Design and Development of Alcohol Detection Sensor Mechanism for Safe Driving in Automobile

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Abstract

The present work describes the design and develop an alcohol detection sensor system that ensures safe driving of vehicle. The mechanism is capable of instrumenting a locking system that will ensure the start of vehicle only after checking the level of alcohol taken by the driver. The proposed system make use of pre-existing alcohol sensor (MQ-3), which is integrated with Arduino board. The system is also capable of sending the messages to the nearest competent authorities and dear one's of the driver, as soon as alcohol consumption is detected through the app integrated with the system. This paper includes designing of the sensor, Algorithm for app development, material description for the sensor. The proposed work if adopted as a regulation by the government agencies, will lead to prevent many casualties due to road accidents.
Keywords: Locking system, MQ-3, Arduino, App development.

1. INTRODUCTION

Product development and simulation has emerged as a powerful research tool [1-3]. A lot of work have been reported on research on vehicle performances in terms ensuring vehicle safe design [4-6] and modification in functionalities [7-10], but a very few work have been reported about the proficiency of driver. The increased hazardous rate due to road accidents by the consumption of alcohol should be the area of concern for the automobile industries and government agencies. There is a need of design, development and implementation of an alcohol detection sensor mechanism which will be primarily targeting on saving lives of people by not allowing the driver to start the car with alcohol consumption. The consumption of liquor is a typical propensity in numerous societies, related with customs' merriments, however even a little amount of liquor will influence human behavior [11]. In the past there had been many researches done on detecting toxic gases, vehicle location and accident, instrumenting locking system of vehicle for security purposes, implementation SMS based alcohol detection with vehicle controlling etc. Safety of vehicle is of prime concern amongst these aspects. Public safety in general and roads safety in particular. The idea is characterized by being deliberately dependent on personal contribution [12]. Research are continuously being done to get optimum solutions for tracking and locking automatically. The automobile industries are now also considering these issues seriously [13].
Many researches have been found in literature on using GPS and GSM module for tracking but the information that was provided through it, was sometimes a bit confusing in exact identification, because the SMS receives location in terms of latitudes and Longitude, which is tough to interpreter. K Sandeep et al. [14] proposed the use of the Internet of things (IOT) device as Raspberry Pi three model B as a core. It mainly includes Touch sensor, alcohol concentration detection sensor, Facial recognition, Heart beat rate, to safeguard the drowsy driver. Izanoordi Ahmad et al. [15] Proposed a model based on MQ-3 alcohol sensor with HC-05 Bluetooth module. Whenever system crosses the threshold value of alcohol the system is used to send the message to one of its relative via Bluetooth transmission. S.V. Altaf et al. [16] used MQ-3 alcohol sensor with microcontroller ATS8951 in which the sensor was fitted in front of the driver seat. The proposed system work on the concept when MQ-3 sensor detects the alcohol the car ignition will immediately will be turned off and it detects while driving then it will reduce the fuel supply [17-22].

However a lot of work is done to provide the safe driving mechanism but a lot has remained in term of integration of these technologies for the optimal solution. Present work provides a way to deal with the most sophisticated and advanced system which prohibits the driving by a alcohol consumed person. The present work addresses the development of an alcohol sensor by using pre-existing technologies followed by app development on android studio [22-29]. The safeguards are provided with the help of GPS module, Triggering an alarm and Automatic ignition off etc. Alcohol sensor mechanism is developed with the help of MQ-3 sensor, Microcontroller (ATS 8051), LCD Display, Buzzer, Relay, Analog to Digital Converter, DC Motor (For System Demonstration), GPS and GSM Module followed by CATIA model, proteus model and value proposition canvas. The app was

developed on android studio [29-32]. The main purpose of the app is to send the location of a car with drunk driver to one of its family member and competent authority.

2. PROPOSED SYSTEM

The Prosed system is shown in figure 1. Alcohol sensor mechanism is developed with the help of MQ-3 sensor, Microcontroller (ATS 8051), LCD Display, Buzzer, Relay, Analog to Digital Converter, DC Motor (For System Demonstration), GPS and GSM Module followed by CATIA model, proteus model and value proposition canvas.

