Wireless Vehicle Deceleration Speed System (WVDSS)

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Abstract: - This work presents an analysis of the problem related to road safety, the idea is to introduce the importance of obtaining more seriousness with committing the traffic rules, and more safety for roads and vehicles. This work provides a system, which replaces the systematic road bump with a transmitter that sends a signal to the coming vehicle's Electronic Control Unit (ECU). Wireless connection will be between the vehicle and the transmitter placed at the bump's supposed position, to send signals or waves to be received by the receiver in the vehicle's ECU. It was found that this system will increase the commitment of drivers to traffic signals which control the speed of cars and limit their speed at the allowable speed limits.

Key-Words: - ECU, Safety, Roads, wireless Connection, Speed control, Vehicle Speed Sensor (VSS).

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1 Introduction

The main causes of accidents are unit vehicle over-speeding, driving once overwhelming alcohol, distraction throughout driving, non-adherence to traffic signals, non-wearing of seat-belts and safety gears, tailgating, poor lane discipline etc. However, in most of the countries dashing or excessive vehicle speed on the road is taken into account to be the only biggest issue for road accidents conducive to fatal injuries or perhaps death and monetary prices to society.

The main turning purpose in history is formed by the industrial revolution, and virtually every aspect of our way of life was influenced in a way. In a part, average financial gain and population began to exhibit unprecedented sustained growth [1].

After or through this industrial revolution as spoken before, it has effects, many things have been made in order to meet the human needs. Of course, revolution's influences continue many years after, one of the biggest noticed results from it were the car founding. Humans have been using cars over many years, and this is why they are produced to service the humans, but it also as seen it has many effects on the human life, like increasing death percentage caused by driver vigilance which causes in traffic accidents, increasing in driving speed, and decrease the health level due to increasing in the percentage of the emissions in the air.

Deceleration of the vehicle's speed is very important to avoid collisions. The traffic system consists of vehicles with wide variation in their dimensions, weights characteristics, which affect their deceleration behavior.

Drivers must decelerate their vehicles from their maximum speed to zero speed in the shortest time [2].

Some technologies will shield folks in collisions solely to a precise extent, these technologies like pretension life belt, airbag, Anti-Lock brake, Traction system, and Electronic Stability Programs. They solved this drawback by causing a warning to drivers once the driving force seems drowsy, Zutao Zhang, et al. [6].

This is a big problem, the expected solution is by follow laws and rules called the ''Traffic Rules'', like: the main and the most important rule is the side of the driving in the road, left or right. Then the location of the signs according to the type of the road. High vehicle speed, more than the maximum limits at the roads, is one of the problems to avoid crashes. The width of the road also takes a place in reducing crashes, for example, single or multilane road. Multilane street or road can accommodate more than

two vehicles, whereas single lane just one vehicle for each direction [3].

According to Kong W., et al. [4], and Li G., Lin W. [5] studies, a serious issue was the apparent decrease within the driver's sensory activity senses, like feeling, recognizing, and dominant the vehicle's skills, once they became drowsy. Statistics show that the best explanation for deaths and injuries in traffic accidents is the low level of driver alertness.

In many countries, roads are designed and organized on specific rules and shapes. One of the visual and touchable safety factors on the road is the bump or hump, which is used to force the drivers to decrease vehicle's speed at some locations on the road. These bumps are a little high in the pavement layer, and constructed in a specific way and made of asphalt or rubber. Using such bumps commits the driver to the traffic rules and safety bases, has many disadvantages on the vehicle and on the passenger's comfort and may cause serious mechanical faults.

Vehicle acceleration was also one of the factors that contributed to highway design and construction aspects. Vehicle acceleration characteristics are affected by gear transmission type, power to weight ratio, vehicle average speed, and loaded and unloaded states. For example, when a vehicle begins from rest, the force available at rest must exceed the tractive effort caused by friction between the tires and the pavement surface. However, except in emergency situations, motorists rarely experience maximum accelerations on multilane highways [11, 14].

Brooks [15] investigated the characteristics of acceleration on rural roads. It was discovered that drivers normally accelerate more when the vehicle is at rest and tend to decrease when the driver wants to bring the vehicle up to their desired speed. In this case, there will be no acceleration because the driver is content with their current speed and does not want to change it. The best description of the driver's behavior is provided by studying the acceleration model on a linear basis. According to Wallace et al., [16], driver acceleration characteristics can be measured because different drivers exhibit different characteristic behaviors. This is also significant because it may have an impact on driver performance or may help identify who is driving. In addition to acceleration characteristics, deceleration characteristics are important in analyzing speed profiles. In this case, a driver will gradually or abruptly reduce or decelerate their vehicle from the previous speed to zero when they reach the stop line.

