A PROJECT REPORT

On

"AI - Driven Library Visitor Log"

Undertaken by

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IV Semester

Master of Computer Applications

Bengaluru City University

K.L.E SOCIETY'S

S. NIJALINGAPPA COLLEGE

DEPARTMENT OF COMPUTER SCIENCE

Under the guidance of:

Prof. Sharada C

Department of Computer Science

Academic Year

2024-2025

Bengaluru City University

K.L.E SOCIETY'S S.NIJALINGAPPA COLLEGE

RAJAJINAGAR, BANGALORE-560010.

DEPARTMENT OF COMPUTER SCIENCE

CERTIFICATE

This is to certify that project work entitled "AI – Driven Library Visitor Log" has been successfully carried out by Karthik K (P18EB23S126011) in partial fulfillment for the award of IV semester MCA during the academic year 2024-2025.

Signature of the Guide
Prof. Sharada C

Name of the examiners:

1.

2.

INTERNSHIP CERTIFICATE

ANALOGICA

ANALOGICA SOFTWARE DEVELOPMENT PVT. LTD

308, 1st floor, 59th cross, 3rd block, Bhashyam Circle Main Road, Bangalore - 560010

CIN: U72900KA2019PTC126238

Internship Completion

Date : September-25 -2025

To whom it may concern

This is to certify that **Mr. Karthik K**, pursuing MCA (Final Semester), has successfully completed his internship as a **Data Science & Machine Learning Intern at Analogica Software Development Pvt. Ltd.**

During his internship, **Mr. Karthik** gained valuable exposure to the complete data science workflow. He worked extensively with Python, SQL, and exploratory data analysis (EDA) for cleaning, processing, and visualizing datasets to improve data quality. He applied machine learning algorithms for model development and evaluation, and further explored deep learning techniques to address advanced automation challenges.

Through his project, ***"AI-Driven Library Visitor Log"***, he demonstrated the ability to integrate Flask, Tesseract OCR, and SQLite to design a scalable digital system capable of automating student registration. This work not only enhanced his technical expertise but also strengthened his problem-solving skills by translating real-world needs into practical AI solutions.

Beyond technical learning, Mr. Karthik showed notable progress in documentation, teamwork, and timely project delivery, reflecting a strong professional approach.

We appreciate his contributions during the internship and wish him success in his future academic and professional endeavors.

Internship Duration: 3 Month
Start Date: 24th June 2025
End Date: 24th September 2025

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25 SEP 2025

ACKNOWLEDGEMENT

The satisfaction and euphoria that accompanies the successful completion of any task would be incomplete without the mention of the people who made it possible, whose consistent guidance and encouragement crowned our efforts with success. I consider it our privilege to express our gratitude and respect to all those who guided us in the completion of this project.

I thank our Principal **Dr. Arunkumar B Sonappanavar**, for providing us with a congenial environment to carry out our Project and Academics.

I would also like to express my heartfelt thanks and gratitude to my project guide guide **Prof. Sharada C** for her guidance and support throughout the tenure of the project without whom the completion of the project would be impossible.

Last but not the least I would like to extend our gratitude to our parents and all those who directly or indirectly helped for this project to be carried out.

Karthik K

ABSTRACT

The “AI-Driven Library Visitor Log” project has been developed as an efficient and low-cost solution to overcome the challenges of manual visitor record-keeping in academic libraries. Traditional handwritten registers are often error-prone, time-consuming, and difficult to analyze, making them unsuitable for modern educational environments.

This system addresses these limitations by introducing an automated, intelligent approach to capturing and managing visitor information. The core functionality of the system relies on a webcam-based image capture module that scans student ID cards and applies Optical Character Recognition (OCR) through Tesseract to extract essential details such as Name, Registration Number, and Department.

These details are verified using rule-based validation (regex for ID formats and keyword matching for departments) before being stored in a structured SQLite database.

This ensures that only accurate and complete data is logged, minimizing errors while maintaining reliability. On top of this data layer, a Flask-based web dashboard has been developed to provide librarians with a user-friendly interface for real-time visitor management.

The dashboard supports multiple features including search by ID, department, or date range, CSV export of records, live visitor tracking, and secure authentication. These functionalities not only streamline the day-to-day operations of librarians but also allow for easy generation of insights and reports. Implemented in Python, the project demonstrates the effective integration of computer vision (OpenCV), OCR (Tesseract), database management (SQLite), and web technologies (Flask, HTML/CSS).

Designed to be lightweight and portable, the system can run on standard hardware without requiring specialized infrastructure. Beyond its current scope, the project provides a strong foundation for enhancements such as face recognition, QR/RFID-based entry, cloud deployment, and advanced analytics, making it a scalable and adaptable solution for future.

CONTENTS

INTRODUCTION

Background of the problem

Libraries are not only knowledge hubs but also important spaces for tracking academic engagement and resource utilization. Maintaining accurate records of student visits helps institutions monitor library usage patterns, allocate resources effectively, and plan improvements. However, manual record-keeping often leads to incomplete data, transcription mistakes, and difficulty in generating meaningful insights. Automated solutions not only improve accuracy but also ensure that data is stored in a structured, digital format. This allows institutions to analyze usage trends, improve resource planning, and integrate visitor logs with other academic management systems. Furthermore, digital systems can enhance transparency and reduce administrative workload by minimizing human intervention in routine tasks.

Recent advancements in computer vision and natural language processing have opened new possibilities for low-cost, intelligent visitor logging systems. By leveraging technologies such as OCR, student ID cards can be scanned directly using a standard camera, eliminating the need for manual entry. When combined with AI- driven validation and a database backend, this approach provides a scalable and reliable alternative to traditional logbooks. Thus, modernizing the visitor log process not only solves existing inefficiencies but also aligns with the broader vision of digital campuses and smart libraries.

Problem Statement

The existing manual visitor logging process in libraries is inefficient and error-prone. Handwritten entries can be illegible, time-consuming to maintain, and difficult to analyze for administrative purposes. Moreover, traditional registers cannot integrate with modern data systems, making it challenging to track student activity or generate reports. Therefore, there is a need for a cost-effective, AI-driven system that automates the visitor registration process, ensures accuracy, and maintains a digital database for easy retrieval and analysis.

