Project Report

on

Smart Toll Collection System Using Machine Learning

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Sant Gadge Baba Amravati University

In partial Fulfillment of the Requirement

For the Degree of

Bachelor of Engineering in

Computer Science and Engineering

Submitted by:

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2022-23

SHRI SANT GAJANAN MAHARAJ COLLEGE OF ENGINEERING,

SHEGAON – 444 203 (M.S.)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

This is to certify that **Mr. Ajinkya Pimple, Mr. Vishal Rathod, Mr. Yash Gourshettiwar, Mr. Shreyash Chatarkar** and **Mr. Sanket Tayde,** students of final year B.E. in the year 2022-23 of Computer Science and Engineering Department of this institute has completed the project work entitled **"Smart Toll Collection System Using Machine Learning"** based on syllabus and has submitted a satisfactory account of his work in this report which is recommended for the partial fulfillment of degree of Bachelor of Engineering in Computer Science and Engineering.

Dr. R. A. Zamare
Project Guide

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SHRI SANT GAJANAN MAHARAJ COLLEGE OF ENGINEERING,

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

This is to certify that the project work entitled "**Smart Toll Collection System Using Machine Learning**" submitted by **Mr. Ajinkya Pimple, Mr. Vishal Rathod, Mr. Yash Gourshettiwar, Mr. Shreyash Chatarkar** and **Mr. Sanket Tayde,** students of final year B.E. in the year 2022-23 of Computer Science and Engineering Department of this institute, is a satisfactory account of his work based on syllabus which is recommended for the partial fulfillment of degree of Bachelor of Engineering in Computer Science and Engineering.

Internal Examiner **External Examiner**

Date: **Date:**

Abstract

These days most highways toll plazas are operated by hand, wherever operator collects money from the driver and provides a receipt. Since this procedure are often slow, we frequently makes traffic jams at the toll plazas on busy highways. Smart toll assortment can save time, man power and effort. During this work purpose an occasional value and economical technique known as IoT based toll gate system image processing based Automatic Toll Gate System as a solution to solve the traffic problems and also to maintain transparency of the toll collection system. Our aim is to make a digital toll collection system which will be less time consuming and automated monitoring and control of vehicle entry-exit in high way. Smart Toll Collection system is an efficient and innovative solution for toll collection, enhancing the travel experience for users and improving revenue collection for toll authorities. The Smart Toll Collection system is an automated toll collection system that utilizes image processing technology to recognize the number plate of passing vehicles and deduct toll fees automatically from the user's account if their number plate is registered in the system. The system provides a seamless experience for users passing through toll booths on highways and roads, with the option for users to register their vehicles on a web-based platform. The system's integration with an SMS API allows for easy communication with users regarding the toll fees deducted from their account. The future scope for the system is promising, with the potential for further development and integration with other technologies such as facial recognition, GPS, and electronic payment systems.

Acknowledgement

The real spirit of achieving a goal is through the way of excellence and lustrous discipline. I would have never succeeded in completing my task without the cooperation, encouragement and help provided to me by various personalities.

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Abbreviations

HOV	high-occupancy vehicle
ETC	Electronic toll collection
RFID	Radio Frequency Identification
DSRC	Dedicated Short-Range Communication
OCR	Optical Character Recognition
ANPR	Automatic Number Plate Recognition

SMART TOLL COLLECTION SYSTEM USING MACHINE LEARNING

CHAPTER 1

INTRODUCTION

1.INTRODUCTION

1.1 PREFACE

These days most highway toll plazas are operated by hand, wherever the operator collects money from the driver and provides a receipt. Since this procedure is often slow, we frequently make traffic jams at the toll plazas on busy highways. Smart toll assortment can save time, man power and effort. During this work, an occasional value and economical technique known as IoT based toll gate system image processing based Automatic Toll Gate System as a solution to solve the traffic problems and also to maintain transparency of the toll collection system. Our aim is to make a digital toll collection system which will be less time consuming and automated monitoring and control of vehicle entry-exit in highways.

Smart Toll Collection system is an efficient and innovative solution for toll collection, enhancing the travel experience for users and improving revenue collection for toll authorities. The Smart Toll Collection system is an automated toll collection system that utilises image processing technology to recognize the number plate of passing vehicles and deduct toll fees automatically from the user's account if their number plate is registered in the system. The system provides a seamless experience for users passing through toll booths on highways and roads, with the option for users to register their vehicles on a web-based platform. The system's integration with an SMS API allows for easy communication with users regarding the toll fees deducted from their account. The future scope for the system is promising, with the potential for further development and integration with other technologies such as facial recognition, GPS, and electronic payment systems.

1.2 OVERVIEW

An intelligent highway toll collection system is an intelligent way of controlling traffic. It can be implemented for various traffic control applications such as automatic toll collection, Automatic tollgate system is a combination of Vehicle detection, image capturing, licence plate recognition, and tollgate controlled by automatic toll collection. License Plate Recognition (LPR) is a combination of image processing, edge detection, and optical character recognition technologies used to identify vehicles by their licence plates. Since only the licence plate information is used for identification,

The Smart Toll Collection system is an automated toll collection system that aims to simplify the toll collection process and enhance the overall travel experience for users passing through toll booths on highways and roads. The system utilises image processing technology to recognize the number plate of a passing vehicle and deduct toll fees automatically from the user's account if their number plate is registered in the system. Users can register their vehicles on a web-based platform, and the system validates their registration number and stores their registration details in a database. If the number plate of a passing vehicle is not registered in the system, the user will be required to register their vehicle before they can pass through the toll booth. The integration of an SMS API allows for easy communication with users regarding the toll fees deducted from their account. Overall, the Smart Toll Collection system is an efficient and innovative solution for toll collection, with the potential for further development and integration with other technologies in the future.

1.2.1 IMAGE PROCESSING

In our day-to-day life, toll plazas are often a source of inconvenience and traffic congestion. Users are required to wait in long queues and pay an amount to the government for using the toll roads. This process not only wastes valuable time but also contributes to unnecessary traffic on the roads. To address this issue, an automatic payment system using image processing techniques has been proposed.

Image processing refers to the manipulation and analysis of digital images to extract useful information from them. In the context of toll plazas, the image processing system treats captured images as 2D signals and applies various predetermined signal processing methods to obtain relevant data.

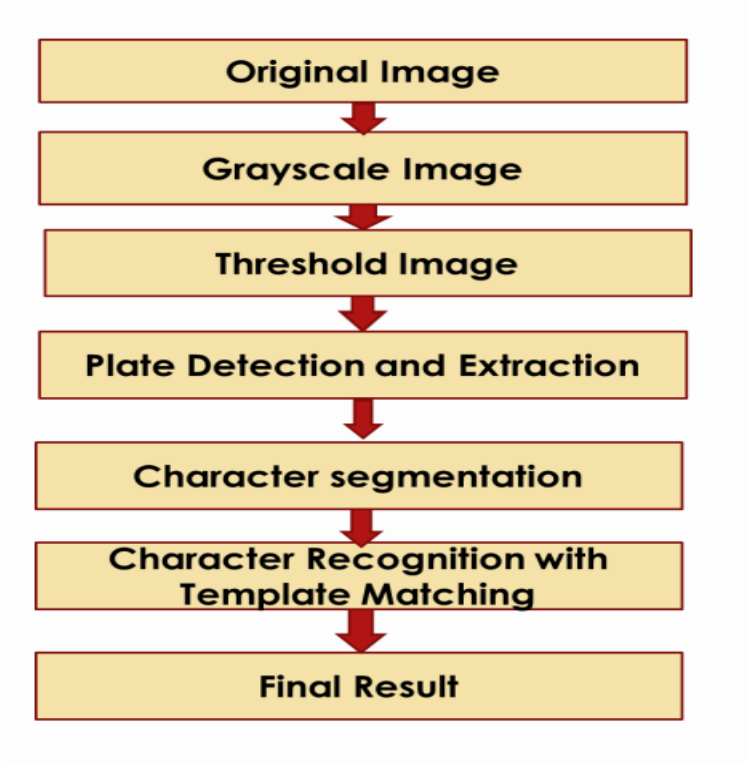


Fig.1.1 Number Plate Extraction Using Image Processing

The implementation of an automatic payment system at toll plazas can significantly improve the efficiency and convenience of the overall process. Here's how it works:

