iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 3 **Issue:** XII **Month of publication:** December 2015

DOI:

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

Volume 3 Issue XII, December 2015
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Road Railway Safety System to Avert Accident in Unmanned LC

A.Risvin[1], S.V.Anandhi[2]
[1]*M.E student,* [2]*Assistant Professor CSE*
[1, 2] *Department of CSE, Dr.Sivanthi Aditanar College of Engineering, Tamilnadu, India*

Abstract— **Railway transportation is one of the safest modes of transport. In unmanned level crossing the number of horrible fatal accidents that road vehicle driver and pedestrians cause. To reduce the accident in LC to introduce new technique Smart Video Surveillance Security System. This intelligent monitoring system that is tuned toward detecting and evaluating the abnormal situations induced by pedestrians, vehicle drivers and unattended objects. This technique starts by detecting, separating and tracking of moving objects in LC.Then HMM (Hidden Markov Model) is used to estimate the ideal trajectories, allowing the detected targets to discard dangerous situations. After that each detected object risk is estimated by Dempster Shafer fusion technique. The video surveillance monitoring system is connected with a communication system which sends alert message it to users approaching LC which takes the information on the dynamic status of LC (safe or presence of dander situations).**

Keywords— **Video Surveillance Security System, Hidden Markov Model, Dempster Shafer**

I. INTRODUCTION

Recently, road railway infrastructure considered as a week point in Level Crossings (LCs).Safety became an important field of academic research and took increasing railway undertaking concerns. Improving the safety of people and road railway facilities is an essential key element to ensuring good operation of the road and railway transport. Statistically nearly 55% of LC users have a negative perception of the environment, which consequently increases the risk of accidents [1]. we know from the accident statistics that the behavior of pedestrians, road vehicle drivers and railway operators cannot be estimated beforehand. According to Griffon [2],human errors cause 99% of accidents at the LCs,93% of which are caused by road users. To overcome this problem the initial idea ,first carried out in the framework of the VSS(Video Surveillance Security System) safer project was to introduce some technological components in the management of LC.These technical approach was developed and tested in life situations can be summarized in Fig 1.

The general view of the architecture for detection and communication system is implemented in the VSS safer project. This architecture can be summarized into two points

A. One equipment dedicated to the detection of potentially dangerous situations due to video sensing and image processing (this will constitute the main part of this paper).

B. One equipment of communication whose role is to send to the users approaching the LC the status of the LC.These two equipment devices are installed in the LC premises.

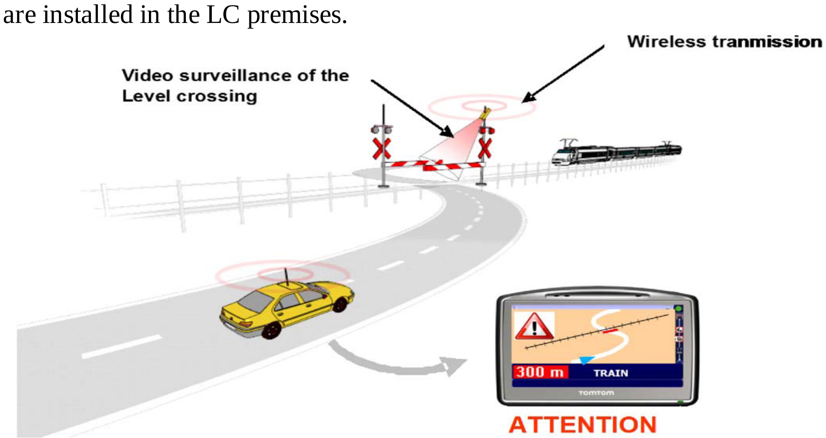


Fig. 1 General architecture of VSS safer project

Volume 3 Issue XII, December 2015
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

II. RELATED WORKS

In these paper main objectives is to perform a video-analysis-based system to identified the hazard situations and estimate the degree of danger for each detected and tracked moving object at LC zone. To propose a new technique to detect and separate all moving objects enter into a given surveillance. To obtain separated objects, this method consists in clustering moving pixels by comparing specific energy vectors associated to each target and each moving pixel. The second step object tracking which starts when there are enough detected pixels belonging to moving objects. In existing system, there are two major kinds of methods to perform visual tracking. The first type is based on target representation such as blob, kernel and contour tracking. The second type of methods uses particle filter which has advantages and disadvantages but it cannot track correctly all the pixels or the majority of them from a given object.

