Vellore Institute of Technology

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M-Tech Integrated Software Engineering

SWE1010-DIGITAL IMAGE PROCESSING

REVIEW – 3

Moving Object Tracking Using Kalman Filter

Group Members:

Sl No	Reg No	Name
1	16MIS0133	M.SAI DEEPU
2	16MIS0263	S.SAI CHARAN

Submitted to

Prof. Lakshmi Priya G.G

Abstract- In this paper, we displays a multilevel structure for single moving object following in straightforward and furthermore in complex conditions. The frontal area protest is acquired utilizing Fuzzy Inference System (FIS) to significantly manage the brightening changes, shadows, dreary movement of the s and messes in the scenes. Single protest following is performed utilizing Kalman Filter (KF). Kalman Filter gives a proficient gauge of its position at each time step. The proficiency is guaranteed if all commotion is Gaussian. KF gives great outcomes in light of estimation of position to maintain a strategic distance from impediment. Hungarian Algorithm is utilized to locate a specific human in progressive casings. The multiindividual following is a speculation variant of the single individual tracker. We accept that the movement of every individual is free of others and for each question in the scene, a different KF is instated and models its direction.

1 INTRODUCTION

Single Human following and Detection is a noteworthy issue in PC vision. Single Human following frameworks can likewise be utilized as a part of observation , occasion checking frameworks, Anomaly location/Intruder discovery, Motion Capture and Identification, Measurement of movement stream , Accident recognition on Highways , Tracking and Counting Pedestrians, Automotive security, Intelligent control and so forth., A continuous visual reconnaissance framework for identifying and following different individuals and observing their exercises in an outside situation . For following the question in a video, the initial step to be done is to distinguish the protest position in the present casing and with a specific end goal to discover the area of the protest in progressive edges the identification of forefront is required. A few techniques are accessible in the writing to recognize the frontal area. Foundation subtraction is one of the strategies yet is delicate to light changes and foundation variety. Here, In this paper a foundation demonstrating technique utilizing Fuzzy Inference System is taken to gauge foundation. Fluffy Inference System can be connected straightforwardly on shading pictures.

Subsequent to finding the closer view KF is utilized to track the individual human in the scene. By utilizing this, Kalman Filter keeps up a different track for each human in the video. This paper is composed as takes after. Area II clarifies about writing review; Section III gives a diagram of Proposed Algorithm, Section IV clarifies about the Background Modeling, Section V clarifies about Human following, Section VI portrays comes about got. Segment VII we portray the conclusion.

2 LITERATURE SURVEY

At Present , a vast collection of research on visual question following has been distributed in the writing. Lipton et al. [5] and Liu et al. proposed [7] contrast between edges that utilization of the pixel-wise contrasts between any two edges to perceive the articles which are moving . Stauffer and Grimson et al. [6] proposed a Gaussian blend show in view of the foundation estimation to recognize or identify the Moving Human. Also, visual question following is used by the MPEG4 video pressure standard (Sikora 1997) [8]. Desa and Salih et al [9], proposed a mix of foundation subtraction and casing contrast that has been enhanced the past aftereffects of foundation subtraction and casing distinction. Sugandi et al. [10], proposed another system for the most part for Object Detection utilizing outline distinction on the low Resolution picture. Here,Visual question following additionally has a few human-PC cooperation applications that incorporate Hand signal acknowledgment (Pavlovie et al. 1997) [11][12]. Vasuhi and Vaidehi [13] utilized Mixture of Gaussian and KalmanFlter (KF) for the most part for Human Tracking. Presently, lets talk about the Overview of algorithm.

3 OVERVIEWS OF ALGORITHM

Here, this paper proposes an approach which depends on static camera demonstrate. To show the foundation, Fuzzy Inference System (FIS) is utilized. This will take the RGB data from the info casing, and models the foundation. For each progressive edge it will check outline power. The movement is in foundation then foundation model will be refreshed.

