IoT Based Digital Toll Collection System :Using RFID

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Abstract— The human toll collection technique has resulted in a significant increase in traffic on the roads in major countries. thus this highlights the necessity of creating an effective automated toll system for applications that require real-time processing. This study will properly investigate the toll area found within a bridge. The registration details of the car and the driver will normally be recorded within the data table included Within the suggested prototype. The first toll payment can be collected using The suggested system for digital toll collection, which also offers an accommodating framework for the system for managing tolls. The study-based undertaking makes use of a confirmation of accuracy that is roughly 95.4%. The outcome of this strategy Within the Bridge will assist authority in correctly collecting *toll revenue from each mode of transportation.*

Keywords: RFID, reader, IoT, ARDUINO, time utilization, and automatic toll collecting.

Introduction

In modern times, traffic congestion on bridges with tolls is regarded as a major obstacle for drivers. Toll traffic is a nuisance that we encounter on a daily basis in many countries. The primary cause of traffic congestion is manual fare collecting. In order to solve this issue, this research study presents an autonomous method of collecting tolls toll collection system that uses RFID technology based on Arduino to help ease traffic congestion. Travelers are also permitted to pay the toll with a credit/debit card and Bkash in addition to having the amount deducted from the owner of the vehicle's bank account. many country's is experiencing an IoT revolution these days. This country's is developing at a never-before-seen pace in the information technology sector. A digital nation where toll revenue collection provides the majority of the nation's economic support.

Digital systems and associated technologies are still used today. not present in the toll management system domain. If the toll management system site is to grow along with IoT, then more IoT applications need to be provided in this area. In this industry, traditional approaches for identifying issues and determining potential solutions are quite complex. AI systems will make it easier for them to identify the car. This Create a smart card-based, Internet of Things-based digital toll collection system to reduce wait times at toll booths. The primary focus of our project is "Digital Toll management system," as the name implies. This study aims to explore the definition of automation. Automation, to put it simply, is the process of substituting a machine for a human worker in order to reduce the amount of labour required while also saving more money and time.

RFID is regarded as a key concept in the Internet of Things (IoT) in current digital age. The current toll collection zone will be developed with the aid of IoT application. To provide a suitable response, it is vital to learn about the issues and relevant specifications in this industry. Government policies, rules, and software industry specifications must be understood in addition to the course methodology that must be used in the area used for toll collecting.

Through conducting a brief study on authority and drivers, This study can pinpoint the problems with toll regions and the Internet of Things that continue to be a potential obstacle to reducing traffic congestion.
Below are some of the primary inquiries related to this thesis:

- What is the current status of transportation and how is the Internet of Things being used in Bangladesh's toll industry?
- What limitations exist for leveraging IoT in the toll sector to reduce traffic jams?
- How can the limitations of the toll system be overcome to reduce traffic congestion?

The use of a digital toll management system has some advantages.
The use of IoT has certain technical and commercial goals. This study creates an effective model for toll collection in an automatic manner. Additionally, by employing the suggested paradigm, this research project hopes to motivate hardware and software developers to collaborate with the Internet of Things. The development of the hardware model, the excel sheet, and the automated record-transport information system come next.
Recognizing this pressing issue, a burgeoning wave of innovation fuelled via which the Internet of Things (IoT) has begun to reshape the landscape of toll management systems, promising to revolutionize the way tolls are collected, processed, and managed. At the heart of this transformation lies the integration of RFID technology, Arduino-based automation, and digital payment solutions, offering a glimpse into a future where congestion becomes a relic of the past.

This research endeavor seeks not only to address the immediate concerns surrounding traffic congestion but also to delve deeper into the multifaceted intersection of transportation infrastructure, digitalization, and economic development. By exploring the utilization of IoT within Bangladesh's toll industry, this study endeavours to shed light on the current state of transportation and unveil the untapped potential for technological intervention.

Through a comprehensive analysis of the challenges and constraints hindering the widespread adoption of IoT in toll management, this research aims to chart a course toward innovative solutions that transcend traditional boundaries. By elucidating the regulatory landscape, technological requirements, and stakeholder dynamics, this study endeavors to pave the way for a more efficient, equitable, and sustainable toll collection ecosystem.

