# Advance Anti-collision Device for Vehicles Using GPS and Zigbee

**Satyajeet Patnayak, Anisha Swain and Manaswini Das**

## 1 Introduction

Increase in population leads to subsequent increase in the number of automobiles plying regularly on the roads. As a consequence, the number of accidents in the world is on a hike. According to a report by WHO, around 1.25 million people perish each year owing to road accidents. The safety of mankind depends on us. Collision avoidance systems have proved their worth since the recent past nevertheless they are inadequate in their attempts. The major objective of this project was to introduce an advance collision avoidance system that can reduce the chance of accidents up to a significant extent. The key feature of this system is to access the location of all the vehicles within a demarcated area and spontaneously apply brakes if there exists a chance of imminent collision. This device is not just a conventional collision detection system but a smart collision avoidance system that can detect a chance of collision and take appropriate action even when a user is unaware of an obstacle in front of them. Hence, we hope this system brings forth a decline in the accident rates to a certain extent. Though the other vehicles do not have the required device, the user's controller can still sense and avoid head-on

S. Patnayak (✉)
Department of Mechanical Engineering, College of Engineering and Technology, Bhubaneswar, India
e-mail: satyajeetpatnayak@gmail.com

A. Swain
Department of Instrumentation and Electronics, College of Engineering and Technology, Bhubaneswar, India
e-mail: anishaswain2@gmail.com

M. Das
Department of Computer Science and Engineering, College of Engineering and Technology, Bhubaneswar, India
e-mail: dasmanaswini10@gmail.com



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collision by means of mmWave sensor. The best use of this system will be when the other vehicles contain a similar system for which the vehicles can even avoid side collisions, collisions in t-junctions, or collision in dividers.

## 2 Literature Survey

Till now innumerable devices have been invented, but the outcome is not up to the extent of avoiding accidents. Research has also been conducted in the area of adaptive cruise control to develop it further [1]. The front-end collision systems are being used in vehicles for a long time, and further researches are been conducted with the help of IR sensors to prevent front-end collisions [2]. Yet the current front-end collision warning system is not capable enough to establish their importance. Research has been extended further on the rear-end collision warning systems and systems where drivers can get a warning if there is a chance of collision from behind [3]. Engineers have found out that there may be a possibility that collisions can be avoided if there exists a peer-to-peer network in between the vehicles [4]. Recent works are more focused on the inter-vehicle communication by various means such as Tatchikou et al. [5]. In his paper, he has used dedicated short-range communication links for inter-communication between vehicles. Further researches have been conducted by Biswas et al. [5], for enhancing highway traffic safety by using dedicated short-range communication. Still some effective way has not been deciphered to achieve higher safety figures. Anurag et al. [6] in his paper has put some efforts to warn the drivers before collision. The system uses IEEE 802.15.4 for the communication. It operates on the free industrial scientific medal (ISM) of 2.4 GHz band. However, it had a few disadvantages as the search was basically for dumpers in mines and was unable to use the device in the real scenario. Apart from that the device was performing poor for unicast systems. Also using 802.15.4, the connectivity between two vehicles was highly depending on nature of path and most beneficial in LOS communication et al. [7]. Another paper by Uvaraja et al. [8] revealed a system using RFID and FLIR cameras, meant to be used in railways and not on roads.

## 3 Observation

In the recent past, there are less types of vehicle that use the conventional collision avoidance system with the help of cameras, radars, and infrared sensors. But the devices fail to work in places where there is no LOS contact of front vehicles and on road intersections. The other types of collision avoidance system which will be used in the near future are the interconnection of vehicles which keeps track of the speed and location of one vehicle with the other through a wireless channel. These types of systems are commonly known as CWS (CCWS). The demerits of the CWS systems are they cannot avoid an obstacle directly; however, by the help of local wireless networks, the vehicle can detect other vehicles without any visible line of contact between them. The system that was made by D. Anurag (GPS-based vehicular collision warning system using IEEE 802.15.4 MAC/PHY standard) has not yet been exercised on the standard vehicles using ECU.

