

A Comprehensive Survey of Traffic Sign Recognition and Vehicle Control Techniques

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ABSTRACT: The paper focuses on comprehensive survey of traffic sign recognition techniques proposed and hence controlling the speed of the car. There are various methodologies put up in the domain of road safety using different intelligent control systems. Various literatures are included representing the idea of vehicle speed control using the concepts of Radio Frequency Identification, Wireless Technology and Image Processing. The paper aims to survey specific aspects of these methods and compare them with respect to various parameters along with the study of feasibility of each method. Hence the paper tries to come up with a scrutiny of these techniques and a blend which will be accurate and can be implemented easily as well. By studying and surveying this domain we also have mentioned the future scope of the topic which can be implemented in real time vehicles.

KEYWORDS: Vehicle speed control, traffic sign recognition, ADAS, GPS, GSM, RFID, ECU.

I. INTRODUCTION

Road accidents are globally recognized as a serious public safety problem. This problem is much more serious in our country where close to 5 lakh road accidents cause yearly 1,46,000 deaths. Double of the number got seriously injured in last year. The Compound Annual Growth Rate (CAGR) of number of road accident fatalities, increased from 3.7 percent to 4.4 percent during the same period.

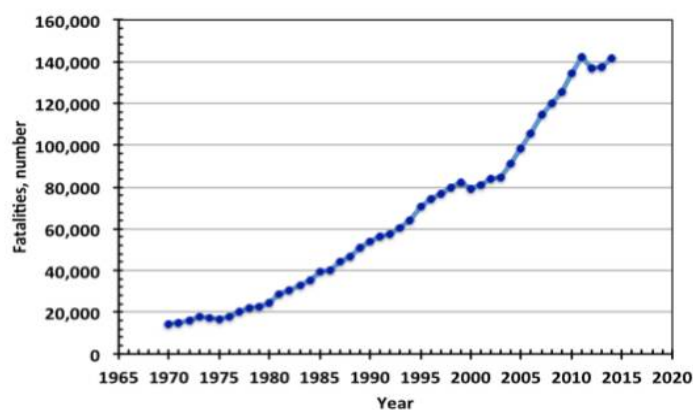


Figure Number.1 :Number of fatalities per year^[6]

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Figure number 1 above shows the growth of personal motor vehicles registered in India by year 2020 according to official data (Transport Research Wing, 2014). The analysis of road accidents in terms of causal factors reveals that the drivers' fault is the most important factor responsible for accidents. It accounted for 77.1 percent of total road accidents which contains ignoring of road side sign boards, another factor observed is bad light on roads and blocked visibility because of which information on road side couldn't get interpreted by the driver. Hence to reduce the number of accidents various techniques are developed using embedded control systems. An overview of such methods is taken in the paper based on their functionality and operation techniques used.

II. PROMINENT CONTRIBUTIONS IN DOMAIN

Several conferences were held during the course of time through which proceedings were submitted, which contributed various methodologies and embedded solutions for development in the field. The prominent conferences are:

- 1) The proceedings presented in the conference 'International Joint Conference on Neural Networks'(IJCNN) 2011 summarize most of the prominent solutions for traffic sign reorganization through image processing.
- 2) The conference Global High Tech Congress on Electronics'(GHTCE) 2013 was based on controlling vehicle dynamics like acceleration, braking, gears and mechanical terrains to achieve the speed control over the motors and implementation of fuzzy logic for achieving the control.
- 3) IEEE RFID 2015 The conference was based on providing ingenious solutions to prominent problems through RFID based techniques. Due to reliability and high hit rate of these techniques a precise working direction is given in the domain.
- 4) The conference 'Embedded Real Time Software Exhibition & Congress'(ERTS) 2016 was based on smarter applications of Global Positioning System (GPS). Some of the conference proceedings proposed traffic sign reorganization and vehicle speed measurements techniques and Advance Driver Assistance System (ADAS).
- 5) International Conferences on Advance Driver Assistance System (ADAS) 2001, 2007, 2015, 2016 were periodically inculcating the work done in the driver assistance and smart transportation domain over the course of time. All the techniques hypothesized and implemented using various modules were assessed and integrated in these conference proceedings. Through the proceedings in ADAS conferences continue booming of the domain of traffic sign reorganization and vehicle regulation took place.

II. RESEARCH DIRECTION

In the domain of 'Traffic sign reorganization and vehicle regulation' the research carried through this document analyses various proposed solutions. Comparisons are made among current solutions by scrutinizing with respect to following aspects:

- Accuracy of solution.
- Designing intricate nature of the solution.
- Cost efficiency.
- Feasibility during on site performance.
- Maintenance required.
- Reliability of the solution in the extreme conditions.

IV. TERMINOLOGIES

- Advance Driver Assistance System (ADAS): ADAS is an embedded system consisting of several integral modules which helps the driver in entire driving process by providing a safe human machine interface.

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- Global Positioning System (GPS): GPS is a system of global navigational satellites that provides geo-positional information to a receiver anywhere on the earth.
- Global System for Mobile communication (GSM): GSM is a standard developed by European Telecommunication Standard Institute (ETSI) to describe the protocols for second generation digital cellular network, used by mobile phones.
- Radio Frequency Identification (RFID): RFID refers to a small electronic module elongated with an antenna which is typically capable of carrying 2000 bytes of data.

V. LITERATURE SURVEYED

1. Authors of the paper automatic Speed Control of Vehicle Using RFID^[4] proposes the idea of Traffic sign recognition using RFID technology and controlling of vehicle without intervention of the driver if the signs are not followed. The RFID tags containing speed limit information are mounted at the beginning and end of the speed limit zones. The receiver module placed in vehicle detects the signal transmitted and the decoded information is conveyed to the driver by means of LCD placed on the dashboard of the car. If the speed limit is not achieved within the specific interval of time then the controlling unit placed in the car takes corrective measures by itself and the required speed limit is achieved. For demonstration purposes a 12V DC motor is used to represent the engine of the car. Low complexity, High accuracy and reliability make this system highly feasible and implementable.