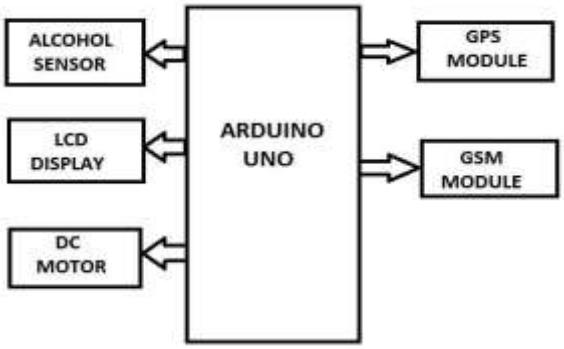

Figure 1 Proposed system

2.1 MQ-3 Sensors

MQ-3 Model is based on Taguchi design with a coating of oxide sensing[8]. In MQ-3 MQ stands for metal oxide semi-conductor (MOS) type gas sensor. MQ-3 sensor provide fine range for detection of alcohol particles in the air varies from 25 to 50 ppm with a accuracy of +/- 6.7 ppm and it is suitable for making breathalyzer. The MQ-3 sensor works on 5V draws 800MV. Table 1 shows the specification of MQ-3.

Table1: Specification of MQ-3 sensor

Operating voltage	5V
Load resistance	200 KΩ
Heater resistance	33Ω ± 5%
Heating consumption	<800mw
Sensing Resistance	1 MΩ – 8 MΩ
Concentration Scope	25 – 500 ppm
Preheat Time	Over 24 hour

2.2 Analog to Digital Converter

Analog to digital converter allows microcontroller ATS8051 to complete it circuit. Analogue signal regularly change their value, which come from mQ-3 sensor. In analog signal there is continuous change in value in terms of voltage, sensors while in case of binary the representation of value is only in one and zero so, here analog to digital converter comes into play which shows real life value which is easily monitored.

2.3 Microcontroller ATS8051

Microcontroller consist of CPU, Ram, and it is the main part of the system. The microcontroller has bit address for data, which makes transmission of data, which make transmission of data very smooth. The single chip contain four port, two timers and one serial port and during assembly, it can be easily programmed.

2.4 LCD Display

LCD stands for liquid crystal display it is a flat board display or other electronically adjusted optical equipment, which do not transmit light straight forward. LCD is made of substance, which is permanent liquid substance LCD provide a good quality contrast, brightness and clear images.

2.5 GPS and GSM Module

GPS module is used for tracking it is a satellite based navigation system. GPS is used to navigate or locate the location of cars. GPS convert received signal into longitude and latitude. GSM Module is a technology of second generation (2G). GSM is a cost-effective device, which applies sim card of any operator to transmit message from one person to another person. The model will also send the message of whereabouts of the vehicle through SIM900A. Another reason to choose GSM Module is that it support all mobile system.

2.6 Relay

Relay is very important part of the circuit as relay helps in closing and opening of the circuit if the relay is open it energized the circuit while if relay is closed it does not energized the circuit and if the circuit of the relay analyze the fault current in the circuit it give energy to the magnetic which produce magnetic field. It works on the principle of electromagnetic attraction.

3. METHODOLOGY

The experimental set for the sensor is shown in figure 2. For assembling of sensors, we are using pre-existing technologies. Microcontroller act as a heart of the system [6]. The main eight components for development of sensor are MQ-3 sensor, Microcontroller ATS8051, Analog to Digital Converter, GPS and GSM Module, LCD Display, Buzzer, Relay, DC Motor (For System Demonstration) and there are other off components which are in use. The flow chart works when a person sitting inside a car on driver seat has consumed alcohol or not. If person has not consumed alcohol then car will run smoothly else, if MQ-3 sensor detects alcohol particles in the air then it will show the value of alcohol concentration on LCD display if value is more than recommended level the microcontroller give signal to buzzer circuit and buzzer is turned on and at the same time relay is turned off due to this ignition of the car is deactivated. Alcohol detection system with buzzer indicate project is extend by adding an ignition key at the input and a DC motor at a output. The input ignition key is given to the microcontroller. It is used to find out the car whenever a car is started whenever a key is inserted into the ignition lock at the that time the alcohol detection process is started [17] as soon as alcohol detects sensors GPS and GSM Module comes into play it will helping us in sending the location to one of its family member to pick up from the location and the location will be shared through the app developed during this project. The proteus model is also developed for this project.

