International Journal of Scientific Research and Engineering Development-– Volume 2 Issue 6, Nov- Dec 2019

Available at www.ijsred.com

RESEARCH ARTICLE OPEN ACCESS

RFID Future of Red-Light Violation Detection System: An Analysis on What Does It Look Like and What are the Public Perceptions

Arun Yadav, Author

Research program – University of Southampton;International Intern with University of Sunshine Coast, Australia

Senior Researcher and Road Safety volunteer

Tel: 91-08860068491; Email: yadav.arun09@gmail.com

Dr. Bridie Scott-Parker, Corresponding Author

PhD QUT (Adolescent Risk Research Unit (ARRU), Senior Research Fellow at the University of the Sunshine Coast, Sunshine Coast Mind and Neuroscience - Thompson Institute, Consortium of Adolescent Road Safety (cadrosa.org), University of the Sunshine Coast (USC), Australia

Thompson Institute, 12 Innovation Parkway, Birtinya Qld 4575 Australia

Tel: 61-7-5456-5844; Email: bscottpa@usc.edu.au

ABSTRACT

Automatic traffic light detection plays an important role in the efficient functioning of theintelligent transportation system (ITS). A variety of detection methods have beenimplemented around the world with the objective toincrease the accuracy of red-light violation detection systems (RLVDS). Under the traditional method, a traffic police officer identifies red-lightviolators and apprehend them on the spot. Not only this is an expensive method of enforcement, but it may breed corruption including other drawbacks. So, to overcome these limitations many countries have shifted tothe modern enforcement method, underwhich atraffic light camera was used to detect red-light violators by capturing the number plate of the offending vehicle. However,ithas its ownlimitations, includingthe capture of a blurry image of poor resolution, obscuring of numbers and/or letters during hours of darkness and more. Therefore, many red-light transgressions remain undetected, and un-punished.This paper discusses the various limitations of the existing detection systems and proposes a Radio frequency identification (RFID) based solution to overcome theselimitationsand improve the accuracy of RLVDS.In doing so, various red-light enforcement methods have been studied, and the need for an RFID based RLVDS have been discussed.Furthermore, to understand the public perception, data from the questionnaire survey based on a random sample of 1000 respondents including a wide range of their characteristics from India were analyzed using an econometric technique. Findings from this research provide several important implications that could support the current practices of RLVDS.

KEYWORDS

Intelligent traffic control systems, Radio frequency identification, Red-light violation detection systems, Online survey, Red-light cameras

INTRODUCTION

The end of the 20th century and the start of the 21st century saw aconstant growth inurbanization, industrialization,and human population around the globe which has led to a tremendous increase in traffic using road networks worldwide. It has been predicted that traffic fatalities will be the sixth leading cause of death worldwide and the second leading cause of death in developing countries such as India by the year 2020. (1,2).Road rules and traffic enforcement relies upon both general deterrence and specific deterrence. Deterrence theory argues that for a behaviour to be extinguished, punishment for that behaviour must be swift, certain, and severe. (3). Drivers are deterred from risky driving behaviour as a result of the presence of traffic police on road, and vicariously through observation of other drivers who have been detected and apprehended for road rule violations (general deterrence). Drivers also can be deterred from future risky driving behaviour because of being detected and subsequently being punished for that transgression (specific deterrence). Importantly, Scott-Parker and colleagues found that avoiding punishment through deliberately changing the driving route or having someone else pay the infringement increases the likelihood that the driver will continue to be problematic on the road. (4). Finally, note that in the context of the considerable growth in the number of vehicles around the globe, haphazard traffic enforcement and avoidance of punishment for transgressions undermines the effectiveness of a deterrence-based enforcement system. Therefore, one of the challenges for police officers is to manage road user behaviour, and compliance with road rules. (5).

