

Automatic toll tax deduction using licence plate detection

A. Overview of Current Toll Collection System (FASTag):

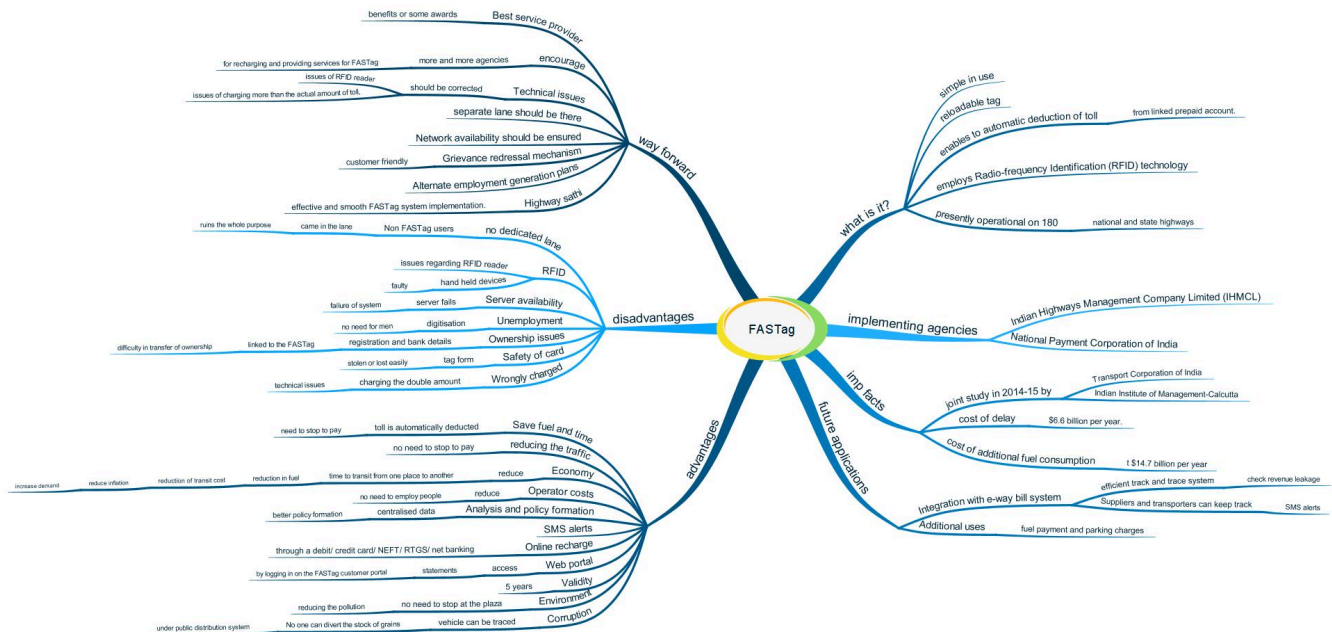
The electronic toll-collecting system known as FASTag has completely changed how tolls are paid on roads and motorways. FASTag was created to simplify the toll-collecting process by removing the need for cash transactions at toll booths by utilising Radio Frequency Identification (RFID) technology to enable smooth and automated payment of toll costs.

Functionality of FASTag

- Purchasing FASTag: FASTag is available through approved banks, toll plaza counters, internet retailers, and other channels. Users must present certain documentation at the time of purchase, including identification verification, KYC paperwork, and the car registration certificate. Users receive an RFID tag and a FASTag account connected to their car after paying the necessary costs.
- Activating FASTag: Users **must link their FASTag account to a linked bank account or prepaid wallet to activate it after getting the RFID tag**. Under regulatory standards, users might have to provide more information and finish the KYC (Know Your Customer) verification procedure.
- Recharging FASTag Account: Customers may use UPI, mobile banking, Internet banking, authorised agents, and retail locations to reload their FASTag accounts. One-time top-ups or automatic recharges based on preset threshold limitations are two possible recharge methods. After every recharge, users get real-time information and notifications about their account balance and transaction history.
- Passing Through Toll Plaza with FASTag: The RFID readers at the toll booth identify the FASTag RFID tag when the car gets closer to the toll plaza. The user's FASTag account is automatically credited with the appropriate toll

amount by the toll plaza's system. The toll gate barrier is lifted to enable the vehicle to pass through without stopping, and the transaction is performed in real time. Transparency and verification are provided via the SMS and email alerts that users get about the toll deduction and transaction information.

- Post-Passage Updates: The RFID readers at the toll booth identify the FASTag RFID tag when the car gets closer to the toll plaza. The user's FASTag account is automatically credited with the appropriate toll amount by the toll plaza's system. The toll gate barrier is lifted to enable the vehicle to pass through without stopping, and the transaction is performed in real time. Transparency and verification are provided via the SMS and email alerts that users get about the toll deduction and transaction information.



