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RESEARCH ARTICLE

Detection of Over Speeding Vehicles on Highways

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Abstract- This paper presents a device to detect rash driving on highways and to alert the traffic authorities in case of any violation. In past, lot of devices to detect rash driving on highways has been made. Most of the approaches require human concentration and involve a lot of effort, which is difficult to implement. In this paper we intend to design a system aimed at early detection and alert of dangerous vehicle driving patterns related to rash driving. The entire implementation requires an IR transmitter, an IR receiver, a control circuit and a buzzer. The speed limit is set by the police who use the system depending upon the traffic at the very location. The time taken by the vehicle to travel from one set point to the other is calculated by control circuit and displays that on seven segment displays. Moreover, if the vehicle crosses the speed limit, a buzzer sounds alerting the police.

Keywords- "555 Timer", "IR transmitter", "IR receiver", "Speed control", "Buzzer"

I. INTRODUCTION

Rash driving is the cause of many road accidents all over the world. A total of 4,73,084 traffic accidents were reported during the year 2001 in India. The road accident analysis chart [1], [2] sorted by the rate of road accidents is shown in fig. 1. The traffic population has increased considerably in India as there is no means to control or monitor the speed of vehicles running on roads. This system proves highly effective in detection of over speed driving. It is not at all necessary that such accidents are results of driving under the influence of alcohol as even a person who hasn't consumed alcohol can drive in a reckless manner [3]-[5]. To overcome this problem and decrease death rate due to accidents, introduction of new and innovative speed enforcement technology is necessary.

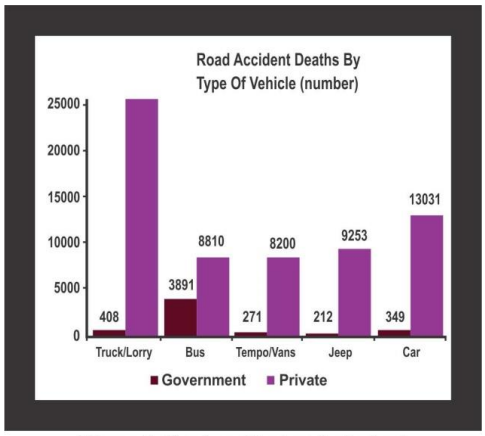

Figure 1. Road accident analysis chart

Nowadays, rash driving causes a serious danger to the driver as well as general public. Despite the fact that rash driving is a serious problem, its current methods of detection by patrol officers lack sufficiency [6], [7]. First of all, given the huge mileage of driveways, the number of patrol officers is far from enough to observe and analyze every driver's behaviors. Second, the guidelines of rash driving patterns are only descriptive and visual observations cannot specify the details of driving at night or in poor weather. In the present system, to detect rash driving police has to use a handheld radar gun [8], [9] and aim at the vehicle to record its speed. If the speed of the vehicle exceeds the speed limit, the nearest police station is informed to stop the speeding vehicle. This is an ineffective process as after detecting one has to inform the same and a lot of time is wasted. With the number of vehicles increasing day by day, this method cannot be trusted with the lives of people.

After keeping all these considerations in mind, we have designed a model of highway over-speeding vehicle-detecting circuit to control rash driving by the use of different electronic devices such as timer, counter, logic gates, seven segment display and several other components [10]. Though the proposed model can also be designed by using microcontroller but due to its high complexity and high cost, use of timer is preferable over microcontroller.

A wide range of sensor technologies are also available, such as inductive loops, video, ultrasonic detectors, microwave detectors and radar based detectors [11]-[13]. The history of speed enforcement is replete with examples of new enforcement techniques; subsequent negative public reaction and resistance; and finally, assuming survival through legal challenges to these techniques. The public's distrust of the use of high technology by enforcement officials is often evidenced by claims that the technology is simply another attempt by an article of Time magazine, "Big Brother Is Driving" [14] to invade their lives.

The advantage of our proposed over speed driving warning system is that it will come handy for the highway traffic police as it will not only provide a digital display in accordance with a vehicle's speed but will also sound an alarm if the vehicle exceeds the permissible speed for the highway. The proposed system will check on rash driving by calculating the speed of a vehicle using the time taken to travel between the two set points at a fixed distance. A set point consists of a pair of sensors comprising of an IR transmitter and an IR receiver, each of which are installed on either sides of the road. The speed limit is set by the police who use the system depending upon the traffic at the very location. The time taken by the vehicle to travel from one set point to the other is calculated by control circuit. Based on that time, it then calculates the speed and displays that on seven segment displays. Moreover if the vehicle crosses the speed limit, a buzzer sounds alerting the police. This concept can be extended in future by integrating a camera with the system which could capture the image of the number plate of the vehicle to sends that to the traffic authorities.

