ISSN:2319-2607 IISUniv.J.Sc.Tech. Vol.9(1), 57-62 (2020)
RESEARCH ARTICLE

# Analysis of Vehicle Theft Detection System at Toll Plaza

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## Abstract

One of the major issues facing by everyone from many years is to detect and recover the theft vehicle. Vehicle theft detection is the least solving cases by police department these days. In this research paper we examine vehicle theft detection system works at toll plaza using different technologies. The current Automated Toll Collection (ATC) system plays a vital role in detection of theft vehicle because the vehicles are RFID enabled. In current system when the vehicle is stolen and reported at police station, the Regional Transport Office (RTO) blacklisted the Radio Frequency Identification (RFID) tag mounted on the windshield of the vehicle and when this particular vehicle reaches at toll plaza, the RF reader scan the tag. If the scanned tag shows blacklisted, the silent alarm buzzes and the vehicle do not allow passing the toll plaza. If the RFID tag is not blacklisted, then the amount deducts from the account of vehicle owner and it allows the vehicle to pass.

Now days different technologies are available for Toll collection and Vehicle theft detection at toll plaza includes: GSM, GPS, OTP, RFID, QR Code, Smart Phone Application, Fingerprint Identification System, Automatic vehicle license recognition system, RFID Car Theft Detection and Arresting System (RCTDAS).

The objective of present research paper is to analysis limitations of existing vehicle theft detection system at toll plaza. An attempt has been made to propose a model to overcome these limitations. Till date no such model has been introduced where the theft vehicle can be detected if someone remove RFID tag or change number plate of the vehicle. After applying the proposed model, the theft vehicle could be detectable whether the RFID tag removed or the number plate has been changed of the theft vehicle.

**Keywords:** ETC, FASTAG, GPS, GSM, QR code, Regional Transport Office (RTO), RFID, Vehicle Theft Detection System

## Introduction

Vehicle Theft Detection System used to detect stolen vehicle using different technologies like RFID, GPS, QR Code and many other navigation systems which operates through satellites and some ground stations.

The current process of vehicle theft detection is like this, when the owner of the theft vehicle lodge FIR of the same, then police department informs RTO and blacklisted the RFID tag of the vehicle, which is mounted on the windshield of the theft vehicle. Whenever the vehicle having blacklisted tag arrived at the toll plaza, the toll plaza detects that the tag is blacklisted with the help of RFID reader and the toll plaza will not allowed to pass the vehicle and inform the owner and nearby police station. But there are still many situations, where the toll plaza is not able to detect the theft vehicle.

The research article includes the introduction of RFID technology which can be used for Vehicle Theft Detection and also Electronic Toll Collection System at Toll Plaza in India. The RFID tags which are applied on the windshield of the vehicle are called FASTAGs.

The article also includes current Vehicle Theft FIR process as well as recovery process in India. There were different types of mechanisms discussed in previous papers to detect theft vehicle but still the recovery rate of the same is too low. To solve this problem and to increase the recovery rate of theft vehicle, the new model has to be proposed including different technologies.

### Vehicle Theft Statistics in India

According to the report of Times of India published on Jan 20, 2018 only 13% stolen vehicles recovered in 2017 at Mohali (Times of India, 2018).

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According another report published on Jan 10, 2019 over 5 vehicles reported stolen every hour in Delhi during 2018 (Jakhar, 2019).

The report published by The Hindu says that Police data shows motor vehicle theft the least solved crime. According to the report in 2018, 44158 cases reported of motor vehicle theft from which only 19.6% solved in capital of India (Bhandari, 2019).

Previously the theft vehicle detected through police department manually but currently it is done online. The online FIR website or application include links like: a) Register FIR b) Retrieve FIR c) Retrieve Final report d) FIR Status e) FAQs through which the complaints can be easily lodged by vehicle owner by entering some basic information about vehicle, place and owner detail. The person can retrieve the copy of the FIR immediately from the application or website. The process makes the way to lodge FIR against theft vehicle very smooth and easy but still the recovery rate is very low as per records. (http://mvt.delhipolice.gov.in/).

**Current FIR process for Vehicle Theft Detection**

Once the vehicle has been stolen, the owner has to lodge FIR of the same. For lodging FIR of theft vehicle, some states have started web applications. There is no need to go to police stations and the vehicle complaints can be lodged through mobile or web applications anytime anywhere. Now this system works only for vehicle lifting cases and vehicle theft cases. If wrong information is provided by citizens, the case will be registered against them under relevant IPC sections using the E-FIR service.

