot able to track[23]. This method tracks multiple objects. And also handle occlusion and reduces the complexity[23]. Jong-Min Jeong et al.[24] propose method for Multiple Objects Tracking based on Kalman Filter which is Robust to Occlusion. This method solves the occlusion problem by calculating the cost function using some factors such as distance and area[24]. This method track multiple objects in surveillance area and robust to occlusion[24]. Shao-Fan Lien et al.[25] propose a method for object tracking based on Kalman filter and camshaft approach. Cam-Shift is the template matching based process in a sequence of frames[25]. The method is able to track the moving object in a complex background and also in an occlusion case[25]. This method is very efficient and easily implemented in a real-time system[25].

IV. PROPOSED METHODOLOGY

Object Detection:- Object Detection is the initial step for tracking in surveillance system. Background subtraction based method has been used for detection and it is divided in to two stages:

1) Background Modelling
2) Background Subtraction

1) Background Modelling:- It is a first stage of detection method. This stage consists of two steps.

1) Background Model Initialization
2) Development of Background Model

Background Model Initialization

Here, for Background model initialization first we consider the n initial frames as {f1, f2,.............., fn}, where $20 \le n \le 50$. Then from any pixel location (i, j) in all n initial frames, elements are collected and put into a vector let U. A window of size W < n is slide from U (1) to U (n). Let V be a vector of dimension W[5].

Here, the operation of this method is performed in following steps:

1) Input : Initial n frames from input video($20 \le n \le 50$)
2) Any pixel location (i, j) in all n initial frames, elements are collected and put into an vector U
3) Let one window W of size<n which is slide from U(1) to U(n)
4) Let V be a vector of dimension W
5) Calculate the standard deviation of vector V

$$\sigma = \left(\frac{1}{n}\sum_{i=1}^{n}(v_i - \bar{v})^2\right)^{\frac{1}{2}} \quad (1)$$

Where,

$$\bar{v} = \frac{1}{n}\sum_{i=1}^{n} v_i \quad (2)$$

6) Classify the pixels in these frames as stationary or non-stationary by analyzing their deviations from the mean by following below steps:
   1) Find out the $\vec{D}$

   $$D(p) \leftarrow |V(\lfloor W \div 2 \rfloor) - V(p)| \quad (3)$$

   for each value of p = 0...., (W − 1) and $p \neq \lfloor W \div 2 \rfloor$
   2) Calculate the sum S as:

   S ← sum of least $\lfloor W \div 2 \rfloor$ magnitudes of $\vec{D}$
   3) Classify pixels of frame using below condition:

   If $S \le \lfloor W \div 5 \rfloor \times \sigma$ is true
   $V(\lceil W \div 2 \rceil)$ is stationary
   Else
   $V(\lceil W \div 2 \rceil)$ is non stationary.
7) Output : Frames having pixels classified as stationary or non-stationary

After traversing the all elements of vector U, the pixels from $U(\lceil W \div 2 \rceil)$ to $U(n - (\lfloor W \div 2 \rfloor))$ are labelled as either stationary or non-stationary. The entire process followed at pixel location (i, j) is repeated for all pixel locations in the frame. Finally, frames $f_{\lceil W \div 2 \rceil}$ to $f_{n - \lfloor W \div 2 \rfloor}$ will have pixels which are classified as either stationary or non-stationary[5].

Development of Background Model

In development of background model stage, first the stationary pixels at any pixel location (i, j) in the frames form frames $f_{\lceil W \div 2 \rceil}$ to $f_{n - \lfloor W \div 2 \rfloor}$ are put into a vector R. And then Minimum and maximum value from it are determined and kept in two two-dimensional vector M (i, j) and N(i, j) respectively. The entire process is repeated for each pixel location in the frame. Finally, M (i, j) and N (i, j) will contain the minimum and maximum value of the stationary pixels from frames which are produced as output of above section at respective pixel location (i, j). M (i, j) and N (i, j) represent the background model which defines a range of values for location of each background pixel[5].

