Name: Conciseness screening tool for detecting instances of impairment or toxicity.

Problem statement: Many individuals, particularly the younger generation, who have recently started drinking, find themselves uncertain about whether to continue or discontinue the use of alcohol. According to research done by madd (mothers against drunk driving) (11), there are 63,000 drunk driving related incidents every year in Canada. We are proposing a tool to help individuals who are interested in assessing their alcohol levels for better-informed decisions.

Also, governments are highlighting the importance of alcohol detection technologies and actively exploring precise methods for detecting driver impairment. Potential technologies include air and touch sensors for alcohol level detection and gaze or steering tracking. The US NHTSA agency emphasizes that any standardized technology must be "passive," requiring no specific action from the driver, such as blowing into a breathalyzer tube.[1] While certain studies explore breathalyzer-based techniques in cars [1], adopting a passive approach appears to be more effective.

Goals:

Offer users an accurate assessment of their level of intoxication and provide tailored recommendations in accordance with their current state of inebriation.

Features:

- Line walking test
- Eyes glaze detection
- Short term memory buffer test
- Speech-emotion recognition through users' voice
- Suggestive output

Introduction:

The user initiates the testing process with a series of voice, eyes fixation test, short term memory buffer, and speech assessments. If they fail, a progressively easier version of the test is administered. If failure persists, an algorithm is activated, calculating the individual's estimated blood alcohol concentration (BAC). The device's owner can customize the algorithm by setting the "X" value according to specific requirements, such as a transportation company mandating a 0% BAC policy. Successful completion of any one of the three initial tests grants access to the second stage, evaluating line walking and balance. Regardless of the outcome, the algorithm is applied, comparing the result to the present value of X.

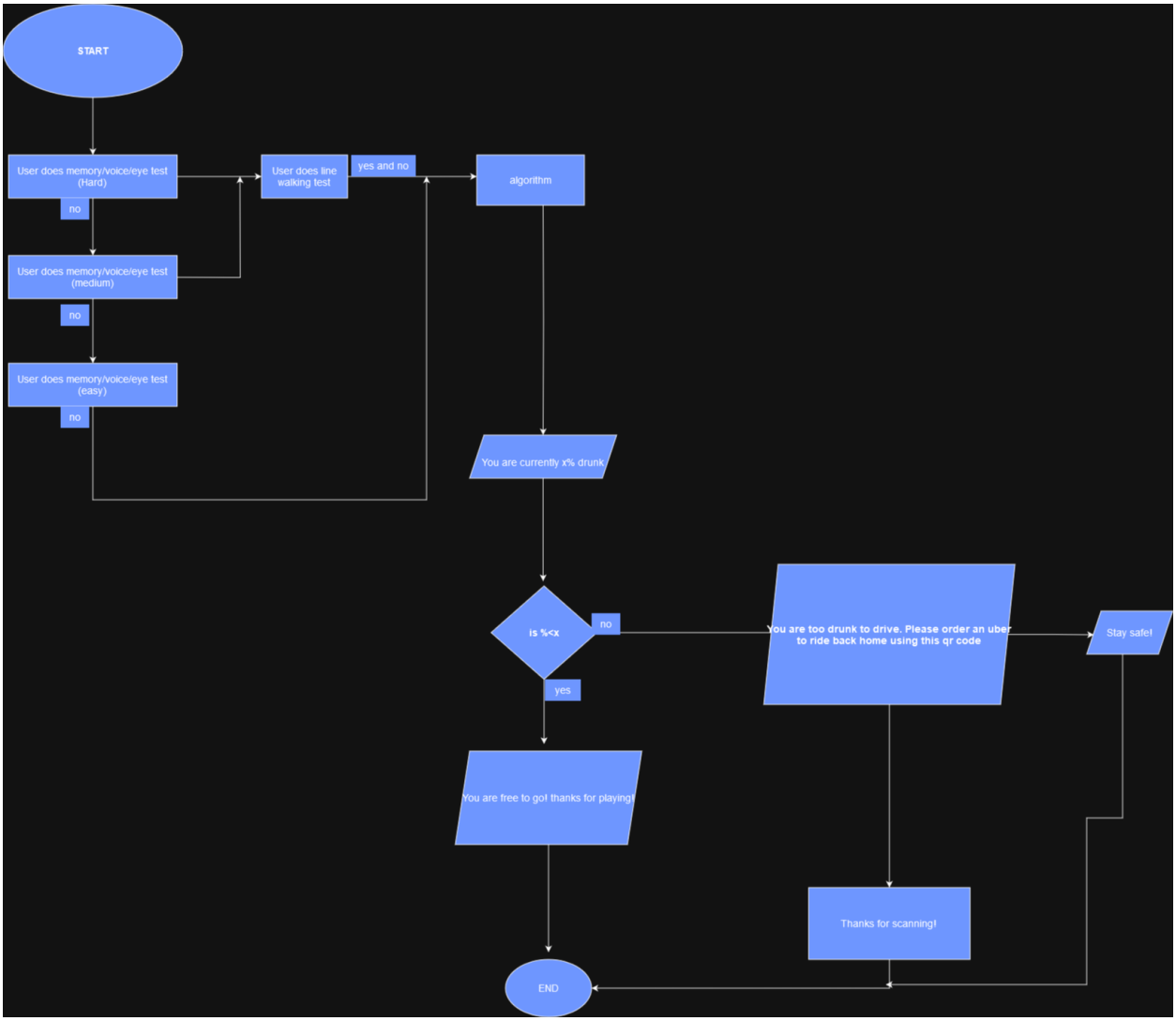
If the calculated percentage exceeds the X value, the user is informed of a high BAC and advised to arrange alternative transportation. If the percentage is below X, the user is deemed not intoxicated, and they receive appreciation for their participation. The determination of the X value varies among companies and adheres to local regulations. It evolves over time as the

