IMPLEMENTATION OF COLLISION AVOIDANCE SYSTEM FOR HAIRPIN BENDS IN GHATS USING PROXIMITY SENSORS

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Abstract

Often modern cars have a collision avoidance system built into them known as Pre-Crash System, Forward Collision Warning System, or Collision Mitigation System in order to reduce the severity of a collision. But majority of vehicles on the road, especially heavy motor vehicles lack in such a system. In this paper, the implementation of the Collision Avoidance System is aimed to reduce the risks of collisions at the hairpin bend on a Hilly track, Ghats, or other Zero visibility turns. The proposed system contains a set of proximity sensors, warning lights combined with a convex mirror is installed by the side of the road. It uses four IR sensors, which are placed on either side of the hairpin bend. The sensors are mutually exclusive and are connected to microcontroller through wires. Based on the output of sensors, position of vehicles on either side of the bend is detected which is provided as an input to the microcontroller. The priority algorithm intelligently controls the movement of the vehicles at the hairpin bend based on the sensor values giving appropriate warnings on detection. For different conditions appropriate warning LED is triggered thereby prioritizing the vehicles' movement. In case of a system breakdown a caution LED is triggered also sending a signal to notify the maintenance department about the same.

Index Terms: Collision Avoidance, Hairpin Bends, Microcontrollers, Proximity Sensors, Warning Sign.

I. INTRODUCTION

A rapid growth in transportation and vehicles have resulted in an increase of accidents every day. Accidents mainly occur due to carelessness, breaking traffic rules and bad conditions of the road.

As a major component of road geometric design, curved road segment, due to their alignment characteristics are most prone to traffic crashes among all road geometric elements. According to a survey, crashes on curved segments accounted for 10% of total number of traffic crashes. Correspondingly, the number of deaths accounted for 13% of total number of deaths.

In Narrow roads, Hilly areas, Ghats sections, negotiating hairpin bends and curves is not an easy task. Driver has to be alert all the time while driving in such situations. Accidents mainly occur due to over speeding of vehicle while driving through a sudden curve. In Ghats and hairpin bends, first preference should be given to vehicles moving uphill. But, rules are not strictly followed and hence resulting in roads blocks and accidents. In existing system drivers are unable to judge which and when vehicles arrive at curves. Hence, we have developed a model using which drivers can negotiate the curve and judge the arrival of the vehicles from the other end more confidently.

II. Existing Methodology

Currently, the following methods are being incorporated to negotiate a hairpin bend on a Hilly track, Ghats or any other kind of zero visibility turns.

A. Vehicle Horn

This is one of the traditional ways to negotiate a hairpin bend. The drivers on both sides judge the distance of one another based on the intensities of sound from their respective horns. This method although being the simplest poses to be highly inefficient also causing a lot of confusion between the drivers.

B. Headlights

Flashing headlights during the night works similar to the vehicle horn making it yet another inefficient method. Also this method is completely ineffective in day light conditions.

C. Convex Mirrors

This setup is most widely used nowadays to give a glimpse of any vehicle approaching the hairpin bend from the opposite end. But, these have their shortcomings such as the mirror needs to be kept clean at all times which is difficult in hilly areas as its always cold and misty, thereby reducing its visibility. Also the time taken for the driver to view the mirror and react is high resulting in a poor judgement in return resulting in a mishap.

R. S. Rahul et al in [1] have proposed a model to implement the vehicle mishap averting system using Arduino microcontroller. Through Wi-Fi a signal is transmitted to driver about the traffic and vehicle arrival on the other bend followed by a buzzer on the hairpin bends. Jessen Joseph Leo et al in [2] talks about an inbuilt system in vehicles using GPS technology which takes care of location of the vehicles with respect to the hairpin bend to decide the priority in which the vehicles have to move. The main disadvantage of this method is the complexity in installing the system in all vehicles and communication between the vehicles in hairpin bends.

EiEi Thwe in [3] gives an idea to reduce the accidents and safety measuring techniques in hairpin bends using obstacle detection system. A GUI is developed to monitor and control the system which detects the obstacles within 13 feet range of the vehicle using ultrasonic sensors.

III. Methodology

This paper proposes a simplistic approach for the implementation of a Collision Avoidance System in hairpin bends on a hilly track, Ghats, or zero visibility turns using proximity sensors. Fig. 3.1 shows the block diagram of proposed methodology. It uses four IR sensors, which are placed on either side of the hairpin bend. Two sensors S1 and S2 are installed by the side of the uphill section of the road, similarly two more sensors S3 and S4 are installed by the side of the downhill section of the road. The sensors are mutually exclusive and are connected to ATmega328P microcontroller through wires. Based on the output of sensors, position of vehicles on either side of the bend is detected which is provided as an input to the microcontroller. The microcontroller which works on a power supply of 9V runs a Priority algorithm which triggers the warning LEDs to glow (W1 in Downhill or W2 in Uphill) and thereby intelligently controlling the movement of vehicles at the bend. Warning LEDs along with a convex mirror are placed at the center of the outer curve of a hairpin bend. Another LED (W3) is placed in order to notify a system breakdown.

