Enhancement Method for Mobile Cars Design Traffic Camera to Detect and Tack Accurately Estimate Speed of Vehicles

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ABSTRACT

Traffic cameras are really important because they help keep an eye on traffic and make sure people are following the rules, like sticking to the speed limit. Accurately determining the speed of vehicles is crucial for ensuring safety on the road and enforcing regulations effectively. In order to accurately estimate speed, traffic camera design and optimization utilize enhancement methods. These methods use advanced technology in imaging, image processing, and machine learning to tackle the difficulties of monitoring traffic. Cameras are able to consistently and effectively capture violations in all conditions with great accuracy. In this paper, we will be discussing a project that aims to enhance traffic safety by utilizing a controller based on Arduino. The controller will be used to capture images of license plates of vehicles that are speeding. In general, it's really important to keep an eye on and make sure people follow traffic rules. This is crucial for keeping our roads safe and ensuring the well-being of the public. The advancements in technology for traffic cameras are really important because they help accurately measure and enforce speed limits.

Keywords: Speed Estimation , Traffic Cameras, Detect Camera.

1. Introduction

Security cameras are placed in strategic locations near roads and traffic to identify and capture instances of vehicular violations such as running red lights or engaging in reckless driving. Law enforcement agencies around the world emphasize the importance of regularly monitoring traffic to prevent accidents and protect lives and property. This is due to the significant number of traffic violations that lead to these unfortunate incidents. Violation control cameras, also known as enforcement cameras, are devices specifically designed to identify traffic violations such as speeding and running red lights. These cameras offer a more modern approach to traffic enforcement, unlike traditional methods such as patrols. It's been proven worldwide that camera technology is really effective in deterring violators and reducing accidents and the harm that comes with them. [2]. Overall, strategically installed security cameras help monitor roads, catch traffic violations, and curb reckless driving - a preventative approach law enforcement advocates to enhance public safety. Regarding deterrence, the empirical evidence from various regions of the world has demonstrated that the presence of surveillance cameras instills a sense of heightened control among motorists, leading them to exercise caution in order to avoid surpassing speed limits or disregarding traffic signals. However, it is worth noting that certain studies have suggested that the cameras are most effective in deterring the category of individuals who commit the highest number of violations [3]. The use of speed radar cameras has resulted in a substantial decrease in the proportion of motorists who surpass the prescribed speed limit on roadways. Undoubt-

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edly, electronic control plays a significant role in facilitating human supervision. However, it is imperative to acknowledge that reliability alone is insufficient; human oversight, as the executive component, is indispensable. Moreover, while electronic control primarily focuses on monitoring, human oversight encompasses the crucial aspects of awareness and guidance for both leading vehicles and road users. In contrast, electronic control is capable of executing control functions in situations where conventional control methods are inadequate. In instances of congestion, the camera possesses the ability to effectively manage violators, a task that proves challenging for traffic patrol officers [4]. The road conditions and engineering design further impede the traffic patrol's capacity to regulate speed violations, whereas the camera effortlessly accomplishes this task. Additionally, it is worth noting that unlike humans, the camera remains unaffected by illness or fatigue throughout the day. Furthermore, the user's familiarity with the medium is unknown. The aforementioned issues hold significant importance within the domain of traffic control procedures [5].

The global empirical evidence also reveals a disparity in the efficacy of this technology, with the magnitude of decrease in accident casualties varying from approximately 10% in certain regions to exceeding 60% in other regions. The assertion that the implementation of traffic cameras is not a panacea for resolving traffic issues is justified, as certain prerequisites must be met for their efficacy. To ensure their effectiveness, it is imperative to establish certain criteria for camera installation, carefully select appropriate locations, analyses the data collected, and evaluate their overall performance. This paper explores the utilization of image capture techniques to analyze the inherent inclination towards high speed in automobiles. The study involves the implementation of laser sensors and equations derived from engineering principles, specifically the equation u = d / t, to accurately calculate the velocity of the vehicles. The distance is measured in relation to the changing time, and the acquired images are processed using the LabVIEW software program. The resulting images are then stored on a desktop computer for further analysis.

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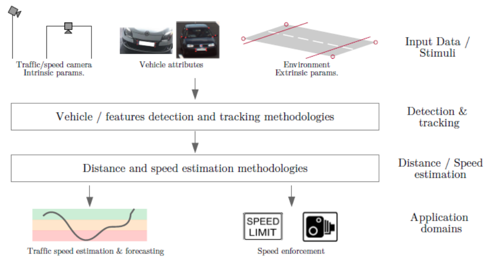

Figure (1): The primary components of a vision-based system for estimating vehicle speed at a high level include: input data acquisition, object detection and tracking, distance and speed estimation [1].

