IFERP connecting engineers... developing research

ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)
Vol 5, Issue 2, February 2018

Implementation and Comparative Study of Tracking Methods for Human Tracking

[1] Kavita V. Wagh, [2] Dr. Sudhir S. Kanade, [3] Jayashree H. Pawar, [4]Manish Gangavane, [5]Dr. Alam N. Shaikh
[1] Research Scholar, [2] HOD, Electronics And Telecommunication Department, [3][4]Asst.Prof, Electronics Engineering Department, [5] Principal
[1] NIELIT, BAMU ,Aurangabad, [2]TPCT's COE, Osmanabad. BAMU Aurangabad, India,[3][4][5]Padmabhushan Vasantdada Patil College of Engineering, Sion, Mumbai

***Abstract* - The paper includes the different tracking methods, classify them into different categories according to its performance, speed, accuracy. Tracking, in general, is a challenging problem. Difficulties in tracking any object or human can arise due to its abrupt motion, changing appearance patterns of both human and the scene, nonrigid object structures, object-to-object and object-to-scene occlusions, and camera motion. The goal of human tracking is segmenting a region of interest from a video scene and keeping track of its motion, positioning, and occlusion. Human detection and classification are preceding steps for tracking human in sequence of images. Detection is performed to check existence of object in video and to precisely locate that object. Detected object can be classified in various categories like human, vehicle, floating clouds, swaying trees and other moving objects. It is used in video surveillance, robot vision, traffic monitoring, Animation. The paper presents a brief analysis and comparative study of algorithms i.e Kalman Filter and Particle filter related to human tracking**

Index Terms— Particle, Weight, Degeneracy, Background Detection, Tracking, Navigation.

I. INTRODUCTION

A plethora of surveillance cameras put in service in the last few years since the measure attacks India, France, US. Closed Circuit Television (CCTV) has grown significantly from being used by companies to protect personal property to become a tool used by law enforcement authorities for surveillance of public places [7][12]. However, several important research questions must be addressed before we can rely upon video surveillance as an effective tool for crime prevention. So, we have design a system which can track multiple human or targeted human using different tracking algorithms and report to the system. Many different algorithms have been implemented for motion tracking which is the field of interest in many applications such as surveillance, robot vision, traffic monitoring, animation, detection of human, vehicle, tennis ball i.e. in sports, and analysis of athletic performance and content-based management of digital image database[9]. Even there are various methods introduced for human tracking previously many problems in the science require proper estimation and continuous tracking of particular or multiple person tracking. In this paper we will concentrate on the algorithms the two methods for motion tracking i.e kalman filter [2][4][9] and particle filter.

Initially we have used the videos detected by CCTV cameras. Detection of human can be achieved by using background modeling and finding deviation from the model for each incoming frame. The significant change in an image region from the background model signifies the moving human. The pixels constituting the region undergoing changes are marked for further processing. Usually, a connected component algorithm is applied to obtain connected regions corresponding to the objects. And the process is referred to as background subtraction.

II. OPERATION

The proposed system consists of Kalman filter used for tracking of targeted human [1][3], which estimates the position of the target in each frame of the sequence.

A. Kalman Algorithm

Kalman algorithm is the set of mathematical equations that provides efficient computation to estimates the state of process in estimation of past, present and future states [10] [11]. There are variations in position, size of the object, width and length of the search window of the object due to the mobility. Kalman algorithm uses a series of measurements observed over time, containing noise and other inaccuracies, and produces estimates of unknown variables that tend to be more precise than those based on a single measurement alone. The equations consist of two groups: time update and measurement update equations. Kalman filter initially estimates of the current state variables. Time update equations are projecting forward the current state and error covariance estimates to obtain the prior estimate for the next time step. The measurement update equations are responsible for the feedback as shown in Fig. 1.

ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)
Vol 5, Issue 2, February 2018

Fig. 1 Kalman Filter Cycle

Once the outcome of the next measurement is observed these estimates are updated.

