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Intelligent Autonomous System To control Red Signal Jumping

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Abstract : Vehicle Technology has increased rapidly in recent years, particularly in *braking and sensing systems*. As technology evolves over time, we could see opportunities to reduce vulnerable road deaths, like deaths due to *red signal jumping*. *ASS* (active safety systems) is being researched and being developed to prevent accidents and also to target mitigation.Statistics shows that most of the road accidents are held due to jumping of traffic signals. This project is proposal of a system named Intelligent Autonomous System to Control Red Signal Jumping, which is triggered by traffic signal. This system is designed in such a way that it uses *image processing* technique and *autonomous emergency system* to achieve the need. Our system not only aims at reducing the number of casualties but also to prevent the vehicles from jumping the red signal against the driver's will.
Keywords : Braking and sensing systems, Active safety system, red signal jumping, image processing, autonomous emergency braking.

Introduction

The number of vehicles is increasing day by day. Now days, accidents are increasing and are uncertain. Accidents are mostly caused by delay of the driver to hit brakes. As red light running is defined as any observation during which a vehicle crossed the stop line after the occurrence of a red traffic light. Red light running violations, being prohibited by state law, are dangerous to public health and safety. Over 1.2 million people die each year on the world's roads and between 20 and 50 million suffer non-fatal injuries. A number of studies on red light running behaviour have indicated that red light running is a significant road safety problem.Driver noncompliance with traffic control devices in the form of red light running is a serious violation with potentially hazardous implications. Fatalities associated with red light running often involve innocent drivers and pedestrians since this crash type often occurs suddenly and unexpectedly.Injuries occur in 45 percent of all red light running crashes, whereas only 30 percent of all other crash types result in injuries.Most drivers obey traffic signals all the time. However, some drivers, due to temporary inattention, distractions, poor decision-making, or aggressive driving fail to stop for red lights. Those red light running drivers create crash opportunities. Traffic engineers seek ways to increase compliance with traffic signals at locations where red light running is higher than normal. Sometimes engineering countermeasures can be used, such as changing signal phasing or timing or modifying signal displays. However, often the problem is driver's decision-making, and enforcement becomes necessary. Crashes related to red light running account for more than 800 deaths and thousands of injuries each year in the United States. Many states and local jurisdictions have undertaken studies and enacted programs in reaction to this major transportation safety concern. Fatalities increased by 2 percent

from 10,001 in 2011 to 10,219 in 2012[6]. This project is about a system that can control braking system effectively to bring red light running issues under control.

Experimental

The RGB camera that is fixed in the vehicle captures the red signal. This captured image is sent to the raspberry pi via USB for image processing. A test image (Lena) is coded in the form of image comparison code in raspberry pi. Image comparison of the captured image with Lena is done as per the instructed code. If the image taken by the RGB camera matches with the standard test image an electric signal of range 3.5 – 3.8v is generated as an output by raspberry pi. A relay is used in series with this raspberry pi to produce a power of 12v.

This signal is used for autonomous emergency braking by the following process. The power from relay is sent to a microcontroller which in turn is connected with a piezo metric sensor, brake cylinder and solenoid valve. Piezo metric sensor is used to sense the braking operation by the driver. If the driver fails to brake then microcontroller energises the solenoid valve by passing a required electric pulse. This solenoid valve in turn makes the piston in the brake cylinder to work due to Lorentz force. This brake force is transferred to the wheel brakes and hence the vehicle stops in its braking range. Thus red signal jumping can be prevented.

Working of image processing:

There are certain existing systems like RFID capture, camera at signals, which are in poor use. This proposed model might help to bring red signal violation under control by automatically controlling the braking system in vehicles.

In this model, the RF transmitter is installed 20meters before every signal that could transmit its id in its specific range. The corresponding RF receiver is installed in the vehicle which responds to the RFID transmitted by the transmitter. This setup is used to create a zone before the traffic signal, only where the entire system works. The RF receiver once it enters the zone created by the RF transmitter gets triggered and starts giving out signals [9].

An RGB camera is installed in the vehicle in the top of windshield which starts working on receiving the signal generated by the RF receiver. This RGB camera is placed in a position in which it can capture the image of the signal from a distance of 20 meters [7]. When the vehicle enters the RF zone then the RF receiver in the vehicle gets triggered and starts sending an impulse to the RGB camera so that it starts capturing the signal images at the rate of one per second. These images captured have to be image processed for which a raspberry pi set up is used. The raspberry pi is installed in the vehicle in which the image comparison program is coded. A sequence of images of the signal including red and green taken from 20 meters before the traffic light is fed as the reference set to the image comparison code. This raspberry pi is interfaced with the RGB camera [8].