**Current Vehicle Theft Recovery Process**

The Insurance Information Bureau (IIB) has been introduced service called V-Seva in year 2014 to find out theft vehicles. It is the unique database collected by all stakeholders, including general public, police and insurers. With the help of V-Seva, the police can find out theft vehicle with the data provided like cars chassis and engine number (Times of India, 2014).

Another application to track lost vehicle launched in 2016 across the country. This Vahan Samanvaya app is helpful to check the current status of theft vehicle and will also help public and police to trace the database of theft vehicle.

Union Minister of State for Home Haribhai Parathibhai Chaudhary launched an application named Vahan Samanvaya. A web portal also launched named Fake Indian Currency Note (FICN) helps NCRB to get all states data (Gadgetsnow, 2016).

**Technologies Using for Vehicle Theft Detection System**

***Radio Frequency Identification (RFID)***

To identify people and other objects, radio wave technology is used called Radio Frequency Identification (RFID) technology. In this technology, a reader device reads information contained in a wireless device called Tag. The reader does not need any physical contact to device or any line of sight to read the device. RFID is basically a wireless non-contact use of frequency waves to transfer data. RFID technology is more cost-effective and efficient.

RFID (Radio Frequency Identification) has been using from many industries in recent years. It is not a new technology and has been used since 1945 (https://en.wikipedia.org/wiki/Radio-frequency_identification).

***Barcode***

Barcode is a rectangular or square shape image. It consist a series of parallel black lines and white spaces of varying widths. These can be easily read by devices called scanner. Barcodes uses for quick identification of products and are applied on products.

When a barcode on vehicle scanned, the information send to the master server which searches related information of vehicle and vehicle owner. After vehicle identification, the owner received an OTP from bank, then the toll amount deducted from the owners account after OTP verification (Raj *et al.*, 2019).

**Existing Toll collection and Vehicle Theft Detection Working Process at Toll Plaza**

**The working process of Automated Toll Collection System:** The vehicle owner purchase RFID tag and mount it on windshield own vehicle. When vehicle reaches at toll plaza, the RFID reader scan RFID tag, it sends the radio waves and the waves activate the RFID tag mounted on the vehicle. Then activated tag sends the information about the particular vehicle to the RFID reader. The RF reader sends all the information to the lane controller. The lane controller transmits the information to the central computer and then the toll deducts from the vehicle owners account (Fig.1).

A RFID tag mounted on vehicle can detectable through RF reader devices at toll gates. Then the amount of toll automatically deducts from vehicle owners bank account. A camera also installed at the same toll plaza which uses

to capture images of the number plate of vehicles. This captured image also uses to detect the vehicle information. The speed of the particular vehicle can also be controlled using the RFID technology. The whole data stores at the Central server and the transaction bill will send to the owner monthly (Laghari, 2012). Video cameras on the toll plaza use to make sure that any vehicle should not cross toll plaza without having RFID tag in the same. When vehicle passes from plaza, camera clicks the picture of number plate and sends notice to the vehicle owner through the email. The system proposed by Laghari in 2012 uses RFID technology, camera, central server and traffic controller system.

The Camera also used for capturing the vehicle number plate image in paper. Using Automatic Number Plate Recognition (ANPR), the captured image will convert into the text and the toll amount would be deducted from the owners account and then the toll gates open. In system proposed in 2013, if a vehicle is stolen, and vehicle entry made by the police in the central database then whenever the theft vehicle passes through the toll plaza, silent alarm buzz and indicate the operator that the approaching vehicle is a theft vehicle. Thus the research proposed image processing based toll collection system uses high quality camera and front number plate of the vehicle. But there are some drawbacks with ths system also which have to resolve (Jog *et al., 2013*).

The RFID Reader fixed at toll plazas gate. The reader reads information of the RFID mounted vehicle by scanning the tag of the vehicle. After validating the related information of vehicle, toll deduction takes place and the amount deducts from vehicle owners account. The message sent to registered contact number of vehicle and the toll gate opens automatically. The system proposed on 2015 also helps to detect the theft vehicle. The real time information of the vehicle, which passes from the toll plaza, stores in database for future references. This system helps in lower fuel consumption, increase efficiency of toll collection and eliminates the manual cash handling at toll plaza (Chapate and Nawgaje, 2015).