Image processing techniques are used to capture images of vehicles passing through the toll plaza. These images are then processed to extract key features that can uniquely identify each vehicle, such as licence plate numbers or RFID tags. The extracted information is then matched against a database of registered vehicles and their corresponding payment details. This database can be maintained by the government or the toll plaza management system. Once a vehicle is successfully identified, the automatic payment system calculates the applicable toll fee based on factors such as vehicle type, distance traveled, and any additional charges. The

system can integrate with various payment gateways, allowing users to make payments electronically. Image processing algorithms can be used to monitor the flow of vehicles in real-time. This information can help optimize the traffic management system by identifying congestion points, analyzing traffic patterns, and suggesting alternative routes.

The automatic payment system eliminates the need for physical toll booths, reducing the number of stops and delays for users. This non-intrusive approach helps to maintain a smooth traffic flow and reduces the chances of accidents caused by sudden braking or merging. By implementing an automatic payment system using image processing, toll plazas can overcome the issues associated with manual payment processes.

The benefits of such a system are numerous:

1. With an automated payment system, vehicles can pass through the toll plaza smoothly without the need for waiting in queues. This helps to minimise traffic congestion, particularly during peak hours.

2. The elimination of physical toll booths and manual payment transactions saves significant time for both the users and toll plaza operators. It also reduces operational costs associated with maintaining toll booths and employing toll collectors.

3. Image processing algorithms can accurately identify vehicles and retrieve relevant information from the database, minimizing the chances of errors in payment calculations and vehicle identification.

4. The automatic payment system can incorporate security measures such as encryption and authentication to ensure the safety of user data and payment transactions. This helps to build user trust and confidence in the system.

5. The image processing system can provide valuable insights into traffic patterns, peak hours, and usage trends. This data can be used for better planning of road infrastructure, toll plaza expansions, and traffic management strategies.

1.2.2 AUTOMATED TOLL COLLECTION SYSTEM

Technology is rapidly advancing, revolutionising various aspects of our lives and making them more time-efficient. One crucial area where time-saving measures are highly desired is transportation, particularly on roadways. In this fast-paced world, people are constantly on the go and do not wish to waste their valuable time waiting in traffic. While there are numerous strategies to alleviate traffic congestion, toll booths have emerged as a viable solution. However, manual toll collection systems, which have been in place for decades, are gradually being replaced by automatic toll stations that enhance the overall toll collection process.

Electronic toll collection (ETC) systems have gained significant popularity in recent years. These systems utilise wireless technology to automatically collect usage fees or toll charges from vehicles traversing toll roads, high-occupancy vehicle (HOV) lanes, toll bridges, and toll tunnels. ETC systems have revolutionised the toll collection process by eliminating the need for physical payment transactions, thus streamlining traffic flow and reducing delays.

The implementation of automatic toll stations offers several advantages over traditional manual systems. Let's explore them in more detail:

1. Enhanced Efficiency: Automatic toll stations significantly improve the efficiency of toll collection processes. With ETC systems, vehicles can pass through toll plazas seamlessly, without the need to stop or slow down. This streamlined process minimizes congestion and enables smoother traffic flow, saving valuable time for commuters.

2. Time and Cost Savings: Automatic toll collection systems eliminate the need for toll booth attendants and manual payment transactions. This reduction in labour-intensive processes translates to substantial time and cost savings for toll authorities and operators. Furthermore, the increased efficiency allows for faster throughput, reducing the number of toll booths required and minimising infrastructure costs.

3. Improved Accuracy: ETC systems utilise advanced technologies such as image processing, RFID (Radio Frequency Identification), or dedicated short-range communication (DSRC) to accurately identify and classify vehicles. These technologies ensure precise toll calculations based on vehicle type, distance travelled, and any additional charges. By eliminating human error, automatic toll stations enhance the accuracy of toll collection.

4. Convenience for Users: Automatic toll collection systems offer greater convenience to users. Instead of stopping and searching for cash or coins, drivers can seamlessly pass through toll plazas with pre-registered accounts or transponders attached to their vehicles. This convenience encourages greater adoption of electronic payments, further reducing traffic congestion and enhancing the overall transportation experience.

5. Integration with Intelligent Transportation Systems (ITS): ETC systems can be seamlessly integrated with ITS infrastructure. By connecting toll stations with real-time traffic management systems, traffic authorities can gain valuable insights into traffic patterns, optimise toll pricing strategies, and implement dynamic tolling schemes based on demand and congestion levels. This integration helps to better manage traffic flow, improve overall transportation efficiency, and reduce environmental impacts.

6. Enhanced Security and Data Privacy: Automatic toll collection systems employ secure encryption protocols to safeguard user data and payment transactions. Measures such as authentication and data encryption ensure the privacy and integrity of personal information, instilling confidence in users to adopt electronic payment methods without concerns about data breaches or fraud.

7. Future Scalability and Interoperability: Automatic toll collection systems are designed to be scalable and interoperable. They can be easily expanded to accommodate increased traffic volume, new toll roads, or additional lanes. Moreover, ETC systems can be integrated with other transportation systems, such as parking

facilities and transit services, enabling seamless travel experiences across different modes of transportation.

1.3 MOTIVATION

Traditional toll collection methods are inefficient, time-consuming, and can lead to traffic congestion, safety hazards, and revenue losses. The implementation and adoption of smart toll collection systems face several challenges, including technological complexity, interoperability, data privacy and security concerns, cost-effectiveness, and public acceptance.The motivation behind the project Smart Toll Collection is to to improve efficiency, safety, revenue generation, user experience, and environmental sustainability. The "Smart Toll Collection" project is motivated by the need to improve the efficiency, accuracy, and convenience of the traditional toll collection process. By leveraging image processing techniques and automation, the project aims to streamline toll transactions, reduce waiting times, and eliminate the need for manual payment interactions. The system will automatically detect and recognize vehicle number plates, deduct the appropriate toll fees, and provide real-time notifications to users via SMS. This project not only saves time for commuters but also enhances security, simplifies vehicle registration, and opens doors for future scalability and integration with intelligent transportation systems.

1.4 OBJECTIVES

1. To improve the efficiency of toll collection systems by implementing smart toll collection technologies.
2. To reduce traffic congestion and waiting times at toll plazas by using automatic vehicle identification and payment systems.
3. To enhance the safety of toll plaza operations by reducing the need for manual intervention and human error.
4. To provide a cost-effective solution for toll collection system operators by reducing the need for toll collection staff and infrastructure.
5. To enable real-time monitoring and data analytics of toll plaza operations for better decision-making and system optimization.