[1] https://www.wired.com/story/us-regulators-cars-drunk-driver-detection/

dataset expands, always remaining below the legal BAC limit. To identify intoxication, the camera assesses the user's ability to read simple sentences displayed on a screen. Subsequently, a short-term memory buffer test requires the user to remember a sentence and repeat the sentence out loud within a limited time. Upon passing these tests, the user undergoes a straight-line walking test utilizing a laser and a camera.

The device's screen provides guidance and displays the output, conveying whether the user exhibits signs of intoxication. This output will be intake by AI suggesting service Recomdee [7] and will suggest user what is the best thing to do example) Drink water, go home or call an ambulance.

Omitting breathalyzer testing due to hygienic concerns, the device's iris test, memory test, and voice detection accuracy improve with increased data from diverse users. An essential aspect involves developing these functionalities to self-learn and adapt based on the acquired data over time.



Deep drive into the feature:

Line walking:
This test involves a real-time monitoring system using gait analysis to detect intoxication. It uses cameras and laser pointers to guide individuals along a path and record their walking patterns. This model identifies signs of intoxication by comparing observed gait patterns with its dataset, which includes variations in stride length and balance. A study (8) by Park which used the same principles without the generative ai found that this system had a 74.94% accuracy of detecting whether or not the user is drunk. Once we integrate generative AI into the mix, we will use generative models to create diverse and synthetic gait data. This data would encompass a wide range of gait patterns under different levels of alcohol influence. The generative AI can simulate various scenarios and body types, enhancing the robustness and accuracy of the deep learning model used for gait analysis. This approach ensures that the system is well-trained to recognize intoxication signs in different individuals and under various conditions, improving its effectiveness in real-world applications. The setup is designed for use in areas like bars and transportation company parking lots, aiming to prevent drunk driving by non-invasively detecting intoxicated individuals.

Eyes gaze detection:

Eye gaze detection employs deep learning-based image recognition to conduct eye tracking. Leveraging eye gaze patterns proves to be a valuable tool in identifying instances of drunk driving.

In one study by Reidulf G. Watten and Ivar Lie involving 18 participants with an average age of 26.2 years, the impact of varying alcohol levels on the oculomotor system was examined. The study, which was double-blind and placebo-controlled, investigated the effects at three blood alcohol concentrations (BACs) of 0.0%, 0.05%, and 0.1%. The findings indicated that with increasing alcohol dosages, there was a rise in both the number and duration of eye fixations, suggesting a decline in oculomotor function.

The authors of this study [2] developed and evaluated a novel machine learning system designed to detect drunk driving using driver monitoring cameras. The system focuses on extracting information from gaze behavior and head movements captured by these cameras. The goal is to predict whether drivers exceed two critical thresholds for blood alcohol concentration (BAC): (1) BAC values above 0.00g/dL but below the World Health Organization (WHO) recommended legal limit of 0.05g/dL for early warnings, and (2) BAC values above the WHO recommended limit.

Short term memory buffer test:
Alcohol affects the capacity of the short-term memory buffer.

