Video Processing Applications Using IR(Infrared) Image Sequence

Vivek Chamoli, Kamlesh Kukreti, Shubham Negi, Akhilesh Kandwal
Deptt. Of Electronics and Communication Engineering, Graphic Era (Deemed to be University), Dehradun
vivekchamoli08@gmail.com, shubham.negi.1992@ieee.org

Abstract: Video processing is an important application of electronics and computer science. It is actively used in our day to day life for the purpose of surveillance. 'PC vision' cameras are used almost everywhere and these do not prove to be at par when it comes to recording under low light and at night. Hence, in this article IR cameras have been used in place of the former, especially for object tracking when visibility is low. Updated Kalman filter algorithm has been employed in the present work for tracking the object through IR cameras. The above-mentioned algorithm has been successfully used here for tracking and sensing the movement of humans and vehicles in low light conditions. The visual result presented herein shows satisfactory performance.

Keywords— Human movement sensing, Image processing, Object detection and tracking, Vehicles Sensing, Video processing

I. Single Object Tracking Using Kalman Filter

For tracking, we use the Kalman Filter (KF). The Kalman filter can be utilized to anticipate the future position of physical objects and to lessen noise in the detected area [1]. To use the Kalman filter, the target must be moving at consistent rate and acceleration. The Kalman channel algorithm includes two stages [1-4].

1. Prediction (KF produces estimates of the current state variables, along with their uncertainties) [4]

2. Rectification.

The present article has been divided into five sections including the present introductory section. Section II gives a brief about the different applications pertaining to video processing applications. Next, the Kalman filter tracking algorithm has been discussed in III section. It is followed by results given in section IV. The results shows that the algorithm presented gives better results. Finally concluding remarks are given in Section V.

II. Applications of Image /Video Processing

Some of the imperative uses of object tracking are [5, 6]:

1. Automated video surveillance: The end goal is to observe the happenings in a specific region, detect and perceive moving objects and to report suspicious, criminal exercise, applications are produced in PC vision framework [5]

2. Robot Vision: For navigation of robot through diverse obstructions in the way are recognized by the controlling framework so as to maintain a strategic distance from the impact. In the event that the deterrents are itself in movement then we require an ongoing object following framework.[6]

3. Monitoring of Traffic: Highway activity can be consistently checked utilizing moving cameras. The vehicle infringing upon a law or engaged with any unlawful activities can be detected and followed utilizing an object following framework

4. Animation: Animation can be upheld by utilizing object tracking calculation.

5. Human PC Connection: It can be utilized for programmed participation framework in numerous regions and to record the in and out time of the object.

III. Kalman Filter Tracking Algorithm

Figure.1 shows the idea of object tracking using prediction (Kalman filter). Here first we predict the position, than using measurement parameters we update it and find the next position of the object.

Figure.2 shows the tracking idea but the difference here is that we use the previous state 'x' to predict the next position of the object. Due to Kalman filter tracking, we use it to predict the future position of the targets and/or objects.

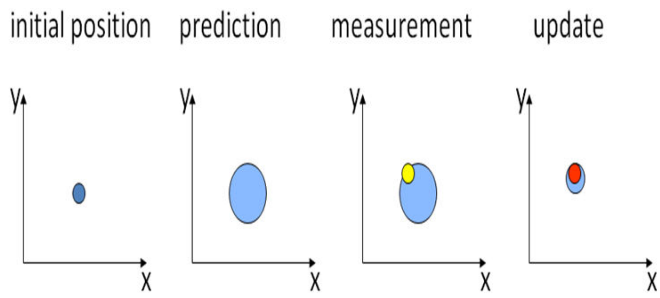


Fig. 1. Schematic views of Kalman filter tracking idea.

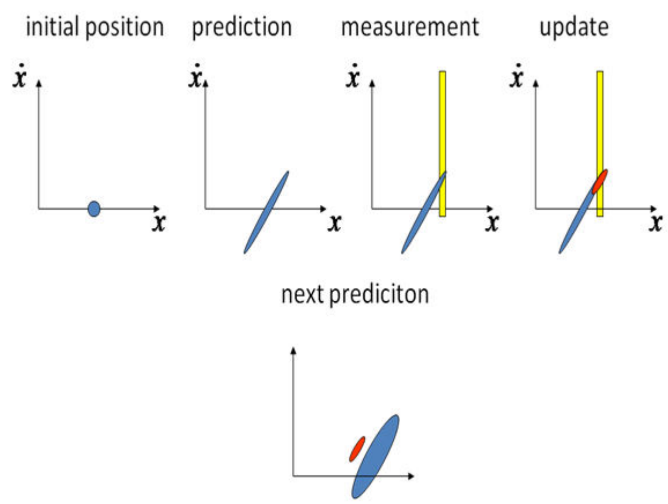
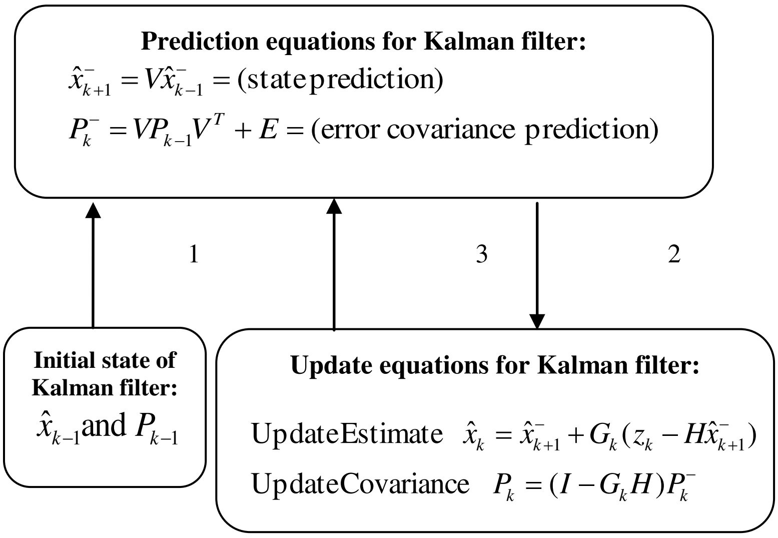


