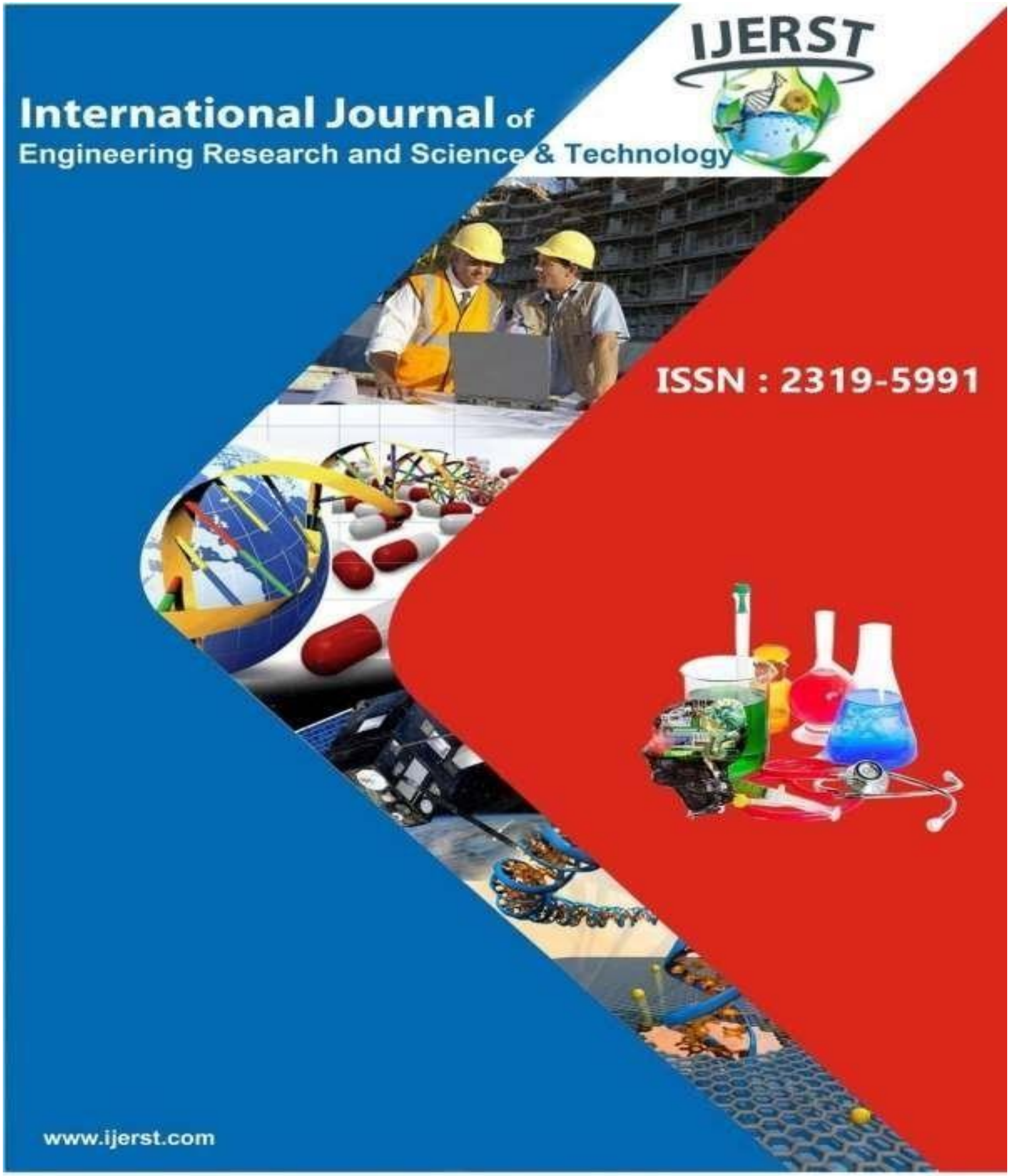

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DETECTDUI: AN IN-CAR DETECTION SYSTEM FOR DRINK DRIVING AND BACS

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ABSTRACT

As one of the biggest contributors to road accidents and fatalities, drink driving is worthy of significant research attention. However, most existing systems on detecting or preventing drink driving either require special hardware or require much effort from the user, making these systems inapplicable to continuous drink driving monitoring in a real driving environment. In this paper, we present DetectDUI, a contactless, non-invasive, real-time system that yields a relatively highly accurate drink driving monitoring by combining vital signs (heart rate and respiration rate) extracted from in-car WiFi system and driver's psychomotor coordination through steering wheel operations. The framework consists of a series of signal processing algorithms for extracting clean and informative vital signs and psychomotor coordination, and integrate the two data streams using a self-attention convolutional neural network (i.e., C-Attention). In safe laboratory experiments with 15 participants, DetectDUI achieves drink driving detection accuracy of 96.6% and BAC predictions with an average mean error of 2 _ 5mg/dl. These promising results provide a highly encouraging case for continued development.