CHAPTER 2

LITERATURE SURVEY

2. LITERATURE SURVEY

[1] Smart Toll Collection System Using ZIGBEE and RFID

S. Dhilip Kumar, C. Arunachalaperumal, 2020 [1] As a survey stated almost 15 crores vehicles utilise national highways around India, and if on average each vehicle have to wait idly for 10 minutes in toll booths it results in a loss of Thousand two seventy two crore a day. The issues involved in manual toll collection involve hurdles like exact change, system malfunction at times, staff changeover per duty and manual imperfections. It is proposed to implement a smart card named INDIA-Pass compatible with other transportation services used in India. But it is highly appreciable to arrive with a solution explicitly for automated toll collection. One such solution is proposed in this paper, an automated toll collection system with wireless transceiver and cloud-local hybrid database maintenance. In the automated toll collection system, the driver does not need to stop at the toll gate and one also has to stand still in a long line to pay his entry fee. Though it sounds simple the proposed method decreases the utilisation of fuel, lessens street blockage, enhances street security and makes travelling a pleasure for all. This paper introduces the idea of gateless computerised ETC (Electronic Toll Collection) utilising ZIGBEE handset with RFID. ZIGBEE mechanised ETC can eliminate human intervention in manual toll collection and consequently bring down the cost of activity.

[2] Intelligent toll collection system for moving vehicles in India

Rajeev Kumar Chauhan, Kalpana Chauhan, 2022 [2] In this paper proposes an automatic toll collection system to debit the toll of moving vehicles at a toll plaza in India. An effective approach is presented here to localise the licence plate of vehicles. A database has been created and linked to test the performance of the prototype toll collection system of moving vehicles.

[3] A Survey on Smart Toll Collection Management System with Security

Sundareswaran, Veena & Indumathy, & G.Monisha,2019 [3] In this paper authors include the database of the number of vehicles, vehicle owner's name, the unique identification number of the vehicle owners, their mobile number and balance of the linked bank account. The results show a significant reduction in the vehicle waiting time, queue length, fuel wastage, and excretion of pollution at a toll plaza. In the future the system can be used for the theft control.

[4] Automatic Check-Post and Fast Track Toll System Using RFID and GSM Module with Security System

K. Balamurugan, Dr.S.Elangovan, Dr.R.Mahalakshmi R. Pavithra, 2019 [4] In this paper the design and analysis of Automatic check post and fast track toll system using RFID and GSM module with security system.This paper proposes on electronic toll payment which is very flexible that automatic the verification process of vehicle pass by toll both. In this paper they used AT mega 328 Arduino microcontroller it has inbuilt GPS and GSM.This Ideology can drain the prevalent botheration of bouncing the edit action at the check post and decreases man power. In this proposed system various controllers are used in the arm. Automated toll cash collection system by road transportation. Expressway transportation has become more and more important in today's road network and the manual toll collection system has become outdated due to its number of drawbacks. By employing an automated toll collection system, drivers of vehicles need not to stop at a window or and waste time waiting in a long queue to pay their toll. This reduces the consumption of fuel; reduces congestion, increases road safety. An Automated Electronic Toll collection (ETC) system is basically designed for an uninterrupted toll collection, which has become an important part of intelligent transportation system.This paper presents the concept of Automated ETC using system. This work eliminates the need for motorists and toll authorities to manually perform ticket payments and toll fee collections, respectively. Data information is also easily exchanged between the motorists and toll authorities, thereby it is able to eliminate possible human errors for efficient toll collection.

[5] Automated Toll Cash Collection System for Road Transportation

Ms.Galande S.D.et al,2021 [5] In this paper author explained, the first and foremost goal of this research and development project is to build an Automatic toll collection using RFID. Design an Automatic toll plaza which is based on a GPS system to save the time at toll plaza & having cash free operation. The ETC system based on the E-PASS system, uses Tran scoretechnology.It reads by receiver automatically balance deducted from account.Most important impacts is to development of sustainable technologies to reduce traffic conjunction & save energy & time.

[6] Automated tollgate System Using Online Payment And Image Processing

Miss. Anusha S , Miss. Thrupthi S Ullal , Miss. Shwetha K, Miss. Shraddha 2019 – [6] Here author explained that a Automated tollgate system using online payment and image processing. In our daily life, travellers pay an amount of money in the form of tax through toll gates to the government. The national highways have toll gates where people pay tax for using the highways by standing in the queues. This will cause a break in the journey and waste of time. To overcome the waiting problem this system was proposed where automatic toll tax will be collected from the people using image processing and online payment of the money. In the image processing system the image of the number plate will be captured and compared with the database. To capture the image of the vehicle number plate the camera will be fixed at the tollgate. And in the online payment tax will be given where money deduction will take place only if the user gets registered. This makes tollgate transaction more convenient for the public use

[7] Automated Toll Collection System Based on RFID Sensor

Sabbir Ahmed , Tamkin Mahmud Tan , Anna Mary Mondol , Zawad Alam , Noshin Nawal,2019 [7] In this paper, RFID based Automated Toll Collection System is introduced as a solution of the traffic problems and also to maintain transparency in the toll collection system. The proposed system aims to make a digital toll collection

system which can eliminate the delay on toll roads, toll bridges and toll tunnels without cash and without requiring cars to stop. This paper focuses on an electronic toll collection system which uses radio frequency identification (RFID) technology to identify a vehicle specifically for collecting toll. The proposed RFID system uses tags that are mounted on the igital number plate of the vehicles, through which information embedded on the tags are read by RFID readers. It is possible to reduce the need for vehicle owners and toll collection authorities to distribute tickets and collect tolls manually in this system Information on the toll payment can also be easily exchanged between the vehicle owners and toll authorities. As a result, transparency in toll payment can be ensured with reduced manual labour and human errors. Thus, building smart transportation system will become easier.

[8] Automated Toll Plaza Verification System

N.Poornima,M.P.Arvindhan,R.Karthikeyan,S.Gokul Raj ,2022 [8] In this paper the author explained, the first and foremost goal of this research and development project is to build an Automatic toll collection using RFID. Design an Automatic toll plaza which is based on a GPS system to save the time at toll plaza & having cash free operation. The ETC system based on the E- PASS system, uses Tran scoretechnology.It reads by receiver automatically balance deducted from account.Most important impacts is to development of sustainable technologies to reduce traffic conjunction & save energy & time.

[9] Smart Traffic & Parking Management using IoT

Amit Roy, Priyam Poddar, et.al , 2020 [9] In this paper the author proposed the electronic payment system on toll tax which is inexpensive and secure. This methodology is also used for tracking the number of vehicles passing on highways, by which corruption in toll taxes can be completely removed. number plates. Optical character recognition technique is used to identify the licence plate of a vehicle. This information passes to the server system for the pattern matching and identification of the vehicle. After successful reorganisation of the vehicle, toll tax payment is

deducted from the owner's credit card account and confirmation mail is sent to the owner.

[10] Intelligent Traffic Management System

Prithvinath Manikonda, et al., 2021 [10] In this paper by using RFID technology the vehicle gets information about the traffic congestion in the city. In this system the RFID tag reader collects the data from the vehicle and calculates the average speed of each vehicle from source node to destination node. This data is transmitted to the central server which uses the Dijkstra's algorithm to identify the fastest route to all junctions by considering each node as the initial point in the city. This data is then accessed by the user through the interface module placed in the vehicle.