Objective of the project

The primary objective of this project is to design and develop an **AI-Driven Library Visitor Log** that automates the student registration process using computer vision and OCR. The system captures student ID cards via a camera, extracts key details (Name, Registration Number, Department) using OCR, and stores the information in an SQLite database. A Flask-based web dashboard is developed to display recent

entries and allow administrators to manage visitor records efficiently.

Scope and Limitation

Scope

The **AI-Driven Library Visitor Log** system is designed to modernize visitor management in academic libraries by replacing traditional handwritten registers with a digital solution. The scope of the project includes:

- **Automated Visitor Registration**: Capturing student ID cards using a live camera stream and extracting key details (Name, Registration Number, Department) through **OCR**.
- **Data Storage**: Storing visitor information in an **SQLite database** for efficient retrieval and long-term maintenance.
- **Web Dashboard**: Providing a **Flask-based dashboard** for librarians to view, filter, and manage visitor records.
- **Search & Export Features**: Allowing librarians to search records by ID, department, or date range, and export the data in CSV format.
- **Authentication**: Ensuring that only authorized librarians can access the dashboard through a login system.

Limitations

- **OCR Accuracy**: The accuracy of text extraction depends on the quality of the ID card image (e.g., lighting, clarity, font styles). Poor-quality captures may lead to misclassification.
- **Format Dependency**: The system works best for standardized student ID card formats. Significant variations may reduce recognition accuracy.
- **Local Database**: Since SQLite is a lightweight local database, it may not scale efficiently for very large datasets compared to enterprise solutions like MySQL or PostgreSQL.
- **Hardware Dependence**: The performance of live scanning depends on the camera quality and system resources available.

Flowchart

Student Registration Process:

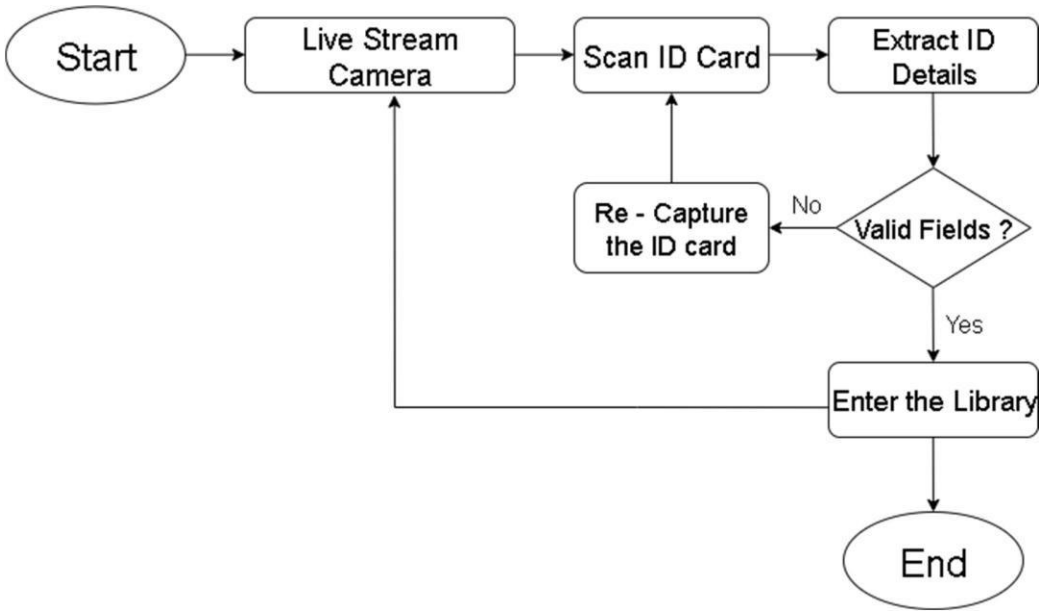


Fig no. 1.1 Student Flowchart

a) **Start**

- System initializes.
- Libraries: *Flask* (for server), *OpenCV* (for camera initialization).

b) **Live Stream Camera**

- A live webcam feed is activated to capture ID cards.
- Libraries: *OpenCV (cv2.VideoCapture)*.

c) **Scan ID Card**

- The system frames and captures the ID card image.
- Libraries: *OpenCV* (image capture & preprocessing).

d) **Extract ID Details**

- Text is extracted from the captured ID card.
- Libraries: *pytesseract* (OCR), *OpenCV* (grayscale, thresholding, resizing for better OCR).

e) **Valid Fields?**

- The system checks if the required fields (Name, Registration No, Department) are present and valid.
- Libraries: *re (regex)* (for extracting ID formats), *custom logic* (department keyword matching).

f) **Re-Capture the ID Card (if invalid)**

- If fields are missing/incorrect, the system prompts the user to try again.

g) **Enter the Library**

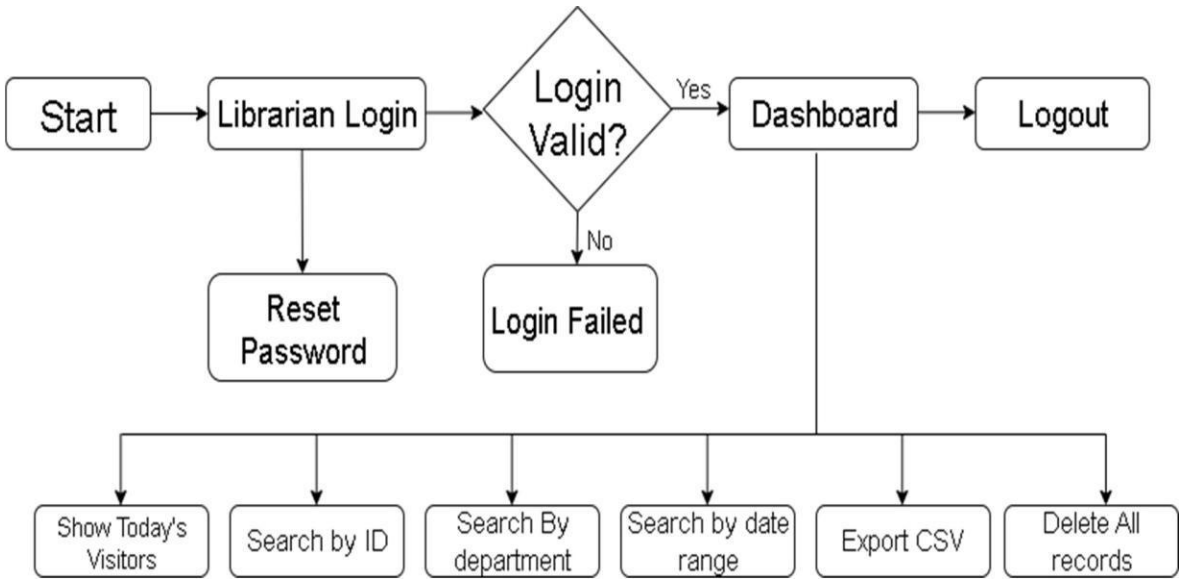
- If valid, details are stored in the database.

