Vehicle Speed Control based on Automatic Electromechanical Breaking System

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Abstract— In this paper we consider an automatically controlling speed mechanism for vehicles at restricted areas such as schools, hospital zones etc. It is not practical to monitor these sensitive areas throughout. In this system, a way for controlling the speed of the vehicles within certain limit in restricted zones without interruption of the driver's role is discussed. A mechanical setup along with a stepper motor is designed for a specific vehicle which is controlled by a micro-controller. A radio-frequency (RF) trans-receiver is used for this purpose with interface to micro-controller for control operation. Results and discussion shows that this proposed system is reliable scalable and effective for the regulation of speed according to coded signal transmitted by transmitted in the sensitive accident prone zones.

Key words: RF Trans-Receiver, Stepper Motor, Automatic Speed Control, Electromechanical System

I. INTRODUCTION

Most of the road accidents in India occur due to over speed and rash driving of vehicles on public roads. The rate of accidents has increased as more vehicles come on to ground. To control and monitor the speed of vehicle on public roads the respective departments of government has taken necessary step. But it is not doing enough. Presently the motor vehicle departments have been provided with laser speed detectors. But a man has to be there on road, which is not an ideal way for monitoring. Also, the laser tracker is very costly. Here in this project, we tried to develop a system to track the speed of the vehicle in a much simpler, economical way. This system has to work 24x7 automatically. The first idea was to use laser module, but finding it costly it was dropped. Later we found out that IR transceivers will help in achieving the goal, which is very simple to construct and very cheap, but it works only if the line of sight is maintained which was the main reason it was dropped. Finally, it is found that RF trans receiver module can fulfill our requirements with its key features as more economic, high reliability etc.

II. LITERATURE SURVEY

In [1] this paper proposed work by authors is based on using the GPS receiver module which helps in tracking vehicle's position. Using the per-loaded map and speed zone database correlation speed adaption is done. But its disadvantage is it requires large memory to store the complete map and speed zone database. Another author in his paper [2], proposed to control the vehicle by using optical reorganization system. In this camera is used to record continuously, when sign board is approached, the sign is recognized by image processing techniques. The disadvantage of this system is in some critical cases like the sign board is covered by Tree, Branches the system does not detect sign board.

Using Dead Reckoning (DR) mechanism, the author's in this system [3] used sensors to plot the path taken by the vehicle. By superimposing this path onto a digital map, the DR system acknowledges whereabouts the vehicle approximately, what are the various zonal speed limitations, vehicles speed etc. Complexity of this system increases as it uses several sensors and chances of deviation from actual position are high. In [4] according to author, by using RF and global system for mobile communication (GSM), first they alert the driver when his speed of car exceeding speed limit.

If he doesn't follow the rule then message goes to police station using GPS. But the disadvantage of system is global satellite positioning (GPS) requires network or range for all time. If network is not on the road, then system does not work properly. In [5], according to author by using RFID (Radio Frequency Identification) module as its main component speed is automatically controlled. In this RFID tag is fixed on the different sign board and RFID reader on the vehicle. When the reader comes in the speed limit area, speed is controlled automatically. Requirement of large memory to store the database and its cost are the demerits of this system. Researchers in [6], proposed that by using buzzer, they fix some sort of transmission (TX) system on the highways which can detect the speed of vehicle and convey to the driver that is not in the permitted speed limit in particular area and alert the driver through buzzer. But the disadvantage of system is, there is not automatic control on speed, so driver can break the rules. Author's in paper [7] proposed that by using Wireless technology like GPS, they tried to maintain the speed control over restricted area like schools, hospitals etc. Disadvantage of system is GPS always require a network into sim card and it requires large memory to store the complete map and speed zone database.

According to authors in [8], by using path frame work, they focus on the control layer that manages the different platoons in the traffic network and that controls speed and lane changes of the platoons. Demerits of this system is that it requires path framework and platoons. In [9] According to author in this system work were done by using ARM7. In this project, they proposed the dynamic model where the system controls the vehicle according to the data frame transmitted by receiver-transmitter unit (RF-TX). This is RFID based speed control system and the disadvantage of system is, they use RFID to store more data in database, so large memory is required.