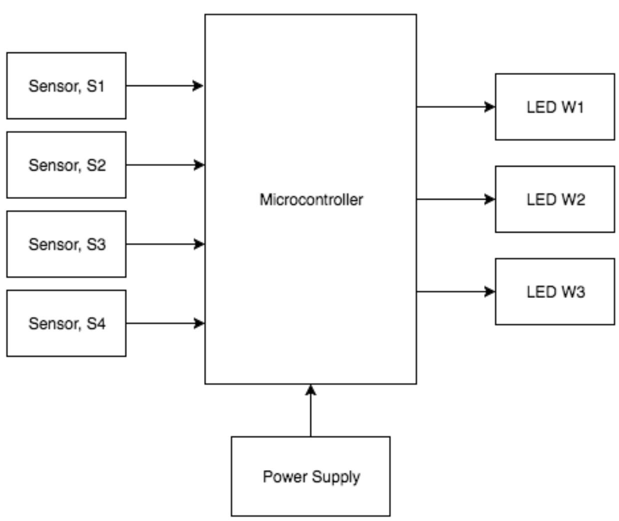

Fig. 3.1 Block diagram

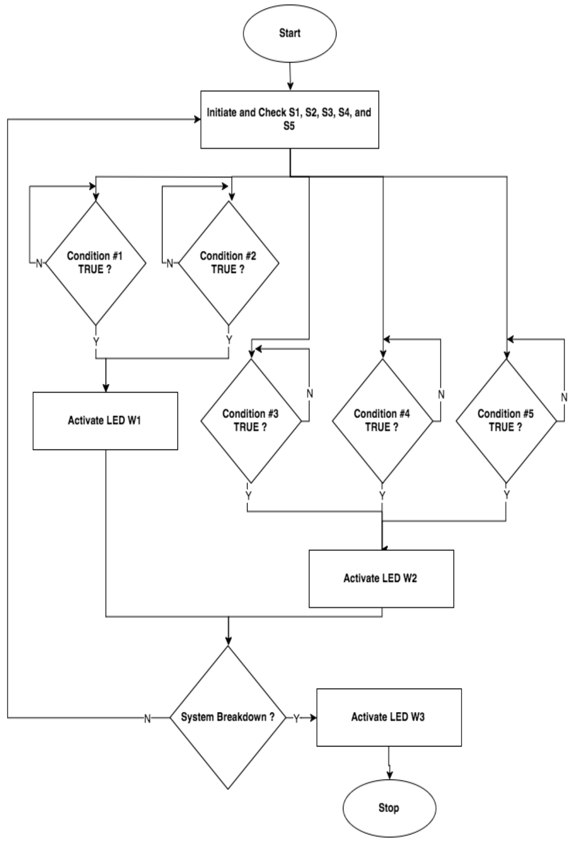

Fig. 3.2 Flowchart

Fig. 3.2 shows the flow of algorithm used to prioritize the movement of the vehicle while negotiating a hairpin bend. All four sensors S1, S2, S3, and S4 are initialized to start monitoring the vehicle movement. Sensors S1 and S2 separated by a distance of d=15m are installed at a distance of dmin = 150m from the center of the hairpin bend. Similarly, S3 and S4 separated by a distance of d=15m is placed at a distance of dmin+50m on the uphill section as shown in Fig. 3.3. Priority is given to vehicles climbing the curve in order to maintain their momentum. For condition #1 and #2 as specified in the Priority table given in table 3.1 warning LED W2 is triggered thereby giving priority to the vehicles moving downhill. Similar, for conditions #3, #4, and #5 LED W1 is triggered thereby giving priority to the vehicles moving uphill. In case of a system breakdown a caution signal W3 is triggered also sending a signal to notify the maintenance department about the same.