2. Authors of the paper Traffic sign recognition application based on Image Processing techniques^[2] proposes software approach for Traffic Sign Recognition (TSR), which contains image processing technique. The traffic sign along the side of road is captured in the form of image and further this information is conveyed to the automobile. Idea presented in this paper is supported by practical implementation, a short survey is provided based on the results of execution. The paper describes mathematical techniques used in recognition of traffic signs. The image of traffic sign is taken through camera, based on successive images, Laplasian of Gaussian (LOG) of the image is obtained, which gives spatial derivative of the image. The sign recognition system will be activated if the spatial derivative is not equal to zero. Once the system is enabled the image is converted into gray picture which is then passed through edge filter for obtaining region of interest(ROI).From the ROI based on size ,elimination is carried out from the frame. Once the edges of sign are obtained then image in those edges is normalized based on factors like contrast, resolution, colour and shape. This normalized image is then compared with all the normalized values stored in the database and cross correlation is obtained for every comparison. Based on the threshold of cross correlation exact sign is identified. Thus the information in the sign is displayed in the vehicle using LCD.

3. Authors of the paper RF Based Automatic Vehicle Speed Limiter by Controlling Throttle Valve^[1] proposes an idea of limiting the speed of automobile in the restricted zone. RFID technology is applied for transferring the zone related information, based on it throttle valve is manipulated to control the speed of vehicle. The paper has covered the present technologies through which the same task is implemented. Simulation circuits are provided in paper along with the results which support the technology proposed. The zone related information is sent in the form of different frequencies through RFID, a receiver unit will be placed in automobile which will interpret this information. Especially NI DAQ 6009 is used for this purpose. Based on this interpreted information controlling of fuel supply through valve is done. Prominently controlling methodologies are described for valve manipulation through throttle control Drive by wire throttle control and Electronic throttle control.

In drive by wire throttle control the accelerometer is mechanically connected to valve, so restricting moment of throttle is tedious, hence the requirement of another valve is insisted whose moment in controlled. Based on the controlled moment limited fuel will be supplied to vehicle thus speed of vehicle is regulated accordingly. In electronic throttle control the moment of throttle will be conveyed electronically to ECU, based on that moment the fuel supply to vehicle is controlled. Hence in the restricted zone, electronic signal from throttle is first controlled according to limits and then fed to ECU to achieve the speed regulation of automobile.

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4. Authors of the paper Speed Control for Motor Vehicles Using Global Positioning System^[3] proposes the idea of speed control of motor vehicles using the combination of GPS and GSM. Instead of using GPS or GSM individually for tracking the location of the vehicle, a combination of both the technologies is used which improves the accuracy and reliability of the system. In this method, GPS value obtained from the satellite is continuously displayed on the LCD. If the vehicle enters a pedestrian zone, the GPS value of the zone is transmitted to the vehicle through zigbee transmitter fixed in the zone. The GPS values of vehicle and pedestrian zone are compared and then the instantaneous speed of the vehicle is compared with the speed limit obtained. If instantaneous speed is more, then the speed is reduced by sending appropriate commands to ECU. By referring these values the condition of the vehicle can be sent through GSM as a SMS and can be displayed on LCD.

VI. COMPARISON TABLE

PAPER TITLE	TECHNOLOGY PROPOSED	NATURE OF RESULTS	COMPLEXITY	COST EFFICIENCY	RELIABILITY	ACCURACY	MAINTENANCE REQUIRED
Automatic Speed Control of Vehicle Using RFID:	Radio Frequency Identification	Simulated	Low	High	High	High	Low
Automatic Speed Limit Violation Detection and Warning System Using GPS and GSM Modem	GPS+GSM	Hypothetical	Moderate	Moderate	Moderate	Moderate	Low
Traffic sign recognition application based on image processing techniques	Image Processing and conditioning	Experimented	High	Low	Moderate	High	Moderate
RF Based Automatic Vehicle Speed Limiter by Controlling Throttle Valve:	RFID+ valve control	Simulated	Low	High	High	High	Low

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VII. FUTURE SCOPE

Through the thorough scrutiny of the work put up in the domain of 'Traffic Sign Recognition and Vehicle Regulation' domain, we remark that the domain is integral part of ADAS and it contributes its enormous share in the development of smart transportation systems. The work done till the date, even it is prominently focused on RECOGNITION and REGULATION, though complete regulation of the automobile in analogous with the mandatory signs is unilluminated. Hence a system can be developed which recognizes the traffic sign, interprets the information to driver, takes the corrective measure in case it is not taken by driver and records the overruling of the incidence.

This will cause a drastic change in the current transportation system and so in the domain of ADAS. The increase in annual death rate due to road accidents might be controlled drastically due to this dynamic controlling system, which could be an integral part of the vehicle in future.

VIII. CONCLUSION

The comparative and comprehensive survey of traffic sign recognition techniques showed a wide range of conclusive aspects. The accuracy, complexity and reliability of the systems were the core comparison points which led to the outcome of the survey. Sign recognition through image processing proved to be highly accurate but resulted in complex systems having low reliability and high cost which again led to lower feasibility in the implementation. Wireless Technology using GPS and GSM is simple and easy to implement but not so accurate and reliable. Traffic sign recognition based on Radio Frequency Identification technique proved to be state of the art solution as it provides highest accuracy, low cost and high reliability as well as low system complexity at the same time. These features increases the feasibility of the system making it highly implementable.

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