To avoid these problems a wireless system will be designed to provide information to the vehicle's control unit to automatically slow down the speed if the driver will not respond to speed limitations at the road. In the next sections, the systems' principle work will be described by using some appropriate flow chart, mathematical representation and a description of simulation representing the system and its steps of programming. Also the results of some tests are presented and discussed.

2 Working principle of Wireless Vehicle Deceleration Speed System

The system composed of a sender or transmitter of signals and a receiver, the sender must be placed at the supposed pump location, and the receiver in the vehicle, the sender device distributes the signals to be detected from the receiver of the incoming vehicle, when the receiver starts to detect the signals from the sender, these signals provides information to the vehicle about the speed limit, and gives alarm to the driver in order to start reducing the speed, depending on the strength of the received signal, if it was strong that's mean the vehicle's speed must be reduced to the allowable speed. As the receiver detects the signal, it sends an order to the warning sign (lamp) at the dashboard to illuminate immediately as shown in Figure 1.

Fig.1: Some warning traffic signs

If the driver does not respond or make any action, then the WVDSS skips to the next step, which is responsible to process the input signals and send a signal to appropriate actuators to control and limit the speed. Wireless Vehicle Deceleration Speed System (WVDSS) Imagine, that you can avoid the breaking

in traffic rules, and mechanical damage in car that caused by bumps, now it is possible using wireless vehicle deceleration speed system (WVDSS), which is based on wireless network that provide signal to the vehicle through alternate signals, used for alarm the driver.
Wireless vehicle deceleration system, the system formed from sender or distributor signals and a receiver, which the distributor must place at the supposed bump locate, and the receiver in the vehicle, the sender device distributes the signals to be detected from the receiver of the incoming vehicle, when the receiver starts to detect the signals from the distributor, these signals provides information to the vehicle in order to start alarming driver or reducing it speeds, depending on the strength of the received signal, if it was strong that's mean the vehicle speed's must be reduced to the allowable speed [12, 13].
If the driver does not make an action, WVDSS is skip to next step, which is responsible to process the input signals that coming from different devices and sends a signal to different actuators to control the speed in gasoline engines Wireless vehicle deceleration speed system is focus of three main categories:

- Network.
-Road.
-The vehicle.

Many researchers discussed this issue, the first study by Salameh A. Sawalha, [7], created a system that aimed to regulate vehicle's speed in accordance with the road and road regulations. The system finds out the whereabouts of the vehicle then it identifies the allowed speed for that individual place. After this, it starts decreasing the speed bit by bit till it reaches the fascinating limit. Once the vehicle runs, The GPS finds the placement of the vehicle then it sends the great circle and therefore the latitude to the management unit to spot the regulation of the road.
If it's found that the vehicle speed exceeds the permissible limit, a symptom is distributed to the brake to scale back the speed till it drops to the utmost limits. one in every of the foremost vital options of the system is that it senses the distances between 2 vehicles victimizing the inaudible sensing element, that permits a precise distance between them commensurate with their speed, which ends up in no accidents and accidents. All this can be evaded Olympian the regulation of the streets. Within the event of a system failure within the event of any malfunction, a warning message containing the vehicle range and knowledge concerning it'll be sent to the Traffic Department as a comment.]7[

A. Christy, S.Vaithyasubramanian, Viji Amutha Mary, Naveen Renold J., [8], presented a successful technique for automatically controlling the decelerating system by proactively recognizing accident-prone zones and avoiding accidents from occurring for effective operation of the decelerating system, this technology employs Arduino, L293d motor driver, and ultrasonic sensor, Machine Learning methods, RFID, and RFID protocols. This technology must be embedded in a vehicle's dashboard and backed by secure RFID and machine learning algorithms in order to properly operate the decelerating mechanism. To reduce the incidence of accidents, the driver's driving style in different situations is analyzed using the Car Trips data log and the terra acelerolinear dataset. The trained data is used to develop a mobile application which when installed in the windshield of the vehicle helps the driver to control the deceleration system thus avoiding accidents and reckless driving [8].

