DEVELOPMENT OF WIRELESS SENSOR NETWORK FOR COLLISION AVOIDANCE SYSTEM USING EMERGENCY SITUATION PREDICTION MECHANISM

P. PARTHASARADHY[1], K. S. CHANDRAGUPTA MAURYAN[2] , MALOTH NARESH[3]

An efficient and secure transportation system is critical and imperative for the development of a country. In modern societies the transport system can be expected to be easy, safe and effective. Most collision avoidance frameworks are right now being researched and dependent on street vehicles or inter-vehicle communication. Such organizations are dependent on the vehicle, thereby limiting its compliance with the production of vehicles equipped with the right technologies. In this work, the Emergency Situation Prediction Mechanism (ESPM) framework has been developed and validated to predict the likelihood of a road accident occurring on the Indian National Highway. ESPM uses Wireless Sensor Networks (WSN) for detection and warning information for drivers to prevent accidents. ESPM performs three stages such as reporting, monitoring and prediction in times of emergency. Within the ESPM, the correct prediction is calculated against the vehicle density in three dissimilar states. In these three visualizations, it can be seen that the small gap between assessment and modeling is not analytical results. The results show that the working of the ESPM has increased the reliably towards the prospect. The accuracy of the ESPM prediction on vehicle density is nearly 98 percent in all three scenarios. ESPM framework has been designed and validated for traffic accident prediction and this is considered as the basis for traffic accident prevention methods.

Keywords: Emergency Situation Prediction Mechanism, Wireless Sensor Networks, Collision Avoidance, Inter-vehicle Communication

1. INTRODUCTION

Nowadays, vehicles have been increasing rapidly in the world in recent times, so is the number of accidents that are happening. The lives of more than 12.5 lakh persons each year have been reduced as the consequence of vehicle accidents on the roads. According to the World Health Organization (WHO) many people suffer between 20 and 50 million injuries, without causing disability as a result of their injury. The majority of them occur during night driving. The introduction of

[1] Department of EEE, Guru Nanak Institutions Technical Campus, Hyderabad, India.
[2] Department of EEE, Guru Nanak Institutions Technical Campus, Hyderabad, India.
[3] Department of EEE, UIET, Guru Nanak University, Hyderabad, India.
parthapabbi@gmail.com[1], cgmauryan@gmail.com[2] and naresh219.m@gmail.com

vehicle collision warning systems represents the next major leap in automotive safety technology, giving drivers sufficient time to take appropriate actions to avoid being seriously subverted or completely prevented.

With this as an invitation, the Collision Avoidance System was launched. The fundamental goal of the collision avoidance system is to provide the most focused effort to advance the development of active collision avoidance systems such as fatigue and drowsiness and human errors in the automobile industry. It develops a complete collision alert system; detects the hazardous conditions ahead, and the ability to alert the driver to the side areas of the vehicle.

The system is optical capable of detecting potential dangers ahead of the vehicle in situations where the driver loses consciousness or long distance radar in the alarm system to wake him up and bring him back to consciousness Integrate sensor use If you change lanes during an event of losing control of a short-range sensor vehicle Fig. 1, to detect a nearby object, Warning lane detection system [1]. Rather than trying to alert current systems or take active control of the vehicle, the driver focuses on implementing a set of technologies that are discussed by Fig. 2 [2].

Night driving leads to accidents due to sleepiness. This can be a result of driver fatigue, Drowsiness or any other serious medical problem which helps determine if there is an active state (eg: Stroke, Heart-Attack etc.) [3]. Emergency services alert in a situation where the driver alerts to wake up prevent of a potential crash and also the driver does not wake up after a certain amount of time. Information and Communication Technologies (ICT) provides effective and secure travel knowledge for Transportation Systems. This technology encircles four fundamental criteria: Sustainability, reconciliation, security, and responsiveness. These strategies will assume a crucial job in accomplishing key targets of canny transportation frameworks, including access versatility, supportability of the earth, and financial advancement. The work comprises three main sections. The first illustrates and discusses how sensors technology can be integrated into transportation infrastructure. Second discuss fatigue detection and alert system.

2. RESEARCH BACKGROUND

Most of the road accidents are caused by fatigue driver inattentiveness and. For this reason, ADAS has been introduced as part of the Vehicle Dynamic Safety feature [5]. One of the systems under ADAS umbrella has been known to reduce collision avoidance (CA) to minimize human error [6]. An Important Safety In their 2016 report, the CA became one of the most advanced areas of study in the aforementioned field, with the National Transportation Safety Board of the United States being included as a component of highway vehicles [7]. A typical CA system consists of a complex combination of threat assessment, trajectory restoration and route tracking strategies. The risk assessment in the implementation of emergency interventions in emergency situations by providing a range of risk assessment remediation measures. Although there are various types of CAs, such as time-to-collision (TTC), the required speed-up method and time-headway, the risk of multi scenario anomalies to these strategies reveal. However, most of the techniques are not suitable for mobile robots such as cars and cars due to non-time-dependent dynamic constraints [19]. One of the oldest trajectory project work relating to car mechanics is where the boundary curve is analyzed by a particle trajectory [20] and the shortest path is determined, including the reported and low curve features [21]. It is proposed that this technique can be utilized in robots, for example, cars and car-like robots, due to play out an ebb and flow coming about because of non-transient and philosophical imperatives [22]. In any case, such ways are just a hindrance to arranging techniques, and they have been archived in unfriendly conditions [23].

