Ahsanullah university of science and technology

Department of Computer Science and Engineering

Project Report

Project Name: RFID Based Highway Toll Tax Collection System with Arduino

Course No: CSE3118
Course Title: Microprocessor & Microcontroller Lab

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Introduction:

In this project, we'll introduce you to the RFID module and Arduino-based Automatic Smart Toll Tax Collection System. There is a great hurry these days to pay the toll fee at toll plazas. Therefore, an automatic toll collector can be employed to lessen traffic and save time. The project's goal is to automatically recognize the RFID tag in a car and display the precise amount that must be paid in order for the user to pass the toll. The user can cross the gate if he pays the fee; else, he will be barred.

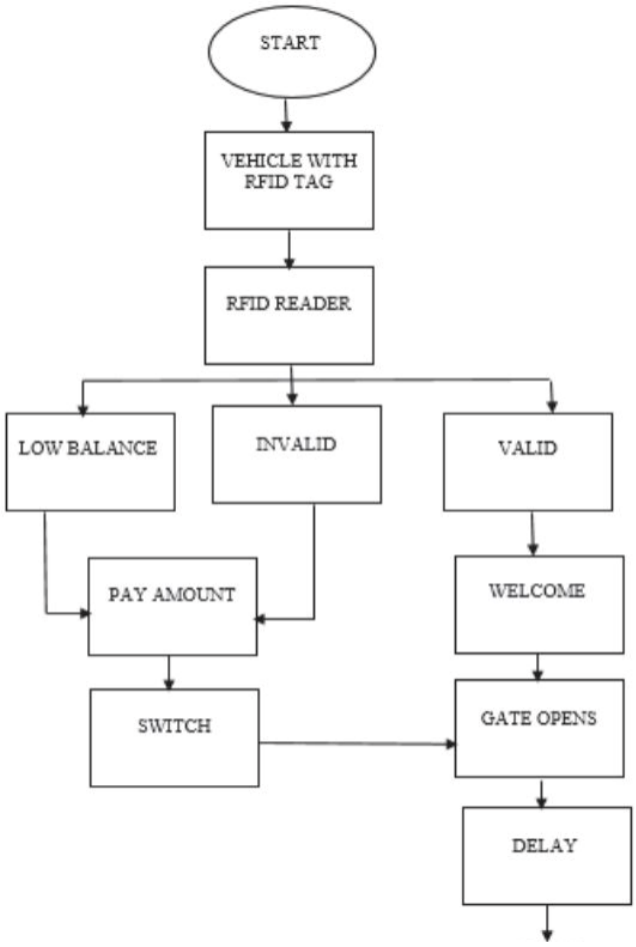
This project is a smart toll tax collection system demonstration. Think of the Toll Plaza as having n numbers of automobiles. The gate will close as soon as these cars pass through the IR sensor. The LCD will also indicate when it is time to insert the Card into the reader for scanning. After that, you can use RFID to pay a bill by inserting your card. Once the bill has been successfully paid, you can proceed to the 2nd Gate. The gate will open and let you through when a car passes the second IR sensor. If the card is empty, you can add money to it using this RFID and Keypad by typing the appropriate amount.

System Overview:

The Automated Toll Collection System employs an RFID reader to determine card validity and balance status. If the card is invalid or has insufficient balance, the LCD displays an "insufficient balance" message. Users can recharge their RFID cards using the keypad.

When a card is recharged, users gain access to pay and pass through the toll gate. The toll gate is controlled by a servo motor, which moves the gate spindle in fixed steps. Upon card swiping, the controller verifies its validity. If valid, the controller instructs the servo motor to rotate counterclockwise, opening the gate. The gate remains open briefly, allowing the vehicle to move. After a delay, the controller signals the servo motor to rotate clockwise, closing the gate.

Here is the Flow-Chart:



Social Values:

Automated Toll Collection Systems bring forth a multitude of advantages compared to conventional toll collection methods. Here are some key benefits that underscore their superiority:

1. **Eased Congestion**: By removing the need for manual toll collection, automated systems effectively mitigate traffic congestion at toll plazas, ensuring smoother traffic flow.
2. **Time and Monetary Savings**: Both drivers and toll operators reap time-related benefits. Commuters can avoid long queues, reaching their destinations quicker, while toll operators experience streamlined operations.

