Turkish Online Journal of Qualitative Inquiry (TOJQI)
Volume 12, Issue 5, May 2021: 2232-2239

Implementation of Accident Avoidance Driving Assistance Systems for Hairpin Curves and Foggy Areas of Mountain Roads using Arduino

Kavitha P [a] , Niitha J [b], Prabhavathy D [c], Vanisha E [d], Ganesh Moorthy G [e]

[a]Associate Professor, Department of EEE, R.M.K. Engineering College, RSM Nagar, Kavaraipettai 601206.
[b,c,d]Final Year Student, Department of EEE, R.M.K. Engineering College, RSM Nagar, Kavaraipettai 601206.
[e]Manager, SH 120, Sriperumbudur, Kanchipuram, Tamil Nadu 602106

Corresponding author: [a]pkt.eee@rmkec.ac.in [b] niki17213.ee@rmkec.ac.in [c] prable181218.ee@rmkec.ac.in [d] vanile181222.ee@rmkec.ac.in

Abstract

Road safety is one of the foremost intentions on designing an accident avoidance driving assistance system. At the present time everyone needs to have an assurance of a safer transport system. The most dangerous roads in the world are mountain roads and curved roads with varying fog. Fog-related deaths are increasing as compared to the previous year. The main drive for car-to-car communication systems is safety and avoiding accidents due to collisions. The main objective of this project is to decrease the number of accidents taking place in hairpin bends and U turnings. The drivers of the vehicle were not able to see the other side view which caused accidents. In this paper a methodology is proposed to reduce these types of problems. It is mainly used to avoid accidents on hill stations because the driver is not able to see another side of the vehicle which is called blind spot. By using a signal and sensor based system, the movement of the vehicle is tracked by sensor and it indicates vehicle movement to the drivers using signal. This is done by alerting the driver by means of LED light which glows when a vehicle comes from the other side of the curve. Arduino is used for this purpose since it is a cheap and efficient controller.

Keywords: Fog; Road crash; Safety; hairpin bend, accident avoidance

1. Introduction

Accidents are undesirable happenings which lead to loss of life or destruction to property and belongings. Road accidents are the biggest reason behind such damage. There is a massive escalation in road accidents due to fast moving, low visibility due to dense fog, hilly roads, drink and drive and minor driving. Weather has an extensive and substantial effect on the roadway environment. Weather related accidents lead to bounteous costs in terms of fatal injuries and damage to property.[1-3]

The precarious roads in the world are either hilly roads, narrow curve roads, U turns, hairpin bends or T roads. The most risky mountain roads are very narrow and they have many curves and hairpin bends. The key issue in curve roads is that the other end of the curve road cannot be seen by the driver due to the obstacles like trees or rocks present in the middle which causes a number of accidents. Because of the presence of unexpected obstacles 2.3 million people die in India per year [4-9]. The main reason for the accident in the curve roads is

because drivers are not able to see the vehicle or obstacles coming from the other end of the curve. Due to very speed it is difficult to control the vehicle and chances of falling to the cliff increases.[10-17]

Fig.1 shows the hair pin bend road on a mountain. In this type of road the driver of the vehicle cannot see the vehicle which is approaching from the opposite direction.

Fig.1. Hair pin bend road

Generally horn is preferred to produce sound and to alert other drivers but in the raining seasons there is a minimum chance of hearing this sound. In order to astound these difficulties a sensor based automatic accident prevention system for mountain roads is proposed. [18-26]

Fig. 2. Foggy mountain road

Fog is recorded when its occurrence obstructs visibility stunningly. Fog formation is a natural process and its occurrence is observed when air chills down under its dew point. The difference between temperature and dew point is less than 2.5°C or 4.5°F. Fog is classified into two types namely Radiation Fog and Advection Fog. Fig.2 shows the hilly road covered with dense fog.

Here infra-red sensor is installed on one side of the road before the curve and keeping a LED light after the curve. IR sensor (obstacle sensor) sends signal in form of pulse. If a vehicle is passing, a signal hits the vehicle and then it is received by the sensor. During this time LEDs existing at the other side of the curve start glowing. In the absence of the vehicle the above process will not occur. The driver can reduce the speed of the vehicle when the LED glows and if it's needed he could even stop the automobile. This system is appropriate when the driver is unable to see the vehicle coming from the other end of the road. All the mountain roads and curve roads can become safer from accidents by this system application and thousands of lives can be saved. The necessity of this is, to aware the people regarding density of vehicles in the foggy area, to prevent the accidents due to fog and to control the traffic in case of accidents.

Fog is considered as a disturbing weather condition for driving, due to the density of fog enhances, the visibility distance drops down exponentially. It is difficult to framework fog areas that may be 100 km or more distant. The problem becomes more strenuous during night due to minor operating stations, thus increasing the probability of fog.