[11] Automated Toll Plaza using RFID

Sachin Bhosale and Dnyashwar Natha Wavhal,2019 [11] A system which explains the problem of waiting period and payment concerns in conventional manual toll collection system. The paper proposes a system which includes transponder, antenna, traffic controller system and central server. The transponder is a RFID tag which has a unique identification number. It also stipulates the types of tags as discussed in the paper. The traffic controller system builds a system differently from others. This system manages the allocation of incoming vehicles across a set of parallel tollgates. It makes use of lane allocation algorithm. This algorithm allocates the gates entry for each of the car approaching among the available set of tollgates. Electronic Toll Collection System utilises Radio Frequency Identification (RFID) technology. A RFID tag is mounted on each vehicle with unique ID. This ID is invisible on tag, it contains all the information about the vehicle and owner. When vehicle reaches at toll plaza tag will emit the radio wave signal. RFID reader receives the signal from tag, decode that signal and send to the ARM controller [4]. The controller will display the vehicle number and amount on LCD. Microcontroller is interfaced with computer to collect the vehicle data through serial port for future use. When accessed form database, it shows all the vehicle details on computer screen such as ID, vehicle number, date and time. Microcontroller checks the balance, if sufficient balance is

there, it deducts predefined amount from prepaid account and update the balance in that account.

[12] Electronic Toll Collection System Based on ARM

Amol A. Chapate, D.D. Nawgaje, 2019 [12] FASTag is a simple to use, reloadable tag which enables automatic deduction of toll charges and enables one to drive through toll plazas without stopping for the cash transaction. FASTag is linked to a prepaid account from which the applicable toll amount is deducted. The tag employs Radio-frequency Identification (RFID) technology and is fixed on the vehicle's windshield. FASTag can be recharged by making payment through cheque or online through Credit Card/ Debit Card/ NEFT/ RTGS or through Net Banking. FASTag account can be recharged up to a maximum of Rs 1 lakh and a minimum of Rs 100. Toll Plazas may have a dedicated FASTag lane or provision for validating FASTag through a handheld reader. You need to have some balance in FASTag in advance whenever you travel. Details will be in the database along with the number plate details. The captured number will be compared with the number in the database. If the number matches then the amount points will be checked and deducted and the balance amount will be shown.

[13] A Cloud-Based Intelligent Toll Collection System for Smart Cities

Segun I. Popoola, Oluwafunso A. Popoola, Adeniran I. Oluwaranti, Aderemi A. Atayero, Joke A. Badejo & Sanjay Misra 2018 [13] City management may decide to implement Electronic Toll Collection (ETC) systems to reduce the disadvantages associated with using conventional or manual toll collection systems, such as the lengthy vehicle lines, fuel waste, increased accident risks, and environmental pollution. In this paper, an intelligent system is created for a smart city that uses the seamless interconnection of Wireless Sensor Networks (WSNs), web and mobile applications, and an Internet of Things (IoT)-enabled cloud platform to reduce long traffic jams, fuel waste, high accident risks, and environmental pollution. An Arduino UNO, XBee S2 radios, an XBee Shield, and a Seeduino GPRS Shield are used to design and build a ZigBee WSN. For car owners to pay tolls, see historical toll information, and receive toll news Using Hyper Text Mark-up Language (HTML),

Cascading Style Sheets (CSS), Javascript, and PHP, feeds, a web application, and a mobile application are created and put into use. Android is the platform used for the mobile application's deployment. Additionally, using PHP as a scripting language and MySQL as the database engine driver, a cloud platform for business logic functionalities was created. Long vehicular lines, fuel waste, high accident risks, and environmental pollution in urban centres will be significantly reduced by the implementation of the proposed ETC system in smart and connected communities.

[14] A Unique Identity based Automated Toll Collection System using RFID and Image Processing

Prakshaal Jain; Prashant Dhillon; Anand Vardhan Singh; Kaustubh Vats; Shrivishal Tripathi 2018 [14] The purpose of this study and its output is to develop a smart toll collection system for Indian highway scenarios. The purpose of this article is to present a potential remedy for the issues with manual toll collecting systems, such as time spent at the toll plaza, cashless transactions, excessive toll collection, corruption on the toll plaza, etc. Additionally, the proposed technology will assist the authorities in swiftly resolving cases of car theft. The toll, under the suggested approach, would be outfitted with RFID sensing and optical character recognition (OCR) technology to gather data on passing vehicles and conduct hassle-free digital transactions based on the unique identity. A lookup can reduce the amount of time transactions take to process data. Using GPS sectoring of cars in a 200 M radius, a priority table based on that information will be used. The proposed system's use of centralised accounts for toll collecting across the nation gives the government knowledge of the toll charges collected at toll centres and aids in decreasing toll charge overcollection.On the basis of Hyper Text Mark-up Language (HTML), Cascading Style Sheets (CSS), Javascript, and Hyper Text Pre-processor (PHP), feeds, a web application, and a mobile application are created and constructed. The Android platform is used to deploy the mobile application. Using PHP as a scripting language and MySQL as the database engine driver, a cloud platform was also created to offer business logic features.

CHAPTER 3

PROPOSED METHODOLOGY

3. PROPOSED METHODOLOGY

3.1 ANACONDA IDE

Anaconda Python is a free, open-source platform that allows you to write and execute code in the programming language Python. It is by continuum.io, a company that specialises in Python development. The Anaconda platform is the most popular way to learn and use Python for scientific computing, data science, and machine learning. It is used by over thirty million people worldwide and is available for Windows, macOS, and Linux.

People like using Anaconda Python because it simplifies package deployment and management. It also comes with a large number of libraries/packages that you can use for your projects. Since Anaconda Python is free and open-source, anyone can contribute to its development.

Anaconda software helps you create an environment for many different versions of Python and package versions. Anaconda is also used to install, remove, and upgrade packages in your project environments. Furthermore, you may use Anaconda to deploy any required project with a few mouse clicks. This is why it is perfect for beginners who want to learn Python.

Common Anaconda Tools

You also install Conda, Anaconda Navigator, and hundreds of other packages when you install Anaconda. This section will define some of these tools and why they are helpful.

Anaconda Distribution

Anaconda Distribution is a free, easy-to-install package manager, environment manager, and Python distribution with over 720 open-source packages.

Conda

Conda is an Anaconda package and environment manager that helps you install, update, and remove packages from your command-line interface. You can use it to write your own packages and maintain different versions of them in separate environments.

Miniconda

Miniconda is a smaller version of Anaconda that includes the conda package manager and Python.

Anaconda Navigator

Anaconda Navigator is a desktop graphical user interface that allows you to launch applications and efficiently manage conda packages, environments, and channels without using command-line commands.

Spyder

Spyder is a Python development environment with many features for working with Python code, such as a text editor, debugger, profiler, and interactive console.

Jupyter Notebook

Jupyter Notebook is a web-based application that allows you to create and share documents that contain live code, equations, visualizations, and narrative text.

Anaconda Prompt or Terminal

Anaconda Prompt is a command line interface with Anaconda Distribution. The terminal is a command line interface that comes with macOS and Linux.

Package

A package is a collection of modules installed using Conda. A module is a Python file that has a .py extension.

Environment

An environment is a directory that contains all the files needed for a particular application, such as Python interpreter, packages, and configuration files. You can use Conda to create separate environments for different projects.