The Foreground blobs are additionally handled to get the correct centroid position of the every individual, for example, disintegration and widening idea . The Centroid position of every individual is put away in a cluster. The exhibit is given to the Kalman Filter for progressive edge following. Figure 1 portrayed square chart of the Multiple Human B. Fuzzification Tracking framework. It comprises of five squares Fuzzy Inference System, Detection of Centroid, Kalman Filter, Measurement Assignment lastly Tracking. KF in relationship with Hungarian Algorithm is utilized to Track Individual protests in progressive edges.

4 BACKGROUND MODELING

RGB or shading pictures are utilized to demonstrate the foundation utilizing Fuzzy Inference framework. The current Background displaying calculations for the most part uses dim pictures for foundation demonstrating. In any case, while changing over RGB pictures to dark pictures loss of data may happen. A case, dull red and dim maroon will have a similar force value. For staying away from this issue, we need to perform Background Modeling in RGB shading space or whatever other shading space. Since we can’t discover frontal area objects on the off chance that we Have same dark level force for Different hues pictures. Foundation model is made utilizing a N number of foundation casings. The estimation of N for the most part relies on upon the Dynamic way of the scene.

5 HUMAN TRACKING

5.1 Kalman Filter

Here, in this paper the fundamental thought behind the Kalman Filter is portrayed with regards to Human Tracking. The movement model of a protest which is moving (which contains some sort of powerful clamor), and some uproarious perceptions about its position, the Kalman Filter gives a productive l gauge of its position at each time step. The optimality is guaranteed if all commotion is Gaussian and the channel decreases the Mean Square blunder of the assessed elements like position and speed and to define aKalman Filter issue we require a discrete time direct unique framework with added substance background noise models capricious unsettling influences. The Kalman Filter tries to foresee the state x which has a place with R" of that framework which is administered by the vector distinction condition demonstrated as follows:

$$x_k = Ax_{k-1} + Bu_k + w_{k-1} \tag{3}$$

$$z_k = Hx_k + v_k \tag{4}$$

The Random Variable Wk., Vk portray the procedure and Measurement clamor separately. They are thought to be zero mean, repetitive sound covariance lattices Q, R separately and the other way around.

What's more, Matrix A will be a thought to be Transition framework which relates the past state Xk-1 to present state xk. Framework B is Optional and relates the control contribution to the state xk . In the perspective of our tracker, there is no Control input, in this way the element BUkis expelled from the Equation. The Matrix H relates the estimation Zk to xk• The Kalman Filter considers the beneath two appraisals of states.

- x(k/k - 1) :It is utilized to gauge of the state at time step k, given the information of process up to k-1.
- £(k/k) :It is utilized to gauge of the procedure state at time step k given the information of the estimation Zk .

It likewise considers the accompanying two Error Covariance networks of the state appraise.

- P(k/k - I): It is from the earlier gauge Error Covariance of x(k/k - 1).
- P(k I k): It is a posteriori evaluate the Error Covariance of x(k/k) .

The Kalman Filter works in two stages on each time step k. The fir .h d" f h . x(k1 k-I) st one IS t e pre lctlOn 0 t e next state estllllate utilizing the past one. The second one is the adjustment of the gauge utilizing the estimation demonstrated as follows

1. state forecast: x(kI k-I) = A. x(k I k-I)

2.error covariance forecast P(k I k - I) = A.P(k - II k - I). A T + Q

3. estimation forecast 2(k/k-I) = H. x(k1 k-I)

4. lingering rk=zk-z(klk-l)

5. estimation forecast covariance T sk = H.P(k I k - I).H +R

6. Kalman pick up T - 1 w k =P(klk-l).H .S

In this way, inorder to introduce the Kalman Filter we need to characterize the State move lattice An and the Measurement network H, the two clamor covariance grids R,Q, and at each time venture to encourage the channel with a Measurement Zk. At each time stepKalmanFilter will discover the estimations of state expectation and redress. On the off chance that Measurement is available then the Correction is performed as for the Measurement or if no estimation is available then the Correction is being performed utilizing the anticipated esteem.

