ABSTRACT

A wireless ad-hoc network is a decentralized type of wireless network [7]. InVANET, or Intelligent Vehicular Ad-Hoc Networking, defines an intelligent way of using Vehicular Networking [7]. InVANET combines different ad-hoc networking technologies for easy, accurate, effective and simple communication between vehicles on dynamic environment. Vehicular Ad-hoc Networks are expected to implement a variety of wireless technologies such as Dedicated Short Range Communications (DSRC) which is a type of WiFi. Vehicular Ad-hoc Networks can be viewed as component of the Intelligent Transportation Systems (ITS). Therefore a VANET safety application is considered to represent a vital step to improving road safety and thereby increases traffic efficiency. In this paper, we will discuss different approaches for detecting driver or driving behavior and alert them to the prevent road accidents.

Keywords: Context-Aware, Driver Behavior, Drowsy, Drunk, DSRC, Fatigue, Invanet, ITS, Reckless.

I. INTRODUCTION

Wireless communications and mobile computing have led to the improvement of an intelligent transportation system (ITS), it mainly focus on road safety applications [1]. Road traffic safety refers to methods for reducing the accidents of a vehicle using the VANET application. Vehicle communications includes the communication between vehicles, vehicles and the infrastructure and ensures road safety. DSRC network device is a short range communication services used to connecting vehicles and intelligent transportation infrastructure.

The context-awareness based approach is used to detecting the behavior of driver. Driver's behavior is a combination of different factors such as the driver, the vehicle and the environment [5]. It is difficult to obtain the static and dynamic nature of behavior during driving. Two types of driving behavior are normal or abnormal. Abnormal behavior includes fatigue, drunk or reckless.

The information obtained from the driving environment includes both contextual and uncertain contextual data. Contextual information is data directly obtained from the various sensors or equipments fitted within the vehicle. Uncertain contextual information is the actual behavior exhibited by the driver and it is not directly obtained from the sensors.
The paper is organized as follows. Section I focuses on VANET safety and various driving behavior. Section II contains the comparative study of various behavior detection systems. Section III is devoted to presenting the summary of various driver monitoring and detection systems. Conclusion of the paper is included in section IV.

II. COMPARATIVE STUDY

A. Providing context-awareness in the smart car environment

A context-aware smart car system uses a hierarchical model [2] used to collect the contextual information. The contextual information is data collected from driver, vehicle and driving environment. After analysing the system will react.

![Smart Car Architecture](image)

**Fig.1:** Smart Car Architecture

- Traffic situation: Collecting relative positioning and distance between the objects. A scanning technology is used to recognize the distance between the car and other road users.
- Driver situation: Most of the accidents occur due to the human behavior. To keep the driver’s attention on the road, smart uses a camera monitoring the driver’s attention and activity. Physiological sensors are used to find whether the driver is in good or bad condition.
- Car situation: A controller area networks (CAN) [2] is used to check whether the car functions normally or abnormally. The functions of the car are read from the engine, the brake.

Assessment module determines the possible risks, and takes appropriate actions to avoid or reduce the risk. Two levels of risks including notifying the driver through HMI (Human Machine Interface) and taking necessary actions by car actuators. HMI alerts the driver of the potential risks in non-emergent situations such as an acoustic alarm or vibrating seat [2]. The car actuators will execute certain function on the car such as stopping car, popping up airbags or emergency call without the driver’s commands.

B. Use of water cluster detector for preventing drunk and drowsy driving

A non-contact breath sensor [3] and an alcoholic sensor simultaneously measure both positively and negatively charged water clusters in a person’s breath. It can be easily detect the electrical signals in the breath helps to prevent drunken and drowsy driving. The breath alcohol detector consists of a breath sensor unit and an alcohol sensor unit.
Fig. 2: Breathe-Alcohol Sensor

The architecture of Breathe-Alcohol sensor is shown in Fig. 2. By applying electric field the water clusters in expired gas contain saturated vapour pressure and a temperature that can be easily separated into positively and negatively charged clusters. The solid state sensor present in the alcohol sensor unit detects the drunk and drowsy behavior.

C. Mobile Phone Based Drunk Driving Detection

Highly efficient mobile phones based system aimed at early detection of drunken behavior and alert the vehicles. Based on sensor readings, a program installed on the mobile phone computes accelerations and compares them with typical drunk driving patterns extracted from real driving tests. If drunk driving is present, the mobile phone will automatically alert the driver or call the police for help before accident occurs.

The driving behavior is related to both vehicle movement and driver behavior. The different categories of drunken driving are mapped into lateral acceleration and longitudinal acceleration of vehicles [4].

- Lateral Acceleration
  The lane position problem occurs due to abnormal curvilinear movements which results in change on lateral acceleration.
- Longitudinal Acceleration
  The abnormal occurrence of acceleration and deceleration, unexpected stop and jerky stops will cause longitudinal acceleration.

Fig. 3: Working of the drunk driving detection system.
Mobile phone is placed in the moving vehicle. The calibration process starts when vehicle start moving. The program loaded in the mobile phone start monitoring the driving behaviors and collects the lateral and longitudinal acceleration. The collected data is processed by the pattern matching algorithm. If the pattern is matched with the existing drunken pattern then automatically alert the driver or call the police. If the pattern is not matched then no action takes place and continues to sensing new information.