MOTIVATION

Following are some of the motivation of this project.

a) Violation of signal
b) Corruption by traffic police
c) No discipline in following traffic rules
d) Reduce the workload of traffic police
e) To establish a secure connection between RFID reader and tags
f) Reduction in accidents

ANALYSIS ON EXISTING RED-LIGHT VIOLATION DETECTION SYSTEMS

Officer Based Red-Light Violation Enforcement System

Under the traditional method of red-lightviolation enforcement system, an individual (usually a traffic police officer) monitor traffic and identifies violations such as red-light running, using a mobile phone while driving, driving without a seat belt and more. Not only this is an expensive method of enforcement (in terms of salary) and may breed corruption including other drawbacks. Furthermore, it may also create a risk of injury due to the possibility of high-speed pursuits in caseswhere offenders try to avoid apprehension.(6). For example, For the year ending March 2016, the Independent Police Complaints Commission (IPCC) has highlighted a sharp increase in the number of vehicle pursuit-related deaths. According to them,28 people died including police officers from pursuit-related incidents which are highest in the last 11 years. (7). Moreover, it is not possible to have a traffic police officer at every intersection of the city and town to monitor the traffic violations 24 hours a day and 7 days a week.

Red-light running (RLR) has been identified as a serious traffic rule violation which has increased with time and contributes to unsafe roads for other road users. To illustrate, according to the Insurance Institute for Highway Safety for the year 2014 in the United States alone,RLR was responsible for more than 700 fatalities and 127,000 injuries.(8).Also, as per the World Health Organization, an estimated 1.2 million people die and around 50 million people incur non-fatal injuries each year on roads.(9).Multiple engineering and enforcement countermeasures are currently used to detect the red-light violators, including red-light cameras (RLCs) which are widely used at signalized intersections globally. This method of automated enforcement has changed the driver's behavior through both general deterrence and punishment of individual violators through enforcement penalties. The effectiveness of RLCs in reducing the number of red-light violations has been examined in various studies. For example - Chen and other researchers explored the general deterrence effects of red-light cameras at non-camera sites that subsequently implemented camera enforcement in British Columbia. The analyses revealed a 69% reduction in the rate of red-light violations at the non-camera intersections one month after the introduction of cameras and a 38% reduction after six months. Overall, the results suggested that camera enforcement leads to large reductions in red-light running violations, ranging from 22% to 78%. (10).

To overcome the existing limitations and to further enhance the existing red-light violation detection systems (RLVDS) an Intelligent Traffic Control system (ITCS) has been proposed in this study by using RFID concept. The key idea is based on the principle of RFID tracking of vehicles, a topic on which many organizations are doing/have done extensive research. For example – RFID based highway toll collection systems which are now routinely employed in many countries, like the Telepass system in Italy or the Autopass system in Norway. Other uses include monitoring systems to avoid vehicle theft, access control to car parking or private areas and embedding of RFID tags in license plates with specially coded IDs for automatic vehicle detection and identification. (11).

Importantly, manual enforcement of red-light running notably has the following limitations:

a) Detection of traffic violations in terms of on-site policing is costly;
b) Manually issuing tickets to traffic violators is time-consuming, with police in India allowed limited time for traffic regulation and for clearing subsequent traffic jams;
c) The manual system of enforcing traffic violations may not be transparent and can facilitate corrupt policing practices;
d) Manual systems, such as in Qatar, may not link to previous traffic violations,with repeat offenders escaping higher penalties for recalcitrant;
e) There can be a misappropriation of fines paid during real-time detection by police, with unscrupulous police officers found to use duplicate receipt books.(12).

Considering these limitations, several engineering countermeasureshave been implemented to reduce red-light running. There generally involve changes to the intersection and/or the signal which:

a) Increased the visibility of traffic light (e.g., using overhead traffic light displays rather than pole-mounted signals);
b) Increased the likelihood that drivers will stop at red lights (e.g., by installing warning flashers to warn drivers when traffic light are about to change to yellow);

c) Reduced intentional violations (e.g., by careful timing of signal cycle lengths to ensure yellow intervals are long enough and that red cycles are not so long that drivers become frustrated and unwilling to wait for the next green interval); and
d) Eliminated the need to stop (e.g., by removing traffic light and replacing them with an alternative traffic control device, such as a stop sign or roundabout). (13,14).

