

Automatic Toll Tax Collection System

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Abstract— The toll tax collection system using RFID and Arduino is a type of automatic toll collection system that uses radio frequency identification [RFID] technology to identify and charge vehicles for using toll roads. The system consists of RFID tags, the RFID reader that are installed at toll plazas and an Arduino microcontroller that acts as a gateway between the RFID reader and servos (gates). when a vehicle passes through the toll plaza, The RFID reader reads the tag deduct the amount and automatically opens the toll gate.

Keywords— **TOLL TAX, RFID, ARDUINO, SERVOS**

I. INTRODUCTION

A Toll Booth is a counter on a toll road where the driver should stop the vehicle to pay the toll taxes and drive any further. Toll roads are located on the national and state highways where we can see the toll booths. As we all know, transportation is an essential component of every country's economy [1]. Improvements in transport networks lead to a better way of living in which we have incredible freedom of movement, massive business in manufactured products and services, and a greater rate of employment and social mobility. In reality, the economic state of a country has long been linked to effective means of transportation. The increased number of automobiles on the road causes a variety of issues such as traffic congestion, accident rates, air pollution, and many more. All economic operations employ various modes of transportation for various tasks. As a result, boosting

transportation has an immediate influence on national and economic output. lowering the cost of moving resources at manufacturing locations and transportation [2] Improvement in transportation leads to a decent lifestyle that give us remarkable flexibility for movement. In toll plaza we see much traffic due to delay in toll tax collection, so the toll lines are splitted even though the waiting time for the traveler is more, to overcome this problem we have designed a toll tax collection system in this project RFID reader reads the tag by the Arduino system then the amount is deducted from the RFID account and opens the tollgate automatically.

The advantages of this system include:

shorter lines at toll plazas due to increased toll booth service rates

faster and more efficient service.

The capacity to make payments by maintaining a balance on the card and use of postpaid toll statements

Other general benefits include decreased fuel waste and emissions by lowering deceleration rate, waiting time of vehicles in queue and acceleration. In the case of Toll [2]

II. LITERATURE SURVEY

In early days the toll tax is collected manually but

this method consumes lot of time for the traveler, and it also require much manpower. It leads to traffic in the toll plaza, so the fast tag system was implemented. In this automatic toll tax collector, no manpower is needed at the toll plaza, RFID reader reads the tag by the Arduino system when the amount is deducted from the account the tollgate open itself without the support of any humans.

The Toll collecting System has evolved dramatically over the years, from a single boundary and a tiny passing booth to a massive toll collecting infrastructure that plays an important part in income production as well as the operation of a city or even a state's traffic. While the bulk of the population travels by diverse ways, traffic management has become a requirement and regulatory mechanism [8]

"Automatic toll gate system"

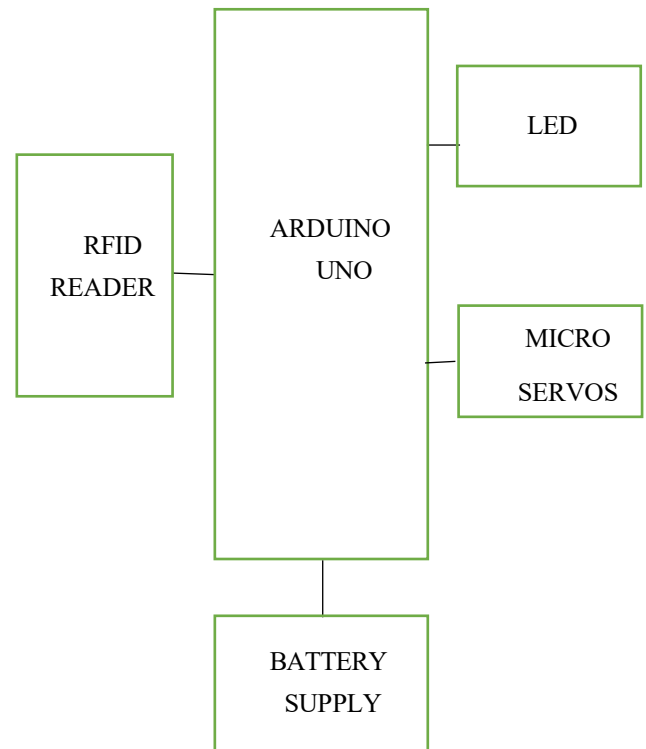
T Madanmohan, V Keerthi, S Prathap, M Bhanuchandra are explained automatic toll gate system, in this the raspberry pi system is used when the vehicle enters the tool booth the name plate details captured by the camera, if the vehicle is registered then the toll gate opens automatically.