The steps of the development of background model are given as below:

1) Input : Frames having pixels as stationary or non-stationary
2) Stationary pixels at any pixel location (i, j) in the frames are put into a vector R
3) Minimum and maximum value from it are determined and kept in to two-dimensional vector M(i, j) and N(i, j) respectively

   For each pixel location in the frame

   $$M(i, j) = \min[f_s(i, j)] \quad (4)$$

   $$N(i, j) = \max[f_s(i, j)] \quad (5)$$
4) Finally, M(i, j) and N(i, j) will contain the minimum and maximum value of the Stationary pixels
5) Output: Background model consisting of min M(i, j) and max N(i, j) frame

2) Background Subtraction:- After successfully developing the background model, background subtraction is used to detect the moving object using a local Thresholding based method. Here, constant C is used which helps to calculate the local lower threshold T_L and the local upper threshold T_U. These local threshold values help in successful detection of objects, removal of misclassified objects, and suppressing shadows if any[5].

The steps of the background subtraction process are given as below:

1) Input: Background model and a frame f.
2) At each pixel location threshold T(i, j) is calculated as

   $$T(i, j) = \frac{1}{C}[M(i, j) + N(i, j)] \quad (6)$$

   Where, C is a constant, which is varies between 3 and 13
3) Considering T(i, j) local thresholds are calculated

   Local lower threshold:

   $$T_L(i, j) = M(i, j) - T(i, j) \quad (7)$$

   Local upper threshold:

   $$T_U(i, j) = N(i, j) + T(i, j) \quad (8)$$
4) If f(i, j) value lies in between T_L and T_U, then it is a background pixel else a foreground pixel.
5) Output: Detected objects in frame f

This process is repeated for each location in the frame.

3) Morphology Operation:- The input scenes normally contain background clutter and different classes of multiple objects, with different aspect views, different representations of object, of object, and high/low contrast object variations[28]. So, several morphological operations are use for above detection problem. Here, three morphological operations Opening, Closing and fill region and holes are used.

Object Tracking:- After object detection next step is tracking the all detected objects for surveillance system. Tracking is the process of locating a moving object (or multiple objects) over time in each frame of videos. Here, kalman filter has been used for multiple object tracking.

Kalman Filter

The Kalman filter is consists of two stages[26].

1) Time update (prediction),

2) The measurements update (correction).

The time update equations projecting forward (in time) the current state and error covariance estimates to obtain the a priori estimates for the next time step[26]. The time update equation is called predictor equation. The measurement update equations incorporates a new measurement into the a priori estimate to obtain an improved a posterior estimate[26]. The measurement update is called corrector equation.

In the proposed algorithm, the same number of the Kalman filter is applied to estimate object's state[25]. Kalman filter estimates the position, (x, y) of object in the frame for tracking that object. Kalman filter is configured as follows:

$$x_k = Ax_{k-1} + w_k \quad (9)$$

$$z_k = Hx_k + v_k \quad (10)$$

Where, x_k = is the state vector containing the terms of interest for the system (e.g., position, velocity) at time k

$= [p_x \; p_y \; v_x \; v_y]^T$

$p_x \; p_y$ = Centre position of x-axis, the centre position of y-axis and $v_x \; v_y$ = Velocity of x-axis and y-axis,

A = Transition matrix, which relates the state at time k to the state at time k+1

H = Measurement matrix, which relates the state to the measurement

T = Time interval between two adjacent frames,

w_k = Gaussian noise with zero mean and the error covarianceQ_k,

v_k = Gaussian noise with zero mean and the error covarianceR_k,

Process of the Kalman filter:- There are six step of Kalman filter process which is given below:

1) Time update of the state estimate:-

$$x_{k|k-1} = Ax_{k-1|k-1} + w_k \quad (11)$$

2) Predicted measurement:

$$z_{k|k-1} = Hx_{k|k-1} + v_k \quad (12)$$

3) Time update of the state error covariance:

$$P_{k|k-1} = AP_{k-1|k-1}A^T + Q_k \quad (13)$$

4) Data association process

For tracking of multiple objects' location using Kalman filter where many measurements exist, matching between object and measurement should be performed correctly. Here, multiple measurements are obtained through detection algorithm. Data association is necessary to track objects correctly. For classifying the correct measurement corresponding to each object from many measurements, distances has been calculated between the estimated positions and the measurements.