3. **Enhanced Efficiency**: Automated toll systems excel in transaction speed. Employing technologies like RFID, these systems swiftly and precisely scan transponder data, facilitating swift and seamless toll transactions.
4. **Augmented Safety**: The contribution of automated toll collection to improved highway safety, particularly during high-traffic periods, cannot be overstated.
5. **Optimized Revenue Collection**: Revenue generation for toll operators receives a boost through automated systems. By curtailing toll evasion instances and ensuring accurate collections, these systems play a pivotal role in revenue enhancement. Furthermore, they provide comprehensive transaction records and real-time data analytics, empowering effective financial management.
6. **Environmental Advantages**: Automated toll systems translate to environmental gains. Reduced traffic congestion and smoother vehicular movement lead to diminished fuel consumption and lowered carbon emissions.
7. **Integration with Smart Transportation Systems**: Automated toll collection isn't an isolated solution; it integrates seamlessly with other intelligent transportation systems. This interconnectedness enables flawless interoperability between toll systems, traffic management setups, and transportation infrastructure, thereby enabling superior traffic monitoring, incident management, and data interpretation.

So, automated toll collection systems offer a myriad of merits, spanning from congestion alleviation and resource savings to operational efficiency and environmental benefits. Their alignment with intelligent transportation systems cements their position as a compelling avenue for revamping and optimizing toll collection processes.

Required Components:

- Arduino Uno with atmega328P
- IR sensor
- Plastic geared Micro servo
- Jumper wires
- Mini Breadboard

- Lithium-ion battery with case
- Double Sided Tape
- Arduino programming cable
- A Piece of a popsicle stick
- RFID Reader
- RFID Card
- I2c Module
- 16x2 Serial LCD Module Display
- 4x4 keypad
- Button

Estimated Budget:

Equipment	Quantity	Budget(TK)
Arduino UNO	1	1000
RFID Reader	1	300
Micro servo	1	200
RFID Card	2	80
Breadboard	2	300
Double Sided Tape	1	60
Jumper wire (M-F)	2	150
Jumper Wire (M-M)	2	300
popsicle stick	1	10
Button	2	20
4x4 Keypad	1	150

9V Battery	1	100
15V Battery	1	100
IR Sensor	3	300
I2c Module	1	200
16x2 LCD Module Display	1	300
Total		**3570**

Working procedure:

An Arduino-based Automated Toll Collection System can be implemented using various components and sensors. Here is a simplified working procedure for such a system:

1. **Vehicle Detection:** Use sensors such as infrared sensors, ultrasonic sensors, or laser sensors to detect the presence of a vehicle approaching the toll plaza. These sensors can be placed at a suitable distance from the toll booth to ensure accurate detection.
2. **RFID Reader:** Integrate an RFID reader module with the Arduino board. When a vehicle is detected, the RFID reader reads the unique identifier stored in the RFID tag affixed to the vehicle's windshield.
3. **Transaction Processing:** The Arduino board processes the information received from the RFID reader. It retrieves the vehicle details associated with the RFID tag, such as the vehicle class and account information.
4. **Toll Calculation:** Based on the vehicle class and any additional parameters, calculate the toll amount using predefined rules or algorithms. The Arduino board performs the necessary calculations to determine the appropriate toll.
5. **Payment Deduction:** If the vehicle has a prepaid account, deduct the toll amount from the account balance. This deduction can be managed by

interfacing with a payment gateway or a separate module for financial transactions.

6. **Display and Feedback:** Use an LCD display or LED indicators to provide visual feedback to the driver, indicating the toll amount and transaction status. This allows the driver to be informed about the transaction details.
7. **Gate Control (Optional):** If the toll system includes physical barriers or gates, interface the Arduino board with suitable motors or solenoids to control their operation.
8. **Transaction Logging:** Maintain a log of each transaction, including the vehicle details, toll amount, date, and time. This log can be stored in a local memory module or transmitted to a centralized database for further analysis and record-keeping.

It's worth noting that the implementation details of an Arduino-based toll collection system can vary based on specific requirements and hardware components used.

