Virtual Digital Retarders System

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Abstract

This work presents a digital inhibitor system for vehicles speed control using Global Positioning System (GPS).In this work the vehicle will reduce its speed by applying the brake out of driver control, programmed coordination points will cause receiving a GPS signal using GPS receiver to an imbedded system, which appears on the LCD screen, to inform the driver that he has entered in the target area. It is found that this system may help in reducing the huge number of accidents on roads, controlling the inappropriate behavior of reckless drivers, saving time and effort to police departments by decreasing the number of patrols (fixed and moving) spread on the roads. The GPS is used in this project because it's fixed simply inside the automobile without need of operational cost, and because of the wide coverage for satellite system; the GPS reaches any point on the Earth without need for large numbers even huge numbers of workers without affording additional costs, so the money and manpower can be saved without abandoning the desired goals. This system has many advantages; it can be used in wide range and also can be fitted in any vehicle.

Keywords: Road retarders, GPS, Automobile, Deceleration, Digital inhibitor, Virtual retarders.

1. Introduction

The main problem of this work is to discuss the huge number of roads accidents, and the human and financial invoice paid by the nation. Autotronics science works to find sustainable solutions for such problems, and to replace the temporary solutions used in roads as well as to get rid of the negatives impact on vehicles. The increase in the number of vehicles increases the rate of accidents on the roads, which has become one of the most important international problems that causes the need to search for solutions to stop this carnage. The importance of speed inhibitor, traditional retarder, speed reducers and physical bumps is to reduce the speed of the vehicle to increase the stander of security and safety, but the speed inhibitor sometimes, takes different shape from international known, it's higher from street and takes the width of street and it takes place inappropriate to it, in addition, there is no sign that indicates the person about it, that must be about 400 to 500 m before speed inhibitor. There must be more than one sign that indicates it present such as colorful painting, as shown in Fig.1 [1, 6].

Fig. 1. Sign warn the driver that there is speed inhibitor

The speed inhibitor Fig.2 carried out by ordinary workers without applying any of the standers, especially who put the retarder in the inner road located in residential areas. Fig.3 represents a new inhibitor style.

Fig. 2. Invisible speed inhibitor due to the deficiency of paint or light reflectors usage

Fig. 3. Modern speed inhibitor made of rubber and springs

1.1 Type of speed Inhibitor (traditional retarder):

Traditional retarder -speed inhibitor- may be: single speed inhibitors, with 20 cm height and 2 m width, or rubber speed inhibitor, supported by springs to absorb the shock, with 5 cm height and 1 m width. The places of using speed inhibitors must be in region that could black spot where accidents happened frequently and they should be carried out by specialists to meet international standards.

1.1.1 Advantages and disadvantages of using speed Inhibitor:

The traditional speed Inhibitor is used to limit the vehicles speed in front of schools and sites where it is dangerous to exceed the speed limits .Speed Inhibitor achieves some of its objective, but there are many problems that make it important to find alternative solutions. Here are some of its disadvantages:

1. Limit the movement of ambulances, police vehicles and emergency vehicle in general.
2. The mechanical complication that the retarder makes (especially that one which is not according to the standards).

1.1.2 The speed Inhibitor divides into:

1. High speed Inhibitor: it is appeared to the driver during driving and can be avoided.
2. Low speed Inhibitor: it cannot be avoided and the losses of the vehicle are worst.[1]

The losses in vehicle that cross the speed inhibitor effected by many factors such as: type and model of vehicle, the speed of vehicle when it crosses the retarder is the main factor, and the load of the vehicle, when the load is increasing losses increases.

Fig. 4. The front axle component

1.2 Effects of inhibitors on vehicles

Vehicle may be affected by inhibitors with many losses like:

1 -The disintegration of the nuts and bolts which **fixed** to the vehicle parts .

2 -Breaking one of the wheel arms, or both.

3 -Break in the balance of the front axle.

4 -A warp main bridge front longitudinal, incidental.

