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Anti-Drunk Driver Pedal Lock and Carbon Monoxide Alarm using Gas Sensor Detection

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Abstract: Drinking alcohol is not a good habit and will give side effects on health, some people still choose to drink because they need a mechanism to relieve stress and to forget their bad days when things do not happen as planned. Drinking and driving are essentially referred to as drunk driving and are one of the deadliest things in life for any alcohol user. Over the eight-year period from 2011 to 2018, 1,147 individuals died as a result of drunk driving accidents in Malaysia. Besides that, the number of automobiles and parking spots is growing and in 2018, new registrations of motor vehicles increased by 8.2% to 1,218,662 compared to 1,125,900 in 2017. Therefore, when the number of cars increases, the long exposure to carbon monoxide (CO) could occur. This could lead to confusion, vomiting and nausea. The main objectives are to design a breathalyzer to detect the drunk driver and to develop a pedal lock for the car system to prevent drunkards from driving with an additional feature of CO detection in the car with the application of notification. The method used is by detecting the presence of alcohol and CO with MQ3 and MQ7 sensors and transmitting data to Blynk for notification purposes. We obtained the data from the sensor via Arduino IDE and analyzed it by using Matlab R2020b. Comparisons are made and evaluated the overall performance and the system. The graph outcome that we obtained shows the level of concentration, effectiveness and accuracy of the system. It can be concluded that the system is able to determine the condition of the driver and the car before it can be driven. For future development, a GPS system could include in this implementation because it could help the user locate themselves accurately for locating purposes.

Keywords: Breathalyzer, Alcohol, Pedal Lock, CO Detection

1. Introduction

Although drinking alcohol is not a good habit and will gives side effect to health, some people still choose to drink because they need a mechanism to relieve stress and to forget their bad days when things does not happen as plan and also has become a social norm. Drinking and driving essentially referred to as drunk driving and is one of the deadliest things in life for any alcohol user. A total of

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1,147 people have lost their lives in drunk driving incidents in Malaysia over the eight-year period from 2011 to 2018 [1].

People know the harmful effect of drunk driving but there are still a lot of car accidents in Malaysia. In this case, blood testing and testing urine samples were introduced and implemented to reduce the number of car accidents due to drunk driving. Unfortunately, in recent years' blood testing and testing urine samples are getting more impractical, inefficient and time-consuming because of the lengthy procedure. Therefore, breath alcohol testing devices were created.

Car accidents due to drunk driving have always been a major problem in Malaysia. Police estimates revealed that the number of people who died due to drunk driving incidents was 49 (2010), and 33 (2011), before rising markedly to 136 (2012) and continuing on an overall upward trajectory of 207 (2013), 193 (2014), 229 (2015) and 237 (2016) [1]. This shows those car accidents because by drunk driving are very dangerous and death threatening.

Moreover, Malaysia has also seen a rapid increase in the number of automobiles over the last decade. According to the Malaysian Department of Statistics, there were 22,702,221 registered motor vehicles in 2012. In comparison, 20,188,565 and 21,401,269 vehicles were registered in 2010 and 2011, representing a two-million-plus rise from 2010 to 2012. The combustion of hydrocarbons in motor vehicles produced a variety of gases and particulates, which were then released into the air and carbon monoxide is an unstable chemical and is the most harmful to humans.

The objectives are to design a breathalyzer to detect the drunk driver and to develop a pedal lock for the car system to prevent drunkards from driving with an additional feature of CO detection in the car with the application of notification. This is to ensure that if a person is intoxicated, the system will prevent the driver to drive and notify others via the app of their condition. The CO detection system is to alert the driver and passenger of the concentration level of CO in the car and leads them to safety.

2. Materials and Methods

This section will present the methodology used to design and implement the drunk pedal lock system with gas sensor detection with the additional feature of the CO detection system including the notification system. The first subsection presents the flow chart of the system and followed by the materials used in this project.

2.1 Materials

The breathalyzer system includes an Arduino UNO as a microcontroller, ESP8266 and an MQ3 sensor while the CO detection system includes an Arduino UNO also, ESP8266, a Raspberry Pi Zero W, a servo motor, an MQ7 sensor and a pedal lock. All this hardware was obtained from Cytron Technologies, Malaysia. The properties of the breathalyzer system were investigated by detecting the presence of alcohol from a hand sanitizer, perfume and a bug spray. Moreover, strong smells from edible such as durian, onion and coffee were also tested for effectiveness of the system. The properties of the CO detection system were tested with the presence of CO from smoke emanating from a cigarette, smoke from a person puffing a cigarette and smoke from burned newspaper and whitepaper.

