Monitoring of Temperature and Toxic Gases in Autonomous Vehicles: Simulation Using Tinker-cad

N. Parimala , J.Ashok kumar, Dr.Satish Addanki, Dr.N.Bhoopal
B V Raju Institute of Technology
Narsapur, Telangana, India
parimala.ashokkumar46@gmail.com, jashok6@gmail.com, satish.a@bvrit.ac.in,
bhoopal.neerudi@bvrit.ac.in

Abstract

With the raise of vehicle usage the technology development also grooming up by introduction and the usage of multiple sensors in ECU – Electronic control unit as the result of this the heating up problem existing so that the carbon di oxide emission is also getting increased. Another major problem which arises in the Automotive embedded system in the autonomous vehicle is the safety and security based system by priority based monitoring and controlling the temperature and the toxic gas emission to minimise the drastic cause like the death due to the emission of toxic gases like CO_2 from temperature raise and Freon from the air conditioner in car. To make the drawbacks to bring out the betterment in the autonomous vehicle by using the Tinker cad simulation tools.

Keywords
ECU, Sensors, Freon and Autonomous vehicle

1. Introduction
Now a day, along with the growth of population the usage of the vehicle is also getting increased though fuel price is reaching the peak. There may lot of advancement available in the vehicles the number of accidental rate is not in decreasing rate it's the bitter truth. Approximately 1.35million people die in road crashes each year worldwide. 20-50 million suffer non –fatal injuries often resulting in long term disabilities. 2-8% is lost from a country's GDP due to road crashes. Most of the accidents were caused by human errors.

The most trending in the transportation is the autonomous vehicles. That is the most advanced autopilot mode of driving will be present along with the technological development in the automotive means. That is the most important three aspects such as sustainability, conformability and the safety means. The sustainability here figures out the emission of heat. Due to the expel of the heat the level of carbon di oxide level get increased due to temperature and the emission of the Freon gas from the car air conditioner so as to avoid these the term sustainability is incorporated, the second on is the conformability which talks about the comfort of the people present inside the vehicle, so according to the physical appearance of the members the persons can alter the seating arrangement and the third important aspect is the safety and security which is introduced for the caution driving for both the vehicle and the driver. This huge is achieved by the usage of multiple sensors. Tesla is the world number one position for the usage of the multiple tasks in it. Though multiple number of sensors are used there are three or four accidents occurred recently, with the low budget Waymo Company working under this autonomous as it tries to make a lead as like the best mileage provider for cars in the world

1.1 Objectives
By using the AutoSar standard in collaboration with the sensors and priority used in order to have a hassle free and safe journey with vehicles the task of increase of toxic gas like Co_2 and Freon gas detection by using the simple Arduino uno , sensors and buzzers in order to a) find the raise of the temperature prediction, b) the prediction of the toxic gas Freon inside the vehicle which expels out from the Air conditioner of the car and as a overview of safety driving of the autonomous vehicle is made in to concern to give the better results of safety driving eco friendly.

2. Literature Review

The concept of increasing the Lighting function in automotive systems vehicles to raise the efficiency. S. Chen et al. (2019) The framework for the self-driving cars is end to end system and perception based system. Brain-Inspired Cognitive Model or the novel model deals with the three factors convolutional neural network, cognitive map and a recurrent neural network. The main advantage of this system is estimating the free space, detecting the distance, learning the driving behaviour and the dynamic behaviour. For the evaluating the model three cameras are placed and 40000 images are captured along with the human driving and the vehicle states in the recorded manner.

Wang and Yin (2019) As the advancement of technology is incorporated in the autonomous vehicle, the automotive driving comes under this as the major one. For performing these control operations ECU process. For the multicore architecture the multiple controlling operations are performed parallel under the utility time , so based upon the priority of the task the round robin scheduling algorithm is used for the utilization of the CAN network, the single core architecture pays more time consuming for performing the low priority operations, the layers such as the MCAL, BSW,RTE and the ASW are present in the AUTOSAR the concern tasks are performed in the concern layer , like MCAL performs the i/o operations , memory access and the communication will be taking place and ECU which performs are given by ECUAL.

