Ahsanullah University of Science and Technology

Department of Computer Science & Engineering

Course Name: Microprocessors and Microcontroller Lab

Semester: Spring 2023

Course No: CSE3118

Project name: Automated Toll Collection System

Proposed to:

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Objective

The Automatic Toll Collection System with RFID aims to streamline toll transactions by integrating RFID technology. Each vehicle is equipped with an RFID card, allowing for seamless identification and automatic toll payment. The system features a keypad for user interaction, enabling functions such as balance recharge. The servo-controlled gate opens upon successful RFID identification and payment, ensuring efficient toll collection. The project prioritizes security with measures to deny unauthorized access and utilizes visual (LCD display) and auditory (buzzer) feedback for user communication. Overall, the system enhances toll collection efficiency, minimizes manual intervention, and provides a convenient and secure experience for both system administrators and drivers.

Social Values

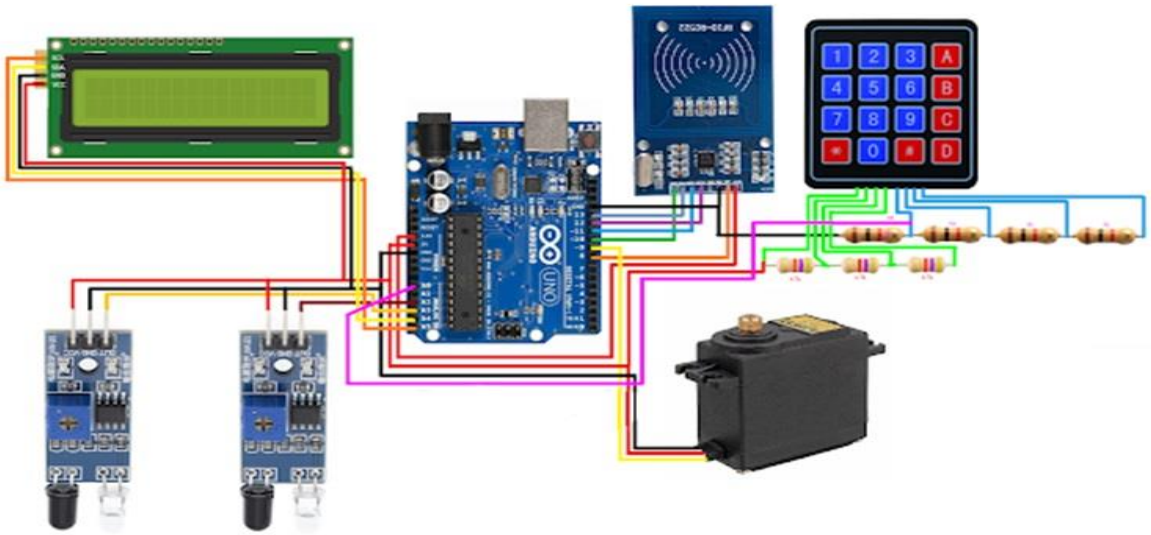
The Automatic Toll Collection System with RFID contributes significant social values by enhancing traffic flow and reducing congestion at toll booths. By automating toll transactions through RFID technology, the system minimizes wait times, leading to reduced fuel consumption and lower vehicular emissions. This not only helps in creating a more environmentally friendly transportation system but also contributes to overall road safety by decreasing the likelihood of accidents and traffic-related stress. This project, with its focus on efficiency, convenience, and environmental impact, aligns with broader goals of creating smarter and more sustainable urban transportation systems.

Required Components and Budgets

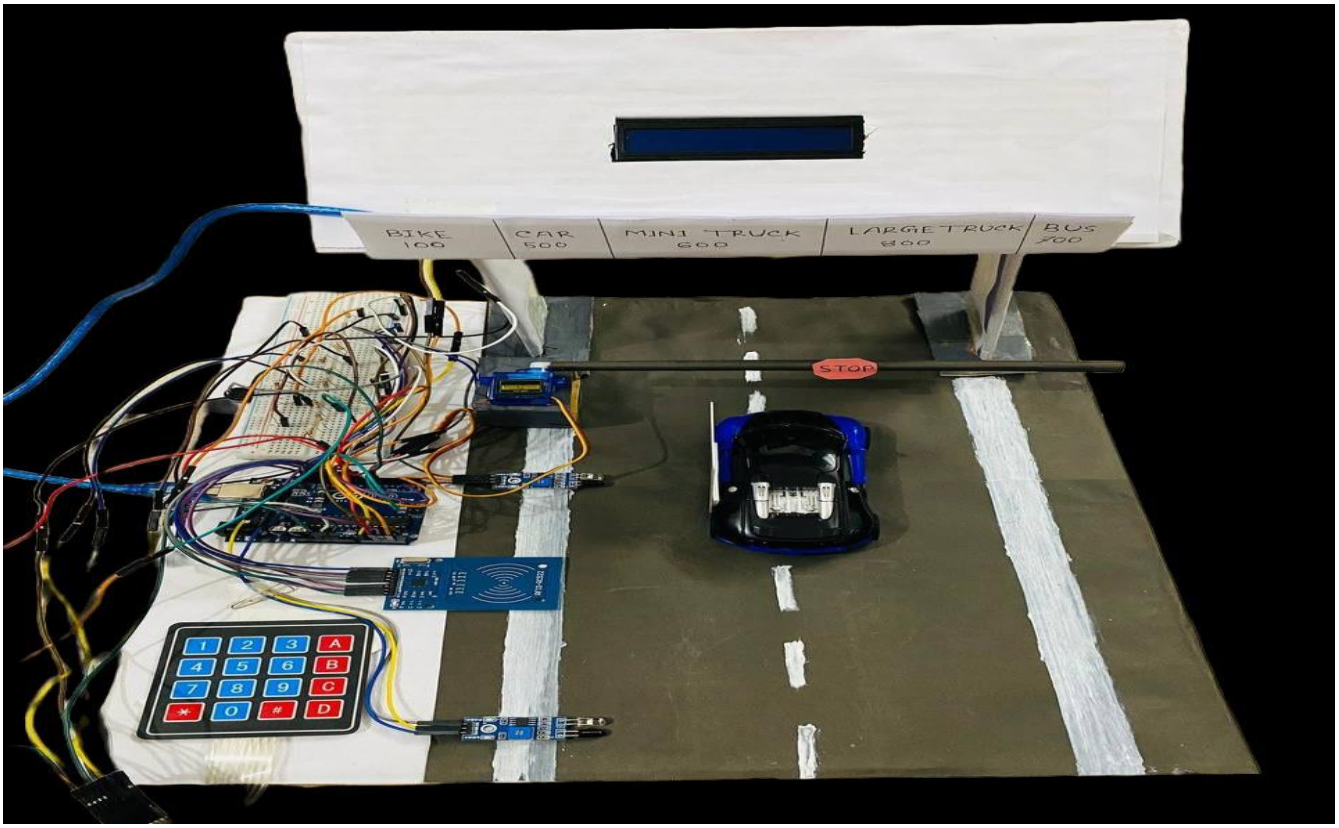
Equipment's	Quantity	Budget (Taka)
Arduino UNO	1	750/=
16*2 LED Display	1	350/=
Keypad	1	150/=
Servo Motor (MG995)	1	200/=
RC522 RFID	1	200/=
RFID Card	2	100/=
IR sensor	2	150/=
Breadboard and Jumper Wires	1	100/=
Buzzer	1	30/=
Battery and Case	1	270/=
Demo car	1	300/=
Extra Expenses		500/=