5 -Destruction in the bases engine or gearbox, tires, or rims

6 -Damage of the exhaust tank.
7 -Corrupted steering box.
8 -Breaking any part of the lower parts of the vehicle like the engine, gearbox or radiator.
9 -Deviation in the wheel angles balance due to the bad road condition.

1.3 Advices from Maintenance engineering to drivers through transit in any traditional speed Inhibitor:

Cross the speed Inhibitor in less speed as possible (less than the speed supposed to cross the street legally) to maintain the parts of the car. When a car crosses a few speed inhibitors, the components of the vehicle require disclosing its bottom and conducting periodic maintenance of all parts, changing the damaged part, and controlling the pressure of the tires. In terms of government, applying a warning phosphorous signs before any speed Inhibitor at sufficient distance will warn the driver to avoid him entering the speed inhibitor as shown in fig.5, as well as, paint the speed inhibitor phosphorescently to be clear at night, this eliminates sudden speed inhibitor in the highways, where it is difficult to avoid the driver such obstacles if they are warned late in the road.

Fig. 5. Cat's eye is one of the used methods to warn the drivers.

1.4 The latest developments in speed Inhibitors world

Studies were also carried out for the speed Inhibitors of the use of material that absorb shocks and reduce the impact applied to the car using spring and rubber; these kinds of retarders protect their color over time.

Fig. 6. The new speed Inhibitors made from rubber.

There are little studied discussed this problem. The backbone study considered here is made by Mohammed A. et al. (2009) which introduced a novel approach, relying on intelligent engineering, whereby the maximum speed limit at which vehicles on the road can cruise is controlled from some central or distributed facility .The system, as designed, leverages the use of the ubiquitous cellular infrastructure to cut down the costs involved that would otherwise accrue as a result of the need to build a dedicated traffic control system .In the new system maximum speed limits are transmitted from a Central Control Facility to all stretches of roads and highways dispersed across urban areas in a highly dynamic manner .The system uses information arriving via a dynamic feedback system on prevailing weather conditions, road conditions, and bulk of traffic, amongst others, before it would broadcast maximum speed limit information to various destinations .deploying in its final release, will be done using a highly automated system with little human intervention .The work elaborated the TTC Network Design and RSU Network Distribution for the Tele-Traffic Speed Control System, to remotely manage, enforce, and control the maximum speed limit allowed on road stretches in rural and urban areas for different vehicle categories .The new system has been deployed successfully in a laboratory controlled environment on three vehicle categories; one category represents passenger vehicles, another buses and commuter transport, while the third representing trucks and freight traffic .It is expected that when the system is fully deployed on the wireless infrastructure, speed-related traffic accidents will witness a drop by more than 65–70 % according to known accident statistic [2].

Some invented ideas talks about generating electricity from inhibitors, this applied to transfer the vertical movement resulting from the pressure of the car to circular motion, then this movement is transferred to the generator which produces electricity; which is stored in batteries that are used for street lighting or traffic signals.This improvement is fund of two parts :the first placed inside a hole under the street level, a depth of about 30 cm and the second part is the highest level of the street. When the car crosses speed inhibitors the upper part will go down slightly, during this movement of the retarder, the motion resulting is converted from the vertical pressure due to the weight of the car to a circular motion to move the generator to generate electric current.

The amount of electricity generated -that can be applied by this kind of retarder- is 10 KW continuously through the movement of over 12 hours.Another advantage of speed Inhibitors that they are relatively safer for the vehicles than the kinds that actually existing; reducing the mechanical losses and damage caused by the speed Inhibitors for some vehicles parts. As for the nature of the materials which make them applicable, inhibitors can be made of pig iron, to protect them of the pressure of vehicles that passes by every day, and costs a single industry to nearly $1500, but may be less , especially if the contract has been signed with companies for the production of large numbers of them.