Advantages of FASTag

- Easy to Apply: Once the tag arrives, you need to paste it on the windshield so that it is visible. That's it, you are all set!
- Efficient: As the car passes the toll plaza, the electronic machine reads the FASTag chip and the toll is deducted. reducing waiting time and fuel consumption and thus the operating cost of running the vehicle.
- Reduced Human Interaction: No human contact has a double advantage – social distancing norms are followed and without cash entering the picture, there is transparency and accountability about the toll charges paid digitally.

Disadvantages of FASTag

- Time Wastage: Vehicles have to stop at the toll plaza for a few seconds still for the scanner to scan the vehicle's FASTag, thereby increasing the fuel consumption of the vehicle.
- Activation Issues: Sometimes, users are unable to activate their FASTag accounts, which can be frustrating.
- Technical Issues: These problems can include incorrect toll deductions or faulty tags. Sometimes the tag is read twice which requires a complaint to be lodged.
- Compatibility Issues: If the vehicle has a metal body, it may interfere with the radio waves used by FASTag, resulting in compatibility issues. In such cases, you can use a tag holder or a bumper to ensure the proper placement of the tag.

B. Automatic Toll Tax Deduction Using License Plate Detection

The objective of our project is to automate the toll tax collecting procedure through the use of licence plate detection technologies. This method improves toll-collecting operations' efficiency by doing away with the necessity for human toll payments.

Key Components

1. License Plate Recognition (LPR): License Plate Recognition (LPR) makes it possible for licence plates to be automatically detected and recognised. LPR systems take video snapshots of passing cars at toll plazas using cameras and by using object detection algorithms and OCR technologies, they decode the licence plate from the frames of the video. With the use of this technology, cars may be identified without the need for human interaction or stoppage, resulting in a smooth and effective toll tax deduction procedure.
2. Aadhar Linkage: Our method assumes the vehicle RC (Registration Certificate) number to be linked with Aadhar. The Income-tax Act makes it mandatory for every PAN card holder to intimate his Aadhar Number so that the Aadhar and PAN can be linked. Therefore by linking the RC numbers to Aadhar, we can directly deduct money from one's bank account as soon as their vehicle passes a toll road. It also enables us to confirm the identities of vehicle owners and keep a centralised database of toll transactions, thereby guaranteeing accuracy and accountability in toll tax deductions.
3. Bank Account Deduction: The method deducts appropriate toll tax from the associated bank account after detecting the licence plate and linking it to Aadhar. To ensure the quick and precise processing of toll payments, bank account deduction is enabled via secure electronic payment channels.

Workflow

1. Licence Plate Detection: The LPR system takes video of the lane for fixed intervals (10-15 seconds) without any gap. While recording for the next interval, the current recording is then processed frame by frame (60 fps) to recognise the vehicles passing in that duration (using the YOLO object detection algorithm) and then extracting the license plate text of that vehicle (using the OCR algorithms). The license plate texts are processed to remove false positives and duplicate records and then stored in a CSV file.
2. Bank Account Selection: The CSV file is then passed on to the vehicle records to get the associated Aadhar number and then select the bank account to deduct the respective toll amount from it.
3. Toll Amount Deduction: After obtaining the bank account number, the toll amount is deducted from it corresponding to the type of vehicle (for example: car, motorcycle, bus, truck etc.) since each vehicle type has a different toll amount.

Algorithms Used

1. YOLOv8 (You Only Look Once): The YOLO model's 8th version is renowned for its real-time performance and high accuracy. With the use of **anchor boxes** (bounding boxes for objects of different shapes and sizes) **and multi-scale prediction** (detect objects of different sizes and aspect ratios effectively) in a deep convolutional neural network architecture, YOLOv8 predicts bounding boxes and class probabilities at the same time, processing whole pictures in a single pass. In the project, the COCO (Common Objects in Context) dataset is used to train the YOLO model which is used to detect vehicles in the video frames. The model is further trained with a license plate dataset which is used to detect license plates from the detected vehicles.

2. EasyOCR: EasyOCR is a Python library that offers a simple and effective way to extract text from pictures. It requires very little setup and preparation to reliably detect and recognise text in a variety of languages and fonts through the use of optical character recognition (OCR) techniques combined with deep learning models. In the project, EasyOCR is used to recognise the text from the detected license plates along with the confidence scores.
3. SORT (Simple Online and Realtime Tracking): SORT is a real-time tracking algorithm for 2D multiple object tracking in video sequences. It is designed for online tracking applications where only past and current frames are available and the method produces object identities on the fly. The algorithm is used to track the vehicles in different frames and assigns them an identity which is later used to club the actual license plate text amongst the predicted ones.

Benefits from the Current System

1. Efficiency: Our system streamlines toll tax collection processes, reducing waiting times at toll plazas and enhancing traffic flow, since the toll amount is deducted without having the vehicles to halt at any point.
2. Transparency: Aadhar linkage and bank account deduction provide transparency and accountability in toll tax collection, enhancing trust and reliability.

C. Research Papers:

1. [IOT and Machine Learning based Automatic Toll Collection System](#)
2. [Toll Tax Collecting System Using Optical Character Recognition](#)
3. [Simple Online and Realtime Tracking](#)