5.2. Single Human Tracking

The Random Variable Wk, Vk portray the procedure and Measurement commotion individually. They are thought to be zero mean, repetitive sound covariance networks Q, R separately and the other way around.

What's more, Matrix A will be a thought to be Transition network which relates the past state Xk-1 to present state xk. Network B is Optional and relates the control contribution to the state xk . In the perspective of our tracker, there is no Control input, in this manner the variable BUkis expelled from the Equation. The Matrix H relates the estimation Zk to xk• The Kalman Filter considers the beneath two evaluations of states.

- x(k/k - 1) :It is utilized to gauge of the state at time step k, given the information of process up to k-1.
- £(k/k) :It is utilized to gauge of the procedure state at time step k given the learning of the estimation Zk .

It likewise considers the accompanying two Error Covariance networks of the state evaluate.

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2.error covariance expectation P(k I k - I) = A.P(k - II k - I). A T + Q

3. estimation expectation 2(k/k-I) = H. x(k1 k-I)

4. remaining rk=zk-z(klk-l)

5. estimation expectation covariance T sk = H.P(k I k - I).H +R

6. Kalman pick up T - 1 w k =P(klk-l).H .S

Thus, inorder to instate the Kalman Filter we need to characterize the State move grid An and the Measurement lattice H, the two commotion covariance networks R,Q, and at each time venture to encourage the channel with a Measurement Zk. At each time stepKalmanFilter will discover the estimations of state expectation and revision. On the off chance that Measurement is available then the Correction is performed concerning the Measurement or if no estimation is available then the Correction is being performed utilizing the anticipated esteem.

By Using Kalman Filter, following of single individual in the scene is a moderately simple Task.

Accept (px, py) be the two dimensional directions of x y the protest and (mx, my) be the two Dimensional directions of the estimation and (vx , vy) thought to be the speed toward each path.

The State vector Xk and the estimation vector Zk of the KF on the edge k are characterized as. x k = (p x, p y , v x,v

y) zk = (mx ,my)

Where, px ,py , vx and vy depict the position and speed in x and y heading individually. mx, my are Measurements in x and y Direction.

The state measurement matrix is defined as,

$$H = \begin{bmatrix} 1000 \\ 0100 \end{bmatrix}$$

The state transition matrix,

$$A = \begin{bmatrix} 1\ 0\ dt\ 0 \\ 0\ 1\ 0\ dt \\ 0\ 0\ 1\ 0 \\ 0\ 0\ 0\ 1 \end{bmatrix}$$

By characterizing these vectors and networks at each time step we refresh the Kalman Filter with the new measured esteem and anticipate an expected Xk .

Assume, if single individual following if at some casing k more than one estimation (because of clamor likely) is found in the situation, then the estimation nearest to the individual's last evaluated area is allotedto that protest and being utilized to refresh the Kalman Filter. At the point when there is no estimation accessible, then a KF is refreshed by its anticipated state and furthermore not being amended by any Measurement performed.

5.3 Measurement Assignment

As before 0 signifies the arrangement of items and M the arrangement of estimations Let DN*N be a network of the separations between

every $o \in O$ and $m \in M$ such that $D(i, j) = dist(o_i, m_j)$

$$D = \begin{bmatrix} d_{1,1} \ldots\ldots d_{1,N} \\ d_{2,1} \ldots\ldots d_{2,N} \\ \ldots\ldots\ldots\ldots \\ \ldots\ldots\ldots\ldots \\ d_{N,1} \ldots d_{N,N} \end{bmatrix}$$

We will utilize the Hungarian Algorithm to locate the effective task for the above network. In this usage at first ,we have to ascertain the combine astute separations of each protest and estimation and afterward utilize an occasion of the Hungarian Algorithm. Given that the quantity of s is generally little, the calculation is then extremely productive and can be utilized as a part of our constant tracker.