Automated Enforcement for Red Light Running

An increasingly popular alternative to police enforcement to detect red light violators is automated enforcement via red light cameras (RLCs). RLCs allowtraffic police to enforcetraffic light complianceremotely without the need for an officer to be present at the scene of the violation. This method of enforcement helps in reducing the likelihood of a potentially dangerous high-speed pursuit and reduces the possibility of human bias, corruption, discrimination, or selective enforcement. (15). As a result, the use of RLCs to increase compliance with a traffic light is increasing. However, RLCs are not a new technology,despite the relatively recent increase in their application, with the technology being used for almost 50 years. Israel first used RLCs for traffic enforcement as early as 1969; in Europe,the early 1970s; RLCs were adopted on a wide scale in Australia in the 1980s;RLCs were first used in 1993 in New York City.(16). Although, legal challenges, data securities concerns, public opposition, and upfront costs have prevented many cities from implementing such a system.

Generally,RLCserves three purposes. First, they are used to enforce traffic light compliance;second, they reduce the frequency of red light violations and have proven effective in reducing fatal collisions due to RLR; and lastly, they generate a revenue for the city that in many cases funds enforcement programs or invests in the community (e.g., parks, recreation, etc.). (17). The success of these three functions depends on how the camera is installed, environmental conditions, and the technology that is in place.

RLCs are generallyplaced in weatherproof, vandalism-proofed, metal boxes close to the intersection on hinged poles, or fixed onto a traffic light structure. These boxes are mounted 10–15 feet in the air, as shown in Figure 1. Other RLC camera systems are integrated into the existing traffic light hardware, thus their presence can be obscured. Irrespective of the on-site integration of the RLC, they are connected to the traffic lightcontroller.When a traffic light switches to red, the automated enforcement system is activated, and the camera is ready to take a picture of violators. Vehicles in violation will cross a trigger mechanism, whichmay compriseroad tubes, inductive loop sensors, piezoelectric strips (pressure sensors), radar, and/or lasers. A photograph of the violating vehicle is taken, and a second photograph is taken to document the traffic light color and the offending vehicle in the middle of the intersection. In

some cases, a third photograph is taken to capture the offending vehicle's license plate.Although traffic equipment vendors may claim that one automated enforcement camera system can monitor four lanes of traffic, studies performed in New York City have shown accurate photography can only be accomplished in configurations of a maximum of three lanes. (18,19).

Figure 1 - Example of a Red-light Camera

RFIDBased Red-Light Violation Detection System

Radio Frequency Identification technology originated inthe 1990s and developed through three stages: electromagnetic induction (the production of an electromotive force (i.e., voltage) across an electrical conductor in a changing magnetic field); non-contact identification of the target tracking; and two-way data communication of the new automatic identification technology.(20).Three key factors drove a significant increase in RFID usage in the 21st century. These include: (a) decreased cost of equipment and tags; (b) increased performance to a reliability of 99.9%; and (c) a stable international standard regarding ultra-high frequency (UHF) passive systems.(21).On the other hand, RFID based traffic violation detection systems use radio-frequency waves to identify vehicles that are endowed with unique identification numbers in the form of RFID tags. RFID (Radio Frequency Identification) is one of the upcoming technologies in the field of engineering and innovation. It has several applications in the market starting from vehicle identification at tolls to security systems at malls. These RFID based systems consist of 3 main components, namely RFID Reader, RFID Tags, and RFID Database.RFIDisa three-component based system consisting of tag, reader, and database. RFID is an identification technique that uses radio waves for the identification of objects bearing the tag.RFID tags, or simply "tags", are small transponders that respond to queries from a reader by wirelessly transmitting a serial number or similar identifier. There are three parts ina tag: antenna (the antenna is designed for a specific frequency of operation and is tuned according to the properties of the material to be read), a semiconductor chip (aka integrated circuit,IC) and encapsulation (used to incorporate materials on a micrometric scale). (22).

