

Location Sensitive Speed Adaptation System for Automobiles

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ABSTRACT: Location sensitive speed adaptation (LSSA) is a safety technology that alerts drivers when they exceed the speed limit. LSSA activates when a driver exceeds the posted speed limit for a section of road by a set speed. Audio and visual warnings activate to remind the driver that they are going too fast. LSSA contains a speed control system which helps in forcibly reducing the speed of the vehicle to comply with the speed limit of the zone it is to enter. Speed control is done by controlling the fuel flow to the engine.

KEYWORDS: Location sensitive, speed limit, control, forcible, flow control.

I. INTRODUCTION

Location Sensitive Speed Adaptation (LSSA) is any system that constantly monitors vehicle speed and the local speed limit on a road and implements an action when the vehicle is detected to be exceeding the speed limit. This can be done through an advisory system, where the driver is warned, or through an intervention system where the driving systems of the vehicle are controlled automatically to reduce the vehicle's speed. Location Sensitive speed adaptation uses information about the road on which the vehicle travels to make decisions about what the safe speed should be. This information can be obtained through use of a digital maps incorporating roadway coordinates as well as data on the speed zoning for that roadway at that location, through general speed zoning information for a defined geographical area (e.g., an urban area which has a single defined speed limit), or through feature recognition technology that, detects and interprets speed limit signage. The purpose of LSSA is to assist the driver in keeping to the lawful speed limit at all times, particularly as they pass through different speed zones. This is particularly useful when drivers are in unfamiliar areas or when they pass through areas where variable speed limits are used. Most drivers do not appreciate the extra risks involved in traveling just a few km/h over the speed limit. Most think that the risk of a casualty crash is doubled if traveling at least 25 km/h over the speed limit. Research has found that, in urban areas, the risk of a casualty crash is doubled for each 5 km/h over the limit. So traveling at 70 km/h in a 60 km/h zone quadruples the risk of a crash in which someone is hospitalized. As a result, it is estimated that about 10% of casualties could be prevented if the large group of motorists who routinely travel at up to 10 km/h over the limit were encouraged to obey the speed limits. About 20% of casualties could be prevented if all vehicles complied with the speed limits. Savings in fatal crashes would be larger. There are many types of systems of which GPS based system is the most recent and effective system. A GPS receiver is used with the LSSA system to detect the vehicle's current location on the earth as coordinates, and this coordinates are used to find its location by a preloaded map which contains the information about the roads and its various highway signals and speed limit.

II. SYSTEM OVERVIEW

LSSA determines the location of the car through global positioning (GPS) navigation and cross references this information to a digital road map containing speed limit information for each road. It then analyses the speed of the car and issues a visual and audio warning to notify the driver if they are travelling at a defined amount (e.g. 2km/hr.) or more over the speed limit. If LSSA is used as an active speed limiter it can physically prevent the driver from exceeding the posted speed limit by reducing the throttle signal going to the car's computer if it detects excessive throttle for the current speed limit zone the car is travelling in.

Speed limit of the area > vehicle current speed = not over speeding, speed limit of the area < vehicle current speed = over speeding
The above equations are made use in the processor which collects and compares data and determine if the vehicle is over speeding or not in that current location it is travelling in.

III. DRIVER ASSISTANCE

It performs the role of advising the driver when the speed limit is being exceeded and advising when speed limits change along a stretch of road such as those associated with traffic conditions, weather or school zones advising of the current posted speed limit in any location preventing excessive speeding.

IV. NEED OF LSSA

On considering the issues that can be resolved by implementing our project on a large scale, is give below. This depends on the data collected on the percentage of road accidents caused due to over speeding alone.

A. Approximate statistical data

- Serious injury crashes could be reduced by up to 13%
- Fatal crashes could be reduced by up to 24%
- LSSA can contribute to significant reductions in fuel consumption and automobile emissions without significant increase in travel times

V. LOCATION SENSING AND DATA INPUT TO SPEED CONTROL SYSTEM

- The computing application that is made use for the location sensing and in providing the appropriate data input to the speed control system as and when required

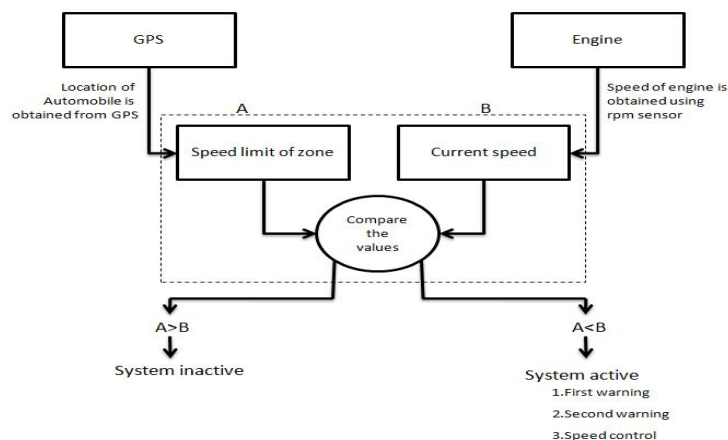


FIG. 1 PROCESS FLOW CHART OF PROCESSOR

VI. MAJOR COMPONENTS IN LSSA

The LSSA system contains two major components which play the vital roles in its working. They are:

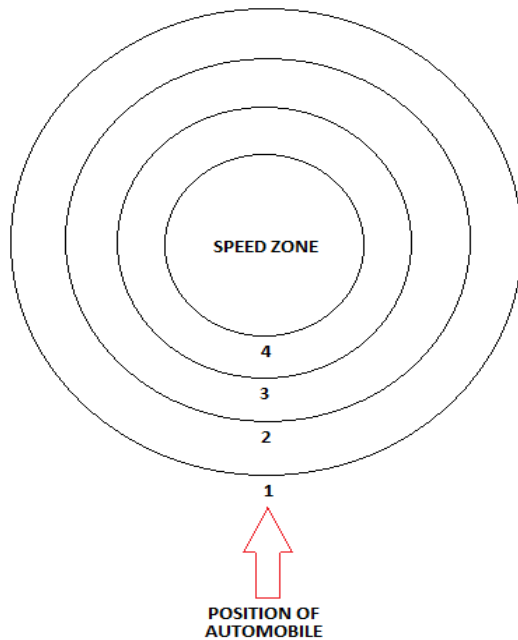
A. Location sensing

This system receives and interprets the required data from the Global Positioning System (GPS), which contain information about the current location of the automobile and the speed zone it is travelling in as well as the speed zone it is to enter. There are special applications in android, apple and Windows which contain information about the speed limits and speed zones of each area. This system helps in diagnosing in advance if the automobile is over speeding or not by comparing its current speed to allowable speed of that zone it is going to enter.

Parts of location sensing system:

- Global Positioning System (GPS): To receive the location of the vehicle and speed limit of that zone.
- RPM sensor: To recognise the speed at which the vehicle is travelling.
- Audio-visual warning system (for driver): Acts as an interface between the system and the driver to keep him informed.

a) Processor: Programmed to compare the speed of the vehicle with the maximum allowable speed of that zone obtained from the GPS and to decide whether the speed control system should become active or stay passive.



Key:

1. Speed awareness (advance sensing of next speed zone). First audio visual warning (if over speeding).
2. Second audio visual warning (if speed not reduced)
3. Speed control system active
4. Automobile complies with the speed limit and then enters the zone.

Fig. 2 Advance Zone Recognition and Processing

1) *Equations*

Let the speed limit be "x"

a) *Entering Speed awareness zone (1-2)*

Speed of the vehicle sensed using the rpm sensor

Let the current running speed be Y1

Compare "X" and "y1"

No warning given if

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$x=y1$ or
 $x>y1$
First warning (beep sound) given if
 $x<y1$

b) At 3: Second warning zone (3)

Comparing "x" speed from rpm sensor to "Y2" current travelling speed
No warning given if,

$x=y2$

Or

$x>y2$

Second warning given with alarm if

$x<y2$

c) At 4 entering speed control system active zone

Comparing speed "x" with "y3" current speed from rpm sensor

Speed control system inactive and no warning given if:

$x=y3$

Or

$x>y3$

(Here the top speed possible is the speed limit of the locality currently in)

Speed control system active and warning system active if:

$x<y3$

(Speed reduction is active showing an audio visual warning system to the driver of the automobile)

B. Speed Control System

A non-conventional principle of flow control of fuel is used for controlling the speed of the automobile, the usage of such a system helps in increasing the quality and life time of it, unlike the conventional brake system which is used for speed control. During braking, there is wear and tear which may decrease the engine efficiency and its lifetime to a certain level.

C. Flow control system

The flow control system contains a solenoid valve which is placed in the fuel line between the fuel tank and the Fuel Injection Pump (FIP). This valve is used to control the flow rate of the fuel flowing through to the FIP. The solenoid valve is operated according to the electrical signal it receives from the processor. When the solenoid valve is activated, the flow rate of fuel fed to the FIP is reduced which in turn reduces the speed of the automobile accordingly. But a small opening is provided in the valve during the activated position for fuel required for idling of the engine to keep it alive.

When the valve is the activated (closed) position, a back pressure is created in the fuel line. This back pressure is neutralized using a pressure relief system which sends the excess fuel back to the fuel tank.

When the electrical supply for the solenoid valve is cut off by the processor, the valve opens allowing normal flow of fuel to be regained.