Distance:- Here, distance is determined between the latest positions of targets to be tracked and the positions of the obtained measurements. If it has smaller value, the probability that corresponding measurement is true is higher. Distance is determined using below equation[24]

$$D_k(i,j) = \frac{|\sqrt{(p_{x_j}^{k-} - z_{x_i}^{k})^2 + (p_{y_j}^{k-} - z_{y_i}^{k})^2}|}{\max |(p_{x_j}^{k-} - z_{x_i}^{k})^2 + (p_{y_j}^{k-} - z_{y_i}^{k})^2|} \quad (14)$$

Where, i=1,......,m, j=1,.......,n

$p_{x_j}^{k-}$ and $p_{y_j}^{k-}$ = Centre position of x and y obtained from the $x_{k|k-1}$ in the j[th] Kalman filter.

$z_{x_i}^{k}$ and $z_{y_i}^{k}$ = Centre position of x and y obtained from i[th] measurement at frame k.

m = Number of detected measurements at frame k

n = Number of targets in frame k-l.

5) Kalman gain

$$K_k = P_{k|k-1}H^T(HP_{k|k-1}H^T + R)^{-1} \quad (15)$$

A Kalman gain depends on the accuracy of a measurement. The Kalman gain has high value for high accuracy of the measurement. Otherwise, the Kalman gain has relatively low value.

6) Measurement update of the state error covariance

$$P_{k|k} = (I - KH)P_{k|k-1} \quad (16)$$

7) Measurement update of the state estimate

$$x_{k|k} = x_{k|k-1} + K_k(z_k - z_{k|k-1}) \quad (17)$$

After each time and measurement update pair, the process is repeated with the previous posterior estimates used to project or predict the new a priori estimates[25].

Decision of Occlusion:- It is one of the most important problem in multiple objects tracking. Occlusion includes merge and split problems. Combining two or more objects into one is called merge problem and separating from merging objects is called split problem. Merge and split are illustrated in Figure 2

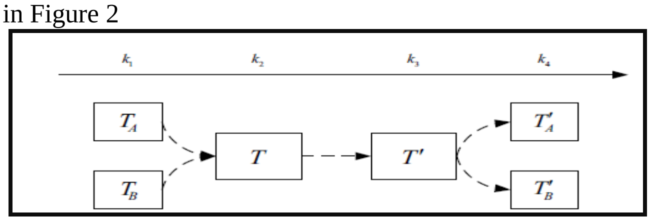


Fig. 2 Merge and Split condition illustration[27]

As shown in above figure, when occlusion occurred in time k_1 two moving objects T_A and T_B are merged into one object T at time k_2. And then from time k_2 object T will be tracked as a new object. During time k_2 to time k_3 , object T_A and T_B will be updated while updating object T. When the update has finished, object T turns to object T'. And then object T' starts to split at time k_3 and during time k_3 to time k_4 .object T' splits into two objects T_A' and T_B'. Then check whether object is T or not, if it is T object, then the moving object T is the one which is merged before, then match T_A' and T_B' with T_A and T_B in a certain range of objects' locations, establishing and updating the correspondence, then delete object T. If it is not, the splitted out object is a new, and then initializes a new Kalman filter motion model for that new object respectively.