There are two types of readers:stationary readers,which can be fixed at a specific location and can be read within this range, andmobile readersthat are moveable devices.(23). Finally, a web-based database to facilitate the centralization of information/records of red-light violation detection. There areseveral methods of identification in an RFID system, but the most commonoption is to store a unique serial number that identifies a personor object on a microchip that is attached to an antenna.The combined antenna and microchiparetheRFID transponder or RFID tag andworks incombination with an RFID reader, the RFID systemthus consisting of a reader and one or more tags. There are two tag technologies: passive tags are tags that donot contain their own power source or transmitter. Whenradio waves from the reader reach the chip's antenna, theenergy is converted by the antenna into electricity that can power up the microchip in the tag. The tag is thenable to send back any information stored byreflecting the electromagnetic waves.In contrast, active tags have their own power source andtransmitter. The power source, usually a battery, is usedto run the microchip's circuitry and to broadcast a frequency-based signalto a reader. Frequency refers to the size of the radio waves used to communicate between the RFID systems component. The read range of a tag ultimately depends on many factors: the frequency of RFID system operation, RFID tag, the power of the reader, environmental conditions, the physical size of the tag antenna, and interference from other RFID.The passive RFID technology is more suited for fast-moving vehicles. Fast-moving vehicles and their details are detected at minimal cost and with maximum efficiency by using RFID technologies. The passive RFIDs could be deployed with a lower cost when compared to active RFIDs. Vehicles within the reader's range are given more than one chance to be identified. Once RFIDs are properly identified, the reader mutes the transfer to avoid unwanted transmission of data. The conventional anti-collision algorithm assumes only static RFID, but it is used to identify mobile RFID tags. It could read from multiple lanes, reducing the amount of hardware.Data exchange is faster and minimal resources are needed. It could retrieve data from fast-moving objects. The weaknesses are that the use of inefficient readers might increase the required resources and that they do not achieve the efficiency and tag collision avoidance possible with active RFIDs.

PUBLIC PERCEPTION ON RFID BASED RED-LIGHT VIOLATION ENFORCEMENT METHOD

Overview

The data was collected by conducting an online survey and the survey was sent to the general public. However, the sample for this survey was limited to drivers with age 18and above whohasavalid driving license and drives a four-wheeler. A questionnaire was designed in a simple and easy format for the respondents to understand. The questionnaire was divided into three parts. In the first part, the questions are related to socio-economic characteristics, while the second part is related to vehicle use and driving characteristics of the drivers. The first two parts were designed based on the selected influencing factors of drivers' attitudes such as:

a) Socio-economic characteristics: gender, age, family status, education.
b) Vehicle use and driving characteristics: vehicle type, challan and accident history, average travel distance per week, driving license.

In the last part of the survey, questions related to red-light running, primary reasons, measures available and attitude towards new RFID based red-light violation detection system is assessed.

Understanding the Survey Results

The questionnaire survey was conducted from January 2019 to May 2019. A total of 1000 people in the study areas were asked to complete the online questionnaire.

Table 1. Socio-economic characteristics of drivers

Socio-Economic Characteristics	Total	Percentage	Male	Female
	1000	**100%**	560	440
Age				
18-24	224	22%	123	101
25-34	280	28%	157	123
35-44	266	27%	151	115
45-54	180	18%	101	79
55-64	30	3%	17	13
Above 64	20	2%	11	9
Education				

High school	50	5%	28	22
Some college	90	9%	50	40
Trade/vocational/technical	30	3%	17	13
Associates	140	14%	78	62
Bachelors	282	28%	168	114
Masters	278	28%	146	132
Professional	90	9%	50	40
Doctorate	40	4%	23	17
Family Status				
Single	387	39%	246	141
Married	353	35%	168	185
Separated	70	7%	39	31
Divorced	60	6%	34	26
Widowed	30	3%	17	13
Prefer not to say	100	10%	56	44

By running a cross-tabulation; Gender with other Socio-economic characteristics of drives (Table1) it is evident that the male drivers with the age group 25-44 years, having the highest level of education as bachelors, and are single, have dominated the Indian roads as one would have expected.