Channel

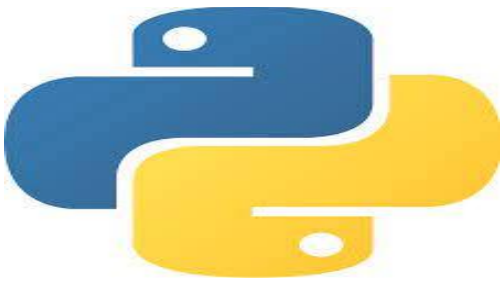
A channel is a repository of packages from which you can install any number of packages. The default channel for Anaconda Distribution is the Anaconda channel.

Now that Anaconda is installed and you are familiar with the tools, you can start writing your first Python program!

3.2 PYTHON PROGRAMMING LANGUAGE

Python is a high-level, general-purpose programming language. Its design philosophy emphasises code readability with the use of significant indentation via the off-side rule. Python is dynamically typed and garbage-collected. It supports multiple programming paradigms, including structured (particularly procedural), object oriented and functional programming. It is often described as a "batteries included" language due to its comprehensive standard library. Python is a multi-paradigm programming language. Object-oriented programming and structured programming are fully supported, and many of their features support functional programming and aspect-oriented programming (including metaprogramming and metaobjects). Many other paradigms are supported via extensions, including design by contract and logic programming. Python uses dynamic typing and a combination of reference counting and a cycle-detecting garbage collector for memory management. It uses dynamic name resolution (late binding), which binds method and variable names during program execution. Its design offers some support for functional programming in the Lisp tradition. It has filter, meandrous functions; list comprehensions, dictionaries, sets, and generator expressions. The standard library has two modules (itertools and functools) that implement functional tools borrowed from Haskell and Standard ML.

Python is a popular programming language. It was created by Guido van Rossum, and released in 1991.



Application

- web development (server-side),
- software development,
- mathematics,

- system scripting.

Application

- Python can be used on a server to create web applications.
- Python can be used alongside software to create workflows.
- Python can connect to database systems. It can also read and modify files.
- Python can be used to handle big data and perform complex mathematics.
- Python can be used for rapid prototyping, or for production-ready software development.

Features

- Python works on different platforms (Windows, Mac, Linux, Raspberry Pi, etc).
- Python has a simple syntax similar to the English language.
- Python has syntax that allows developers to write programs with fewer lines than some other programming languages.
- Python runs on an interpreter system, meaning that code can be executed as soon as it is written. This means that prototyping can be very quick.
- Python can be treated in a procedural way, an object-oriented way or a functional way.

Modification

- The most recent major version of Python is Python 3, which we shall be using in this tutorial. However, Python 2, although not being updated with anything other than security updates, is still quite popular.
- In this tutorial Python will be written in a text editor. It is possible to write Python in an Integrated Development Environment, such as Thonny, Pycharm, Netbeans or Eclipse which are particularly useful when managing large collections of Python files

3.3 NUMMY

NumPy

When it comes to scientific computing, NumPy is one of the fundamental packages for Python, providing support for large multidimensional arrays and matrices along with a collection of high-level mathematical functions to execute these functions swiftly. NumPy relies on BLAS and LAPACK for efficient linear algebra computations. NumPy can also be used as an efficient multi-dimensional container of generic data.

3.4 CV2

Open cv

OpenCV is a huge open-source library for computer vision, machine learning, and image processing. OpenCV supports a wide variety of programming languages like Python, C++, Java, etc. It can process images and videos to identify objects, faces, or even the handwriting of a human. When it is integrated with various libraries, such as Numpy which is a highly optimized library for numerical operations, then the number of weapons increases in your Arsenal i.e whatever operations one can do in Numpy can be combined with OpenCV.

This OpenCV tutorial will help you learn Image-processing from Basics to Advance, like operations on Images, Videos using a huge set of Opencv-programs and projects

3.5 PYTESSERACT

Python-tesseract is a wrapper for Google's Tesseract-OCR Engine. It is also useful as a stand-alone invocation script to tesseract, as it can read all image types supported by the Pillow and Leptonica imaging libraries, including jpeg, png, gif, bmp, tiff, and others. Additionally, if used as a script, Python-tesseract will print the recognized text instead of writing it to a file.

Functions

- Get_languages Returns all currently supported languages by Tesseract OCR.
- Get_tesseract_version Returns the Tesseract version installed in the system.
- Image_to_string Returns unmodified output as string from Tesseract OCR processing
- Image_to_boxes Returns result containing recognized characters and their box boundaries
- Image_to_data Returns result containing box boundaries, confidences, and other information. Requires Tesseract 3.05+. For more information, please check the Tesseract TSV documentation
- Image_to_osd Returns result containing information about orientation and script detection.
- Image_to_alto_xml Returns result in the form of Tesseract's ALTO XML format.
- Run_and_get_output Returns the raw output from Tesseract OCR. Gives a bit more control over the parameters that are sent to tesseract.

3.6 TKINTER

The tkinter package ("Tk interface") is the standard Python interface to the Tk GUI toolkit. Both Tk and tkinter are available on most Unix platforms, as well as on Windows systems. (Tk itself is not part of Python; it is maintained at ActiveState.)

Running python -m tkinter from the command line should open a window demonstrating a simple Tk interface, letting you know that tkinter is properly

installed on your system, and also showing what version of Tcl/Tk is installed, so you can read the Tcl/Tk documentation specific to that version.

3.7 EVOLUTION OF STATE OF ART IN SMART TOLL

The evolution of state-of-the-art smart toll systems has seen significant advancements, leveraging cutting-edge technologies to enhance the efficiency, accuracy, and user experience of toll collection. Here are three key areas that have evolved in the state of the art in smart toll systems:

Image Processing and Computer Vision: Image processing and computer vision techniques have greatly evolved in the context of smart toll systems. Advanced algorithms can now accurately detect and recognize vehicle number plates, even in challenging lighting and weather conditions. This evolution has led to improved accuracy in toll fee calculations and reduced false positives or negatives in vehicle identification. Furthermore, advancements in machine learning and artificial intelligence have enabled more sophisticated image analysis and pattern recognition, enhancing the overall performance and reliability of smart toll systems.

1. **Wireless Communication and Connectivity:** The evolution of wireless communication technologies has been pivotal in the advancement of smart toll systems. The integration of RFID (Radio Frequency Identification) and DSRC (Dedicated Short-Range Communication) technologies enables seamless and automatic toll fee deductions as vehicles pass through toll plazas. These technologies facilitate real-time communication between toll booths, backend systems, and users' accounts, ensuring instant updates and accurate billing. Additionally, advancements in cellular networks and internet connectivity have enabled remote monitoring, system management, and data analytics for efficient toll operations and maintenance.

2. **Integration with Intelligent Transportation Systems (ITS):** The state of the art in smart toll systems has embraced integration with Intelligent Transportation Systems. By seamlessly connecting with other transportation infrastructure and systems, such as traffic management systems, parking facilities, and transit services, smart toll systems can optimize traffic flow, improve route planning, and enhance overall

transportation efficiency. The integration with ITS allows for dynamic toll pricing based on traffic conditions, congestion management, and the implementation of various strategies to incentivize efficient use of toll roads. This evolution promotes better integration of toll systems into the larger transportation network and enables a more holistic approach to traffic management.