Steps of Algorithm for Multiple Object Tracking:-

1) If the current frame is the first frame of the video, establishing motion model and assigning tracking window for each moving object in the scene. If the current image is the k[th] frame, and if any moving object has not assigns any tracking windows, consider it as a new object, establishing a new Kalman filter motion model, initializing the model for tracking.
2) Searching features for each object near the tracking window in the scene, calculate the value of the distance using below equation[24] and the minimum value is the best match.

$$D_k(i,j) = \frac{|\sqrt{(p_{x_j}^{k-} - z_{x_i}^{k})^2 + (p_{y_j}^{k-} - z_{y_i}^{k})^2}|}{\max |(p_{x_j}^{k-} - z_{x_i}^{k})^2 + (p_{y_j}^{k-} - z_{y_i}^{k})^2|} \quad (18)$$

3) Judge whether there is a occlusion happened or not, if it happened, go to the merge or split treatment. If not, keep tracking the object until it disappeared. Here, I use the

Kalman filter for multiple object tracking, data association that is matching process between targets and measurements is necessary. Here, I define the cost function for data association when merge or split is occurred. When merge or split problems are occurred, cost function depends on only distance which is calculated using below equation[24]:

$$C_k(i,j) = D_k(i,j) \quad (19)$$

Where, $$D_k(i,j) = \frac{\left|\sqrt{(p_{x_j}^{k-} - z_{x_i}^{k})^2 + (p_{y_j}^{k-} - z_{y_i}^{k})^2}\right|}{\max\left|(p_{x_j}^{k-} - z_{x_i}^{k})^2 + (p_{y_j}^{k-} - z_{y_i}^{k})^2\right|}$$

4) Then handle the next frame until the object disappeared, the tracking is complete.

V. EXPERIMENTAL RESULTS

To show the efficiency of proposed detection and tracking methods, this paper shown the qualitative analysis and quantitative analysis.

Qualitative Analysis:- For qualitative analysis proposed method has been implemented on different datasets. And those datasets are:

1) WATERSURFACE(WS):
This sequence shows a person entering and leaving a scene. This sequence shows a scenario with water in the background[32].

2) CURTAIN(CT):
This sequence shows a person entering and leaving a room where the curtains of the window are not stationary and there are significant illumination variations[32].

3) FOUNTAIN(FN):
This sequence shows a scenario with a fountain of water in background. There are one or two person are moving in the scene. It contains people moving against a background of a fountain with varying illumination[32].

4) AIRPORT(AT):
This sequence has significant cast shadows of people moving at an airport. There are multiple person which are moving in the scene[32].

The results of different frames are depicted in Figures 1 to 4 which are shown below:

Fr. No	1499	1515
Original Frame		
Ground Truth of Detection		
Result of Morphology operation		
Ground Truth of Tracking		
Tracked Object		

Fig. 1 Result of detection and tracking for dataset 1 WS

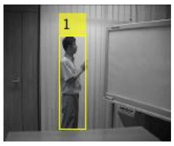
Fr. No.	23229	23787
Original Frame		
Ground Truth of Detection		
Result of Morphology operation		
Ground Truth of Tracking		
Tracked Object		

Fig. 2 Result of detection and tracking for dataset 2(CURTAIN)

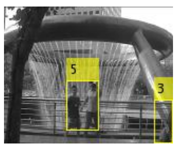
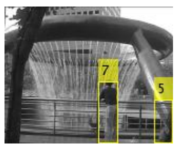
Fr. No.	1174	1480
Original Frame		
Ground Truth of Detection		
Result of Morphology operation		
Ground Truth of Tracking		
Tracked Object		

Fig. 3 Result of detection and tracking for dataset 3(FOUNTAIN)

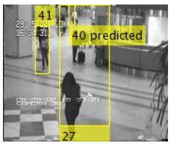
Fr. No.	2926	3800
Original Frame		
Ground Truth of Detection		
Result of Morphology operation		
Ground Truth of Tracking		
Tracked Object		

Fig. 4 Result of detection and tracking for dataset 4(AIRPORT)

Quantitative Analysis

For detection Percentage of correct classification (PCC)[5] has been calculated as the metric which shows the accuracy rate of this method.