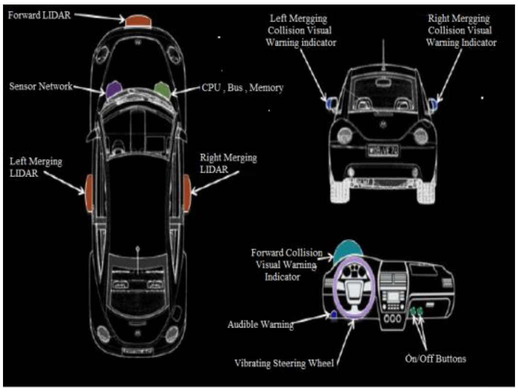

Fig. 1 Components - Collision Avoidance

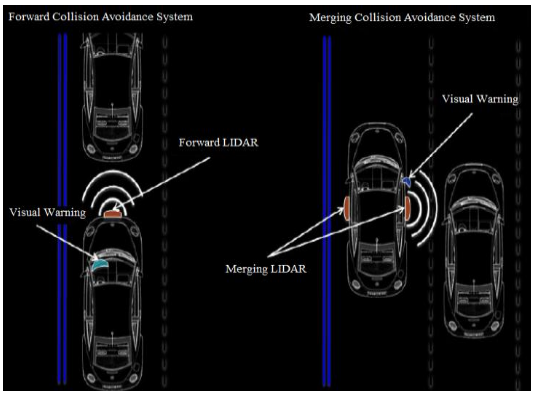

Fig. 2 Collision avoidance System

Then again, a geometric way arranging utilizing the opportunity to-collision strategy [24] is pursued. In spite of the fact that the CA framework is equipped for lessening the accident, a little collision on the edge of the hindrance is unavoidable.

The control tracking way of a CA framework enables the vehicle to pursue the replanned pattern of a crisis circumstance [25]. A better than average PT High-speed collisions and moving impediments require multiple input and multiple-output (MIMO) activations to deal with high interoperability [26]. Outstanding amongst other realized models is Model Prediction Control (MPC), the MPC framework that uses the model of plant elements to anticipate future states and coordinates the procedure control process with prompt time step [28]. With the ability to think about equations for its control laws and MPC system gives alluring answers for pragmatic ventures [29-31].

3. MATERIALS AND METHODS

Fig.3 expose the overall proposed. There are three parts to the proposed task. First discuss about how sensor innovation can be incorporated into transportation framework. Second discuss the fatigue detection and alarm system.

3.1 Sensor Technology of Intelligent Transport System (ITS)

Intelligent Transport System identifies the types of sensors and applications to provide solutions to:

I. Parking and traffic hurdles
II. Lengthier travelling timings
III. CO2 emissions for higher leaves
IV. Increment in the quantity of road accidents

Increasingly the same driving experience to improve the performance of a vehicle among others is of critical importance. Fig. 4 shows few of the commonly used sensors in the present vehicles.

3.2 Applications for In-Vehicle Sensors

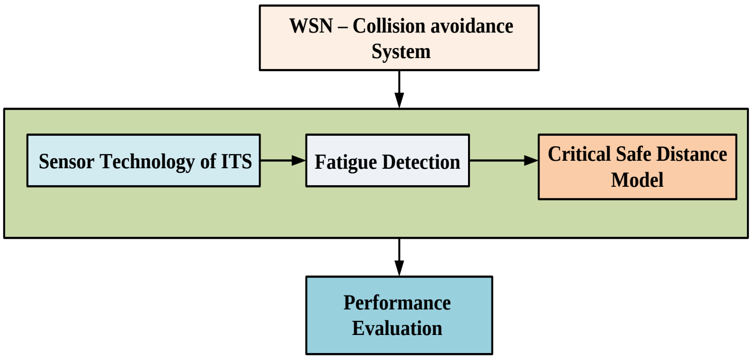

Fig. 3 Block diagram of proposed system

Continuous monitoring of air pressure in the tires is required as per National Traffic Administration to alert the drivers if the air pressure is low alert with low noise, light or vibration. Ultrasonic and electromagnetic sensors are used for parking planning and identifying the nearby. Proximity sensors detect when the vehicle closer to an object. Ultrasonic sensors use the sonar type to determine how the object is delicate driver and when the vehicle is away is closer than the limit.