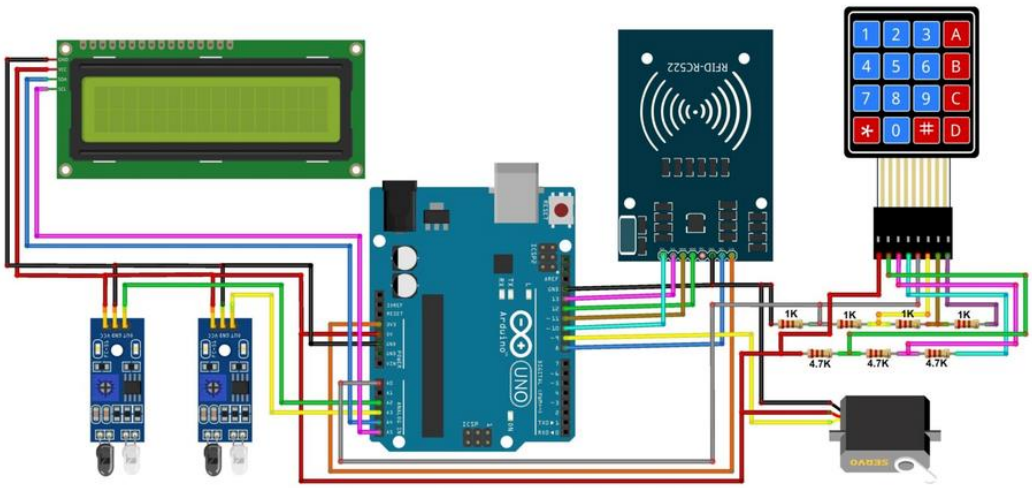


Image: Circuit Diagram

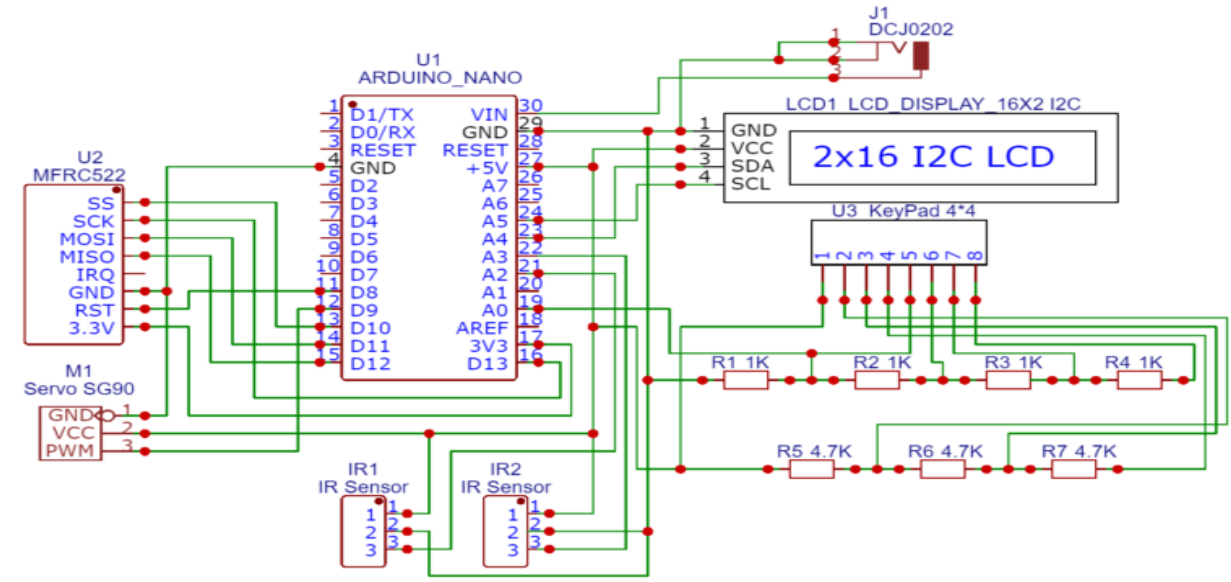


Fig 3: Block Diagram of the system

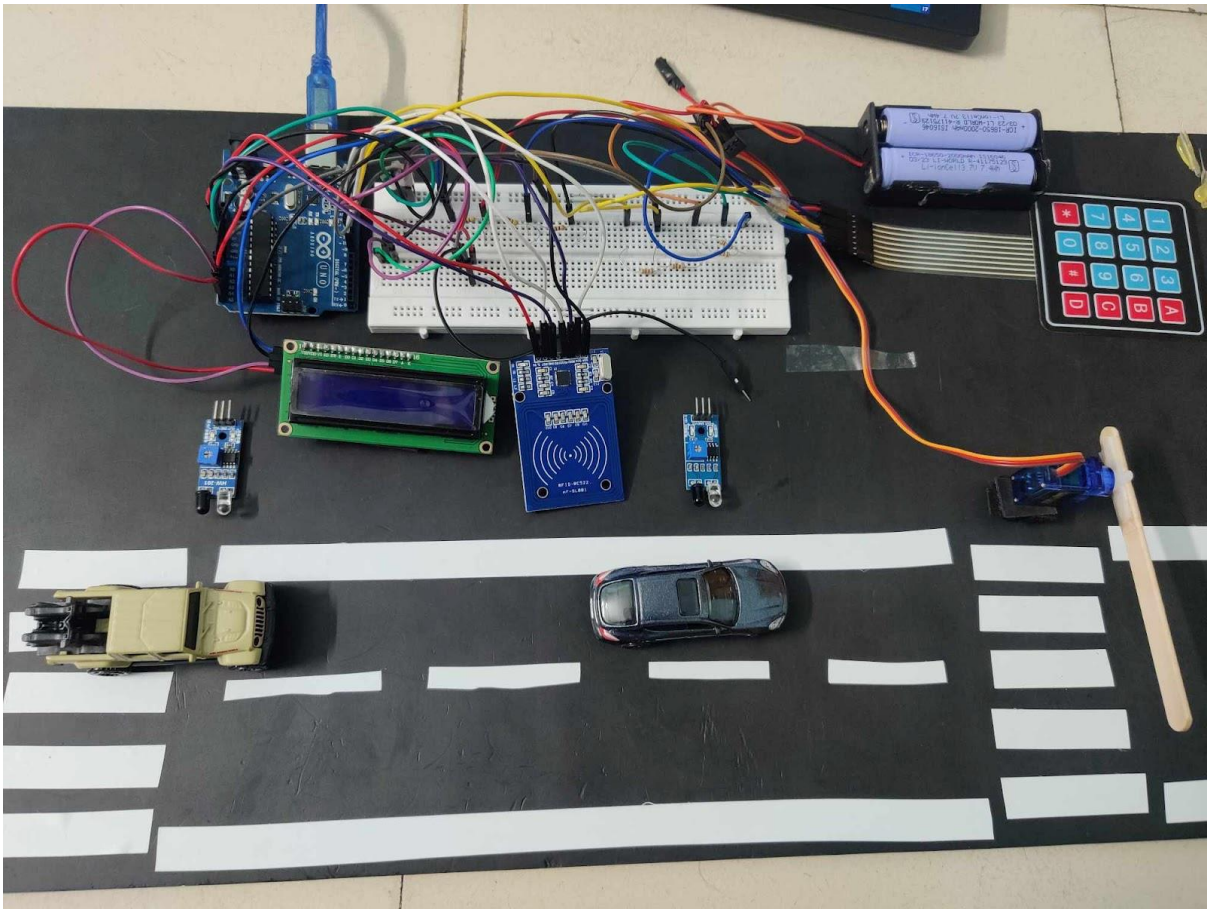


Fig 4: Automatic Sensor Barrier hardware implementation snapshot

Conclusion:

In conclusion, the Arduino-based Automated Toll Collection System introduces a highly efficient and advanced approach to toll collection. By seamlessly integrating RFID technology, sensors, and microcontrollers, the system streamlines toll processes and offers benefits such as reduced congestion, enhanced efficiency, and improved user experience. Through rapid vehicle detection, precise toll calculation, and seamless payment processing, this project exemplifies the power of automation in modern transportation. The system's ability to provide real-time feedback to drivers, control gates, and maintain transaction records solidifies its comprehensive functionality. In essence, this project signifies a significant leap towards smarter and more efficient toll collection, showcasing the transformative potential of technology in enhancing transportation infrastructure.