$$PCC = \frac{TP+TN}{TPF} \times 100 \tag{20}$$

Where, TP = (true positive), number of correctly detected foreground pixels,

TN = (true negative), number of correctly detected background pixels,

TPF = total number of pixels in the frame

Here, TP and TN are measured from a predefined ground truth frame. Then, the window size (W) is chosen experimentally which is used during classification of a pixel as stationary or non-stationary. The constant C is used to calculate the local threshold and the value of C is varying between 3 and 13 in Background Subtraction stage. By varying the value of constant C value of PCC also varied. Here, I have calculated accuracy of this method by taking the value of C is 7, so I achieved PCC maximum of 98.90%. The PCC obtained for each case which is listed in Table 1.

ACCURACY RATE					
WS	1577	1597	1601	1615	1620
	98.5	**98.9**	98.7	98.5	97.3
CT	23242	23266	23786	23801	23854
	96.1	94.3	94.3	94.4	97.3
FN	1204	1426	1430	1453	1489
	96.9	94.1	93	94.5	94.3
AT	3434	3872	3960	4257	4348
	94.6	97.1	96.2	**92.4**	97.2

Table 1 Result Analysis

The higher accuracy of PCC is achieved because the proposed algorithm defines intensity range for each background pixel around its true intensity. Therefore, the advantage of this method is to removing the shadows at the time of detecting the objects.

For Tracking accuracy is quantitatively measured by calculating the Euclidean distance between centroid of ground truths and centroid of tracking result. Centroid of the ground truth which is shown as blue colored filled circle in above figures 1 to 4. The value of distance shows the how accurate the results are. Euclidean distance is determined from the below equation:

$$D_E(i,j) = \left| \sqrt{(p_{x_i}{}^k - z_{x_i}{}^k)^2 + (p_i{}^k - z_{y_i}{}^k)^2} \right| \tag{21}$$

Where, i=1,......,m. j=1,.......,n

$p_{x_j}{}^{k-}$ and $p_{y_j}{}^{k-}$ = Centre position of x and y of i[th] tracked object in at frame k

$z_{x_i}{}^k$ and $z_{y_i}{}^k$ = Centre position of x and y of i[th] object of ground truth at frame k.

m = Number of detected measurements at frame k

n = Number of targets in frame k-l

The Euclidean distance D_E obtained for each case which is listed in Tables from 2 to 3

	Fr. No	Centroid of GT(x,y)	Centroid of tracked result(x,y)	D_E
WS	1548	(94,66)	(93.85,67.4)	1.50
	1625	(116,64)	(117,64.28)	1.04
CT	23774	(22,72)	(21.27,71.0)	1.90
	23787	(63,70)	(63.80,71.9)	1.47

Table 2 value of Euclidean distance for WS and CT dataset

FN				
Fr. No.	**No. of Object**	**Centroid of GT (x,y)**	**Centroid of tracked result (x,y)**	D_E
1436	1	(88,91)	(87.22,88.57)	2.54
	2	(152,110)	(153.1,112.1)	2.42
1492	1	(111,91)	(111.5,94.6)	3.72
	2	(152,109)	(152.6,109)	0.69

Table 3 value of Euclidean distance for FN dataset

VI. CONCLUSION

There are various applications in surveillance system such as Intelligent Transportation System (ITS), Traffic Monitoring surveillance System, understanding of human activity, observation of people and vehicles within a busy environment, Security in Shopping Centre or Offices etc. There are different algorithms for Object Detection. This paper presents the Background Subtraction method for object detection. This method consists Background Modelling and Local threshold based Background Subtraction and this method gave the better result and high accuracy rate compared to other existing method. Proposed method works well under the conditions like shadow, small illumination changes and noise and achieves accuracy rate up to 98%.