Implementation:

Matlab Code:

```
clc; close all; clear all; video =
VideoReader('Realtime.avi'); %in place of aviread
%nframes = length(video);
nframes=video.NumberOfFrames; for i=1:nframes
mov(i).cdata =read(video,i)
%creating '.cdata' field to avoid much changes to previous code
end temp = zeros(size(mov(1).cdata)); [M,N] =
size(temp(:,:,1)); for i = 1:10 temp = double(mov(i).cdata) +
temp; end imbkg = temp/10;centroidx = zeros(nframes,1);
centroidy = zeros(nframes,1); predicted = zeros(nframes,4);
actual = zeros(nframes,4);
R=[[0.2845,0.0045]',[0.0045,0.0455]'];
H=[[1,0]',[0,1]',[0,0]',[0,0]'];
```

```
Q=0.01*eye(4);

P = 100*eye(4);

dt=1;

A=[[1,0,0,0]',[0,1,0,0]',[dt,0,1,0]',[0,dt,0,1]'];

kfinit = 0; th = 38; for i=1:nframes

imshow(mov(i).cdata);

hold on imcurrent = double(mov(i).cdata); diffimg

= zeros(M,N); diffimg = (abs(imcurrent(:,:,1)-

imbkg(:,:,1))>th) ...

| (abs(imcurrent(:,:,2)-imbkg(:,:,2))>th) ... |

(abs(imcurrent(:,:,3)-imbkg(:,:,3))>th);

labelimg = bwlabel(diffimg,4); markimg =

regionprops(labelimg,['basic']); [MM,NN]

= size(markimg); for nn = 1:MM if

markimg(nn).Area > markimg(1).Area

tmp = markimg(1); markimg(1)=

markimg(nn); markimg(nn)= tmp; end end

bb = markimg(1).BoundingBox; xcorner =

bb(1); ycorner = bb(2); xwidth = bb(3);

ywidth = bb(4); cc =

markimg(1).Centroid; centroidx(i)= cc(1);

centroidy(i)= cc(2); hold on rectangle('Position',[xcorner ycorner

xwidth ywidth],'EdgeColor','b'); hold on
```