2. Methodology

Mountains are with the number of hairpin bends, which are very dangerous when compared to normal routes. Chances of accidents in ghat sections is more due to narrow roads, sharp bends, improper camber, valley side etc. To overcome this problem place an IR sensor on one side of the roads and alert the driver about the hitch or

vehicle in Ghat sections. When the signal is green it indicates that it is safe to take a turn since there is no vehicle coming in the opposite direction. These two IR sensors can give input to the Arduino and this Arduino will send data to the LED lights which directs the vehicle. Fig 3 is the flow chart to explain the working methodology of the proposed accident avoidance driver assistance system.

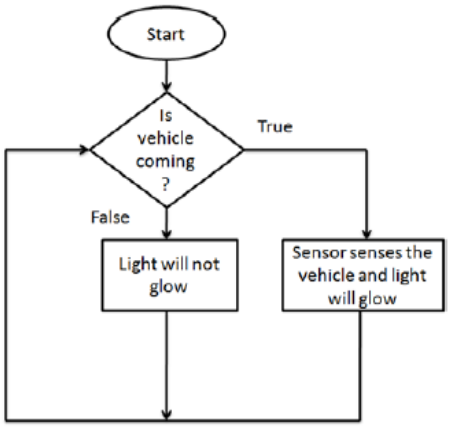

Fig.3 Flow chart for the proposed methodology

3. Components Required

Arduino UNO

The Arduino Uno is a microcontroller board used to insert the code as input using USB and can get the desired output. This platform comprises a physical programmable IDE that runs on a computer, used to mark and upload code to the board. The ATmega328 on the board comes pre-programmed with a boot loader that permits uploading new code to it without the use of an outside hardware programmer. Arduino board design uses a mixture of microprocessors and controllers. The boards are set with digital and analog input/output (I/O) pins that may be interfaced to a choice of development. It can be programmed using C and C++ programming languages. The Arduino board is shown in Fig. 4

Fig. 4. Arduino board

IR Sensor

Infrared sensors are used as proximity sensors which are passive or active. Passive infrared sensors are basically IR detectors. These sensors are not using IR source and detects energy released by hindrances in the view. The active IR sensors contain two elements which are IR source and IR detector. IR source a laser diode and detectors include photodiodes or phototransistors. The energy emitted by source is mirrored by an obstacle and falls on the detector. Based on the force of the reception by the IR receiver, the output of the sensor is defined. The IR transmitter and receiver is shown in Fig 5.

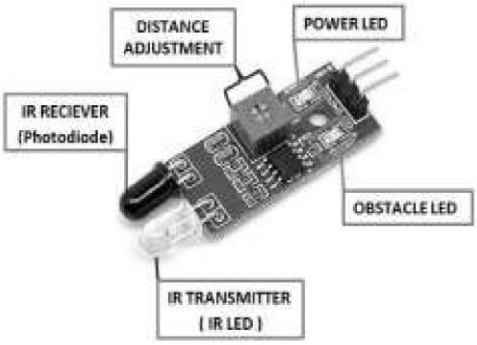

Fig. 5. IR Transmitter and receiver

LED Lights

A Light Emitting Diode (LED) is an electronic device of a semiconductor source that emits light when an electrical current is passed through it. The early LEDs are to produce only red light, but the current LEDs can produce several different colours, including red, green, and blue (RGB) light. The recent advances in LED technology have made it probable for LEDs to produce white light as well. LEDs are generally used for indicator lights (such as power on/off lights) on electronic devices. They also have few other applications, with electronic signs, clock displays, and flashlights.

Fig. 6. LED of different colours

4 Working Principle

This paper proposes an unsophisticated Scheme to avoid accidents in hairpin bends on a hilly track or zero visibility turns using proximity sensors. It uses two IR sensors, which are placed on one side of the hairpin bend. These two IR sensors are sensed by the side of the downhill section of the road. The sensors are mutually exclusive and are connected to ATmega328P microcontroller through wires. Based on the output of sensors, position of vehicles on the other side of the bend is detected which is provided as an input to the microcontroller. The microcontroller which works on a power supply of 9V runs a Priority algorithm which triggers the warning LEDs to glow and thereby intelligently controlling the movement of vehicles at the bend. Warning LEDs are placed at the side of the uphill section of the hairpin bend.

