Grenze International Journal of Engineering and Technology, June Issue

Smart Toll Plaza for Minimum Distance Travelled Vehicle using Cloud Computing

RanjithKumar.P[1], Devika.R[2], Durgadevi.K[3] and Gengakaviya.S[4]
[1]Professor, Electronics and Communication Engineering, P.S.R Engineering College, Sivakasi, Tamilnadu, India
Email: ranjithkumar@psr.edu.in
[2-4]B.E Student,Electronics and Communication Engineering, P.S.R Engineering College, Sivakasi, Tamilnadu, India
Email: rdevika0503@gmail.com, durgadevikalai12@gmail.com, gengakaviya14@gmail.com

***Abstract*— In the landscape of modern transportation infrastructure, toll gate systems stand as pivotal instruments for both financing the maintenance and expansion of road networks and managing the flow of vehicular traffic. However, the traditional model of toll collection, which relies on a static end-toend fee structure, has been increasingly challenged by its inability to adapt to the dynamic needs of contemporary road users and the evolving demands of sustainable urban mobility. Vehicle users traversing toll roads or bridges are currently subjected to a flat toll rate, irrespective of the distance they travel along the route. This method, while straightforward, often results in inequitable billing, where travelers may pay more than their actual usage of the road warrants. Moreover, this system can lead to congestion at toll booths and a strain on infrastructure maintenance budgets. In order to address these pressing challenges, this project introduces a transformative Toll Gate Payment System that capitalizes on a sophisticated amalgamation of Radio Frequency Identification (RFID) technology, Arduino microcontroller, GPS, Wifimodule, Cloud. The objective of this innovative approach is to revolutionize toll collection by enabling vehicle users to pay exclusively for the distance they traverse, thus fostering a fairer, more accurate, and efficient system that better aligns with the contemporary dynamics of transportation.**

***Index Terms*— Smart City; Toll plaza ; RFID;GPS; Wifi**

I. INTRODUCTION

The notion of a smart city entails the amalgamation of many technologies to enhance infrastructure, amenities, and correspondence. The Indian government's Ministry of Urban Development is leading the Smart Cities Mission, a retrofitting and urban revitalization initiative. Smart cities are urban settings that use data and technology to improve efficiency, sustainability, and living standards for residents. To gather and share data, smart cities employ sensors and devices integrated into their utilities, buildings, and other infrastructure. This makes it possible to monitor and manage numerous systems, including computers and smartphones in real time. Reliable and fast connectivity is essential for applications involving smart cities. Real-time information regarding public transit timetables is provided by smart transportation systems, helping commuters plan their journeys more efficiently. Contactless payment methods and digital ticketing options streamline the public transportation experience, reducing waiting times and improving overall efficiency. Any society needs a well-designed and effectively run transportation system. For a city to function effectively, its transportation system must be strong. When there are

Grenze ID: 01.GIJET.10.2.224

no suitable routes for transit, life completely stops for individuals who live in cities. The quality of living in contemporary high-tech cities is determined by the effective means and management of transportation channels. Smart cities and metro areas can completely transform how people commute with the help of intelligent transportation systems (ITS). Innovative approaches to provide various forms of transportation, cutting-edge infrastructure, traffic, and mobility management solutions are provided by ITS. Numerous electronics, wireless, and communication technologies are used. An advanced toll collection system using technologies like RFID tags, license plate recognition, and connected infrastructure for faster, more efficient, and data-driven tollbooth operations. Smart toll gates represent a significant advancement in tollbooth technology, offering potential benefits for drivers, governments, and the environment.