The image captured by the RGB camera is fed as an input to the raspberry pi setup [1]. The program code is activated and these input images undergo image processing process with the reference set as instructed in the program. This process continues as long as the vehicle is in the RF zone. If this input image matches with the image of the red signal that has been given as the reference image, then the condition 1 is activated and the vehicle undergoes braking. Else, if the input image matches with the image of the green signal in the reference image, and then condition 0 is activated, where the vehicle continues to move without breaking. In certain cases if the image captured by the RGB camera does not match with any of the reference image then again condition 0 is activated (fig. 3.1).

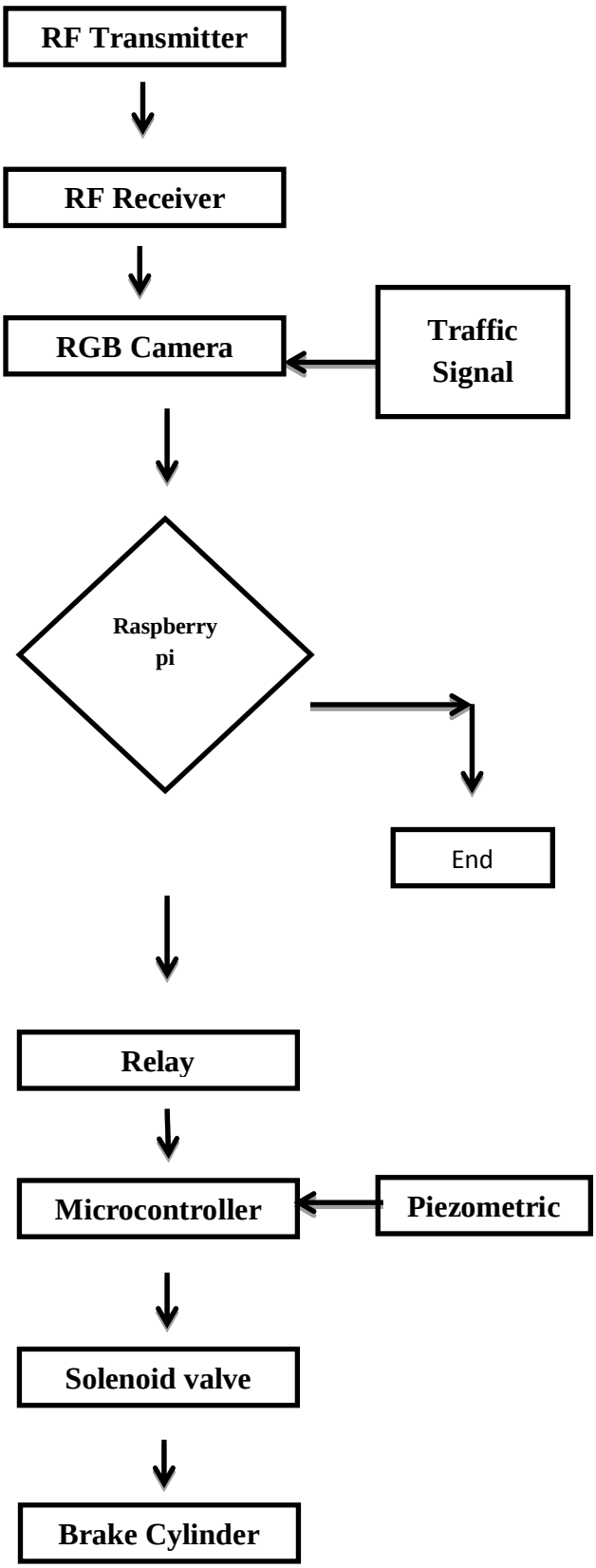
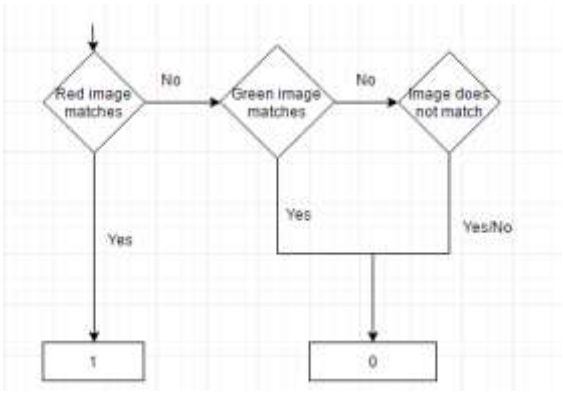


Fig 1 – Flow of technology



Comparison of the images taken by the RGB camera and comparing with the reference set.