2.Materials and methods

The system consists of the following parts: PIC controller, GPS device, servo motor, LCD screen, LED, Buzzer and Voltage regulator as illustrated on fig.8. The GPS in the circuit always monitors the speed of the vehicle at all times, and during that it reads the position of the vehicle too.When it does read a digital retarder location which its already programmed in the GPS device, the GPS sends a signal to the PIC controller. That signal includes the position and the speed of the vehicle, then the PIC controller sends a control signal to the servo motor and it includes the amount of the force that will be applied by the servo motor.The servo motor acts on the brake pedal by applying it to the exact amount (displacement) which decelerates the vehicle to the desired speed previously programmed in the PIC controller. In addition there is a signal send from the PIC controller to the LED screen, buzzer and LED; to give the driver a readable and audible indication that the vehicle will reduce its velocity .Furthermore there is a signal send to a mechanical device that prevents the throttle pedal from accelerating in case of deceleration. Fig. 7 shows system functional diagram and fig.8 shows the system flowchart .[3, 4,5].

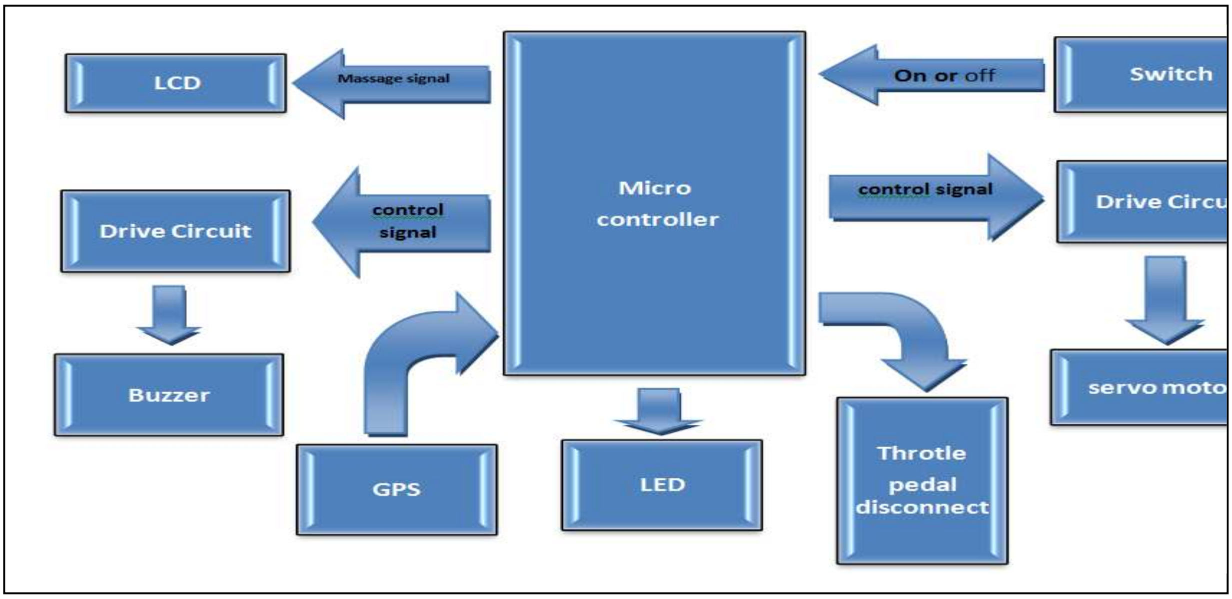

Fig. 7 .System functional diagram.

