Collision Detection and Avoidance System (CDAS)

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***Abstract-* Population growth is the major cause in rise in pollution and accidents. Among the main factors responsible for fatalities is vehicle collision. Driver inattention, distraction, irresponsible driving, and other factors, all lead to collisions. Accidents can occur accidentally and occasionally at random, but typical reason is unanticipated obstructions in the way of travel. In this study, the use of an ultrasonic sensor by a vehicle to identify and prevent impending collisions was thus discovered. The main objective is to swiftly locate situations that may lead to potentially fatal collisions. This study focuses on creating a model of rear-end car collision avoidance system that uses a microcontroller to determine the distance between vehicles m in the moving in same lane same direction then warns the driver. An ultrasonic sensor is utilised to measure the gap after experiencing the obstruction first, after that if the driver don't maintain the bare minimum distance of safety, it will reduce the vehicle's speed. As a result it will prevent a crash from taking place. Because of their low price and high efficiency, these systems are easily attainable and can be used to avoid collisions.**

Keywords-Ultrasonic sensor, Collision detection and avoidance system (CDAS)

I.INRODUCTION

Throughout the past twenty years, the activity taken for car's safety frameworks has changed. Seatbelts, airbags, knee bolsters, crush zones, and other character passive devices and functions were initially used for saving the lives and minimizing accidents when a twist of fate happened. Eventually, safety measures like improved vision, headlights, windscreen wipers, tire traction, etc. have been implemented to reduce the likelihood of encountering an unfortunate circumstance. We are now in the stage of actively preventing collisions and offering the highest level of protection to the passengers of cars and even pedestrians. The systems which can have severe improvement mainly consist of collision avoidance systems. The amount of traffic on the roadways is getting worse, and accidents are happening more frequently. One of the main reasons for fatalities and injuries in road accidents is vehicle collisions. Accidents still happen as a result of driver mistake, vehicle problems, and other circumstances, despite numerous safety features and laws.

By collecting and analyzing speed-related data broadcast to a base station, the proposed system easily adapts for speed control [1]. Ultrasonic sensors for obstacle detection and GPS/GSM for location and accident avoidance can be added to a successfully validated car monitoring system with autonomous hardware operation using embedded C programming [2]. A wireless sensor network and a symmetric double-sided two-way ranging algorithm are used in the proposed model for real-time vehicle speed tracking to eliminate clock drift between the transmitter and receiver [3]. Given the potential for political opposition from the auto industry to adoption, ISA suggested that the significance of early standardization efforts be stressed. [4]. Autonomous braking and adaptive headlights are the most practical technologies, which are increasingly present in new automobiles and have developed a secure vehicle system, according to a study [5]. A system for detecting and monitoring vehicles on the road that are a substantial source of air pollution utilizing RFID tags fitted with gas sensors [6]. An "Automated Control System" was implemented to recognize and notify drivers of vehicle pollution levels. Using a smoke sensor, transducer, and MQ7 sensor to measure CO concentration, the system creates a safer environment [7]. a programmer that uses an SMS-based accident locator to automatically find accidents. The Haversine algorithm is employed to identify a hospital around the accident scene [8]. developed an intelligent system that focuses on post-accident reporting and detection. The GPS, GSM, and flex sensor module used to create the prototype [9]. Using GPS data and a map matching algorithm, the car's location on the road is determined. Here, speed comparisons are performed at 0.1 second intervals. Many accident victims benefit from this approach. [10]. Introduced a strategy by positioning the interrogator in the street and only reading license plate tags. A prototype discoed-shaped antenna is developed to meet the requirements of the in-road reader and a microwave sensor is employed [11]. creating an accident detection, navigation, and reporting system using the internet of things, deployed in three stages: vehicle registration, passenger registration, and web-based accident monitoring. The prototype makes use of several sensors [12]. employed methods for digital image processing to correctly calculate truck capacities depending on vehicle length. Without the need of complex calibration techniques, they able to achieve an accuracy rate of 92%. [13]. built the VVDC truck data collection system, achieving 97% accuracy in length-based truck categorization. However, difficulties arise due to camera movement, headlamp reflections, and vehicle obstruction. [14].