State Prediction $Xpred_k = A * X_{k-1} + B * U_k + W_{k-1}$ (1)

Error Covariance Prediction $Ppred_k = A * P_{k-1} * A^T + Q$ (2)

U_k is control vector.
B relates optional control vector Uk into state space.
W_{k-1} is a process noise.
$Ppred_k$ is predicted error covariance at time k.
P_{k-1} is a matrix representing error covariance in the state prediction at time k-1.
Q is the process noise covariance.

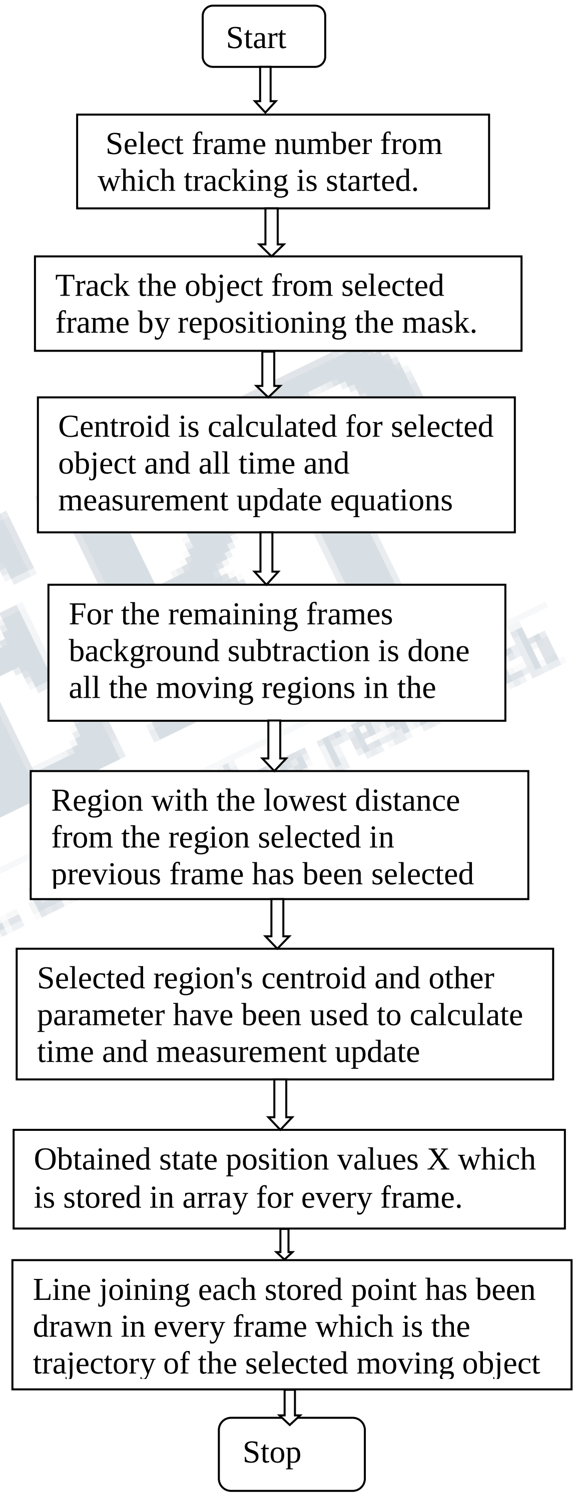
Kalman Gain $K_k = Ppred_k * H^T * (H * Ppred_k * H^T + R)^{-1}$ (3)

State Update $X_k = Xpred_k + K_k * (Z_k - H * Xpred_k)$ (4)

Error Covariance Update $P_k = (I - K_k * H) * Ppred_k$ (5)

K_k is Kalman gain.
H is matrix converting state space into measurement space
R is measurement noise covariance.
X_k is a process actual state.
Using Kalman gain K_k and measurement Z_k process state X_k can be updated.

Z_k is the most likely x and y coordinates of the target objects in the frame. Equations (3) and (4) are measurement update equations. After using the time update steps, the Kalman filter uses measurement to correct its prediction during the measurement update. The final step in Kalman filter is to update the error covariance $Ppred_k$ into P_k as given in eq. (5). After each time and measurement update pair, the process is repeated with previous posteriori estimates used to project orpredict the new priori estimate (4). The steps for tracking using Kalman Filter are Explain using the Flowchart 1



Flowchart 1: For object tracking using Kalman filter.