1.INTRODUCTION

10,511 people lost their lives in drunk driving accidents in the United States in 2018 [1]. According to the World Health Organization, up to 20% of drivers who die in accidents in high-income nations have blood alcohol levels that are too high.1 Even if the number of fatalities caused by COVID is far higher, we must not forget how many people died before the epidemic. It is tragic

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that drunk driving causes tens of thousands of fatalities annually. The US economy will feel the effects, either, at a cost of $44 billion2 in a single year [1]. Both the Ride Act (S.B. 1331) [3] and the Halt Act (H.R. 2138) [2] mandate that all future vehicles have technology to prevent drunk driving. To aid in the prevention of drunk-driving accidents, in-vehicle drunk-driving detection devices are in high demand.

Interrupting the driving process is necessary for most conventional ways of identifying intoxicated drivers. The police need to flag the motorist down to stop over before they can administer a breathalyzer, which gives the driver enough time to figure out how to escape detection. Because they are intrusive, blood tests force drivers to pull over. Peripheral pupil measurement tests and urine testing also need specialized procedures and trained examiners. It would be ideal to be able to tell whether a motorist is intoxicated before they get behind the wheel in order to avoid accidents, but it's also likely that the effects of alcohol take some time to kick in, and the driver might still drink and drive. Consequently, the best approach is to continuously monitor drivers for signs of intoxication without obstructing their vision or hearing.

This is related to the abundance of literature on the topic of using sensing technology to ascertain BAC and degrees of intoxication. A transdermal sensing bracelet was created by You et al. [4] and paired with a Bluetooth-enabled smartphone app that measures and records blood alcohol concentration (BAC). In contrast, a smartphone accessory was created by Jung et al. [5] to do colorimetric analysis on saliva. But these systems need supplementary hardware, and that hardware may be pricey. Other methods of detecting intoxication using simply smartphones have been discovered by researchers. One such software was developed by Kao et al. [6]. It uses an inference model that may learn to identify aberrant gaits that are often linked with intoxication. Using the data collected by a user's phone's sensors, Bae et al. [7] construct a machine learning model to differentiate between episodes in which the user drinks and those in which they do not. In a similar vein, Markakis et al. [8] look for indicators of inebriation in shifts in each individual's distinctive patterns of coordination. These methods identify alcoholics based on their psychomotor and cognitive abilities. However, there are a

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number of things that users are obligated to do that get in the way of really driving.

We have developed a technology, identify DUI, that can passively and continuously identify drunk driving. Detect DUI uses WiFi signals to monitor a driver's heart rate and respiration rate, as well as their psychomotor coordination via the controls on the steering wheel. It is critical to discover a non-disturbing method of evaluating psychomotor coordination, although unambiguous vital signals are difficult to extract under the complex driving settings. A multi-stage procedure is used by us to control the interference. In order to remove reflections caused by other passengers and the car's interior (such as seats and windows), we use a power delay profile to isolate the driver's chest reflection from multipath interference. The WiFi signal is transmitted via a network of smaller carriers. Subcarriers' sensitivity to small changes in the chest is not uniform. We use principal component analysis (PCA) to filter out noise and keep the first principal component in order to make the most of the varied data from all subcarriers without interference. As a result of the uneven road surface, the received signals exhibit amplitude-shifted, abrupt fluctuations. We filter out abrupt shifts and keep just signals from times of steady driving; they have a distinct cyclic pattern matching breathing cycles, but the pattern of the pulse is obscured by its far smaller amplitude. We provide an innovative adaptive variational mode decomposition (AVMD) approach to this issue, which partitions the mixed signal into various modes and retains the modes associated with breathing and heart rate, respectively. The majority of prior research has focused on measuring psychomotor coordination via the use of mobile devices or computer-based tasks, neither of which are practical in a driving context. By observing how the driver uses the steering wheel, we discover an intuitive approach to evaluate their psychomotor coordination. Specifically, we capture gyroscope and acceleration data while operating with the help of IMU. This manner, we can keep an eye on the driver's psychomotor coordination in real time without getting in the way. Neural networks and an attention mechanism integrate the psychomotor signals with the vital indicators. To get more specific BAC readings, we employ Random Forest (RF). A 96.6% success rate in identifying a drunk driver was shown in trials involving 15 volunteers by Detect DUI. In addition, it had a mean

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absolute error (MAE) range of 0.002% to 0.005% when predicting a person's BAC.