Assessment of video-based vehicle classification methods emphasized their benefits while also pointing out problems that needed to be fixed and emphasizing the need for better algorithms [15]. Created a method to improve overall efficiency in video-based

traffic monitoring by detecting moving cars and removing cast shadows [16]. Vehicle classification involved segmenting the vehicle region from video images and calculating moment-invariant characteristics. These features were then transmitted to a BP neural network, which used them to categorize the type of vehicle [17]. The three steps of the vehicle classification procedure were region extraction, tracking, and classification. They employed metric-based categorization, geometric parameter application, and background subtraction [18]. creating a yaw rate controller for an independent in-wheel motor vehicle. A PID controller was utilized to manage the lateral acceleration [19] (2007). A slip controller for a 5-DOF EV with in-wheel motors was created using a nonlinear model predictive controller (NMPC), it avoids wheel lock-up on low friction roads during acceleration and braking. [20] (2015). used Mecum wheels and brushless DC electric motors to create a teleoperated Omni-directional compact UGV. The UGV permits movement in several directions [21] (2013).
Using motors with a PID controller for speed control, created a driving system for EVs. For online tweaking of the PI controller parameters, addition of neural network to boost efficiency and significantly cut down on errors was done [22] (1993).

Key finding-
1. Ultrasonic sensors were effective at spotting and preventing probable collisions.
2.Incorporating different other components, such as a combination of lidar, radar, and cameras, can improve or enhance the result.

II. OUR APPROACH

1. Choose a suitable ultrasonic sensor from the market's selection: You should pick the ultrasonic sensor that best meets your unique needs. Aspects including detecting range, precision, and power consumption should be taken into account.
2. Install the ultrasonic sensor: The sensor needs to be set up such that it can detect things in the path of the moving vehicle. If you're creating a collision detection system for a car, for instance, you might install the sensor on the front bumper.
3. The ultrasonic sensor should be connected to a microcontroller since it normally produces a signal that changes depending on how close an object is near the sensor. You must attach the sensor to a microcontroller that can recognize this signal and make use of it. Popular microcontrollers for this application include Arduino.
4. Creating the software: The collision detection system's software typically follows three key steps: a) setting off the ultrasonic sensor to emit a sound wave; b) timing the amount of time it takes for the sound wave to return from an object; and c) using the measured amount of time to determine the item's distance. To continuously monitor the environment and identify any potential collisions, this process is performed at regular intervals.
5. Once you get the distance data, you must put the collision detection logic into practice. This can entail establishing a distance beyond which a collision is deemed probable and setting off an alarm or an emergency stop device.

Our implementation plan:
Our first step is to connect the Arduino Uno CH340 to the computer. Next, we take the Motor Driver Shield L392D and attach it to the Arduino board that we are using. The four DC motors were connected to the motor driver shield, and the servo motor was connected to one of the servo motor pins on the Arduino. After completion of other connections attach the ultrasonic sensor to the Arduino's proper pins. Configuring the appropriate software libraries for the motor driver shield, servo motor, and ultrasonic sensor would be done following the first stage of establishing hardware connections. As examples, consider the AFMotor library for managing DC motors and the Servo library for managing servo motors. Once the libraries are set up, initialize the driver shield, DC motors using the AFMotor library, and servo motor using the Servolibrary. Now, in order to detect collision, an ultrasonic sensor comes into use. First, the distance between the automobile and the obstructions is determined. After it attains the required data, read the sensor values and calculate the distance. To tell if an obstruction is inside the danger zone, establish a threshold distance. The method to prevent this potential collision now occurs after any obstruction is discovered. The system for avoiding collisions is activated. If the distance drops below the threshold, the ultrasonic sensor rotates while being examined by a servo motor. Making the right action selection to avoid the barrier based on the sensor readings on to steer the car away from the obstruction, relevant DC motors are turned on. Designing a control system that bases decisions on sensor data is now required for all these things to occur (i.e. collision detection and avoidance).by taking into account elements including vehicle speed, direction, and the distance between obstacles. Put control logic into place to handle various situations (such as turning, halting, and reversing). • Once the hardware configurations, addition of the appropriate libraries, and uploading of the code to the Arduino to detect and prevent collisions while taking into consideration various parameters have been completed, it is time to test the collision detection and avoidance system in a controlled situation. After gathering relevant data, analyze the performance of the system and make any necessary improvements. For better precision, fine-tune the sensor calibration and control algorithm. Integrate the system into the car after it is operating properly. Verify the security and dependability of every connection. Set the system's validation parameters for real-world use.