1. Problem Statement:

It is extremely important to be able to accurately estimate the speeds of vehicles. This helps in enforcing traffic laws, making traffic flow better, and ensuring the safety of pedestrians. Standard traffic cameras face challenges when it comes to accurately measuring speed due to factors such as low image quality, obstructions, and

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changes in lighting conditions. Although machine learning algorithms have been used to improve accuracy, there are still a number of issues that need to be addressed.

a. The varying image quality of traffic cameras makes it difficult to accurately estimate speeds. Other factors such as glare and obstructions can also cause readings to be inaccurate.

b. Bad weather can make it really hard for machine learning models to accurately track and measure vehicle speeds because visibility is reduced.

c. The complex movements of vehicles, such as changing lanes and sudden starts or stops, might be too difficult for current algorithms to accurately predict speeds.

d. The model's adaptability to different road settings is limited because there is not enough training data available. Expanding datasets takes a lot of time and effort to annotate.

e. Real-time speed measurement, which is often expected from traffic cameras, can sometimes create conflicts with computationally demanding algorithms.

f. Privacy concerns can arise when we collect and process images of vehicles and the people inside them. Finding the right balance between public safety and privacy can be quite complex.

The Objective

The challenges and variations in ultrasonic measurements are discussed in this work. The author made the observation that ultrasound is reliable for measuring round objects but delivers inaccurate results for non-round ones. Consequently, the study proposes a shift from ultrasound to laser technology, specifically laser sensors, which offer precise and successful measurements by employing a binary system of readings (0 or 1). The sensor's ability to determine distance to an item is compromised under certain conditions, such as when the object is positioned at a distance more than 3 meters, when the angle of incidence is too shallow, when a flat object is not oriented towards the sensor, or when the surface of the object lacks reflectivity. The second objective pertains to the camera, which presented significant challenges during the search process. Due to the absence of a photo processor in the Aardoino, establishing a complete connection proved to be problematic. However, this issue was resolved by integrating the camera with the Labview program. This integration enables the monitoring of speed offenders and the registration of any irregularities committed by them. The ultimate aim of this endeavor is to mitigate accidents and safeguard human lives, thereby providing valuable assistance to traffic officers.

3. Literature Review

Extensive research has been conducted in this particular domain, employing a synergistic integration of radar, lazar, and stereo cameras. Stereo cameras, which emulate the visual system of the human eye, are frequently employed for the purpose of depth prediction. The process of monitoring and locating objects within a depth map enables the extraction of valuable velocity data. Certain solutions leverage the inher-

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ent characteristic of cameras, which entails the conversion of camera coordinates into real-world coordinates. First, the optical flow displacement vectors are converted to the physical world's displacement vectors. Then, a simple speed formula is applied to those vectors to determine the speed. Another strategy is to figure out how things are laid out around you and use that knowledge to make sense of the situation. To better understand their environment, the researchers in reference [6] used the predetermined parameters of camera height and angle. They later calculated the speed of a vehicle based on how far it traveled. Researchers tracked the vehicle's whereabouts by locating the license plate's four corners. A limitation is introduced by this method, however, as vehicle tracking relies on being able to see the license plate. The implementation in reference [7] is strikingly similar and shares the same constraints. [8] camera calibration to transform pixel displacement vectors into object displacement vectors has also been documented. In a previous study [9], a comparable approach was suggested, wherein an initial auto calibration of a camera on a road is performed, followed by the utilization of the aforementioned transformation to estimate vehicle speeds. Nevertheless, it is important to note that the aforementioned approach necessitates the calibration process, which is contingent upon the characteristics of the road network. The methodology employed in reference [10] incorporates optical flow as a means of analysis, while simultaneously depending on the car's proximity to the driveway line and other relevant road characteristics. The method described in Reference [3] is similar in approach. The approach proposed by Reference [4] utilizes color calibration for the purpose of car detection. Subsequently, it employs the fixed camera's angle to convert pixel velocities into real-world velocities. The utilization of camera features for transformation-based prediction has been demonstrated in a previous study [10]. In a similar vein, certain notable aspects captured in the footage can be juxtaposed with preexisting maps or photos in order to approximate displacement [4].