"Automatic toll tax collection system using cloud database" According to E. Khan, every car in this system is equipped with an RFID tag that contains the vehicle's registration number and is read by a sensor. It will transmit this data to an IoT controller and a cloud database where toll fees are immediately subtracted.

"Automatic toll tax collection system using NFC." Ms. Hafis Muhammed N F, Ms Sreereng Ravindran, Ms Shivadeep Shetty, Ms. Vinit Shetty explained, in this vehicle are provided with the NFC tag which are having a different identification number, which is provided by the toll authorities. In this the NFC tag is read by the NFC reader installed at the toll plaza the NFC reader send the scanned details to the server for verification according to the type of vehicle the amount is deducted, and the gate opens.

"An Automatic Toll Gate System using VANET" In this Biswa Ranjan Senapati, Pabitra Mohan Khilar, and Naba Krushna Sabat explained that to minimise average waiting time per vehicle and TST, an automated toll system using vehicular ad hoc network (VANET) is suggested. The proposed routing protocol is compared to the existing VANET routing protocols, Geographic Source Routing (GSR) and Anchor based Street Traffic Aware Routing (A-STAR), in terms of generic network metrics such as End-to-End latency and TST

III. BLOCK DIAGRAM



A. ARDUINO UNO

Arduino is a microcontroller which is based on the ATmega328P. It has 14 digital input/output pins in which 6 can be used as PWM outputs and 6 are analog inputs and the others are 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and finally reset button.

Arduinos are used in different projects and applications. The Arduino software is easy for the beginner, and it is also flexible enough for advanced users. It runs on Mac, Windows, and Linux.

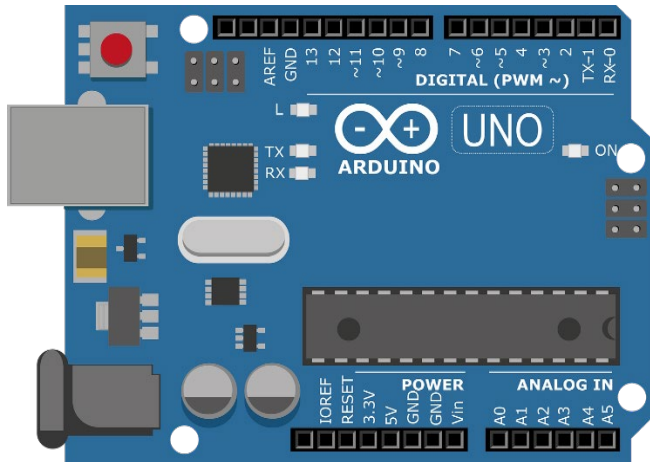


Fig3.1:Arduino uno

B. Micro servo

It is one of the motor types that receives power from a DC source which may come from an external source or from a controller is known as servo motor. A micro servo motor sg90 is a compact, light-weight servo motor with high output power. It implies that the SG90 micro servo motor will use all of its effort necessary to finish the task at hand. Servo motors have a wide range of uses, including industrial automation, robotics, cameras, antennas, and telescopes. As the name SG90 suggests, a motor rotates from 0 to 180 degrees at intervals of 90 degrees. Servo motors feature a gear that regulates the motor's RPM to control its rotational speed and verify the torque.