Libraries: *SQLite3 (Python sqlite3 module)*.

h) **End**

- Visitor successfully registered.

Librarian Dashboard Process:



Librarian Flowchart

a) **Start**

- Librarian accesses the web application.
- Libraries: *Flask* (web server).

b) **Librarian Login**

- Secure login page is presented.
- Libraries: *Flask-Login / Flask session*, *Werkzeug* (password hashing).

c) **Login Valid?**

- System checks entered credentials against database.
- Libraries: *SQLite3* (verify credentials).

d) **Login Failed → Reset Password Option**

- If invalid, librarian can reset password.

e) **Dashboard (Successful Login)**

- Main control panel to manage records.

- Libraries: *Flask (templates)*, *Jinja2* (HTML rendering).

f) **Dashboard Functionalities**

- **Show Today's Visitors** – Query database for current date records (SQLite).
- **Search by ID** – SQL query filtering by student ID.
- **Search by Department** – SQL query with department filter.
- **Search by Date Range** – SQL query with BETWEEN clause.
- **Export CSV** – *Pandas* or *csv module* to export DB entries.
- **Delete All Records** – SQL command DELETE FROM visitors;.

g) **Logout**

- Ends session and returns to login page.
- Libraries: *Flask session management*.

h) **End**

LITERATURE SURVEY

Review of existing methods/ Solution

a) Manual Logbooks

- Paper registers; low cost, zero tech.
- Issues: illegible handwriting, duplication, slow lookup, no analytics, poor archival.

b) Barcode / QR-Code Based Entry

- Student IDs carry barcodes/QR; scanner reads ID → DB entry.
- Pros: fast, accurate parsing; low compute.
- Cons: requires preprinting codes and scanner hardware; fails if code is damaged; still needs separate identity verification.

c) RFID / Smart Cards

- Contactless readers log entries automatically.
- Pros: very fast; minimal friction.
- Cons: card + reader cost; security/anti-passback configuration; institutional rollout effort.

d) Biometric (Fingerprint / Face at Gate)

- Turnstile or kiosk validates identity.
- Pros: high assurance, detailed audit.
- Cons: privacy/consent, data protection requirements, higher cost, ambient-light/latency issues for face.

f) OCR on ID Cards (Camera-based)

- Camera captures ID card; OCR extracts Name/RegNo/Dept.
- Pros: uses commodity webcams/phones; no reprinting cards; retrofits existing IDs.

Related Work

- **OCR Pipelines for ID Documents**

  Typical pipelines use **OpenCV** (grayscale, denoise, resize, threshold) → **text detection** (rule-based or deep models like EAST/CRAFT) → **text recognition** (Tesseract). For student/employee cards, many works report that careful **preprocessing + region cropping** boosts Tesseract accuracy on alphanumeric IDs.

- **Lightweight Library Management Stacks**
  Small institutions often favor **Flask + SQLite** for quick deployment and on-prem data control. Admin UIs commonly include **date filters, CSV export**, and **role-based access**.
- **Alternatives to OCR in Libraries**
  Studies of **RFID** and **QR** show high throughput but require infrastructure (printers/encoders/readers). OCR stands out where **retrofit** and **minimal hardware** are priorities.

Gap Analysis

a) **Cost and Infrastructure**
- Existing RFID/biometric systems require expensive hardware and infrastructure changes.
- Gap: Not feasible for small/medium institutions with budget constraints.
- This Project: Uses existing student ID cards + standard webcam with open-source libraries → minimal cost.

b) **Dependency on Network/Cloud**
- Many mobile app or cloud-based visitor systems depend on internet availability.
- Gap: Unusable in offline environments or with poor connectivity.
- This Project: Works fully offline with **SQLite** and can later be extended to cloud if required.

c) **OCR Data Reliability**
- Generic OCR tools often misread alphanumeric IDs and department names.
- Gap: Lack of **domain-specific validation** results in inaccurate records.
- This Project: Implements **regex-based ID extraction**, **keyword-based department detection**, and **length checks** for high accuracy.

d) **Data Quality Assurance**
- Existing OCR-based systems often accept raw OCR output without verification.
- Gap: Leads to incomplete or noisy data in the database.
- This Project: Accepts data **only if all three fields (Name, Reg No, Department) are valid**, otherwise prompts for re-capture.

e) **Ease of Operation**
- Some systems require manual actions (e.g., pressing keys) for each capture.
- Gap: Slows down library workflow.
- This Project: Provides an **auto-capture loop** that continues until valid ID details are extracted.

f) **Scalability and Extensibility**

- Existing systems are often designed for one specific method (RFID-only or QR-only).
- Gap: Limited scope for future enhancements.
- This Project: Designed modularly to allow **future features** like face recognition, QR scanning, and cloud integration.

g) **Privacy and Compliance**

- Biometric-based systems (fingerprint/face) raise privacy and consent concerns.
- Gap: Institutions may be reluctant to adopt such systems.
- This Project: Focuses on **ID card OCR only**, collecting minimal data stored locally, reducing privacy risks.

2.2. Summary of Findings

The review of existing systems shows that most solutions either require significant infrastructure investment (RFID, biometrics), depend on internet connectivity, or lack strong data validation (generic OCR). These gaps lead to cost barriers, operational inefficiencies, and unreliable records.