2.2 Flow Chart

Before the user is able to drive, they need to start the system first. As shown in Figure 1, the system starts by detecting the concentration of CO and if it is high, the buzzer will activate. The carbon monoxide detection system always detects the presence of CO in the car interior even while driving. After that, detect the condition of the user by using a Breathalyzer as shown in Figure 2. If BrAC level is less than 0.22mg/l, it will automatically unlock the pedal lock but if the BrAC level is 0.22mg/l and above [2], the pedal will remain locked and an app will alert and give notice to the user listed contact people. The breathalyzer system only operates when the user wants to start driving. This is to ensure the condition of the driver before driving. Both of the systems will shut down when the user stops driving.

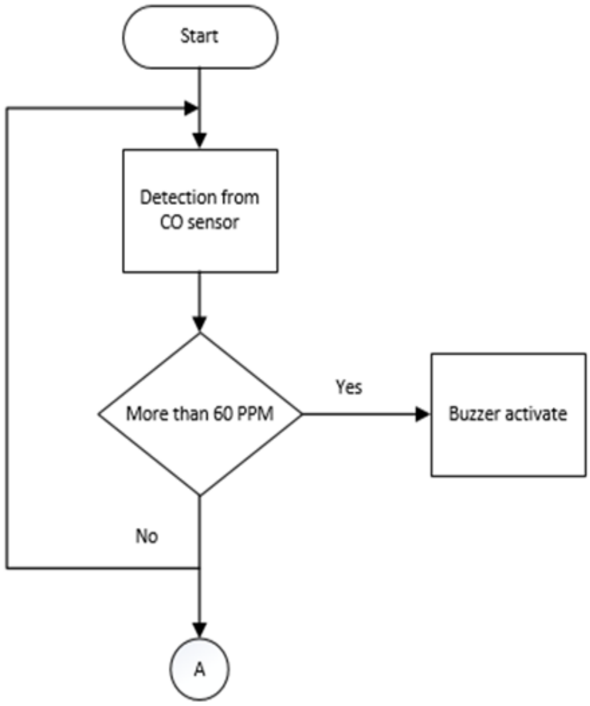

Figure 1: Flow Chart of CO Detection System

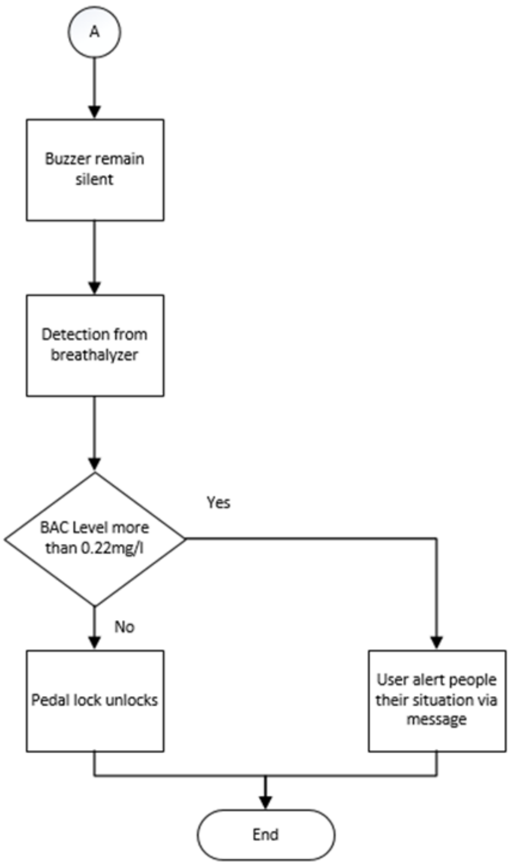

Figure 2: Flow Chart of Breathalyzer System

2.3 Methodology

For each system, it was tested with several specimens. The breathalyzer system was tested with the smell of a hand sanitizer, a perfume and a bug spray while the carbon monoxide system was tested with the presence of smoke emanating from a cigarette, smoke coming out from a person puffing a cigarette, smoke from burning newspaper and a white paper. Each experiment for both systems was conducted at a specific time taken which was 2 minutes for the breathalyzer system and 6 minutes for CO detection system observation respectively. To ensure the breathalyzer system is valid and only able to detect the presence of alcohol, the breathalyzer system was also tested with various strong smells from edible and drinkable such as onions, durian and coffee. Furthermore, the outcome when received the data from each system will send to the apps to ensure the capabilities to receive notifications from the system.