The forty male subjects, divided into two groups based on their intelligence test scores, participated in sessions involving alcohol administration and subsequent memory tasks. Despite a practice effect observed in the recall task, wherein subjects performed better on the second occasion, this was partially attributed to increased reading time for the second passage. Alcohol, administered at 1.0 ml/kg body weight, led to a significant 7.8% slowing of reading time [3].

We will design a game where a user has to memorize a sentence under a certain amount of time. Then the user repeats the sentence to the microphone while looking at the camera directly. If the user is unable to repeat the sentence AI will generate an easier sentence for the user to memorize and repeat again. If the user fails, that Aswell then they will move on to the next game.

The correctness and time user take to finish arranging will determine user alcohol concentrations.

Users have different levels of intelligence and memory buffer in general. However, the AI will correct data from users' overtime and produce more accurate answers.

Voice and consciousness:

According to La Trobe University, the researchers there have designed an artificial intelligence (A.I.) algorithm to support breath testing devices in venues such as pubs and clubs. By using a 12-second voice recording, the technology built by the algorithm will have the capability to ascertain whether a person has exceeded the alcohol limit with an accuracy up to 70% [5].

Moreover, we can also add emotion recognition along with voice recognition (features of speech such as pitch, tone, speech rate, will be pinpointed by the AI we developed to give guesses on the speaker’s feelings, emotions for their concerns and could even reassure them by using our built-in chatbots). Speech emotion recognition could also be associated with hospitals and health centers to provide additional assists and customized requests. Not only that, but we can also extend voice recognition to a variety of languages and not only limited to English, so it can be more accessible for everyone [6].

Our speech emotion recognition tool will be created mainly by applying deep learning techniques specifically CNN (Convolution Neural Networks) and RNN (Recurrent Neural Networks).

RNN is a popular algorithm for tasks especially related to speech recognition and is used in companies like Google and Apple. RNN is likely to identify sequential patterns in data and make predictions on the upcoming scenarios based on past-learned patterns. What makes a difference for RNN is that it possesses internal memory, allowing them to retain information from prior inputs. This unique feature empowers RNN to make decisions by considering both current input and insights from past inputs [9].

CNN is originally a structure designed for categorizing images into predefined categories/classes. Despite CNN is a feature that mainly focuses on image processing but because of how it represents the data in a multidimensional array, it works well with huge

numbers of data [10]. Furthermore, CNN has utilizations like filters and MaxPooling which involve the reduction of noises and would be a good aid for RNN.

Game

Test 1:
We combine 3 aspects (eye gaze, short term memory and voice/consciousness) into one game test where
Memory and Speech Test: Users memorize and then repeat a sentence within a set time limit, then the user repeats the sentence while looking directly at a camera. The sentence is not visible to the user at the part when they are repeating the sentence to the device. This tests short-term memory and speech clarity.

Eye Gaze and Head Movement Analysis: During the test, the camera analyzes eye movements and head gestures, leveraging deep learning to detect signs of intoxication based on altered motor functions and gaze patterns.

Voice Analysis: Alongside, a microphone assesses the user's speech for signs of alcohol impairment. This includes analyzing speech characteristics like pitch, tone, and rate, and possibly emotional cues.

There will be 3 attempts to this test. First test will be a sentence that will not take more than 12 seconds. If the user passes it, we move onto the next stage. However, if the user fails the first round they get an easier sentence to memorize and repeat. If they pass this they move to next stage. If not, they get an even easier sentence to repeat. User will move onto the next stage regardless of passing or failing this one.

Test 2:

The second stage requires a user to walk a straight line in front of the device. The device emits a laser which shows the user the line the user will have to walk. There will be a short countdown before the user starts walking along the line set out by the device. The line is emitted in a way that the user will come towards the device. The camera analyzes user movement and compares specific features such as stride length and balance with the stored data in its database. This will evaluate if the person is drunk.

This method help reduce human basis on judging how straight the person can walk.

Output (results/benefits)

Our idea utilizes a large screen (>3m) strategically placed in designated areas to assess blood alcohol levels for legal compliance. The process integrates audio, gaze tracking, walking in a line, and a sequential reading test. To make tasks more time efficient, we combine audio, reading and gaze tasks. Users will begin by focusing on the camera to capture eye movement. Subsequently, a series of sentences will be presented for memorization and recitation, involving voice analysis and tracking gaze patterns. The reading tasks vary in difficulty, starting with a challenging one. Successful recall and repetition of the first task led to progression to the next stage, a walking test. Failure prompts users to attempt the second sentence, with success advancing them to the next level. If the final reading and memorization task is incomplete, the user fails the test, indicating potential impairment. Successfully passing the memorization phase allows users to proceed to the walking task, where they are instructed to walk along a designated laser line on the floor and return.

