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AN INTELLIGENT ONLINE DRUNK DRIVING DETECTION SYSTEM BASED ON MULTI-SENSOR FUSION TECHNOLOGY

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ABSTRACT: Since drunk driving poses a significant threat to road traffic safety, there is an increasing demand for the performance and dependability of online drunk driving detection devices for automobiles. However, the majority of current detection devices only contain a single sensor, resulting in a low degree of detection accuracy, erroneous judgments, and car locking. In order to solve the problem, this study firstly designed a sensor array based on the gas diffusion model and the characteristics of a car steering wheel. Secondly, the data fusion algorithm is proposed according to the data characteristics of the sensor array on the steering wheel. The support matrix is used to improve the data consistency of the single sensor data, and then the adaptive weighted fusion algorithm is used for multiple sensors. Finally, in order to verify the reliability of the system, an online intelligent detection device for drunk driving based on multi-sensor fusion was developed, and three people using different combinations of drunk driving simulation experiments were conducted. According to the test results, a drunk person in the passenger seat will not cause the system to make a drunk driving determination. When more than 50 mL of alcohol is consumed and the driver is seated in the driver's seat, the online intelligent detection of drunk driving can accurately identify drunk driving, and the car will lock itself as soon as a real-time online voice prompt is heard. This study enhances and complements theories relating to data fusion for online automobile drunk driving detection, allowing for the online identification of drivers who have been drinking and the locking of their vehicles to prevent drunk driving. It provides technical support for enhancing the accuracy of online systems that detect drunk driving in automobiles.

Keywords: drunk driving test; sensor array; data fusion; intelligent detection; alcohol ignition interlock

INTRODUCTION As the number of motor vehicles in countries around the world continues to rise, the problem of drunk driving affecting road safety becomes increasingly severe. Intoxicated drivers cause 4.13-times as many traffic accidents as sober drivers [1–3], and drunk driving has become a major component of criminal activity. Using Chinese public security department data as an example, more than 1.74 million people were prosecuted for criminal offenses in 2021, of which more than 350,000 were prosecuted for dangerous driving, accounting for 20% of all criminal offenses and ranking first [4]. The control of drunk driving is entirely dependent on the traffic control department, which generally conducts spot checks on vehicles and can only be applied to some vehicles [5].

However, drunk driving is characterized by randomness and dispersion; therefore, the aforementioned methods have obvious limitations. If the online detection system for drunk driving can be installed in vehicles, dangerous driving will be drastically reduced, and safety will be ensured. In the 1960s, nations across the globe began to develop anti-drunk driving systems. The most prevalent anti-drunk driving technology involves the relevant government personnel and requires blowing air or drawing blood to detect the driver's blood alcohol content. This method has a low level of automation and is susceptible to false detection and detection omissions [6]. Angel [7] is a new type of on-board alcohol detection instrument developed by Italian researchers in 2009. When the driver's breath alcohol concentration reaches a predetermined threshold, the system issues a warning and prevents the vehicle from starting. In 2012, TruTouch, a technology company based in Albuquerque, New Mexico, United States, applied optical detection to alcohol detection technology and invented an infrared alcohol detector [8] that can determine whether alcohol is present in the human body based on the amount of infrared light reflected. In 2014, the National Highway Traffic Safety Administration (NHTSA) created a new type of driving technology [9] to combat drunk driving. This technology detected the driver's blood and breath alcohol concentration. Taking into account the current situation, the majority of studies on antidrunk driving system technology employ single-sensor technology, which entails the use of a single sensor to measure the same object, and indicates drunk driving based on the measurement results. It is easy for it to form erroneous judgments and cause false alarms, which negatively impacts the driver's ability to operate normally. In recent years, multi-sensor data fusion technology has been developed to compensate for the lack of reliability and measurement precision of single-sensor, anti-drunk driving technology. Its defining characteristics include utilizing multiple sensors to measure the same object in order to obtain the multi-source information about the object and making full use of the redundancy and complementarity of multi-source information in order to form a more reliable judgment of the surrounding environment [10,11]. Additionally, it can maintain accuracy in the event of a poor surrounding environment or equipment failure. Shifat [12] utilizes multi-sensor data fusion technology to effectively detect motor running state, which can detect and classify a variety of fault characteristics and improve the accuracy of fault diagnosis. Zuo [13] utilized multi-sensor data fusion technology to collect various underground mobile device detection data in real time, allowing the data management center to reflect the actual monitoring information of underground mobile devices. Liu [14] utilized multi-sensor data fusion technology to eliminate measurement errors for the indoor positioning of smart phones, a technique that is highly stable and robust. The average positioning error is reduced by 37.4–67.6% when compared to the classical extended Kalman filter method. However, no research has been conducted on multi-sensor data fusion technology to achieve the online intelligent detection of automobile drunk driving and improve the reliability and precision of drunk driving detection results. To sum up, this study carries out research on multi-sensor data fusion technology for automobile drunk driving detection. Firstly, the sensor array is designed based on the gas diffusion model and the characteristics of the car steering wheel are considered. Secondly, the data fusion algorithm model is proposed according to the data characteristics of the sensor array on the steering wheel. Finally, in order to verify the reliability of the system, an online intelligent detection device for drunk driving based on multi-sensor fusion is developed, and different combinations of drunk driving simulation experiments are conducted using three participants