II. PROPOSED MODEL

In this section, we have designed a highway speed checker circuit to detect the rash driving using different electronic components such as timer, counter, logic gates, seven segment display and all other components. Fig.2 shows the typical block diagram of speed checker to detect rash driving on highways using a Timer which consists of sensor module, logical module, power supply, sound detector and display module. Further logical module comprises timers, NAND gates and decade counters.

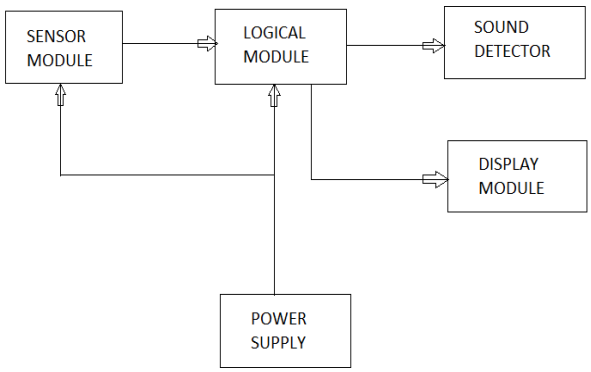

Figure 2. Block diagram of Vehicle speed detector using Timer

A photodiode used as sensor is a type of photo detector capable of converting light into either current or voltage, depending upon the mode of operation. Photodiodes are similar to regular semiconductor diodes except that they may be either exposed (to detect vacuum UV or X-rays) or packaged with a window or optical fibre connection to allow light to reach the sensitive part of the device. Many diodes designed for use specifically as a photodiode will also use a PIN junction rather than the typical PN junction. When a photon of sufficient energy strikes the diode, it excites an electron, thereby creating a mobile electron and a positively charged electron hole. If the absorption occurs in the junction's depletion region, or one diffusion length away from it, these carriers are swept from the junction by the built-in field of the depletion region. Thus holes move toward the anode, and electrons toward the cathode, and a photocurrent is produced which goes to the Timer. In this case, we use 555 Timer IC which is an integrated circuit (chip) implementing a variety of timer and multi-vibrator applications. The 555 has three operating modes:

Monostable mode: in this mode, the 555 functions as a "one-shot". Applications include timers, missing pulse detection, bounce free switches, touch switches, frequency divider, capacitance measurement, pulse-width modulation (PWM) etc.
Astable - free running mode: the 555 can operate as an oscillator. Uses include LED and lamp flashers, pulse generation, logic clocks, tone generation, security alarms, pulse position modulation, etc.
Bistable mode or Schmitt trigger: the 555 can operate as a flip-flop, if the DIS pin is not connected and no capacitor is used. Uses include bounce free latched switches, etc.

The circuit uses standard power supply comprising of a step-down transformer from 230v to 12v and four diodes forming a bridge rectifier that delivers pulsating dc which is then filtered by an electrolytic capacitor of 1000µf. The filtered dc being unregulated IC LM7812 is used to get 12v constant output at its pin no 3 irrespective of input dc varying from 9v to 14v. The input dc shall be varying in the event of input ac at 230volts section varies in the ratio of v1/v2=n1/n2. The regulated 12volts dc is further filtered by a small electrolytic capacitor of 0.1 µf for any noise so generated by the circuit. This is used as the supply for different ICs in the circuit.

A buzzer or beeper is an audio signaling device, which may be driven by an oscillating electronic circuit or other audio signal source, driven with a piezoelectric audio amplifier. Sounds commonly used to indicate that a button has been pressed are a click, a ring or a beep. Here, piezo-buzzer sounds an alarm if the vehicle crosses the distance between the IR Diode set-ups at more than the selected speed. Fig. 3 shows the theory of buzzer so as to emit the sound. Simultaneously, the time taken by the vehicle to cross both the IR Diode beams is displayed on the 7-segment display.

III. METHODOLOGY

This system has been designed assuming that the maximum permissible speed for highways is either 40 kmph or 60 kmph as per the traffic rule. Before operation, using a multimeter we have to check whether the power supply output is correct. If yes, apply power supply to the circuit by flipping switch to 'on.' In the circuit, we use long wires for connecting the two PHOTO DIODEs, so that we can take them out of the PCB and install on one side of the highway, 100 meters apart. We have installed two IR Diode transmitters (such as IR Diode torches) on the other side of the highway exactly opposite to the PHOTO DIODEs such that IR Diode light falls directly on the PHOTO DIODEs. Reset the circuit by pressing RESET switch, so the display shows '0000.'