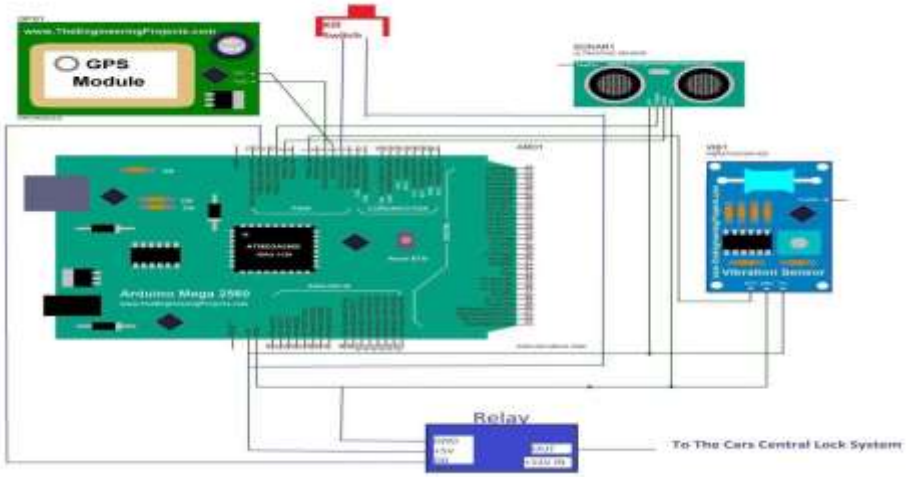

Figure 2 Experimental set up of sensors

4. RESULTS AND DISCUSSION

4.1 Modelling of the Sensors

In development of any prototype designing plays an important role In order to understand the dimension, size, function. The sensor is designed in such a way that it will easily install on the steering of the car keeping in mind that MQ-3 sensor has a fine sensitivity range of 2 meter. Figure 3 shows the drafting model of the sensors.

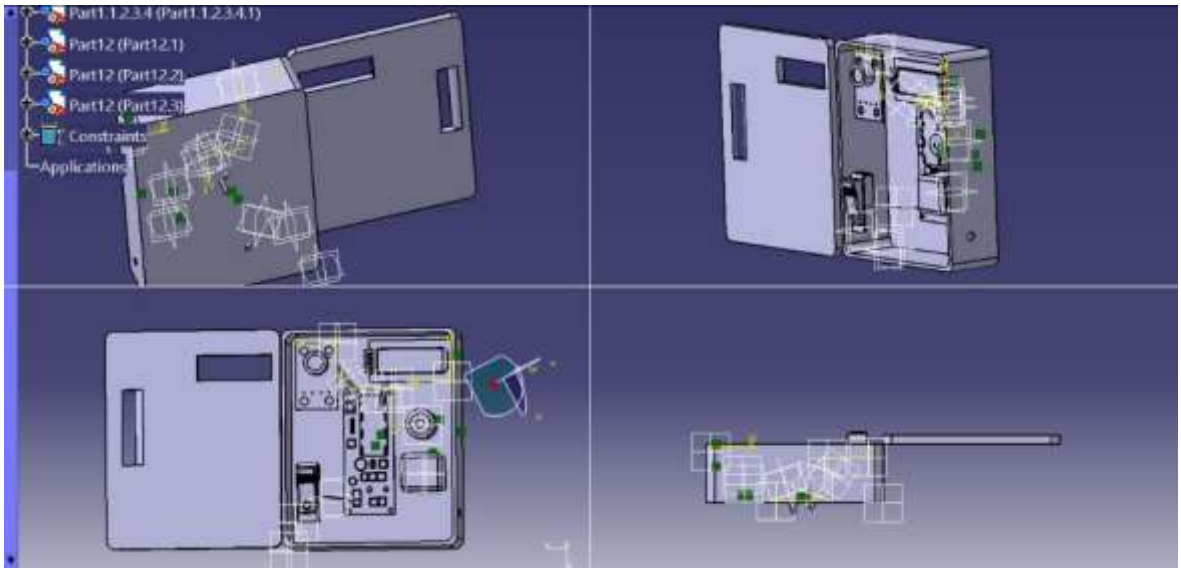

Figure 3 Drafting model of the sensors

4.2 Algorithm for an App Development

Figure 4 shows interface of an app development. The steps for algorithm for the app development is as follows:
Step 1- Getting the Google Map API key
Step 2- Create a New Android Project
Step 3- Select Google Map Activity, click next, and finish.
Step 4- Open google_map_api.xml, where you will enter the Google Map API KEY and now build the Gradle.