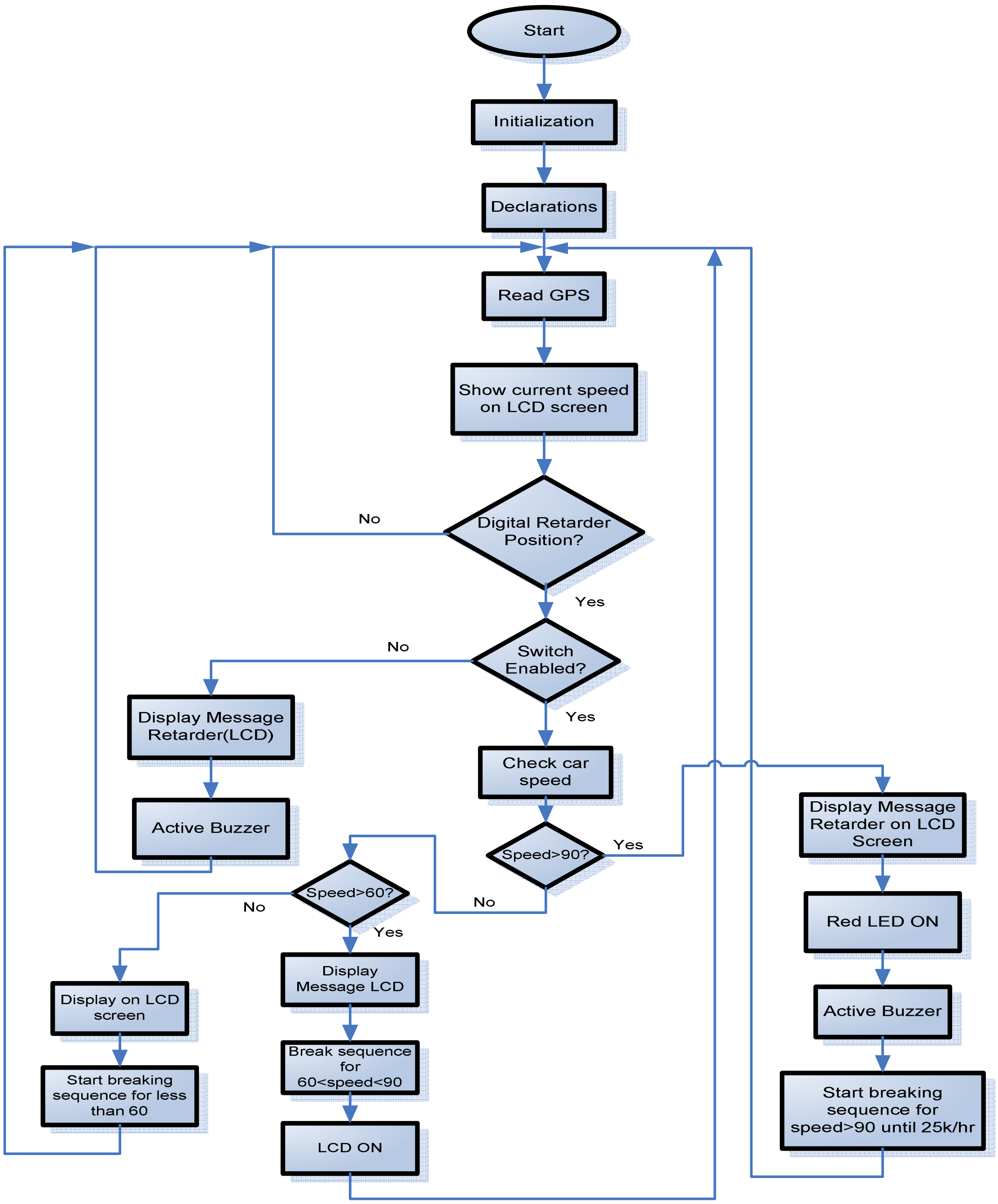

Fig. 8. System flow chart.

This system consists of many hardware parts such as liquid crystal display (LCD) which is used to display warning messages to inform the driver that the digital retarder zone has been entered.The next device is the voltage regulator which is used to reduce the input voltage of the circuit to 5 volts .Also the light emitting diode is used to give a light indication when entering the digital retarder zone, so as the buzzer which is used to give audioable indication too, fig.9. Finally the servo motor which is a device that converts the electrical signals to mechanical movements at high torques and it is used for applying the brake pedal . See fig.10. While figure 11 shows the hardware components of all the embedded system, [3, 4, and 5].

