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IOT Based Automated Toll Collection System using NodeMcu and Blynk App

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Abstract: *India has to be digitalized in every manner imaginable given its continuous development and economic expansion. To lessen the line at the toll plaza and the amount of staff needed, the toll collecting system in India has to be digitalized. In this project, the RFID-based Automated Toll Collection System is used to reduce traffic congestion and guarantee system transparency. With the help of the suggested system, traffic jams on toll roads, bridges, and tunnels might be eliminated without the need of cash or the requirement that cars stop. This tactic is based on an electronic toll collecting system that utilises radio frequency identification (RFID) technology to identify a vehicle specifically employed for toll collection. The proposed RFID system uses tags that are fastened to the automobiles' digital licence plates, giving RFID readers access to the data contained on the tags. It is possible to reduce the need for vehicle owners and toll collection companies to physically issue tickets and collect tolls using this method. Vehicle owners and the toll authority may easily exchange information about toll payments. As a result, toll payment transparency may be ensured with minimal manual labour and human error. It will be easier to develop a smart transportation system as a consequence.*

Keywords: Automatic toll collection, RFID, Embedded, Blynkapp

I. INTRODUCTION

Fees at the rates specified by the rules made in support of services or benefits related to the use of transportation, permanent bridges, temporary bridges, tunnels on national highways, and sections of national highways are levied by the Central Government and are communicated to the public through the publication of an announcement in the official newspaper. These fees are intended to generate revenue for the Central Government. For publicly funded, annuitized, and SPV projects, the government is responsible for collecting the user charge (toll) by hiring the contractors through a competitive e-bidding process. On the other hand, the concessionaire is responsible for collecting the user charge (toll) for privately funded and OMT projects (toll). Tolls in India are normally collected using an open system; the price is a flat rate that is determined by the whole distance covered by the project, which is typically sixty kilometres. When a stretch is less than anticipated, the user fee that is based on real length is the only one that is collected. The user price for a particular fee plaza is decided by the length of the stretch of highway below that plaza, the width of the roads, the structures (bridges, tunnels, and bypasses), the applicable fee legislation, and the conditions of the concession agreement. The classification of automobiles is done so for the sake of everyone's safety on the road. The primary factors that determine how a vehicle is categorised are its dimensions, the maximum payload it can carry, the amount of wear and tear it inflicts on the pavement, and the function it is designed to do (commercial or personal). The pricing rules from 2008 stipulated that there should be a gap of sixty kilometres between any two toll plazas that were located in close proximity to one another. The following is a list of the primary arguments for establishing a charge plaza within a radius of sixty kilometres:

- Land availability
- Long enough lines of sight are available for the acceleration and deceleration zones.
- Town or municipal limits are formed from the fee plaza.
- location of the bypass from the planned charge plaza.
- Location of significant detours on national highways.

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In order to make the project economically viable, two charge plazas will be built in the project region of New Hampshire at a distance of sixty kilometres of each other.

It has been determined that the New Hampshire development endeavour fulfils the requirements. As a result, two neighbouring sections that are less than sixty kilometres in length and that were constructed at different periods under different contracts may have charge plazas that are located near to one another. It's possible that the distance between two neighbouring toll plazas is less than 60 kilometres (km), and the reasons for this range from a shortage of land to traffic congestion to an undesirable location.

Customers who come in often and from the surrounding area are eligible for discounts as a kind of welfare. The concessions that are being provided can be different from one another due to the fact that they were granted at different times and were subject to different fee standards and concession agreement stipulations. The new user fee laws stipulate that yearly adjustments are to be made beginning on April 1 and that the cost must be adjusted to the nearest Rs 5 after each adjustment. On the other hand, some roads that were built before 2008 are subject to outmoded restrictions, which state that the price must be rounded down to merely one rupee. User fees are calculated and collected in accordance with the conditions of the concession agreement as well as the applicable laws governing fees. When a project is seventy-five percent complete, the collection of user fees may be authorised under specific conditions.

People will find it simpler to use the completed piece of the road as a result of this, and they will only be required to pay for the segment of the road that is open to traffic for seventy-five percent of its whole length. User fees are calculated and collected in accordance with the conditions of the concession agreement as well as the applicable laws governing fees. A concessionaire, in general, has the right to collect user fees until the end of the concession period that is granted under the agreement. In order to recuperate the costs associated with the construction of a roadway, a charge is going to be collected from drivers. After the initial expenditures have been recouped, the toll is then collected at a rate that is decreased by forty percent in order to ensure that the roadway remains in pristine condition for drivers. The list of vehicles that are not need to have certain documentation changes due to the fact that exemptions were granted in line with a variety of rules that were in place at the time that the route was being constructed.