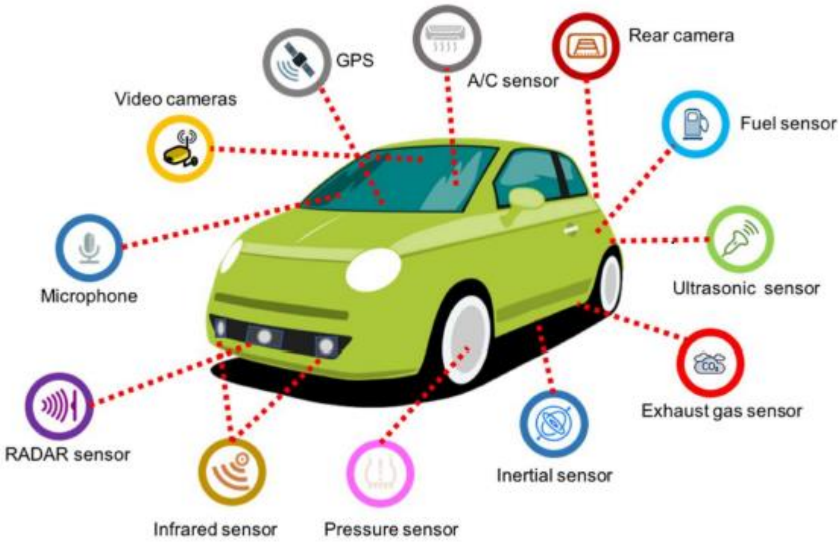

Fig. 4 Various Type of Vehicle sensors

The front and rear bumpers are in the vicinity of an electromagnetic object. The RADAR and Laser Sensors allows Road scan and safety applications in continuous brain, side and rear collisions allow the use of radio waves to detect distance between obstacles and sensors that enable throttle adjustment and brakes to prevent potential debris or hazardous conditions. Driver notification automatically triggers the brakes to avoid a collision when the application finds something close to the vehicle.

The motion navigation system (INS) is used to determine vehicle position, orientation, speed vehicle elements such as gyroscope and accelerometer. Global Positioning Systems (GPS) are used together with INS to enhance the accurateness. Radar and speed sensors are used, where potential hazard alerts the drivers if they change lanes or wander from a lane. The driver is usually alerted to the sound or vibration in the seat or steering wheel using a sound. One of the key parts in autonomous vehicles is LIDAR (Light Detection and Ranging).

4. FATIGUE DETECTION AND ALERT SYSTEM

Proposed Emergency Situation Prediction Mechanism Provides Better Reliability and Efficiency. ESPM based Fatigue Detection System Workflow Chart appears in Fig. 5. The system can be broken into the eye detection function, which covers the second half of the preprocessing routine, and the first half of the drowsiness detection function. Upon entering a facial image, the preprocessing image is made possible by the image processor, and the noise is made to double and remove the image.

The extreme width of the face, then the right and left edges of the face can be seen so that it follows that the lines running through the vertical position of each eye and the width of the face on the face are not independent of an area defined by the outer point's center line. This is the extent in which each eye is located. If zones of eye presence are defined, they can be refreshed by monitoring the movement of the eyes. Stop or refresh release of areas in the presence of the eye simultaneously with eye transparency level. This value is used to determine whenever the eyes are open or closed and if these eyes are correct or not. If the face of the system judges that the image of the face to the eyes is not properly detected. The following procedure describes the eye detection procedure in sequence.

4.1 Preprocessing

Preprocessing operations include a facial image binarization to enhance the processing speed and save on memory capacity and noise elimination. This fatigue alert system is developed for image processing that enables small pixels of white pixels and small black pixels to work on image processing to reduce noise.

4.2 Facial Feature Extraction

The objective is to remove the features from the images identified in the inverted phase. The location of the input acquisition as gray scale and the intensity continuum of the image being monitored create a brilliant new edge detection gray scale image. The clever new edge detection technique is outlined below.

- Soften the image with a Gaussian filter to reduce noise and unwanted information and textures.
- Repeat the thin edges of the pixels to the non-extents of the edges in A_T (step 1 is to extend the edges). To do this, make sure to notice if each non-zero slope $A_T(a,b)$ is greater than its two neighbors. Then, maintain $A_T(a,b)$ unaltered, or else, fix it to 0.

- Earlier result with two dissimilar thresholds T_1 and T_2 (where $T_1 < T_2$) to attain two binary images T_1 and T_2. Consider when you have fewer false edges with less gaps in the edge segment but larger gaps when related to T_1 with less T_1 .
- Develop a continuous edge in T_2 to the link edge segment. To do this, track each segment in T_2 to its last part and explore its nearby in T_1 to find any edge segment in T_1 to fill the gaps till achieving the next edge segment in T_2 .

In the objective approach, the system properties are obtained via the Local Tetra Pattern (LTrP) method.

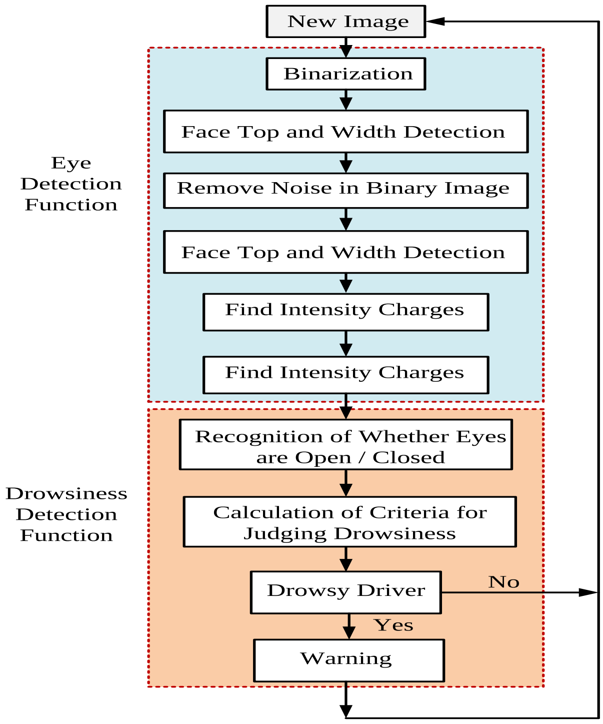

Fig. 5 Flowchart of Fatigue detection system

The central pixel and neighborhood pixel values are computed where there are two formats such as tetra and size shapes such as LTrP. In a particular LL band, if the center is specified as the pixel value P_c, and the horizontal and vertical neighborhood is represented as P_h & P_v respectively.