The proposed **AI-Driven Library Visitor Log** addresses these gaps by offering:

- A **low-cost, offline-capable system** using existing ID cards and webcams.
- **High data quality** through regex/keyword-based validation.
- **User-friendly automation** with live camera capture until valid extraction.
- A **modular architecture** ready for future upgrades like face recognition or cloud integration.

Thus, this project effectively bridges the gap between traditional manual logs and expensive enterprise systems, providing a practical, scalable solution for academic libraries.

SYSTEM ANALYSIS

Requiement Analysis

The system is designed to automate the process of logging library visitors using OCR-based ID card scanning. The key requirements are to ensure **accurate data capture, efficient storage, and user-friendly access** through a dashboard, while maintaining low cost and scalability.

Functional Requirements:

- **ID Card Capture**: The system should capture student ID cards using a webcam.
- **OCR Extraction**: Extract Name, Registration Number, and Department from the scanned ID card.
- **Data Validation**: Ensure extracted details are valid before storing (regex for ID, keywords for department).
- **Database Storage**: Store visitor records in **SQLite** for easy access and long-term storage.
- **Librarian Login**: Only authorized users (librarians) should access the system dashboard.
- **Dashboard Features**:
  - View today's visitors.
  - Search by ID, department, and date range.
  - Export visitor logs to CSV.
  - Delete records when required.
- **Auto-Capture**: Continuously scan until valid fields are detected.

Non- Functional Requirements:

- **Usability**: The interface should be simple and easy to use for non-technical staff.
- **Performance**: OCR and validation should work in real-time with minimal delay.
- **Reliability**: Ensure data accuracy by validating extracted fields.
- **Scalability**: System should allow future upgrades like face recognition or QR integration.
- **Security**: User authentication for librarians to protect visitor data.
- **Portability**: Should run on standard Windows/Linux systems without special hardware.

SYSTEM ARCHITECTURE

The system follows a three-layer architecture:

a) Data Layer

- SQLite Database stores visitor records, login credentials, and logs.Handles CRUD (Create, Read, Update, Delete) operations for visitor data..

b) Application Layer

- Flask Framework manages backend logic.
- OCR & Preprocessing with OpenCV and pytesseract.
- Validation Logic with regex and keyword matching.

c) Presentation Layer

- Web Dashboard (Flask + HTML + Jinja2 templates) for librarians.
- Includes login, search filters, data export, and visualization of visitor entries.

Technology Stack

a) **Programming Language**

- **Python** → Core language for building Flask backend, OCR, and database scripts.
- Reason: Beginner-friendly, rich ML/AI ecosystem.

b) **Framework**

- **Flask (Python Web Framework)** → Lightweight, flexible, and easy for REST APIs and web dashboard.

c) **Database**

- **SQLite** → Local relational database for storing visitor records, OCR results, and future face- match results.

d) **OCR Library**

- **Tesseract OCR (via pytesseract wrapper)** → Extracts text from ID card images (Name, Reg No, Department).

e) **Image Processing**

- **OpenCV** → Capturing images from webcam, preprocessing (resize, grayscale, cropping).

f) **Frontend (Presentation Layer)**

- **HTML5, CSS3, Bootstrap** → Dashboard templates for displaying visitor logs.
- Optional: **JavaScript (jQuery/AJAX)** for dynamic updates.

g) **Environment & Tools**

- **VS Code** → Development environment.
- **Postman** → API testing.
- **GitHub** → Version control & collaboration.

Design Considerations

a) Simplicity & Scalability

- Start with a simple OCR + SQLite pipeline.
- Keep code modular so advanced features (face match, QR scan) can be plugged in later.

b) Error Handling & Validation

- OCR results vary → Regex and keyword filtering are applied.
- Ensure Reg No format (13 characters), Department validity ("MCA"), and no duplicates.

c) Data Integrity & Security

- Prevent duplicate entries in database.
- Validate visitor info before inserting into SQLite.
- In future → Role-based access for librarians (admin login).

d) Performance

- Optimize preprocessing (resize, grayscale) for faster OCR results.
- SQLite indexing for quick search of visitor history.

e) Usability

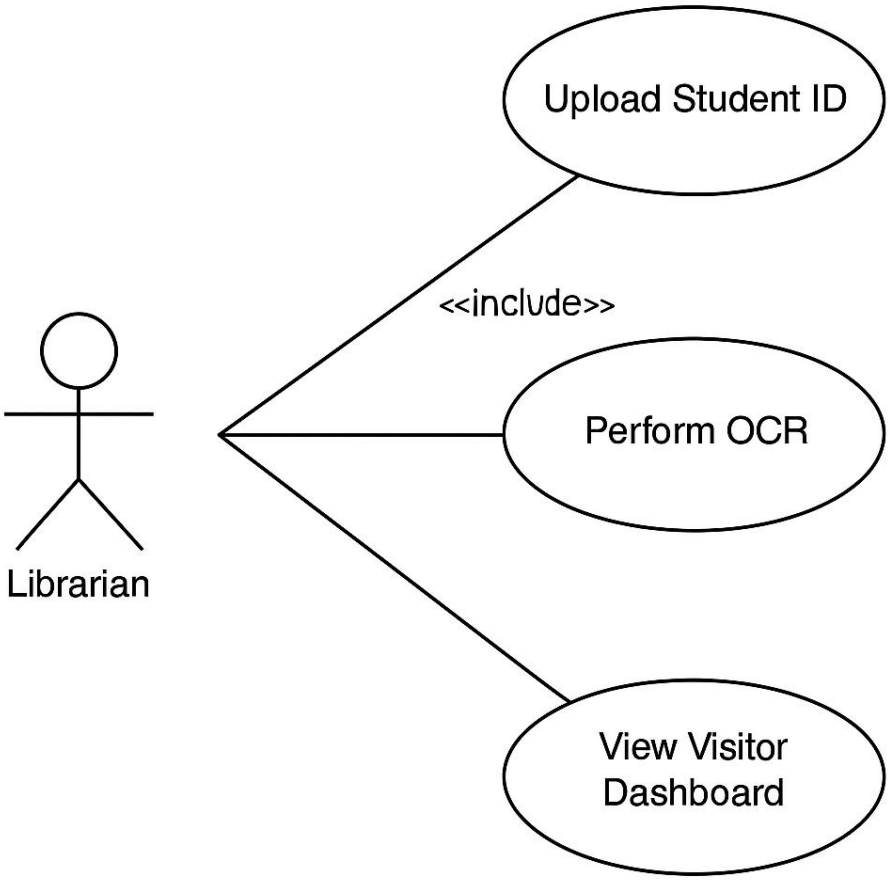
- Dashboard should show latest visitors clearly.
- Auto-update after each

registration. f)Extensibility

- Database schema prepared with extra fields (face_match_status, timestamp).

