Smart-Steering: An IoMT-Device to Monitor Blood Alcohol Concentration using Physiological Signals

IEEE International Conference on Consumer Electronics, Jan 4-6, 2020

Laavanya Rachakonda[1], Saraju P. Mohanty[2], Elias Kougianos[3], Md Abu Sayeed[4]

Smart Electronic System Laboratory (http://www.smohanty.org/SESL/), University of North Texas, USA. Email: {rl0286[1],saraju.mohanty[2], elias.kougianos[3], mas0758[4]}@unt.edu

DUI Incident Breathe Analyzers S-S Thing

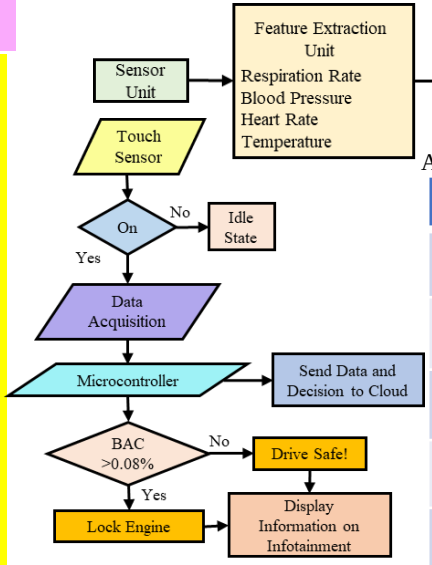
(1) There are nearly 40,000 fatal car accidents recorded in the United States per year with more than 90 Americans dying in car accidents per day.
(2) Out of these 40,000 accidents, 40% are due to drunk driving, 30% are due to speeding and 33% are due to irresponsible driving.

Novel Features:
(1) A non-invasive, automated real time monitoring system which is activated by human touch.
(2) A system which determines the state of the person by monitoring physiological parameters and decides if the person can drive by the measured physiological parameters.
(3) A system that predicts BAC and checks if the driver is in inebriated or not through out the driving period to eliminate any scope of accidents.
(4) A system that detects the exact BAC with 5 intervals in order to educate the driver of his driving capability.

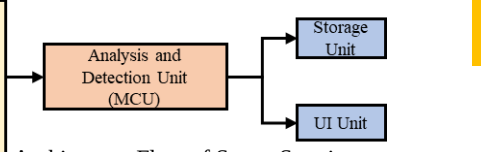
Driving Under Influence (DUI) or Driving While Intoxicated or Impaired (DWI) is a serious offense. The alcohol percentage in a person's bloodstream is known as Blood Alcohol Concentration (BAC).

As BAC increases, the level of intoxication of a person increases. BAC of 0.08% is determined as the legal limit a person can drive in most states of the US.

Issues of existing solutions: detection accuracy, don't account multiple sensors for more effective BAC detection, don't account biometric sensor data, no unified detection and management, lack fully automation features.



Design Flow of Smart-Steering



Architecture Flow of Smart-Steering

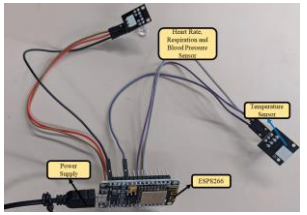
RR	BP	HR	T	BAC
12-20	110/70-120/80	60-90	97-99	Sober
10-12	120/80-125/85	90-100	99-101	0.02
9-10	125/85-130/85	100-105	101-102	0.04
5-9	135/85-140/90	>105	>102	0.06
<5	>140/90	>105	>102	>0.08

Feature Considered	Baseline Condition	BAC Condition
Heart Rate (HR) beats/min	60-90 beats/min	> 90 beats/min
Temperature (T) F	97-99F	> 99F
Respiration Rate (RR) breaths/min, Blood Pressure (BP)	12-20 breaths/min, 110/70 to 120/80	m*nl>/<m*nh; (m =PPG peak, l-low, h-high)

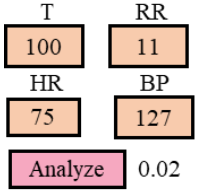
Using obtained Physiological data, the sensor data is checked with the regular baseline information and a decision of the driver's sobriety is made. The exact BAC present in the human body is also determined. The information is processed on a microcontroller with an approximate accuracy of 93%.

Value Proposition: (1) Allow automated BAC detector in smart car, and
(2) Locking the engine's car along with notification to the user.

There are many smart phone base applications, breathe analyzers and limited area touch sensor technologies. However, most of these require users to manually log the information. Both, not-reporting and under-reporting has been identified as problems with user-entered data, stimulating research to automate this.



Hardware Implementation



[1] Y. L. Y. Chen, C. Lin and C. Zhao, "Non-invasive detection of alcohol concentration based on PPG signals," *IET Image Processing*, vol. 12, no. 2, pp. 188–193, 2018.
[2] J. M. Ryan and L. G. Howes, "Relations between alcohol consumption, heart rate, and heart rate variability in men," *Heart (British Cardiac Society)*, vol. 88, no. 6, pp. 641–2, 2002.
[3] R. T. Roehrs T, "Sleep, sleepiness, and alcohol use," *Alcohol Res Health.*, vol. 25, no. 2, pp. 101–9, 2001.
[4] S. M. Simet and J. H. Sisson, "Alcohol's Effects on Lung Health and Immunity," *Alcohol research : current reviews*, vol. 37, no. 2, pp. 199– 208, 2015.