Research on Sensor Array for Drunk Driving Based on Gas Diffusion Model As shown in Figure 1, a car interior space mainly includes the driver's seat, the co-pilot seat, and the back seat. In order to realize the intelligent online detection of drunk driving, we need to implement accurate alcohol detection to the driver's seat and lock the car, while avoiding any reaction to the backseat passengers' and the co-pilot's alcohol level. Gas sensors can convert chemical signals into easy-to-handle signals to realize the detection and identification of drivers' exhaled gas after drinking [15]. The selection of gas sensors affects the final detection results [16]. The typical volatile metabolite in drivers' breath after drinking is ethanol [17]. An MQ3 gas-sensitive sensor can have high sensitivity and good selectivity to ethanol vapor [18], therefore it is selected as the unit of sensor array

Fig: Interior space of the car

In order to have accurate drunk driving detection, it is necessary to properly select the position of the drunk driving detection sensor according to the location and diffusion process of the ethanol emission source in the car. In the existing research on gas diffusion in a fixed confined space, the widely used gas diffusion models include the Gaussian diffusion model and the gas turbulence diffusion model. Since the Gaussian model does not take the influence of gravity on diffusion into account, it is generally suitable for the leakage and diffusion of light gases with a smaller density than air. However, the density of ethanol is higher than air, therefore the turbulent diffusion model of gas is more suitable

EXISTING SYSTEM

Drunkenness Detection

Hardware-Based Detection: First used in the United Kingdom in the 1970s [17], breathalyzers are the world's most commonly used tools for testing inebriated drivers. Over its years of usage, researchers have connected breathalyzers, as well as other types of breath alcohol sensors, to smartphones via Bluetooth to improve BAC tracking, especially for self monitoring by drivers themselves. Example systems include: BACtrack Mobile Pro [18], Breathmeter [19]. One major disadvantage of breathalyzers is that the results are highly susceptible to the oral environment [20] and certain diseases (e.g., diabetes, liver and kidney diseases [20]), which may lead to false detection. Alternatives to breathalyzers include SCRAM, a transdermal sensor that measures the wearer's BAC through their sweat every 30 minutes [21]. The same kind of system is available in a tight wristband that fits closely to the skin [4]. However, SCRAM-based systems require a close contact between the skin and the sensor. Any space or anything between the skin and the sensor will affect the detection accuracy. Moreover, these systems require users to purchase extra devices or sensors, which may be expensive.

Camera-Based Detection: Camera-based drunk driving systems have also been developed [22], [23]. In [22], facial landmarks and motions are recognized in images to detect whether the driver is drunk driving or not. In [23], an audiovisual database is utilized to realize bimodal intoxication detection. However, camera-based approaches are sensitive to lighting conditions and there is potential risk of privacy violation [24].

Behavior-Based Detection: The side effects of alcohol consumption include arrhythmia [14], slowed respiratory rates [15], impaired psychomotor performance [8], and unsteady gait [6]. This abnormality in vital signs and behaviors can be leveraged to detect whether the user is under the influence of alcohol. Bae et al. [7] developed a smart phone based system to track the drinking episodes of users based on built-in sensors (e.g., accelerometer) and the smartphone status (e.g., battery and network usage). Leveraging alcohol's influence on motor coordination and cognition,

Markakis et al. [8] designed five human-computer interactions to detect BACs (such as swiping or touching the screen in particular ways), akin to the finger-to-nose DUI tests. However, these works require users to interact with their phones (swipe the phone or engage in games), which interrupts the driving task and cannot offer a continuous drunk driving detection.

Disadvantages

- An existing methodology doesn't implement variational mode decomposition method.
- DetectDUI can't measure a person's vital signs through WiFi signals and their psychomotor coordination through steering wheel operations.