Upon successful completion of the walking task, users pass the test, indicating they are not under the influence of alcohol or drugs. Conversely, failing the test suggests the opposite. We will have AI which will output using recombee to suggest user what to do [7]

If a user is found to be intoxicated, a QR code will be displayed on the screen, directing them to an online taxi service like Uber. Upon utilizing the service, users will receive scores and an encouraging message applauding their responsible decision. Passing the test also earns users points for interacting with the screen, incorporating gamification elements. These accumulated scores can be redeemed for discounts at partnering services or restaurants, fostering continued engagement and incentivizing the use of our service.

User Survey Analysis:

We designed a brief survey to gather insights into users' experiences with alcohol. The survey seeks to understand preferences regarding the use of a system that can help individuals determine if they are under the influence of alcohol. A QR code with the link to the survey and the questions we asked is shown on the following page.

- **Drinking Habits:**
  - 2.3. On average, how many drinks do you have during a drinking session?
    - 1-2 drinks
    - 3-4 drinks
    - 5-6 drinks
    - 7 or more drinks
- **Occasions and Settings:**
  - 3.1. In which social settings do you usually consume alcohol?
    - Parties
    - Bars/clubs
    - Restaurants
    - Home with friend
    - Other (please specify)

What is your main transportation after drinking session

- urber/ taxi
- Bus
- car

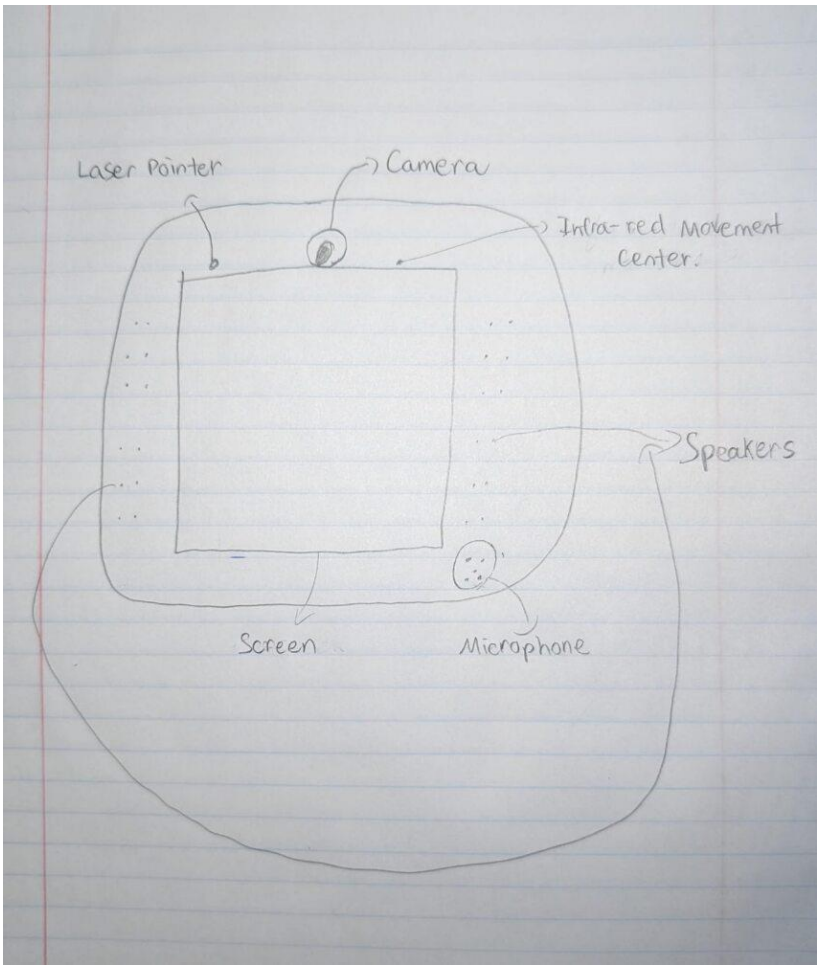
- **Effects on Behavior:**
  - 4.1. Have you noticed any changes in your behavior when you are drunk? If yes, please describe.
    - Yes
    - No

