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International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Multi Sensor Based Vehicle Control and Safety System

G. Sanjay Kumar[1], Y. Jagadish[2], M. Vasu[3], Ch. Sai Kumar[4], M. Kartikeya[5], U. Sai[6]

UG Students[2,3,4,5,6], Dept. of Mechanical Engineering, GMR Institute of Technology, Rajam.
Assistant Professor[1], Dept. of Mechanical Engineering, GMR Institute of Technology, Rajam.

ABSTRACT

Now a days robots are used in different industries as they have high degree of performance, that is helpful for the society. For the purpose of identifying obstacles and preventing collisions, there is an obstacle avoidance system. Using various sensors, the robot gathers data from the surroundings. For example, some sensors like infrared sensor, ultrasonic sensor, and other sensors are utilized for identify obstacles. Most effective sensor for detecting obstacles is an ultrasonic one, which is also inexpensive and capable of great distances. After the first level of alert, if the driver's condition doesn't alter, the vehicle's speed progressively decreases and it stops moving. The majority of accidents in hilly regions happen because the driver is in a panic over what to do when the car is about to tumble off the edge of the ghat roads. To avoid such occurrences, the edge detection system is helpful. The IR sensor is able to track and quantify the distance between the road and the vehicle's chassis continually thanks to this technique. When the predetermined distance is surpassed, the sensor initiates the safety protocol, causing the vehicle to immediately stop and turn around in order to prevent rolling down a hill.

Keywords- *Ultrasonic sensor, Eye blink sensor, infrared sensor, Arduino UNO*.

1. INTRODUCTION

Reducing accidents is one of the main issues globally because of the quick increase in the number of cars and their efficient users. A significant portion of deadly traffic accidents are caused by driver inattention, sudden obstacles, and a vehicle that cannot be controlled on ghat roads. About two million people were engaged in car accidents because they were sleepy, and a poll by the National Sleep Foundation (NSF) found that 105 million people had their driving privileges revoked because of sleepiness. The goal of the project is to create a safe vehicle that moves utilizing eye blink, infrared, and ultrasonic sensors. In order to carry out the requested operation, an Arduino uno is utilized. Robots are machines that can carry out tasks on their own. Most of the time in robotics, physical devices and computational intelligence are combined (motors). One aspect of computational intelligence is the usage of preprogrammed instructions. The concept recommends creating a robotic vehicle with intelligence that can self-direct if there is a barrier in its way. This robotic vehicle was built using an Arduino Uno. An ultrasonic sensor, which uses sound waves to identify any obstructions in its route, transmits a command to the Arduino. Autonomous intelligent robots are those that can carry out desired activities in unstructured environments without continual human supervision. Obstacle detection is a critical requirement for this autonomous robot. The robot can gather information about its environment thanks to the sensors that are mounted on it.

A multi-level, real-time, non-intrusive, and non-obstructive practical warning system for tracking driver attention is described in this paper. The technique uses a number of in-wheel sensors to track changes in earlier cars. Data from sensors and the distance between the vehicle's chassis and the road are combined, analysed, and processed to produce information on the level of driver drowsiness. If the driver is assessed to be drowsy, if there is a barrier in the path, or if the vehicle starts to deviate off the road, the system will sound an alarm. After getting the first level warning, if the driver is still drowsy, the car will stop moving. In other situations, such as when there is a barrier in the way, the car stops, looks for a movable path, and then drives on in that direction. The sensor starts a safety protocol and shifts into reverse when a vehicle suddenly veers off the road or appears to be about to fall off a steep road. This action continues until the car is fully back on the road. The number of deaths from traffic accidents is decreased by the vehicle's safety measures. The Arduino code is what drives the sensors to function. There will be unique codes for each sensor that are used for that sensor's specific purposes. The sensors are connected to the Arduino via jumper wires. Simple specified conditions are used as the basis for the programming. The sensor measures the distance and sends the information to the Arduino, which compares the collected results to the preset values and instructs the vehicle system.

