Vehicular Speed Detection and Surveillance

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VEHICULAR SPEED DETECTION AND SURVEILLANCE

ABSTRACT

This project aims to solve the fundamental problems of traffic violations like over speeding by coming up with a two-fold approach which involves both the fields of Computer Vision and Arduino Microcontrollers. The system consists of two IR sensors which are kept separate at a fixed distance and the time instants of motion of the vehicle is calculated at the two points. Alternative approach is a computer vision based surveillance camera which can record the speed by using motion detection technique of Background Subtraction. The entire project is an example of an Internet Of Things (IOT) system which can be implemented in smart cities for automatic monitoring and regulation of traffic without the need of any human supervision. We hope to reduce the number of traffic accidents and aid the traffic policemen in their work through this project.The speed calculated has been tested in many experiments and proven to have achieved a satisfactory performance.

KEYWORDS

Arduino, Computer Vision, Motion detection, Speed detection, Traffic Violation.

INTRODUCTION

The aim of this project is to develop a device that detects over speeding of vehicle on road of restriction area (college, school, hospital road) and alerts traffic authorities in case of any speed limit violation. In the present, conventional system, handheld ultrasonic sensor and camera is used to detect and record a vehicle's speed is an ineffective method.

The proposed system checks an over speeding vehicle or rash driving by calculating the speed of the passing vehicle using the time taken to travel between two set points (at a specified distance). A set point consists of a pair of sensors comprising IR transmitter and an IR receiver and each pair is installed on either side of the road. Speed limit is set by the traffic police depending upon the traffic and priority of the location. Time taken by a vehicle to travel from one set point to the other is calculated by control circuit. If the vehicle crosses the set speed limit, a led glows and a buzzer beeps for an alert.

The system is made fault tolerant by using a separate computer vision motion detection approach in which we draw a boundary initially to capture the background image. Then the camera is switched to its motion tracking mode in which it captures images of moving vehicles and stores them in real time with a date-stamp and speed value in a database. Thus this adds the necessity of monitoring the roads instead of only speed detection which is a primary importance in traffic regulation and safety.

RELATED WORKS

Various methods are used for vehicle speed detection. These method used in various area according to their function, advantages and limitation. There are various method describe which are used for speed detection of vehicle in different areas :-

RADAR (Radio Detection and Ranging) [1]
A radar speed gun (also radar gun and speed gun) is a device used to measure the speed of moving objects. A radar speed gun is based on a Doppler radar unit that may be hand-held, vehicle-mounted or static. It calculate the speed of the objects at which it is pointed by detecting a change in frequency of the returned radar signal caused by the Doppler Effect.

Limitations of radar
Training and certification are required so that a radar operator can use the equipment effectively. Stationary traffic enforcement radar must occupy a location above or to the side of the road, so the user must understand trigonometry to "guess" vehicle speed as the direction changes while a single vehicle moves within the field of view. Vehicle speed and radar measurement are rarely the same for this reason.

LIDAR (Light Detection and Ranging) [2]
A LIDAR speed gun is a device used by the police for speed limit enforcement which uses LIDAR to detect the speed of a vehicle. Unlike Radar speed guns, which rely on Doppler shifts to measure the speed of a vehicle, these devices allow a police officer to measure the speed of an individual vehicle within a stream of traffic. LIDAR relies on the principle of time-of-flight of two (or more) short 905 nm wavelength (near infrared - NIR) LASER pulses.

Limitations of lidar
The LIDAR is generally used as a stationary device and fired in clear air. There is a low probability that a police officer will try to operate it in heavy rain or through a windshield from inside his vehicle. Unlike police radar, it is able to pick a single vehicle out of a group.

MOTIVATION AND OBJECTIVE

The primary motivation behind this project is for its implementation in smart cities to reduce road accidents by increasing automation and avoid over dependence on traffic police. Rash driving is the major cause for road accidents. In 2015, around 1,46,000 people were killed in highway road. This translates into 11 deaths per one lakh people or one live snuffed out every 3.6 minutes. [3] 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 and marking it. 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. To overcome this problem and decrease death rate due to accidents, introduction of new and innovative speed enforcement technology is necessary.

Our method presents a new Speed Detection Camera and Arduino System (SDCAS) that is applicable as a radar and lidar alternative. It uses several image processing techniques on video stream from single camera in offline mode, which makes it capable of calculating the speed of moving objects avoiding the traditional radars' problems. Also due to the Arduino module attached to it, it provides better reliability in terms of hardware performance. It offers an inexpensive alternative to traditional radars with the same accuracy or even better.