Flask routes designed RESTfully (/register, /visitors)

Use Case Diagram:



IMPLEMENTATION

Detailed explanation of modules /components:

The system is modular, with each part handling a specific responsibility. Below is a breakdown of the main components:

a) Image Capture Module

- **Purpose:** Captures the ID card image from webcam or uploaded file.
- **Libraries:** cv2 (OpenCV) for camera streaming and frame capture, os for file handling.
- **Process:**
    - Opens webcam feed (live camera).
    - Frames the ID card region and saves the image once conditions are met.
    - Stored image passed to OCR for text extraction

OCR Extraction Module

- **Purpose:** Extracts textual information (Name, Reg No, Department) from ID card image.
- **Libraries:** pytesseract, cv2, re.
- **Process:**
    - Preprocessing: grayscale conversion, resizing, noise reduction.
    - OCR text extraction using **Tesseract**.
    - Regex & keyword-based parsing:
        - **Name:** first valid non-college line.
        - **Reg No:** extracted after "Reg No:" labels.
        - **Department:** matched from predefined department keyword list.

b) Data Validation Module

- **Purpose:** Ensures extracted data is valid before storing.
- **Rules Implemented:**
    - Reg No must be exactly **13 characters**.
    - Department must match **MCA** (case-insensitive).
    - Name should not contain unwanted college keywords.
- If conditions fail → record is discarded.

c) Database Module (database.py + models.py)

- **Purpose:** Stores visitor details in SQLite database (library_visitors.db).

- **Libraries:** sqlite3 + SQLAlchemy (ORM).
- **Process:**
    - Table: visitors
    - Fields: id, name, reg_no, department, timestamp, face_match_status (future extension).
    - Handles duplicate check → no duplicate Reg No entries.

d) Flask Web Application (app.py)

- **Purpose:** Provides REST API and dashboard interface.
- **Libraries:** Flask, Jinja2, SQLite.
- **Endpoints:**
    - /register → Uploads image, extracts data, saves to DB.
    - /dashboard → Displays recent visitors (Name, Reg No, Department, Time).
- **Templates:** HTML + CSS for user-friendly dashboard.

e) Dashboard Module

- **Purpose:** Visual representation of registered visitors.
- **Features:**
    - Recent entries displayed in a table format.
    - Auto-refresh capability (future).
    - Possible extensions: graphs, search, and filtering.

Algorithms used

The system mainly leverages **OCR, Regex Parsing, and Database Handling algorithms**:

a) OCR Extraction Algorithm

- Uses **Tesseract OCR**:
    - Converts pixel intensity → text characters.
    - Steps:
        1. Preprocess image (grayscale, resize).
        2. Pass to pytesseract.image_to_string().
        3. Collect raw text.

b) Regex & Keyword Matching Algorithm

- **Name Extraction:**
    - Skip lines with unwanted keywords (e.g., "College", "Validity").
    - Take the first remaining line as candidate.
- **Reg No Extraction:**

- Regex: *r"(Reg(istration)?\.?\s?No[:\-]?\s*)([A-Z0-9]+)"*.

- **Department Extraction:**
  - Matches against fixed keyword list.

c) Data Validation Algorithm

- Steps:
  1. If len(reg_no) != 13 → reject.
  2. If department.lower() != "mca" → reject.
  3. Else accept and proceed.

d) Duplicate Detection Algorithm

- Before inserting a visitor:
  - Query SQLite: SELECT * FROM visitors WHERE reg_no=?.
  - If found → skip insertion.
  - Else → insert new record.

e) Dashboard Rendering Algorithm

- Flask queries latest entries:

  SELECT name, reg_no, department, timestamp

  FROM visitors ORDER BY timestamp DESC LIMIT 10;
- Pass results to HTML template via Jinja2.
- Display in a clean tabular format.

SOFTWARE TESTING

Software Testing

Software testing is the process of evaluating a software application to ensure that it functions correctly, meets the specified requirements, and is free from defects. It is a vital phase in the software development life cycle that helps ensure quality, reliability, and user satisfaction before deployment.

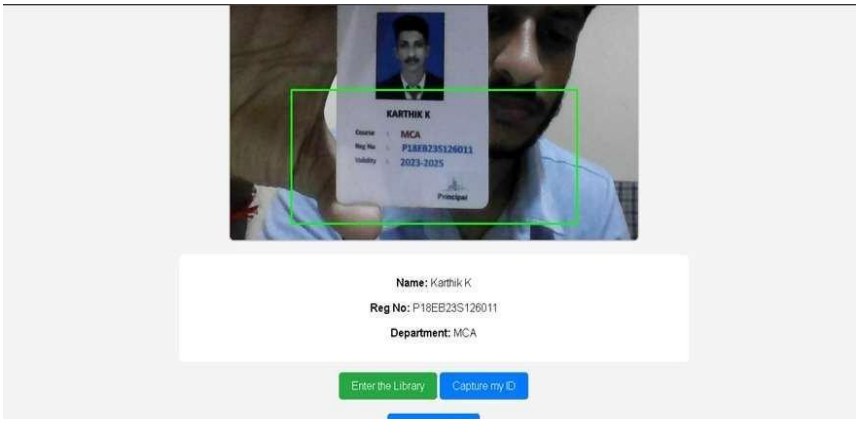
Test Case	Input/ Action	Expected Output
Register valid visitor	Upload valid ID	Success, record saved in DB
Invalid Reg No length	Upload ID with short reg no	Error: Invalid Reg No
Wrong department	Upload ID with dept = CSE	Error: Dept must be MCA
Duplicate entry	Upload ID already in DB	Error: Duplicate found
Auto-capture valid fields	Camera scans card → all 3 fields found	Data stored, loop stops
Missing department	Camera reads name & reg_no only	Continues scanning, no save
Dashboard refresh	After new registration	New visitor appears instantly

RESULTS AND SNAPSHOTS

Output of the System:

1) ID Capture & OCR Extraction:

- The system captures the student ID card via webcam, extracts Name, Reg No, and Department using OCR, and displays the results for confirmation.