The in-car inertial measurement unit (IMU) and WiFi technologies may assist in DUI detection. Data may be gathered to fine-tune the learning-based detection model locally without compromising privacy, allowing for its lightweight deployment.

To summarize, the following are some of the ways this study contributes: • In our opinion, Detect DUI is the first contactless approach for detecting drunk driving, which includes the ability to measure the driver's blood alcohol concentration (BAC) while they are behind the wheel.

To accurately extract human vital signs from Wi-Fi transmissions given chest movements, we have developed a suite of signal processing algorithms.

• We have suggested using C-Attention to integrate vital signs and psychomotor coordination data in order to arrive at a comprehensive drink driving forecast.

Extensive trials involving fifteen people demonstrate that DetectDUI can differentiate between sober and drunk driving in real-time, with an estimated BAC of the driver within a margin of error (MAE) of 0.002% to 0.005% and a 96.6% accuracy rate.

2.LITERATURE SURVEY

One of the most popular ways to check whether a motorist has been drinking is using a breathalyzer, which was first used in the UK in the 1970s. Researchers have spent years perfecting the technique of Bluetooth connecting breathalyzers and other breath alcohol sensors to cellphones in order to enhance BAC tracking, particularly for self-monitoring by drivers. Systems such as BACtrack Mobile Pro and Breathmeter are examples. Breathalyzers have a number of drawbacks, one of which is that they might provide inaccurate findings due to the oral environment and illnesses including diabetes, liver disease, and renal disease. A transdermal sensor called SCRAM may test a person's blood alcohol concentration (BAC) via perspiration every half an hour, which is an alternative to breathalyzers. Another option is a skin-tight bracelet that uses the same technology. Having said that, systems that rely on SCRAM need skin-to-sensor proximity. Accurate detection is compromised in the presence of any gap or obstruction between the skin and the sensor. On top of that, many systems need the acquisition of additional, potentially costly,

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devices or sensors by users. There are other systems that use cameras to detect intoxicated drivers. In order to determine whether a motorist is under the influence of alcohol or drugs, the system analyzes photos for certain facial landmarks and movements. To achieve bimodal intoxication detection, an audiovisual database is used. Nevertheless, methods relying on cameras are vulnerable to privacy invasion and highly dependent on ambient light.

3. EXISTING SYSTEM

A. Drunkenness Detection

Hardware-Based Detection: Breathalyzers, which were first employed in the UK in the 1970s [17], are the most popular instruments used globally to check whether drivers are drunk. Researchers have used Bluetooth to link breathalyzers and other breath alcohol sensors to cellphones for better BAC tracking, particularly for self-monitoring by drivers. Breathmeter [19] and BACtrack Mobile Pro [18] are two systems that serve as examples. Breathalyzers have a number of drawbacks, one of which is that their readings may be influenced by factors in the mouth and certain medical conditions, such as diabetes, liver and renal illnesses, and others, which can cause false positives. One alternative to breathalyzers is the SCRAM, a transdermal sensor that monitors the user's blood alcohol concentration (BAC) via perspiration every half an hour [21]. A skintight bracelet with a similar technology is also available [4]. Having said that, systems that rely on SCRAM need skin-to-sensor proximity. Accurate detection is compromised in the presence of any gap or obstruction between the skin and the sensor. On top of that, many systems need the acquisition of additional, potentially costly, devices or sensors by users.

Cam-Based Detection: Drunk driving systems that rely on cameras have also been created [22], [23]. To determine whether a motorist is under the influence of alcohol or drugs, the method described in [22] uses image recognition of face landmarks and movements. The use of an audiovisual database to achieve bimodal intoxication detection is described in [23]. The use of cameras in these systems does introduce some privacy concerns and is very light-dependent [24].
A number of adverse consequences, including arrhythmia [14], reduced

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respiration rates [15], poor psychomotor performance [8], and an unstable gait [6], may be detected by behavior-based methods when alcohol is consumed. You can tell whether someone is drunk by looking for these unusual changes in their vital signs and behavior. Using the accelerometer and other in-built sensors as well as the current state of the smartphone (battery life, network use, etc.), Bae et al. [7] created a system that uses smartphones to monitor users' drinking episodes. Capitalizing on the effects of alcohol on one's ability to think and move, Similar to the finger-to-nose DUI testing, Markakis et al. [8] developed five HCIs to detect BACs, such as swiping or touching the screen in certain ways. Unfortunately, these works don't provide continuous drunk driving detection since they demand users to interact with their phones—swiping or playing games—while driving.