3. Results and Discussion

This section analyses and explains the outcomes that have been acquired throughout the investigation. All the results were obtained by using Arduino IDE and transferring all data to Matlab R2020b for plotting purposes. Both systems which are the breathalyzer system and the carbon monoxide detection system were tested and analyzed.

3.1 Evaluation of Breathalyzer System

3.1.1 Comparison of Data Set of Alcohol-Based

Based on Figure 3, hand sanitizer has the highest peak value while perfume comes in second and bug spray has the lowest concentration level of alcohol. It shows both hand sanitizer and perfume have a high level of alcohol when both values increase drastically when the MQ3 sensor started to detect the presence of alcohol. Moreover, both hand sanitizer and perfume decrease gradually but are still above the alcohol detecting range. Bug spray shows that it has a low alcohol level and depleted quickly below the alcohol detection range.

Essentially, it demonstrates that the MQ3 sensor is operational and capable of obtaining critical data. When three of the specimens have their own factors, the results showed different outcomes. All the substances tested have their own concentration level of alcohol and other chemical substances but still could lead to negative impact especially nausea, dizziness, drunk and even intoxication if the individual use the alcohol-based product irresponsible [3].

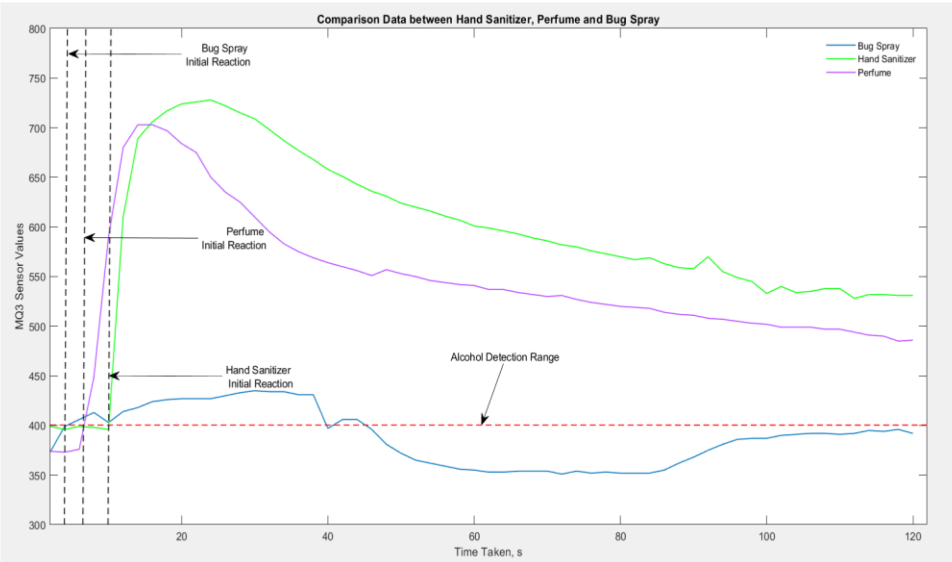

Figure 3: Comparison Data Between Hand Sanitizer, Parfume and Bug Spray

3.1.2 Detection of Non-Alcohol Based Materials

Based on Figure 4, shows that all of the specimens were far below the alcohol detection range. Even durian which famously has one of the strongest smells barely reaches the alcohol detection range. The highest peak value from the smell of durian was 370 while onion had 358 and coffee had 349. Even though all of the specimens were categorized as non-alcoholic, the MQ3 sensor was still able to slightly detect their presence. This is because the concentration level of sulfur in the specimen affects the reading and durian has the highest level of sulfur among them [4][5][6]. However, this shows that even the strongest smell of food could not affect the breathalyzer system and could run perfectly without any disturbances.

