

## PROJECT ABSTRACT

# RFID Library Book Return Bin with Self Check-in and Librarian Dashboard

*An RFID book return bin for college libraries: RC522 self check-in through a servo-controlled slot, ultrasonic bin-fill monitoring and a companion librarian dashboard with live returns feed and overdue flags. Delivered built-to-order with working prototype, firmware, dashboard demo, tagged demo books, report, PPT and viva kit.*

## 01. Introduction / Background

College libraries lose staff hours to manual book check-ins: every returned book is scanned one by one at the counter, queues build up at peak hours, and after-hours returns pile up unsorted. Commercial RFID self check-in kiosks are priced for large libraries and hide the tag-to-database loop from students. This project builds a working return bin around an ESP32 and RC522 reader: a book dropped through the slot passes the reader, its tag UID is matched against the demo catalogue, and the return is logged instantly with a timestamp. A servo flap, ultrasonic fill sensing and a librarian dashboard complete a genuinely useful library workflow.

## 02. Problem Statement

Manual check-in is slow, staff-intensive and unavailable after hours, while commercial kiosks are unaffordable teaching tools. The project addresses this with a student-built return bin demonstrating the full RFID loop: single-book slot discipline via a servo flap, instant UID-to-catalogue matching over Wi-Fi, fill-level monitoring with collection alerts, and a dashboard showing the live returns feed, fill gauge and overdue flags from the demo catalogue.

## 03. Objectives

- Identify each returned book with an RC522 RFID reader as it drops through the slot.
- Control the slot flap with a servo for single-book discipline and tamper resistance.
- Monitor bin fill with an ultrasonic sensor and raise collection alerts.
- Match tag UIDs against a demo catalogue over Wi-Fi and log returns with timestamps.
- Render a librarian dashboard: live returns feed, fill gauge, hourly chart, due-date table.
- Deliver the complete student kit: prototype, tagged books, firmware, docs, report, PPT and viva Q&A.;

## 04. Proposed Methodology

The build has three parts. (1) Bin mechanics: an IR break-beam wakes the reader as a book enters; the RC522 reads the tag UID in the antenna zone; the servo flap opens for the drop and closes after. (2) Firmware: the ESP32 matches the UID against the demo catalogue over Wi-Fi, logs the return with a timestamp, confirms with green LED and buzzer (red for unknown tags), and re-measures fill after each drop. (3) Dashboard: the live returns feed, fill gauge with collection threshold, per-hour returns chart and due-date status table render from the event

stream; a 0.96-inch OLED at the bin shows the last return and today's count.

## 05. System Architecture / Working

A book dropped through the slot breaks the IR beam, triggering the RC522 read window; the UID is matched against the catalogue via a Wi-Fi API and the return is recorded. The servo flap cycles open-closed per drop, the ultrasonic sensor updates the fill level, and every event publishes to the dashboard. The dashboard's returns feed shows title, member and UID per return; the fill bar tracks toward the 85% collection alert; the table flags overdue and due-soon items from catalogue due dates.

## 06. Hardware / Software Requirements

- ESP32 development board
- RC522 RFID reader (13.56 MHz)
- SG90 servo (slot flap)
- IR break-beam sensor
- Ultrasonic fill sensor
- 0.96-inch OLED + LEDs + buzzer
- Demo book set with RFID tags + catalogue records
- Arduino IDE (C/C++ firmware)
- Companion dashboard (single-file HTML/CSS/JS)

## 07. Expected Outcomes

- A working return bin checking in tagged books in under 2 seconds per drop.
- A librarian dashboard with live feed, fill gauge and overdue flags.
- Demonstrated fill-alert behavior before overflow.
- A complete report, PPT and viva Q&A; on RFID, actuation and UID matching.

## 08. Applications

- Teaching RFID system design end to end.
- Demonstrating servo-actuated workflow discipline.
- Academic study of UID-based identification and its limits.

## 09. Future Scope

- Anti-theft gate pairing at the library exit.
- Integration with a real ILS such as Koha.
- Multi-bin deployment with a central dashboard.
- Book sorting conveyor as a mechanical extension.