

SPEEDZAP

An Embedded based speed control device

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Abstract -- In the recent years, the growth in India's automobile market is exponential, thanks to 100% FDI allowed by the Indian government. Though the number of vehicles on road increased multi fold, not much is done in the field of road safety. In India, there is one accident for every minute and one death for every three minutes due to road accidents^[1]. Road safety is not only the concern in India but also globally so much so that UN General Assembly adopted a resolution in 2010 to declare 2011 – 2020 as the Decade of Action for road safety. According to the Transport Research wing of Indian Ministry of Road Transport & Highways ^[1], 42% of road accidents are caused due to over speeding. Out of it 30.3% the accidents are caused by people in the age group of 15-24 years. In order to prevent and reduce such tragedies, an embedded electronic device is designed to prevent the over speeding of vehicles and thereby the accidents caused due to over speeding. SpeedZap device continuously governs the speed of vehicle and cautions the driver with a warning message if the vehicle speed nears 95% of the speed limit and if the speed limit is crossed, the vehicle would be forced to halt after giving a grace period for navigating the vehicle safely to the side of road. It simultaneously sends an SMS with the vehicle number to a preprogrammed traffic control room GSM number and the vehicle can be restarted only on the receipt of clearance SMS from the traffic authorities.

Keywords-- speedzap, over speeding, Road traffic accidents.

I. INTRODUCTION

Thanks to the liberalized economic policies of the Indian government, Indian road network grew tremendously - more than 11 times between 1951 and 2011^[1]. Now it boasts a network connectivity of 4.7 million Km which is the second largest in the world next only to USA. The quantum leap in the road infrastructure coupled with the 100% FDI in automobile industry saw a 473 fold increase in registered motor vehicles within the last 60 years. The number of registered vehicles touched a staggering figure of 114,952,000^[4]. This has revolutionized the travel industry.

Today India has 1% of the total motor vehicles in the world, but unfortunately, 6% of the global road traffic

accidents are taking place here^[2]. This is mainly due to the apathy of our government in improving and implementing the advanced road safety measures in line with the modern high speed motor vehicles on road.

Road traffic accidents are not only India's grave concern, but also has become a global phenomenon which prompted the UN general Assembly to adopt the resolution 64/255 in 2010 which declared 2011- 20 as the 'Decade of action for road safety'^[3].

II. STATISTICS ON ROAD TRAFFIC ACCIDENTS

Across the world, nearly 1.3 million people die yearly due to road accidents while 20 to 50 million people are becoming disabled ^[4]. Young adults of age 15-44 years form 53% of road traffic fatalities ^[7].

In India, 61% road traffic accident death victims are either driver or passengers of motor vehicles. 2% of accident victims endure permanent disability^[4].

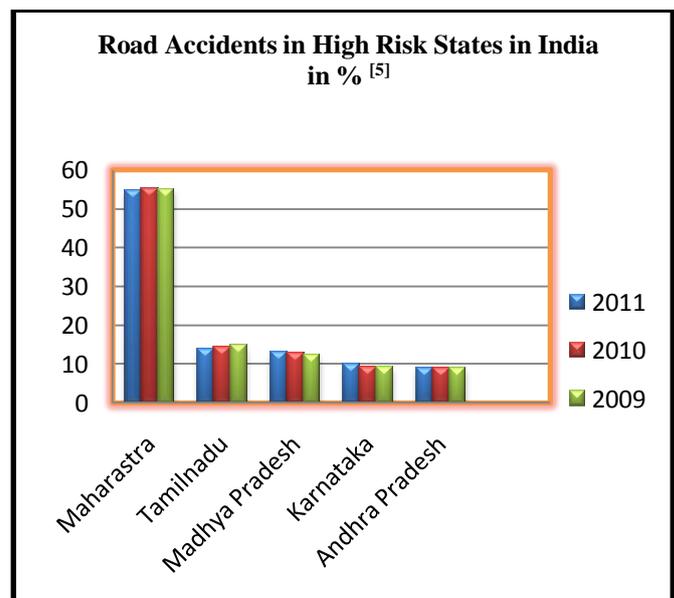


Figure 1: All India Share of Select States (in %)^[5]