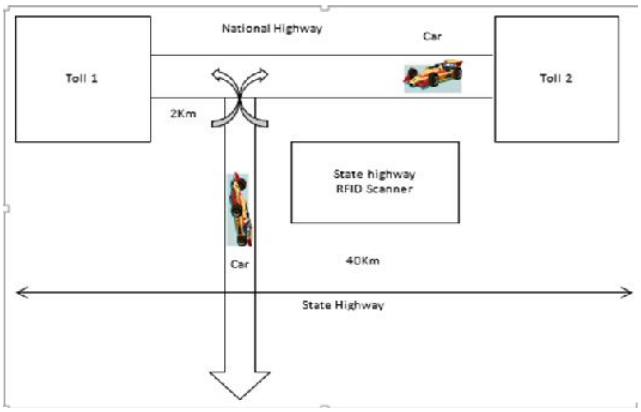

Fig 1: Concepts of Proposed System

II. Related Work

Ahmed TamimZabir Prince et al.(2023) deployedan automatic toll collection mechanism where users don't need to pay the money manually.[1] The current day, as all nations develop, more and more bridges are built in tandem with that development to advance the nation's economy, international relations, transportation network, and communication. Accordingly, there is no cost-effectiveness or efficiency to this manual toll collection method. This study offered a speculative solution, "Smart Prepaid Toll Management System Using RFID," as a solution to the previously outlined situation. This mechanism collects tolls automatically. SonaliPatil et al (2023) deployed a GPS-based toll collection system. There are several issues with the current toll collection system, such as variable toll rates on different roads, high traffic, etc. The toll collection system, especially in India, has problems with long wait times, theft from toll plazas, and other things. These systems can only service up to 300 cars per hour, thus if more cars come there than that, there may be major traffic jams. Current toll collecting techniques, such as Radio Frequency Identification (RFID), nevertheless take a long time. This study examines a GPS-based toll collection system in order to address the aforementioned problems. The location of the moving object would be tracked by this system each time a car moved from a highway to a service road. Therefore, anytime along the freeway, the user can pay the toll without being stopped. Since blockchain technology has lately gained popularity and has the potential to revolutionize the field of intelligent transportation systems, this system will make use of it to build a decentralized and intelligent method for toll collection and tracking data. The system maintains record integrity and security through the use of blockchain smart contracts. hence outlining a plan for implementing an efficient toll collection system with the highest level of openness.S.Chandrappa et al.(2023) employed a raspberry pi approach to collect a toll amount more quickly than with a previous system. However, it doesn't adjust the amount based on distance. The drawback of this study is that it uses RFID to collect the actual amount for each vehicle. To get over this issue, we use RFID to collect the amount faster and in accordance with the vehicle's actual distance traveled. Rajeev Kumar Chauhanetal.(2022) deployed a design and development of an automatic toll collection system aimed at debiting tolls from moving vehicles at toll plazas in India. The system effectively localizes vehicle license plates by utilizing image processing techniques and automated license plate recognition (ALPR) technologies. The LABVIEW software, the MyRio hardware module, the visual aid, and morphological filters are key components of the system. In order to facilitate smooth toll processing, a database is developed to hold vehicle and owner information.Md. Nazmul Hossain Mir (2021) deployed The manual toll collection technique has resulted in a significant rise in traffic on the roads. This emphasizes the necessity of creating a productive automated toll system for real-time applications. This study will properly investigate the toll zone found within a

bridge. The registration details of the car and the driver will normally be recorded in the data table included in the suggested model. The initial toll payment can be collected using the suggested digital toll management system, which also offers a structure for toll management system appeasement. The project based on research utilizes an accuracy validation of around 95.46%. The outcome of this strategy for the Bridge will assist the government in correctly collecting toll money from each transport owner or driver.sSheenamNaazet al.(2021) deployed an AI-based solution to lower labor expenses and collect the toll amount in a manner similar to that of a human.We don't use AI technology in our system; instead, we collect the toll based on the distance driven by the vehicle.P.Jagadeeswara Rao et al.(2020) deployed the Reducing hardships brought on by the manual toll assortment system and in a handful of seconds, pass the vehicle through the toll barrier without stopping is the only goal of this paper. The same procedure as this paper is likewise carried out in our project, and we additionally incorporate toll collecting based on the vehicle's distance traveled.Sabbirahmed et al.(2019) deployed rfid in order to save time at the toll plaza and collect real money.[2] In addition, our system stores the vehicle information in the cloud and lowers the real toll plaza based on the distance traveled by the vehicle.Nagashree R N et al.(2019) deployed a rfid based toll collection system.[3] This system's primary goals were to lessen air pollution and save gasoline for users who were waiting to pay the toll. The RFID is utilized in this system to save time. The system employs NFC to replace manual collecting in order to acquire data more quickly. K. Balamuruganetal.(2017) Deployed An automated system for collecting tolls and checking posts using RFID technology.This system designed with the basis trouble of licence, insurance and RC book during vehicle checking time. This technology links specific vehicle information, such as the unique ID, to an RFID tag that is fastened to the car.Every specification is efficiently observed by a computer and can also be stored for periodic gaps in a databank. The tax amount is deducted from the driver's account balance as the car passes the toll plaza and the scanner scans the tag. This paper will detect the actual amount from the user. In our paper we detect the amount from their account according to the distance which is travelled by the vehicle.