ID Capture & OCR Extraction

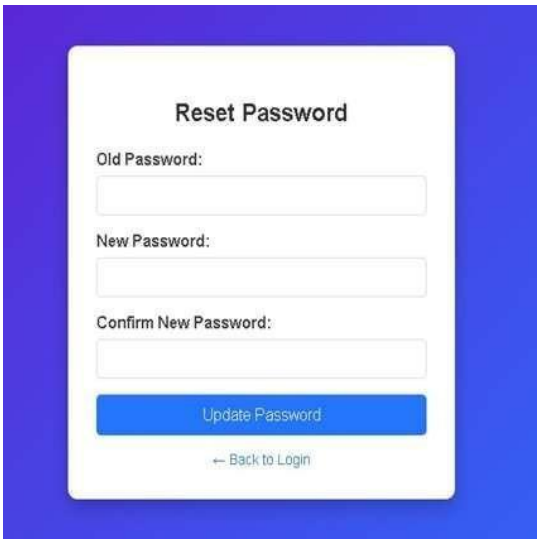
2) Librarian Login Page:

- Secure login interface for administrators to access and manage the Library Visitor Log system.

Librarian Login

3) **Password Reset Page:**

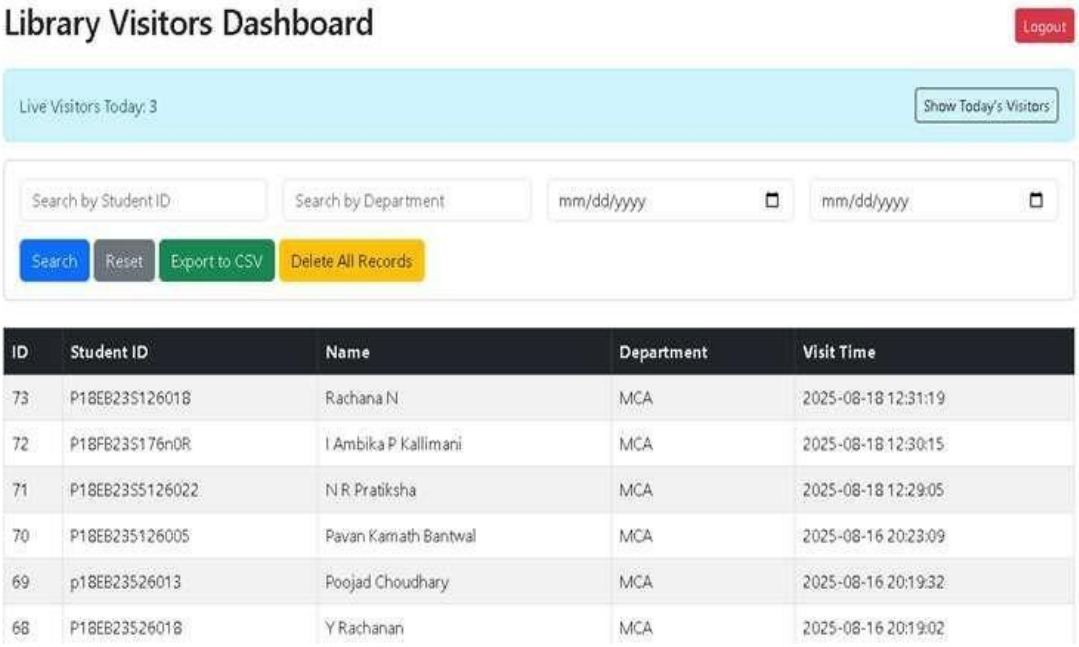
- Provides administrators the ability to reset their password securely before accessing the dashboard.



Reset password

4) Library Visitors Dashboard

- Displays a searchable and filterable list of registered visitors with options to export data, reset filters, or delete records.