Then we use the horizontal first-order derivatives and the neighborhood pixel perpendicular directions. To achieve more direction and neighborhood pixel size. If the center pixel direction and the neighboring pixel are not identical, the LTrP may assign the resulting bit value depending upon the circumstance in **Fig. 6**. From equation (9) and (10), we get 8-bit tetra patterns for all core pixels. Follows, the entire pattern must be divided into three parts depending on the direction of the core pixel. Finally, the tetra pattern (i.e. direction) for all parts is converted into 3 binary patterns.

In equation (4.12), $\theta = 2,3,4$, and the calculation of the central pixel direction is indicated by Eq. (19), the three binary forms an equation computed (11) and (12). Similarly, the central pixels holding the directions are computed by tetra shapes (2), (3) and (4). Thus, through the four tetra forms, the 12 binary forms are reached from each direction. Following this; 13th binary method is computed by applying the increase of horizontal and vertical first-order stocks.

Following the calculation of the four tetra types from all four directions, twelve binary forms and one realtor pattern must be achieved. Thereafter, thirteen binary formats are used to characterize the image object.

4.3 Detection of vertical eye positions

The position of each vertical eye is found independently in an area where the face is visible from the width of the face, the center line, and it runs through the right and straight lines and leaves the outer edges of the face. In a binary image, the eyebrows, nose, mouth, and other facial features are black pixels. These collections of black pixels are identified on the basis of acting as a catalog and each eye position is coordinated to coordinate the position of the facial image and carry it to explore each labeled area.

4.4 Eye Tracking

This procedure involves defining a curve in the presence of the eye in terms of the coordinate (xk, yk) in the intersection point for the central lines running through the eye's feret diameter. The area is in the presence of the eye in which the next image is looking for the next frame image data. This process makes it possible to track eye position by using information about the position of the eye to define the position of the eye to obtain the next facial image data. It is clear from this description that the eye level variations are partial. If the eyes are viewed properly, their degree of transparency will always vary in some range for each individual driver. As a result, if the value detected by the system falls outside the range, it is most likely that the eyes will see correctly. Knowing each eye position from the entire face image is repeated after the procedure.

$$g(a,b) = G_\sigma(a,b) * f(a,b) \quad (1)$$

Where $G_\sigma = \frac{1}{\sqrt{2\pi\sigma^2}} \exp(\frac{a^2+b^2}{2\sigma^2})$ (2)

Calculate the slope rate of $\mathbf{g(a,b)}$ by the Sobel operator to achieve

$$A(b,b) = \sqrt{g^2{}_b(a,b) + g^2{}_b(a,b))} \quad (3)$$

$$and\ \theta(a,b) = \tan^{-1}\left(\frac{g_b(a,b)}{g_a(a,b)}\right) \quad (4)$$

Threshold A:

$$A_T(a,b) = \begin{cases} A(a,b), if\ A(a,b) > T \\ 0, otherwise \end{cases} \quad (5)$$

$$Z_{0^\circ}(P_p) = Z(P_h) \quad Z(P_c) \quad (6)$$

$$Z_{90^\circ}(P_c) = Z(P_v) \quad Z(P_p) \quad (7)$$

$$L_{dir}(P_c)=\begin{cases}1, & Z_{0^\circ}(P_c)\ge 0\, and\, Z_{90^\circ}(P_c)\ge 0\\ 2, & Z_{0^\circ}(P_c)< 0\, and\, Z_{90^\circ}(P_c)\ge 0\\ 3, & Z_{0^\circ}(P_c)< 0\, and\, Z_{90^\circ}(P_c)< 0\\ 4, & Z_{0^\circ}(P_c)\ge 0\, and\, Z_{90^\circ}(P_c)< 0\end{cases} \tag{8}$$

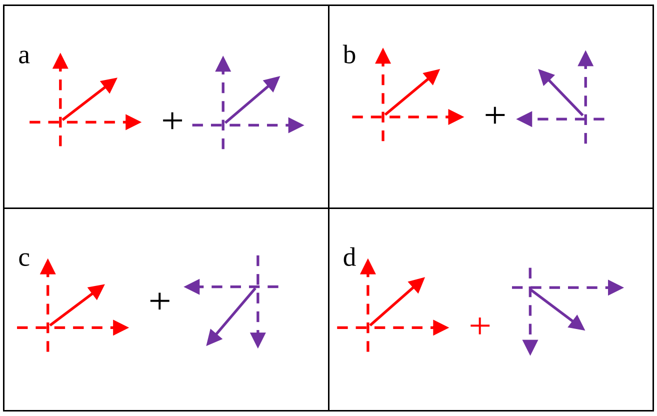

Fig. 6 Representation of the four directions

$$R(Pc)=\{g(L_{\mathrm{dir}}(P_{\mathrm{c}}),L_{\mathrm{dir}}(P_1),g(L_{\mathrm{dir}}(P_{\mathrm{c}}),L_{\mathrm{dir}}(P_2),.......g(L_{\mathrm{dir}}(P_{\mathrm{c}}),L_{\mathrm{dir}}(P_d))\}\Big|_{d-8} \tag{9}$$