D. Driver Drowsiness Recognition Based on Computer Vision Technology

A nonintrusive drowsiness recognition method used to detect drowsiness of driver. The system is based on detecting eye movement and image processing [6]. The problems caused by changes in illumination and driver posture can be addressed by introducing eye detection algorithm

Driver is sitting in front of camera and takes front-view images. An Active Shape Model (ASM) algorithm [6] is used to locate the human eyes from the front-view image. Then the self-quotient image, $Q$ [6] is obtained from the original image, $I$ is defined as

$$Q = I - \frac{I}{F*I}$$

Where * is the convolution operation

$I$ is the smoothed $I$

$F$ is the smoothing kernel.

The mean-shift algorithm is applied on the self-quotient image to locate the eye region.

![Self quotient image obtained as a result of ASM][4]

To find the drowsiness, the system uses six measures [6] to characterize the eye lid motion such as percentage of eyelid closure, maximum closure duration, blink frequency, average opening level of the eyes, opening velocity of the eyes, and closing velocity of the eyes. It can be combined using Fisher’s linear discriminant functions [6].

E. Context-Aware Driver Behavior Detection System in Intelligent Transportation System

The driver behavior detection system using context-aware system is to detect the normal or abnormal behavior exhibited by the driver. To obtain driver’s state by collecting contextual information by monitoring the behavior of the driver, the vehicle, and the environment. Four types of driving behavior are normal, fatigue, drunk and reckless. A five layer context-aware architecture [1] is used to collect contextual information then to perform effective reasoning and alert the driver or vehicle by operate in-vehicle alarm or to send the corrective message to other vehicles through the DSRC network device.

![Procedure for driver behavior detection][5]
The functionality of the Driver Behavior Detection System architecture is divided into three phases:

- **Sensing phase**: Gathering contextual information by sensors.
- **Reasoning (thinking) phase**: Responsible for extracting high level contextual information.
- **Application (acting) phase**: Depending on the current behavior of the driver, the system is responsible for sending warning message or by operating in vehicle alarm.

The various sensors present in vehicle senses contextual information about the vehicle, the driver, and the driving environment. The interpreter transform the data collected from the various sensors by applying ontology modelling techniques that can be processed by the processor. Then the behavior detection algorithm is designed to reason the uncertain contextual information and to obtain the type of the behavior exhibited by the driver. If the driving behavior is a normal, no action will be taken by the processor and the vehicle will continue to sense new information. If the driving behavior is abnormal such as being drunk, fatigued, or reckless, the processor performs the corrective action for other vehicles on the road and operating in-vehicle alarm. The DSRC network device is used to send the corrective message to other vehicles on the road.

### III. SUMMARY OF VARIOUS DRIVER MONITORING AND DETECTION SYSTEM

<table>
<thead>
<tr>
<th>System</th>
<th>Technique</th>
<th>Strength</th>
<th>Weakness</th>
</tr>
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<tbody>
<tr>
<td>Providing context-awareness in the smart car environment</td>
<td>A hierarchical model that is able to collect, to reason about, and to react to contextual information about the driver, the vehicle, and the environment.</td>
<td>Context representation approach is used to define the attribute of each entity and context situations of complex knowledge.</td>
<td>Requires more sophisticated sensing technologies to detect the physiological and psychological status to enhance the representation of smart car situations.</td>
</tr>
<tr>
<td>Use of Water Cluster Detector for Preventing Drunk and Drowsy Driving</td>
<td>A non contact breath alcoholic sensor simultaneously measure the electrical signals in the breath helps to prevent drunken and drowsy driving</td>
<td>Highly Sensitive breath sensor is designed to detect both drunk and drowsy behavior.</td>
<td>Limit to detect only the drowsiness and drunken behavior of the driver.</td>
</tr>
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<td>Mobile Phone Based Drunk Driving Detection</td>
<td>A program installed on mobile phone based technology detects and alert dangerous vehicle on the road.</td>
<td>Detect any abnormal or dangerous driving behavior.</td>
<td>To improve the system by integrating all available sensing data on a mobile phone.</td>
</tr>
<tr>
<td>Driver Drowsiness Recognition Based on Computer Vision Technology</td>
<td>A non-intrusive drowsiness detection system based on eye-tracking and image processing.</td>
<td>The six measures of drowsiness are evaluated.</td>
<td>To improve accuracy of drowsiness recognition combining general criteria developed from many participants.</td>
</tr>
<tr>
<td>Context-Aware Driver Behavior Detection System in ITS</td>
<td>A five layer context-aware architecture is used to collect contextual information about driving environment.</td>
<td>The dynamic behavior model can capture the static and the temporal aspects related to the behavior of the driver thus leading to robust and accurate behavior detection.</td>
<td>No corrective action algorithm to calculate the appropriate corrective actions for other vehicles on the road.</td>
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<tr>
<th>System</th>
<th>ContextAwareness</th>
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<th>Fatigue</th>
<th>Drowsy</th>
<th>Reckless</th>
</tr>
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<td>Providing context-awareness in the smart car environment</td>
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IV. CONCLUSION

In this paper, we have reviewed the various methods available to determine driver and driving behavior in intelligent transportation system. The driver behavior detection systems focus on the detection of driver’s state by monitoring the driver or the vehicle and by issuing warning messages to the driver to prevent road accidents. To improve road safety, the context-aware system is able to collect and analyze contextual information about the driver, the vehicle’s state, and environmental changes and to perform reasoning about certain and uncertain contexts. It then alert in-vehicle alarm and by sending warning message containing corrective actions [1].

V. REFERENCES