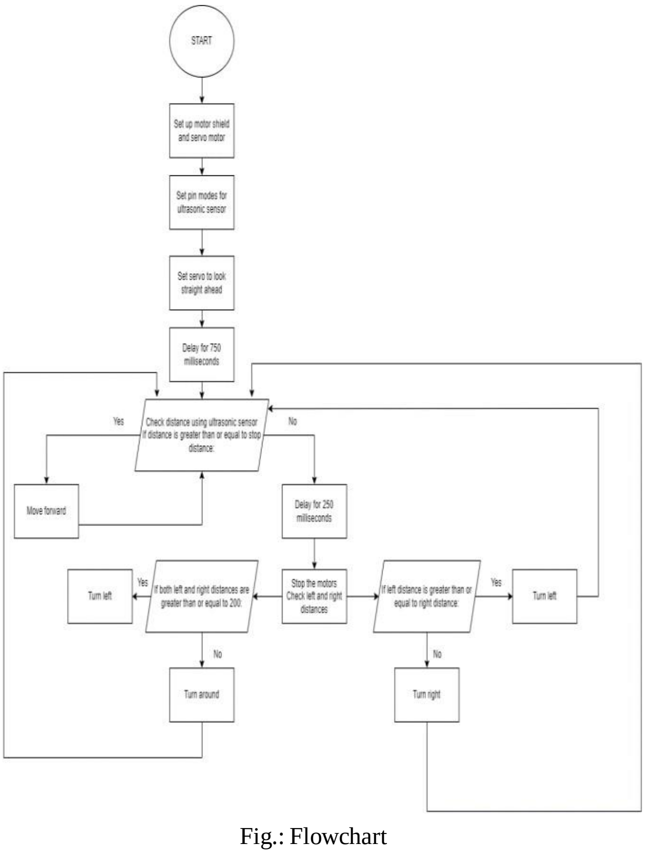

Fig.: Flowchart

III. DESIGN

Design parameter-

Sno.	Name of material	Specifications
1	Battery	Voltage - 9V Weight - 37g
2	Car frame	Weight - 185.6g
3	HC-SR04 ultrasonic sensor	Working voltage - DC 5V Working current - 15mA Working Frequency - 40 Hz Min. Range - 2cm Max. Range - 4m
4	Wheels	Diameter: 35mm Width 28mm
5	DC Gear Motor	Operating Voltage : 3.0 V – 6.0 dc Current: (No load) : 3V-150mA, 6V – 200mA Speed: (No Load) : 3V – 90rpm, 6V -200rpm Torque: 0.8kg*cm Weight: 13.7 grams
6	Arduino Uno CH340	Atmega 328 microcontroller Operating voltage: 5V Clock Speed: 16Mhz Flash Memory: 32 kb 14Digital I/O Pins 6 Analog Input Pins DC Current per I/O Pin: 40Ma
7	L293D Based Arduino Motor Shield	Control 2 Servos Logic Control Voltage VSS:4.5-5.5V Motor Supply Voltage VSS:15v Drive operating current-IO:1.2A 8 Stage Serial Shift Register
8	Servo Motor	Voltage:4.8 Volts Item Dimensions L*W*H: 50 x 50x 50 Millimeters
9	Jumper Wire	As per requirement

Fig.List of design parameter

Implemented hardware setup

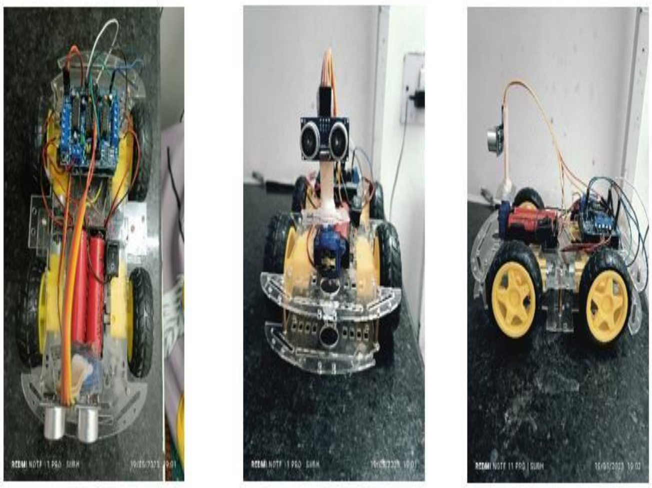

Fig.Hardware setup

IV. CONCLUSION

In conclusion, the use of ultrasonic sensors in a collision detection and avoidance system is a successful method of avoiding collisions. The obstacle detection and reaction capabilities of the system were adequate in terms of accuracy and speed. The system, however, has some restrictions, and the environment can have an impact on how well it performs. This means that in order to assure safety, the system needs be used in addition to other collision avoidance techniques. The precision and range of the ultrasonic sensor might be increased through further study, and the possibility of integrating numerous sensors for collision avoidance could also be explored.

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