To propose a new method that significantly improves the tracking performance of each pixel affected by motion with the detected objects using Harris point based optical flow propagation technique and its followed by Kalman filtering based correction. The third step of the system is to predict the ideal trajectories of detected targets to avoid potentially dangerous situations by using real time HMM.Finally to estimate the degree of danger related to each object, the predicted ideal trajectories are analyzed using an information fusion framework based on Dempster Shafer theory.

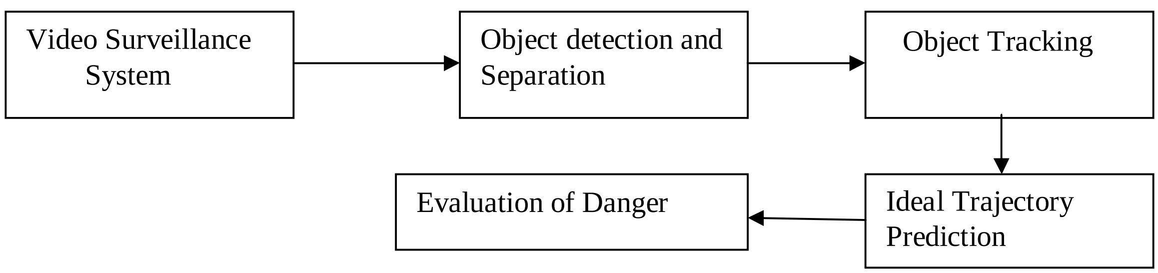


Fig. 2. Synopsis of the video Surveillance system.

III. MOVING OBJECT DETECTION, SEPARATION AND TRACKING

A. Objectives

In real scenarios different object detection and separation algorithms are applied to robustly tracking objects and perform object tracking to track all object pixels in real scenes without loss of information. In Fig 3 illustrated the global object detection, separation and tracking process. The method detecting pixels affected by motion which is a pre-treatment phase. To each target detect and a separate object consists in clustering moving pixels by comparing specific energy vector. Once the targets are extracted from the current frame then the objects is to track them is achieved by objects tracking method based on optical flow.

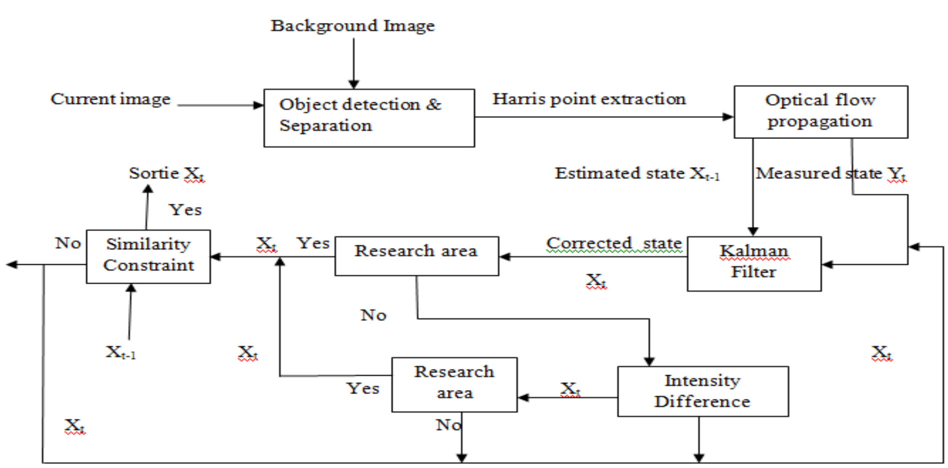
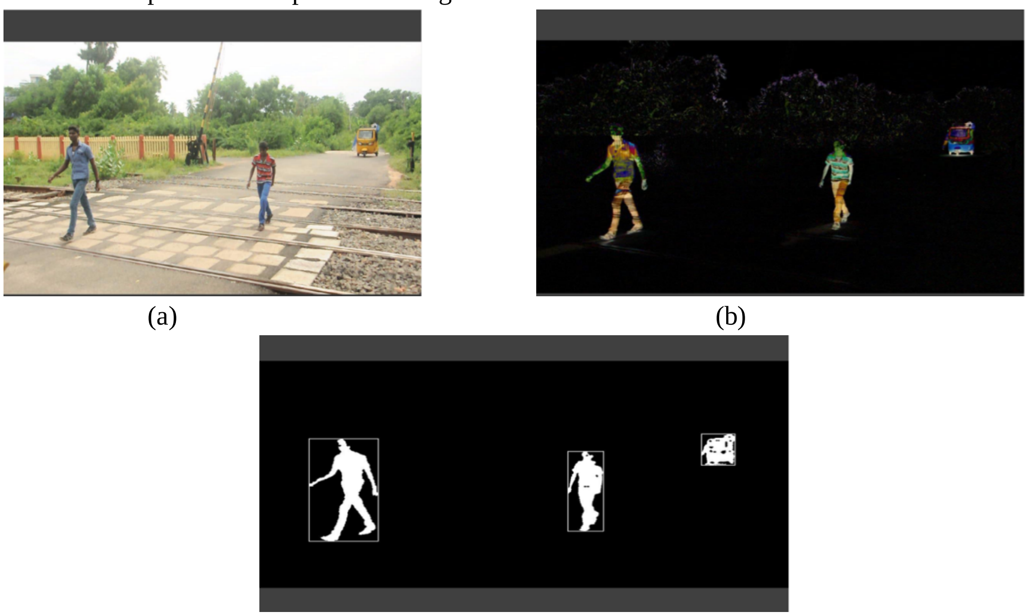