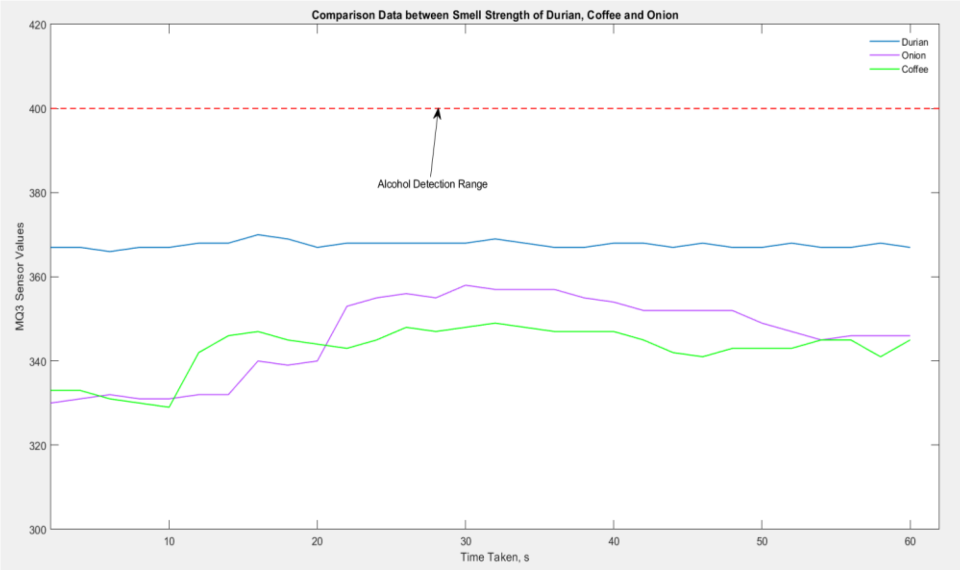

Figure 4: Comparison of Data Between Smell Strength of Durian, Coffee and Onion

3.2 Evaluation of CO Detection System

3.2.1 Comparison of Data Set of CO Substances

Based on Figure 5, shows that smoke emanating from cigarette increase exponentially from the start while the smoke from burning newspaper increases gradually till 25 seconds. The burn of whitepaper resulting high detection of CO levels but not as high burn newspaper. Afterward, the value skyrocketed and almost have the same value as smoke emanates from cigarettes. Furthermore, the value increases only when the MQ7 sensor detects smoke from puffing a cigarette. This is because the carbon monoxide resides only when the smoke is blown out to the sensor. Both of the value from burning newspaper and smoke emanating from cigarette decreases when they reached peak value.

Overall, it shows that the MQ7 sensor run perfectly and is able to obtain crucial data. The results showed different outcomes because four of the specimens have their own factors. Burn newspaper commonly results in CO an average of 119.67ppm ± 26.31 while burn whitepapers have an average of 3184.67ppm ± 10.21 [7]. When a cigarette smolders between puffs, 2.5 times more CO is produced than when it is really smoked. In enclosed situations, the release of CO in sidestream smoke from tobacco products has occasionally resulted in short-term CO levels of up to 50 ppm [8].