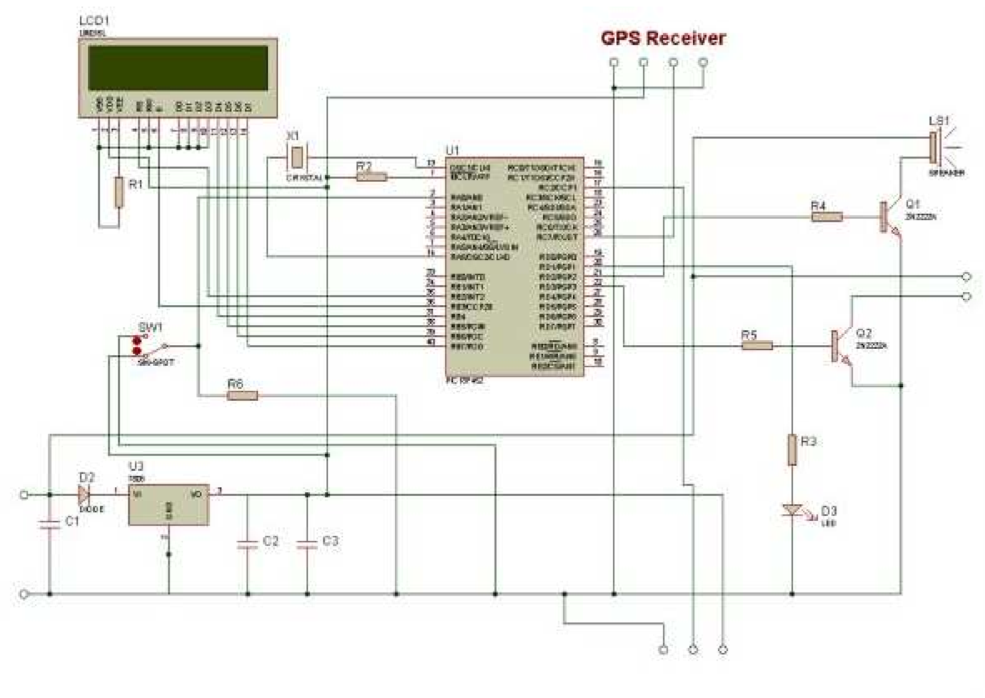

Fig. 9 :digital retarder circuit.

Fig. 10 Servo motor fix behind the brake pedal

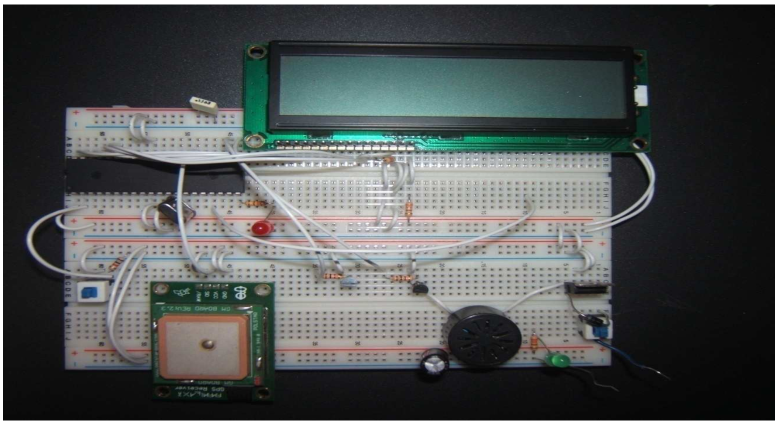

Fig. 11. Digital retarder circuit.