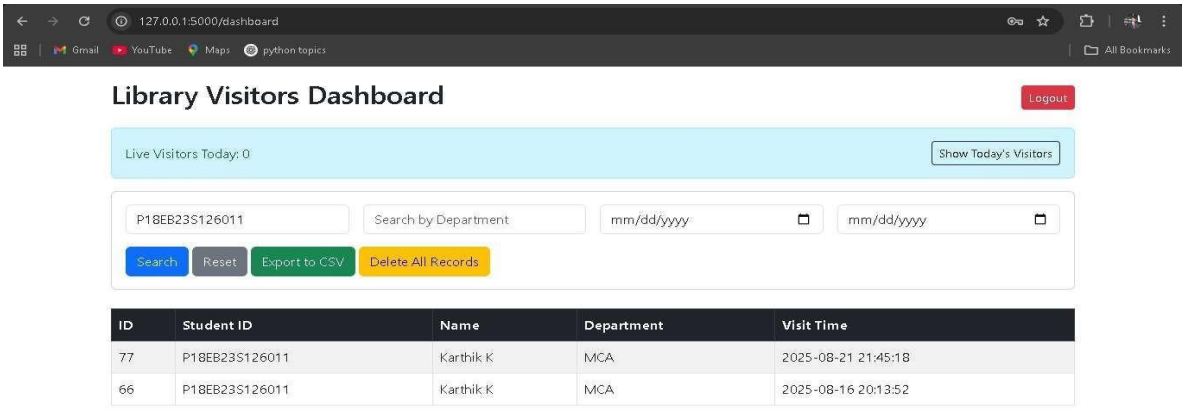


Dashboard

Test Result Librarian

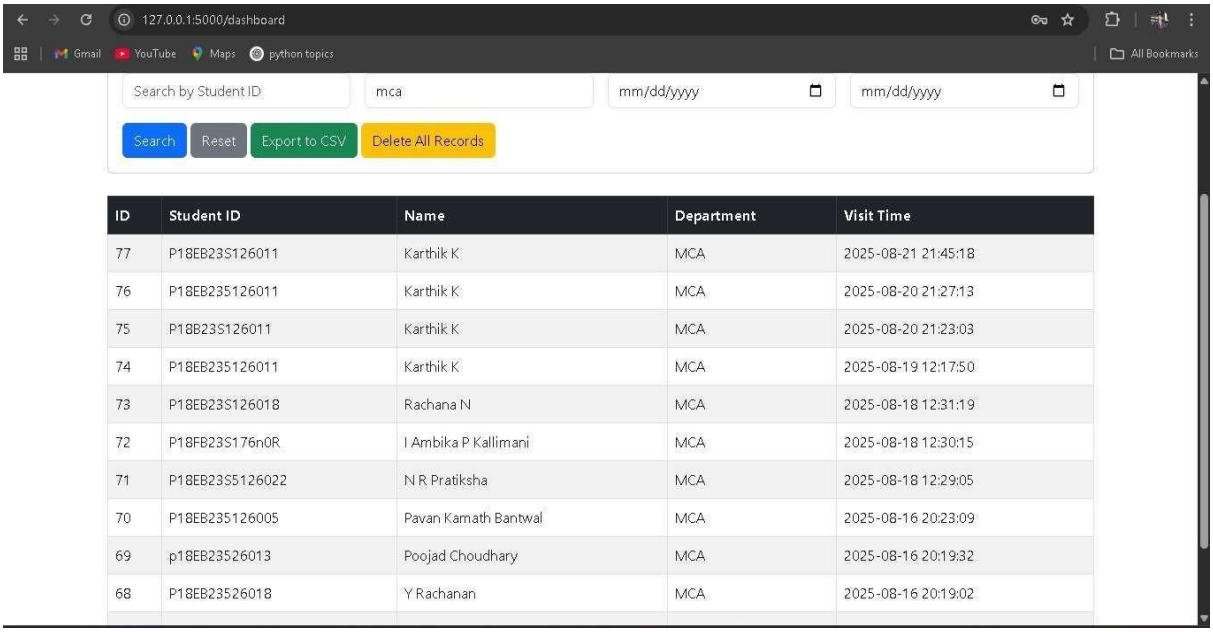
Dashboard

- Quickly find a visitor's record by entering their unique student/registration number.



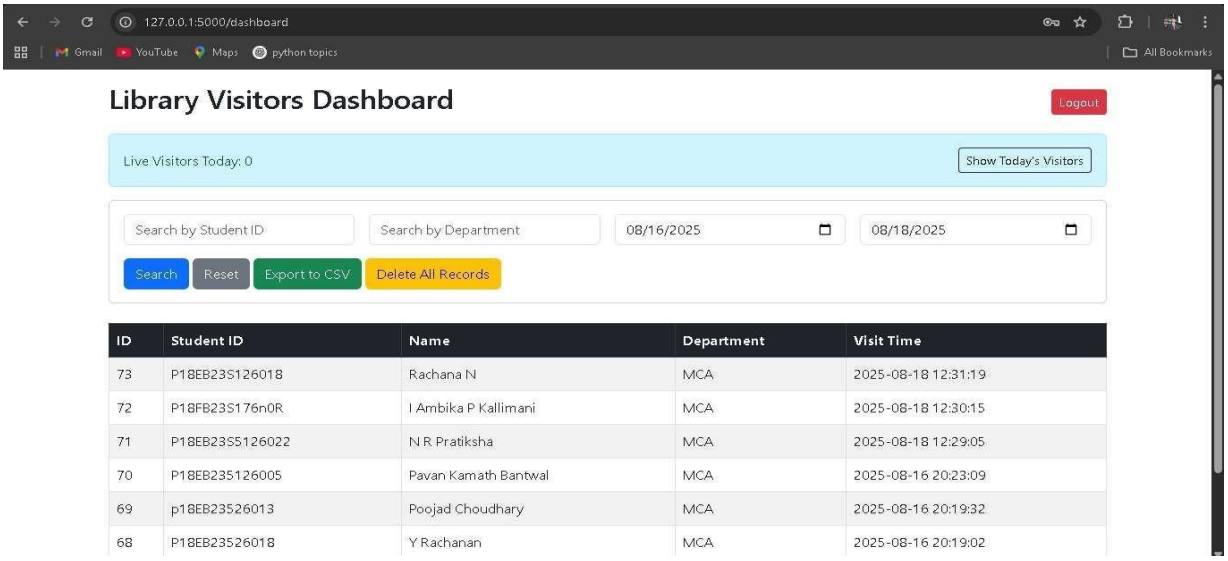
Search by ID

- Filter the visitor list to show only entries from a selected department (e.g., MCA, CSE).



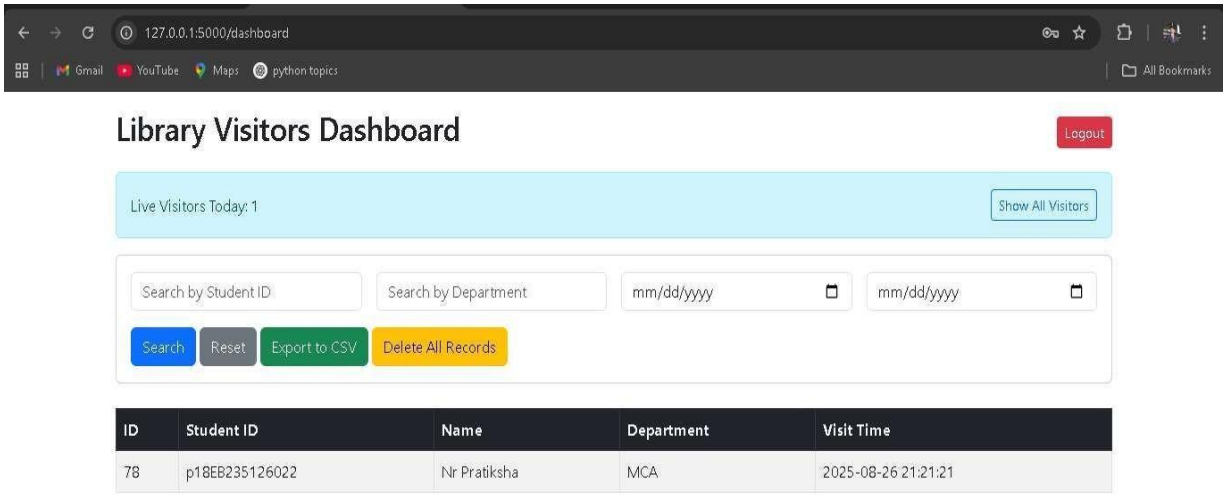
Search by Department

- Display visitors who registered between two chosen dates for easy auditing.