Gandhi and Salvi (2019) The idea of combination of the artificial intelligence and the block chain technology for the autonomous vehicle for the purpose of driverless cars. Autonomous vehicles works under the reinforcement learning which nothing but the learning is process of trial and error method. For keeping the break while collision on the wall can be self-learned by the multiple time of collision on the wall. To avoid the too much damage to the autonomous cars, single car is tend to have reinforcement learning, with the result of this the remaining cars can be learnt for collision detection, because of this the damage for cars becomes less and time is also consumed here Gao et al. (2020) IOT plays major support for the intelligent transportation system of autonomous driving. Though the follow up of the front part of the road using the Lidar with the cloud system it fails to the mentioning of the smoothness of the road which may become harm to the driver. So as to overcome these issues the graphical processing unit (GPU) is used with Inverse Distance Weighted (IDW) interpolation algorithm for the obstacle detection and the increase of the accuracy and efficiency of the road point.

Sajjad et al. (2021) Deep learning methods effectively supports and act as a milestone in the autonomous vehicle. With the usage of the less hardware and the effective deep learning technique for the capture of the image and directorate towards the path and with the simple technique the huge accidents are avoided by means of this using of ultrasonic sensor. With the use of Q Algorithm the directions and the obstacles in the pathway is also predicted effectively M. Masmoudi et al. (2021) the concept of depth of red green blue frame work is introduced here. In the autonomous vehicle systems (AV) the artificial intelligence is used under the concept of two algorithms one is the You Look Once (YOLO3) and the reinforcement learning algorithm is used .YOLO3 is used for the distance detection and the deviation of angles, whereas the reinforcement learning, Q algorithm which makes the real time navigation system for the collision with the objects. Yalcin et al. (2021) The system on chip (SOC) is used for eradicating the hurdles caused during the communication between the secure on-board communication (SecOC) and the electronic control unit (ECU) using the advance encryption standard (AES). And it implemented in the FPGA using the HDL language.

Camara et al. (2021) said that the sensing of stack, through detection and recognition, to till the pedestrians tracking in the lower level is given here. For the active prediction of the static and the moving pedestrian the following techniques are implemented they are behaviour modelling, prediction and interaction control, Seo et al. (2022) said that the major concern in the autonomous vehicle are safety and tracking. The novel control design is thus applied to the control inputs and tracks the desire measures for the safety. The dynamic inversion method is applied over the control barrier function for handling the safety constrain and the tracking. the safety and stability is analysed by using the closed loop using a singular perturbation method.

Ni et al. (2022) stated that intelligent transportation system is trending in the self-driving cars. So the classification of images also pays a special role in the finding similarities and differences in the images to improve the autonomous car. An improved network based classification using region convolution neural network is used.to avoid the redundancy the mixture of ReLu and ECU in used in the convolution kernel. It results with a good yield in the efficiency. Santaella et al. (2022) stated that lighting in the headlamps and rear lamps use halogen lamps is the usual way in any type of the electric car, or as a normal car or it may be the autonomous cars, to make a revolution in

when low power consumption and very long life. Here the concept Quantum dot film (QDF) is used with the two kind of Des green (531nm) and red (465nm), the blue light wavelength is passed through the lights the white light is emitted at the output for the lighting in both the interior and exterior part of the vehicle so that the power efficiency is achieved

3. Methods

In this autonomous vehicle system**,** Figure 1 shows the controlling part of the Electronic controlling unit ECU is carried out by the arduino uno, the temperature sensor and the gas sensors are connected to it out to have a eco-friendly ride.

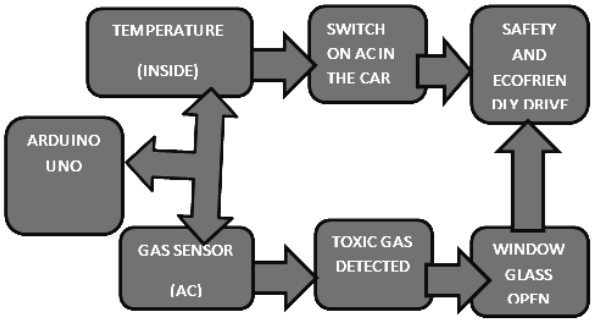

Figure 1. Block Diagram (Real Time Process)