IFERP
connecting engineers... developing research

ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)
Vol 5, Issue 2, February 2018

The Kalman filter update an estimate of the state and find the innovations driving a stochastic process by linear projections i.e. application of the Kalman filter is limited to linear models with additive Gaussian noises. Next we are going to demonstrate the system using Particle Filter.

B. Particle Filter

The particle filter implements a recursive Bayesian filter by Monte Carlo solution [6]. Particle filter is used when the quantity to be estimated has multimodal distribution and it is not Gaussian. Particle Filter is concerned with the estimation of the distribution of a stochastic process at any time instant, given some partial information up to that time. In particle filter, initially the required posterior density function by a set of random samples with associated weights and then compute estimates based on these samples and weights[5] [8].

For each particle there are following steps to be followed.

- Use motion model to predict new pose (sample from transition priors)
- Use observation model to assign a weight to each particle (posterior/proposal).
- Create A new set of equally weighted particles by sampling the distribution of the weighted particles produced in the previous step.

Following algorithm is used for tracking.

1. Read the first image.
2. Initialize the particle position and size of ellipse.
3. Calculate the features of object based on initial value (Q).
4. Generate Ns particle and initialize the weight of each particle to 1:Ns.
5. Predict the Ns particle states using the state equation, Sk.
6. Read next image.
7. Calculate the features for each particle, state, S_k (P_y).
8. Calculate (P_y*Q) which gives likelihood.
9. W_i-W_{i-1*} likelihood normalizes W_i.
10. Expected value, E(S_k*W) will be given the position of object then again predict the Ns particle states using Sk.

Degeneracy Problem.[5]

A common problem with the particle filter is degeneracy problem. After few iterations, it is likely to have particles with negligible weights. The variance of the important weights will only increase over time and thus it is impossible to avoid the degeneracy phenomenon. Because of degeneracy, large computational effort is required to update particles whose contribution to the approximation to $p(x_k|z_{1:K})$ is almost zero. A measure of

degeneracy of the algorithm is the effective sample size, N_{eff} and given by

$$N_{eff} = \frac{N_S}{1+var(w_k^{*i})}$$

where w_k^{*i} is true weight of particle.

an estimate $\overline{N_{eff}}$ of N_{eff} can be obtained by

$$\overline{N_{eff}} = \frac{1}{1+\sum_i^{Ns}(w_k^{*i})^2}$$

where is w_k^{*i} is now normalized weight of particles Thus , particle filter with re-sampling is.

III. RESULT

The algorithm has been run on a real-time system. The human to be tracked is shaded with red color as shown in frame Frame 1 and Frame 2 and it is observed that the kalman filter is best estimator for linear systems. But if the system doesn't fit into linear system then kalman filter doesn't give proper output.

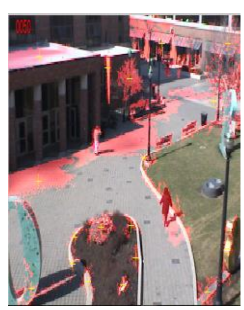


Fig. 2: Frame 1

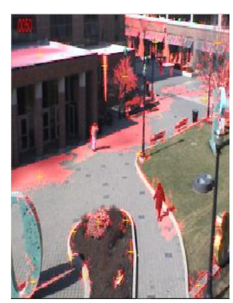


Fig. 3: Frame 2

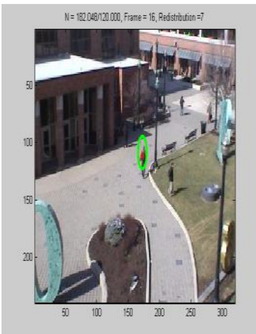


Fig. 4 Frame 3

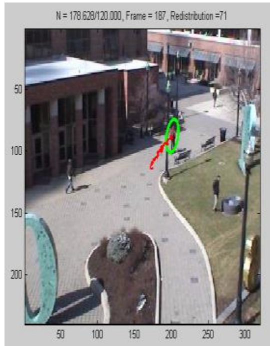


Fig. 5 Frame 4

Frame 3 and Frame 4 shows tracking using Particle filter. Particle filter can work properly for non-linear and non gaussian systems. Mathematical computations are more for Particle filter than Kalman filter but Particle filter gives better accuracy and performance than Kalman filter.