In this paper, we have made use of progressive technology different from the conventional methods of anti-collision devices by two strategies. First, after detecting the collision, our system will automatically transfer the signal to the ABS of the vehicle for applying brakes, and secondly, machine learning has been applied to understand the response of the driver and sense the right time for the application of brakes, which is the time when it will be impossible for the driver to avoid the collision. To the best of our knowledge, this is the first work in developing a vehicle anti-collision device and integrating it with vehicle's ABS system. In addition to this, this system also makes use of machine learning in the ECU for better performance.

## 4 Proposed Model

From the many types of GPS and microcontrollers available, we zeroed in on NEO-6M GPS module and Arduino UNO as it was economic and could easily be implemented on microcontrollers.

### *4.1 Finding the Safety Zone of Vehicles*

A safety zone or an imaginary rectangle surrounding the vehicle will be constructed and will be responsible for saving the coordinates of the safety zone that will be found by taking the size of vehicle in the device, i.e., its length and breadth as shown in Fig. 1.

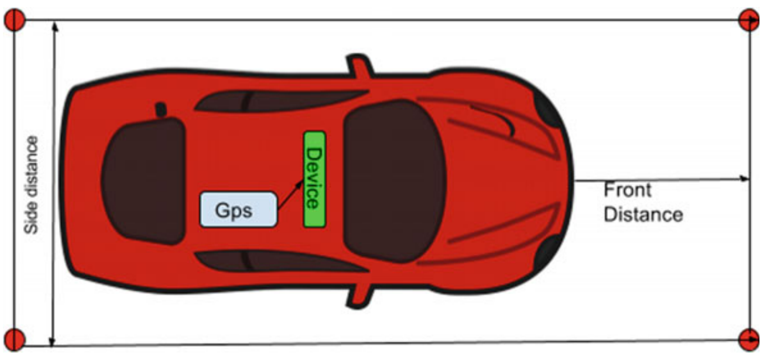


**Fig. 1** Front and side distances of a vehicle

## 4.2 Variation in the Safety Zones by Various Factors

The safety zone or imaginary coordinates that the device will always detect will have varying coordinates, viz the size of the imaginary safety region will increase or decrease continuously taking into account certain conditions. For instance, when the speed of vehicle will alter the safety coordinates, the size will increase or decrease accordingly. Also the safety zone will decrease by taking into account the driving conditions; i.e., whether the vehicle is located in a crowded city or expressway.

### 4.2.1 The Variation of the Safety Zone with Speed is

If

$v$ Velocity of vehicle,
$\mu$ Coefficient of friction (0.60 assumed),
$g$ Acceleration due to gravity (9.8 m/s assumed),
$d$ Stopping distance.

So,

$$d = \frac{v^2}{2\mu g} \tag{1}$$

Therefore, $d = X$ (the coordinate will be changed, and the distance will be made close to the stopping distance).

So, by calculating the stopping distance of the vehicle, we will change the coordinates of the rectangle accordingly. Apart from this, when the vehicle is travelling in crowded places, the imaginary coordinates will be chosen closer to vehicle in order to avoid any unnecessary warning. In this way, the device will adapt as per the surrounding and the behavior of the driving conditions of the driver.

## 4.3 Automatically Braking of the Vehicle

We altered the ECU for the vehicle comprising of Arduino by making a parallel connection with the vehicle's preinstalled ECU such that the preinstalled ECU will function smoothly without any hindrance. The ECU sends a signal to the ABS System where the motors receive the instructions and exercise brakes automatically by opening and closing the solenoid valves in order to prevent collision.