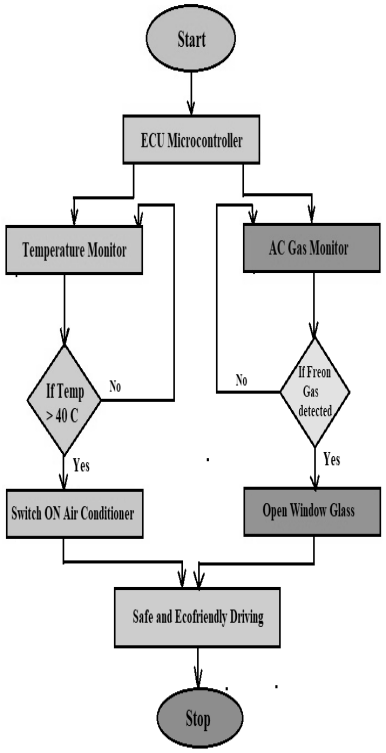

Figure 2 Flow chart of the complete ECU controlling process

Figure 2 shows the flow of the automotive process of the temperature and gas inside the autonomous vehicle, ECU does its controlling part of the sensors and actuators; here the flow of control is about the temperature and the gas sensors which monitors and detects the abnormalities which follows the flow.

4. Data Collection

The schematic representation of the complete process for gas monitoring system by the components and sensors connection to the arduino uno is shown in Figure 3.

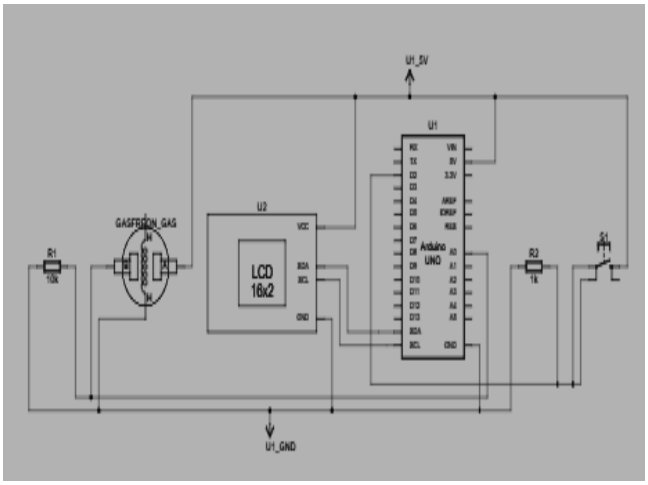

Figure 3. Toxic gas monitoring and detecting

The list of components which are represented in the schema of the gas monitoring system is given in details along with the values is seen in Table 1

Table 1. list of components for gas monitoring and detection

Name	Quantity	Component
Gas1	1	Gas sensor
U1	1	Arduino Uno R3
U2	1	MCP23008 based 32LCD 16*2(I^2C)
R1	1	10KΩ Resistor
S1	1	Push button
R2	1	1kΩ Resistor

The temperature monitoring process schema with the connections of the sensors , components and controller is illustrated in Figure 4.

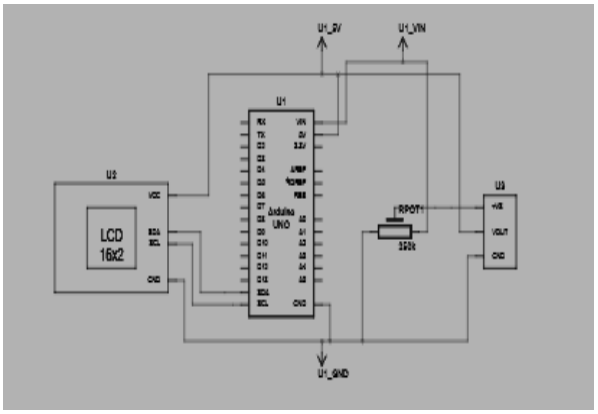

Figure 4. Temperature monitoring and detecting

The list of components required for the temperature monitoring systems with the values are shown in the Table 2.

Table 2. list of components for temperature monitoring and detection

Name	Quantity	Component
U1	1	Arduino Uno R3
U2	1	MCP23008 based 32LCD 16*2(I^2C)
U3	1	Temperature sensor[TMP36]
Rpot1	1	250kΩ potentiometer

5. Results and Discussion

Figure 5 shows the result of the Temperature Monitoring task inside the vehicle body. As the average temperature of the human body that can bearable is 37 ^{O}C , the threshold temperature is fixed inside as the 40 ^{O}C . If the temperature is below the fixed threshold level value, the LCD will just notifies that the temperature is normal.