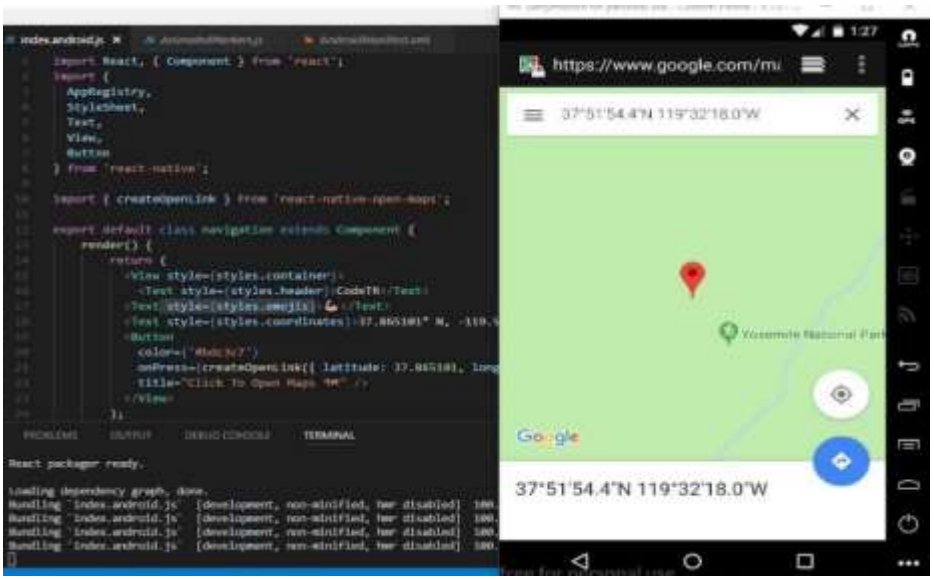

Figure 4: Interface of an app development

Step 5- Define internet and location permission in Android Manifest
Access_fine_location
Internet
Step 6- Code MapsActivity.java file for inserting functions in Google Maps.
Step 7-Functions needed
OnMapReady () - it is used when the map is ready to use.

OnConnected ()-when device connection is successful.
OnConnectionSuspended ()-device is in disconnected state.
OnConnectionFailed ()-failed to connect.
OnLocationChanged ()-when there is change in location of device.
GoogleApiClient () - build this to use google play services to ensure that the permissions are granted and to build its object and add API () to specify which API are requested by your app.
AddConnectionCallbacks () - to receive connection events from GoogleApiClient ().
AddOnConnectionFailedListener () - to receive connection failed events from GoogleApiClient ()
Step 8- Change map types, zoom controls.
Step 9 - Run the app with internet connections.

5. CONCLUSION

The proposal system check whether the person has consumed alcohol or not while driving the car, which will help us in reducing in car accident due to drunk driving. The project is categorized into three parts. The first part discuss about the electronic control unit that is used in this prototype that comprises of Arduino board, Sensor, Microcontroller. The second part is designing of the sensor to check the compatibility, availability of the passage in the car to fix it. The third category comprises of development of a navigation system to locate the car.