II. LITERATURE SURVEY

P. Arokianathan and colleagues [1] built a model of an automated toll booth with a theft detection system. The model requires the user to input the source and destination before being directed to the payment option, which is a procedure that is still time-consuming. The most important benefit, on the other hand, is that the theft detecting system that was built into this structure makes it possible to recover a stolen vehicle when it arrives at the toll plaza.

Sabbir Ahmed and colleagues [2] devised a model of a toll collection system that makes use of RFID technology. This technology helps to decrease the amount of physical work that is necessary in order to collect the toll tax. However, there was no mechanism in place to check whether or not the RFID tag that was being read was exclusively associated with the car that had just passed through the toll plaza. Therefore, this continues to be a significant drawback of the paradigm that they have suggested.

Chintaman Bari and colleagues [3] investigated the toll plaza that is now in use at the Ghoti Toll Plaza, which is located in Nashik, India. In conclusion, they said that the manual toll collecting method (MTC) was 95 percent more time consuming than the electronic toll collection system (ETC).

In order to solve the issue that currently exists with human toll collecting, Rajiv Israni and colleagues [4] developed an automated toll collection system. The method of image processing is his primary focus in terms of technology. This method is similar to OCR, which stands for optical character recognition, and it extracts the licence plate number from a car by using a camera. After the data has been extracted from the picture using image processing, it is looked up in a database to determine if it is legitimate or not registered. The amount of the toll is immediately detected, and the vehicle is permitted to go through the toll plaza if the registration number is correct.

Raed Abdulla and colleagues [5] developed an electronic toll collection system that makes use of RFID technology and the internet of things. When a car passes through the toll, the RFID tag attached to it is read, and the Internet of Things is utilised to communicate data to the main office through the cloud. In this instance, the author suggests a new approach in which the barrier gates are opened and do not shut for the people who have proper registrations. Therefore, the passage through the toll booth takes an average of six seconds, which is a significant amount of time.

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Since there is often a very lengthy line for automobiles, Mavik Patel et al. [6] has used RFID and FASTag in order to cut down on the amount of time spent waiting for vehicles. This opens the door for a more environmentally friendly option and also lowers the quantity of carbon emissions; nevertheless, there is a danger, and as a result, we need to check twice that a vehicle has truly paid the toll amount.

An automated toll collecting system that makes use of RFID tags has been created by Kavyashree M et al. [7]. In addition to it, GPS and GSM modules have been included. These modules were used to identify car accidents, and they may also be used to detect vehicle theft. An SMS app was used to alert users of the vehicle accidents and thefts that were detected.

Deepashree K et al. [8] have developed and put into operation an automated toll collection system that utilises RFID tags. In this instance, the author has provided the user with a variety of options for making payment at the toll booth, such as using a credit card or google pay. The government should consider doing this since it would cut down on the country's total pollution and cut down on the amount of time people spend waiting in line at toll plazas.

Toll gate automation, which was designed by the author of paper [9] and was built to collect information such as the owner's name, the date of registration, the automobile type, and other information, was able to be used. This technology is useful for automating toll gates, managing time, and automatically tracking vehicles. This article demonstrates how automation of toll gates is now being used, which is a step toward improved tracking and monitoring of vehicles that are travelling along predetermined routes. This gadget can instantly identify the automobile and record the current time as well as the vehicle's identification number. If the car in question is registered to an authorised person or organisation, the toll booth will open on its own, and a certain amount will be deducted from the driver's account as soon as the door is opened.

In the research paper [10], we investigate several ways in which the RFID-based toll deduction system might be enhanced and made more efficient. Each vehicle will be equipped with a radio frequency (RF) tag that is capable of communicating with the RF Reader located at the toll booth. After that, the amount that was indicated will be subtracted from the user's account. This research study has the potential to be used in today's automobiles due to its adaptability and scalability.

In the paper [11], it is stated that the recent road use pricing experiments in Hong Kong, as well as the route guidance experiments in Berlin and London, make it clear that the technological advancement in the fields of data communications and road traffic "informatics" (RTI) will reopen the age-old discussion regarding how use of the road system should be billed for. These experiments were conducted in Hong Kong and Berlin and London, respectively. If automobiles could be automatically charged for road use without being stopped, this may have a significant impact on current pricing systems for road use, despite the fact that there may still be significant opposition on both the social and governmental levels. The paper is not just focused on the technological issues posed by autonomous toll collection, but it is clearly positioned within the social and political context that surrounds any general adoption of such a policy.

III. PROPOSED SYSTEM

The block diagram of the proposed system is shown in Fig. 3.1.Flow of RFID based toll tax collection system are:

- Detection of vehicle
- Display of toll
- Payment through RFID card
- Displaying the information of all the vehicles passing through toll gate to toll collector.