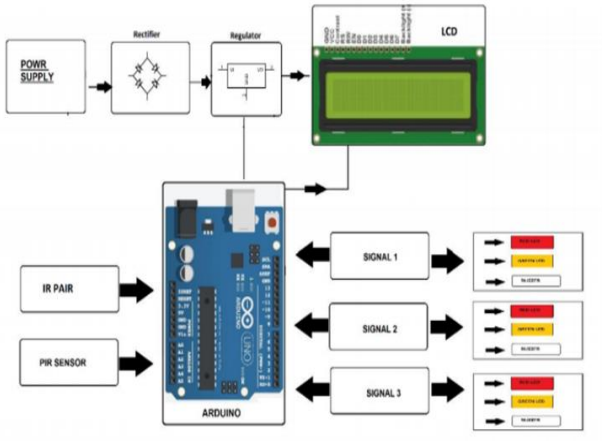

Fig.7. Block diagram of proposed system

5. Experimentation And Results

The coding of Arduino UNO which is a set of commands to process the data from the sensor and to activate the LED. The connection of sensor, LED and Arduino UNO where the sensor senses the vehicle and the Arduino UNO operates LED according to program output. Next to this step the analyzing, debugging and running of the program is carried out. Once this process is completed the program is embedded to Arduino UNO. The output is the distance between two vehicles. Final step is making of hardware model which includes fixing of Arduino UNO, IR sensor and LED light to the model of curve road as shown in fig 5 where the blue line indicates the road side, yellow blocks indicates the IR sensors, pink color dots indicate the traffic signals and the grey color indicates the road. The sensor detects when the vehicle passes through the road by sensing the received signal.

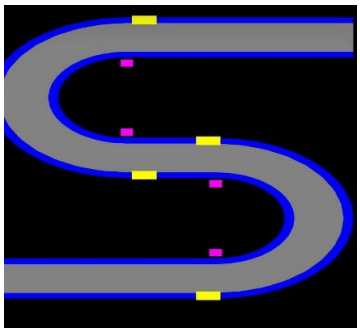

Fig. 8 Prototype of the hairpin bend road

It is an experimental demonstration. The output is obtained by glowing the LED when the signal is received by the sensor after reflecting back from the vehicle. The experimental implementation is performed productively and result of glowing Led is obtained and sensor based accident prevention driver assistance system is ready to perform its expected task and accomplishes the main objective.

Fig.9 Prototype of the accident avoidance system

Case A:If no Opposite vehicle exists:

Here no vehicle is coming from the opposite direction (b) so the buzzer and the indication signal at point b flashes green. So this says that the vehicle is safe to make a turn . Since the vehicle is coming from point (a) the indication is red and since this is one vehicle case the buzzer is in off condition which is shown in Fig. 6.

Fig.10. No vehicle in the opposite direction

Case B: If Opposite vehicle exists:

Here two vehicles are approaching each other and this is the condition where the alarm rises and since at both the ends, the indication lights are turned red here it prevents both the vehicles without being hit which is given in Fig. 7.

Fig.11. Vehicle in the opposite direction

The observation made from the prototype is given in the table 1 below. Various conditions of the vehicles passing the road and the status of LED and buzzer are discussed in Table 1.

Table 1. Signal and buzzer conditions

Vehicle	Signal and buzzer			
	A	B	C	D
No car in either side of the road	Off	Off	Off	Off
one car in Curve A signal A direction	Off	On	Off	Off
Two car in Curve A in opposite direction of signal A&B	On	On	Off	Off
one car in Curve A signal B direction	Off	Off	On	On

Two car in Curve B in opposite direction of signal A&B	On	Off	Off	On

6. Conclusions

An intelligent road safety system for accident avoidance driving assistance systems for hairpin curves and foggy areas of mountain roads using Arduino had successfully been designed and developed. This can be implemented very easily in real life situations. With the help of an early warning system and the indication system the accidents can be reduced. The proposed system helps to overcome the problems due to weather affected and hairpin bend in the mountain track. The system has to be employed in all the vehicles in the real time for the above cited perceptions. Based on the methodology mentioned, the prototype was tested and implemented. In future, the voice message can also be added to alert the drivers instead of just LCD display.

References

[1] J. B. Edwards, "The Relationship between Road Accident Severity and Recorded Weather", Journal of Safety Research, vol. 29, no. 4, pp.249–262, 1998.

[2] S. Roy, R. Bose, D. Sarddar, "A Fog-based DSS model for Driving Rule Violation Monitoring Framework on the Internet of Things", International Journal of Advanced Science and Technology, vol. 82, pp. 23-32, 2015.

[3] M. Abdel-Atya, Al-Ahad Ekrama, H. Huang, K. Choi, "A study on crashes related to visibility obstruction due to fog and smoke", Accident Analysis and Prevention, vol. 43, pp. 1730– 1737, 2011.

[4] M. Colomb, K. Hirech, P. André, J.J. Boreux, P. Lacote, J. Dufour, "An innovative artificial fog production device improved in the European project FOG", Atmospheric Research Journal, vol. 87, pp. 242–251, 2008.

[5] J. P. Tarel, N. Hautiere, A. Cord, D. Gruyer, H. Halmaoui, "Improved visibility of road scene images under heterogeneous fog", Intelligent Vehicles Symposium (IV), 2010 IEEE, pp. 478-485, June 2010.