A new system also proposed that makes the process of toll collection much easier and faster. The technologies used in proposed system are camera, QR code and an application program. The camera clicks the image of the QR code from the passing vehicle and detects the vehicle information. The barrier will be opened automatically if the QR Code is valid and the toll amount will be deducted from vehicle owners bank account. The vehicle owner then receives the message of acknowledgement. The entire process takes 20-30 sec. approximately and after the validation of QR code, if the system finds that the vehicle is stolen, toll gate remains close and alert message sent to Regional Transport Office (RTO) and owner of the vehicle. This system uses QR code technology, camera, application program, and vehicle detection system at toll plaza but there are some limitations. The QR code can be duplicate, and also not durable, which effects detection of vehicle (Khatri *et al.*, 2015).

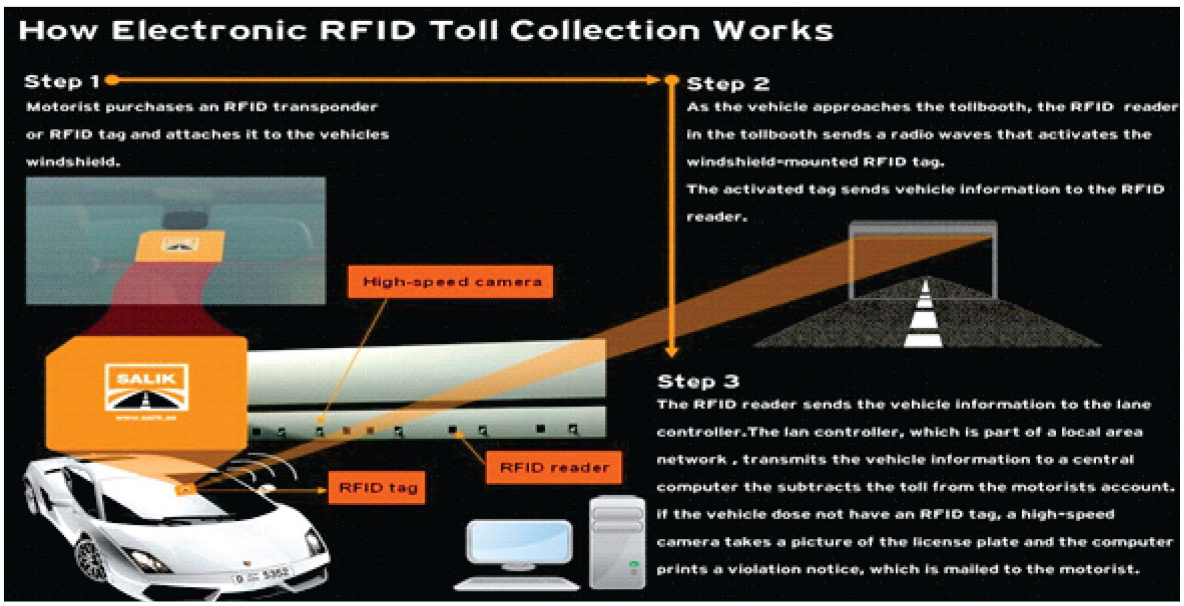


**Fig. 1. Working of Automated Toll Collection System (Parimi, 2014)**

When the owner of theft vehicle registered complaint with RTO, an entry of theft vehicle registered to the central database. When theft vehicle arrives at the plaza, the registered ID in category of theft vehicle can be easily detected and alert message sent to RTO and the vehicles owner. Then the detected vehicle will be not allowed to pass the toll gate. Also detected theft vehicle location can be tracked with the help of global positioning system (GPS) if there is large distance between two toll booths or if there is no nearby toll plaza in such areas. Smart cards also used for traffic control and to assure the vehicle drivers authority. Smart cards are using fingerprint identification technique to verify that the person is having license or not. Thus the system proposed in 2016 uses Fingerprint Identification, GPS, smart card technology for vehicle detection and congestion free toll collection. With use of proposed system, we can reduce waiting time; traffic and burning of fuel (Pund and Galande, 2016).

To locate and report an accident site an intelligent framework has been introduced in 2017. That research focuses on Automatic Accident Detection Sensor (AADS) which includes GSM modem and GPS use to locate the exact location of the vehicle. AADS keeps date wise information. The emergency notifications of accident go the family members, hospitals and police station. Thus the same uses GSM, GPS, accident emergency notifications and AADS for vehicle identification (Raj and Priya, 2017).

