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Efficient Lane Tracking by Navigation, Positioning Filter Algorithm

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Abstract – In this research paper, we introduce Lane Tracking by Using navigation,positioning and tracking filter i.e dealing to make the hybrid of two filter.This two filters are "Kalman filter and Particle filter". Presented approach gives us idea about perfect and efficient and clear view tracking. Model is designed to make a tracking near real time. This idea further introduces the lane detection which is a essential part of tracking by using Hough Transform to get efficient and ideal model. Measurement of improvement in lane tracking have been increased and measured extensively by the hybrid model. Model is developed on matlab. The designed tracking model was tested on various weather conditions during different time. This tracking model is developed for the assistance of driver in rainy ,sunlight,night and foggy condition. This model is helpful and gives near real situation of road by tracking using hybrid of kalman and particle filter algorithm. They help in providing clarity to complex shadowing and lighting changes. Use of digitised camera on dashboard or bonet of vehicle and use of warning system is also done in this model in order to warn driver about the bad situation of road for their safety. This model overcomes all the problem that occurred in previous tracking system in different time and weather conditions.

Index Terms – Computer Vision,Lane Tracking,Driver Assistance,Matlab/simulink,Intelligent Vehicle,Navigation filters.

1. INTRODUCTION

Currently many works has been done on lane tracking to make tracking packages by using various sensors, GPS etc. Navigation filters are also used for this purpose before but some work has to do over it to make it more efficient than earlier tracking. Previously some dedicated work on Kalman filter for tracking lane is also done but kalman filter algorithm is not suitable for nonlinear model or road having curvatures in between.This type of tracking model gives false tracking on rural roads. The motivation behind this model is to assist driver at all time in different conditions. The important task of the model is to get exact and efficient tracked lane while driving in the worst weather condition. This model is based on hybrid of two filters i.e. navigation,positioning and tracking filter. particle filter is nonlinear type of filter while kalman filter is linear type of filter. This model will definitely work well in both linear and nonlinear condition. This model gives safety measures of on-going road which will gives idea about the situation of road position or obstacles between the road and curvatures that road have.

The system can be making real-time by putting camera (CCD) on the dashboard or front of vehicle to capture images of road continuously.Camera put on the outside area of vehicle will give more clear vision of continuously captured images than the camera inside the vehicle. Image processing is applied on these taken images in order to detect lane before tracking. Detected images also plays main role to give exact tracking before application of tracking algorithm.Tracking algorithm can be applied on both detected and non-detected lane but detected lane makes clear visualization of tracked lane. Marking of lanes are detected and is used in kalman filter measurement. Design of kalman filter is suitable only for highway not on rural road i.e not on curved road.In kalman filtering sometimes wrong prediction can be made due to the different or bad road conditions. To overcome or to avoid this false prediction particle filter is used. This filter is suitable in different scenarios to get efficient tracking.

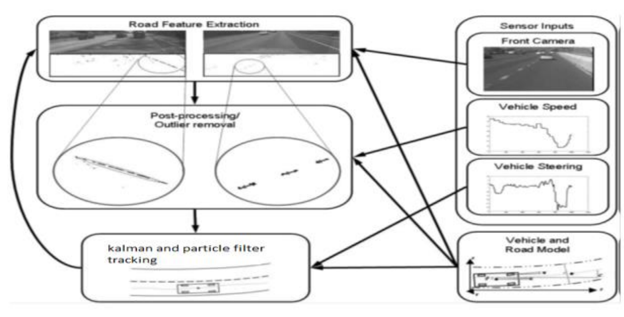

Fig 1.Processing Levels

FIG 1.BLOCK DIAGRAM OF PROPOSED LANE TRACKING

We combined Kalman and particle filter to combat the problem of tracking.Some local limitations of kalman filter is reduced when it combined with particle filter.Kalman filter propagates and update mean and covariance of distribution but in non-linear system or in non-Gaussian system it is very difficult to find distribution. The effeciency and the performance of system is analyzed and tested on road in different weather conditions. This system is designed to give position of curvature of road. System is beneficial for long distance buses where safety is critical and essential issue. The vision based computer tool is used to handle this tracking model. Alarm is generated if there is some obstacles in lane or situation which is not convenient or safe for fast driving.