[6] S. Roy, R. Bose, D. Sarddar, "A Fog-based DSS model for Driving Rule Violation Monitoring Framework on the Internet of Things", International Journal of Advanced Science and Technology, vol. 82, pp. 23-32, 2015.

[7] T. Tan, N. Pettersson, L. Petersson, "Visibility Enhancement for Roads with Foggy or Hazy Scenes", proceedings of the IEEE Intelligent Vehicles Symposium, Istanbul, Turkey, pp. 19-24, June 2007.

[8] N. Hautiere, J.-P. Tarel, and D. Aubert, " Mitigation of visibility loss for advanced camera based driver assistance", IEEE Trans. Intell. Transport. Systems, vol. 11, no. 2, pp. 474-484, June 2010.

[9] Jessen Joseph Leo., R. Monisha., et.al. "Vehicle movement control and accident avoidance in hilly track", IEEE Int. Conf. on Electronics and Communication Systems (ICECS).pp. 1-5 2014.

[10] Wegman, "The future of road safety: A worldwide perspective," IATSS Research, vol. 40, no. 2, pp. 66–71, 2017.

[11] R. Gallen, A. Cord, N. Hautiere, D. Aubert, "Towards night fog detection through use of In-vehicle multipurpose cameras", 2011 IEEE Intelligent Vehicles Symposium(IV), Baden-Baden, pp.399- 404, 2011.

[12] Deeksha ashutha K. Aravinda B, Chaithra lakshmi C. "Sensor based accident prevention system", International Journal of Computer Applications, pages 36–39, 2012.

[13] S. Kumar, D. Toshniwal, "Analysis of hourly road accident counts using hierarchical clustering and cophenetic correlation coefficient (CPCC)", Journal of Big Data, vol. 3, no. 13, July 2016.

[14] A. S. Mueller, L. M. Trick, "Driving in fog: The effects of driving experience and visibility on speed compensation and hazard avoidance", Accident Analysis and Prevention, vol. 48, pp. 472-479, 2012.

[15] M. Pavlic, H. Belzner, G. Rigoll, S. Ilic, "Image based fog detection in vehicles", Intelligent Vehicles Symposium (IV), 2012 IEEE, pp.1132-1137, June 2012

[16] S. Bronte, L. M. Bergasa, P. F. Alcantarilla, “Fog detection system based on computer vision techniques”, 12th International IEEE Conference on Intelligent Transportation Systems, pp. 1-6, 2009.

[17] M. Berman, J. Liu, L. Justison, “Fog Detection and Warning System”, White Paper, ICX Technologies, 2009. ‘

[18] S. Jeevan, L. Usha, “Image Based Visibility and Speed Estimation under Fog Condition”, International Journal of Engineering Research in Electronic and Communication Engineering, vol. 3, no. 5, May 2016.

[19] Yan X., Li X., Liu Y., Zhao J., 2014. Effects of foggy conditions on drivers’ speed control behaviors at different risk levels. Beijing Jiaotong University, Beijing 100044, China.

[20] Bullough, J. D., & Rea, M. S. (2016). Impacts of fog characteristics, forward illumination, and warning beacon intensity distribution on roadway hazard visibility. The Scientific World Journal, 2016

[21] M. Syedul Amin, J. Jalil, and M. B. I. Reaz, ‘‘Accident detection and reporting system using GPS, GPRS and GSM technology,’’ in Proc. Int. Conf. Informat., Electron. Vis. (ICIEV), May 2012, pp. 640–643.

[22] P. Berade, K. Patil, P. Tawate, M. U. Ghewari, ‘‘Intelligent accident identification and prevention system using GPS and GSM modem,’’ Int. Res. J. Eng. Technol., vol. 5, no. 2, pp. 1915–1919, 2018

[23] D. B. Tushara and P. A. H. Vardhini, ‘‘Wireless vehicle alert and collision prevention system design using atmel microcontroller,’’ in Proc. Int. Conf. Electr., Electron., Optim. Techn. (ICEEOT), Chennai, India, Mar. 2016, pp. 2784–2787.

[24] U. Patil, P. More, R. Pandey, and U. Patkar, ‘‘Tracking and recovery of the vehicle using GPS and GSM,’’ Int. Res. J. Eng. Technol., vol. 4, no. 3, pp. 2074–2077, 2017.

[25] Li, C., Feng, H., Zhi, X., & Zhao, N. “Intelligent guidance system for foggy area traffic safety operation”. 14th International IEEE Conference on Intelligent Transportation Systems (ITSC), pp. 428-432. 201.

[26] McCann, K., & Fontaine, M. D. (2016). Assessing driver speed choice in fog using visibility data from road weather information systems. In Transportation Research Board 95th Annual Meeting (No. 16-1866)