RFID BASED HIGHWAY TOLL TAX COLLECTION SYSTEM

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ABSTRACT:

Most highway toll plazas are now operated by hand, with the operator collecting money from the driver and providing a receipt. Because this procedure is frequently slow, we frequently cause traffic jams at toll plazas on busy highways. Toll collection can save time, manpower, and effort. During this work, an occasional value and cost-effective technique known as IoT-based toll gate system using Arduino that automatically collects tolls from moving vehicles after they cross the toll plaza tract will be used. We also assume that an owner has a paid account, so that tolls are automatically deducted from the driver's account at plaza. The owner will receive payment details, which will be saved on the server, and there will be no need for him to stop the vehicle. Because a database of all vehicles is maintained, the project detects unregistered vehicle entries as well. Because Arduino is IOT-enabled, vehicles data bases can be created and linked to the server via an app installed on any mobile device. In addition, if a vehicle is involved in an accident, the system sends an SMS to the appropriate authorities, including the location of the incident as determined by GPS.

Keywords: *GPS, GSM, SMS, RFID Reader, RFID Tag, Arduino, IoT*

INTRODUCTION:

On highways, there are numerous toll booths, and hundreds of thousands of vehicles pass through a single toll gate every hour. If toll taxes are collected manually, it takes a long time because vehicles must form a queue and wait for a long time to cross the toll plaza. Because people are pressed for time, they eagerly await their turn to arrive at their destination on time. They must wait in line to pass through a toll gate, which entails queuing in line, stopping at the toll gate, taking a ticket, paying, and then passing through the gate. The entire procedure takes time. During the waiting period, there is also a waste of time and fuel. As a result, there is a need to create a system that will aid in reducing the process's complexity. Many people worked on developing systems that allowed vehicles to pass through toll booths without stopping. To cross the toll plaza, drivers will not be required to pay in cash or obtain a token from the toll manager. This paper describes one such system that provides a convenient route for highway vehicles. This system is based on RFID technology, which can determine whether a vehicle is registered in a toll payment system by matching the unique ID for each vehicle recorded in the system with the unique code stuck to the vehicle's windscreen. When the vehicle passes through the plaza, the corresponding amount is deducted from the owner's bank account. This entire process will be completed before the vehicle arrives at the toll plaza and opens the gate, allowing the vehicles to pass. If the vehicle does not have a unique code or is not registered, they must wait in line and pay the tax manually. The benefit of this technology is that it reduces

congestion in toll plazas as well as the inconveniences associated with manual payments. RFID (radio frequency identification) is a technology that uses radio frequencies to uniquely identify objects over long distances. RFID comes in a variety of forms all over the world. RFID tags are divided into two types: active tags and passive tags. It also includes a reader/writer, an antenna, and a computer host. Because an active tag has its own power supply, it has a greater reading range. A passive tag lacks a power supply, has a shorter reading range, and is powered by an external source. Interrogator is another term for RFID reader. This is located at the toll gate where vehicles pass through. RFID readers include an RF module that serves as both a transmitter and receiver of radio frequency signals. RFID readers generate a signal in order to receive data from tags. This signal is sent to a computer, which contains a GUI (Graphical User Interface) and a database of all users. The ID number on the tag is compared to data in the database, and the toll tax is deducted. The microcontroller and computer system are linked so that the microcontroller displays the deposits on the LCD screen and opens the gate. [1]

People in the twenty-first century live lives that are entirely dependent on technology. New innovations are developed to make our lives less demanding, calmer, and more pleasurable. The primary goal of advancement has been to increase capability while decreasing effort. The world is rapidly approaching automation in the current scenario. Automation is the use of various management systems to run instruments such as machinery processes in factories, boilers, and heat-treating ovens, change on telephone networks, steering and stabilisation of ships, craft, and various applications and vehicles with potentially reduced human intervention and improved accuracy. Highways or toll roads are built to improve traffic flow, the distribution of goods and services, and people's mobility and accessibility. The issue arises when there is a long queue. This queue forms because the rate at which vehicles arrive at toll gates is much higher than the rate at which they are serviced. This congestion will result in wasted time waiting, incendiary fuel combustion, and air pollution from vehicle exhaust. The use of an automated toll collection gate will help to improve toll service by saving time, fuel, and lowering gas emissions. The RFID reader in the proposed system will read the RFID tags mounted on vehicles, and the system will automatically deduct a specific amount of toll from the scanned tag id using the database. Because there is no need for vehicles to stop or toll authorities to manually collect tolls, this system eliminates traffic jams and potential human errors that occur in a toll collection system, making it a more efficient process. [2]