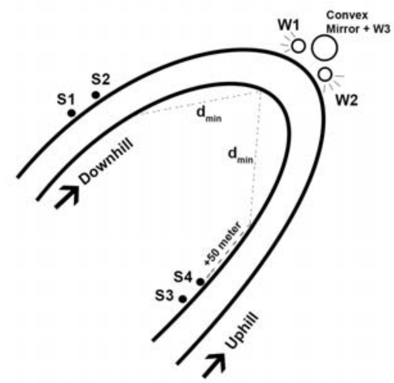

Fig. 3.3 System Setup

Table 3.1 Priority Conditions

Condition	S1	S2	S3	S4	Output
#1	ON	ON	ON	OFF	W2
#2	ON	ON	OFF	OFF	W2
#3	ON	OFF	ON	ON	W1
#4	OFF	OFF	ON	OFF	W1
#5	ON	ON	ON	ON	W1

IV. HARDWARE SETUP

Fig. 3.3 illustrates the hardware setup of the proposed system mainly consisting of three major components which are listed below:

A. ATMEGA328P MICROCONTROLLER

The high-performance Atmel 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1KB EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts.

By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.

B. IR PROXIMITY SENSORS

Infrared sensors are being used as proximity sensors and they can be passive or active. Passive infrared sensors are basically Infrared detectors. These sensors do not use any infrared source and detects energy emitted by obstacles in the field of view.

Active infrared sensors consist of two elements: infrared source and infrared detector. Infrared sources include an LED or infrared laser diode. Infrared detectors include photodiodes or phototransistors. The energy emitted by the infrared source is reflected by an object and falls on the infrared detector. An IR sensor consists of an IR LED and an IR Photodiode; together they are called as Photo – Coupler or Opto – Coupler. When the IR transmitter emits radiation, it reaches the object and some of the radiation reflects back to the IR receiver. Based on the intensity of the reception by the IR receiver, the output of the sensor is defined.

C. *TRAFFIC MIRROR*

Traffic mirrors are safety enhancing specialty convex mirrors which make navigating dangerous intersections, drives and high risk accident areas safer and less stressful.

V. RESULTS

The working of proposed system setup in various real life scenarios are shown below using Fig. 5.1, 5.2, 5.3, 5.4, 5.5, and 5.6.