REFERENCE

1. Yadav J., Pitta P., Maan A. (2018) Swisng Tower of Loader Backhoe Arm for Dynamics and Stress Analysis by Modeling and Simulation. In: Siddiqui N., Tauseef S., Abbasi S., Rangwala A. (eds) Advances in Fire and Process Safety. Springer Transactions in Civil and Environmental Engineering. Springer, Singapore https://doi.org/10.1007/978-981-10-7281-9_18
2. Maan A., Pitta P., Yadav J. (2018) Performance Evaluation of Rectangular Fins by Modeling and Simulations. In: Siddiqui N., Tauseef S., Abbasi S., Rangwala A. (eds) Advances in Fire and Process Safety. Springer Transactions in Civil and Environmental Engineering. Springer, Singapore 10.1007/978-981-10-7281-9_26
3. Yadav, Jitendra, et al. "Nonlinear dynamics of controlled release mechanism under boundary friction." Results in Engineering 11 (2021): https://doi.org/10.1016/j.rineng.2021.100265
4. Yadav, J., Kurre, S.K., Thakur, S. (2022). FEM-Based Impact Analysis of Roll Cage of an All-Terrain Vehicle. In: Singh, M.K., Gautam, R.K. (eds) Recent Trends in Design, Materials and Manufacturing. Lecture Notes in Mechanical Engineering. Springer, Singapore. https://doi.org/10.1007/978-981-16-4083-4_17
5. Yadav, Jitendra, Santosh Kumar Kurre, and Shubham Thakur. "Estimation of the dynamic response of roll cage under impact loading by modeling and simulation." Materials Today: Proceedings 50 (2022): 2181-2188. https://doi.org/10.1016/j.matpr.2021.09.445
6. Kurre, S.K., Yadav, J., Thakur, S. (2022). Comparative Study of the Rear and Rear Side Impact on a Roll Cage Using FEM. In: Singh, M.K., Gautam, R.K. (eds) Recent Trends in Design, Materials and Manufacturing. Lecture Notes in Mechanical Engineering. Springer, Singapore. https://doi.org/10.1007/978-981-16-4083-4_37
7. R. Kumar and A. Kumar, “Design and hardware development of power window control mechanism using microcontroller,” 2013 Int. Conf. Signal Process. Commun. ICSC 2013;61–365 doi: 10.1109/ICSPCom.2013.6719813.
8. R. Kumar, N. J. Ahuja, and M. Saxena, “Improvement and approval of impediment recognition and activity for power window,” 2018, doi: 10.1007/978-981-10-5903-2_89.
9. R. Kumar, N. J. Ahuja, M. Saxena, and A. Kumar, “Modelling and Simulation of Object Detection in Automotive Power Window,” Indian J. Sci. Technol., 2016;9 (43) doi: 10.17485/ijst/2016/v9i43/104393.
10. R. Kumar, Divyanshu, and A. Kumar, “Nature Based Self-Learning Mechanism and Simulation of Automatic Control Smart Hybrid Antilock Braking System,” Wirel. Pers. Commun., 2021; 116(4); 3291–3308 doi: 10.1007/s11277-020-07853-7.
11. Gasparesc, G. (2018). Driver Alcohol Detection System Based on Virtual Instrumentation. IFAC-PapersOnLine, 51(6), 502–507. https://doi.org/10.1016/j.ifacol.2018.07.110
12. Al-Youif, S., Ali, M. A. M., & Mohammed, M. N. (2018). Alcohol detection for car locking system. ISCAIE 2018 IEEE Symposium on Computer Applications and Industrial Electronics, 230–233. https://doi.org/10.1109/ISCAIE.2018.8405475
13. Prof. Bhavana Patil, Harsh Amrite, Kailas Gaikwad, J. D. & S. H. (2018). smart car monitoring system using Arduino. International Research Journal of Engineering and Technology (IRJET), 05(03), 1554–1557. www.irjet.net