    - 4.3. Do you engage in activities when drunk that you might not do when sober?
        - Yes
        - No
- **Memory and Awareness:**
    - 6.1. How well do you remember your actions and conversations when you are drunk?
        - Very well
        - Somewhat well
        - Not very well
        - Not at all

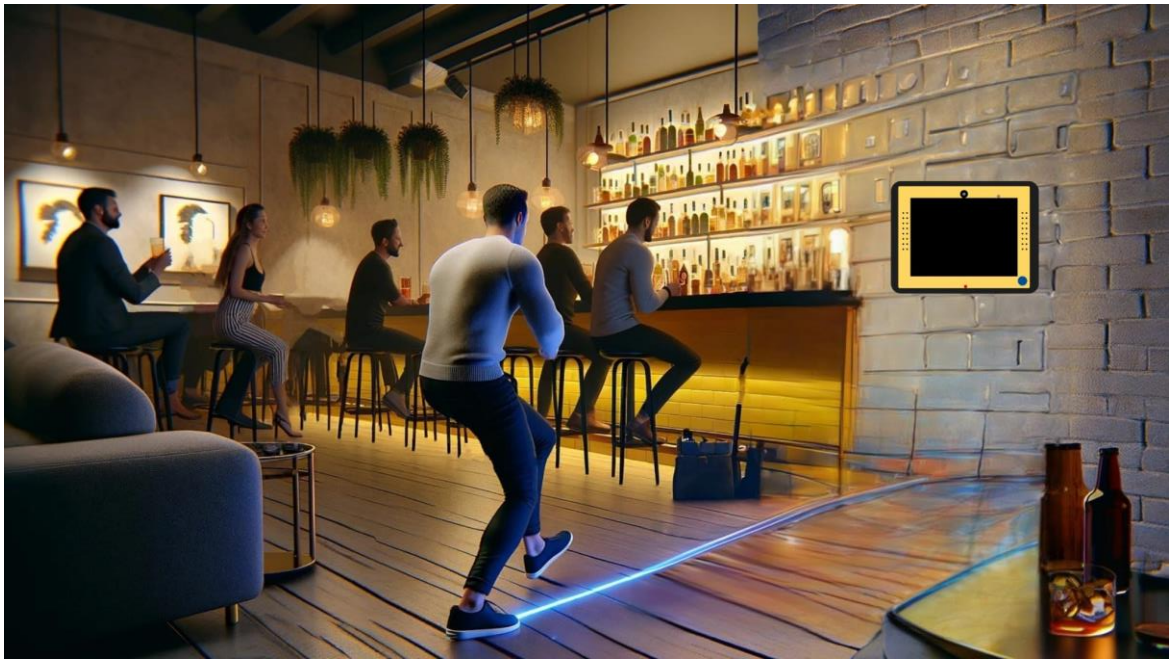
Our survey gathered responses from 17 participants. Slightly over half of the participants expressed an interest in using the proposed device, with 29% indicating they would not, while the remaining participants chose not to respond to this particular question.

Additionally, we discovered that 47% of users prefer utilizing public transportation, specifically buses, when under influence, whereas only 12% stated a preference for using a car in such circumstances.

Low prototype:


Laser Pointer
Camera
Infra-red Movement Center
Speakers
Screen
Microphone

High prototype:



Challenges:

Ethic- What if the tools prompt wrong results causing user to choose to continue drinking?

How would you know that you're conscious when you're not conscious

(Uber) Proof that our phone cameras are good and can be used to detect alcoholic people, so like a remote scanner instead of having to go to the company.

We need to do for low prototype.

We need to decide which feature comes first.

How to get Club's to put this machine.

Target Audience & Funding plans:

This project is suitable for proposals to a variety of organizations, including companies, universities, and any institution prioritizing the sobriety of its employees, including construction workers. The initiative aligns with the goal of maintaining intoxication-free environments. Additionally, it qualifies for consideration in grant applications and health systems fundings to promote healthy behaviors and educate people about drink responsibility.

Bars & Government in partnership:

Canada.ca › Departments and agencies › Health Canada

Health Canada announces nearly $40 million in funding to help support people who use substances across Canada

From: Health Canada

Backgrounder

July 2022

To help support the response to the overdose crisis and address harms related to substance use and the toxic illegal drug supply, the Government of Canada has announced nearly $40 million in funding for 73 innovative community-led projects across Canada.

The government of Canada have nearly $40 million in funding to help support people who use substances across Canada [4].