$$g(L_{\mathrm{dir}}(P_{\mathrm{c}}),L_{\mathrm{dir}}(P_{\mathrm{d}})=\begin{cases}0, & L_{\mathrm{dir}}(P_{\mathrm{c}})=L_{\mathrm{dir}}(P_{\mathrm{d}})\\ L_{\mathrm{dir}}(P_{\mathrm{d}}), & \mathrm{else}.\end{cases} \tag{10}$$

$$R(P_c)\,|_{dir=2,3,4}=\sum_{d=1}^{D}2^{(d\ \ 1)}*g(R(P_c))\Big|_{dir=2,3,4} \tag{11}$$

$$g(R(P_c))\Big|_{dir=\theta}=\begin{cases}1, & if\ s(c_p)=\theta\\ 0, & else\end{cases} \tag{12}$$

$$S(L(P_d))=\sqrt{(Z_{0^\circ}(C_d))^2+(Z_{90^\circ}(P_d))^2} \tag{13}$$

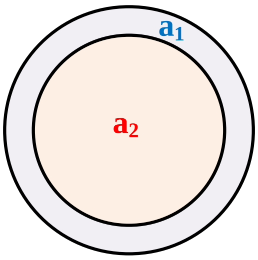

Fig.7 Eye Movement Detection

The inner circle of a good match is several dense pixels, and the area between the two circles is several bright pixels. This match happens when the inner circle of the inner circle and outer circle of the whiteness applies. Competition M (a1, a2) is calculated as

$$M\left(a_1,a_2\right)=\sum_{(p,q)\in a_1} I(p.q)-\sum_{(p,q)\in a_2} I(p.q) \tag{14}$$

A lower value of *M* (a_1, a_2) corresponds to a better match in Fig. 7. The template fits across the predicted eye region and is said to be the best match. Track the eye by detecting the dark pixel in the predicted area. The effectiveness of the proposed method of recognition of fatigue is explored in the statistical killing measures described below.

Accuracy: Accuracy identification picture measures how close the query image is.

$$Accuracy=\frac{(TP+TN)}{(TP+FP+TN+FN)} \tag{15}$$

Sensitivity: The question of whether sensitivity is successfully recognized is the measurement of the proportion of images that are relevant to the images.

$$Sensitivity=\frac{TP}{TP+FN} \tag{16}$$

Specificity: Specificity measures the uniqueness is correctly identified and measures the proportion of images that are relevant to the images.

$$Specificity=\frac{TN}{FP+TN} \tag{17}$$

5. CRITICAL SAFE DISTANCE MODEL

In this section, the proposed CSD model is presented based on the aforementioned mobility features. In this work, all trail case results were considered based on the introduction of the directions and the vertical height results of the vehicle. **Assumption 1:** Vehicles can map their Global Positioning System (GPS) locations on their own, including coordinates and Geographical Information System (GIS).

Assumption 2: Vehicles broadcast over time is detecting neighborhood areas, accelerations for beacons and speeds [33, 34]. Assumption 1 says that GPS and GIS are now popular and automotive devices are cheaper because they aren't immediately satisfied. Assumption 2 is especially fair for automotive networks where they need to constantly be able to inform others around their current state to improve vehicle safety. On top of two hypotheses, the CSD proposes:

5.1 CSD under different movement configurations

In this chapter, the CSD picture is appeared on account of a solitary lane, and will be inspected under various situations is appeared in **Fig..8** Supposing the removal of S_A is conveying cautioning messages right now that the danger of providing that dangers has vanished. Where A can likewise be fixed, ie S_A is zero. The uprooting of B is S_B in light of the fact that got a notice message when the collision was effectively maintained a strategic distance from. S_0 indicates the base separation permitted among A and B when departures. S_0 is set to focus in the later investigation for comfort. It can likewise be set to a specific separation permitted by various security necessities and driver courage. At the point when there is an alternate arrangement of development conditions, S_{CSD} indicates the relating CSD among A and B, ie

$$S_{CSD} = S_B - S_A$$

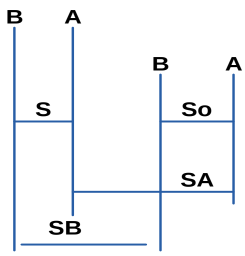

Fig. 8 CSD Analysis

Here, the emergency situation Prediction Mechanism is forced to stop immediately following a few crashes, to explore the above CSD, where three cases are fully explored.

A. 'A' be stationary

During A is stationary, if B can securely stop in the wake of accepting cautioning messages from A, its relocation will be
Relocation will be

$$S_B = S_1^B + S_2^B + S_3^B \tag{18}$$

Base on vehicular movement features

$$S_1^B = V_B^0(t_1 + t_2) \tag{19}$$

$$S_2^B = V_B^0 t_3 - \frac{1}{6} a_{\max}, Bt_3^2 \tag{20}$$

$$S_3^B = V_1^B t_4 - \frac{1}{2} a_{\max}, Bt_4^2, V_1^B = V_B^0 - \frac{1}{2} a_{\max}, B_3^t \tag{21}$$

Where

V_B^0 & $a_{\max,}B$ = B's initial speed, the needed S_{CSD} under situation as given by

$$S_{CSD} = S_B \approx V_B^0\left(t_1 + t_2 + \frac{t_3}{2}\right) + \frac{(V_B^0)^2}{2a_{\max,}B} \tag{22}$$

B. 'A' driving with a constant speed

A material of demolition speed at a uniform speed consists of two sub cases: the initial velocity of A is greater than that of a B velocity and less than a B velocity. The former is safe in comparison. For that reason, we will basically be doing the latter. WARNING To collect a warning message, B is restricted to preventing an accident.