Table 2. Vehicle and Driving Characteristics of Drivers

Vehicle and DrivingCharacteristics		**Frequency**	**Percent**
Vehicle used for	Personal use	720	28%
	Commercial use	280	72%
Years of driving	Less than 6 years	460	46%
	6 years or more	540	54%
Days per week driving	Less than 3 days	280	28%
	3 days or more	720	72%
Challan issued in the past 12 months	Yes	460	46%
	No	540	54%
The primary reason for challan in the past 12 months	Over speeding	184	40%
	Red light crossing	147	32%
	Drink and drive	41	9%

	Driving without seatbelt	69	15%
	Other	19	4%

Table 3. The result of Variable Analysis on Challans Issued Towards Years and Days of Driving

	Challan issued in past 12M	
Variables	**Coefficient**	**Z-test**
Days per week	0.004	1.27
Years of driving	0.299	2.73**

In the second part, a variable relationshipis tested by defining an independent variable as challan issued in the past 12 months, Yes and No; and dependent variables asdays per week and years of driving. It is interesting to see that the drivers who have driven vehicles for 6+ years and for more than 3 days in a week have been issued more challans in the past 12 months vs the drivers who have driven less than 3 days a week; whereas speeding is the primefactorfor issuing the majority of challansfollowed by a red-light running.

Table 4. AttitudeTowards RLR Detection and Available Measures

RLRDetection and Measures		**Frequency**	**Percent**
Red-light running in the past 12 months	Never	350	35%
	Occasionally	470	47%
	About half the time	140	14%
	Most of the time	40	4%
	Always	0	0%
The primary reason for running a red-light	In a hurry, intentionally running a red light	403	62%
	At the end of the yellow light, but runs a red light	182	28%
	Emergency vehicle at behind	52	8%
	Other	13	2%
Encountered crash while running a red-light	Yes	247	38%
	No	403	62%

Available measures in your city for RLR detection	Red-light cameras	290	29%
	A police officer at the spot	550	55%
	Not sure	160	16%
Are available measures enough to identify RLR	Yes	310	31%
	No	690	69%
Measures you think can reduce RLR in your city	Install automatic facilities	420	42%
	Install countdown signal lights	330	33%
	Strengthen education and awareness of traffic safety	250	25%
Do you support automatic RLR detection system using RFID	Yes	800	80%
	No	200	20%

In the last part, the driver's attitude towards red-light detection and available measures in their cities were studied and mostof the drivers suggested that the primary reason for them to cross a red light is that they are in a hurry and have intentionally run a red light; while running a red light 35% had indulged in an accident. Respondents rated Police on spot (55%) as the prime measure available in their city for a red-light violation detection system. Most drivers strongly agreed that Installing countdown signal lights (33%) and automatic facilities (42%) can help reduce the RLR, followed by strengthening education on traffic safety (25%).

At the end of the questionnaire, the drivers were asked to express their opinion about whether the available measures are enough to identify red-light runners in their cities. As expected, overall more than 60% of the drivers said the available measuresare not enough to identify red-light violators in their city. While those who said the available measuresare enough, out of those 25% supported RFID based red-light violation detection system.Overall 80% of respondents supported this measure. Hence, respondents showed a positive attitude towards implementing automatic red-light violation detection method using RFID technology.

** Detailed information regarding RFID technology and its implementation were provided to the respondents before asking their views on the same.*

Table 5. RLR in Past 12 months and Attributes

Attributes		**Red-light running in the past 12 months**	
		Yes	**Percentage**

		650	100%
Challan in the past 12 months	Yes	182	28%
	No	468	72%
Crash while crossing a red light	Yes	228	35%
	No	423	65%

It is also interesting to see that (in table 5), people who rana red light (65%), out of that 72 % had not issued a challan in the past 12 months and 65% did not encountered any crash.The possible reason could be, no police office presented at the traffic intersection,or notraffic camera to monitor the traffic violations. Thus, these red-light transgressions remain undetected, and thus un-punished.

RFID ENFORCEMENT FOR RED-LIGHT RUNNING - IMPLEMENTATIONS, STRENGTHS, LIMITATIONS AND RELATED SYSTEM

Theoretical Implementation

RFID readers will be affixed on each side of the road for the time interval when the signal is green or yellow, the reader remains inactive and vehicles are free to transit within this period. However, as soon as the signal becomes red, the reader activates and propagates the radio waves/frequency. During this period, any vehicle attempting to cross the red-light will be in direct contact with the active waves. The antenna attached to the vehicle collects the energy from the waves and converts that energy into a radio frequency (RF) wave, which is further sent into the red zone. Once the tag is read within this red zone, the RFID tag's internal antenna draws in energy from the RF waves. The energy moves from the tag's antenna to the IC and powers the chip, which generates a signal back to the RF system via a process called a backscattering i.e., the reflection of waves, particles, or signals back to the direction from which they came.