A person is required to register their vehicle with the RTO office before they may purchase a vehicle. In addition to a licence plate, the personnel of the RTO will provide it with a tag that is equipped with RFID technology. This card's one-of-a-kind identification number is only valid for usage in conjunction with the specified automobile. In addition to that, they will establish a unique account for that smart card and keep a database with a record of all of the transactions made with it. It is necessary for the person who owns the automobile to deposit at least some money into this account.

When a vehicle that has been previously registered draws near the toll booth, the RFID circuit is activated so that the RFID-enabled smart card that is affixed to the windshield may be scanned. The infrared sensors are the ones that make the first discovery that there is a vehicle in the area. The procedure will start, and depending on the amount that is available, the vehicle will either be relocated to another lane so that the tax may be paid manually, or the toll will be

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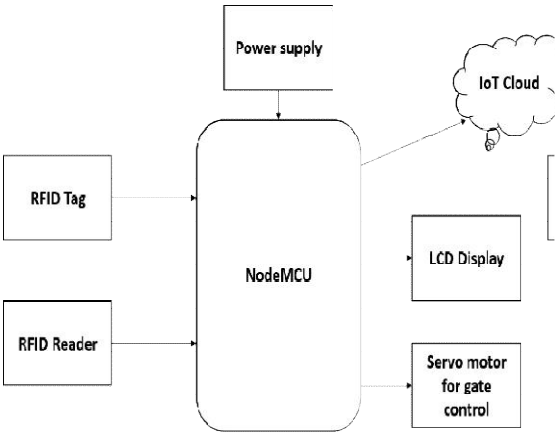
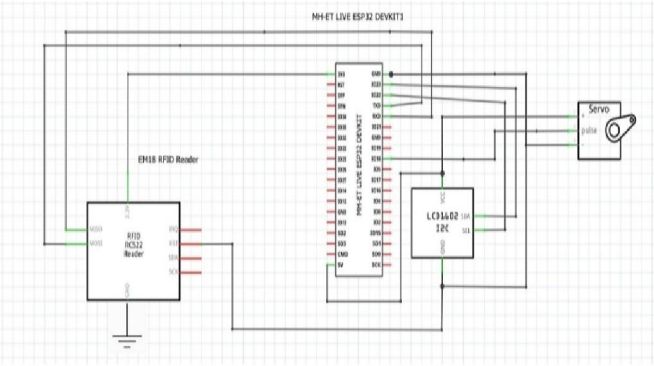
promptly deducted from the vehicle's account. The programme refreshes the information that is saved on the primary database server.



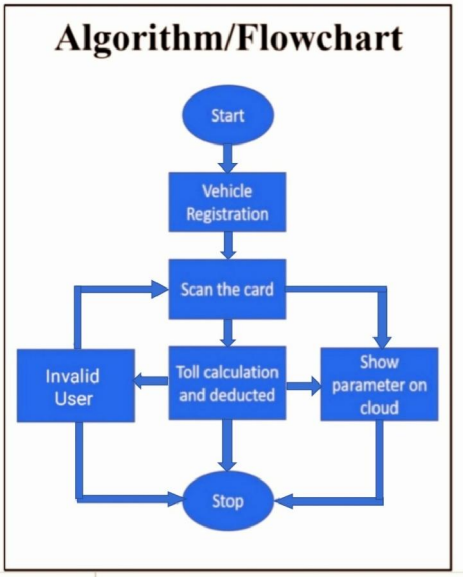
Block Diagram of the proposed system

In addition to this, it will send a text message to the user and will activate the mechanism that is responsible for creating the bill. The mechanism that is being suggested takes into account counting both the heavy and light cars that go through the facility that collects tolls.

The circuit diagram of the proposed system is shown in Fig. 2.



Circuit diagram of the propsoed system



Flowchart of the system

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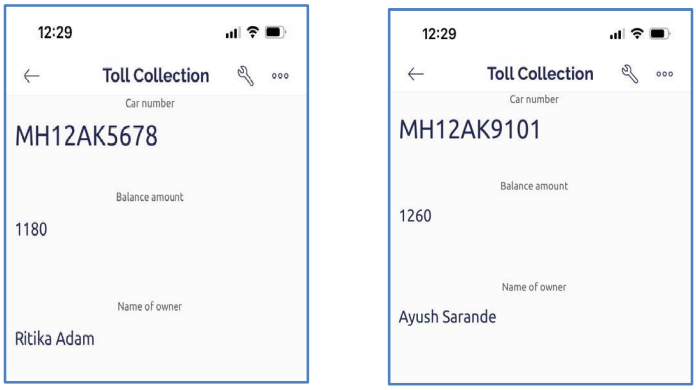
We have included an RFID reader into the circuit diagram so that the tags on the cars can be read, and the appropriate amount of toll tax will be withdrawn from the account whenever the vehicle passes through a toll station. The notice of the scanned card and the name of the owner of the automobile will be transmitted to the blynk server of the owner, together with the amount of money that is now available in their account and the number of the vehicle.