Fig 3. Architectural design of proposed system

In tracking process it is done by computing optical flow of corner points by Harris operator using Lucas-Kanade algorithm. To make the tracking process more robust against noise and to rectify the optical flow for each pixel using Kalman filter (KF) based iterative process is designed. The output of optical flow given the KF is evaluated with two test constraints. The first test verify if the proposed solution is inside an optical flow research area and if the test is positive then revaluated the optical flow solution with the second test constraint which is similarity test constraint. If the second test is positive the proposed solution is retained. If the test is negative then KF is applied again to reach a new solution. If the research area test is negative a color intensity optimization algorithm is applied to propose a new solution.

B. Object Detection and Separation

In video surveillance system object detection and separation for moving objects is important task in computer vision. To facilitate the process of detecting moving targets and to reduce the processing time of the object tracking algorithm. In first step subtract the current image from the reference image (background image) to obtain all pixels affected by motion it is the pre-treatment step. The second step starts by determining the targets in the current image by grouping connected pixels. Each moving pixels in contour of a object is separated by using bounding box. The moving pixel inside a current bounding box may belong to new or old target. It depends on the intersection between the current bounding box and all the existing targets extracted from the previous frame and represented by bounding boxes. If a current bounding box intersect with one or other existing bounding box to calculate the energy vector to the pixel with respect to the target number.



(a) (b) (c)

Fig 4. (a)First frame in video. (b) Background removal in (a).(c) Object detection and separated using bounding box (b).

C. Object Tracking

Once the targets are extracted from the current frame, the objective is to track them. To achieve that an object tracking method based done in two steps: Optical Flow propagation and Kalman Filtering.

1) *Optical Flow propagation:* In object tracking once the targets are extracted from the current frame, the objective is to track them. To achieve that an object tracking method based on optical flow is applied. The tracking process start by computing optical flow of corner points extracted by Harris operator using the Lukas-Kanade algorithm, To consider these particular points have a stable optical flow. To propagate the optical flow results from textured areas into untextured ones, to consider that the optical flow of all pixels of a target has a Gaussian distribution. The parameters of Gaussian distribution are mean and standard deviation of Harris points optical flow(x, y).