3.Results and Discussion

There is relationship between time of braking and the velocity of the vehicle. The total time needed for the vehicle to stop consists of many periods such as time of driver reaction, time of system drive operation, time for deceleration increase, and the braking operation itself as shown in fig.12, and 13.

$$t_s = t_r + t_{dr} + t_{in} + t_{br} \quad (1)$$

Where,

t_s : is the total time for stopping.

t_r : is the reaction time, the time needed by the driver to realize that the brake should be applied . (0.4 –1) second.

t_{dr} : the brake system drives operation time . (0.2 -0.4) seconds.

t_{in} : the time for the deceleration increase .(0.05 – 0.2) seconds.

t_{br} : the braking time.

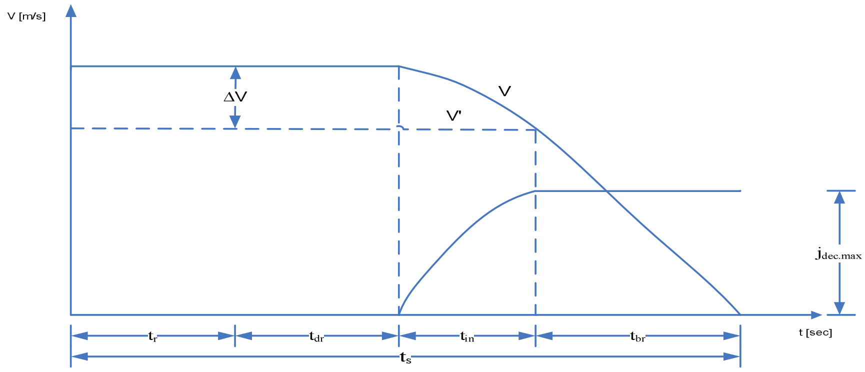

Fig. 12. The theoretical relationship between velocity, maximum deceleration verses time.

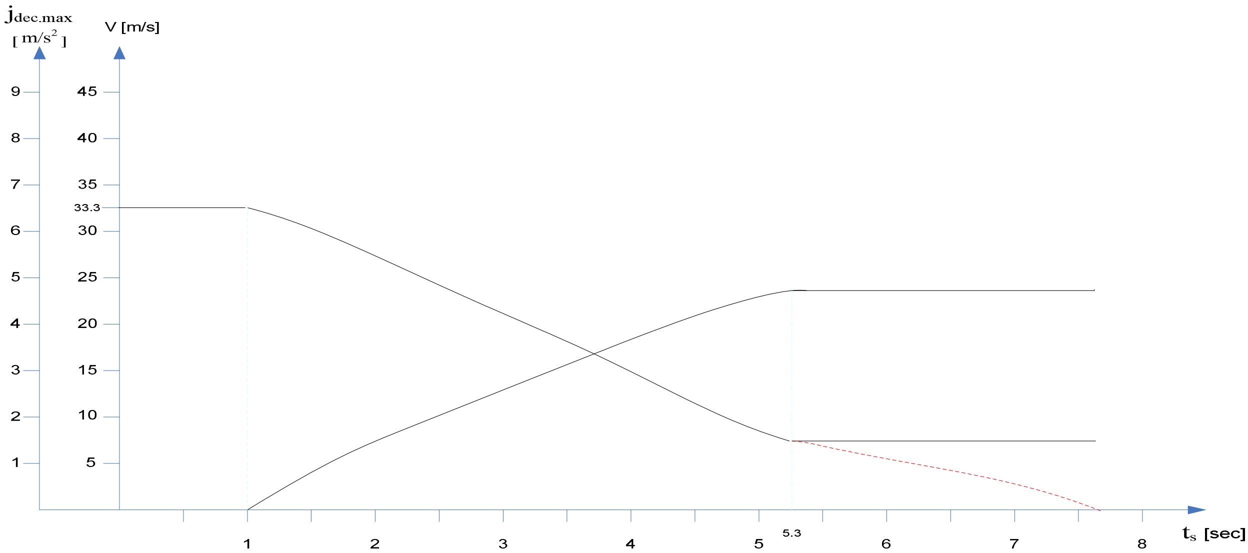

Fig. 13.The actual relationship between velocity, maximum deceleration verses time.