1.1 Past Studies:

The major objective of this model is to create an autonomous car that can recognise signs of driver weariness and control the vehicle to avoid any accidents. An IR sensor for detecting driver blinks and an adaptive speed controller with stepper motors for accurately positioning the throttle valve to manage any vehicle's speed are the two main components of the system.[1] (Ganesh N. Khare et.al). The project displays a drowsy driving detection and alert system with a buzzer and eye blink sensors. Automobile accidents are also identified using a system for SMS alerts to user-defined emergency or cell numbers. In the field of embedded systems, connections based on GSM alerts are developed and implemented. The proposed Automobile Accident

Detection and relating accident sends an SMS alarm. [2] (Dr. Madhu B K et.al). The automatic system's maximum accident reduction was achieved while using the adaptive system because it was able to better balance safety with the driver's awareness of and ability to avoid hazardous situations.[9] (Hirleka, S et.al). The observed collision will occur in one second or less because it takes between 0.3 and 0.4 seconds to practically generate the automatic action. If not, it is presumed that a warning generation approach will be engaged. The velocity window problem can be overcome when real-time collision avoidance control is used instead of the dynamic window method. [5] (Wang.J et.al). The findings demonstrated that including visual and physiological characteristics enhanced the specificity and accuracy of accident prediction to avoid vehicle collisions. Results demonstrated that using drivers' risky states as inputs increased the accuracy of crash prediction.[11](Al-Nsairat, M et.al). This time, the wheeled robot is being created with better safety, intelligence tracking, and obstacle avoidance in mind. The system's full functionality, including the software and hardware, has also been realised. This system will be very important and act as an invaluable standard for ongoing research and the development of the smart car industry. Additionally, it offers validation and practicality for the eventual realisation of unmanned intelligence.

This project is intended to achieve the following objectives:

1. The creation of an affordable car that uses embedded technology to detect the driver's slumber.
2. To create a car that will automatically warn the driver when something impeding their path (such a wall, a vehicle, or a person).
3. To create a system that will take control of the car if it begins to go off a hill or off the road.

1.2 The Existing System:

1) Collision Avoidance System: The car will stop in its current position if there is a possibility of a collision, according to previous test results (obstacles present in front of the vehicle). Without giving the driver any warning, it pulls up to the stop position instantly. A collision avoidance system's primary flaw is this.
2) Drivers Sleep Detection: Based on the past papers, it is known that the sensor detects the changes in the eye. While the eye is open, IR rays travel through the eye. If the eye is closed, the sensor sends a signal to the wheels and a buzzer if the eye is closed for a lengthy period of time. The vehicle immediately stops after a few minutes considering that the driver has fallen sleep. The buzzer sound helps in intimating the driver about the sleeping. If the driver doesn’t wake up the vehicle stops.
3) Edge Detection: Based on the previous studies the edge detection helps in preventing the vehicle falling from the hills or ghat roads. The sensor identifies that there is no road in front of the vehicle then the vehicle immediately stops and takes a backward up to the safe distance helps in preventing the accidents.

1.3 The Proposed System:

The suggested system combines an edge detection system, a collision avoidance system, and a sleep detection system. The suggested systems improve the car's performance and accident prevention precision. This device warns the driver of impending impediments so that he can take appropriate action. This technology lowers the amount of time the car must stop by using automatic diversion rather than abrupt stopping. The car will stop automatically to prevent a collision if there is insufficient space between it and the obstruction and there is no chance for a detour. The sensor recognises when the driver nods off and emits a buzzer sound to let them know they are dozing. If the distance between the road and the car's chassis is greater than it should be, the edge detecting system alerts the driver, and the vehicle promptly shifts into reverse and retreats to a safe distance.

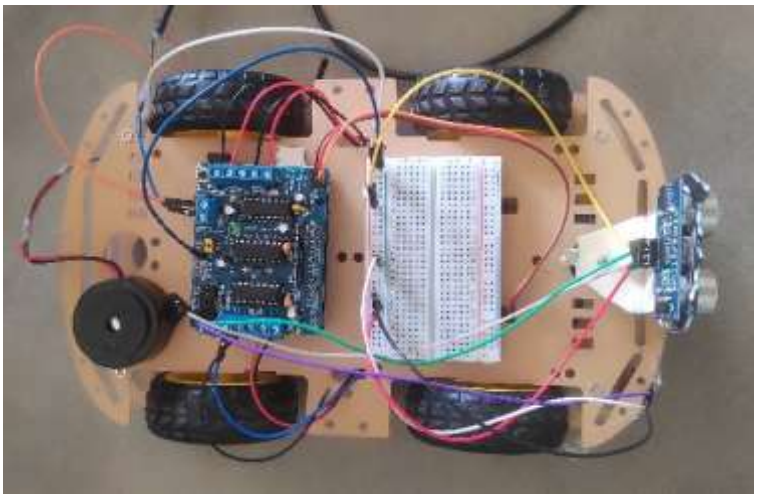

Figure 1: Fabrication of vehicle

2. METHODOLOGY:

The system's design, which was created during the project's design phase and needed to be properly implemented during the project's implementation, is shown in the figure. The growing use of autonomous technologies in cars has proven to be economical. The proposed system has an effect on the automotive sector and has the ability to revolutionise autos. As a result, this project has been an expert- or non-expert-based system-based strategy to monitoring the roads for obstructions and taking appropriate action. The complete process that makes up the system is described by the methodology used in this project. It entails identifying the issue and gathering information in accordance with it. An integrated circuit is created after researching each system. An algorithm is being created for the project. The code is created in embedded C and validated in the Arduino IDE programme before being uploaded to the Arduino UNO in accordance with the procedure. After that, check to see if the fabrication is operating properly. The project is then put to the test, and the outcomes are analysed.