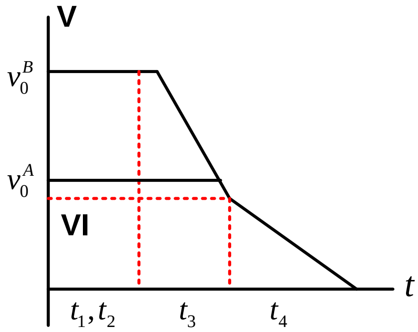

Fig. 9 Both cars with same speed in stage *t*3

While driving at a uniform speed and reducing B speed, the inter-vehicle distance is constantly decreasing over time to equal both cars' speeds. If the vehicle distance is larger than S0 at that time, they are safe. Depending on the condition of the vehicle's movement feature, both cars' speed is shown in Fig. 9.

Sub case 1: As shown in Fig.9, the speed of A is equal to the speed of B at stage t3. Based on the **Fig.9** to achieve the same speed for two vehicles in the following equation

$$V_B\left(\tau_1\right) = V_A^0 \tag{23}$$

Where

$V_A^0 = Initial\ speed\ of\ A$

$$\tau_1 = \sqrt{\frac{2(V_B^0 - V_A^0)t_3}{a_{\max},B}} + t_1 + t_2, \tau_1 \grave{o} (t_1 + t_2, t_1 + t_2 + t_3) \tag{24}$$

C. 'A' initial speed is greater than B

However, as 'A' goes into a standard speedometer, the 'B' continues to move at its earliest speed, and the different speed. The B break action must be taken. There is a long time required by which both cars' speeds are equal

$$\tau_1 = \frac{V_A^0 - V_B^0}{a_{\max}, A} \quad (25)$$

During τ_1, the displacement difference between A and B is

$$S_{AB} = \frac{(V_A^0)^2 - (V_B^0)^2}{2a_{\max}, S} - V_B^0 \tau_1 \quad (26)$$

D. 'A' initial speed is less than B's speed

There are displacements that A and B cannot generate, so that the moment both cars stop safely

$$\left\{ \begin{matrix} S_A = \dfrac{(V_A^0)^2}{2a_{\max}, A} \\ S_B = S_B \end{matrix} \right\} \quad (27)$$

$$S_B \approx V_B^0 \left(t_1 + t_2 + \frac{t_3}{2} \right) + \frac{(V_B^0)^2}{2a_{\max,} B} \quad (28)$$

Therefore

$S_{CSD} = S_B - S_A$

E. Performance Evaluation Metrics - Mean Square Error

The Mean Square Error (MSE) in relation to the maximum possible value of the controlled value is

$$MSE = \frac{\sum_{i=1}^{M} \sum_{j=1}^{N} \left[f(i, j) - F(i, j) \right]^2}{M \times N} \quad (29)$$

Where $f(i, j)$ = Original control signal at pixel (i, j)

$F(i, j)$ = Remodeled signal

$M * N$ = data size and the results in decibels

Integral Square Error $(ISE) = \int_0^\infty e^2(t) dt$ (30)

Integral Absolute Error $(IAE) = \int_0^\infty |e(t)| dt$ (31)

Integral Time Square Error $(ITSE) = \int_0^\infty t e^2(t) dt$ (32)

Integral Time Absolute Error $(IATE) = \int_0^\infty t |e(t)| dt$ (33)

In numerical analysis, the rate of velocity conversion is called the rate at which an advection sequence approaches its limit.

6. RESULTS AND DISCUSSION

The monitor in this figure, the control and fatigue detection the collision avoidance in highways using Emergency Situation Prediction Mechanism (ESPM).