After successful detection of all moving object morphology operations were applied on detected objects which gave more accurate result and then those results were used as input for tracking of all detected objects. Kalman filter based method has been used for tracking which successfully tracks single and multiple objects in all possible scenarios and gives accurate result. Error rate was achieved less than 9.73 and up to minimum value of 0.58. This method handles the occlusion condition and after occlusion it can successfully tracks the splitted objects and give the accurate result.

REFERENCES

[1]Rupesh Kumar Rout, Department of Computer Science and Engineering, Master of Technology, Thesis "A Survey on Object Detection and Tracking Algorithms", National Institute of Technology Rourkela Rourkela ,2013

[2]M.Rashed, Mohammed S. Sayed, Mahmoud I. Abdalla, "Improved Moving Object Detection Algorithm based on Adaptive Background Subtraction", Dina IEEE, 2013

[3]Shih-Chia Huang, "An Advanced Motion Detection Algorithm with Video Quality Analysis for Video Surveillance Systems", IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, VOL. 21, NO. 1, JANUARY 2011

[4]Ka Ki Ng, Thesis, "Background Subtraction and Object Tracking with Applications in Visual Surveillance", Purdue University West Lafayette, Indiana, December 2011

[5]Kalyan Kumar Hati, Pankaj Kumar Sa, and Banshidhar Majhi, "Intensity Range based Background Subtraction for effective Object Detection", IEEE SIGNAL PROCESSING LETTERS, VOL. 20, NO. 8, AUGUST 2013

[6]Muhammad Nawaz, John Cosmas, Pavlos I. Lazaridis, Zaharias D. Zaharis, Yue Zhang, and Hamdullah Mohib, "Precise Foreground Detection Algorithm Using Motion Estimation, Minima and Maxima Inside the Foreground Object", IEEE TRANSACTIONS ON BROADCASTING, VOL. 59, NO. 4, DECEMBER 2013

[7]Bo-Hao Chen and Shih-Chia Huang, "An Advanced Moving Object Detection Algorithm for Automatic Traffic Monitoring in Real-World Limited Bandwidth Networks", IEEE TRANSACTIONS ON MULTIMEDIA, VOL. 16, NO. 3, APRIL 2014

[8]Shih-Chia Huang and Bo-Hao Chen, "Automatic Moving Object Extraction Through a Real-World Variable-Bandwidth Network for Traffic Monitoring Systems", IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS, VOL.61, NO. 4, APRIL 2014

[9]Vikas Reddy, Conrad Sanderson, Brian C. Lovell, "Improved Foreground Detection via Block-based Classifier Cascade with Probabilistic Decision Integration", IEEE Trans. Circuits and Systems for Video Technology, Vol. 23, No. 1, 2013

[10]Object Tracking (2014, December 10) Retrieved from http://en.wikipedia.org/wiki/Video_tracking

[11]Vorgelegt Von Dipl.-Ing. Rubén Heras Evangelio aus Valencia, Thesis "Background Subtraction for the Detection of Moving and Static Objects in Video Surveillance", von der Fakultät IV - Elektrotechnik und Informatik Technische

[12]Kalyan Kumar Hati, Master of Technology, Thesis, "An Approach for Object Tracking in Video Sequences", National Institute of Technology Rourkela, march 2013.

[13]YingLi Tian, Senior Member, IEEE, Rogerio Schmidt Feris, Member, IEEE, Haowei Liu, Student Member, IEEE, Arun Hampapur, Senior Member, IEEE, and Ming-Ting Sun, Fellow, IEEE, "Robust Detection of Abandoned and Removed Objects in Complex Surveillance Videos", IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS, VOL. 41, NO. 5, SEPTEMBER 2011

[14]Reza Oji Department of Computer Engineering and IT, "An Automatic Algorithm for Object Recognition And Detection Based On ASIFT Keypoints", Shiraz University Shiraz, Iran, Signal & Image Processing : An International Journal (SIPIJ) Vol.3, No.5, October 2012

[15]Elham Kerman and David Baseman, "A Robust Adaptive Algorithm of Moving Object Detection for Video Surveillance", EURASIP Journal on Image and Video Processing,springer,2014