We can present this device as a community-driven initiative, fostering collaboration between the government and local bars to mitigate the risk of intoxicated individuals requiring hospitalization. The government may incentivize local bars to participate by providing tax reductions to establishments that choose to install this device. By diminishing the prevalence of intoxicated individuals, we aim to decrease the influx of patients to hospitals, subsequently reducing waiting times and alleviating the strain on healthcare resources. This strategic approach becomes particularly impactful during vulnerable periods, such as holidays, when people are more prone to engage in drinking activities. In essence, this initiative contributes to an overall enhancement of healthcare services by relieving healthcare workers of unnecessary burdens.

Uber:

Upon providing the user's blood alcohol concentration, the device will employ AI-generated suggestions to recommend the most suitable course of action. In instances were returning home is advised, the device will display a QR code for Uber, enabling users to easily scan and request a ride. This strategic integration not only enhances user safety but also opens opportunities for generating commercial fees through partnerships with Uber.

Transportation companies:

Being charged with a DUI as a truck driver is particularly devastating because upon conviction, they will not only be subject to a criminal record and jail but also losing their license and most certainly their job.

Our device offers a solution to transportation companies like Paige Logistics Ltd and J&R Transport Inc, ensuring that their truck drivers maintain a zero-alcohol level during working hours. By implementing this technology, companies can mitigate the risk of fines, reduce legal operation costs, and minimize the potential loss of labor due to DUI-related issues.

Legal and Ethical Considerations:
Continuous monitoring of individuals could infringe on their right to privacy. There are concerns about how data is collected, stored, and used. (walking test thing @zain)
Federal limits: In all Canadian provinces, the maximum legal blood alcohol concentration (BAC) for fully licensed drivers is 80 milligrams of alcohol in 100 milliliters of blood or 0.08. Driving with a BAC of 0.08 or more is a criminal (federal) offence and the penalties are severe.

References:

[1] Tamoghna Sarkar and Sukriti Shaw. 2020. IOT Based Intelligent Alcohol Detection System for Vehicles. In Proceedings of the 4th International Conference on Big Data and Internet of Things (BDIoT '19). Association for Computing Machinery, New York, NY, USA, Article 6, 1–5. https://doi.org/10.1145/3372938.3372944

[2] Koch, K., Maritsch, M., Van Weenen, E., Feuerriegel, S., Pfäffli, M., Fleisch, E., ... & Wortmann, F. (2023, April). Leveraging driver vehicle and environment interaction: Machine learning using driver monitoring cameras to detect drunk driving. In Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems (pp. 1-32)., Chicago,

[3] Maylor EA, Rabbitt PM, James GH, Kerr SA. Comparing the effects of alcohol and intelligence on text recall and recognition. Br J Psychol. 1990 Aug;81 (Pt 3):299-313. doi: 10.1111/j.2044-8295.1990.tb02363.x. PMID: 2224393.
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0050977

[4] https://www.canada.ca/en/health-canada/news/2022/07/health-canada-announces-suap-funding-to-support-people-who-use-substances-across-canada.html

[5] https://www.latrobe.edu.au/news/articles/2023/release/deep-learning-algorithm-can-hear-alcohol-in-

voice#:~:text=According%20to%20the%20researchers%2C%20ADLAIA,higher%20than%200.12%20per%20cent

[6] Chole, V. *et al.* (2023) 'Emotion recognition on speech processing using machine learning', *International Research Journal of Modernization in Engineering Technology and Science*, 5(05/May-2023), pp. 1–2. doi:10.56726/irjmets37895.

[7] https://www.recombee.com

[8] Park, S. *et al.* (2023) *A deep-learning approach for identifying a drunk person using gait recognition, MDPI*. Available at: https://www.mdpi.com/2076-3417/13/3/1390 (Accessed: 20 January 2024).

[9] Ltd., A. (no date) *What is a recurrent neural network (RNN), Arm*. Available at: https://www.arm.com/glossary/recurrent-neural-network#:~:text=A%20recurrent%20neural%20network%20(RNN)%20is%20a%20type%20of%20neural,predict%20the%20next%20likely%20scenario. (Accessed: 21 January 2024).

[10] *Convolutional Neural Network* (no date) *Convolutional Neural Network - an overview | ScienceDirect Topics*. Available at: https://www.sciencedirect.com/topics/engineering/convolutional-neural-network (Accessed: 21 January 2024).

[11] https://maddchapters.ca/parkland/about-us/impaired-driving-statistics/