From the above figure, it is seen that in India, Maharashtra, Tamil Nadu, Madhya Pradesh, Karnataka and Andhra Pradesh are the five high risk states wherein 50.5% of total fatalities occur. [5] From 2002-2011, there is a 6.3% increase in the fatal road accidents and 7.8% increase in casualties [6]. In the year 2011, there were 497,686 road accidents out of which 142,485 people succumbed to the injuries. Road accidents caused financial loss of USD 100 billion dollars to our country in the year 2011, which is 3% of our national GDP.

III. CAUSES OF ROAD ACCIDENTS

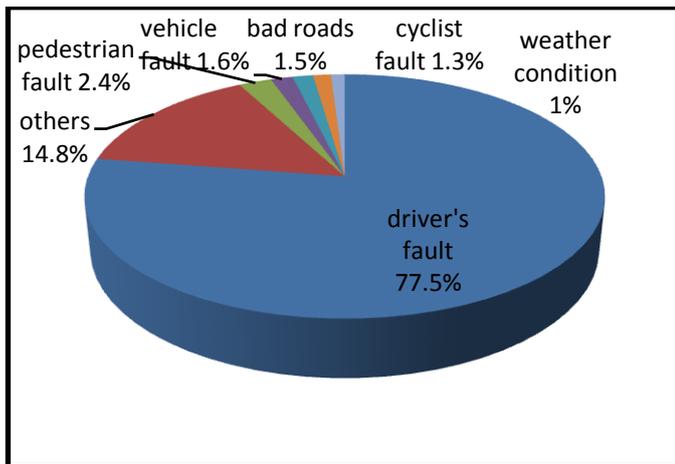


Figure 2: Causes of Road Accidents in India, 2011 [5]

According to the above figure, 77.5% of road accidents are caused due to the fault of drivers such as over speeding, overtaking, etc...

It is heart wrenching to state that these accidents could have been averted if traffic rules were strictly enforced and followed. Laxity in enforcement of traffic rules, blatant traffic violation and non use of safety gears are the major reason for the road accidents.

IV. CURRENT MEASURES IN CURBING OVERSPEEDING

Speed guns are used by traffic police to book the violators. However it calls for high investment in the procurement of speed guns besides deployment of large manpower round the clock.

The other alternative is the construction of speed breakers at accident prone areas. Though this may help to some extent, it poses a risk to drivers on national highways in the night as there won't be any lightings to pre warn them about the approaching speed breakers.

V. SPEEDZAP PROPOSED SOLUTION

To avoid accidents due to over speeding, we designed a small, vehicle mountable and cost effective electronic device which performs the following functions.

- Monitors the speed of the vehicle continuously in real time every second and warns the driver with a LCD message if the speed of the vehicle is close to 95% of the speed limit.
- Halts the vehicle if the speed is beyond the threshold level after giving due warning to the driver. The grace period given to the driver to safely navigate the vehicle to the side of the road is programmable.
- Sends SMS, which contains the vehicle number to the pre, programmed GSM number of Traffic Control Room.
- The vehicle can be restarted only on the receipt of clearance SMS from the traffic control authorities. In addition SMS can also be sent to any family member for information.

This device ensures that, the defaulter pays the fine for over speeding and it helps to avoid accidents due to over speeding as the over speed vehicles will be forced to halt. In addition, it can enable the traffic authorities to generate a log of frequent defaulters for further action like revoking their licenses. It helps to do away with the deployment of man- power for monitoring the vehicle speed.