Zutao Zhang, Dianyuan Luo, Yagubov Rasim, Yanjun Li, Guanjun Meng, Jian Xu, and Chunbai Wang [6], projected a lively vehicle controller safety model supported driver alert detection, scattered illustration victimization cheap, convenient and wearable medical instrument EEG sensors, and thin illustration. The projected system is split into 3 main steps: a wireless wearable EEG assembly, driver alertness detection, and a vehicle speed management methodology. 1st of all, a convenient, low-cost, wearable, home-made brain-computer interface (BCI) system with eight channels for collecting the driver's EEG signal was designed. Second, waveform noise removal and sample bottoming algorithms square measure wont to improve the standard of EEG information, and a Fast Fourier rework (FFT) is adopted to extract the EEG Power Spectrum Density (PSD). At now, PSD is an iniative to assess the driver's attention level victimization thin illustration classification plus k-single-value analysis (KSVD). Finally, to avoid major collisions and traffic accidents, a novel vehicle speed management safety strategy has been projected, that regulates electronic throttle gap and automatic braking once driver fatigue is recognized victimization the preceding approach. Simulation and actual take a look

at results show that the construct of active vehicle safety is feasible [9].

Vytautas Markevicius, Dangirutis Navikas ,Adam Idzkowski, Donatas Miklusis, Darius Andriukaitis , Algimantas Valinevicius,Mindaugas Zilys , Mindaugas Cepenas and Wojciech Walendziuk. [10] found good results thanks to estimate the speed and length of a vehicle remains a challenge for engineers and scientists functioning on Intelligent Transportation Systems. The electricity sensors are created from polyvinylidene salt (PVDF) and used as a reference device. The ways applied within the analysis box live are well-known: the fixed threshold-based technique and additionally the adaptive two-extreme-peak detection technique. However, the improved accuracy of length estimation by mischief is one amongst the ways that depends on calculative the discriminant quotient for a time-discrete signal (representing changes within the magnitude of the Earth's magnetic flux), being determined. The obtained results, i.e., vehicle speed and length, are shown for various values with increment Δn used for numerical differentiation of magnetic flux size knowledge. The results were achieved in real traffic conditions once analyzing the M = 290 knowledge set of auto signatures. Accuracy was evaluated by calculative MAE (mean absolute error), RMSE (root mean sq. error) for various categories of compounds. MAE is within the range from zero.52 m to 1.18 m when an appropriate calibration factor is used. Results depend upon the space between the sensors, vehicle speed, and also the applied signal process methodology [10].

From the last literature review in the first article by Sawalha, [7], the paper discusses vehicles' speed regulation with the help of GPS. While A. Christy, S.Vaithyasubramanian, Viji Amutha Mary, Naveen Renold J. .[12]. and Zutao Zhang, Dianyuan Luo, Yagubov Rasim, Yanjun Li, Guanjun Meng, Jian Xu, and Chunbai Wang, [6], discussed the issue of vehicle deceleration during accidents and also safety during driving by using some appropriate sensors and safety systems like EEG and some mathematical simulation techniques like RFID. On the other side, Vytautas Markevicius, Dangirutis Navikas,Adam Idzkowski, Donatas Miklusis, Darius Andriukaitis , Algimantas Valinevicius,Mindaugas Zilys, Mindaugas Cepenas and Wojciech Walendziuk, [10], used analysis box live, fixed threshold-based technique, and adaptive two-extreme-peak detection techniques to control the speed of cars during transportation.

3 Description of the General System Operation

General system operation is described here, the Wireless vehicle deceleration speed system composition which uses electronic circuits shown in Figure 2 below. As discussed before, the signal has been received, and then the system will act to get the required response.

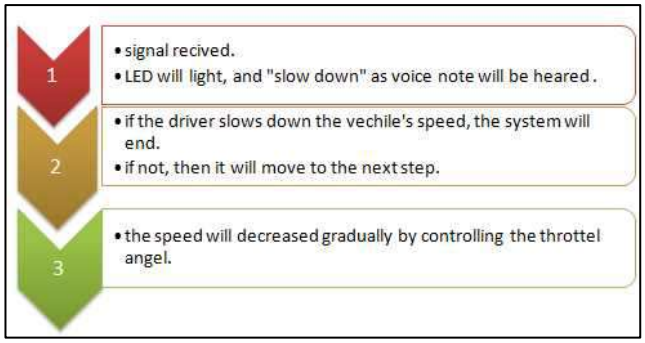


Fig. 2: General System operation steps

First, receiving the signal: Now, what will happen when the signal is received? The next block diagram in Figure 3 shows the block diagram of the first step of what happened to the vehicle.