Once RFIDs are properly identified, the reader mutes the transfer to avoid unwanted transmission of data. The conventional anti-collision algorithm assumes only static RFID, but it is used to identify mobile RFID tags. It could read from multiple lanes, reducing the amount of hardware. Data exchange is faster and minimal resources are needed. It could retrieve data from fast-moving objects.

Finally, the data is sent to the control station, placed in a central location, by using the General Packet Radio Service network (GPRS), a packet-switching technology that enables datatransfers through cellular networks; and the gateway GPRS support node (GGSN) network.

The GGSN is responsible for the interworking between the GPRS network and external packet-switched networks, like the Internet and X.25 networks. (24). The database stores these records which can also be used to detect repeat offenders, and for other research purposes. Further, some additional features can be incorporated, such as issuing an automatic e-ticket that can be sent to the violators on their mobile device and/or to their email address. The data obtained is sent immediately to the sensing data collection (CCS) by wireless or wired channels. The CCS contains a central database processing system (CDPS) for processing vehicular data and a decision-making section (DMS) for sending the online tickets. (25).

Strengths

The following strengths of RFID suggest the advantages this system has over the existing red-light violation detection system:

a) Tag detection does not require human intervention, which reduces employment costs and eliminates human errors;
b) As no line-of-sight is required, tag placement is less constrained;
c) RFID tags have a longer read range than, e. g., barcodes; Tags can have read/write memory capability, while barcodes do not;
d) An RFID tag can store large amounts of data added to a unique identifier;
e) Unique item identification is easier to implement with RFID;
f) Its ability to identify items individually rather than generically;
g) Tags are less sensitive to adverse conditions (dust, chemicals, physical damage, etc.).

Limitations

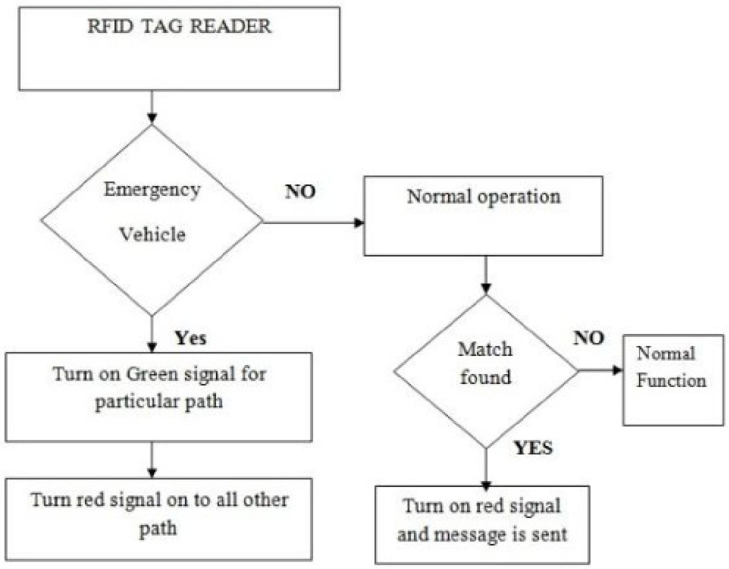
With the increasing adoption of Radio Frequency Identification (RFID) technology opens a new frontier for data threats and data security measures. Broadly speaking, RFID includes a full spectrum of wireless devices of varying capabilities, power, and sophistication, including ExxonMobil Speed Passes, vehicle immobilizers, Electronic Product Code (EPC) tags, and more. RFID tags are small, wireless devices that emit unique identifiers upon interrogation by RFID readers, which emit powerful electromagnetic fields and "read" tag information. Fortunately, network security is a highly evolved, mature technology that brings plenty of powerful tools and technologies to bear on the challenge of keeping networks safe. RFID reader makers can implement a standard, proven security technologies, such as Secure Sockets Layer (SSL) and Secure Shell (SSH). They can close ports that are not secure (e.g., with Telnet). And they can implement secure processes, such as certificates for authentication, which keep out unauthorized readers, competitors, hackers, and other potential threats. Attempting to read several tags at a time may result in a signal collision and ultimately to data loss. To prevent this, anti-collision algorithms (most of them are patented or patent-pending) can be applied at an extra cost. The development of these methods, aimed at reducing overall read time and maximizing the number of tags simultaneously read, still goes on.