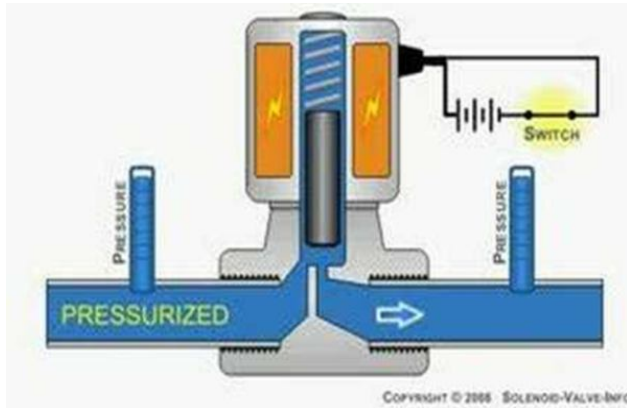


Fig. 2 Solenoid valve

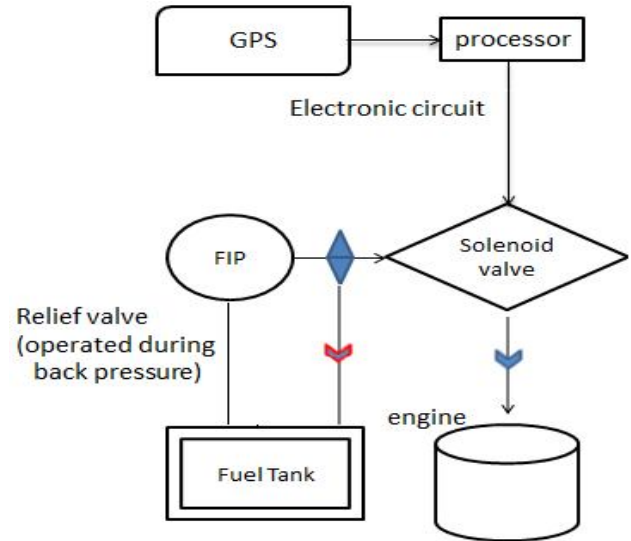


Fig. 3 Block diagram of LSSA

VII. GRAPHICAL REPRESENTATION OF SPEED CONTROL SYSTEM WORKING

When we plot a graph with respect to the corresponding speed of the automobile at each phase of our systems working. A total of 3 phases are taken into consideration namely,

- Speed control system inactive
- Speed control system active
- System inactive (fuel flow regained)

The graph is plotted approximately having 50km/hr. as its speed limit to be maintained

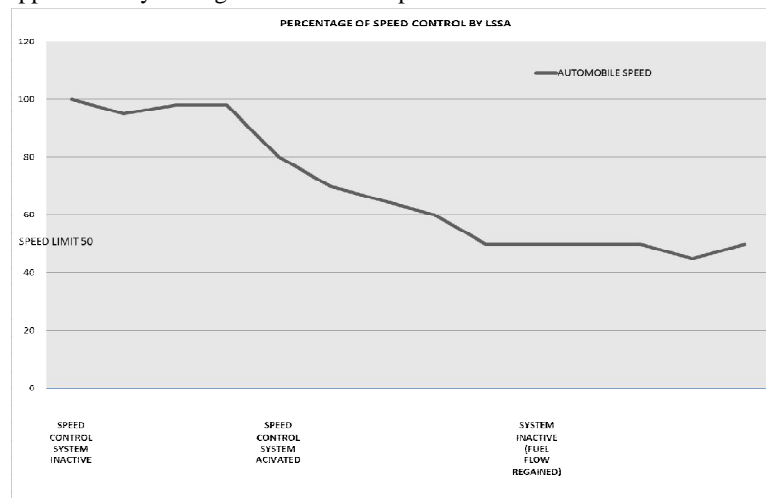


Fig. 2 Advance Zone Recognition and Processing

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- Phase 1: (speed control system inactive)

The automobile travels at any speed as desired by the driver, when LSSA system is active it compares the speed limit of the zone the automobile is about to enter and warns the driver twice. Once the warning is ignored by the driver the speed control system is sent the power supply for its activation.

- Phase 2: (speed control system active)

The slope in the graph in this phase indicates that the speed of the automobile is reduced gradually from 98 to 50 km/hr.

- Phase 3: (speed control system inactive)

When the automobile travels at nominal speeds under the speed limit of the zone the speed control system remains inactive, but this condition is only if the driver complies with the speed limit of the area. In case he again exceeds the speed limit the warnings are given and if ignored like the previous situation again the speed control system is activated making the driver to follow the speed limits without a choice.