2. LITERATURE SURVEY

Existing lane tracking system have dozens of problem regarding to tracking,positioning and navigating.Previously much emphasis is given to the efficient tracking in nonlinear position and linear position but result obtained from that is not satisfactory result oriented.Tracking lane during various weather condition is not a easy task. Some work is needed in this area to make it real time and efficient.

3. ALGORITHM

Lane recognition,detection and tracking is based on two navigation filter i.e kalman filter and particle filter. Kalman filter predicts the scenario between previous and current situation while particle filter predicts scenario of each changing particle and image recognition of lane. In order to make model work in linear and nonlinear condition, hybrid of two navigation filter is used. Model is designed to exploit the advantages of both kalman and particle filter. Rural road scenario can also be tracked properly by this hybrid tracking model in different weather condition at different time.

A. Tracking by Kalman Filter

State vector of tracking system and its error covarience matrix can be obtained by kalman filter algorithm.Process of filtering in kalman can be done by two step. See fig.2,it predicts state vector and its error covariance matrix P and then it correct the predicted state vector by appropriate measures.Error covarience matrix is also corrected.Assumption made before correction made by kalman filter is to predict the state and correct the state are very close to each other.The filter which is used in the detection,tracking and recognition expects continuosly changing road.

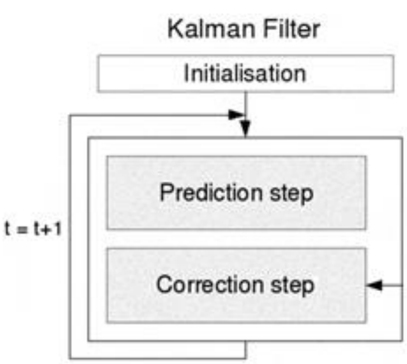

Fig.2 Kalman filter with two step i.e. prediction and correction

The state parameter changes abruptly and continuously because of curvature variations.This error are small at highways but the error are more on rural road due to the variation in state parameter which creates serious problem in lane tracking.Incorrect prediction algorithm gives false tracking.It does not provide cooperation with multiple measurements.It tracks one track at a time.

B.Tracking by Particle Filter

Idea to make hybrid of both this filter is inventory beacuase before this tracking of lane and tracking of object and recognition of body parts while moving is done by using this filter separately.But this experient can give satisfactory output.Condensation algorithm is widely used variant of particle filter. This condensation algorithm is given in fig.3.At the first step i.e. prediction step, each and every single particle is predicted into current time instant. Particle are weighted in the weighting step using the factor F with calculated likehood P(F(x,y)/s) up to normalization factor.

At the process of selecting number of particle that are required in tracking are multiplied depending on the weight and some noise i.e. Gaussian noise is added to each particle. Particle filter is totally depend on variance factor. This is the drawback of particle filter in the application of recognition and prediction.

Step I. For i=1…N draw new particles $x^i{}_k$ from the prior density $\prod(x_k/x^i{}_{k-1})$ and then use likelihood density to calculate the correspondent weight $w_k{}^i=\prod(z_k/x^i{}_k)$.

Step II. Calculate the total weight $T_w=\sum^N W_k{}^i$ and then normalize the particle weights, that is for i=1,…N

let $w^i{}_k=T^{-1}{}_w\, w^i{}_k$.

Step III. Resample the particle as follows

Step 1: Construct the cumulative sum of weights (CSW) by computing $c_i=c_{i-1}+w^i{}_k$ for i=1,…N with $c_0=0$.