IV. RESULTS

The findings of the suggested test, which makes use of RFID for the identification of vehicles, are shown on an LCD screen. The controller for the recommended system is built using NodeMCU as the primary component. Fig.3 is a representation of the hardware module that will be a part of the system that is being suggested.

Picture of the model of the propsoed system

The message received after vehicle pass through the toll collection center for the different users are shown in Fig. 5.



Picture of output of the model on Blynk app

The details contain the user's name, amount available in card and the Vehicle number associated with the vehicle.

V. CONCLUSION

There was a presentation of a design for the RFID-based Electronic Toll Collection system that would be used for expressways. It has several benefits, including cheap cost, high security, the ability to communicate across large distances, efficiency, and many more. Both the capacity of the highway to transport traffic and the degree of charge technology are improved as a result of this. Electronic toll collection systems that are based on RFID are an effective method that may save money on administrative costs and taxes while also dramatically lowering the amount of noise and pollution that are emitted by toll stations. It has been decided to put together the Electronic Toll Collection (ETC) system that has been proposed. Because of this, there are fewer instances of delays and less needs for manual labour on the roadways. This approach of collecting tolls is better for the environment while also increasing the capacity of toll

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lanes. In addition, a component of the anti-theft system is integrated, which prevents any violator cars from proceeding and so increases the level of safety on the road.

REFERENCES

[1]. P. Arokianathan, V. Dinesh, B. Elamaran, M. Veluchamy and S. Sivakumar, "Automated toll booth and theft detection system," 2017 IEEE Technological Innovations in ICT for Agriculture and Rural Development (TIAR), 2017, pp. 84-88, doi: 10.1109/TIAR.2017.8273691.

[2]. S. Ahmed, T. M. Tan, A. M. mondol, Z. Alam, N. Nawal and J. Uddin, "Automated Toll Collection System Based on RFID Sensor," 2019 International Carnahan Conference on Security Technology (ICCST), 2019, pp. 1-3, doi: 10.1109/CCST.2019.8888429.

[3]. C. Bari, U. Gupta, S. Chandra, C. Antoniou and A. Dhamaniya, "Examining Effect of Electronic Toll Collection (ETC) System on Queue Delay Using Microsimulation Approach at Toll Plaza -A Case Study of Ghoti Toll Plaza, India," 2021 7th International Conference on Models and Technologies for Intelligent Transportation Systems (MT-ITS), 2021, pp. 1-6, doi: 10.1109/MT-ITS49943.2021.9529325.

[4]. Rajiv Israni, Damini Tichkule, Bhavna Gopchandani, "Automatic Toll Collection System (ATCS), " JCSE International Journal of Computer Sciences and Engineering, Vol.-7, Special Issue-12, May 2019, E-ISSN: 2347-2693,

[5]. Abdulla R, "A conceptual study of long-range active RFID system for reliable data communication", In Frontiers of Communications, Networks and Applications (ICFCNA 2014-Malaysia), International Conference on IET, 2014, pp. 1-6.

[6]. Malvik Patel, Bharavi Joshi, Kajal Bhagat and Hetakshi Desai and Jekishan K. Parmar, "IOT Based Toll Collection System Using Image Processing," International Journal of Computer Engineering & Technology, 9(3), 2018, pp. 132– 139.

[7]. Kavyashree M,Mamatha M, Manasa N M, Vidhyashree H E and Nagashree R N. "RFID based Toll Collection System," International Journal of Engineering Research & Technology (IJERT), Volume 8 Issue 11 2020 Conference Proceedings

[8]. Deepashree K. Mehendale and Reshma S. Masurekar, "To study the implications of Electronic Toll Collection System using RFID Technology," International Research Journal of Multidisciplinary Studies (IRJMS), Vol. 1, Issue 5

[9]. J. Krishnamurthy, N. Mohan and R. Hegde, "Automation of Toll Gate and Vehicle Tracking," 2008 International Conference on Computer Science and Information Technology, Singapore, 2008, pp. 705-708, doi: 10.1109/ICCSIT.2008.148.

[10]. Sumathi S M, Nikhitha Kale M, Manasa R, Jithesh A, Jithesh A, Megha D. Hegde, 0, Automatic Toll Collection System using RFID, International Journal of Engineering Research & Technology (IJERT), Vol 06, Issue 15,2018

[11]. P. Hills and P. T. Blythe, "The automation of toll-collection and road-use pricing systems," Second International Conference on Road Traffic Monitoring, 1989., London, UK, 1989, pp. 118-1