The relationship between the vehicle speed, maximum deceleration and the stopping time is shown in the following fig. 14 where a comparison between the normal theoretical relationship and the actual relationship using digital retarder .

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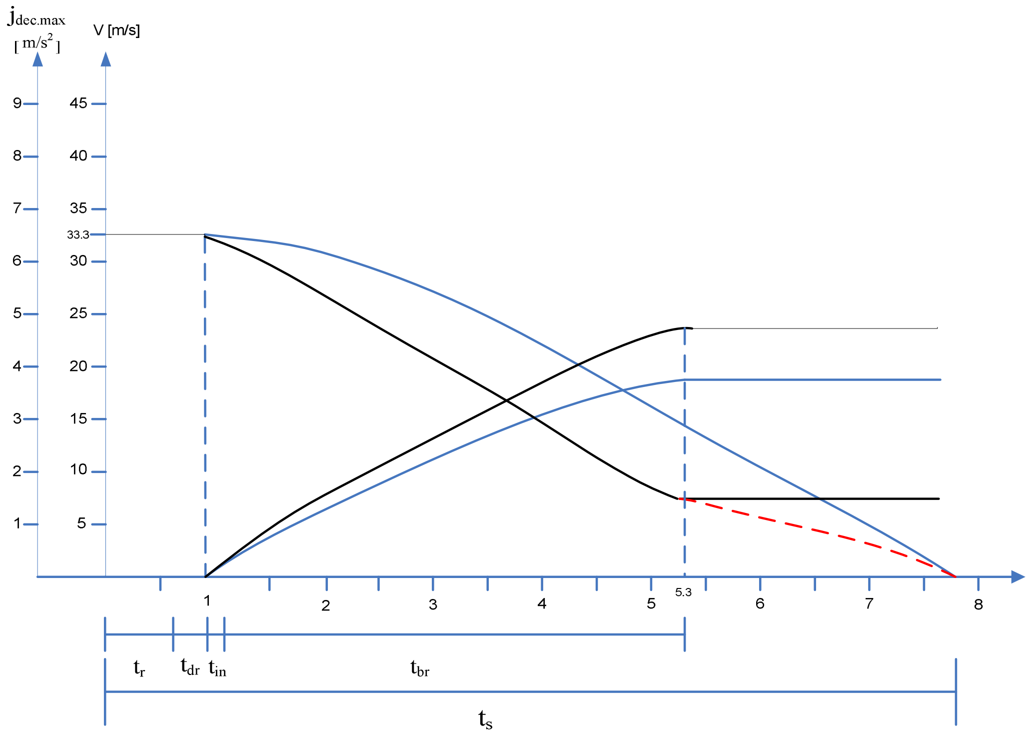

Fig. 14 :The actual and theoretical relationship between velocity, maximum deceleration verses time.

Figur15 shows the installed device inside the automobile and its first measurements of the automobile speed.

Fig. 15. Shows a comparison between device speed value and automobiles speed counter value.

Fig. 16. Shows the systems operation when it receives a GPS signal that there is a virtual retarder or a deceleration point.

Fig. 16. **a**- the system starts working and receives a signal, **b** and **c**- servo motor starting, **d** and **e**- slow down and deceleration.

4.Conclusion

Digital retarder has many advantages such as: reducing the huge number of accidents on roads, control the inappropriate behavior of reckless drivers, replacing speed control systems used by Public Security Directorate, such as radar system and fix speed control cameras, etc . It also saves the efforts for speed control .

So, it is clear that using digital retarder is economically efficient to be applied by the governments. Using the global positioning system in digital retarder provides free wide range usage, and it can be fitted in any vehicle, moreover the idea of sudden brake has been canceled. The servo motor which was used has enough power to pull down the brake pedal and we have chosen the servo with the maximum power in order to be sure that it will operate safely without any problems.

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