4. Methodology

The sensor is connected to the first laser receiver by establishing a connection between the VCC port and +5V, and between the GND port and GND. Additionally, the signal output port of the sensor (OUT) is connected to PIN2 of the Arduino, as well as the sensor of the second laser receiver. The ground (GND) terminal is connected to the ground terminal in the Arduino, while the output signal of the Arduino is linked to PIN3 on the Arduino. The laser transmitter comprises two ports, namely the positive and negative wires. The positive port is directly connected to a +5V source, while the negative port is directly connected to the ground (GND). The second laser transmitter is equipped with two wire ports, namely positive and negative. The positive port is directly connected to a +5V source, while the negative port is directly connected to the ground (GND). The placement

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of each laser transmitter is positioned in opposition to the laser sensor receiver, as depicted in Figure (2).

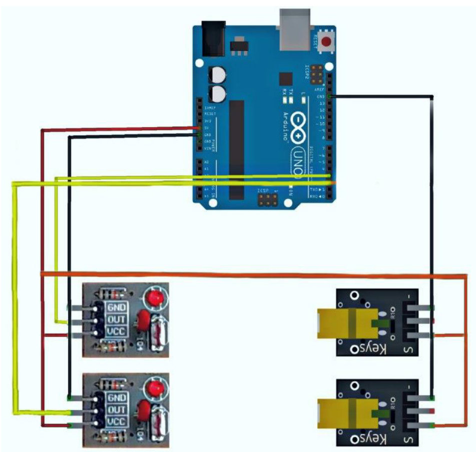

Figure (2): Connectivity to the computer through the utilization USB port.

Upon activation, the two lasers emit light towards the receivers, thereby enabling the receivers to detect the light emitted by the lasers and transmit a reading of "1". Conversely, when the light is obstructed from reaching the two receivers, they transmit a reading of "0". The underlying principle of operation is as follows: when the vehicle obstructs the light detected by the first sensor, it transmits a signal indicating a reading of zero (0). At this point, a timer is activated to measure the duration, with a software component inside the programed responsible for converting the time into milliseconds. The timer ceases its operation upon the car's disconnection from the second sensor, signifying the transmission of a message. The act of reading is a fundamental skill that involves the interpretation and comprehension of written text. It is a cognitive process that allows individuals in this scenario, the meter ceases its counting function, ultimately yielding the measured time. Furthermore, it is important to note that the distance between the sensors remains constant and is already established. By utilizing the temporal data acquired and the predetermined spatial separation of the sensors, it is possible to ascertain the velocity of the vehicle employing the fundamental principle of speed, which posits that speed is equal to the quotient of distance and time. By utilizing this method, we are able to obtain the time measurement in milliseconds (ms), while the distance between the sensors remains constant and is expressed in meters (m). Consequently, the resulting speed is represented in meters per millisecond (m/ms). The velocity of the car is converted from meters per millisecond (m/ms) to kilometers per hour (km/h) according to the units in which the car's speed is measured. The location of this conversion within the program code can be determined by utilizing the following equation.

Distance(km/h) =distance (m/ms)*3.6

So that the distance between the sensors is equal to (5m).

In the end, we assume that the highest speed that the car can reach is (30 km/h) If the car exceeds the speed set in the program, the Arduino gives a command to take the picture through the labview program.