The other possible limitation is the implementation of tag in the old vehicles. Hence, to overcome this challenge, we may collaborate with the technology partners and government to start a drive. The objective is to send the invitation to the general public to come with their cars for the tag implementation. However, a plan of action and a discussion will be required before the execution.

Related Practical System

Application ofRFID tags in high-speed railways systems. Each vehicle is identified using a passive RFID tag mounted underneath the railway car and received by the RFID readers mounted along the railway tracks. The reader is connected to the railway system through a wired network. The readings about the tags are received by the readers and sent to the CPS unit to monitor high speed and very high-speed trains in their respective categories. The arrival and departure of railway cars are reported. The round-trip time for the communication between the fast-moving tags and the reader is decreased. RFID suffers difficulty in picking up readings through metals and liquids as they undergo collision and result in interference of tags.

Pérez et al proposed new infrastructure to the vehicles and a control system for intelligent speed control. The system is based on RFID technology. It measures the vehicles speed with a hall effect-based sensor and controls the speed of the passing vehicles using a fuzzy logic controller. Pérez's method does not discuss traffic light situations.Sundar et al used RFID tags in cars to detect several cars in an intersection to adaptively control the traffic light green period to reduce congestion and to identify emergency cars and stolen Vehicles



This proposed method provides an intelligent traffic control system to pass emergency vehicles smoothly. They suggested that each vehicle is equipped with a special radio frequency identification (RFID) tag which is placed at a specific location that cannot be removed easily. This method makes use of RFID reader, max 232, and PIC16F877A system on chip to read the RFID tags attached to the vehicle. If the RFID tag read belongs to the stolen vehicle, the location is tracked using GPS and then a message is sent using GSM to the police control room. Besides, when an ambulance is approaching the junction, it will communicate to the traffic controller in the junction to turn ON the green light until the ambulance passes and the red light for the other path should the red.

CONCLUSION

Red-light running is well recognized as a risky driving behavior that potentially has devastating outcomes for occupants of vehicles traversing intersections on a green light and other road users. Enforcement of red-light transgressions in person by police officers and red-light camerashave certain limitations, including finite financial capital (to support salaries), quality of the image, risk in high-speed pursuits and more, due to which many red-light violators remain undetected.In this paper, we have discussed the use of the basic concepts and functionality of an RFID technology to overcome the existing limitations of red-light violation detection systems. The objective is to improve the accuracyand reach by using RFID tags and readers along with other components.

Based on the survey results, several groups of drivers seem to give their support to the implementation of automatic RLR detection by using an RFID system. Overall, the results suggest that the automatic RLR detection system was strongly supported by most of the drivers, as one would have expected. Also, it is not possible to have a traffic police officer at every intersection of the city and town to monitor the traffic violations 24 hours a day and 7 days a week. Considering the limitation of RLC and in-person enforcement, it is recommended to have an RFID based automatic red-light detection system which can run 24 hours and can stand harsh environmental conditions along with other advantages. Hence, we can say that RFID is the future of the red-light violation detection system.

FUTURE RESEARCH DIRECTIONS

The next step is to test the prototype system and collectthe real-time feedback from the police and the public. The basic objective is to capture the data under the test conditions, identifying the cost structure, studying the results for a discussion on the implementation process. This experiment will be performed in the inbound experiment facility. Further, to minimize the security threats the scope of blockchain can be studied.

ACKNOWLEDGMENT

The second author is supported by a National Health and Medical Research Council Research Fellowship.