Moreover, beyond the realm of academia, this research aspires to catalyse practical advancements by fostering collaboration among hardware and software developers, policymakers, and industry stakeholders. By conceptualizing and prototyping an integrated model for automated toll collection, this endeavor seeks to inspire a new wave of innovation that not only mitigates traffic congestion but also unlocks new avenues for economic growth and societal advancement.

In essence, this research project serves as a clarion call for transformative change—a call to embrace the boundless possibilities of IoT, automation, and digitalization in reimagining the future of toll management systems. Through collaboration, ingenuity, and a steadfast commitment to progress, we stand poised on the precipice of a new era—one where traffic congestion becomes a relic of the past, and the promise of a seamless, connected transportation network becomes a tangible reality.

LITERATURE REVIEW

There isn't comparable research or work done in many countries to completely eliminate traffic jams on toll bridges. The current status of the toll management system and its application to Internet of Things-based automated toll management systems thus provide the background.
Almost all developed nations have they have improved and eased people's quality of life in tandem with the nation's progress.
They can pay with cash if they don't have a prepaid card. In addition, they calculate the daily frequency of vehicles, all of which is kept in a database. a method that uses radio frequency identification (RFID) and a mobile application. The amount deducted from the owner's account when goods trucks visit the toll booth is based on the weight of the vehicle. If more stuff is put in the car, more money will have to be paid. An automobile that has been stolen can be identified. They also use the piezoelectric sensor in the car to recognize the RFID of colliding vehicles.

Open Road Tolling (ORT) has the capability to identify license plates. Because there is no need for the car to stop or wait to pay the toll fee, toll booths allow for quick toll collection. with a purchasing card or cash. In order to make it easier to verify them later, if necessary, they also recorded video. The benefit of their quick and easy strategy. They have employed cloud computing and RFID, or radio frequency identification. The driver going to be able to use the mobile app to pay for all of his toll taxes under this arrangement. The driver will save money and time by doing this. A system known as image processing was mentioned by Shoaib Rehman Soomro et al. (2012) [6]. makes use of potent algorithms to identify.

This approach will first identify the vehicle and take a picture of its front license plate. As soon as the picture is taken, everything that belonged to the owner of the vehicle will go the toll and have the toll tax taken out of their account.
Their primary goal was using the Smart Pole System to lessen traffic congestion. This technology effortlessly maintains both the toll gate and traffic control. It furthermore offers an emergency lane for use in an emergency. This design also automatically manages barricades and lighting, protecting against floods brought on by strong rains or other natural calamities.
Any car that poses a threat or is stolen is automatically detected by the toll booth, which then captures it. On the e-toll management system, numerous researchers have conducted studies. Every paper has been discussed here. method for managing tolls.

The benefits of bypassing the toll booth include emphasized in order to avoid being a victim of pain and time. Bangladesh sees a serious threat from growing corruption in the toll collection industry, which has put the government at risk. The majority of drivers steal toll money, which has an effect on our economy. Although our government constantly works to assist the citizens of our nation in reducing corruption and traffic congestion, our toll management system lacks smart technology. The government is not devoting enough time and resources to studying our traffic bottleneck in toll management issues, particularly issues with manual toll collecting.

METHODOLOGY

The primary foundation of the proposed research project is IoT technology. This work was completed using the matrix method and the C++ language. Furthermore, instruments such as sensors, bread board, wire, resistor, Arduino, RFID, servo motor, and so forth. If the flow diagram for the project is taken into account, it has been noted that the sensor will identify the vehicle when it first reaches the toll plaza.

This is where the user can input their card details on the RFID module. RFID checks the balance and ensures that there is sufficient funds on the card to determine whether it is authentic. after balancing, takes the balance. When the payment is confirmed, the servo bar opens, allowing the driver to access the vehicle.
If the card is not valid, an additional message appears requesting that you enter a valid card; if you do so, the vehicle will immediately access and function. If the card is not sufficiently funded, a message appears on the screen advising the user to check the balance. Once the amount and payment have been verified, the sensor detects the vehicle, allowing the driver to proceed.