Volume 3 Issue XII, December 2015
ISSN: 2321-9653

2) *Kalmnan Filter:* To make the tracking process more robust against noise and to rectify the optical flow for each pixel, a Kalman filter (KF) based iterative process is designed.The proposed KF provides the corrected state X_t from two inputs X_{t-1} state to be corrected and Y_t measured state from a virtual observation.

$$X_{t-1} = [\, p_x^{t-1}, pt_y^{t-1}, ft_x^{t-1}, ft_y^{t-1} \,]^T \qquad \text{....................................(1)}$$

$$Y_t = [\, p_x^{t}, pt_y^{t}, Ft_x^{t-1}, Ft_y^{t-1} \,]^T \qquad \text{……………………..……..(2)}$$

Where $p^{t-1}{}_x$ and $p^{t-1}{}_y$ are the pixel coordinates at time t − 1. $P^t{}_x$ and $p^t{}_y$ are the pixel coordinates measured at time t. $Ft^{t-1}{}_x$ and $ft^{t-1}{}_y$ are the horizontal and vertical optical flows at time t −1.$Ft^{t-1}{}_x$ and $Ft^{t-1}{}_y$ are the horizontal and vertical optical flows at time t − 1.In Figure 3(b) an optimal solution is obtained when estimated optical flow is inside the research area and verifies similarity constraint. The similarity constraint measures the change in color between the previous position p^{t-1} and the current position p^t.An optical flow inside the research are is considered optimal only if the similarity value is less than a threshold which is fixed 0.15 whereas the normalized color change limit between 0 and 1.when the iterative fails to reach an optimal solution the considered pixel is ignored and no optical flow is assigned to the considered pixel.

(a) (b)

Fig 5. (a) Moving pixels tracking using optical flow. (b) Moving objects tracking using Kalman filter

3) *Intensity Difference Based Optimization Algorithm*

The objective of the optimization algorithm is to improve the accuracy and robustness of the KF when rectifying the optical flow. This optimization is to rectify the optical flow by calculating the intensity difference the considered pixel and the detected Harris points. When the intensity differences at two consecutive instants are equal then the optical flow is obtained.

IV. RECOGNITION OF DANGEROUS SITUATIONS IN LC

The proposed method to recognize potential dangerous situations around an LC.Given target detected by the tracking process, the proposed recognition process has three main steps are

A. Optical Flow Based Object Segmentation

The objective is to segment the target into different region based on optical flow of its pixels. To achieve that use a recursive algorithm that compares neighbouring pixels to extract regions in which the pixels have a homogenous optical flow. The segmentation process consists in assigning this pixel to one of the existing clusters if the optical flow similarity constraint is verified otherwise the pixel is assigned to a new cluste**r.** The similarity constraint takes into account simultaneously the direction and the value of optical flow. The target is partitioned into multiple rectangular boxes representing the different regions with homogenous optical flow.

B. Prediction Of Ideal Trajectories

The next step ideal trajectory prediction, each extracted region is considered by the center of its corresponding rectangular box. The trajectory is associated with each extracted region via its corresponding center. To consider the center of the region to define two trajectories.

Volume 3 Issue XII, December 2015
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

1) *Absolute ideal trajectory*
2) *Predicted ideal trajectory*

At the beginning the absolute ideal trajectory is initialized as a direct lie from the region center to the LC from this absolute ideal trajectory and optical flow of the region center to predict the ideal trajectory using HMM(Hidden Markov Model).The predicted ideal trajectory of the considered region center at time instants t (state q_t :initial state of the HMM)is constructed from the states (q_{t+1},……………. q_{t+tf}) generated by HMM.At each time of the predicted ideal trajectory to considered region center the following parameters are velocity(v_{t+1},……v_{t+tf}),accearation(a_{t+1},…a_{t+tf}),orientation(o_{t+1},……o_{t+tf}),position(p_{t+1},……...............................….p_{t+tf}) and distance(D_{t+1},……… D_{t+tf}) from the region center to the absolute ideal trajectory.