Fig. 2Function of RaspberryPi

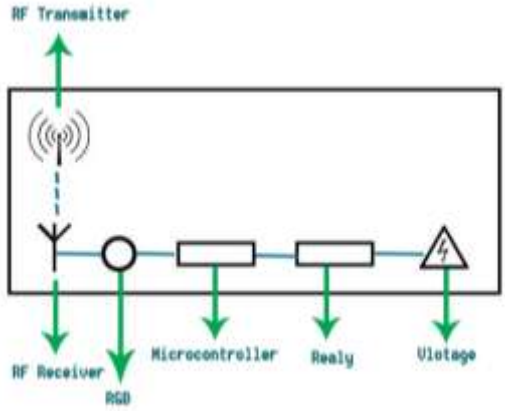


Fig. 3– Working of voltage generation.

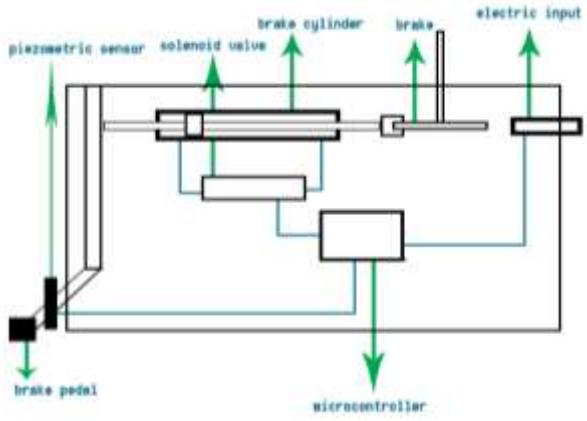


Fig. 4 – Autonomous Braking System.

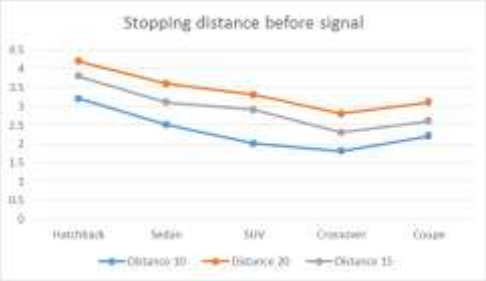


Fig. 5 Braking Distance from the point of red light capture

Various car segments are taken in 'X- axis' and the corresponding stopping distance of the vehicle before the signal from the point where condition 1 is activated along 'Y- axis'. Orange line represents that the vehicles.Thus by the advancement of science and development of engineering, we shall look forward to make a change in the society by reducing such vulnerable road accidents and to improve the safety of human living in all possible ways.

These 1 condition activated by the raspberry pi is fed as an input to the relay, that is connected in series with raspberry pi. Relay is an automatic switch which opens or closes an electrical circuit. When condition 1 is given to relay it starts supplying a required voltage for the autonomous braking operation of the vehicle.

Autonomous Emergency Braking:

Autonomous emergency braking or (AEB) is a new safety technology increasingly being used in vehicles which monitors the traffic conditions ahead and automatically brakes the car if the driver fails to respond to an emergency situation. AEB system is designed to work on different road conditions. The concept of AEB could be used to prevent red light running by electric signal actuating the brake cylinder.

Working of AEB

The relay is connected to the microcontroller in the brake unit. The use of microcontroller is to determine and to control the amount of power required to supply sufficient braking force in order to stop the vehicle within the safety limit. The microcontroller is in turn is linked with a piezometric sensor that is kept behind the brake pedal. This sensor is used to determine whether the driver takes an action in an emergency situation. Then the microcontroller is connected to a solenoid valve. This solenoid valve is used to make the piston in the brake master cylinder work automatically by wrapping a solenoid coil around it. The common solenoid valve used is (3/2) solenoid valve [5].

The electric impulse coming out from the relay is fed to the microcontroller. Once the microcontroller is given an input it waits for a response from the piezometric sensor. If the driver cautiously applies the brake then the piezometric sensor sends a signal which withdraws the entire AEB process. Accidentally if the driver fails to apply brake, the piezometric sensor sends a corresponding set of signal to the microcontroller. The microcontroller sends a set of electric pulse to a solenoid valve that is connecting to it. This solenoid valve is in turn connected to the main brake cylinder. Once the solenoid valve is energised, it makes the piston in the master cylinder to work automatically under the effort of solenoid valve. In case of little more advanced system, a solenoid coil is wounded around the master cylinder that is made of metal. Now the master cylinder with the piston experiences 'LORRENTZ FORCE' and starts working automatically [6]. Thus when the cylinder and the piston are made to work automatically due to the pressure developed in the brake fluid. After stopping, the vehicle the springs bring back the pedal to the normal position.

Result and Discussion

The above mentioned system has been prototyped in the institution and the calculated braking distance for various segments of cars has been displayed below.

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