METHODOLOGY

ARDUINO MODULE

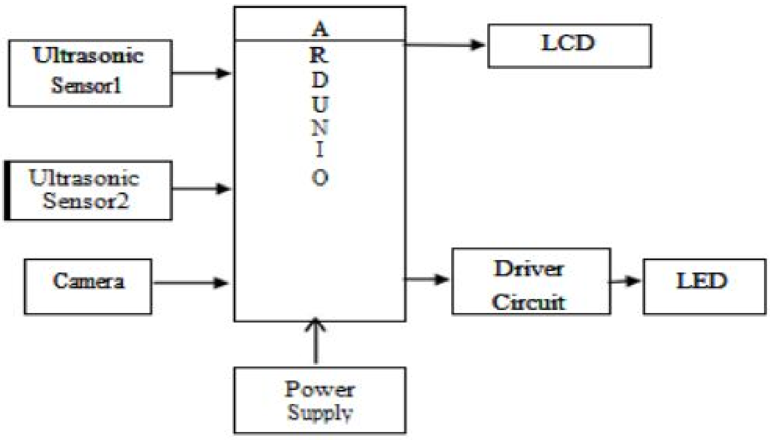

Figure 1: Block Diagram of the Arduino Model

THEORY

Both IR sensors are connected to the interrupt pin of Arduino, and they detect the falling wave. The purpose of using interrupt is that, it improves the efficiency of system. A LCD is connected to Arduino and measured speed is shown on LCD.

When car moves in front of the first sensor, it gives the output signal to Arduino, Arduino detects the falling wave, now internal timer of Arduino is started and when car moves in front of second sensor timer is stopped.

Now Arduino measures the speed of car which is measured by distance time relationship :-

Speed=Distance by car/ Time difference between two sensors

IMPLEMENTATION

MATERIALS USED

COMPONENT	SPECIFICATION	QUANTITY
Arduino	Nano	1
IR Sensor	REES52	2
Buzzer	PB24P34D	1
LED(Green)	WC201-11	1
Power Adapter	5V	1
Bluetooth Module	HC-05	1

CIRCUIT DIAGRAM

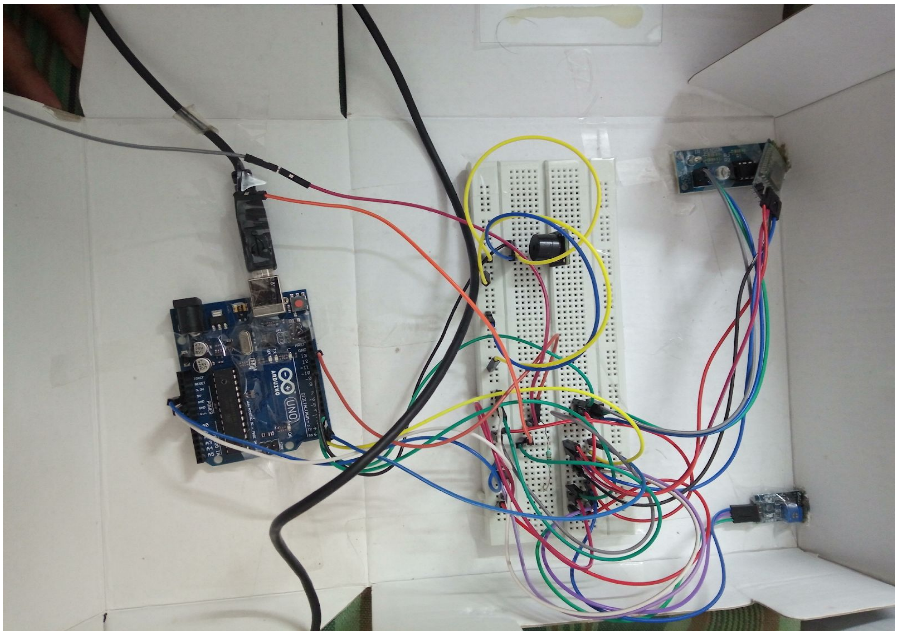

Figure 2: The interior circuit view of the working model

In the Arduino pins D2 and D3 are interrupt, where D2 is INT0 and D3 is INT1. Output pins of the IR sensors are connected to these pins. The led is connected to pin 13 and buzzer to pin 8. The resistance of 1K is connected to the LED in series and the circuit is given a 5V power supply. The Bluetooth module HC05 is connected by connecting the RX pin of the Bluetooth with the TX pin of the arduino and the TX pin of the Bluetooth with the RX pin of the arduino. The speed limit has been set to 18 km/hr for activation of the buzzer.