Fig. 2. Schematic views of updated Kalman filter tracking idea.

A. Updated Kalman Filter (KF) Iteration flow diagram:



Above flow charts shows the Kalman Filter (KF) algorithm Iteration. Where '1'shows initial state equation of the algorithm after that '2' shows the perdition equations and finally '3' shows the updating in the predication equation which helps to predict the future position of the object.

Where,
V= State Transition Model describing state transition between time steps
H=Measurement Model describing state to measurement transformation.
x= x is a state (e.g. position, velocity & acceleration, etc)
P=State Covariance State estimation error covariance
E=Process Noise Process noise covariance
G= Optimal gain

We used KF (Kalman Filter) tracking algorithm for single object tracking of infrared image sequences. Here we used two videos (IR image sequence) are:

1. Tracking of the scooter in dark night.

2. Man wondering in front of the car.

We can't use template matching algorithm (which are mostly used in today era for tracking) in these type videos, because in the first video the whole video was capture in dark night. Due to dark night, the visibility of scooter in not proper and if we do template matching, the tracker pointer loses the target due to same black color by approx. 65% in the video. In the second video, the target is so close and big that if of the frame. We use template matching here than it exceeded the dimension.

IV. Result

A. Tracking of the scooter in the dark night

The IR camera is used to record the videos at the time when the visibility of the light is low. If an object is moving with a non uniform rate it can be easily detected by the human eye, however at the same time if the same object is moving with a uniform velocity and in a straight line it is very difficult to track the object by the naked eye. Here Kalman algorithm has been used to track even those objects.

(a) Video Frame 1

b) Video Frame 10

(c) Video Frame 50

(d) Video Frame 80

Fig.3.Tracking of a scooter using Kalman filter tracking algorithm: (a), (b) , (c), and (d) are showing different frames of video used for tracking of scooter using Kalman filter tracking algorithm.

Fig.3 shows different frames of a video that has been recorded at night in which a test subject (Scooter), is moving with a uniform velocity in a straight line. Kalman algorithm has been used in this video to track the test subject and predict its future position. It can be clearly seen from the different frames in Fig. 3, that Kalman filter algorithm has successfully been used to track the test subject and has been highlighted by a red and blue square boxes in these frames. Thus it can be concluded that the use of Kalman algorithm has been successfully applied for tracking of test subject.

B. Man wondering in front of the car

As stated above, the similar case can be taken for a human subject who is strolling in front of a vehicle at night. Again Kalman algorithm has been applied here for the tracking of the test subject. The only difference here is that, under normal circumstances as soon as the major portion of the subject leaves the frame the camera stops tracking it, but in the case presented here the process of tracking continues up until even a small portion of test subject is within the frame.

Following are the results of tracking:

(a) Video Frame1

(b) Video Frame 10

(c) Video Frame 40

(d) Video Frame 50

Fig. 4. Tracking of a human using kalman filter tracking algorithm; (a), (b), (c), (d) showing the frames used for result of tracking (red rectangle box denote current position and blue rectangle box denote future position) of human using Kalman filter tracking algorithm.

The different frames of Fig. 4 shows this process. The first two figure (frames 1 and frames 10) show that the test subject has been tracked successfully and it is being highlited by the red and blue rectangular blocks. Thereafter, Fig. 4 (c), shows that even when the test subject has left the frame partly or say that it can only be seen partly within the frames, it is still being tracked. And this tracking continues as shown in Fig. 4 (d), where the test subject has rentered the frame. Thus, the Kalman algorithm used is successfully able to track the test subject. Furthermore, it has been enhanced as partial test subject can also be tracked.

V. CONCLUSION

The reason for undertaking this work presented here was the problem encountered in tracking the subject in low visibility conditions by a simple 'PC vision' camera. IR cameras were used as a replacement of its predecessors and Kalman algorithm has been used for tracking of different test subjects. The work presented herein includes tracking of a vehicle and a human moving in low light conditions. The test results presented here shows that the test subject can be tracked with much ease with the updated Kalman algorithm applied here. Further, there is improvement with respect to tracking of partially present test subjects present in the frame. These partial subjects are also tracked here even when there is a small portion of the test subject present in the frame. The future work in this domain can include tracking of test subjects at different velocities, and varying motions.

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