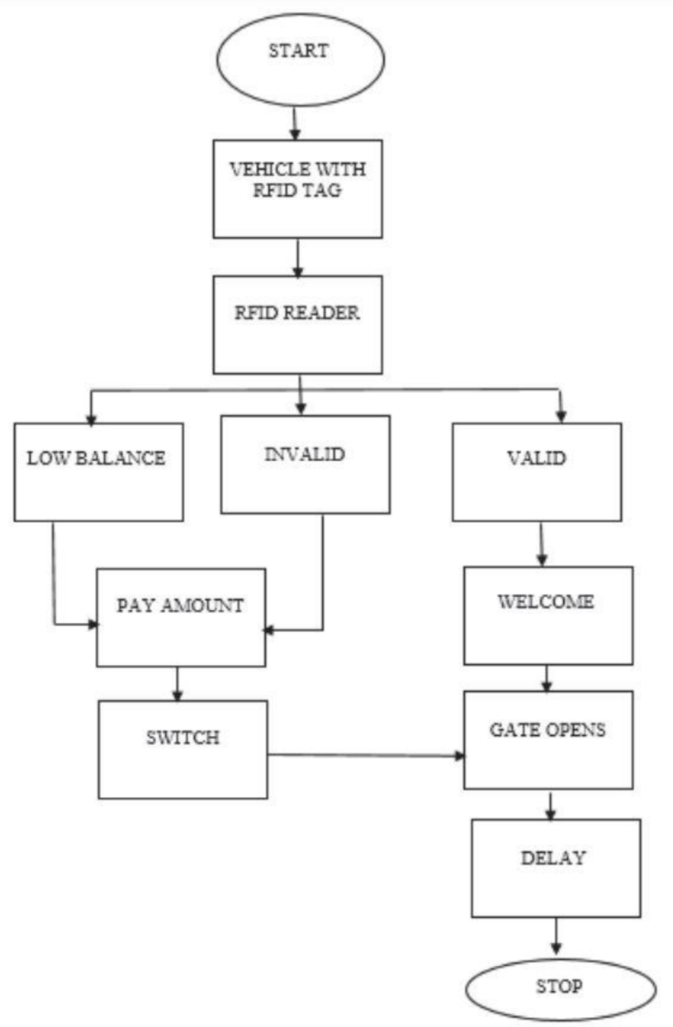

Figure 1: Automatic E-Toll Ticketing Flowchart

RFID is mostly used to read data and identify users. RFID is made up of two different structures: the RFID tag and the RFID reader. RFID is a widespread gadget that may be found in every robotics lab, electronics store, and really affordable prices. There are two different kinds of RFID tags: active RFID tags and passive RFID tags. It makes use of a transponder and a transceiver to read data.

Transceiver work is used to read values, and transponder work is mostly used to identify objects. The term "passive tag" refers to a transceiver, while "active tag" refers to a transponder.
An electronic microchip located in the antenna of an active tag transponder allows it to be detected hundreds of meters away by a passive reader known as a transceiver. The transponder also has its own tiny battery. RFID is among the procedure for data reception and automatic item identification. The receiver uses the appropriate antenna to communicate with a tag. Recent discoveries have indicated widespread use of this radio frequency detection, which served as the basis for advancement.

Arduino Microcontroller:

Arduino is the name of an open-source microcontroller board. The 32 KB capacity of this microcontroller must be used for store resets, leaving 2 KB available. The input voltage is 5v and the operational voltage ranges 6 to 20V, whereas recommended 7–12 V is the input voltage. Six of the analog input pins (A0-A5) give PWM output, whereas pin 14 is a digital input pin. It has a few unique pins, such as the digital pins MISO (master-out), SS (slave select), SDA (serial data), and SCL (serial clock). It is connected to the power supply via a USB port.