Step 2: Let i=1 and draw the straight point $u_i$from the uniform distribution $U(0,N^{-1})$

Step 3: For j=1,…N

1. Move along the CSW by making $u_i=u_i+N^{-1}(j-1)$

2. While $u_i>c_i$ make i= i+1.

3. Assign samples $x^i{}_k=x^j{}_k$.

4. Assign weights $w^i{}_k=N^{-1}$

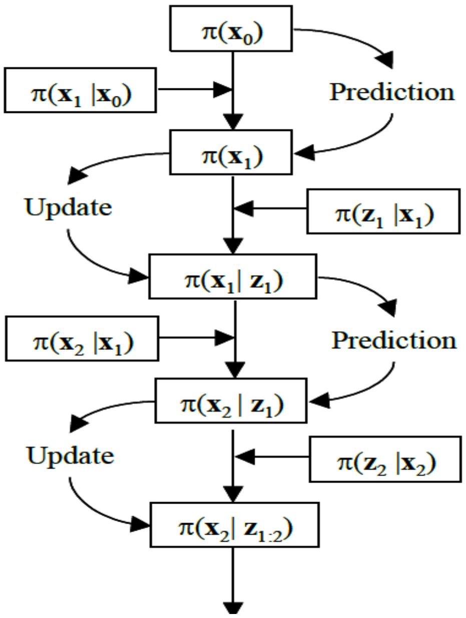

Fig.3 Prediction and update state of kalman filter

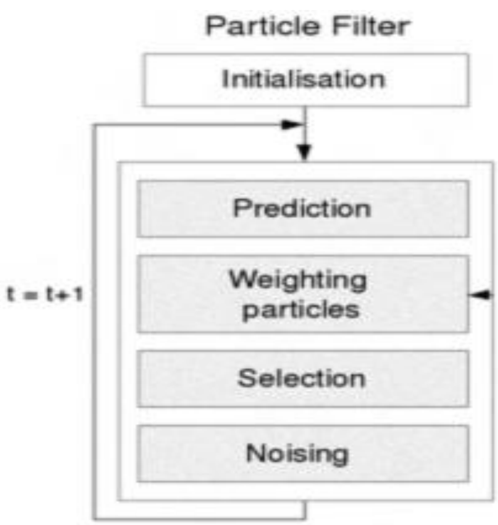

Fig 4.Particle filter with prediction and selection step

4. METHODOLOGY

A.Tracking by Particle and Kalman Filter

Advantages of both kalman and particle filters are taken into consideration in this research. Particle filter takes ovcer all control of multiple hypotheses and also take into account weak cues of the road like color,curvature and texture. In opposition to this, kalman filter does implicit calculation of the error covariance matrix of estimated state vector and correction of the predicted state by measurement of each and every present and coming situation of road .This two filters are combined to help each other and eliminates the drawback of each other and make model more efficient than present model. In fig 5.Prediction step of the particle filter is substituted by a complete kalman filter where every single particle that changes in images captured is corrected after prediction and its covariance matrix is calculated. The vectors are corrected and then weighted by different cues. State vectors of each changed particle show lane hypothesis and also covariance matrix. Therefore kalman particle filter can be used as multi hypotheses algorithm. Since the state vectors are corrected in the Kalman Filter step and the variances are automatically adjusted, the number of particles can be reduced for convinience. The different sources of information Fi are conditionally independent which leads to the joint probability.