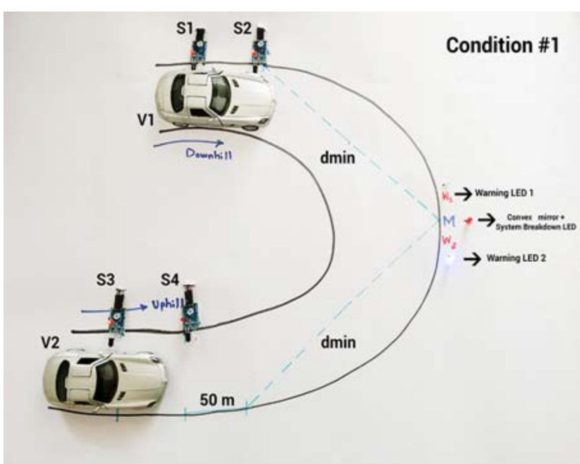

Fig. 5.1 Priority Condition #1

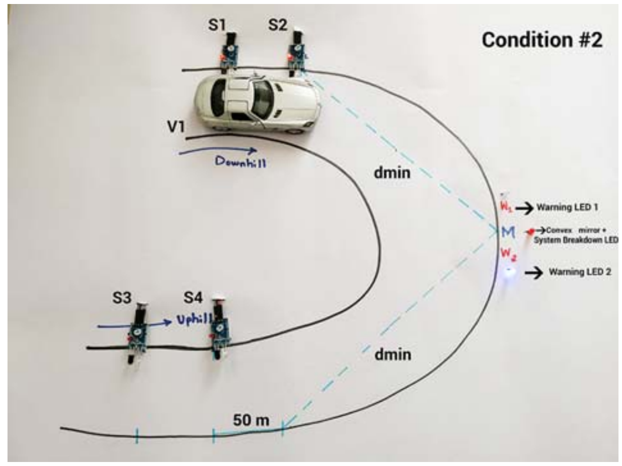

Fig. 5.2 Priority Condition #2

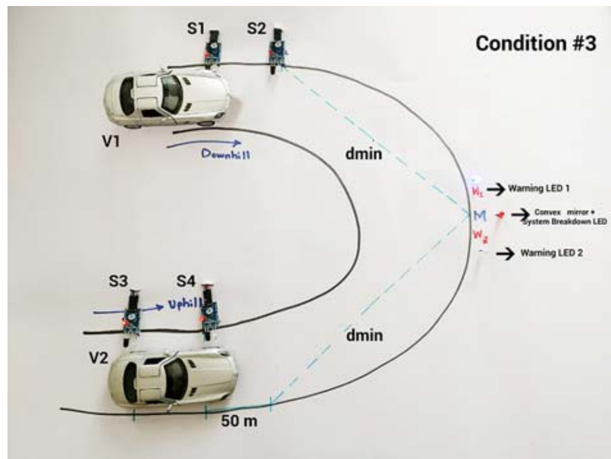

Fig. 5.3 Priority Condition #3

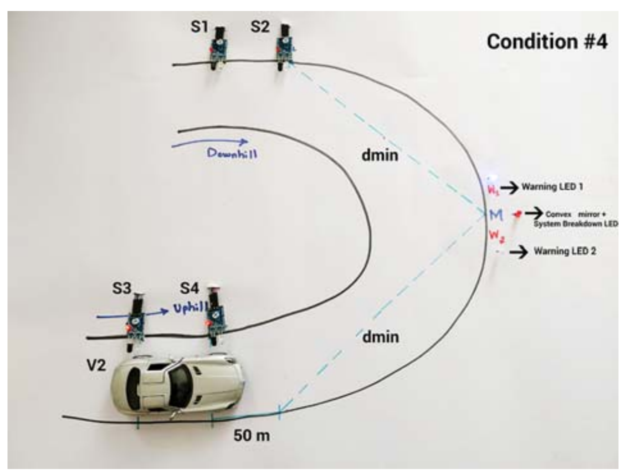

Fig. 5.4 Priority Condition #4

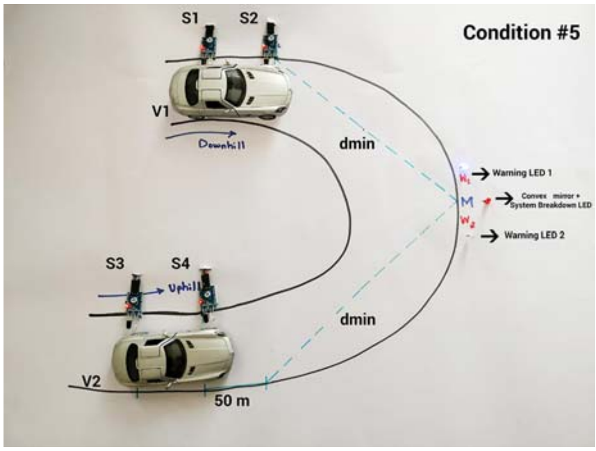

Fig. 5.5 Priority Condition #5

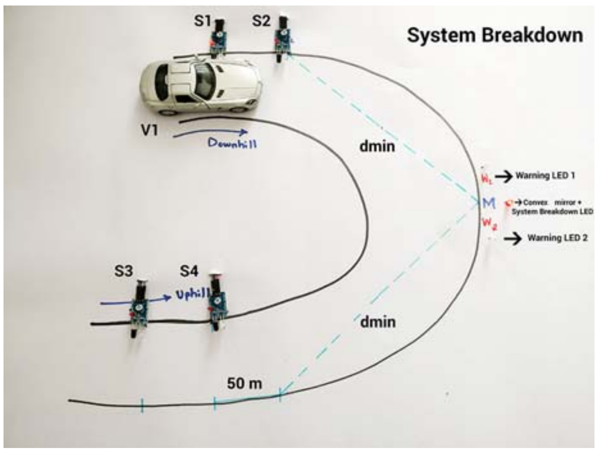

Fig. 5.5 System Breakdown Alert

VI. Conclusion

Our Collision Avoidance System consisting of a microcontroller, IR sensors, warning LEDs and a convex mirror when implemented has proven to be more effective than just a normal traffic mirror setup. The system, as shown in the results, have performed accurately under various conditions prioritizing the vehicles negotiating a hairpin bend on a Hilly track, Ghats etc. This simple yet effective methodology will enable the driver to have a better sense of terrain and will drastically reduce road accidents in hairpin bends or other kinds of zero visibility turns.

REFERENCES

[1] R. S. Rakul S. Ravia K. N. Thirukkuralkani, “Implementation Of Vehicle Mishap Averting System Using Arduino Microcontroller”, International Journal of Engineering Research & Technology, Vol. 5 Issue 04, April-2016.

[2] Jessen Joseph Leo, R. Monishaz, “Vehicle Movement Control Andaccident Avoidance In Hilly Track”, International Conference on Electronics and Communication System JCECS -2014

[3] EiEi Thwe, Theingi, “Design And Implementation Of Data Logger For Vehicle Safety”, International Journal of Engineering and Techniques - Volume 1 Issue 4, July – Aug 2015.

[4] D. Haripriya, Puthanial. M, Dr. P. C. Kishore Raja, “Accident Prevention System And Security For Vehicles”, International Journal of Computer Trends and Technology (IJCTT) – volume 12 number 5 – Jun 2014

[5] Liang Qi, MengChu Zhou, WenJing Luan, “Emergency Traffic-Light Control System Design For Intersections Subject To Accidents”, IEEE transactions on Intelligent Transportation Systems, vol. 17, no. 1, January 2016.