So, from the demonstration it is observed that for nonlinear systems particle filter gives better output than kalman filter.

IV. CONCLUSION

Paper presents the implementation of Kalman and Particle filter and its comparative study. The experimental result from real video sequences shows its reliability, performance and accuracy of both the filters. It is observed that Kalman filters have much lower computational requirements than particle filters, but are less flexible. While the particle filters seems to be more reliable and robust thane Kalman filter.

This is the reason for the authors to conclude that a Particle Filter may be more adequate for multiple human tracking tasks in complex situations, and a Kalman Filter should be the chosen solution in simpler ones, such as human tracking in sensitive areas.

V. FUTURE SCOPE

Future work is to find out the more efficient feature vector to be used for particle filter and also to combine different types of feature vectors in order to boost up the performance of motion tracking for human being in thermal imaging.

VI. REFERENCES

[1] Kaipio, J. and Somersalo, E., 2004, Statistical and Computational Inverse Problems, Applied Mathematical Sciences 160, Springer-Verlag.

[2] Maybeck, P., 1979, Stochastic models, estimation and control, Academic Press, New York.

[3] Kavita Vilas Wagh and Dr. R.K.Kulkarni, Human Tracking System, International Technological Conference-2014 (I-TechCON), Jan. 03 – 04, 2014

[4] Kaipio, J., Duncan S., Seppanen, A., Somersalo, E., Voutilainen, A., 2005, State Estimation for Process Imaging, Chapter in Handbook of Process Imaging for Automatic Control, editors: David Scott and Hugh McCann, CRC Press.

[5] Chandrashekhar N. Padole, Luís A. Alexandre," Motion based Particle Filter for Human Tracking with Thermal Imaging", Third International Conference on Emerging Trends in Engineering and Technology, 978-0-7695-4246-1/10 $26.00 © 2010 IEEE DOI 10.1109/ICETET.2010.120.

[6] C. Hue, J.P. Le Cadre, P. Pérez. "A particle filter to track multiple objects", IEEE Trans. on Aerospace and Electronic Systems, vol. 38, nº. 3, pp. 791-812, July 2002.

[7] M. Marron, M.A. Sotelo, J.C. Garcia, D. Fernandez, I. Parra. "3Dvisual detection of multiple objects and environmental structure in complex and dynamic indoor environments", in Proc. of the 32nd Annual Conference of the IEEE Industrial Electronics Society.

[8] A. Almeida, J. Almeida, R. Araujo. "Real-time tracking of moving objects using particle filters", in Proc. of the IEEE International Symposium on Industrial Electronics (ISIE05), ISBN: 0-7803-8738-4. Vol. I-IV, pp. 1327-1332, Dubrovnik, June 2005.

[9] Q.cai and J.K.Agrawal, "Human tracking motion in structured environment using distributed camera system", IEEE transactions on pattern analysis on machine intelligence, volume 21, number 12, november 1999

[10] J.Wang, F.He and X.Zhang and G.Yun, "Tracking Object through Occlusions Using Improved Kalman Filter", number 6, 2010.

[11] Matthew Turk, Alex Pentland,"Eigenfaces for Recognition", Journal of cognitive Neuroscience, volume 3, number 1.

[12] Alper Yilmaz, Omer Javed, Mubarak Shah,"Object Tracking: A survey", ACM Computing Survey, Volume 38, Number 4, Article 13, December 2006.

[13] G. bradski, and R. Gary, and L.M. Olga, "Computer Vision Face Tracking for Use in Perceptual User Interface", Intel Technology Journal, volume 10, number 5, 1998.

[14] G. Bradski and T.Ogiuchi, and M. Higashikubo "Visual Tracking Algorithm using Pixel-Pair Feature", International Conference on Pattern Recognition, number 4, 2010.

[15] Y. Ruiguo, and Z. Xinrong, "The Design and Implementation of Face Tracking in Real Time Multimedia Recording System" IEEE Transaction, number 3, 2009.