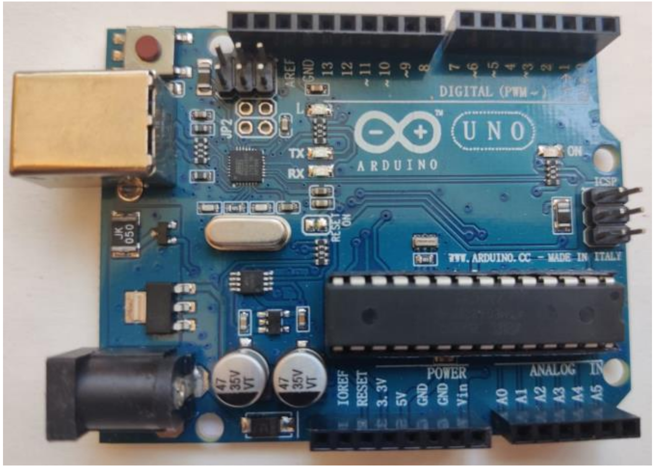

Figure 2: An Arduino Uno

Wi-Fi Module:

Computers and other devices can interact with one another using Wi-Fi. The microcontroller depicted in Figure.

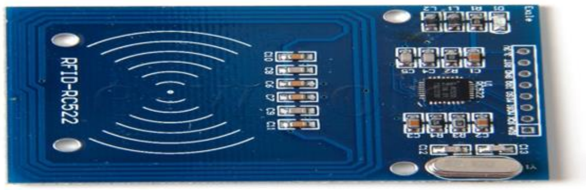

Figure 3: RFID Module with Wi-Fi

IR obstacle sensor:
This little detector blinks red and green lights to identify objects. The sensor is believed to be able to detect the object when the red light crosses the signal. Upon the flashing of the green light, the system has successfully operated. Its detecting range is between 2 and 40 cm.

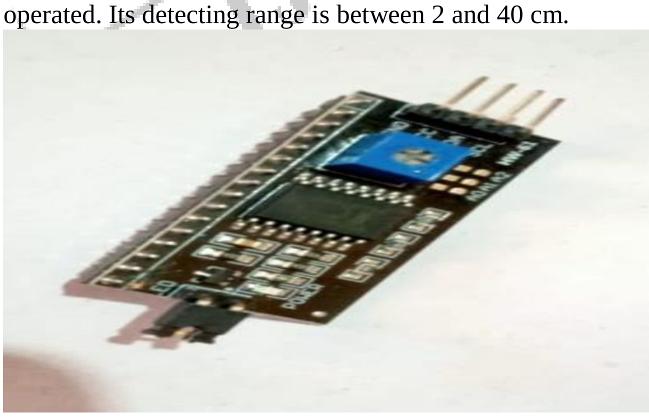

Figure-4: IR Obstacle Sensor

2 by 16 LCD screen:
LCDs (liquid crystal displays) have two lines and sixteen characters per line. It uses a parallel interface with 14 or 16 pins. The operational voltage threshold (4.7) to 5.3 volts.

Figure-5: A 2 by 16 LCD display

4 by 4 Keypad:
This type of keypad makes use of the matrix system and includes 16 buttons, 4 of which are rows and 4 of which are columns. Pins (1–4) indicate the first to fourth row, and pins (5-8) indicate the first to fourth column.

Figure-.6: 4*4 Keypad

Buzzer:

It functions as an alarm or beep sound, and if an RFID card is detected, a beep sound is produced automatically. With just two pins in the buzzer, it converts audio signals into sound signals.

Figure 0.7: Buzzer

10 k Potentiometer:

It is exclusively utilized to adjust the display's resolution. Three pins have been used.

Servo Motor:

A servomotor enables the correct handling of acceleration, velocity, and position—angular or linear. It can be a linear actuator or a mechanical position actuator. It has a device location reaction in addition to a functional motor. Simultaneously, it needs a relatively expensive controller—an eager module made especially for servo motors. Compact, light, and powerful output power. Even if the servo is smaller than the typical type, it will still function if you rotate it 180 degrees (90 degrees on each side).