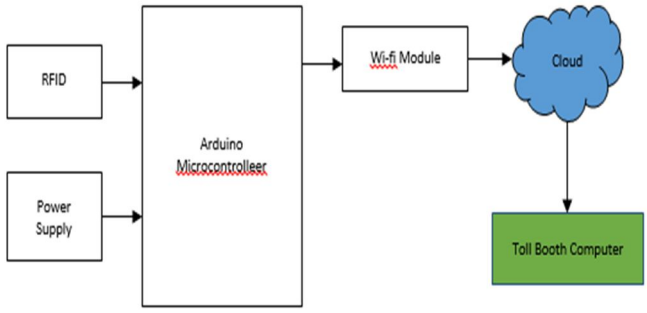

Fig 2: Block diagram of Smart Toll Plaza using Cloud Computing

The location of the vehicle will be constantly tracked by the RFID module in the vehicle. This location information is then uploaded by the microcontroller through Wi-Fi module. The Wi-fi module allows the microcontroller to access the internet. The toll fees will be collected when the travelling vehicle reaches near a collection point which may be a toll gate. The RFID tags attached to cars and the carefully positioned RFID readers at different locations along the toll road are the key components of the proposed system. These RFID tags give automobiles a special identity. Onboard GPS modules track a vehicle's position continually and send information to a central server at the same time. The precisedistance traveled is calculated by an Arduino controller at each toll gate, which interprets data from the GPS module and RFID tag to identify the vehicle's entry and exit points.

This method promotes cost-effectiveness and equity by charging consumers only for the actual distance travelled. Real-time payment processing is provided by the system, guaranteeing a smooth and effective experience for both vehicle users and toll operators. Furthermore, adding GPS technology improves the precision of the billing process, reducing the potential for disputes.The key contributions of this work include a detailed explanation of the system's architecture, the development of an efficient distance calculation algorithm, and an evaluation of the system's performance in terms of accuracy and speed. Our results indicate that the RFID-GPS-Arduino Controlled Toll Gate Payment System not only simplifies toll collection but also minimizes congestion and reduces operational costs for toll operators.This innovative system has the potential torevolutionize toll collection methods, making them fairer, more precise, and adaptable to the evolving needs of modern transportation infrastructure. Furthermore, the fusion of RFID, GPS, and Arduino technologies demonstrates the feasibility of creating intelligent and responsive systems that enhance user experiences while optimizing resource utilization.

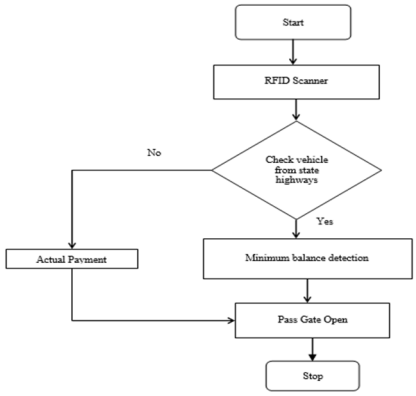

Fig 3: Flowchart of Smart Toll Plaza money collection

Requirements of Smart Toll Plaza using Cloud Computing

Each vehicle is equipped with a unique RFID tag that serves as a digital identifier. These RFID tags are affixed to the vehicle's windshield or another designated location. At various points along the toll road, RFID readers are strategically placed. These readers communicate with the RFID tags on vehicles as they pass through the toll gates, recording entry and exit times. An Arduino microcontroller at each toll gate processes data from the RFID tag and GPS module. It calculates the distance traveled by comparing the entry and exit points of the vehicle and sends this information to the central billing system. A central server consolidates data from all toll gates, calculates the appropriate toll fees based on the distance traveled by each vehicle, and processes payments in real time.The development and implementation of this innovative Toll Gate Payment System involve several key steps and methodologies: Integration of RFID readers, GPS modules, and Arduino controllers at each toll gate and within vehicles, ensuring seamless communication and data collection. Designing a robust and scalable database system to store information about vehicles, RFID tags, toll gate locations, and transaction records. In order to Develop a sophisticated algorithm that calculates the distance traveled by each vehicle based on GPS coordinates and entry/exit points, taking into account various road geometries. By Implementing real-time data processing and payment processing on the central server to ensure efficient billing and minimize delays for vehicle users. Designing user-friendly interfaces for toll booth operators and vehicle users, enabling them to access transaction records and payment details. Physical storage devices like hard disks, USB drives, and DVDs are no longer necessary when using cloud storage. Rather, our data is kept on computers in data centers, frequently spread across several sites for redundancy and dependability. We can access our cloud-stored data from a wide range of devices, including computers, smartphones, tablets, and web browsers. Many cloud storage providers offer dedicated applications to make accessing and managing our files easier. Cloud storage often includes synchronization features that automatically update files across all linked devices. Cloud storage services usually offer scalable storage solutions. The proposed project starts with a small amount of storage and expand as our needs grow, eliminating the need for regular hardware upgrades. Cloud storage providers implement security measures to protect your data from unauthorized access and data loss. This may include encryption, access controls, and redundancy. Cloud storage can serve as a backup solution, offering an offsite location for your critical data. This can be vital in case of hardware failure or data loss. Overall, cloud storage is a convenient and flexible solution for storing and managing digital data, providing easy access from anywhere and eliminating the concerns of local hardware maintenance and backups. To guarantee the system's resilience and efficacy, it must undergo extensive testing of its accuracy, dependability, and efficiency in a range of traffic and environmental scenarios.