The system proposed in 2018 uses RFID technology, API and communication protocol. The main objective of this system is to present a new approach of arresting system and car theft detection using RFID technology at toll plaza. That paper also describes uses of FASTAG, Electronic Toll Collection (ETC) using RFID technology that automatically deducts toll from vehicle owners account when it passes through the toll plaza. The owner can change the RFID tag just like change password. The paper also introduces an application RCTDAS GUI through which user can report anytime from anywhere for missing car (Murugan *et al.*, 2018).

The system proposed by Vinita and Velantina in 2019, uses IOT Based Toll collection system. This system helps the toll plaza to deduct the toll amount by just showing a card. The RFID Reader scans the RFID card shown by the vehicle owner and get information of the RFID cards. The LCD screens on the plaza displays the message that shows the available balance of the card. Then toll amount deducts from available balance of the users card amount. After deduction of toll amount, sms will be sent to the owners mobile number. Also the indication by the red LED lights shows the operation default, yellow shows processing and green shows successful. After successful transaction, the vehicle allows to cross the toll gate. Thus this system includes RFID technology, GSM, Arduino for toll collection and theft detection (Vinitha and Velantina, 2019).

A number plate recognition method is proposed by Akhtar and Ali in 2020. This is done by processing rear or front image of the passing vehicle. After the number plate image is clicked, the toll collection process takes place. The process is divided into four steps. These four steps are: 1. Reprocessing 2.Number plate localization 3.Character segmentation and 4.Character recognition. The accuracy of this method is 90.9% according to the experimental results. Thus the system uses ANPR (Automatic number plate recognition system), Character recognition and Edge detection techniques (Akhtar and Ali, 2020).

**Limitations of the Aavailable Vehicle Theft Detection Systems**

1. After a vehicle theft or stolen, following phases may occur:
   - A vehicle theft but no FIR lodged by owner at police station and the vehicle reach at the Toll Plaza with RFID and Vehicle number plate.
   - A vehicle theft but no FIR lodged by owner and vehicle reach at Toll Plaza with original number plate and damaged/destroyed RFID.
   - A vehicle theft but no FIR lodged by owner and vehicle reach at Toll Plaza with forged number plate and damaged/destroyed RFID.
   - A vehicle theft and reported to the Police Station reach Toll Plaza with RFID and original number plate.
   - A vehicle theft and reported to the Police Station reach Toll Plaza with damaged/destroyed RFID and real number plate.
   - A vehicle theft and reported to the Police Station reach Toll Plaza with damaged/destroyed RFID and forged number plate.
   - There is no model proposed to detect vehicles in all situations.
2. There is no application from which, the overall status of the vehicle can be viewed by the police as well as vehicle owner.
3. The existing system is not secure because if there is weapon carried by thief, then there is high risk to stop the vehicle after theft detection at toll plaza.

4. The existing system is not able to detect the vehicle which speed is more than the limit decided to pass through the toll gate.

**Proposed System**

There is a need to develop a specific model for the detection of theft vehicles, which should include some specific objectives to fulfill. The proposed system can be work for different situations may occur at toll plaza when a theft vehicle approaches. Some of these are as follow:

1. When a theft vehicle approaches at toll plaza, the FIR of the vehicle is lodged or not lodged by owner and the RFID tag removed or damaged of the particular vehicle, then the proposed system can be retrieve the vehicle information by number plate and cross verify the same. If the data showed that the vehicle has been issued RFID but not available, then the system can be check owner detail and verify it at the same time.
2. In another situation, if the vehicle has no RFID tag and the number plate of the stolen vehicle is also changed, then the system verify the vehicle details with the help of available number plate. If the detail does not match with the vehicle, then again the owner verification process can be take place.
3. The system can be also work with some other situations like if the vehicle owner details do not match, then One Time Password (OTP) can be sent to the vehicle owner and ask by the toll employee to the driver. If the OTP given by the driver is correct and verified, then the vehicle allows to or a silent alarm buzze and the vehicle do not allow to pass the toll plaza.