3. **Mobile Applications and Digital Payments:** The emergence of mobile applications and digital payment platforms has significantly transformed the user experience in smart toll systems. Users can now register their vehicles, manage their accounts, and make toll payments conveniently through dedicated mobile apps. These apps often provide real-time updates on account balances, transaction history, and personalised notifications, enhancing transparency and user engagement. Furthermore, integration with digital payment systems, such as mobile wallets or contactless payments, enables quick and secure transactions, reducing the reliance on cash and physical toll booths.

4. In summary, the evolution of state-of-the-art smart toll systems has witnessed advancements in image processing and computer vision, wireless communication and connectivity, integration with intelligent transportation systems, and the introduction of mobile applications and digital payment platforms. These advancements have collectively improved accuracy, efficiency, user convenience, and system integration, making smart toll systems an integral part of modern transportation infrastructure.

CHAPTER 4

PROPOSED ALGORITHM

4.PROPOSED ALGORITHM

4.1 NUMBER PLATE RECOGNITION USING OCR TECHNIQUE

Automatic Number Plate Recognition (ANPR) is a special form of Optical Character Recognition (OCR). ANPR is an image processing technology which identifies the vehicle from its number plate automatically by digital pictures. In this paper we have presented an algorithm for vehicle number identification based on Optical Character Recognition (OCR). OCR is used to recognize an optically processed printed character number plate which is based on template matching. This algorithm is tested on different ambient illumination vehicle images. OCR is the las t stage in vehicle number plate recognition . In recognition stage the characters on the number plate are converted into texts. The char acters are then recognized using the template matching algorithm. Index Terms : Automatic Number Plate Recognition (ANPR), Optical Character Recognition (OCR), Template Matching.

Optical character recognition or optical character reader (OCR) is the electronic or mechanical conversion of images of typed, handwritten or printed text into machine-encoded text, whether from a scanned document, a photo of a document, a scene-photo (for example the text on signs and billboards in a landscape photo) or from subtitle text superimposed on an image (for example: from a television broadcast).[1]

Widely used as a form of data entry from printed paper data records – whether passport documents, invoices, bank statements, computerized receipts, business cards, mail, printouts of static-data, or any suitable documentation – it is a common method of digitizing printed texts so that they can be electronically edited, searched, stored more compactly, displayed on-line, and used in machine processes such as cognitive computing, machine translation, (extracted) text-to-speech, key data and text mining. OCR is a field of research in pattern recognition, artificial intelligence and computer vision.

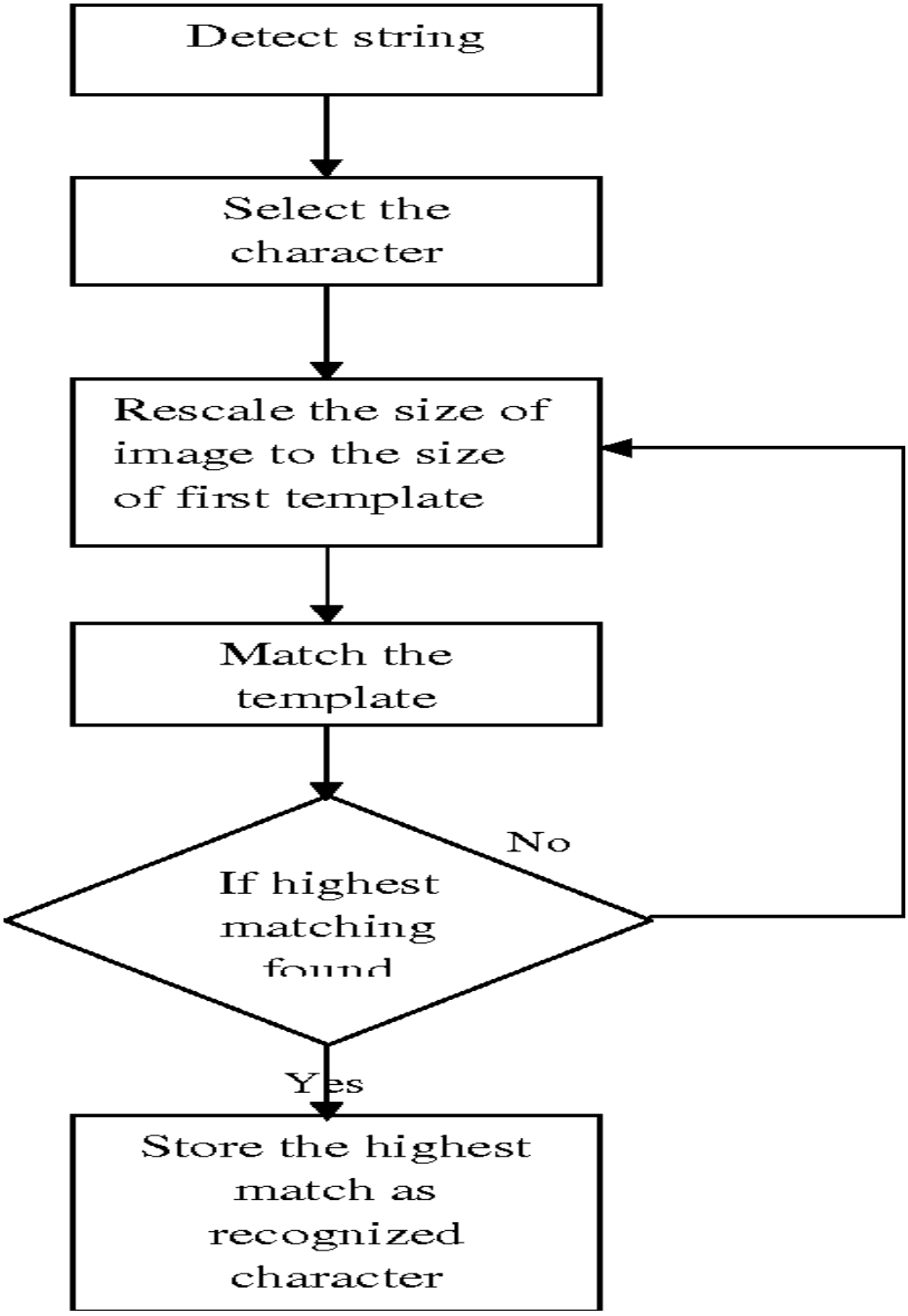


Fig.4.1 Number Plate Detection Using the OCR Technique.

The Smart Toll Collection system is an automated toll collection system that aims to provide a seamless experience for users passing through toll booths. The Smart Toll Collection system uses image processing technology to detect and recognize the number plate of a passing vehicle at a toll booth. This is a python-based project using image processing technology. The project will be developed using the Anaconda IDE. The system will use predefined photos to detect the number plate of the vehicle passing through the toll booth. The system uses Python and Anaconda IDE to develop and run the project, making it a highly efficient and user-friendly toll collection system.

To use the system, users can register their vehicles on the web-based platform by providing their registration number, name, and car type. The system validates the registration number and stores the registration details in the database.
When a vehicle passes through the toll booth, the system captures an image of the number plate and processes it to recognize the number. The system will then use image processing techniques to recognize the number plate, and if the number plate is registered in the system, the toll fees will be automatically deducted from the user's account. Users will be able to register their vehicles by providing their registration number, name, and car type on the web-based platform. The system will validate the registration number, and if it is valid, the user will be registered, and the registration details will be stored in the database. If the number plate of a passing vehicle is not registered in the system, the system will detect it and print "NOT REGISTERED" in the console. The user will be required to register their vehicle before they can pass through the toll booth. The system will be integrated with an SMS API for sending messages to the user regarding the toll fees deducted from their account.