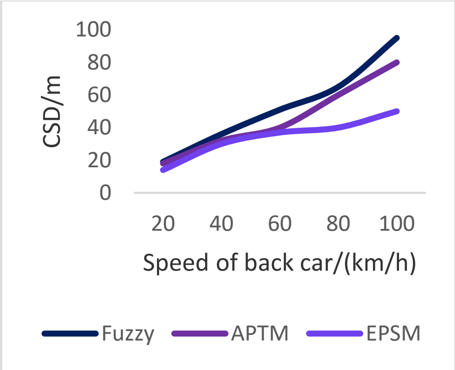

Fig. 10 Different CSD resulting

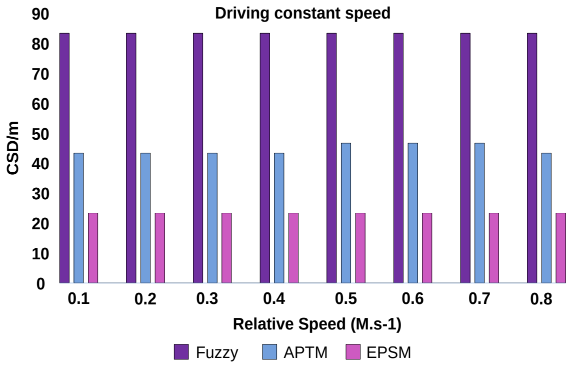

Fig. 11 Driving at constant speed

In this section, we discuss the performance analysis of proposed system with some existing methods. The CSD execution with the first vehicle running at a consistent speed is plotted in **Fig. 11 and Fig. 12** compared to the high and low speeds referenced above in chapters 3.3.4 and 3.3.5 expecting that the accompanying vehicle B is driven at a speed of 90 km/h. As delineated in proposed model uncovers that the CSD execution is down to roughly 60 km/h between the lead and the accompanying vehicle, particularly when the ideal speed is little. Traditional brake models could guarantee safety, but at the same time reduced traffic throughput. By comparison, we were able to conclude that our proposed model can successfully meet both requirements. The performance analysis of error rate is discussed in **Table 1**. The above **Fig. 13** demonstrates the efficient analysis of a proposed system with existing methods. The Performance analysis of Fatigue Detection of proposed ESPM method delivered best results, as shown in table 2.

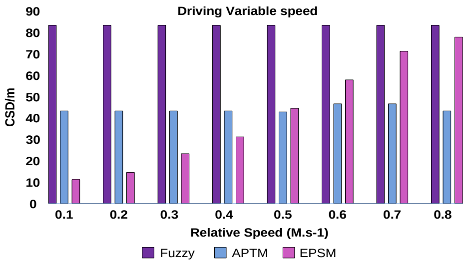

Fig. 12 Driving at variable speed

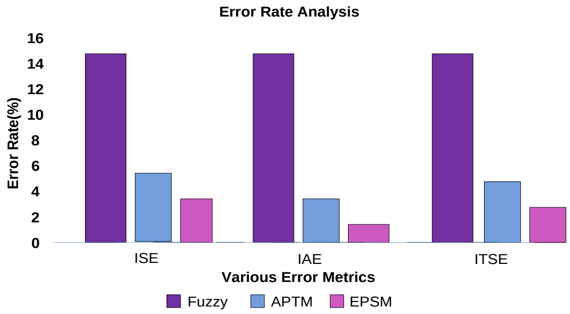

Fig. 13 Performance Analysis

Table 1

Performance of Error Rate Analysis with Different Method

Methods	ISE	IAE	ITSE
Fuzzy	14%	6%	10%
APTM	5%	2%	4%
ESPM	3.5%	0.7%	2.1%

Table 2 Performance analysis of Fatigue Detection

Methods	Sensitivity	Specificity	Accuracy
Fuzzy	89.45	90	90.74
APTM	96.3	95.1	98.23
ESPM	97.2	98.02	99.01

Fig. 14 demonstrates above shows the evaluation parameters derived using the proposed ESPM was delivered the perfect results of every working condition.

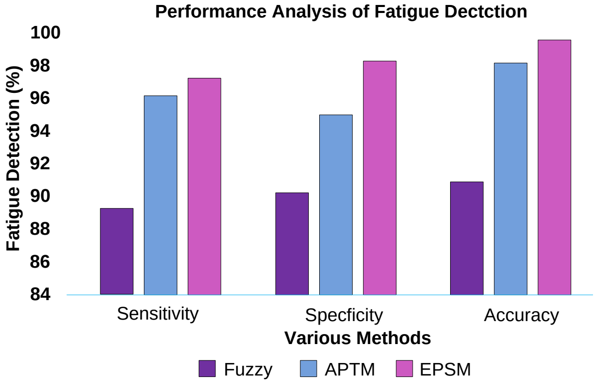

Fig. 14 Performance Evaluation of Fatigue Detection

7. CONCLUSION

Vehicles Accidents are one of the most common causes of Driver in-alertness. Driver fatigue as a result of sleep deprivation or sleep disorders is an important factor in the increase in accidents on today's roads. In this work, the Emergency Situation Prediction Mechanism (ESPM) framework has been developed and validated to predict the likelihood of a road accident occurring on the Indian National Highway. ESPM uses Wireless Sensor Networks (WSN) for detection and warning information for drivers to prevent accidents. ESPM performs three stages such as reporting, monitoring and prediction in times of emergency. In the ESPM framework, the prediction accuracy is calculated against vehicle density in three different scenarios. The efficiency of the proposed system is evaluated by using False alarm rate and Average Time Detection fatigue identification. The sensitivity, specificity and accuracy of ESPM based fatigue detection is 97.20%, 98.02% and 99.01%. The obtained error rate of proposed system is validated through ITAE (3.5%), ISE (0.7%) and IAE (2.1%).

REFERENCES

[1] Abdulkader J, Hazem I and YamanKalaji. Design and implementation of auto car driving system with collision avoidance. Cogent Engineering 5:1, DOI: 10.1080 /23311916. 2018.1485458.

[2] Yujun Lu, Jiatao Lai and Yan Feng. The modeling and simulation of CPS between the driver of a non-motor vehicle and car door. EURASIP Journal on Wireless Communications and Networking,2018.

[3] Chen.Q, Lin.M. Typical pedestrian accident scenarios in China and crash severity mitigation by autonomous emergency braking systems. SAE Technical Paper, DOI: 10.4271/ 2015-01-1464.