In Fig.2 when a theft blacklisted vehicle approaches at toll plaza, and the RFID tag removed by the theft, then our system detects the vehicle detail through number plate. If the number plate of the vehicle also removed or changed, then the proposed system automatically cross verify the vehicle details with owner details already registered. If every detail is correctly verified, then the vehicle will be allowed to pass. If the owner and driver details are not matched, then the system verify the driver authority of driving vehicle with sending OTP to the owner and ask the same from the driver. If the OTP match, the vehicle is allow to pass the gate or the silent alarm buzz and the information of theft vehicle send to nearby police station, to owner of the vehicle and toll gates do not open.

Our system will also work with some other situations like if the RFID tag issued to the particular theft vehicle and there is no tag mounted, then the vehicle will be automatically listed in some specific data and next step of cross verification of driver will take place.

For implementation of our proposed model, a system will be applied on toll plaza from which the toll

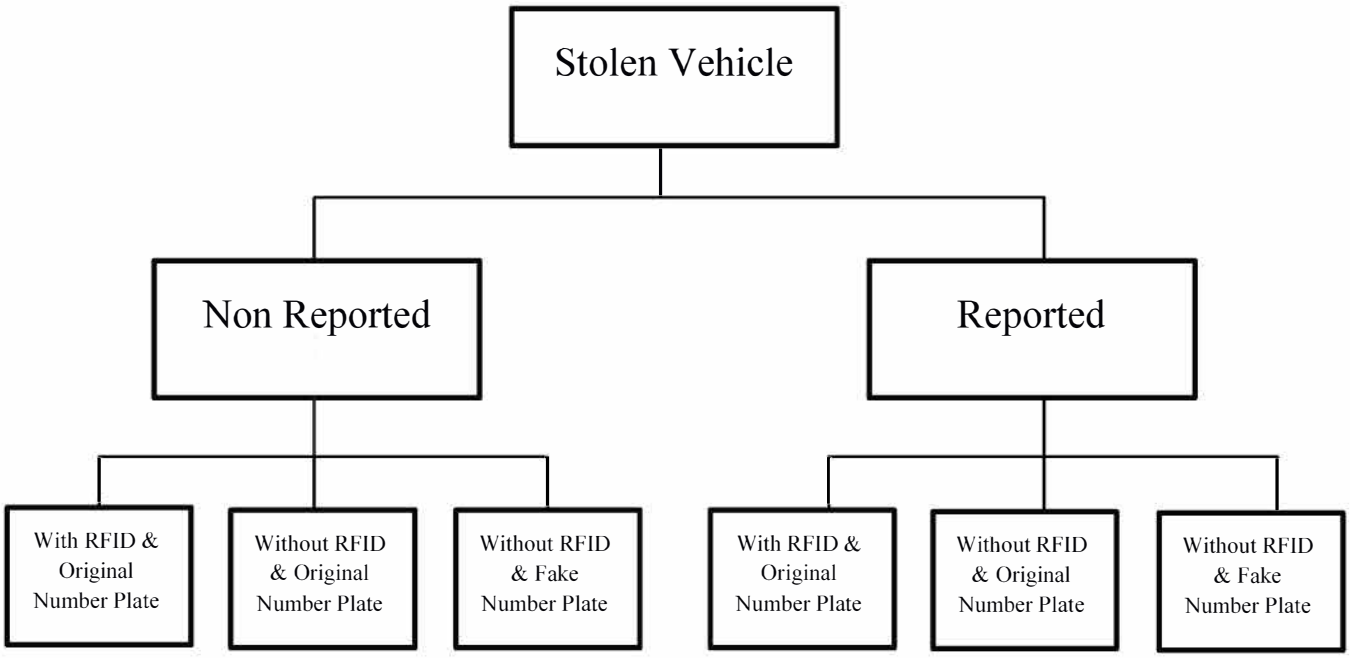


**Fig.2. Probabilities of reaching theft vehicle at toll plaza**

employees cross check whether the RFID tag mounted on the vehicle is blacklisted or not. It will also be checked that the RFID has been issued for the particular vehicle or not and cross verify the number plate of the same.

**Threats to validity**

- The system will not work properly if toll plaza will be removed from national highways.
- Also the system can only work in area where there is no network problem.
- The system needs the authority to access vehicle information database from RTO. So, it will not be possible to track the vehicle status without information.

**Conclusion**

With the help of this proposed system, the theft vehicle will be easily detected whether it is RFID mounted or not. Also the proposed system can help police to identify and recover the theft vehicle and owner also.