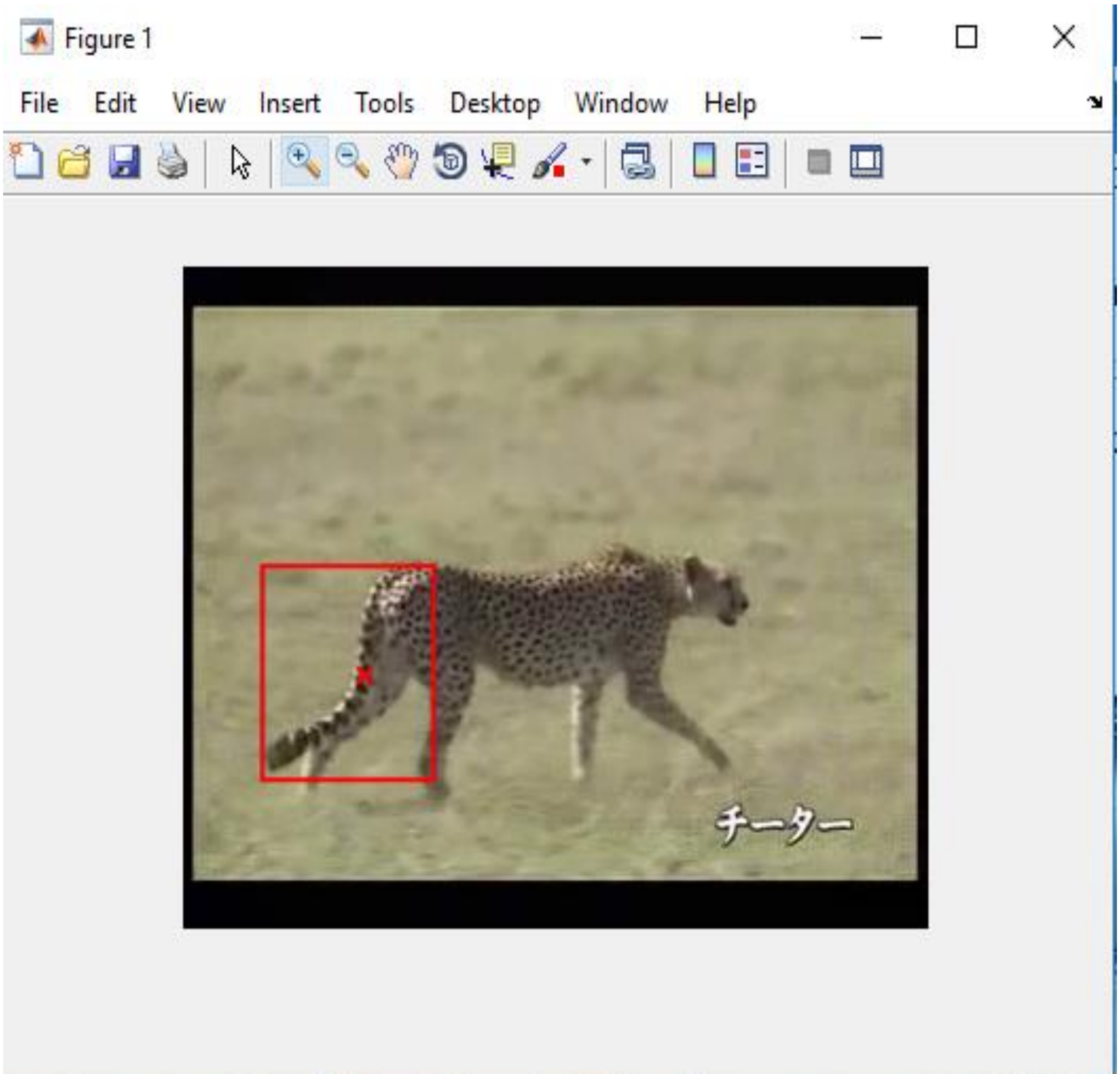
```
plot(centroidx(i),centroidy(i), 'bx'); kalmanx = centroidx(i)- xcorner;
kalmany = centroidy(i)- ycorner;

if kfinit == 0 predicted
=[centroidx(i),centroidy(i),0,0]' ; else
predicted = A*actual(i-1,:)'; end
kfinit = 1;
Ppre = A*P*A' + Q;
K = Ppre*H'/(H*Ppre*H'+R); actual(i,:) = (predicted +
K*([centroidx(i),centroidy(i)]' - H*predicted))'; P = (eye(4)-K*H)*Ppre;
hold on  rectangle('Position',[(actual(i,1)-kalmanx)...
(actual(i,2)-kalmany) xwidth ywidth],'EdgeColor','r','LineWidth',1.5);
hold on plot(actual(i,1),actual(i,2), 'rx','LineWidth',1.5);
drawnow;
end
```