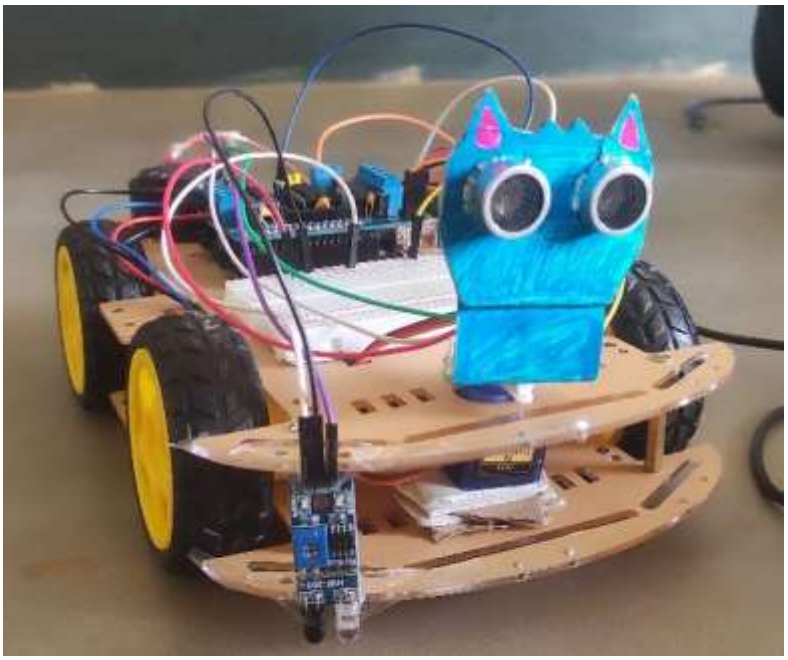

Figure 2: Vehicle with IR and UR sensors.

3. FABRICATION:

The design of the circuit is shown in figure:1 which gives a brief idea about the components used and how they are connected.

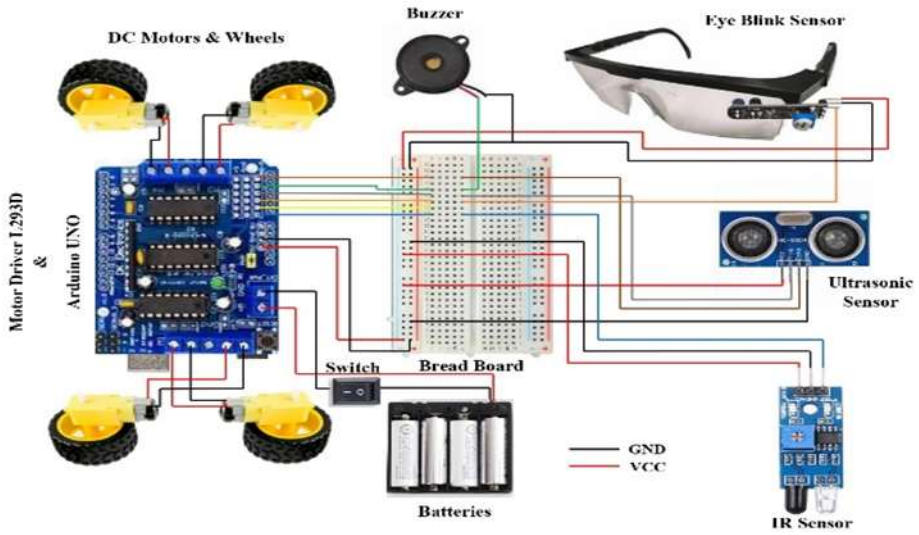

Figure 3: Circuit Diagram of the system

Connections:

- Connecting ultrasonic sensor to Arduino:
  - Trig pin to A3
  - Echo pin to A5
  - VCC to VCC
  - GND to GND of Arduino
- Connecting eye blink sensor to Arduino:
  - VCC to VCC
  - GND to GND
  - OUT to A2
- Connecting IR sensor to Arduino:
  - VCC to VCC
  - GND to GND
  - OUT to A0
- Connecting buzzer to Arduino:
  - Connect the +ve terminal of the buzzer to A4
  - The –ve terminal to the GND of Arduino.