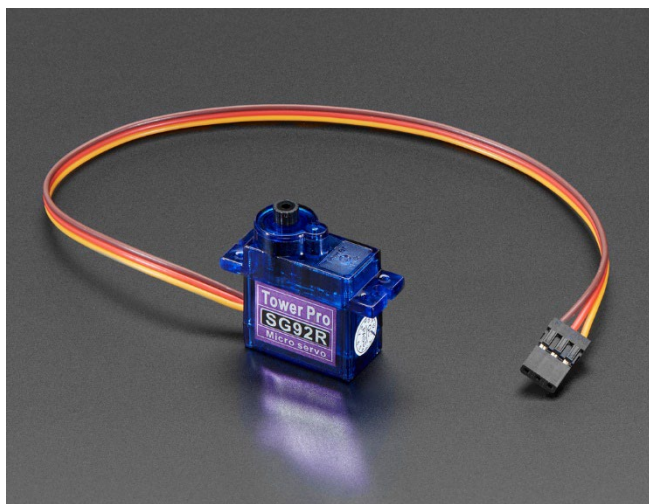


Fig3.2:Micro Servos

C. RFID module

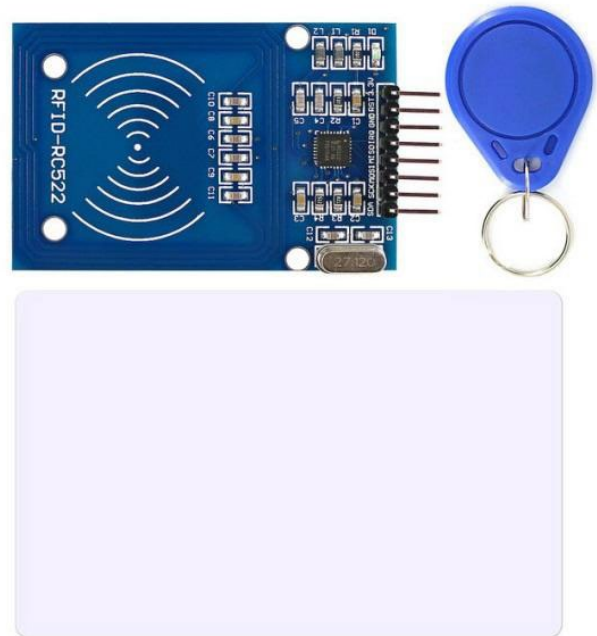


Fig3.3 RFID module

D. RFID Reader

Tags and readers are the two halves of the wireless technology known as Radio Frequency Identification (RFID). A reader is a machine equipped with one or more antennas that transmit radio waves and take in signals from RFID tags. Tags can be passive or active, using radio waves to transmit their identification and other information to readers nearby. The reader in this case powers the passive RFID tags, which are battery-free. On the other hand, active RFID tags are powered by batteries