DESIGN AND HARDWARE IMPLEMENTATION:

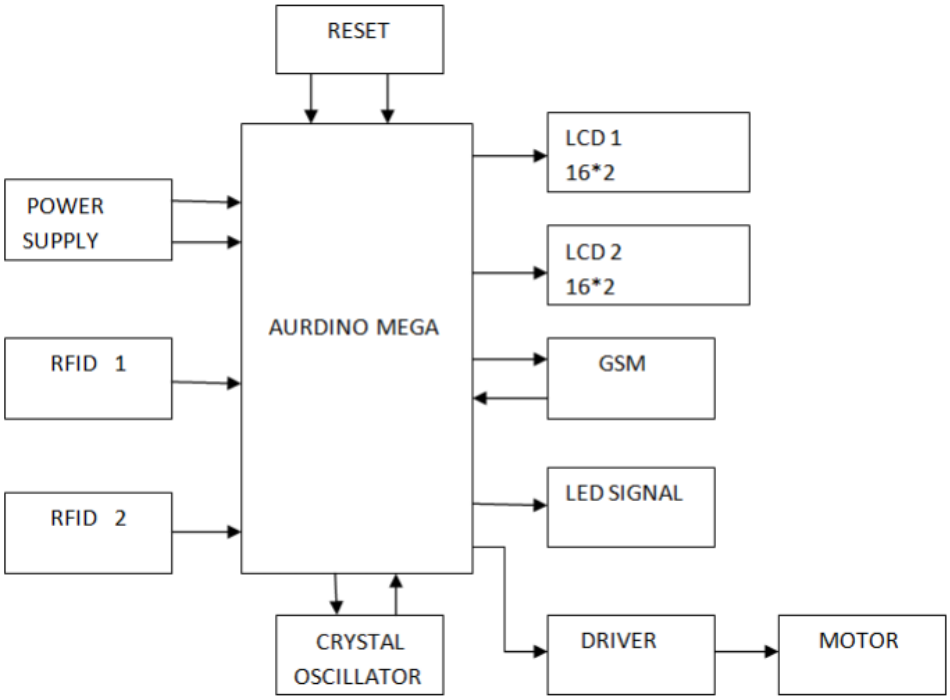


Figure 1: Automatic Toll Gate Billing System's Block Diagram

The microcontroller used for this project is the Arduino Mega R3 2560. The ATmega2560 microcontroller is at the heart of the Arduino Mega R3 2560 board. It is the most critical component of our system; all processing occurs in this block. Different microprocessors and controllers are used in various Arduino models. The supplied board has numerous pins that can be used to communicate with various appliances and boards.

LCD Display (16*2): An LCD is an electronic screen module that generates a visible image by using liquid crystal. This 16x2 LCD display is a fundamental module that is widely used in a variety of systems and circuits. The LCD's job will be to display all system generated messages from the controller. These multi-section modules are preferred over 7-section modules and other LEDs. This LCD has two registries: Command and Data. The LCD command register primarily stores the LCD's instructions, whereas the information register allows the information to be displayed on the LCD.

Motor: A servomotor is a rotary or linear actuator that allows for precise angular or linear position, acceleration speed, and control. In conjunction with a sensor, it is an appropriate position feedback engine. A motor driver is an integrated circuit that is used to drive a motor. We also use it to pull up and down the passing door at the toll square. It is a 3-pin energy engine with cable control and hardware mounting. It rotates through 180 degrees. [3]

EXPERIMENTAL SET UP :

We have created a suitable computerised Toll Collection System in our proposed model. The RFID-enabled car licence plate is assigned to the system. Our Digital Toll Plaza prototype is made up of an Arduino Mega, an RFID reader, a display, and a servo motor for the toll gate. To run the system of our toll plaza, we used the Arduino IDE programming language.