$P(F_1 \ldots F_n/s^-)=\prod p_i(F_i/s^-)$

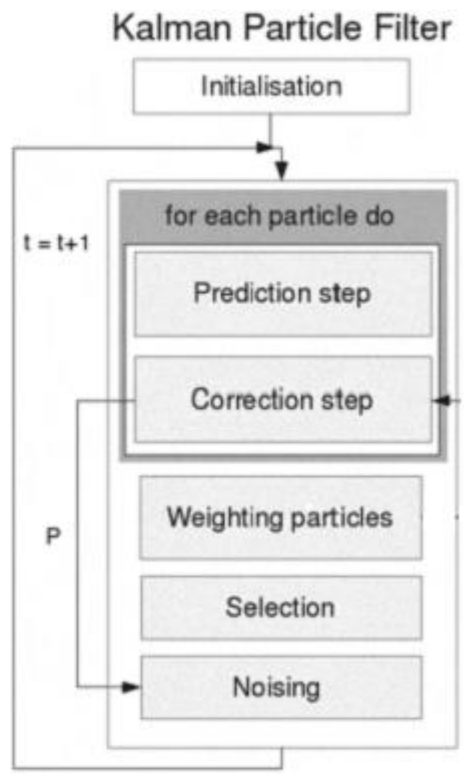

Fig 5. Hybrid kalman particle filter

5. PROCESSING TIME

We assess the additional computational load required to run the integrated lane and vehicle tracking, and compare it to the processing times required for the stand-alone lane tracker, and stand-alone vehicle tracker. While efforts have been made to pursue efficient implementation, neither code nor hardware is optimized. Table 1. provides the processing time per 704 ×408 video frame in milliseconds, for each of the respective systems. The vehicle detector and tracking system requires 33.1 ms to process a single frame, running at real-time speeds of a little over 30 frames per second. The lane tracking system takes 74.1

ms to process a frame, running at 13.5 frames per second. Integrated lane and vehicle tracking takes 90.1 ms to process a single frame, running at roughly 11 frames per second, somewhat less than the sum of the times required for the vehicle and lane tracking systems separately. This speed is near real time.

Tracking System	Processing Time per 704× 408 Frame (ms)
Vehicle Detection and Tracking	33.1 ms
Lane Tracking	74.1 ms
Integrated Lane and Vehicle Tracking	**90.1 ms**

Table 1

6. RESULT

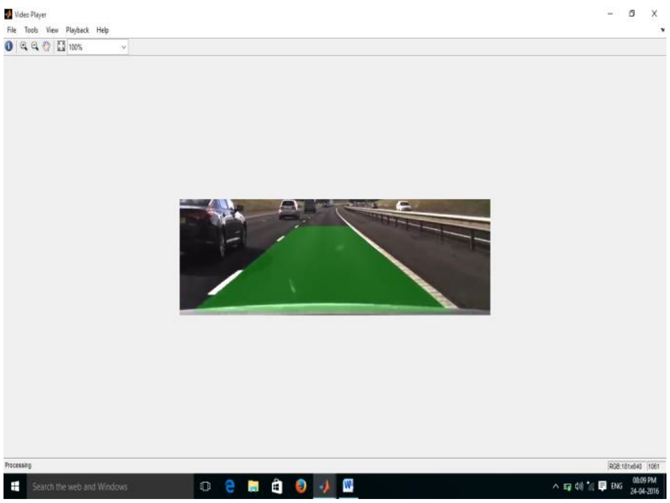

Fig 6 Tracked Path

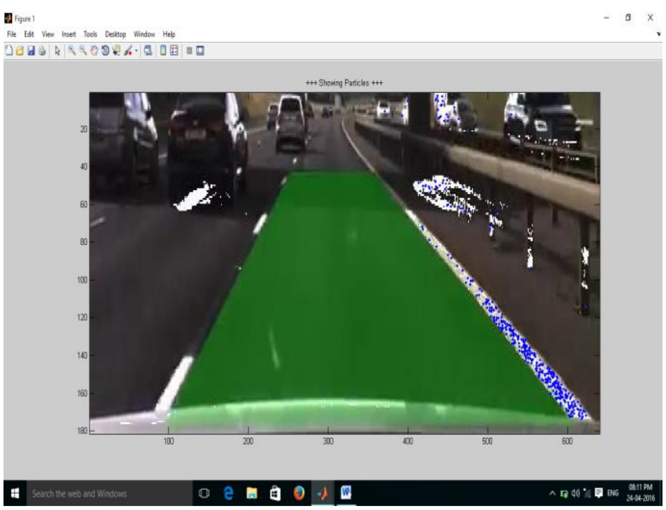

Fig 7 Particle Kalman Output

7. CONCLUSION

Work on this serious issue of tracking is under process by making hybrid of two navigation filters i.e. kalman filter and particle filter.Hybrid can be implemented to make system more and more efficient and real time.The main motivation behind the model is to assist driver at different weather condition like rainy season and foggy season and reduce the chances of accidents.System can give near real time and perfect output if proper work is done in this area by using this filter.

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