III. PROPOSED ALGORITHM

Vehicle motion dynamics is a well-studied topic but techniques to control vehicle's speed as described above have failed, because of technical as well driver's casual driving approach. The proposed electromechanical system doesn't give much freedom to driver to speed up in speed limited zone. The driver is bounded to drive within the predetermined set speed.

In this work, it is decided to make use of micro-controller PIC16F877A, a stepper motor and RF trans-receiver module.

In this project, RF transmitter is placed at sign board and RF receiver is placed at receiver side which is shown in Fig 1 i.e. inside vehicle. When the receiver in speeding vehicle approaches the sign board, its receives the set transmitted speed and accordingly an alarm rings warning driver not to speed up and simultaneously the stepper motor moves the threaded rod upward by certain threads to lock the accelerator paddle, preventing the driver from further accelerating as shown in Fig. 2.

A constant acceleration i.e., a fixed speed is maintained as per local area selected. When vehicle is out of the restricted, the proposed mechanism goes to its idle position and thereby letting the drive as per his required speed. In this way, it reduces all the drawbacks of previously mentioned works and provides an effective and novel solution for speed control. It is simple and easy to implement the proposed work with reduced cost and handle the speed of vehicle in an effective way.

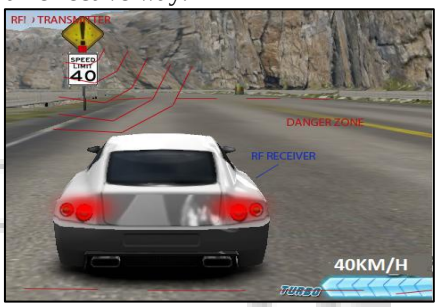

Fig. 1: RF transmitter/receiver antenna on signboard and vehicle respectively.

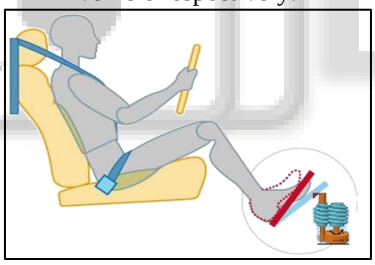

Fig. 2: Electromechanical mechanism at accelerator paddle.

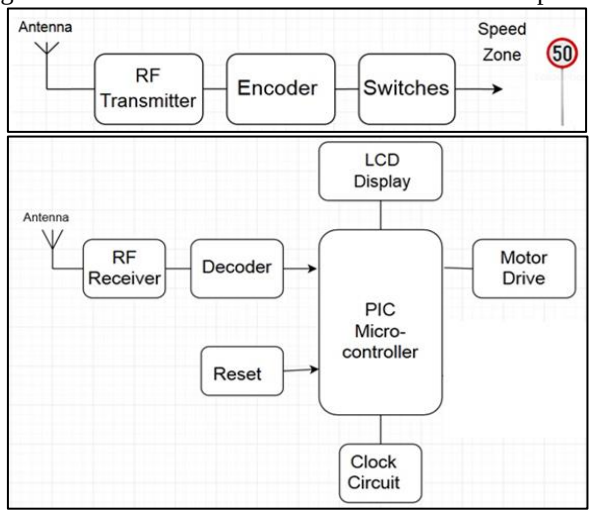

Fig. 3: Block Diagram of Control System mechanism

A detailed analysis, pros and cons of the proposed working mechanism will be studied in future scope of this paper. The working principle is described using the flowchart of Fig.3. In this system, there are two parts first one is Transmitter section and second is receiver section. At transmitter side, we have RF transmitter which is going to transmit encoded signal that signal is encode by encoder and send it through the antenna. This signal is set by switches to set the speed limit i.e. 40km/h or 60km/hr. At the receiver side, there is RF receiver which receives signal from transmitter side through the antenna. After receiving signal is decoded by decoder and give it to micro-controller. Controller sends that signal to motor that rotate clockwise or anti clockwise to restrict the driver to press accelerator beyond the speed limit. This is as per the received signal speed limit i.e. 40km/hr. or 60km/hr. etc. The modules in the proposed system are: RF transmitter consisting of a power source, an Encoder and RF transmitter and Receiver module consisting of RF receiver circuitry connected to the micro-controller through a RF decoder for establishing wireless communication. Stepper motors are interfaced with the motor driver which controls the motors according to the information provided by the controller and this will be displayed on the LCD screen.