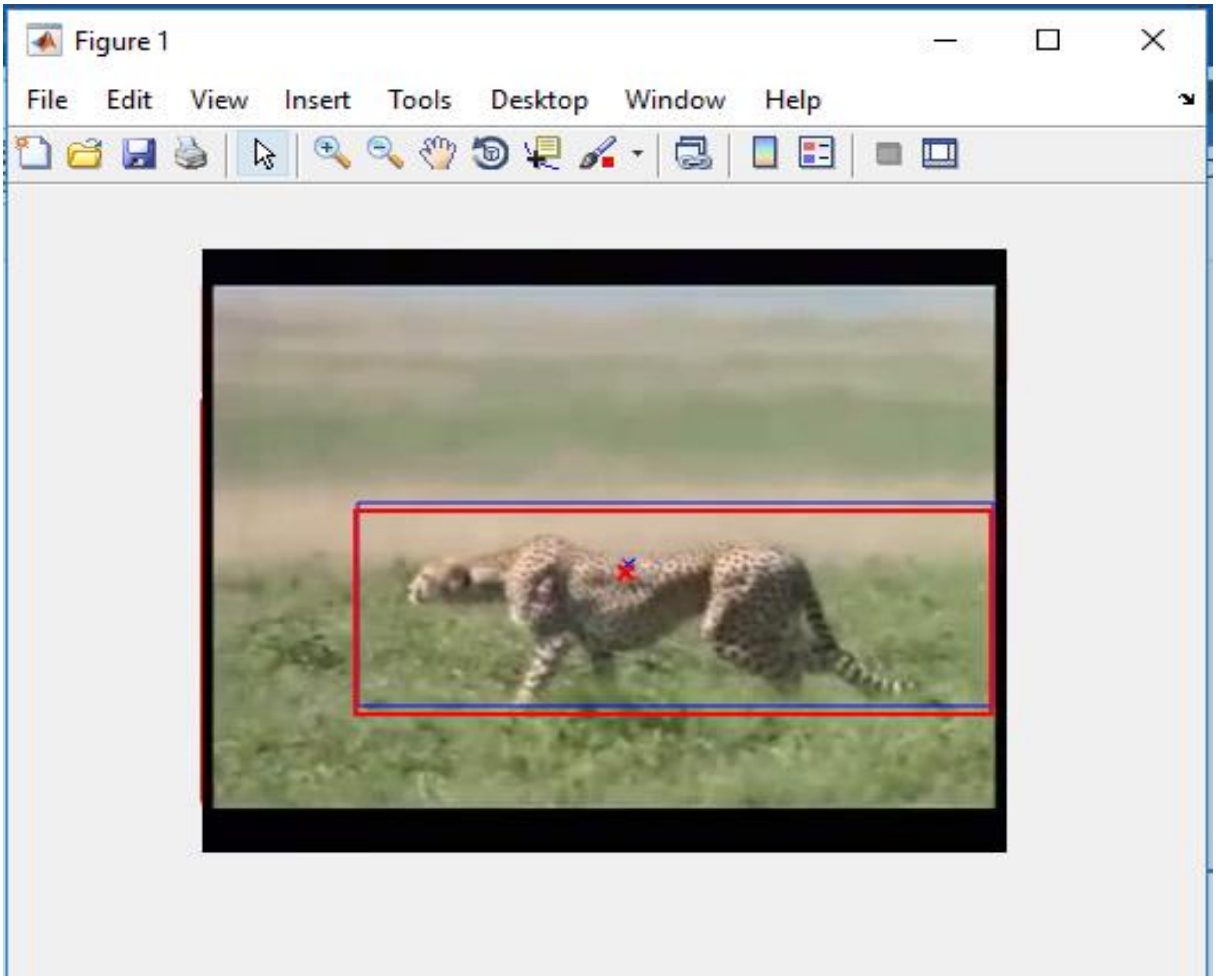
•RESULTS AND DISCUSSION

•Single Human Tracking

At last , following of single individual in blocked condition is appeared in figure beneath Figure 7. You ,can see the individual impeded by a column and the principal section is the info casing and Second segment has been distinguished moving closer view objects and the Third segment is the yield outline in which the recognized

Humans are spoken to by Rectangular Bounding Box built around each identified Human. The First 2 outlines demonstrate the Detected human before impediment and last casing is gotten, after impediment and Kalamn Filter can ready to track the individual despite the fact that the human was blocked.





- **CONCLUSION**

We, presume that in this paper a Reliable and Robust approach for following of human in both mind boggling and continuous conditions has been proposed and effectively demonstrated. The Main Contribution of this approach is Fuzzy Inference System for Background Modeling Kalman Filter for Tracking and Hungarian Algorithm for recognizable proof of the individual . The Proposed techniques ideally conquer the issues that emerge because of different occlusions,Simultaneous following of people and focus on the miss-affiliation. Henceforth the proposed framework is fit for taking care of complex following issue and furthermore gives the response for following particular people within the sight of whatever other various moving individuals. In future, our work is to be enhanced with numerous camera sensors for enhancing observation applications. The Problems about the Background varieties, camera movements, and furthermore including panning, tilt, and zooming make the video outline facilitates with thought to the arrange framework can likewise be considered for Further upgrade .

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