VI. SPEEDZAP ARCHITECTURE

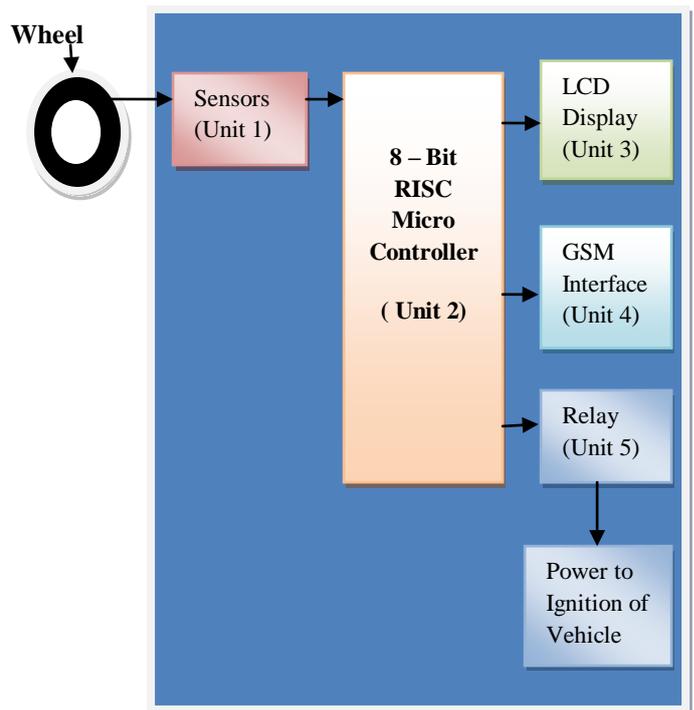


Figure 3: Hardware Architecture of Speedzap

As shown in the above figure the device hardware consists of 5 units.

- Unit 1 consists of proximity sensor which is fitted on the mudguard of one of the rotating wheels.

- Unit 2 consists of 8 bit RISC microcontroller.
- Unit 3 comprises LCD display
- Unit 4 consists of GSM interface
- Unit 5 consists of relay Circuitry.

The software of the device is written using open-source Arduino integrated development environment (IDE). Arduino programs are written in embedded C. The code which monitors and initiates the output operations of microcontroller is written as function under loop () which gets repeatedly executed until the device is switched off.