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```
float tmr,dis,speeder,speeder2 ;
unsigned int retval;
int cont,x,y;
void setup() {
         Serial.begin(9600);
            pinMode(2,INPUT);
               pinMode(3,INPUT);
                                                        {
void loop() {
    cont=0;
    tmr=0;
      digitalRead(2);
    digitalRead(3);
if (digitalRead(2)==0)
                                                        }
   for(int i=0; ;i++)
                                                        }
   delay(1);
     cont=1+i;
if(digitalRead(3)==0)
break;}
tmr=cont*0.001;
speeder=5/tmr;
speeder2=speeder*3.6;
retval = (unsigned int) speeder2;
Serial.write ((retval >> 8));
Serial.write ((retval & 0xFF));
                                                        {
}
```

2. Results and Discussions

The findings presented in Table 4-1, derived from empirical investigations conducted as part of the project, indicate the existence of three potential scenarios.

The initial scenario suggests that there is no discontinuity between the first and second sensors, resulting in a reading of 1. Consequently, it is deduced that the speed and time interval between the two recorded sensors are both equal to 0. As a result, the camera does not capture any images, as depicted in figure 3.

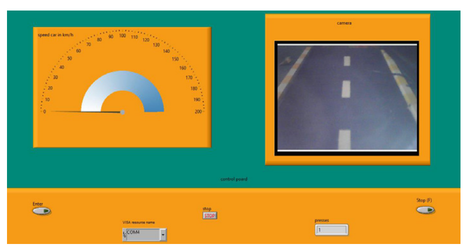

Fig. (3): deduced speed and time interval between the two-recorded sensors are both equal to 0.

In the second, the vehicle does not go faster than allowed. The first sensor is broken since it reports a value of zero. As a result, the timer starts ticking at the stroke of midnight. At the same time, a single is picked up by the second sensor, proving that there is no problem. There is currently 0% speed reading and 0% footage being recorded by the camera. The initial condition assumes a continuity between the first and second sensors, hence the outcome is 1. Therefore, both the speed and the time difference between the two recorded sensors must be zero. Therefore, as seen in figure 3, the camera is unable to record any photographs. In the second, the vehicle does not go faster than allowed. The first sensor is broken since it reports a value of zero. As a result, the timer starts ticking at the stroke of midnight. At the same time, a single is picked up by the second sensor, proving that there is no problem. There is currently 0% speed reading and 0% footage being recorded by the camera. As the car approaches the second sensor, the laser beam is broken, resulting in a zero reading. The first sensor makes a reading of one at the same time. At this point, the timer ceases counting, signifying the end of the time span. It has been determined that there is a difference of 1.0588 seconds between the two detectors. By establishing a relationship between the available time and the fixed separation of the two detectors, the velocity can be calculated. As long as the car stays inside the specified speed range, the camera will not record an image of it, as depicted in Figure 4.

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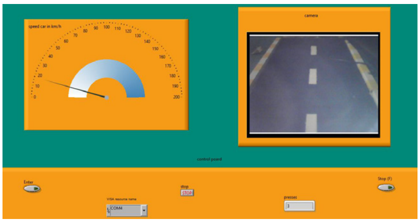

Fig. (4): establishing a correlation between the given time and the constant distance between the two sensors.

The third scenario involves the car surpassing the designated speed limit. This occurrence indicates a disruption in the first sensor, resulting in a reading of zero. Consequently, the timer initiates and begins measuring time. Simultaneously, the second sensor registers a reading of one, indicating the absence of any disruptions. At this juncture, there is no recorded speed reading of zero. Capture an image using the camera. When the vehicle reaches the second sensor and the laser is interrupted, it registers a reading of zero. Simultaneously, the first sensor records a reading of one, marking the conclusion of the timer as it reaches the end of its countdown. The duration between the two sensors is measured to be 0.3913 units of time. The velocity can be determined by establishing the correlation between the given time and the constant distance between the two sensors the distance between the two sensors is constant (5m).

$$\text{Speed}\left(\frac{m}{s}\right) = \frac{\text{Distance}}{\text{Time}} \quad \ldots\ldots\ldots (١)$$

$$\text{Speed}\left(\frac{km}{h}\right) = ٣.٦ \times Speed\left(\frac{m}{s}\right) \quad \ldots\ldots\ldots (٢)$$

In the event that the automobile's speed surpasses the predetermined threshold, the camera will capture an image of the car, as depicted in Figure 5.

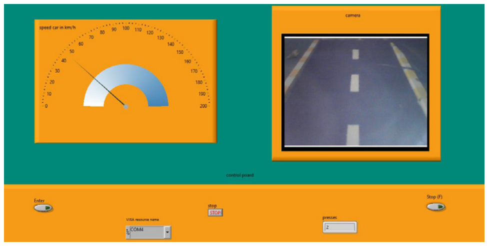

Fig. (5): Capture an image of the car that automobile's speed surpasses the predetermined

In this paper used some parameters that effect of velocity car as shown in table below:

Table (1): Parameters that used in this paper

Possibilities	First Sensor	(Time (S	Second Sensor	(Distance (m	Speed (km/h)	Camera
First Possibilities	1	0	1	5	0	0
Second Possibilities	0	Start time	1	5	0	0
	1	1.0588	0	5	17	0
Third Possibilities	0	Start time	1	5	17	0
	1	0.3913	0	5	46	1

3. Conclusion

The conclusion of this paper is to mitigate the occurrence of accidents resulting from excessive speeding while simultaneously assisting traffic law enforcement officers in monitoring and documenting traffic violations. This is achieved through the utilization of an machine learning which operate under various conditions and at all times to ensure precise and prompt recording of traffic violations. Additionally, the Labview program is employed to issue commands to the camera, instructing it to capture images of speeding vehicles. This paper present a promising initiative to

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enhance road safety and traffic law enforcement by using a combination of technology components such as Arduino, cameras, transmitters, laser receivers, and LabVIEW software. By addressing these key aspects, this paper can contribute significantly to reducing accidents caused by high-speed driving and improving traffic law enforcement. It's essential to plan, implement, and maintain the system with a focus on accuracy, reliability, and legal compliance to achieve your goals effectively using machine learning.

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