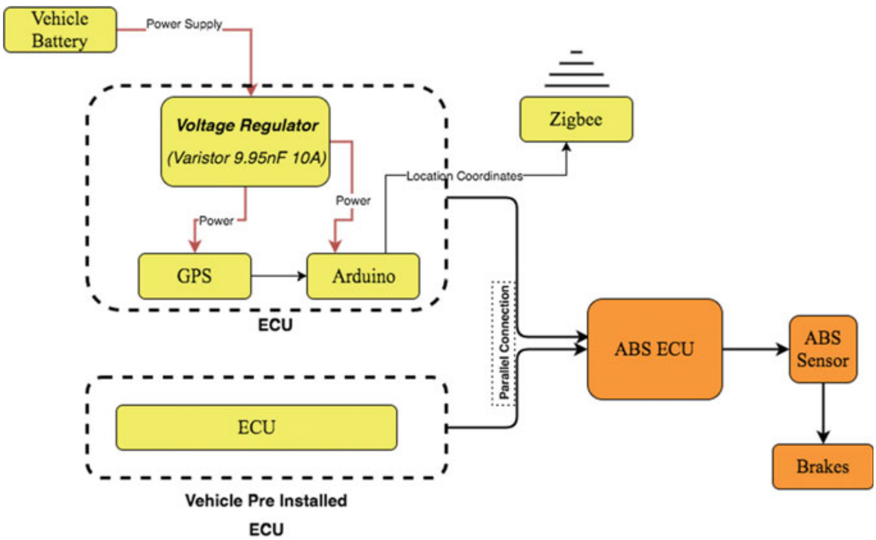


**Fig. 2** Circuit Diagram

## 5 Circuit Diagram of Our Model

The circuit diagram depicted in Fig. 2 was used in our model. The system was made available to vehicles so that they can be connected to each other.

## 6 Results

We successfully demonstrated the vehicle collision avoidance system by using inter-vehicular communications. Our system comprised of four important steps:

1. Introduce an imaginary boundary in the vicinity of the car's outer surface.
2. Connect to other vehicles which are close to it.
3. Apply brakes automatically so as to avoid any chance of collision.
4. Analyze the behavior of the driver so that our device can understand driver's reaction time to determine when it has to automatically apply the brakes.

Our principal technical findings were as follows:

1. Connect the vehicles using standard Zigbee while using vehicle's power sources.
2. To interconnect the vehicle ECU with our own ECU comprised of Arduino UNO, Zigbee, GSM Module within a parallel connection such that we will not hinder the safety and electronics of the vehicle.

## 7 Conclusion

In this paper, we presented a collision avoidance system using Zigbee and GPS. The system was capable of detecting a vehicle absent in the user's immediate line of sight and automatically applying brakes using this ECU from a safe distance. We believe that our system will develop the safety of the vehicles and further lessen the chance of collisions up to a significant extent. We tried to make our system as robust as possible so that it can be used in a wide range of vehicles with significant accuracy.

## 8 Future Work

We intend to extend our research to the vehicles using non-ABS brakes as they make a majority of the automobiles. The vehicles which do not use the ABS systems use conventional drum brakes which are controlled directly through mechanisms. An advanced approach would be spontaneous application of brakes if there is a possibility of an imminent collision taking into account the driver's response and frequency of usage.

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**Satyajeet Patnayak** Satyajeet Patnayak is a final year undergraduate, pursuing Bachelor's in Mechanical Engineering from College of Engineering and Technology, Bhubaneswar, India. He is a former Summer Research Fellow under Defence Research and Development Organisation, Gov. of India. He is a automobile enthusiast and loves to devote his time in the field of research in automobile and its subdomain. His fields of interest include Vehicle Safety and dynamics, Machine Design, and Avionics.

**Anisha Swain** Anisha Swain is a final year undergraduate, pursuing Bachelor's in Instrumentation and Electronics Engineering from College of Engineering and Technology, Bhubaneswar, India. She is a former Summer Research Fellow under Indian Academy of Sciences and a newbie in the field of research. She is a technology enthusiast aiming to develop cutting edge technologies for future. Her fields of interest include image processing, machine learning, and data science.

**Manaswini Das** Manaswini Das is a final year undergraduate, pursuing Bachelor's in computer science from College of Engineering and Technology, Bhubaneswar, India. She is a former Outreachy intern at Open Humans and being new to the research field, contributes to open source software and is ambitious of developing futuristic technologies. Her fields of interest include open source, machine learning, and artificial intelligence.