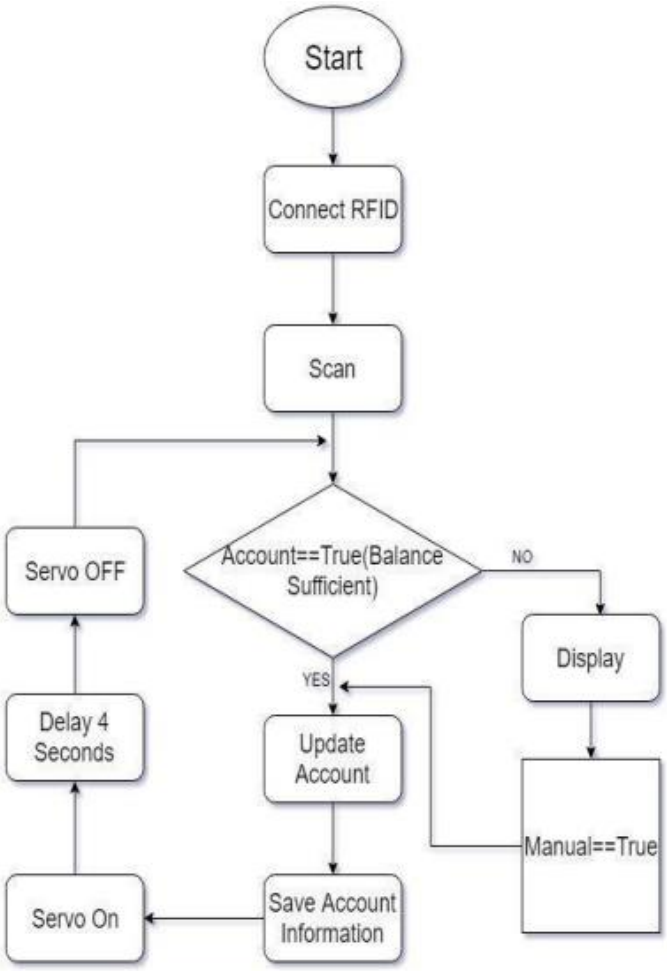


Figure 2: Block Diagram of the System

For vehicle information, we manually implanted the RFID tag in the demo car. Before implementing the project, we scanned each RFID tag to determine the unique ID and saved it in our system's database. We only included the RFID number and balance information in the database in our prototype. When the project is completed, there will be detailed information about the vehicle, such as its weight, model, and tracking system. In the proposed model, the vehicle passes through the toll plaza and an RFID reader reads information about the vehicle's balance using an RFID tag. If the vehicle has a sufficient balance in its account, the toll money has been deducted and the balance in the database has been updated. The RFID number and the text "Go forward" are displayed on the LCD display after scanning. The toll gate then opens for 4 seconds with the assistance of a servo motor before closing.

If an unfortunate occurrence happens that the vehicle does not have sufficient money in its account, the toll gate will not open and display shows "Access Denied, go left". A manual toll collection booth is located to the left. The vehicle must pay there and have the database updated with a warning to maintain sufficient balance. Meanwhile, other vehicles can pass through the toll gate without causing a traffic jam. [4]

OBJECTIVES:

1. To study of Automatic Toll Gate Billing Systems.
2. To analysis of the Smart Toll collection system works with low cost, high security and efficiency.
3. This system mainly focused upon research and development work for toll tax collection at toll gate on highway with help of RFID technologies.

REVIEW OF LITERATURE:

The design and analysis of an automatic check point and fast track toll system using RFID and a GSM module with a security system is presented in this paper. This paper proposes an electronic toll payment system that is very flexible and automates the verification process of vehicles passing through tolls. In this paper, they used an AT mega 328 Arduino microcontroller with GPS and GSM built in. This ideology can alleviate the common annoyance of bouncing the edit action at the check post and reduces manpower.

Venkatesh Suvarna and Jeet Patalia described one of the automated toll collection systems that uses RFID technology to collect toll taxes automatically. According to Saurabh Narkar, Ankit Hendre, Sunil Redekar, and Pranay Targe, RFID-based toll gate systems provide a solution for manual toll collection at toll gates, and because time and efficiency are more important these days, automated toll plaza systems are more useful. According to Ganesh K. Andurkar and Vidya R. Ramteke, RFID-based technology is used in this RFID system, which uses RFID tags and RFID readers to collect all information and automatically debit the toll amount, reducing human error and traffic congestion. They also determined that this is applicable to the environment, such as traffic congestion and congestion in toll areas, which benefits both toll authorities and toll customers. [5]