**References**


Akhtar, Z., Ali, R. (2020) Automatic Number Plate Recognition Using Random Forest Classifier. *COEN* doi: 10.1007/s42979-020-00145-8.

Bhandari, H. (2019) Police data show motor vehicle theft the least solved crime. https://www.thehindu.com/news/cities/Delhi/police-data-show-motor-vehicle-theft-the-least-solved-crime/article25954331.ece. Accessed 29 December 2020.

Bhosale, S., Wavhal, D.N. (2013) Automated Toll Plaza System Using RFID. *Int J Sci* **2**(1):455-460.

Chapate, A. A, Nawgaje, D. D. (2015) Electronic Toll Collection and Theft Detection System on ARM-7 and RFID Technology. *International Journal of Advanced Research in Electronics and Communication Engineering* **4**(4):924-927.

Gadgetsnow. (2016) Vahan Samanvaya app with data on stolen vehicles across the country launched. https://www.gadgetsnow.com/apps/Vahan-Samanvaya-app-with-data-on-stolen-vehicles-across-the-country-launched/articleshow/51394172.cms. Accessed 29 December 2020.

http://mvt.delhipolice.gov.in/. Accessed 29 December 2020.

Jakhar, A. (2019) Over 5 Vehicles Were Reported Stolen Every Hour in Delhi during 2018: Police. https://www.news18.com/news/auto/over-5-vehicles-were-reported-stolen-every-hour-in-delhi-during-2018-police-1997933.html . Accessed 29 December 2020.

Jog, S. R., Chavan, S. D., Takbhate, R. (2013) Automated Toll Booth and Tracking System for Theft Vehicle. *IJEEE* **1**(2):79-83.

Khatri, S., Jadhwani, S., Basantani, C., Makhija, A., Jewani, K. (2015) Automatic Toll Collection with Stolen Vehicle Recognition. *International Journal of Engineering and Management* **5**(5):407-410.

Laghari, A.A, Memon, M. S., Pathan, A. S. (2012) RFID Based Toll Deduction System. *I J Information Technology and Computer Science* **4** (4): 40-46 doi: 10.5815/ijitc/2012/04/06.

Murugan, K., Gobu, R., Zabiyullah, G.S., Gunasekaran, R., Santhosh, V. (2018) An Automation of Vehicle Theft Detection in The Toll Plaza by using The RF Technology. *IJEEE* **1**(3):10-17.

Parimi, J. (2014) How will Electronic Toll Collection work in India. https://www.quora.com/How-will-electronic-toll-collection-work-in-India. Accessed 29 December 2020.

Pund, D. D., Galande, S. G. (2016) Congestion Free Toll Collection, Stolen Vehicle Detection and Tracking System for Authorized Person. *International Journal of Engineering Development and Research* **4**(2):1992-1997.

Raj, U. Nidhi, N. Nath, V. (2019) Automated Toll Plaza Using Barcode-Laser Scanning Technology. Publisher: Springer. Department of Electronics and Communication Engineering, Birla Institute of Technology Mesra, Ranchi 835215, India. © Springer Nature Singapore Pte Ltd. 2019 V. Nath and J. K. Mandal (eds.), Nanoelectronics, Circuits and Communication Systems, *Lecture Notes in Electrical Engineering* 511, https://doi.org/10.1007/978-981-13-0776-8_44.

Raj. S, Priya, S. P. (2017) Automatic Vehicle Detection Using GPS and Challenges in Image Processing. *Int J Civ Eng* **8**(11):287-293.

Times of India (2014) Tracing Stolen Vehicle Just a Click Away. https://timesofindia.indiatimes.com/city/hyderabad/Tracing-stolen-vehicle-just-a- click-away/articleshow/39319578.cms. Accessed 29 December 2020.

Times of India (2018) Only 13% stolen vehicle recovered in 2017. https://timesofindia.indiatimes.com/city/chandigarh/only-13-stolen-vehicles-recovered-in-2017/articleshow/62575258.cms. Accessed 29 December 2020.

Vinitha, V., Velantina, V. (2019) Advanced Automatic Toll Collection and Vehicle Detection System Using Internet of Things. *SSRG - IJEEE* **6**(8): 5-10.

Wikipedia, Radio-frequency identification, https://en.wikipedia.org/wiki/Radio-frequency_identification, Accessed 29 December 2020.