14. Sandeep, K., Ravikumar, P., & Ranjith, S. (2017). Novel Drunken Driving Detection and Prevention Models Using Internet of Things. Proceedings - 2017 International Conference on Recent Trends in Electrical, Electronics and Computing Technologies, ICRTEECT 2017, 2017-Decem, 145–149. https://doi.org/10.1109/ICRTEECT.2017.38
15. Ahmad, I., Suhaimi, M. F., & Yusri, N. A. N. (2019). Development of alcohol sensor detector with engine locking system for accident prevention. AIP Conference Proceedings, 2129(July), 1–7. https://doi.org/10.1063/1.5118204
16. Altaf, S. V, Abhinay, S., Ansari, E., & Anwer, R. (2017). Alcohol Detection and Motor Locking System. International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, 6(2), 989–993.https://doi.org/10.15662/IJAREEIE.2017.0602062
17. Krivec, M., Mc Gunnigle, G., Abram, A., Maier, D., Waldner, R., Gostner, J. M., Überall, F., & Leitner, R. (2015). Quantitative ethylene measurements with MOx chemiresistive sensors at different relative air humidities. Sensors (Switzerland), 15(11), 28088–28098. https://doi.org/10.3390/s151128088
18. R. Kumar, R. K. Pachauri, P. Badoni, D. Bharadwaj, U. Mittal, and A. Bisht, "Investigation on parallel hybrid electric bicycle along with issuer management system for mountainous region," J. Clean. Prod., 2022; 362:132430, doi: 10.1016/j.jclepro.2022.132430.
19. Kumar, R., Kumar, A., Gupta, M. K., Yadav, J., & Jain, A. (2022). Solar tree-based water pumping for assured irrigation in sustainable Indian agriculture environment. Sustainable Production and Consumption, 33, 15-27, doi.org/10.1016/j.spc.2022.06.013.
20. R. Kumar, N. J. Ahuja, M. Saxena, and A. Kumar, "Automotive Power Window Communication with DTC Algorithm and Hardware-in-the Loop Testing," Wirel. Pers. Commun., 2020;114 (4): 3351–3366 doi: 10.1007/s11277-020-07535-4.
21. C. S. Meera, S. Sunny, R. Singh, P. S. Sairam, R. Kumar, and J. Emannuel, "Automated precise liquid transferring system," 2014:1-6 doi: 10.1109/IICPE.2014.7115831.
22. A. Pal, R. Kumar, and V. R. Sanal Kumar, "Conceptual design of an automatic fluid level controller for aerospace applications," Proc. IEEE Int. Conf. Soft-Computing Netw. Secur. ICSNS 2015, 2015, doi: 10.1109/ICSNS.2015.7292433.
23. R. Kumar, K. Bansal, A. Kumar, J. Yadav, M. K. Gupta, and V. K. Singh, "Renewable energy adoption: Design, development, and assessment of solar tree for the mountainous region," Int. J. Energy Res. 2021; 1–17 doi: 10.1002/er.7197.
24. Yadav, Jitendra, et al. "Identification of damping prohibiting stick-slip form friction influenced dynamic system." Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science (2022): 09544062221135517.
25. R. Kumar, P. K. Dwivedi, D. Praveen Reddy, and A. S. Das, "Design and implementation of hydraulic motor based elevator system," 2015, doi: 10.1109/IICPE.2014.7115821.
26. A. S. Das, P. K. Dwivedi, A. K. Mondal, R. Kumar, R. M. Reddy, and A. Kumar, "Storage optimization of automated storage and retrieval systems using breadth-first search algorithm," 2017, doi: 10.1007/978-981-10-2999-8_18.
27. A. Kumar, K. Bansal, D. Kumar, A. Devrari, R. Kumar, and P. Mani, "FPGA application for wireless monitoring in power plant," Nucl. Eng. Technol.2020; 53(4); 1167–1175 doi: 10.1016/j.net.2020.09.003.
28. Dravid Shriram, Jitendra Yadav, and Santosh Kumar Kurre. "Comparison of loosening behavior of bolted joints using plain and spring washers with full-threaded and plain shank bolts." Mechanics Based Design of Structures and Machines (2021): 1-19.
29. Yadav J., Agnihotri G. (2018) Circumvention of Friction-Induced Stick-Slip Vibration by Modeling and Simulation. In: Singh R., Choudhury S., Gehlot A. (eds) Intelligent Communication, Control and Devices. Advances in Intelligent Systems and Computing, vol 624. Springer, Singapore
30. Jitendra Yadav and Geeta Agnihotri (2017), "Modeling and Simulation of the Dynamic Response of a Generic Mechanical Linkage for Control Application Under the Consideration of Nonlinearities Imposed by Friction", In Springer Proceedings of the International Conference on Nano-electronics, Circuits & Communication Systems, Lecture Notes in Electrical Engineering 403, DOI 10.1007/978-981-10-2999-8_26
31. Jitendra Yadav & G. Agnihotri, "Proposed Critical Damping for a Spring Mass System to Avoid Stick Slip" ,Springer Journal of the institution of engineers (India): Series C Volume 96, Number 3, PP 331-335, July-September 2015.
32. Jitendra Yadav & G. Agnihotri, "Modeling and simulation of hydraulic actuator with viscous friction", International Journal of Advanced Technology in Engineering and Science, Volume No 03, Special Issue No. 01, March 2015