Using switch S1, select the speed limit (say, 60 kmph) for the highway. When any vehicle crosses the first IR Diode light, PHOTO DIODE1 will trigger IC1. The output of IC1 goes high for the time set to cross 100 meters with the selected speed (60 kmph) and LED1 glows during for period. When the vehicle crosses the second IR Diode light, the output of IC2 goes high and LED2 glows for this period. Piezo-buzzer sounds an alarm if the vehicle crosses the distance between the IR Diode set-ups at more than the selected speed (lesser period than preset-period). The counter starts counting when the first IR Diode beam is intercepted and stops when the second IR Diode beam is intercepted. The time taken by the vehicle to cross both the IR Diode beams is displayed on the 7-segment display. For 60kmph speed setting, with timer frequency set at 100 Hz, if the display count is less than '600' it means that the vehicle has crossed the speed limit (and simultaneously the buzzer sounds). Reset the circuit for monitoring the speed of the next vehicle.

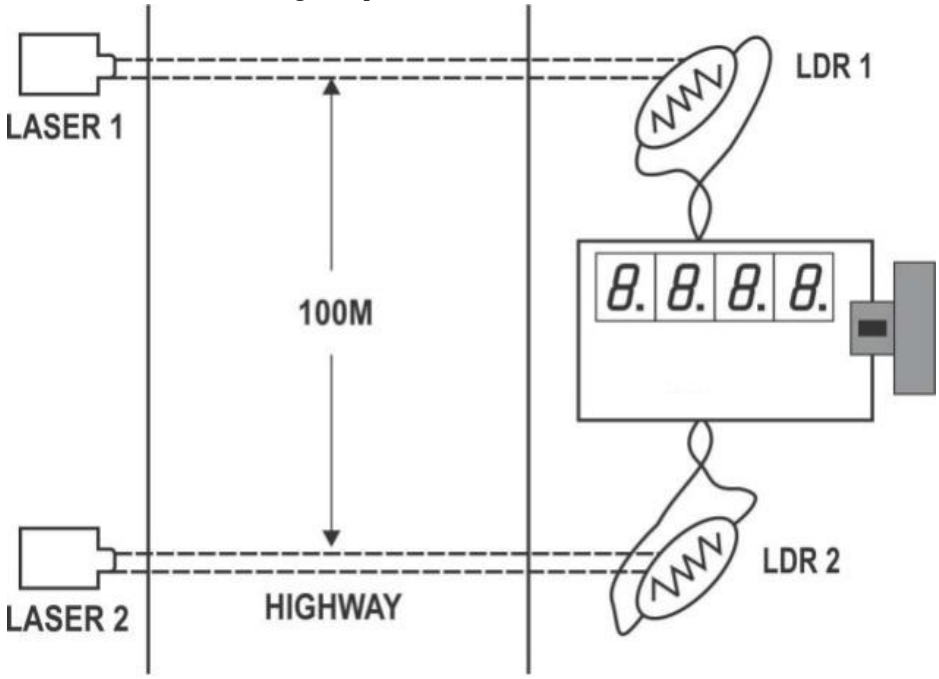

Figure 3. Installation of lasers and LDRs

Since the system comprises two laser transmitters- LDR sensor pairs, which are installed on the highway 100 meters apart, with the transmitter and the LDR sensor of each pair on the opposite sides of the road. The installation of lasers and LDRs is shown in fig 3 below. The system displays the time taken by the vehicle in crossing this 100m distance from one pair to the other with a resolution of 0.01 second from which the speed of the vehicle can be calculated as follows:

Speed (kmph) = Distance/ Time

$$= \frac{0.1 \text{ km}}{(\text{Reading} \times 0.01)/ 3600}$$

Or, Reading (on display) = 36000/ Speed.

As per the above equation for a speed of 40 kmph the display will read 900 (or 9 second), and for a speed 60 kmph the display will read 600 (or 6 seconds). Note that the LSB of the display equals 0.01 second and each succeeding digit is ten times the preceding digit. You can similarly calculate the other readings (or time).