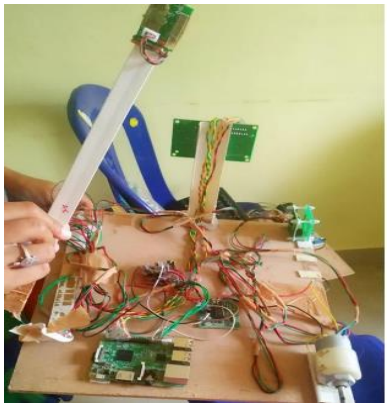
RESEARCH METHODOLOGY:

According to the author of this paper, the primary goal of this research and development project is to create an automatic toll collection system using RFID. Create an automatic toll plaza based on a GPS system to save time at the toll plaza and have a cashless operation. Tran score technology is used in the ETC system, which is based on the E-PASS system. It reads by receiver and automatically deducts the balance from the account. The most significant impacts are the development of sustainable technologies to reduce traffic congestion and save energy and time.

Books, educational and development journals, government papers, and print and online reference resources were just a few of the secondary sources we used to learn about the components, application, and impacts of an RFID-based Highway Toll Tax Collection System.

RESULT AND DISCUSSION:

The Smart Toll Collection System performs as expected; it is low in cost, secure, and efficient. All toll stations' noise and pollutant emissions have been greatly reduced, and an anti-theft solution has been designed. [6]



We can use this to improve the efficiency of the toll collection system. This method also reduces the amount of manpower required for toll tax collection. RFID technology is the most advanced of all automated technologies. This system was primarily focused on research and development work for toll tax collection at highway toll gates using RFID technologies. It has a much higher tracking capacity than the current system.

Figure 3: RFID based Toll gate system

RFID will not replace bar codes, but it will provide additional functionality. It includes features such as an efficient method for storing and analysing data, collecting toll taxes, and managing them. It supersedes the manual data entry system and inspires new technology. This system is only intended to provide solutions to all traffic and toll plaza-related issues. Using a large LCD

(Liquid Crystal Display) screen, motorists can also learn the total cost of the new road and the validity of the toll plaza. [7]

CONCLUSION:

We can have the best solution to traffic jams and time waste by doing this automatic toll tax collection based on RFID technology. We can make efficient use of this. This method also reduces the amount of manpower required for toll tax collection. RFID technology is the most advanced of all automated technologies. This system was primarily focused on research and development work for toll tax collection at highway toll gates using RFID technologies. It has a much higher tracking capacity than the current system. RFID will not replace bar codes, but it will provide additional functionality. It includes features such as an efficient method for storing and analysing data, collecting toll taxes, and managing them. It supersedes the manual data entry system and inspires new technology. This system is only intended to provide solutions to all traffic and toll plaza-related issues. Using a large LCD (Liquid Crystal Display) screen, motorists can also learn the total cost of the new road and the validity of the toll plaza.

REFERENCE:

1. Venkatesh Suvarna and Jeet Patalia, "A Review on Various RFID Based Automated Highway Toll Collection Systems" Computer Engineering Department, NMIMS MPSTME, Mumbai, India.

2. Sodikin, Bambang Riyanto, and Bambang Pudjianto, Kajian Masalah Antrian Pada Sistem Pengumpulan Tol Konvensional Terhadap Rancangan Sistem Pengumpulan Tol Elektronik. Semarang: Universitas Diponegoro, 2005.

3. Myke Predko, Programming and Customizing the 8051 Microcontroller, Edition 1999, Tata McGraw-Hill, Page: 157-167.

4.Chawla, V., & Ha, D. S. (2007). An overview of passive RFID. IEEE Communications Magazine, 45(9), 11-17.

5. Ganesh K. Andurkar, Vidya R. Ramteke, 'Smart Highway Electronic Toll Collection System' Assistant Professor, Dept. of Electronics and Telecommunication, Govt. College of Engineering, Jalgaon, North Maharashtra University, Maharashtra, India, Student of Fourth Sem M.E., Dept. of Electronics and Telecommunication, Government College of Engineering, Jalgaon, North Maharashtra University, Maharashtra, India

6. Sodikin, Bambang Riyanto, and Bambang Pudjianto, Kajian Masalah Antrian Pada Sistem Pengumpulan Tol Konvensional Terhadap Rancangan Sistem Pengumpulan Tol Elektronik. Semarang: Universitas Diponegoro, 2005.

7. Bahubali Akiwate, Manjunath Suryavanshi, Mallappa Gurav ,"Automated Toll Collection "Department of Computer Science and Engineering, K.L.E College of Engineering and Technology, Chikodi, Karnataka, India.