IV. Results And Discussion

The system's success is heavily reliant on the accuracy of distance calculations. The combination of RFID data and GPS coordinates, processed by the Arduino controller, allows for precise determination of entry and exit points of vehicles. During our testing, we found that the system achieved a high level of accuracy, with minimal margin for error. This is crucial for fair billing and reducing potential disputes.

The system's capacity to process payments instantly is one of its most notable characteristics. As soon as a car enters the toll gates, the system immediately determines the corresponding.

The system's efficiency can lead to a substantial reduction in operational costs for toll operators. By billing users solely for the distance they cover, it promotes fairness and cost savings. This can result in a more efficient use of resources, reduced congestion at toll gates, and lower administrative expenses.

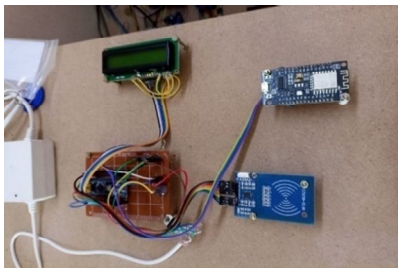

Fig 4: Implementation of Project

Fig 5: Real time payment of proposed project

Fig 6: Real time payment reduction of proposed project

Fig 7:Cloud Storage

V. Conclusion

In conclusion, the proposed Toll Gate Payment System represents a groundbreaking solution to the shortcomings of traditional toll collection methods.This project intends to transform the toll collection process by utilizing cutting-edge technologies like Radio Frequency Identification (RFID), Arduino microcontroller, GPS, Wifi module, and Cloud integration. The main goal of the system is to replace the static end-to-end cost structure with a dynamic and equitable charging system that is based on the actual distance that vehicle users travelled. By addressing the issues of unfair billing and traffic jams at toll booths, this novel approach offers a more equitable, precise, and effective solution that benefits road users as well as infrastructure management.

Acknowledgment

Thanks to everyone who helped us to finish a project, the author says thank you. They express their gratitude to then Almighty, Thiru R.Solaisamy, Dr.S.Vigneswari Arunkumar, Dr.J.S.SenthilKumar, Dr.K.Valarmathi, Dr.P.Ranjith Kumar and other Department of Electronics and Communication Engineering staff members for their patience, guidance, and support during the project.

References

[1] Prince, A. T. Z., Paul, D., Khoka, Z. H., Hasan, M. A., Afnan, A. U., &Ahmmed, A. (2023). Smart Prepaid Toll Management System using RFID,IEEE https://doi.org/10.1109/iccubea58933.2023.10392201

[2] Patil, S., Kulkarni, P. S., Desale, S., Adsul, D., &Choudhary, K. (2023). Smart Toll Booth System Using smart contract,IEEE. https://doi.org/10.1109/i2ct57861.2023.10126123

[3] Chandrappa, S., S, G. P. M., Kumar, H. N. N., Raju, K. S.,&Kumar, D. K. S. (2023). An IOT-Based automotiveAnd intelligent toll gate using RFID, SN ComputerScience,4(2) https://doi.org/10.1007/s42979022-01569-0

[4] Chauhan, R., & Chauhan, R. K. (2022). Intelligent toll collection system for moving vehicles in India. Intelligent Systems With Applications, 15, 200099. https://doi.org/10.1016/j.iswa.2022.200099

[5] P.JagadeeswaraRao.,Sk.Nazneen.,M.DeviDurgaBhavani,V.Tejaswi., V. Vijay Kumar (2020)An iot based automated tollcollection system using rfid.

[6] Proceedings, 2021 International Conference on Artificial Intelligence and Smart Systems (ICAIS 2021): 25-27, March 2021. (2021).

[7] Naaz, S., Parveen, S., & Ahmed, J. (2021). An Artificial Intelligence Based Toll Collection System. Eai. https://doi.org/10.4108/eai.27-2-2020.2303171
[8] Ahmed, S., Tan, T. M., Mondol, A. M., Alam, Z., Nawal, N., & on RFID Sensor. ResearchGate. https://doi.org/10.1109/ccst.2019.8888429
[9] Kavyashree, M. K., Mamatha, M., Manasa, N. M., Vidhyashree, H. E., & Nagashree, R. N. (2020c). RFID based Smart Toll Collection System. International Journal of Engineering Research and Technology, 8(11). https://www.ijert.org/research/rfid-based-smart-toll-collection-system-IJERTCONV8IS11038.pdf
[10] Balamurugan, K., Elangovan, S. G., Mahalakshmi, R.,&Ranganathan, P. (2017). Automatic check-post and fast track toll system using RFID and GSM module with security system.ResearchGate. https://doi.org/10.1109/icaetgt.2017.8341461