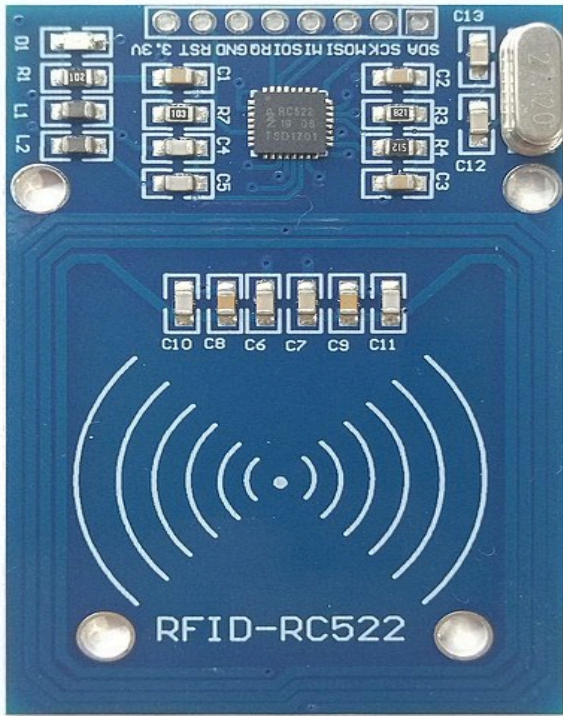


Fig3.4 RFID reader

The RFID tag is read by the RFID reader then the detail of the tag is given to the Arduino if the tag code is registered in the system, and the vehicle owner maintained the sufficient balance in that RFID account the amount is deducted on the basis of vehicle as a toll tax this is check by passing the signals from the RFID to the Arduino microcontroller then the positive signal is generated the green LED become on then the micro servos open the gate. If the tag code is not registered then the red LED becomes on, the gate remains closed.

IV. FLOW CHAT

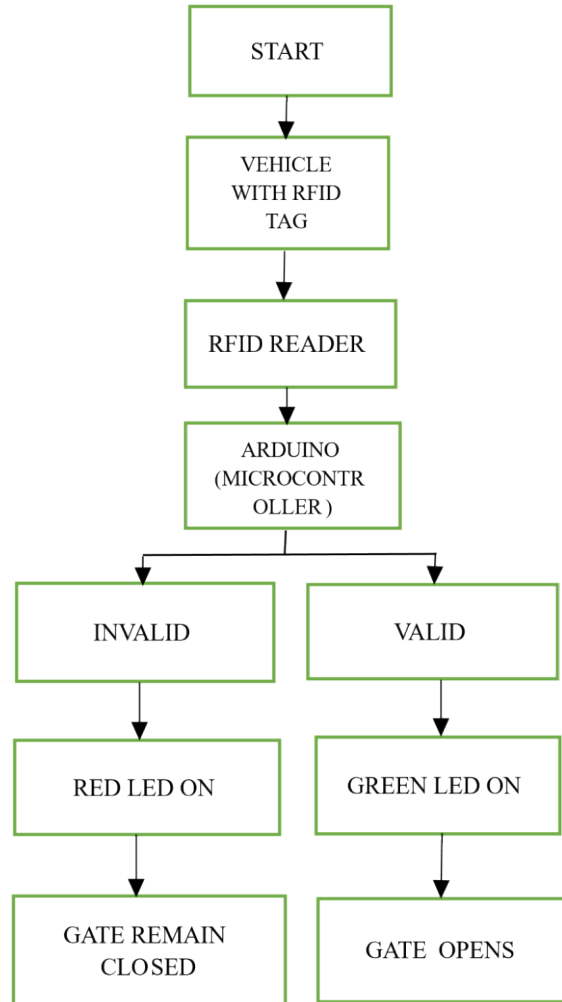


Fig4.1: Flow chat of Automatic toll tax collection system

V. BACKGROUND OVERVIEW

A. existing method

There are now two techniques of collecting taxes. The first is the classic manual approach, in which one person collects money and gives a receipt. The second option is the Smart Card technique, in which the user must show the smart card to the system established at the toll tax department in order for the gate to be opened.

B. Drawback of existing system

Both methods for collecting taxes discussed above are time intensive. There are opportunities to avoid paying taxes. It causes the following vehicles to queue up.[3]

C. List of current system disadvantages:

1) Managing toll information and data gathering is a demanding task.

- 2) The collected toll amount must be counted each time.
- 3) Manual input requires more time.
- 4) It is difficult to keep a large number of records manually.
- 5) Inaccuracy and mistake prone.
- 6) There is no way to track down specifics.
- 7) Human blunders[9].

VI. HISTORY

The beginnings of Tollgate Teashop may be traced back to the early nineteenth century. Built in 1818 as a turnpike for the Lambridge (near Bath) to Cirencester Turnpike Trust Road, its objective was to give a more secure method of collecting tolls than its predecessor, which was simply a gate. The road configuration has evolved over time, with the original gate located at the intersection of Sands Hill and Middletown Lane. Woe field Corner was named in the early nineteenth century.