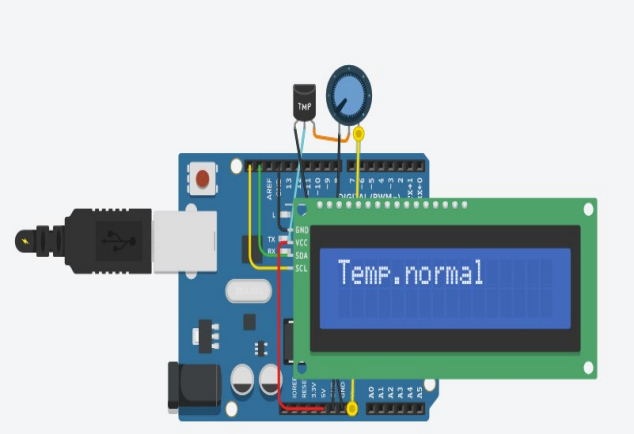

Figure 5. Temperature Monitering

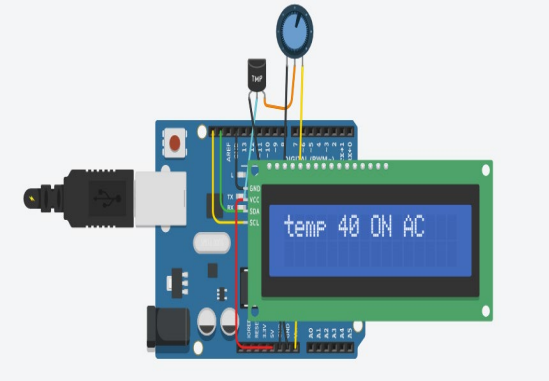

Figure 6. Temperature detection.

Figure 6. The temperature sensor performs the temperature monitoring task continuously So that the normal temperature can be maintained inside the vehicle. If it is raised more than 40^{O}C which is the threshold value fixed, then the switch which is connected to the system of AC inside is then automated by vehicle to have a hassle free cool journey. Here we just point out the raise of the temperature by means of displaying in the LCD as “temp 40^{O}C ON AC”.

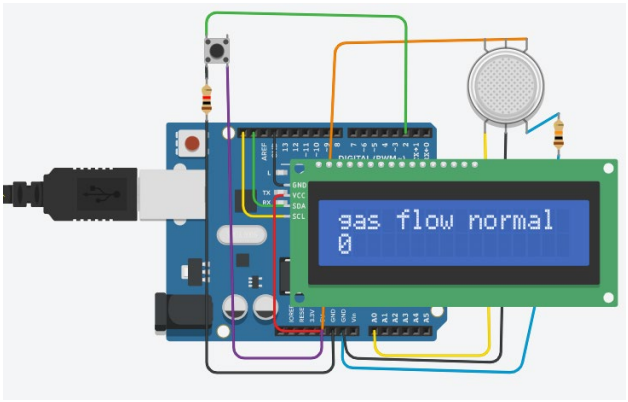

Figure 7. Gas Monitoring

Figure 7, the gas sensor begins to get activated by itself when the AC inside the car body is switched ON automatically and keeps on monitoring if the gas flow is normal then it indicated that the gas level is normal in the LCD display.

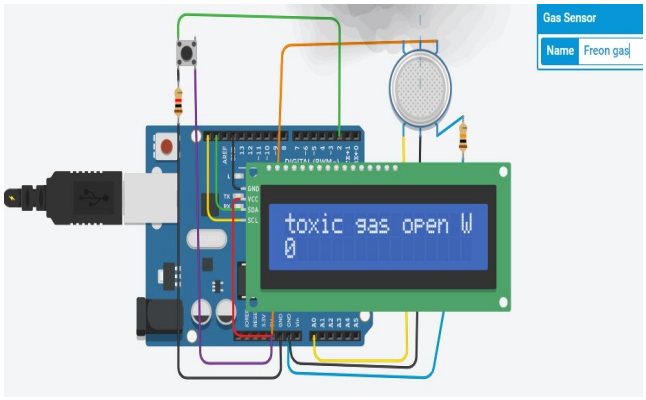

Figure 8. Gas Detection

Figure 8. Shows the Detection of the toxic gases like Freon. The Freon gas is detecting sensor is connected to the AC system so that if the emission of the toxic gas is sensed out then the window side glass will be open itself to send out the toxic gas. Here the flow of the toxic gases is indicated by means of displaying the notification that “toxic gas Open window” in the LCD display.