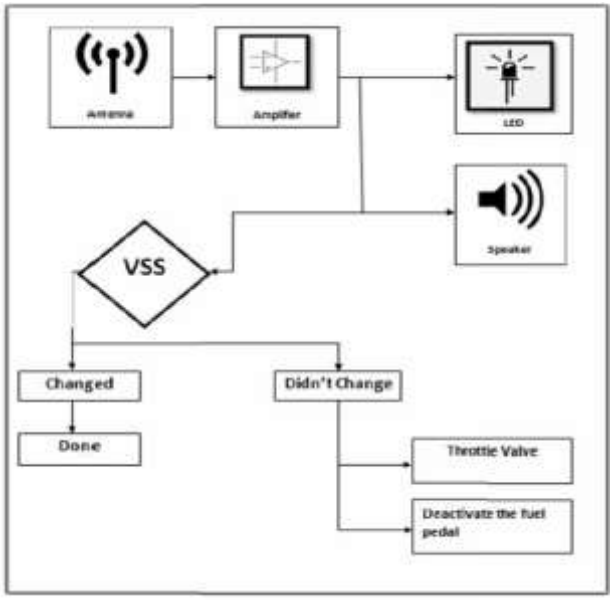


Fig. 3: First step on the system procedure

4 The System Flow Chart

Figure 4 illustrates the principle of a system which is applied on Arduino.

Fig. 4: System flowchart

Deceleration zone when the drivers make an action: It's a zone where the vehicle will travel from when the driver is alert to when it comes to specific speed that the vehicle must pass the road.
From Figures 3 and 4 the system works as follows: the transmitter which is mounted on the traffic sign transmits a signal to the incoming car, the car which has a receiver accept this signal (this is approved by some LED or Speaker) then the signal goes to the Vehicle Speed Sensor (VSS) system, if the driver decelerated his car speed, the job is executed, else the VSS send a message or signal to the throttle valve via a control system using ECU unit to decrease the fuel amount (throttle valve angle) by using the fuel pedal automatically.

4.1 Declaration Time

Deceleration time is divided into several parts as follows:

4.1.1 The Driver's Reaction Tim:

The time required to alert the driver that there is a bump, and determine what he/she can do about it.
This time it takes from 0.5 to 1 second for people with an average age, this depends on the age of the driver, state of mind, busy talking on mobile phone or alcohol drink.
On that period (driver's reaction time) the car is in motion at a constant speed, a vehicle speed follows to this physical law:

$$S = V \times T \quad (1)$$

Where: S is the distance during that time, in meter m, V is a vehicle speed meter per second (m/s) which is equal kilometer per hour divided on 3.6 ((km/ h) /3.6).
T is the driver's reaction time (average 0.75 seconds).
The effect of speed on the driver's reaction distance, for an example: Vehicle's speed 108 km/h where: V= 30 m/s, and the driver's reaction distance will be:
S=V× T = 30 × 0.75 = 22.5 meters.

4.1.2 Time Load Brake

When you press the brake, the work of the brake does not start by simply pressing the brakes, this time in the range of 0.1 to 0.2 seconds; this depends on the situations of the brakes.

4.1.3 Braking Time

The total deceleration time can be calculated according to the state of the driver and the car. If the driver doesn't make an action in the deceleration zone, WVDSS is activated automatically.
The whole deceleration zone in this case is 150 meter according to signal range, this zone is dived to three main distances which are:

A) Alarming Zone
Starting from 0 up to 50 meters, the main cause for existing this area is to warn the driver using a warning lamp and sound order to slow down. Physical law that used to calculate the time needed in this zone is: Time = Distance/Velocity

B) Activation Zone
In this zone, WVDSS is moving to the next step, which is starting to decrease the vehicle speed, while the vehicle reaches to a specific speed, it passive through 70 meters at specific time, this time and acceleration can be calculated by several speed relationships:

$$v = v_0 + at \quad (2)$$

$$r = r_0 + v_0 t + 0.5at^2 \quad (3)$$

$$r = r_0 + vt - \frac{at^2}{2} \quad (4)$$

Where: $r_\circ$ is the particle's initial position, $v_\circ$: is the particle's initial velocity, v is the particle's final velocity, a: is the particle's acceleration. By using the relationship number three we can find the time that needs to reach specific velocity and distance.