VII. SPEEDZAP - FLOW DIAGRAM

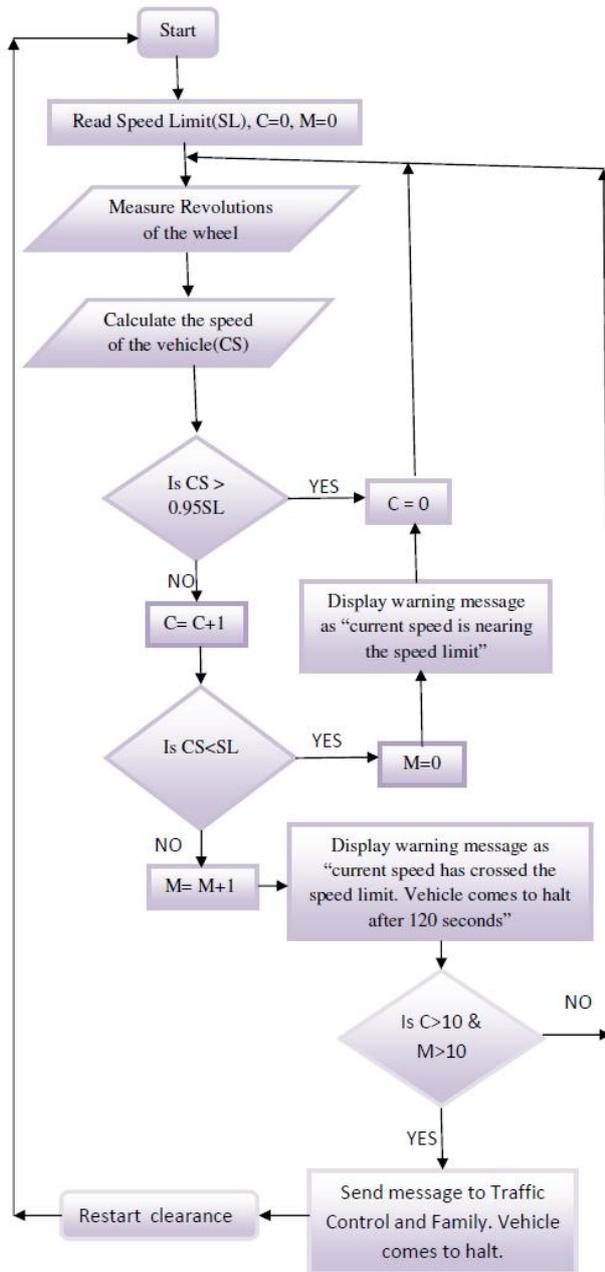


Figure 4: Flowchart depicting control flow in speedzap

VIII. SPEEDZAP - WORKING PRINCIPLE

The revolution of the wheel of the vehicle is determined every five seconds in real time by using proximity sensors mounted near the wheel of the vehicle.

8 bit RISC microcontroller is used as a control element in the device. RISC architecture is selected for the following reasons.

- Each instruction is executed in one clock cycle.
- The program execution time remains same irrespective of the number of times it needs to get executed.
- It ensures constant and reliable response time for the device which is usually in seconds.

The Microcontroller calculates the speed of the vehicle by using the following formula.

$$\text{Speed in Km/h} = (2 * 22 / 7 * r * N * 18) / 5 \quad (1)$$

Where r = outer radius of the wheel of the vehicle in meters.

N = No of revolutions of wheel per minute

IX. SIMULATION STUDIES

Keeping the requirement speed as main parameter to monitor and personnel to be informed about the speeding as another parameter, the Speedzap device is designed and programmed. Before installing in a vehicle, dry testing was carried out by simulating a wheel rotation in front of the proximity sensors using a rotating fan at various speeds.

X. EXPERIMENTAL ANALYSIS & RESULTS

The prototype of Speedzap was designed and successfully tested on Bajaj Discover and TVS scooty. It met all the design parameters and passed the set test conditions. The response time of the device is programmable.

To have ease of implementation and to avoid meddling with the existing vehicle setup, we have used wheel revolutions for calculation of speed, instead of the RPM of the engine. Hence it eliminated the need to know the gear in which the vehicle is being driven. This also minimizes the wiring requirement. This setup acted as a check / verification to the speed calculated by the Speedzap device by comparing with the vehicle displayed speed reading.

The speed calculated by the device is compared with the pre programmed speed limit, continuously by the microcontroller.

When the speed of the vehicle crosses the speed limit, it gives warning message to the driver in the LCD display.

If the driver ignores the warning and increases the speed beyond the preset value, the controller initiates two activities

- It switches off the vehicle by disconnecting the power to the ignition coil after giving the driver

due warning and allowing grace period, the duration of which is preprogrammable.

- It sends SMS to a GSM number of the concerned traffic control room / to anxious parent who wants their ward to drive their vehicle within a certain limit.

Hence the device ensures centralized automatic data generation on all traffic violators around the clock. It doesn't require the deployment of traffic police on roads thereby it eliminates the need for large man power requirement. In addition to that it also ensures the prosecution of all traffic offenders irrespective of their clout, influential power and money power.

The device draws power from the vehicle's battery source.



Figure 5: Prototype Speedzap – Test set up.

XI. CONCLUSIONS.

The device can be mounted on any vehicle without interfering with the performance of the vehicle. The radius of the wheel, the GSM no and the grace time allowed before switching off the vehicle are the parameters to be programmed according to the type of vehicle.

This device can be made available to public at an affordable price of less than one thousand rupees. It efficiently prevents accidents due to over speeding. Since this device can be further improved to provide the location, time and speed at which the vehicle is travelling. By installing the Speedzap on all private transport vehicles like call taxis, private buses many accidents and unwarranted incidents can be avoided by monitoring from a central control room with less manpower.

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