

# RFID Smart Toll Collection System using Arduino

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## 01 Title

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## 02 Introduction / Background

Manual toll collection is a highway bottleneck: plaza queues, wasted fuel and cash leakage. Electronic toll collection such as India's FASTag shows contactless identification with prepaid wallets moves vehicles through without stopping. This project reproduces the complete ETC pipeline at prototype scale.

## 03 Problem Statement

Cash booths cause congestion, fuel wastage and revenue loss. This project removes the booth: an EM-18 reader identifies each vehicle, firmware deducts the toll from a prepaid wallet, a servo barrier lifts, and every transaction logs to a dashboard — under two seconds per vehicle.

## 04 Objectives

- EM-18 reader identifies EM4100 tags at 8–12 cm.
- Firmware registry of tag ID, vehicle number and balance.
- Toll auto-deducted; barrier stays down on low balance.
- Servo barrier lifts within ~1 s of payment.
- OLED shows ID, toll, balance; dashboard logs transactions.
- Buzzer/LED alerts for invalid tags; manual override.

## 05 Proposed System / Working

The ESP32 runs the Arduino firmware. The EM-18 reader outputs each tag's 10-digit EM4100 ID over UART when a card enters its 8–12 cm field. Firmware looks up the ID, verifies the balance, deducts the toll (optional car-vs-truck rate table) and drives an SG90/MG90S servo to lift the barrier in about one second. A 0.96" SSD1306 OLED (I2C) shows vehicle ID, toll and balance. Unknown tags or low balances trigger the red LED, buzzer and dashboard warning while the barrier stays down; a push-button override clears exceptions. Each transaction — tag ID, vehicle number, amount, balance, timestamp — is pushed over WiFi via MQTT/HTTP to a dashboard with transaction log and

registry. Power: 5 V / 2 A (reader draws ~50 mA).

Tapping a registered card shows the deduction on the OLED, lifts the barrier in about a second and logs the transaction instantly. An unregistered card triggers the buzzer while the barrier stays down; the operator clears it with manual override.

## 06 Technologies / Components Used

ESP32 DevKit microcontroller Arduino Uno variant available · EM-18 125 kHz RFID reader module · RFID tags/cards · MG90S servo motor · 0.96" SSD1306 OLED display · Active buzzer + status LEDs · Tabletop toll-plaza model · Web · 5 V power supply · connecting wires · push button

## 07 Key Features

- Contactless ID via EM-18 reader (8–12 cm range).
- Prepaid wallet with auto-deduction and low-balance blocking.
- Servo barrier lifts in ~1 s; transaction under 2 s.
- Dashboard: transaction log, registry, balance table, alerts.
- On-plaza OLED per vehicle; manual override; multi-lane support.

## 08 Applications / Use Cases

- The prototype mirrors real ETC: highway plazas using FASTag-style RFID, prepaid parking, gated campuses and fleet depots.
- The tag-read → wallet → actuator pipeline also fits metro fare gates, weighbridges and warehouse docks.

## 10 Conclusion

This system compresses electronic tolling — identification, billing, actuation and audit — into a tabletop prototype that completes a transaction in under two seconds: a rigorous, relatable final-year project with real-world resonance.