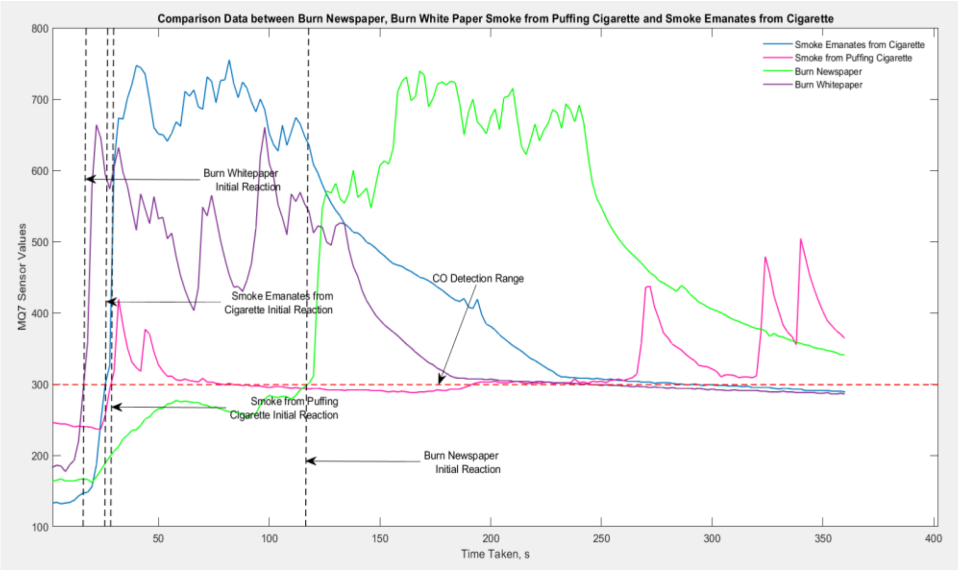

Figure 5: Comparison Data Between Burn Newspaper, Smoke from Puffing Cigarette and Smoke Emanates from Cigarette

3.3 Evaluation of Notification System

Based on Figure 6 and 7, it shows that when the MQ3 sensor detected the presence of alcohol, Blynk will notify and shown the condition of the pedal depend on the situations. Blynk will show the status of pedal lock remain lock when high level of alcohol is detected in Figure 6 while the status of pedal unlocks when low presence of alcohol detected in Figure 7. Based on Figure 8 and 9, it shows that when the MQ7 sensor detected the presence of carbon monoxide, Blynk will notify and warn the user the concentration level of CO respectively. Blynk will shows the warning status when high level of CO is detected in Figure 8 while Blynk will shows the CO level low status when the MQ7 detected low presence of CO in Figure 9.

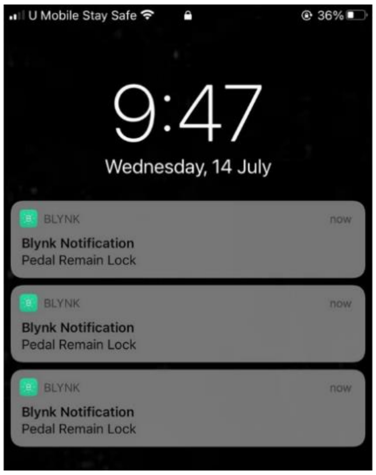

Figure 6: Notification when alcohol level is high

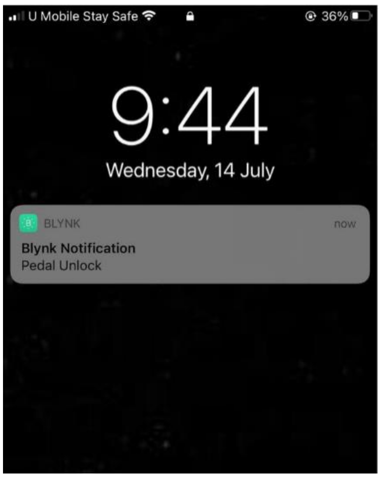

Figure 7: Notification when alcohol level is low

Figure 8: Notification when CO level is high

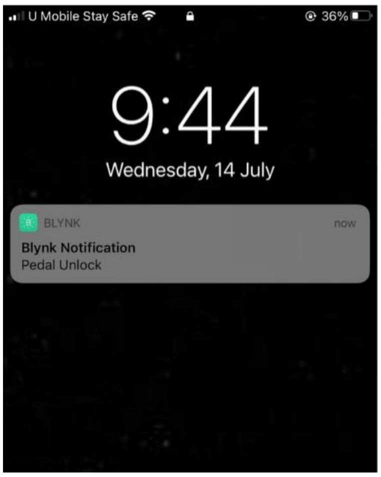

Figure 9: Notification when CO level is low

4. Conclusion

Overall, the development of a pedal lock for a drunk driver with gas sensor detection is successful. Based on the result analysis showed the breathalyzer able to detect and differentiate the presence of alcohol or not. The detection of alcohol was demonstrated by comparison of data from various alcohol-based and the efficiency of the system was demonstrated by being able to differentiate other strong smell subjects. Furthermore, the additional of CO detection system is able to quickly detect the level of CO in the surroundings and the capacity of a notification system to alert the user situation. This system can be implemented by all car manufacturers as an additional feature that users could acquire and, in the future, car manufacturers could also improve the system. For instance, the installation of a GPS system in the breathalyzer system would help the drunk driver to pinpoint his or her location and notify their close people to help them out. This project is able to provide more safety systems when it comes to the automotive industry because the goals of this project are the prevention of drunk driving and the prevention of drivers and passengers from exposure to carbon monoxide gases.

Acknowledgement

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