FrameID	Object ID	Orientation	Velocity	Accelaration	Distance	Position	HMM Model
001.jpg	1	176.6039	176.6039	176.6039	176.6039	268,523	0.087836
001.jpg	2	144.484	144.484	144.484	144.484	275,884	0.038188
001.jpg	3	113.6777	113.6777	113.6777	113.6777	238,1094	0.48073
002.jpg	1	168.6882	168.6882	168.6882	168.6882	269,523	0.00059875
002.jpg	2	143.3894	143.3894	143.3894	143.3894	275,885	0.28152
002.jpg	3	101.5294	101.5294	101.5294	101.5294	240,1095	0.44968
003.jpg	1	169.8339	169.8339	169.8339	169.8339	264,507	0.0078554
003.jpg	2	156.739	156.739	156.739	156.739	272,886	0.011711
003.jpg	3	118.486	118.486	118.486	118.486	238,1095	0.23441
004.jpg	1	164.2006	164.2006	164.2006	164.2006	263,503	0.38317
004.jpg	2	161.6875	161.6875	161.6875	161.6875	268,885	0.056626
004.jpg	3	109.8275	109.8275	109.8275	109.8275	239,1095	2.2209e-005
005.jpg	1	151.8985	151.8985	151.8985	151.8985	263,501	0.032599
005.jpg	2	180.4599	180.4599	180.4599	180.4599	267,886	0.017125
005.jpg	3	110.7261	110.7261	110.7261	110.7261	239,1094	0.19331
006.jpg	1	152.6097	152.6097	152.6097	152.6097	264,502	0.007848
006.jpg	2	190.4386	190.4386	190.4386	190.4386	267,884	3.0621e-005
006.jpg	3	113.1572	113.1572	113.1572	113.1572	238,1094	0.020379
007.jpg	1	160.8555	160.8555	160.8555	160.8555	269,500	0.018034
007.jpg	2	201.2484	201.2484	201.2484	201.2484	267,884	0.27462
007.jpg	3	107.625	107.625	107.625	107.625	239,1095	2.9994e-005
008.jpg	1	191.7067	191.7067	191.7067	191.7067	264,495	0.10598
008.jpg	2	171.039	171.039	171.039	171.039	269,876	0.24025
008.jpg	3	107.7712	107.7712	107.7712	107.7712	238,1094	0.34066
009.jpg	1	200.3782	200.3782	200.3782	200.3782	265,487	0.061287
009.jpg	2	165.6715	165.6715	165.6715	165.6715	271,869	0.00035761
009.jpg	3	106.968	106.968	106.968	106.968	238,1094	0.0167
010.jpg	1	203.9821	203.9821	203.9821	203.9821	265,476	0.049526
010.jpg	2	157.8504	157.8504	157.8504	157.8504	275,867	0.11676
010.jpg	3	105.6842	105.6842	105.6842	105.6842	238,1095	0.29673
011.jpg	1	211.9114	211.9114	211.9114	211.9114	267,456	0.13046
011.jpg	2	161.5067	161.5067	161.5067	161.5067	276,868	0.15383
011.jpg	3	113.1861	113.1861	113.1861	113.1861	238,1094	0.57079
012.jpg	1	218.4908	218.4908	218.4908	218.4908	265,443	0.23637

Fig 6.Prediction of ideal trajectory using HMM.

C. Danger Evaluation

The last stage of the model is to analyse the predicted ideal trajectory by considering various sources of dangerousness. The analysis is based on Dempster-Shafer theory which allows combining danger induced by the different sources to obtain a quantitative measure such as degree of belief of danger. To evaluating the danger assigning the mass assignment for each source of danger. The mass m_p,representing the degree of danger related to the position is computed from the difference between the predicted position p_{t+tf} at time instant $t+t_f$ and the barrier of the LC. The mass m_v,representing the degree of danger related to the velocity is computed from the difference between the predicted velocity V_t at time instant t and the prefixed nominal velocity V_N.

$$V_N = D_{max}/2.n.T_{min} \qquad \text{...(3)}$$

Where D_{max} is the maximum distance that can be covered by a moving object in an LC.

The mass m_o,representing the degree of danger related to velocity orientation is by comparing the orientation of predicted velocity V_t at time instant t with the orientation of the absolute ideal trajectory. The mass m_a,representing the degree of danger related to the acceleration is computed from the difference between the predicted acceleration a_t and a_{t+tf} at time instant t and $t+t_f$

Finally, the mass m_d,representing the degree of danger related to the distance is computed from the difference between the predicted position p_{t+tf} at time instant $t+t_f$ and the absolute ideal trajectory. The Dempster Shafer theory is usually to express uncertain judgment of experts, particularly to combine evidences from the different sources and arrive at a degree of belief that takes into account all the available evidences. In this proposed system to combine the different sources of dangerousness are velocity,acceleration,orientation, position and distance. The Dempster Shafer theory combination is used to determine the degree of danger related to the considered region center.

$$\text{Danger} = \text{Dempster-Shafer}\,(m_v,m_a,m_o,m_p,m_d) \qquad \text{…………………….......................…..(4)}$$

Each source of dangerousness is represented by universal set H=D,S.In universal set to define the hypothesis H,that represents all the possible state of the model.

$$H=\{D,S\} \quad \text{...}(5)$$

where *D* and *S* represent, respectively, the hypothesis of dangerousness and safety.