[4] J Nie, J Yang. A study of bicyclist kinematics and injuries based on reconstruction of passenger car-bicycle accident in China.Accid. Anal. Prev. 2014, 71(2), 50-59.

[5] Li.G,Yang.J, Simms.C. Safer passenger car front shapes for pedestrians: A computational method to decrease overall pedestrian injury risk in realistic impact scenarios [J]. Accid. Anal. Prev. 2017, 100, 97-110.

[6] G Li, Lyons.M, Wang.B. The variations of passenger car front shape on pedestrian injury issues obtained from German in-depth accident data.Accid. Anal. Prev. 2017, 101, 11-21.

[7] P Wang, CY Chan. Vehicle collision prediction at intersections based on comparison of minimal distance between vehicles and dynamic thresholds. IET Intell. Transp. Syst. 2016, 11(10), 676-684.

[8] Leilei.S. A device for improving the safety of door opening, Automob. Appl. Tech. 2016, 9, 274-275.

[9] Guerrero-Ibanez.J.A, Zeadally.S. Contreras-Castillo.J. Integration challenges of Intelligent Transportation Systems with Connected vehicle. Cloud computing and Internet of thing Technologies, IEEE Wireless Commun. Mag. 2015, 22, 122-128.

[10] Ojha.T, Misra.S, Raghuwanshi.N.S. Sensing cloud leveraging the benefits for agricultural applications. Comput. Electron. Agric,2017, 135, 96-107.

[11] Guerrero Ibanez.J.A, Cosío-Leon.M, Espinoza Ruiz.A, Ruiz Ibarra.E, Sanchez Lopez.J, Contreras-Castillo.J, Nieto-Hipolito.J, GeoSoc.A. Geocast based Communication Protocol for Monitoring of Marine Environments. IEEE Latin Am. Trans.2017, 15, 324-332.

[12] Ziraknejad.N, Lawrence.P.D, Romilly.D.P. Vehicle Occupant Head Position Quantification Using an Array of Capacitive Proximity Sensors. IEEE Trans. Veh. Technol. 2015, 64, 2274-2287.

[13] Zhou.Y, Dey.K.C, Chowdhury.M, Wang.K.C. Process for executing the data transfer performance of wireless traffic sensors for real-time intelligent transportation systems applications. IET Intell. Transp. System. 2017, 11, 18-27.

[14] Wu.X, Subramanian.S, Guha.R, White.R, Li.J. Lu.K, Zhang.T. Vehicular Communications Using DSRC: Challenges, Enhancements and Evolution. IEEE J. Sel. Areas Commun. 2013, 31, 399-408.

[15] Wang.T. Song.L, Han.Z. Coalitional graph games for popular content distribution in cognitive radio VANETs. IEEE Trans. Veh. Technol. 2013, 62, 4010-4019.

[16] Mohseni-Ejiyeh, A.; Ashouri-Talouki, M. SeVR. Secure and privacy aware cloud assisted video reporting service for 5G vehicular networks. In Proceedings of the Iranian Conference on Electrical Engineering (ICEE), Tehran, Iran, 2017, 2-4, 2159-2164.

[17] Chen.L, Tseng.Y, Yue.K. Surveillance on the road: Vehicular tracking and reporting by V2V communications. Comput. Netw. 2014, 67, 154-163.

[18] Tomas-Gabarron.J, Egea-Lopez.E, Garcia-Haro.J. Vehicular trajectory optimization for Cooperative Collision Avoidance at high speeds. IEEE Trans. Intell. Transp. Syst.2013, 14, 1930-1941.

[19] Chen.L, Englund.C. Cooperative Intersection Management: A Survey, IEEE Trans. Intell. Transport. Syst.2016, 17, 570-586.

[20] D.Bendjaballah, A.Bouchoucha,ML.Sahli, JC.Gelin. Numerical modelling and experimental analysis of the passenger side airbag deployment in out of position, Int. J. Crashworthiness,2017, 22(5), 1-14.

[21] Na.X, Cole.D.J. Game-theoretic modeling of the steering interaction between a human driver and a vehicle collision avoidance controller. IEEE Trans Human-Mach Syst.2015, 45, 25-38.

[22] Bevan.G, Gollee.H, O'Reilly.J. Automatic lateral emergency collision avoidance for a passenger car. Int J Control,2017, 80, 1751-1762.

[23] Kim.J.H, Bien.Z. A study on active collision avoidance system for the road vehicle. Alice Trans. Inf Syst.2001, 84, 717-726.

[24] Falcone.P, Borrelli.F, Asgari.J. Predictive active steering control for autonomous vehicle systems. IEEE Trans Contr. Syst. Tech,2017, 15, 566-580.
[25] Oh.S.I, Kang.H.B. Object detection and classification by decision level fusion for intelligent vehicle systems, Sensors, 2017, 17 (1).
[26] Jadhav.A.U, Wagdarikar.N.M. A review: control area network (CAN) based intelligent vehicle system for driver assistance using advanced RISC machines (ARM), In: International Conference on Pervasive Computing. IEEE, 2015, 1-3.
[27] Jose.D, Prasad.S, Sridhar.V.G. Intelligent vehicle monitoring using global positioning system and cloud computing. Proc. Comput. Sci. 2015, 50, 440-446.
[28] Lake.B.M. Human level concept learning through probabilistic program induction. Science, 2016, 350 (6266), 1332-1338.