C) Constant Speed Zone.
In this study, the speed of the vehicle is assumed to be constant before go through the bump, and this distance must be not more than 30 meters, to enable the driver to slow down the vehicle speed according to the regulated speed given by the traffic sign. We use the same relationship that used in the alarming zone. For example, let us take several car speeds and calculate the time needed from receiving the signal to reach the specific velocity (that the car must pass through the bump in this velocity). If we take car with 50 km/h speed, and the speed must reach to 30 km/h (This speed represents the speed in traditional bump place), the total time can be calculated:

4.2 Alarming Time
By taking 50 meters an alarming distance from detection the signal to the WVDSS start make a deceleration action, this calculation time is:50/13.88=3.6 s.

4.2.1 WVDSS Action Time
This distance is 70 meters and the speed must reach 30 km/h (8.33 m/s), the time can be calculated is 6.3 seconds.

4.2.2 Constant Speed Time
This distance is 30 m and the speed is 8.33 m/sec, the time is: T=7.7 sec.
The total time is (3.6+6.3+7.7)
=17.6 Sec

5 Results and Discussion
Table (2) shows the time to cross the deceleration zone when the driver doesn't make an action.

Table 2. Results of calculations

Car speed	Alarming time	Action time	Constant speed time	Total time
40	4.5	7.2	7.73	19.43
45	4	6.7	7.73	18.43
50	3.6	6.3	7.73	17.63
55	3.2	5.9	7.73	16.83
60	3	5.6	7.73	16.33
65	2.77	5.3	7.73	15.8
70	2.57	5.04	7.73	15.34
75	2.4	4.8	7.73	14.93
80	2.25	4.5	7.73	14.48
85	2.11	4.38	7.73	14.22
90	2	4.2	7.73	13.93
95	1.89	4.03	7.73	13.65
100	1.8	3.87	7.73	13.4

Figure 5 shows the relation between total time needed for the alarm system and car speed.

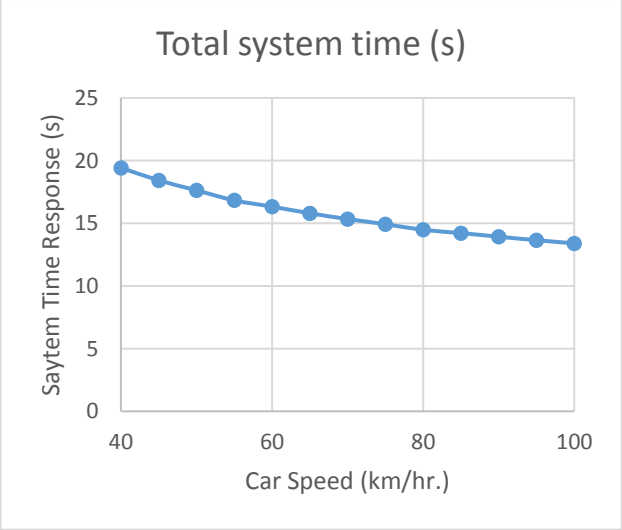
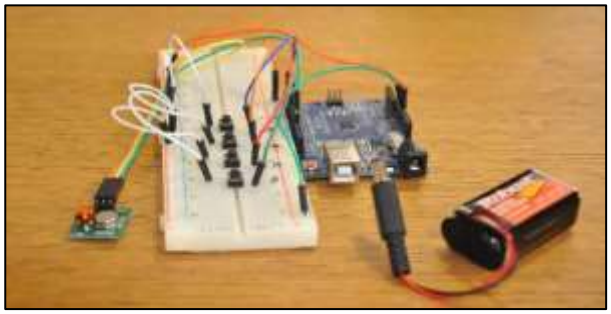


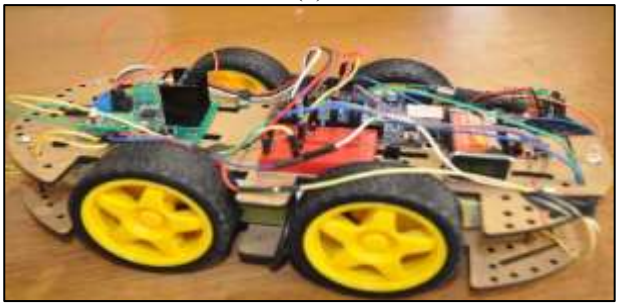
Fig. 5: Total system time response calculations

It can be noticed that as the car speed increases the response time of the system increases.
As the results have shown, the average total time that is needed from the vehicle received the signals is 15.7 sec. The system consists of the receiver, that captures the signal from the first system and then sends it to Arduino which translates this signal to specific commands are applied to the robot that accordance to the signal received from the transmitter, that will be as:
-If the Button (1) compresses the signal sent by the transmitter it makes the robot started at high speed when the voltage applied on its motor 255 volt.
-If the Button (2) compresses the signal sent by the transmitter it makes the robot stopped.