Here is the step-by-step algorithm for the Smart Toll Collection system:

1. Start the Smart Toll Collection system.

2. Initialise the system and set up the Anaconda IDE for development.
3. Create a web-based platform for user registration, allowing users to provide their registration number, name, and car type.

4. Validate the registration number entered by the user.

5. If the registration number is valid, store the user's registration details in the database.

6. Capture an image of a passing vehicle's number plate at the toll booth.

7. Preprocess the captured image using image processing techniques to enhance its quality and remove noise.

8. Apply image processing algorithms to detect and extract the number plate from the preprocessed image.

9. Utilize optical character recognition (OCR) algorithms to recognize and extract the alphanumeric characters from the number plate region.

10. Verify the extracted number plate against the database of registered vehicles.

11. If the number plate is registered in the system, proceed to the next step. Otherwise, print "NOT REGISTERED" in the console.

12. Calculate the toll fees based on factors such as vehicle type, distance travelled, and additional charges.

13. Deduct the calculated toll fees from the user's account.

14. Update the user's account balance.

15. Use an SMS API to send a message to the user, providing details of the toll fees deducted from their account.

16. Repeat the process for each passing vehicle at the toll booth.

17. End the Smart Toll Collection system.

CHAPTER 5

DESIGN AND IMPLEMENTATION

5. DESIGN AND IMPLEMENTATION

5.1 DESIGN

Users can register their vehicles on the web-based platform by providing their registration number, name, and car type. The system validates the registration number and stores the registration details in the database.

Initialise the system and capture an image of a vehicle passing through the toll plaza.System captures an image using image capture devices such as cameras or sensors. The captured image undergoes preprocessing steps. The system will use predefined photos to detect the number plate. Image processing algorithms are applied to detect and extract the vehicle's number plate from the preprocessed image. The system verifies the extracted number plate against a database of registered vehicles. If the number plate is found in the database, the system proceeds to the next step. Otherwise, it generates a notification indicating that the vehicle is not registered. The user will be required to register their vehicle before they can pass through the toll booth. Based on the vehicle type, distance travelled, and any additional charges, the system calculates the applicable toll fee. The calculated toll fee is deducted from the user's account. The account balance is updated accordingly. A real-time SMS notification is sent to the user, providing details of the toll fee deducted from their account and the updated account balance.

5.2 MODEL ARCHITECTURE

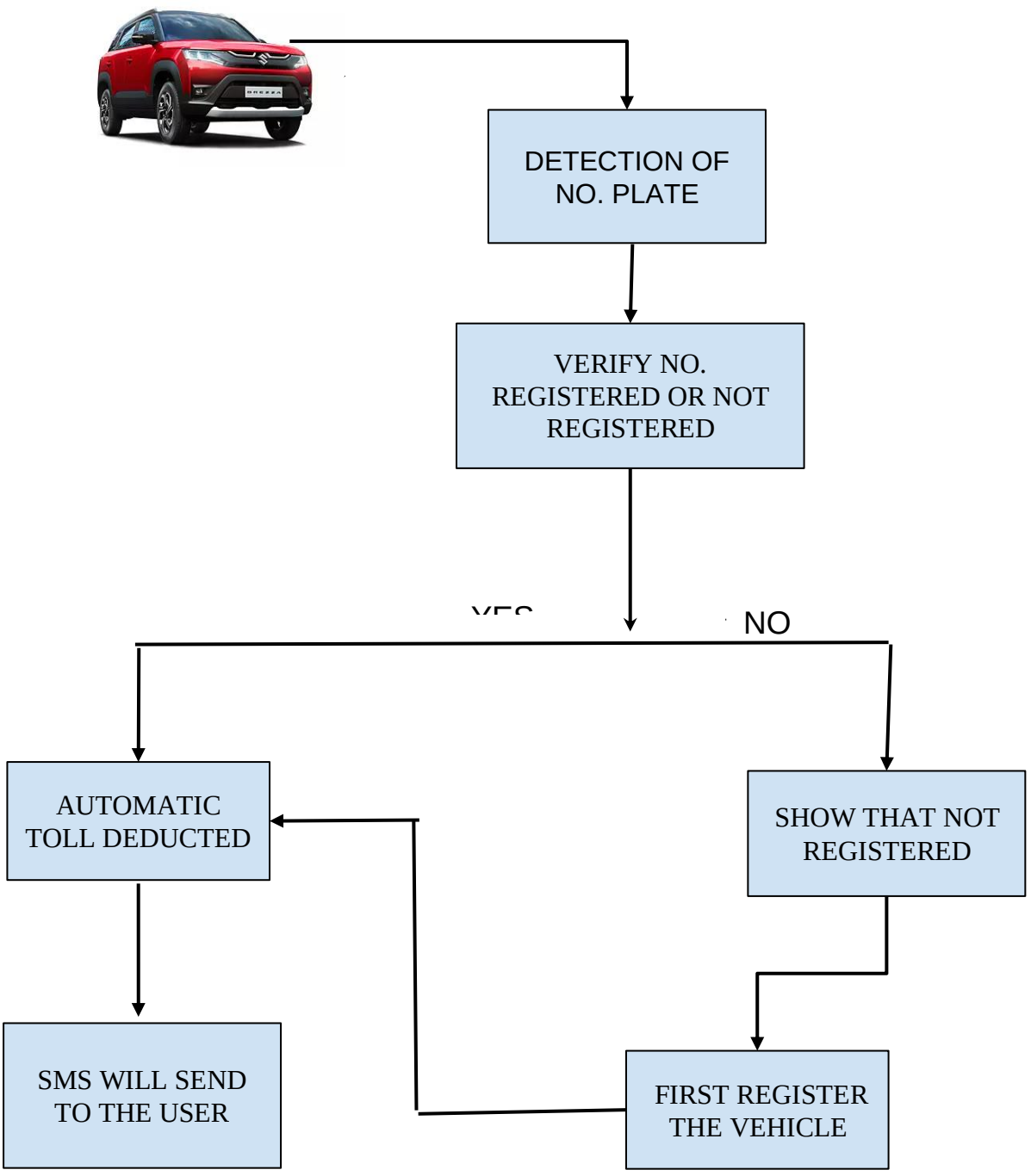


Fig.5.1 shows an automated toll payment process.