The secondary study or research that follows was conducted to comprehend the fundamental needs and key studies of the past and current systems in existence. The research addresses fundamental questions such as what is toll collecting, why it is done, current toll collection methods, issues with each toll collection system, and, finally, the ultimate suggested solution for this project[11]

VII. RESULTS AND DISCUSSIONS

Si no.	system	Time required	Human errors
1.	Manually operating system	5 minutes	Yes
2.	Automatic toll tax collection system	1 minute or less	no

Table5.1: Analysis of manual and automatic toll tax collection

In the manual operating system the toll tax is given to the worker. They must enter the details of the vehicles manually after that, they open the toll gate this process consumes more than 5 minutes. In an automatic toll tax collection system less than 1 minute is enough because there is no manual work required. In manual operating system there is a possibility of human errors but in this no human errors occur, and the fuel consumption is also less compared to manual operating system.

VIII. BENEFITS AND APPLICATIONS

A. Benefits:

- 1) Tolls will be collected while the car is driving and there will be no need for the vehicle to halt.
- 2) Avoids long lines at toll booths.

- 3) It eliminates complications associated with modification with change because payment is made by card.
- 4) It saves you time.
- 5) Vehicle accidents can be recognised and quickly reported to the ambulance and police station.
- 6) Unregistered cars can be readily traced and the relevant steps taken.

B. Applications

- 1) The project may be used at paid parking lots in retail malls.
- 2) The proposal may be implemented in city parking lots.
- 3) It can be employed in an emergency police situation.
- 4) The project may be implemented in a garage parking system[4]

IX. PURPOSE

Radio-frequency identification (RFID) is an automated identifying technology that relies on during and retrieving data via RFID tags or transponder. The technique necessitates some degree of collaboration between an RFID reader and an RFID tag. An RFID tag is a small device that may be attached to or embedded in a product, animal, or human for the purpose of identifying and tracking radio waves. Some tags can be read from seven inters and outside the reader's line of sight. The purpose of a radio frequency identification and detection system is to facilitate missions by using a portable device known as a tag and an RFID reader; and processing it according to the demands of an application toleration mined with the assistance of an RFID reader[10].

X. PROBLEM FORMULATION

In manual toll tax collection system, there is a problem of human errors, time consumption is lot inrush of queues. In order to overcome all these problems an automatic toll tax collection system is designed.

There is a huge difference between manual and automatic toll tax collection systems. The survey is done by Karnataka government in the year 2012 on the toll collection they have proposed to get the tax of 2500 crores/year but in reality, they only collected 900 crores [2], from this survey we can clearly see the difference in the toll tax collection, this happens due to the human errors. Hence in this project RFID tag and microcontroller-based system is used, which leads the RFID tag and collect the amount from the customer account and opens the gate automatically. Therefore, it reduces the role of human work which causes the error, in the toll tax collection, as well it completes the process within 5sec.

XI. METHODOLOGY

Whenever anyone buys a vehicle, the first thing they must do is the vehicle registration in the RTO office. RTO workers will assign a number plate for the vehicle along with that they will give the RFID tag that is having a unique ID feasible to use

with that vehicle only. It is directly connected to the vehicle owns bank account to which the amount is deducted. And they create a separate account for that tag for the transaction history in database. vehicle owners should always maintain sufficient balance in this account. Whenever the registered vehicle come to the toll booth there we can see a RFID reader installed the traveler who is having the RFID tag has to put the card near the reader then the reader reads the card and if he maintained the sufficient amount then it automatically detect the toll tax and the toll gate opens automatically in this process traveler should not need to wait for the toll collector and the data on the toll collection by that vehicle is stored in the data .

XII. FUTURE SCOPE

1) Furthermore, in the future, new functions like as overspeed detection and prevention, overload indication and prevention in bridges, tracking stolen or involved in an accident, and so on, may be added to the system, making the transportation system smarter and more safe. As a result, the suggested model can help to construct a digital and smart road transport system[12].

2) If the balance is not sufficient in the RFID account then the message is sent to the vehicle owner so that no further complications occur.

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