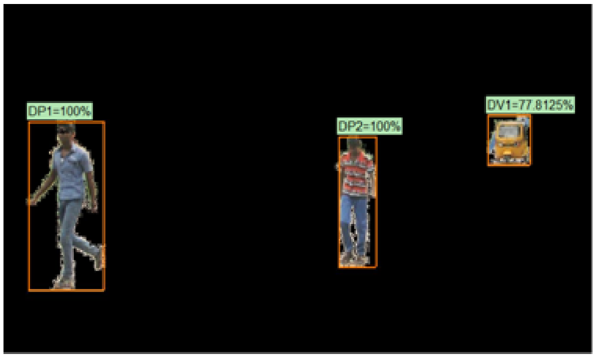


Fig 7.Alert Message Due To Danger.

An essential condition in the Dempster Shafer theory rule of combination is that the source of evidence must be statistically independent .It depends on the quality of the source of the information and how each source treats the problem. In this work each source of dangerousness has its own parameters related to LC environment and the Markov model. the danger level is greater than danger level it will automatically send the alert message to the pedestrians who are in danger level in a track.

V. CONCLUSION

This paper discusses about the security in unmanned LC and improve the safety. Accidents at railway LC have continuously become a serious and road safety problem particularly when it involves fatalities. Many research has shown that the major cause of crashes at railway LC is that the drivers fail to take sufficient care to avoid crash. Situations such as with the presence of pedestrians in LC and presence of vehicle in LC these two situations acquired in real condition. Then apply the proposed recognition method and results are experimentally analysed.

REFERENCES

[1] A. Nelson, “The UK approach to managing risk at passive level crossings,”in Proc. 7th Int. Symp. RailRoad-Highway Grade Crossing Res.Safety, 2002, pp. 1–11.
[2] E. Griffioen, “Improving level crossings using findings from human behaviour studies,” in Proc. 8th Int. Level Crossing Symp., Sheffield, U.K.,2004.
[3] L. Khoudour, M. Ghazel, F. Boukour, M. Heddebaut, and M. El-Koursi,“Towards safer level crossings: Existing recommendations, new applicable technologies and a proposed simulation model,” Eur. Transp. Res.Rev., vol. 1, no. 1, pp. 35–45, Mar. 2009.
[4] J. J. Garcia et al., “Efficient multisensory barrier for obstacle detection on railways,” IEEE Trans. Intell. Transp. Syst., vol. 11, no. 3, pp. 702–713,Sep. 2010.
[5] E. Schnieder, R. Slovak, E. M. El Koursi, L. Tordai, and M. Woods,“A European contribution to level crossing safety,” in Proc. FOVUS,Stuttgart, Germany, Sep. 2008, pp. 222–228.
[6] Government’s IT Strategy Headquaters: New IT Reform Strategy, The Realization of Society, inWhich Everyone Can Benefit From IT, Anytime and Anywhere, Jan. 19 2006, 19.
[7] L. Khoudour et al., “PANsafer project: Towards a safer level crossing,”presented at the 11th Level Crossing Symposium, Tokyo, Japan, 2010..
[8] N. Fakhfakh et al., “Background subtraction and 3D localization of moving and stationary obstacles at level crossings,” in Proc. Int. Conf. Image Process. Theory, Tools Appl., Paris, France, 2010, pp. 72–78.
[9] H.Salmane,Y.Ruiche and L.Khoudour,”Object tracking usig Harris corner points based optical flow propagation and Kalman filter,”in practice IEEE ITSc,2011
[10] R.R Yager,M.fedrizzif and J.Kacprzky,”Advances in Dempster Shafer Theory of evidence” USA.