Proposed System

- As far as we are concerned, DetectDUI is the first contactless method of detecting drink driving, including measuring the driver's BAC that can be administered while driving.
- We have proposed a series of signal processing algorithms for extracting human vital signs from WiFi signals given chest motions with high levels of accuracy.
- We have proposed to use C-Attention to combine the information of vital signs and psychomotor coordination to reach a well-round drink driving prediction.
- Extensive experiments on 15 individuals show DetectDUI is able to distinguish normal driving from drink driving in real-time with a 96.6%-accurate estimation and the driver's BAC to within an MAE of 0.002% to 0.005%.

Advantages

- The proposed system DetectDUI detects drink driving and predicts BAC through a driver's vital signs and psychomotor coordination.The system shows the architecture of DetectDUI. In DetectDUI, vital signs are tracked through a WiFi sensing system and writing as datasets.
- The system proposes a novel adaptive variational mode decomposition (AVMD) method to separate the mixed signal into multiple modes, and then keep the modes that relate to breathing and heartbeat respectively.

CONCLUSION AND DISCUSSION

In this paper, we presented *DetectDUI*, a non-intrusive, contactless, and continuous system of measuring and monitoring the side effects of alcohol on drivers. To develop *DetectDUI* to this stage, we have overcome two main challenges. The first is to eliminate interference in the WiFi signals caused by the motions of a moving vehicle. This problem was solved with a series of signal processing algorithms. The second is determining which specific features of alcohol's side effects best reflect driving under the influence of alcohol. We have addressed this challenge with a C-Attention network. The results of extensive experiments confirm that *DetectDUI* provides highly accurate drink driving detection and BAC prediction. Apart from drinking alcohols, other factors may also affect vital signs and psychomotor coordination, e.g., catching a cold or other respiratory diseases. Respiratory diseases will change breathing patterns, which are expected to be different from the breathing patterns of drinking. However, it is difficult to collect training samples to help differentiate the breathing patterns under the two conditions. In the future, we intend to refine our drink driving detection model by considering other impact factors.

REFERENCES

[1] *Alcohol Impaired Driving: 2018 Data (Traffic Safety Facts. Report No. DOT HS 812 864).* Accessed: Sep. 2019. [Online]. Available: https:// crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812864

[2] *H.R. 2138: Honoring Abbas Family Legacy to Terminate Drunk Driving Act of 2021*. Accessed: Mar. 2021. [Online]. Available: https:// www.govtrack.us/congress/bills/117/hr2138

[3] *S.1331—RIDE Act of 2021*. Accessed: 2021. [Online]. Available: https://www.congress.gov/bill/117th-congress/senate-bill/1331/text

[4] C.-W. You *et al.*, "Enabling personal alcohol tracking using transdermal sensing wristbands: Benefits and challenges," in *Proc. 21st Int. Conf. Hum.-Comput. Interact. Mobile Devices Services*, Oct. 2019, pp. 1–6.

[5] Y. Jung, J. Kim, O. Awofeso, H. Kim, F. Regnier, and E. Bae, "Smartphone-based colorimetric analysis for detection of saliva alcohol concentration," *Appl. Opt.*, vol. 54, no. 31, pp. 9183–9189, 2015.

[6] H.-L. Kao, B.-J. Ho, A. C. Lin, and H.-H. Chu, "Phone-based gait analysis to detect alcohol usage," in *Proc. ACM Conf. Ubiquitous Comput. (UbiComp)*, 2012, pp. 661–662.

[7] S. Bae *et al.*, "Detecting drinking episodes in young adults using smartphone-based sensors," *Proc. ACM Interact., Mobile, Wearable Ubiquitous Technol.*, vol. 1, no. 2, pp. 1–36, Jun. 2017.

[8] A. Mariakakis, S. Parsi, S. N. Patel, and J. O. Wobbrock, "Drunk user interfaces: Determining blood alcohol level through everyday smartphone tasks," in *Proc. CHI Conf. Hum. Factors Comput. Syst.*, Apr. 2018, pp. 1–13.

[9] *Alcohol*. Accessed: 2021. [Online]. Available: https://en.wikipedia.org/ wiki/Alcohol

[10] *Alcohol's Effects on the Body*. Accessed: 2021. [Online]. Available: https://www.niaaa.nih.gov/alcohols-effects-health/alcohols-effects-body

[11] *Hangovers*. Accessed: 2021. [Online]. Available: https://www.niaaa. nih.gov/publications/brochures-and-fact-sheets/hangovers

[12] *What Alcohol Really Does To Your Body*. Accessed: 2005. [Online]. Available: https://www.independent.co.uk/life-style/health-and-families/ health-news/what-alcohol-really-does-your-body-5349097.html

[13] *Alcohol and Cardiovascular Disease*. Accessed: 2020. [Online]. Available: https://alcoholthinkagain.com.au/alcohol-your-health/alcohol-andlong- term-health/alcohol-and-cardiovascular-disease/