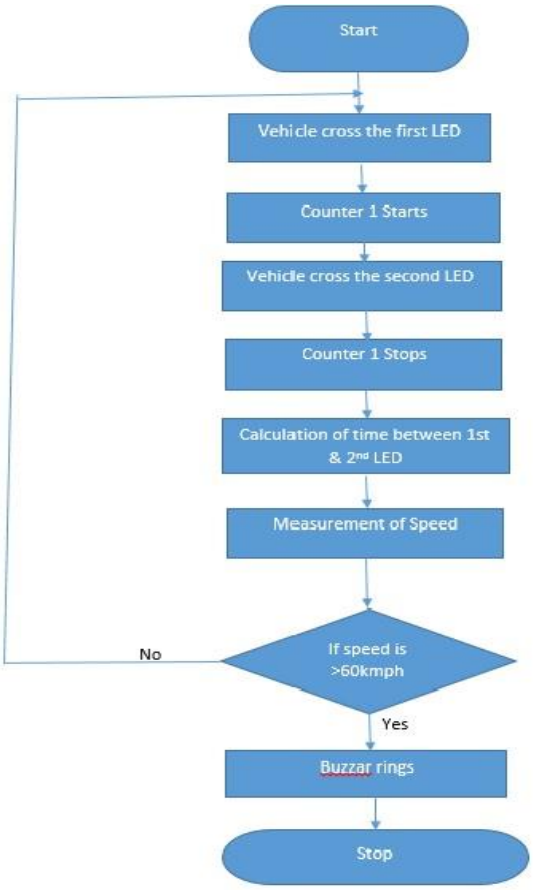

Figure 4. Flow chart of over speeding vehicle detector

This whole process goes under following steps:

Step 1- Apply the power supply by flipping the switch to ON.
Step 2- Reset the circuit so that display shows '0000'.
Step 3- Select the speed limit to 60 kmph.
Step 4- When any vehicle crosses the first IR Diode light, PHOTO DIODE1 will trigger IC1 hence LED 1 glow during for period.
Step 5- When the vehicle crosses the second IR Diode light, the output of IC2 goes high and LED2 glows for this period.
Step 6- If the vehicle crosses the distance between the IR Diode set-ups at more than 60 kmph, the piezo-buzzer sounds an alarm.
Step 7- The counter starts counting when the first IR Diode beam is intercepted and stops when the second IR Diode beam is intercepted.
Step 8- The time taken by the vehicle to cross both the IR Diode beams is displayed on the 7-segment display.

IV. RESULT

While driving on highways, drivers should not exceed the maximum speed limit permitted for their vehicles. However, accidents keep on occurring due to speed violations as drivers follow their speedometers and control their speed according to them, and reduce the speed if they find it to be exceeding and beyond their control. A highway speed checker comes handy for the traffic police, especially against the speed limit violators because it provides the digital display as well as buzzing sound or alarm to detect any vehicle speed if the vehicle exceeds the permitted speed limit. The makeup of these highways, sometimes leads to accidents because most of the times, there is no rule to govern speed limits on these highways. To overcome this problem, we have implemented a circuit called as a speed checker for highways. This kit is inexpensive and it is used for considering the average and high speed of vehicles that move on the highways or roads.

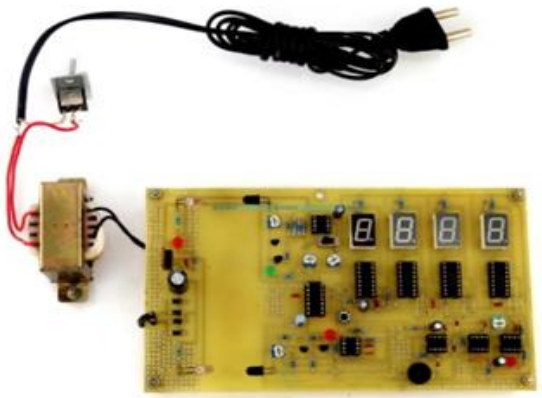

Figure 5. Model of over speed detection system using timer

Fig. 5 shows the model of our speed checker system using timer on highways so as to control the rate of accidents as drivers follow their speedometers and control their speed according to them, and reduce the speed if they find it to be exceeding and beyond their control.

Table 1. Depicting final results of Over Speeding Detection on National Highway No. 1

Vehicle	Speed1 40 Km/h	Speed2 60 Km/h	T1 (s)	T2 (s)	Buzzer Sound
Car	----	70	---	5.14	Yes
Bus	35	---	10.3	---	No
Van	----	54	---	6.67	No
Truck	77	----	4.68	---	Yes
SUV	-----	90	---	4.00	Yes
Tempo	40	----	9.00	---	No

V. CONCLUSION

Since number of accidents on highways increases day by day so it is necessary to check speed of the vehicles on highways so as to remove accident cases and to provide a safe journey by controlling high speed of the vehicle. It also minimizes the difficulties of traffic police department and make ease to control the rash driving on highways. The police can perform their duties while sitting in control room and can provide their service with more ease and accuracy. This concept can be extended in future by integrating a camera with the system which could capture the image of the number plate of the vehicle to sends that to the traffic authorities.

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