REFERENCES

1. McCarthy, The Most Dangerous US Cities for Red-light Running, 2015. https://www.statista.com/chart/3717/red-light-running/.
2. C. J. Murray and A. D. Lopez, The Global Burden of Disease, Harvard School of Public Health for the World Health Organization and the World Bank, Cambridge, Mass, USA, 1996.
3. M. A. Leroch, Punishment as Defiance: Deterrence and Perverse Effects in the Case of Expressive Crime, CESifo Economic Studies, 60, 3, (581), 2014.
4. Scott-Parker, Bridie, Watson, Barry, King, Mark J., & Hyde, Melissa K. (2013) Punishment Avoidance and Intentional Risky Driving Behaviour : What are the Implications for ‘Getting Away with it’? In Castro, Nicolas (Ed.) Psychology of Punishment: New Research. Nova Science Publishers, New York, 013. pp. 55-78.
5. Global Road Safety Partnership. Speed management: a road safety manual for decision-makers and practitioners. Geneva: Global Road Safety Partnership, 2008.
6. Hompson et al., Thompson, R. S., Rivara, F. P. and Thompson, D. C. 1989 A case control study of the effectiveness of bicycle safety helmets. 1989. New England Journal of Medicine.
7. Road Safety GB Academy, 2018. http://roadsafetygb.org.uk/news/n-a-5899/
8. Evaluation of red-light camera enforcement using traffic violations, McCarthy, 2015. https://www.sciencedirect.com/science/article/pii/S2095756416301659#bib16.
9. Road safety in the western pacific region, WHO, 2015. http://www.who.int/violence_injury_prevention/road_safety_status/2015/Road_Safety_WPRO_English.pdf.

10. Chen et al., Evaluating the Safety Effects of Automated Speed Enforcement Programs, 2001.
11. Mithun, C.N.; Rashid, U.N.; Rahman, M.M.S. Detection and classification of vehicles from video using multiple Time-Spatial images. IEEE Trans. Intell. Transp. Syst, 2012, 13, 1215–1225.
12. US department of transportation, 2009 report. https://safety.fhwa.dot.gov/intersection/other_topics/fhwasa09027/resources/Presentation%20Red%20Light%20Running%20Short%20Version.pdf. 2009.
13. US department of transportation, 2009-2012. https://safety.fhwa.dot.gov/intersection/other_topics/fhwasa09027/resources/Intersection%20Safety%20Issue%20Brief%205.pdf.
14. Federal Highway Administration (2004c). Engineering Countermeasures to Reduce Red-Light Running (RLR). Retrieved 14 July 2015 from the Institute of Transportation Engineers Web site: http://library.ite.org/pub/e26c796b-2354-d714-5117-125d2ad594bd, 2004.
15. M. A. Leroch, Punishment as Defiance: Deterrence and Perverse Effects in the Case of Expressive Crime, CESifo Economic Studies, 60, 3, (581), 2014.
16. Bochner, B. & Walden, T. (2010). Effectiveness of Red-Light Cameras: A Texas Transportation Institute White Paper. Retrieved 3 June 2015.http://tti.tamu.edu/group/stsc/files/2011/03/Red-light-camera-effectiveness-070610-w-Garland-correction1.pdf, 2015.
17. Retting, R.A., A.F Williams, and M.A. Greene. Red-Light Running and Sensible Countermeasures: Summary of Research Findings. In Transportation Research Record 1640, TRB, National Research Council, Washington, D.C., 1998. pp. 23-26.
18. New South Wales center for road safety. http://roadsafety.transport.nsw.gov.au/speeding/speedcameras/red-light-speed-cameras.html#faq1.
19. Mesa Police Department.http://www.cityofmesa.org/police/traffic/redlight_photos.aspx.
20. RFID Journal LIVE, 2010.http://www.rfidjournalevents.com/live2010/.
21. RFID Reader and Tag Communication.https://www.researchgate.net/figure/RFID-Reader-and-Tag-Communication-Flow-Diagram_fig1_228863860
22. EPC-RFID information, https://www.epc-rfid.info/rfid.
23. RFID Data Model for Libraries Working GroupAffiliated to Danish Standard S24/u4http://www.biblev.no/RFID/dansk_rfid_datamodel.pdf.
24. Applying RFID and GPS tracker for signal processing in a cargo security system, 2013.https://ieeexplore.ieee.org/document/6664053/.
25. Rajeshwari, S.; Santhoshs, H.; Varaprasad, G. Implementing intelligent traffic control system for congestion control, ambulance clearance and stolen vehicle detection. IEEE Sens. J. 2015, 15, 1109–1113.