Increase in speed above speed limit.	10%	20%	30%	40%	50%
Location					
City roads	3	4	7	9	15
Highway	1	2	4	7	10
Village areas	0	0	2	3	6

Table. 1 Approximate Survey of vehicles Exceeding Speed Limit per 50 vehicles.

VIII. DATA FLOW IN LSSA FOR SPEED CONTROL

The data flow of LSSA that determines the activation of the speed control system can be explained with an example situation of the system, let's take an automobile is about to enter a speed zone of 50 km/hr. zone but is travelling at 100km/hr. speed (i.e. Exceeding the speed limit by 50 km/hr).The processor in our system does the Boolean processing of the data initially received from the engine (current speed) and and from the GPS (local speed limit)

- Equation

Let the speed limit be "50km/hr."

- Entering Speed awareness zone (1-2)

Speed of the vehicle sensed using the rpm sensor

Let the current running speed be 100 km/hr.

Compare "50" and "100" km/hr.

First warning (beep sound) given

$50 < 100$

- At 3: Second warning zone (3)

Comparing "50" speed from rpm sensor to "98" current travelling speed km/hr.

Second warning given with alarm

$50 < 98$

- At 4 entering speed control system active zone

Comparing speed "50" with "80" current speed from rpm sensor
(Here the top speed possible is the speed limit of the locality currently in)

Speed control system active and warning system active
50<80

(Speed reduction is active showing an audio visual warning system to the driver of the automobile)

Speed control system is deactivated when the automobile current speed becomes equal to the speed limit of the zone.

Speed of the automobile is <50 km/hr. or equal to 50 km/hr.

Speed < 50 km/hr.

(or)

Speed = 50 km/hr.

- This condition of the system being inactive is only applicable till the driver complies with the speed limit of the zone, in case of again exceeding the limit the speed control system is activated.

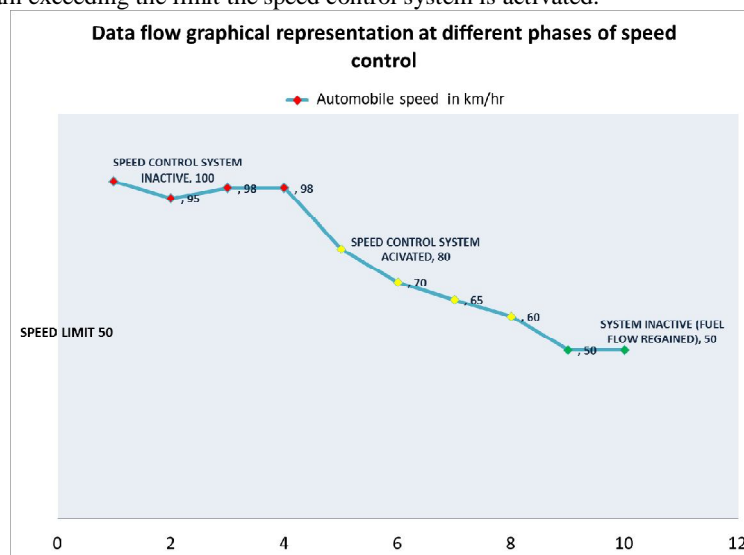


Fig. 3 Advance Zone Recognition and Processing with speed levels in **km/hr.**

IX. ADVANCED LSSA SYSTEM

As a improvisation to our system, in case of using a stepped solenoid valve, we custom set the valves flow level for each corresponding speed of our automobile, then once the automobile speed is reduced to the speed limit by closing of the valve to 30% flow (the stepped valve can close to various % pre-set to it) the valve position will remain so till the time the automobile travels in that zone. Making it mandatory to the driver to comply with the speed limit as he will not be able to accelerate above the speed limit of that area.

X. ADVANTAGES OF LSSA

LSSA, when put to use on a large scale, leads to the following advantages:

- Serious injury crashes could be reduced by up to 36%
- Fatal crashes could be reduced by up to 59%

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- In addition, LSSA can contribute to significant reductions in fuel consumption
- Decrease automobile emissions without significant increases in travel times.
- The efficiency of the engine is not affected, as the flow control in our system is similar to that of the vehicle's deceleration process.

XI. ADDITIONAL FEATURES OF LSSA

This system has some add-on features which would increase driver and pedestrian safety in many ways. Such features are:

- The GPS system can be added with a feature of detecting school and hospital zones where the necessary speed control and anti-honking can be done respectively.
- This system can also be used as a tracking device to track down vehicles by the police.

XII. RESULT AND DISCUSSION

Statistical results can be made possible when applied on a large scale. Hence the over speeding of vehicles can be drastically reduced and a lot of innocent lives can be saved. The speed control system used here being a flow control system wear and tear is very less when compared to the other conventional systems and also proves to be cost effective. The application of this setup is common to all automobiles, usually all automobiles that use fuel injection systems.

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