5.3 IMPLEMENTATION

```python
import numpy as np
import cv2
import pytesseract
import time
import imutils
import tkinter as tk
from tkinter import filedialog

start_time = time.time()
pytesseract.pytesseract.tesseract_cmd = 'C:\\Program Files\\Tesseract-OCR\\tesseract.exe'

# Create a tkinter window
root = tk.Tk()
root.withdraw()

# Open a file dialog to select an image file
file_path = filedialog.askopenfilename()

original=cv2.imread(file_path)  # input image
original1=original.copy()               #
original2=original.copy()

blur = cv2.GaussianBlur(original,(5,5),0)
smooth = cv2.addWeighted(blur,1.5,original,-0.5,0)

#cv2.imshow("input image",image)
gray = cv2.cvtColor(smooth, cv2.COLOR_BGR2GRAY)
```

```python

ret,thresh = cv2.threshold(gray,200,255,0)
# cv2.imshow("thresh",thresh)
# cv2.waitKey(0)

cnts, new  = cv2.findContours(thresh, cv2.RETR_LIST, cv2.CHAIN_APPROX_SIMPLE)
cnts=sorted(cnts, key = cv2.contourArea, reverse = True)[:30]
#NumberPlateCnt = None #initialyy no
cv2.drawContours(original1, cnts, -1, (0,255,0), 1)


count = 0
idx =7
for c in cnts:
        peri = cv2.arcLength(c, True)
        approx = cv2.approxPolyDP(c, 0.04 * peri, True)
        area = cv2.contourArea(c)
        if len(approx) == 4  :
            #print(area)
            NumberPlateCnt = approx
            x, y, w, h = cv2.boundingRect(c) #This will find out co-ord for plate
            new_img = original2[y:y + h, x:x + w]
            # cv2.imwrite('Cropped Images-Text/' + str(idx) + '.png', new_img) #Store new image
            idx+=1
            break
```

```
cv2.drawContours(original2, [NumberPlateCnt], -1, (0,255,0), 3)


cv2.imshow("INPUT IMAGE",original)
cv2.waitKey(0)

cv2.imshow("NUMBER PLATE", new_img)
cv2.waitKey(0)
# converts the license plate characters to string
text = pytesseract.image_to_string(new_img, lang='eng')
text = list(text)
if ',' in text or '.' in text:
        text.remove(',')
if '.' in text:
        text.remove('.')
text = ''.join(text)
print(text)
print("License plate is:", text)
cv2.waitKey(0)
cv2.destroyAllWindows()
#-------------------------------------------------------------------------------
import csv
import pandas as pd
import os
from twilio.rest import Client
```

```
from twilio.rest import Client

account_sid = "AC61d5d0113069fac97003a1b89bef3156"
auth_token = "48c428edf77fa0a4af4781e8042b8c12"
client = Client(account_sid, auth_token)

df = pd.read_csv('registrations.csv')
numbers = df['Vehicle Number']
print(numbers)
j = 0
for i in list(numbers):
        if i.strip() == text.strip():
            print('Vehicle Registered')
            ph = list(df['Phone Number'])[j]
            ph = '+'+str(ph)
            print(ph)
            body = "Chalan generated of Rs.100 for vehicle "+text+"."
            message = client.messages.create(
                        body=body,
                        from_="+16813873540",
                        to=ph
)
            print('message send')
            break
        j += 1
else:
    print('Vehicle is not registered.')
```

- This is the code for the extracting the number plate from the car and convert this image in the text and if the car number is registered in then the Toll fees is send on the registered user's Mobile number.
- Basically in that code we used the various python libraries like the OpenCv, numPy, tkinter. In the code we used the OCR (Optical Character Recognition) for extracting the number plate.
- For sending the massage regarding the toll fees we used the Twilio API.

```python
import tkinter as tk
import csv

# Define a function to handle form submission
def submit_form():
    # Get the values from the entry fields and dropdown menu
    name = name_entry.get()
    age = age_entry.get()
    phone = phone_entry.get()
    car_type = car_type_var.get()

    # Append the values to a CSV file
    with open('registrations.csv', 'a', newline='') as csvfile:
        writer = csv.writer(csvfile)
        writer.writerow([name, age, phone, car_type])

    # Clear the entry fields and reset the dropdown
    name_entry.delete(0, 'end')
    age_entry.delete(0, 'end')
    phone_entry.delete(0, 'end')
    car_type_var.set('Sedan')
```

```python
    car_type_var.set('Sedan')

    root.destroy()

# Create a tkinter window
root = tk.Tk()

# Set the window title
root.title('Registration Form')

# Create a label and entry field for name
name_label = tk.Label(root, text='Name')
name_label.grid(row=0, column=0, padx=10, pady=10)
name_entry = tk.Entry(root)
name_entry.grid(row=0, column=1, padx=10, pady=10)

# Create a label and entry field for age
age_label = tk.Label(root, text='Vehicle Number')
age_label.grid(row=1, column=0, padx=10, pady=10)
age_entry = tk.Entry(root)
age_entry.grid(row=1, column=1, padx=10, pady=10)
```

```
# Create a label and entry field for phone number
phone_label = tk.Label(root, text='Phone Number')
phone_label.grid(row=2, column=0, padx=10, pady=10)
phone_entry = tk.Entry(root)
phone_entry.grid(row=2, column=1, padx=10, pady=10)

# Create a label and dropdown menu for car type
car_type_label = tk.Label(root, text='Car Type')
car_type_label.grid(row=3, column=0, padx=10, pady=10)
car_type_var = tk.StringVar(value='Sedan')
car_type_options = ['Sedan', 'SUV', 'Sports Car', 'Truck']
car_type_dropdown = tk.OptionMenu(root, car_type_var, *car_type_options)
car_type_dropdown.grid(row=3, column=1, padx=10, pady=10)

# Create a button to submit the form
submit_button = tk.Button(root, text='Submit', command=submit_form)
submit_button.grid(row=4, column=0, columnspan=2, padx=10, pady=10)

# Start the tkinter main loop
root.mainloop()
```

- When the car is not registered then the we need to registered the car in the dataset.
- This code is used for the car registration in which we input the user name, car number, user's mobile number and the car type.
- Through this code we registered the user and store the used data in the dataset which is created for system.

CHAPTER 6

CONCLUSION

6. CONCLUSION

Through this method of toll collection will save time, effort and manpower. How many vehicles pass through the toll gate stored in the database. What percentage of vehicles passing through the toll gate hold on within the info. The vehicle is also getting monitored against accidents and regarding its authorization. The web app provided to concerned authority will also get updated with all the information of all the toll gates. The Smart Toll Collection system is an innovative and efficient solution for automated toll collection on highways and roads. It utilises image processing technology and a web-based platform for vehicle registration, providing a seamless experience for users passing through toll booths. Additionally, the ability to assess the percentage of registered vehicles within the system provides a clear understanding of user compliance, helping tailor strategies to boost registration rates and ensure widespread adoption. The system's integration with an SMS API allows for easy communication with users regarding toll fees deducted from their account. Furthermore, the system's capabilities extend beyond toll collection. With its monitoring functionality, it becomes a valuable tool for accident detection and authorization verification. By integrating with surveillance cameras and vehicle tracking systems, authorities can promptly respond to incidents within the toll gate area, enhancing overall safety and security for commuters. The web app provided to the concerned authority acts as a central hub, empowering administrators to access real-time data and efficiently manage all toll gates. From monitoring toll transactions to generating insightful reports, the web app streamlines decision-making processes and facilitates effective communication with users. This seamless communication enables authorities to address concerns, provide updates, and ensure a smooth user experience.

CHAPTER 7
FUTURE SCOPE

7. FUTURE SCOPE

In the future, the Smart Toll Collection system can be further developed to include additional features such as facial recognition technology for enhanced security, integration with GPS for real-time traffic monitoring, and integration with electronic payment systems for more seamless transactions. Additionally, the system could be integrated with smart city infrastructure, allowing for better traffic management and optimization. The Smart Toll Collection system has promising future scope for development and integration with other advanced technologies. Electronic payment systems can be integrated to provide a wider range of payment options, further reducing the reliance on physical currency and cash transactions. Overall, the future scope for the Smart Toll Collection system is promising, with the potential to significantly improve the toll collection process and overall travel experience.

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