[16] C. Beyan A. Temizel, "Adaptive mean-shift for automated multi object tracking", IET Computer Vision, November 2010

[17] Axel Beaugendre,Hiroyoshi Miyano,Eiki Ishidera,Satoshi Goto, "Human Tracking System for Automatic Video Surveillance with Particle Filters",IEEE,2010

[18] Qiang Chen, Quan-Sen Sun, Pheng Ann Heng, Senior Member, IEEE, and De-Shen Xia, "Two-Stage Object Tracking Method Based on Kernel and Active Contour", IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, VOL. 20, NO. 4, APRIL 2010

[19]Mahesh Kumar Chouhan, Rahul Mishra, Dr. Dhiiraj Nitnawwre, "Movable Object tracking by using Mean Shift method with Adjusted Background Histogram", International Journal of Advanced Research in Computer Science and Software Engineering(IJARCSSE), June 2012

[20] Shao-Yi Chien, Member, Wei-Kai Chan, Yu-Hsiang Tseng, and Hong-Yuh Chen, "Video Object Segmentation and Tracking Framework With Improved Threshold Decision and Diffusion Distance", IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, JUNE 2013

[21] Lingfeng Wang, Hongping Yan, Huai-Yu Wu, and Chunhong Pan, "Forward–Backward Mean-Shift for Visual Tracking With Local-Background-Weighted Histogram", IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS, SEPTEMBER 2013

[22] G. Mallikarjuna Rao, Dr.Ch.Satyanarayana, "Object Tracking System Using Approximate Median Filter, Kalman Filter and Dynamic Template Matching", I.J. Intelligent Systems and Applications, 2014

[23] Intaek Kim, Tayyab Wahab Awan and Youngsung Soh, " Background Subtraction-Based Multiple Object Tracking Using Particle Filter", 21st International Conference on Systems, Signals and Image Processing, May 2014

[24] Jong-Min Jeongl, Tae-Sung Yoon, and Jin-Bae Park, "Kalman Filter Based Multiple Objects Detection-Tracking Algorithm Robust to Occlusion", SICE Annual Conference 2014

[25] Shao-Fan Lien, Kuo-Hsien Hsia and Juhng-Perng Su, "Moving Target Tracking based on CamShift Approach and Kalman Filter", An International Journal of Applied Mathematics & Information Sciences, Januray 2015

[26] Sumit Kumar Pal and Sohan Ghorai, "Moving Object Tracking System In Video With Kalman Filter", International Journal of Engineering Research & Technology (IJERT), June 2013

[27]Xin Li, Kejun Wang,Wei Wang and Yang Li, "A Multiple Object Tracking Method Using Kalman Filter", IEEE International Conference on Information and Automation June 20 - 23, 2010

[28]Morphology operation in object detection (2015, April 01) Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/20963056

[29] Opening (2015, May 18) Retrieved from http://homepages.inf.ed.ac.uk/rbf/HIPR2/open.htm

[30] Closing (2015, May 18) Retrieved from http://homepages.inf.ed.ac.uk/rbf/HIPR2/close.htm

[31] Fill regions and holes (2015, May 18) http://www-rohan.sdsu.edu/doc/matlab/toolbox/images/morph13.html

[32] The datasets are available at, http://perception.i2r.astar.edu.sg/bk_model/bk_index.html

AUTHOR'S PROFILE

Patoliya Payal has received her Bachelor of Engineering degree in Electronics & Communication Engineering from S. N. Patel Institute of Technology & Research Centre, Umrakh (GTU) in the year 2012. At present She is pursuing M.E. with the specialization of Signal Processing and Communicationin S. N. Patel Institute of Technology & Research Centre, Umrakh (GTU).

Md. Salman R. Bombaywala has received his M.Tech.degree at SVNIT Engineering College, surat. At present he is an Assistant Professor at S. N. Patel Institute of Technology & Research Centre, Umrakh