Total:3100/=

Diagram:



Final Design:



Working Procedure

The Automatic Toll Collection System with RFID operates as follows: When a vehicle approaches the toll booth, the system utilizes RFID technology to wirelessly read the unique identification code from an RFID card placed inside the vehicle. The IR sensors are strategically placed to monitor the entry and exit of vehicles. Simultaneously, a user-friendly keypad allows drivers to input additional information or perform actions such as account recharge. The system checks the RFID data against a pre-defined code to identify the vehicle and deducts the appropriate toll amount from the associated account balance. If the account balance is insufficient, the keypad facilitates a quick recharge process. The integration of a servo motor controls the toll gate, allowing it to open for authorized vehicles while maintaining a secure and efficient toll collection process. This automated approach minimizes waiting times, enhances traffic flow, and provides a streamlined and user-friendly toll collection experience.

Challenges on the Project

- We have faced several problems while implementing the RFID sensor and card. Some cards weren't working properly and sensor had some loose connection.
- We have faced problems while implementing the 16*2 LCD monitor. The backlight of the monitor was too high that we couldn't see any output.
- We have faced several problems while implementing the keyboard. We used a 4*4 matrix keyboard. We tried to short the row and columns and assign the keyboard in one pin. Unfortunately, that didn't work.

Limitations

- We couldn’t use multiple RFID cards for multiple vehicles.
- Our keypad wasn’t working properly.
- We couldn’t use multiple LCD display for more user-friendly interface.

Maximum Energy Efficiency

Low-Power Sleep Mode:

Implement a sleep mode during non-operational periods to minimize power consumption.

Energy-Efficient Components:

Use sensors with low standby power to reduce continuous power consumption.

Optimize the servo motor's power usage during barrier movements.

Renewable Energy Integration:

Incorporate solar panels to harness renewable energy for powering the system.

Holistic Design:

Take a comprehensive approach to energy-efficient design, considering both hardware and software optimizations.

Stakeholders

- Government Authorities
- Toll Collection Agencies

- Technology Suppliers
- RFID Technology Providers
- Servo Motor Manufacturers
- Solar Power Solution Providers

Multidisciplinary Approach

- Electrical and Electronics Engineering
- Computer Science
- Mechanical Engineering
- Civil Engineering
- Environmental Science
- Information Technology

Safety Norms

1. Electrical Safety: Adherence to standard electrical safety protocols, including proper insulation, grounding, and handling of high voltage components, to minimize the risk of electric shock or fire hazards.

2. Mechanical Safety: Ensuring the structural integrity of components and installations to prevent physical harm to users or damage to the system.

3. RFID Card Handling: Educating users about safe handling of RFID cards to avoid damage or data corruption.

4. Buzzer Use: Setting appropriate sound levels for the buzzer to avoid noise-related discomfort or disturbances.

5. IR Sensor Usage: Ensuring that IR sensors are correctly calibrated and positioned to prevent false readings or failures in detecting vehicles.

Team Contribution

Team Member	Contribution
Naeema Jannat Joyee (20210104005)	20%
Mostafiz Fahim (20210104008)	30%
Asadut Jaman (20210104009)	30%
Sayeda Nimu (20210104022)	20%

Conclusion

The completion of this automatic toll collection system project marks a significant achievement in streamlining and modernizing toll booth operations. By integrating RFID card technology, keypad input, and servo motor mechanisms, the system efficiently automates the toll collection process, enhancing user convenience and reducing traffic congestion. While the project contributes to improving transportation efficiency, its limitations and challenges underscore the need for continuous refinement and innovation in toll collection systems. The multidisciplinary approach, involving expertise in electronics, software development, and mechanical design, highlights the collaborative effort required for successful technology integration. Moving forward, ongoing maintenance, user education, and potential enhancements will be crucial for the sustained success and positive impact of the automatic toll collection system.