-If the Button(3) compresses the signal sent by the transmitter it makes the LED on the robot lighting 5-second then the motors will be decreasing its speed by decreasing the voltage applied on its motor.
To control the response of the system according to the signal received from RF (transmitter) through the receiver, an Arduino board is programmed which is connected with the receiver as shown in Figures (6-8).
As the systems' programming is finished with the Arduino programmer, applying this programming to the pieces used and connecting the parts together to get to the final result as shown in Figure 6.



(a)



(b)

Fig. 6: (a, b) System simulation

After running the programming on the two parts, and as spoken before how first button pushed to active the DC motors to move the vehicle, then pushed the second button to active the transmitter and to be received by the moving vehicle, to start decrease its speed, once while it received the signal a warning or green light, while Figure 7 shows the two systems together in active mood which is WDVSS.

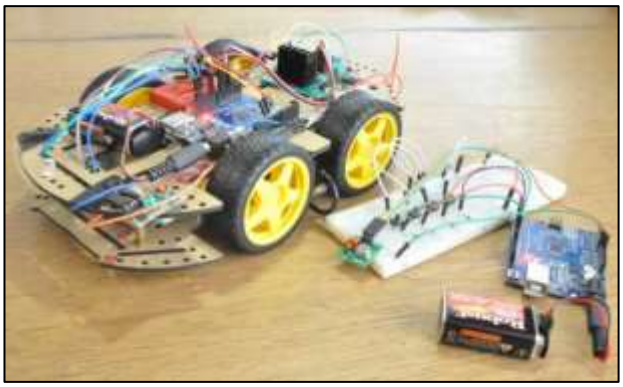


Fig. 7: The two systems together in active mood WDVSS

And Figure 8 shows the vehicle's first alarm, which is lighting the lightning emitting diode with a green color.

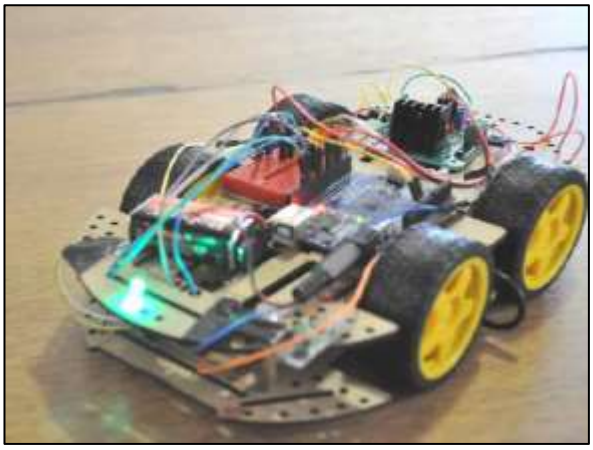


Fig. 8: Vehicle first alarm

After showing how the system is applied on an experimental vehicle driven by DC motor, decreasing the vehicle's speed when it receives the signal from the transmitter also and after lighting the LED, this application on prototype to clear the implementation of this operation.
For expelling how the vehicle will deal with receiving the signal from the antenna it was cleared what steps the vehicle will do whether the driver do an action or not, and for sure the distance of deceleration has been taken into account, and also the time respond for different vehicle speeds from the time the receiver detects the signal due to its frequency and range, developing using technology and commenting traffic rules to get to main aim form this project to be the roads place more safety to drive or use.

Depending on roads situations and its demand, an exact calculations and standards in designing roads and what the allowable speeds in all cases, which has been controlling us in determinations that we used for speed distance of deceleration zone and in time need to decelerate, also how the mastermind of the vehicle the ECU works and how important the information from the different inputs are used in vehicles to decide what to do and what driver want and what vehicle want and the road too.

All of this provide for us a way to make an easy and more accurate controlling and reacts in right time with the right action, while without ECU we can also make an action on the vehicle when it received the signal, by connecting the throttle valve to a variable resistance and such resistance works to divide the current that passes through it after the signal is received to let the current pass by to enable the resistance performing its function, and then controlling the amount of opening angle of the throttle valve.

6 Conclusions

In this system, when the vehicle received the signal, and by connecting the throttle valve to a variable resistance and this resistance work to divide the current that will pass by it after the signal is received to let the current pass by which let the resistance doing its function, and controlling the amount of opening angle of the throttle valve, the speed of the car can be reduced upon regulated speed and so the roads safety increases. This system increases road safety by controlling cars' speed into acceptable values.

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