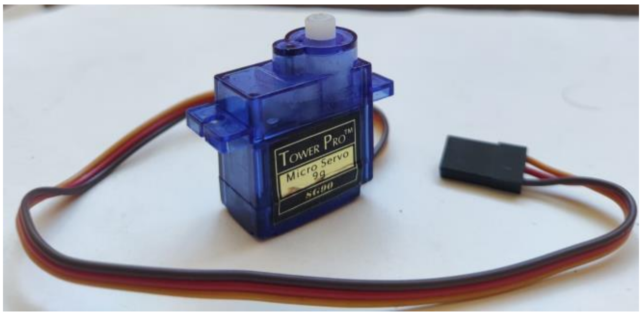

Figure-8: Servo Motor

PERFORMANCE OF THE PROPOSED MODEL

If we look at our project workflow diagram, we can see that when a car enters a toll plaza, a sensor detects it, and an RFID module reads the ID number to see if it is registered or not. If it is, the RFID checks the balance to make sure it is sufficient, and then it deduces the balance. The traffic gate will open when the balance display deposit appears on the LCD, and When a vehicle is detected by the IR sensor, it will close. When a register card is used, RFID is read once again. If the card has enough balance, it can update the balance on the LCD. If the card is not registered, it cannot be accessed.
We successfully tested our project model and had excellent results. Our outcomes were effective. Our project's model will be far more beneficial to our nation. Our model can recognize that the companion card has been recognized by the vehicle transaction from the very beginning.
The model for our project takes a maximum of five seconds to record the information about each vehicle and handle payment. This model can capture driver information such as name, date, vehicle number, time, and ID number; the information can be easily found by the government if they wish to search car data. When comparing our project to a manual project, we concluded that it performed better since it.

EXPERIMENTAL RESULTS AND DISCUSSION

Using this strategy, we obtained the best accuracy. Our work accuracy has produced 100% good results. It is evident from Table 1 that our result is accurate. [2] With E-tolls, numerous researchers have collaborated. Five parameters, for example, the name, car number, date, time, and user ID, are used in this table. When a car pulls into a toll plaza and the driver punches utilizing RFID in the card, the device reads the data and transfers the information to an Excel sheet via a Wifi module. This allows it to gather information such as the date the driver punched the card, the precise moment the payment cleared, original name of the driver that they use when registering at the bank, the vehicle's registration plate number, and their User ID This table makes it simple for the toll organizer to locate the record information if someone ever needs to look for information. To make using E-Toll simple and lovely for our nation, we have made it possible.

CONCLUSION

A design strategy for the RFID-based Electronic Toll Collection system in the expressway was proposed. It is inexpensive, highly secure, efficient, and has far-reaching communication. It raises the standard of charge for technology while also making the expressway easier to traverse. RFID-based electronic toll collecting systems are a useful tool for cutting fees and management expenses while also significantly lowering toll station noise and pollution emissions. Real-time toll collection and an anti-theft solution system are built into the proposed Electronic Toll Collection (ETC) system. As a result, there are less manual labour hours and delays on the highways. In addition to being environmentally beneficial, this toll collection method expands the capacity of the toll lane. Additionally, the implementation of an anti-theft solution system module ensures road safety by preventing any vehicle that is in default from passing.

FUTURE SCOPE

1. Automatic Vehicle Identification: This system's automatic vehicle identification (AVI) component describes the technologies that establish a vehicle's identity or ownership in order to charge the appropriate consumer for the toll.
2. Automatic Vehicle Classification: Different toll amounts may apply depending on the type and class of vehicle. Light vehicles, such as passenger cars, and large vehicles, such as recreational vehicles, are examples of the different vehicle types. The physical characteristics of the vehicle, the number of occupants, the number of axles, and the purpose of usage at the time of classification all contribute to the classification of a vehicle.

3. Video Enforcement System: The video enforcement system (VES), which is utilized for electronic toll collection, takes pictures of license plates of cars that drive through an without a working electronic tag at an electronic tollbooth. While there are significant upfront costs associated with the deployment of these technologies, there are also significant returns on investment. These advantages are covered in the section that follows.

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