IV. ELECTRO-MECHANICAL SYSTEM

Inputs to paddle is applied through foot movement in up and downward direction which causes variations in acceleration and velocity. Several studies have proved that the vehicle speed is a nonlinear function of the throttle angle. Ioannou and Xu [11] proposed that the vehicle speed dependent on the throttle angle, time period and the presence of dynamics during an acceleration process. As illustrated in Equation 1 given below that

$$da = B \times d\Theta \qquad (1)$$

At each small-time interval Δt, the deviation of the acceleration (da) directly changed with the deviation of the pedal angle ($d\Theta$), and B is a constant parameter estimated in [12]. By using this equation, angle of paddle and fixed speed limit can be determined and according the stepper motor can be programmed to prevent the driver from accelerating in the speed restricted zone.

V. MERITS OF THE PROPOSED SYSTEM

1) Speed is fully automatically controlled by use of this system from end to end without any human intervention or ignorance.
2) By application of this proposed mechanism, the rate of accidents in restricted zone is definitely going to be reduced.
3) The deployment of this cost-effective mechanism is simple and easy in any four-wheeler vehicle.
4) This system explains the smart vehicle control based on the RF Transmitter receiver technology and same shown in figure 4. It has explained how transponders and readers can be used to communicate with the vehicle thereby providing auto vehicle control with the speed control unit (SCU). This technique for speed control can prove an effective way to limit speed in upcoming vehicles with adjustable antenna range according to width of highways. In extension of this work, a detailed correlated analysis between vehicle's gear position and accelerator locking position will be implemented. In

Table, the height between accelerator paddle and based is measured of car model TATA Indigo C. Same is imitated and a prototype is developed. After analysis a feedback control system will be designed for quick and robust control of vehicle speed. This speed control mechanism can play important part in future gearless vehicles. Thus, this can revolutionize the speed management and avoid accidents caused due to over speeding or driver's negligence of traffic rules in the near future.

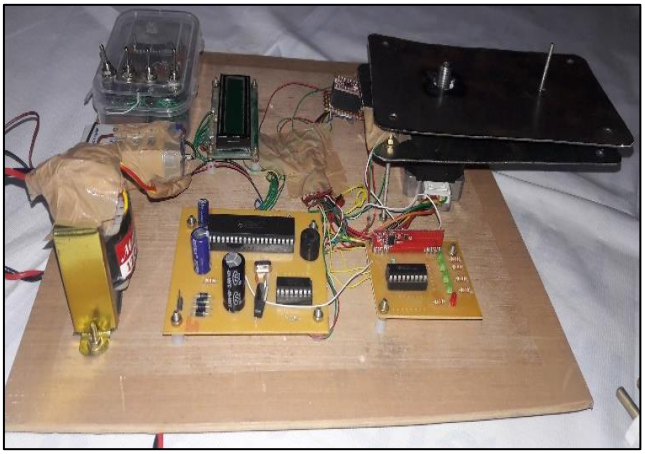

Fig. 4: Electromechanical mechanism of Speed limit system

The above figure shows the circuitry of our system with every component build in it. Here we have used microcontroller, RF trans receiver, LCD, HT12E and HT12D, Bipolar stepper motor, Hall effect sensor, Transformer. We have implemented each component for the proper use.

No.	Speed	With gear	Height
1.	20	1st	3.5cm
2.	20	2nd	4.2cm
3.	40	2nd	1.9cm
4.	40	3rd	4.5cm
5.	60	3rd	4.2cm
6.	60	4th	4.4cm

Table 1: Accelerator calculation for TATA Indigo CS

VI. Conclusion and Future Scope

It is an attempt to test and implement the discussed electro mechanism prototype in paper in nowadays cars. It will be helpful in curbing the road accidents in sensitive zones. The right of driver on overtaking and over speeding is put to limit control. The above prototype can be installed in vehicles which will reduce the speed automatically when the vehicle is about to collide or is nearby another vehicle by implementing the transmitter and the receiver module in individual vehicle.

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