3.1 Algorithm for the Code:

Obstacle Avoidance:

- Step-1: START
- Step-2: DECLARING THE VARIABLES(PINS)
- Step-3: void setup() initialization of code variables and library references
- Step-4: void loop()

This feature actively manages and watches over the Arduino while repeating the commands.

- Step-5: if (distance in cm>15)

Vehicle moves

- Step-6: else if (distance in cm>=10 && distance in cm<=15)
- Step-7: The servo motor integrated with ultrasonic sensor calculates the distance in both left and right directions.
- Step-8: If (R>L)

Then the vehicle moves in right direction.

- Step-9: else If (L>R)

The vehicle moves in left direction.

Sleep Detection:

- Step-1: START
- Step-2: If (distance in cm>350)

Vehicle moves forward

- Step-3: else If (distance in cm < 350)

Eye is closed

Vehicle gives a delay for 4000ms.

- Step-4: if driver not responding the vehicle gives a buzzer sound.
- Step-5: Vehicle STOPS.

Edge Detection:

- Step-1: START
- Step-2: If (distance in cm>50)

Vehicle moves forward

- Step-2: else If (distance in cm < 50)

Vehicle stops and moves backward

- Step-3: Vehicle moves left backward and stops.
- Step-4: STOPS

4. RESULTS AND DISCUSSION:

If the driver nods off, the system alerts him or her audibly. The vehicle will automatically veer left or right as it gets close to an object or obstruction. The driver is spared if the car autonomously reverses to a stop position up to a safe distance if the gap between the chassis and the road is greater than.

The system is tested over a range of distances that are stated in tables and displayed in the serial monitor of the Arduino IDE software. Information regarding the system's performance at various distances is provided in the tables below (distance between vehicle and object).

Table-1: Distance and vehicle movements analysis in obstacle avoidance

S.No	Distance (cm)	Left Distance (cm)	Right distance (cm)	Straight distance (cm)	Left Wheels	Right Wheel
1.	>15	0	0	>15	Clock wise	Anti clock wise
2.	<15	<15	0	<15	Stop	Clock wise
3.	<15	0	<15	<15	Clock wise	Stop

Table-2: Distance and vehicle movements analysis in edge detection

S. No	Detection	Forward	Buzzer	Stop
1.	No	Yes	No	No
2.	Yes	Yes (Delay 4000ms)	Yes	No
3.	Yes	No (> 4000ms)	Yes	Yes

Table-3: Distance and vehicle movement analysis in sleep detection

S. No	Distance(mm)	Forward	Backward	Right
1.	>350	Yes	No	No
2.	<350	No	Yes	Yes

5. CONCLUSION AND FUTURE SCOPE:

The project probably needed a lot of labour overall and required knowledge in a variety of fields, including mechanical engineering, electronics, and software development. By creating and testing this system, we were able to contribute to the creation of new technologies that will eventually help make cars safer and more efficient. In conclusion, the technology marks a significant advance in the creation of automated safety systems for automobiles. The

effort is proof of the ability of engineering and technology to better our world, and the system that was planned and constructed may be able to save lives and prevent accidents. Certainly! The project's future potential for designing and manufacturing an autonomous diversion system for cars with collision avoidance and warning systems is quite encouraging. Several prospective directions for future study and advancement are listed below:

1. Integration with other safety systems: The project's main objective was to develop a collision-avoidance and warning system with an autonomous diversion system. In the future, you can consider integrating this system with other safety features like lane departure warning or blind spot identification..
2. Improving accuracy and reliability: Accuracy and dependability are crucial in any safety system. You might look into ways to enhance the precision and dependability of your system, including employing more sophisticated sensors or enhancing the algorithms that are used to identify probable collisions.
3. Scaling for different types of vehicles: Maybe one particular kind of vehicle was the project's main focus. In the future, you might think of scaling the system for usage in various kinds of automobiles, such commercial trucks or buses.
4. Real-world testing: The system was probably put through a lot of testing throughout the fabrication process, but more testing and validation in actual conditions could assist to improve the system and make sure it functions well in a variety of circumstances.
5. Commercialization: Thirdly, it may take into account how profitable the system might be. It might be sold to automakers or other businesses working on the creation of automated safety systems for automobiles with more research and improvement.

Overall, the project has the potential to open new doors for innovation and continued advancement in the area of automated vehicle safety systems. There are numerous intriguing opportunities for more study and development, and the project's future potential is very broad.

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