5.1 **Numerical Results**

Table 3. Temperature monitoring inside body due to outside

S.No	Time	Outside Temperature	inside Temperature
1	5	20	22
2	10	25	30
3	15	30	35
4	20	35	40
5	25	40	50
6	30	45	60

The Table 3 shows the circulation of the change of temperature of the vehicle inside the car body due to the raise of the temperature outside the car body. when the time interval moves on how much amont of the possibility of the temperature reise is possible is shown. And this is for any latest model cars irrespect of the cost. This values may get varry for the hotter regions basically,

Add numerical results here. Make sure to describe all tables and add inferences (10 font)

5.2 Graphical Results

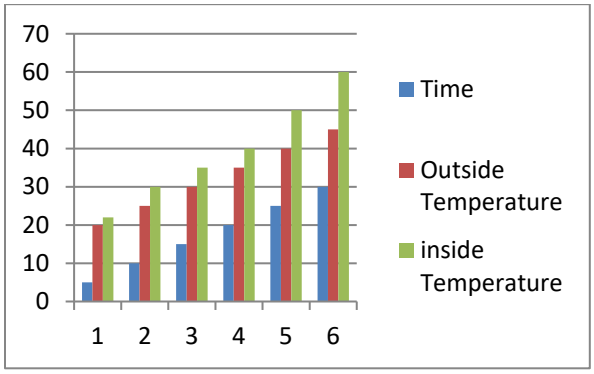

Figure 9. Temperature raise analysis inside and outside vehicle body

The Figure 9, which shows the graphical representation of the analysis of the change of temperature inside the car body due to the outer car body when the moving up time interval of the car is keep on increasing.

5.3 Proposed Improvements

The abrupt technical advancement in the means of self-driving, safety, comfort ability , design appearance, fuel consumption , power consumption , overheating , locking system, tracking system, finger print and facial recognizing etc., in the Autonomous vehicle definitely attracts every of us to float in the dream world no doubt in that. The person who drives the low advancement autonomous car must go through a ecofriendly journey apart from the probability of occurring of harm due to the gas and the temperature is made into notice for the improvement by the successful simulation using tinker cad.

5.4 Validation

The result is thus validated by simulating the monitoring and the detecting process by means of the tinker cad circuit.

6. Conclusion

Thus, this paper insists about the importance of the safety of the people who are travelling inside the autonomous car has to be taken this as the concern. As the accidents can happen because of these toxic gases which expels out and kill us without our knowledge. As a feature work this idea can be incorporated even to the basic cars with the air conditioner facility as it can be fixed with affordable cost.

For minimizing the temperature raise of the car due to the long driving it mandatory to leave a break of minimum 10 to 15 minutes in every 2hours of journey so as to avoid the temperature raise in the car bodies which may help to avoid or at-least the minimal usage of the AC in car decreasing the probability of the flow of the toxic gases which produces harm to both the human and environment to have a ecofriendly safety journey.

References

Chen, S. Zhang, J. Shang, B. Chen, and N. Zheng, “Brain-Inspired Cognitive Model With Attention for Self-During Cars,” *IEEE Transactions on Cognitive and Developmental Systems*, vol. 11, no. 1, pp. 13–25, Mar 2019.
Camara, N. Bellotto, S. Cosar, D. Nathanael, M. Althoff, J. Wu, J. Ruenz, A. Dietrich, and C. W. Fox, “Pedestria

Models for Autonomous Driving Part I: Low-Level Models, From Sensing to Tracking," *IEEE Transactions on I ntelligent Transportation Systems*, vol. 22, no. 10, pp. 6131–6151, Oct. 2021.

Campos, "High-Luminance QD-LED Device With Digital and Dynamic Lighting Functions for Efficient A utomotive Systems," *IEEE Photonics Journal*, vol. 14, no. 2, pp. 1–10, Apr. 2022.

Gandhi and Salvi, "Artificial Intelligence Integrated Block chain For Training Autonomous Cars," *2019 Fifth Intern ational Conference on Science Technology Engineering and Mathematics (ICONSTEM)*, Mar. 2019.