CAMERA MODULE

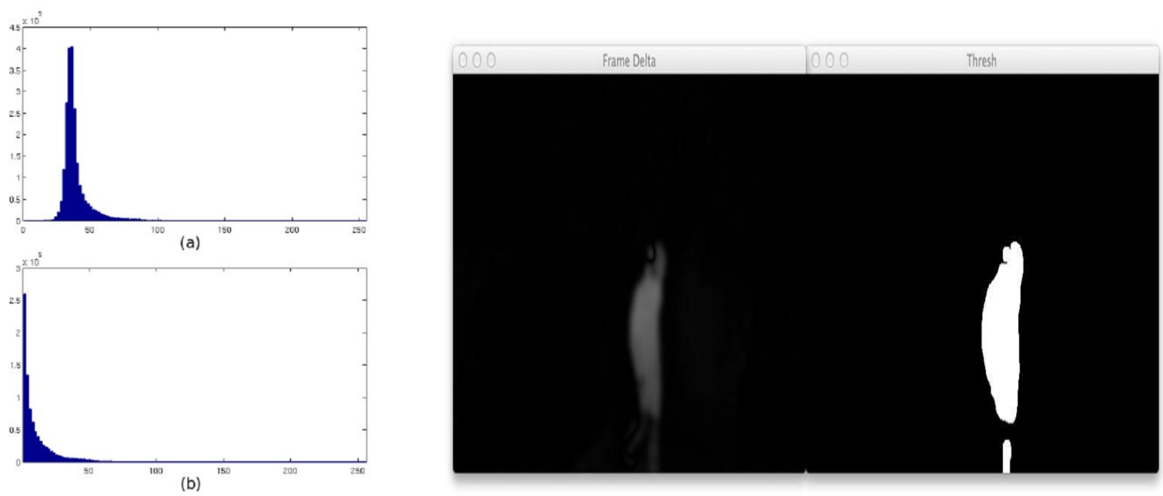

Figure: 3a and 3b: Histogram distribution of original and background separated images

THEORY

In motion detection, we tend to make the following assumption that the ***background*** of our video stream is largely ***static and unchanging*** over consecutive frames of a video. Therefore, if we can model the background, we monitor it for substantial changes. If there is a substantial change, we can detect it — this change normally corresponds to ***motion*** on our video. Now obviously in the real-world this assumption can easily fail. Due to shadowing, reflections, lighting conditions, and any other possible change in the environment, our background can look quite different in various frames of a video. That's why the most successful background subtraction/foreground detection systems *utilize fixed mounted cameras* and in *controlled lighting conditions.* The method of motion detection used here is of Gaussian Mixture Model-based foreground and background segmentation [4] available through the **cv2.BackgroundSubtractorMOG()** function.

IMPLEMENTATION

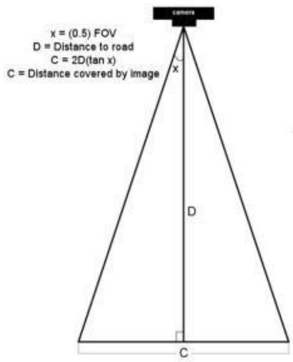

Figure 4: Setup principle of the Surveillance Camera

The **field of view (FOV)** of the camera is about **F** degrees. Let's say the road is about feet (**D**) from our camera. The horizontal distance (**C**) covered by the image at a distance H feet from the lens would be:

$$C=2*H+tan(F*0.5)$$

Once the horizontal distance is known, dividing it by the number of pixels in the width of the frame gives the distance each pixel represents. The speed can be calculated from the time it takes for an object to traverse the pixels.

RESULT

The value of the speed of the vehicle is displayed in the android application by interfacing the Bluetooth module with the arduino. If the speed exceeds the threshold limit, then app returns a red value signalling warning and the buzzer sounds off until the next vehicle comes within its range. The camera captures the image of the vehicle when it crosses the two sensors along with the current date-time and speed.

Figure 5a) Surveillance Camera Working

Figure 5b) Android App showing speed

DISCUSSION

IMPLEMENTATION IN REAL LIFE

The model made by us is a prototype for an advanced fully functioning real life product with more secure casing for durability purposes. The IR sensors don't work in bright sunlight and hence they need to be placed inside a black box so that they can properly detect the vehicles. The usage of laser sensors and better surveillance cameras [5] can give us greater accuracy readings and more importantly detect higher speed moving vehicles which the prototype fails to do due to hardware constraints. The Bluetooth module needs to be replaced by a GSM module for farther ranges as its field of transmission is much wider.

FUTURE WORK

The safety speed limit of different vehicles is different. A heavily loaded truck at a higher speed can cause more damage than a four wheeler car. We plan to use Artificial Intelligence to not only to detect the speed of vehicles but also classify which vehicle it is and accordingly set the speed limit of it. This has to be implemented in real time so that the information can be passed along at that moment only.

CONCLUSION

While driving on highly traffic populated areas, drivers should not exceed the maximum speed limit permitted for their vehicles. This is the major cause of many road accidents and through our product we hope to strictly monitor this problem by using automation and alerting both the drivers and traffic police of the impending accidents which can occur when such over-speeding actions are committed.

ACKNOWLEDGEMENT

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