The downsides

It is not possible to use the variational mode decomposition approach with the current methodology.

• A person's vital signs and psychomotor coordination cannot be measured by DetectDUI using WiFi signals or steering wheel actions, respectively.

New Approach

• DetectDUI is the first contactless system that can measure a driver's blood alcohol concentration (BAC) while they are behind the wheel, in our opinion.

• To accurately extract human vital signs from WiFi signals given chest movements, we have developed a suite of signal processing algorithms.

• We have suggested using C-Attention to integrate vital signs and psychomotor coordination data in order to arrive at a comprehensive drink driving forecast.

• With a 96.6%-accurate estimate and the driver's BAC within an MAE of 0.002% to 0.005%,

DetectDUI can discriminate between regular driving and drunk driving in real-time, according to extensive testing on 15 persons.

The Benefits

DetectDUI, the suggested technology, monitors a driver's vitals and psychomotor coordination to identify drunk driving and estimate BAC.The DetectDUI architecture is shown by the system.

The DetectDUI system uses a WiFi sensing system to record vital signs as datasets. It then suggests an innovative adaptive variational

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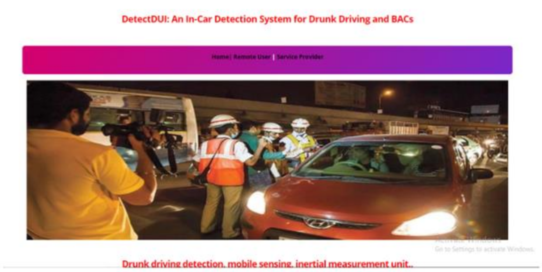
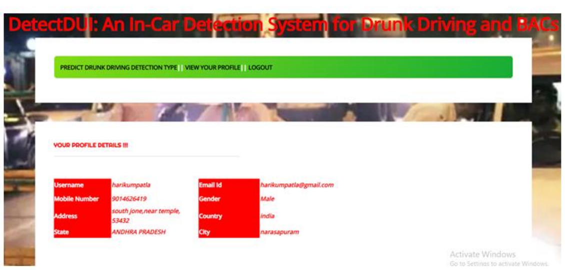
mode decomposition (AVMD) method to divide the mixed signal into multiple modes, with the breathing and heartbeat modes being kept separately.

4. OUTPUT SCREENS

Home Page:

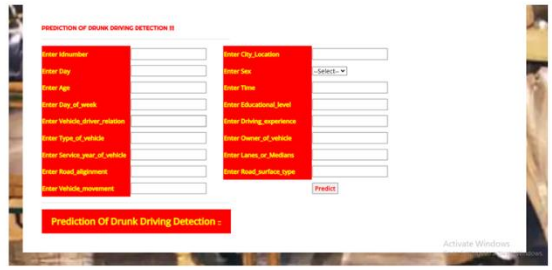


View profile page:



View Remote Users:

OUTPUT:



5. CONCLUSION

We introduced Detect DUI, a continuous, non-invasive, contactless device for testing and monitoring drivers' alcohol-related adverse effects, in this study. We have successfully navigated two primary obstacles in our development of Detect DUI to this point. The primary objective is to eradicate WiFi signal interference that is generated by the movements of a moving vehicle. Several approaches in the field of signal processing were able to cure this issue. The second one is to look at the consequences of alcohol and figure out which ones most closely resemble drunk driving. A C-Attention network has helped us overcome this obstacle. Extensive experimental data show that Detect DUI accurately detects drunk driving and predicts blood alcohol concentration.

In addition to alcohol use, other variables, such as a common cold or other respiratory illness, might impact vital signs and

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psychomotor coordination. Breathing patterns caused by respiratory disorders will likely vary from those caused by drinking. But gathering training samples to aid in differentiating the respiratory patterns under the two scenarios is challenging. Taking more parameters into account is something we want to do when we upgrade our alcohol driving detection algorithm.

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