Gao, B. Wang, L. Xiao, and G. Mei, "Incomplete Road Information Imputation Using Parallel Interpolation to Enha nce the Safety of Autonomous Driving," *IEEE Access*, vol. 8, pp.25420–25430, 2020.

Masmoudi, H. Friji, H. Ghazzai, and Y. Massoud, "A Reinforcement Learning Framework for Video Frame-Bas ed Autonomous Car-Following," *IEEE Open Journal of Intelligent Transportation Systems*, vol. 2, pp.11 1–127, 2 021

Ni, K. Shen, Y. Chen, W. Cao, and S. X. Yang, "An Improved Deep Network-Based Scene Classification Methodfo r Self-Driving Cars," *IEEE Transactions on Instrumentation and Measurement*, vol. 71, pp. 1–14,2022

OrsYalcin, O. Demirci, and M. M. E. Soltekin, "Designing and Implementing Secure Automotive Network for Autonomous Cars," *2021 29th Signal Processing and Communications Applications Conference (SIU)*, 2020.

Seo, J. Lee, E. Baek, R. Horowitz, and J. Choi, "Safety-Critical Control With Nonaffine Control Inputs Via a Rela

Xed Control Barrier Function for an Autonomous Vehicle," *IEEE Robotics and Automation Letters*, vol. 7, no. 2, p p. 1944–1951, Apr.2022

Sajjad, M. Irfan, K. Muhammad, J. D. Ser, J. Sanchez-Medina, S. Andreev, W. Ding, and J. W. Lee, "An Efficient a nd Scalable Simulation Model for Autonomous Vehicles With Economical Hardware," *IEEE Transactions on I ntelligent Transportation Systems*, vol. 22, no. 3, pp. 1718–1732, Mar. 2021

Santaella, S. Rodriguez-Bolivar, L. Puga-Pedregosa, A. Gonzalez-Rico, M. Marin-Gonzalez, and F. M. Gomez-

Wang and D. Yin, "Design and Implementation of Vehicle Control System for Pure Electric Vehicle Based on AUT OSAR Standard," 2019 *22nd International Conference on Electrical Machines and Systems(ICEMS),*. 2019.

Biographies

N. Parimala is graduated in Electronics and communication engineering from Seethaiammal engineering college, Sivagangai district, Tamil Nadu state in 2009.She has earned post-graduation, M.E in computer science engineering from Anna University of technology, Tiruchirappalli district, Tamil Nadu state in 2012. Earned her post-graduation, Mtech in Electronics and communication engineering under the specialization of embedded systems from B V Raju institute of technology, Medak district, Telangana state in 2022. She has a working experience of Lecturer in Seethaiammal polytechnic college for 2 years. She worked as an Assistant professor in computer science engineering in Odaiyappa College of engineering and technology, Theni district for 1 year. She is more eminent person did her every of her graduation and the post-graduation projects under her own idea.

J.Ashok Kumar is graduated in Electronics and communication engineering from Paavai engineering college, Namakkal district, Tamil Nadu state in 2005. Earned his post-graduation, M.E in Electronics and communication engineering under the specialization of Applied electronics from Sathyabama University, Chennai district, Tamil Nadu state in 2010. He is a PhD scholar doing his research work under the specialization of 5G Antenna from NIT, Silchar, Assam State. Working as Assistant Professor in B V Raju Institute of Technology to Till date. He has 15 years of teaching experience and much interested in research work in Microwave and Antennas.

Dr.Sathish Addanki is graduated in Electronics and communication engineering from Anna University in 2007. Earned his post-graduation in embedded system technology Anna University in 2009. He has completed his doctorate in embedded systems technology from Madras University, Chennai in 2017. He has about ten years of teaching experience. He is a member of Indian Association in Engineering, also the member of international engineering and technology institute. He is working as an associate professor in B V Raju Institute of Technology.

Dr.N.Bhoopal is graduated in Electrical and Electronics, JNTU Anandhapur in 1997.Earned his post-graduation in power systems, Osmania University in 2004. He power and energy as has completed his doctorate in power and energy from JNTUH in 2012. He has about 20 years of working experience. He is a life member of ISTE, member of IEEE. He is a professor and Dean working in B V Raju Institute of Technology.