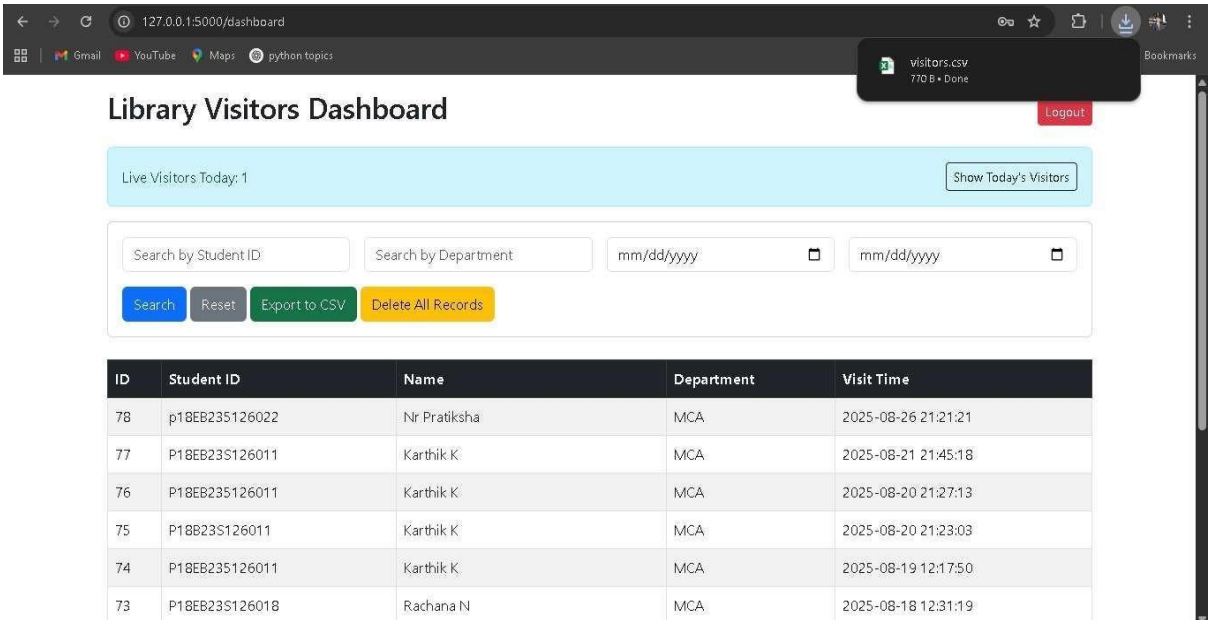
Search by Date Range

- Shows real-time entries of visitors currently checked in or captured from the camera feed.



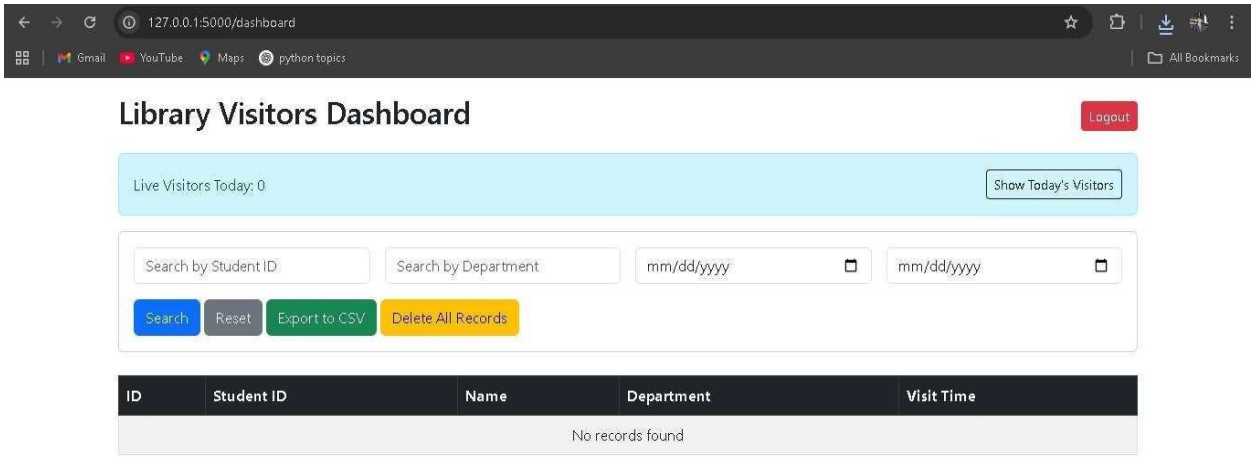
Show Today's Visitors

- Download the current visitor list or filtered results as a CSV file for ofline analysis.



Export to CSV

- Remove every entry from the database (irreversible) — intended for admin use only.



Delete all Records

Experimental setup

- **Operating System:** Windows 10
- **Python Version:** 3.11+
- **Framework:** Flask was used to build the web application for visitor registration and dashboard display.

- **Libraries:** The project utilized key Python libraries including opencv-python for image capture, pytesseract for OCR, sqlite3 for database operations.
- **Validation Logic:** Regex-based text parsing and keyword matching were applied to ensure correct extraction of Name, Student ID, and Department.
- **Deployment:** The Flask app was run locally from VS Code, with endpoints tested in Postman and results displayed on a web dashboard.

Evaluation metrics

- **OCR Accuracy (%):** Ratio of correctly extracted fields (Name, ID, Department) vs. total fields.
- **Extraction Success Rate (%):** Percentage of ID cards where all 3 required fields were captured correctly.
- **Processing Time (seconds):** Average time taken from image capture to database entry.
- **Error Rate (%):** Percentage of records with missing/incorrect fields.

Comparative Results

The traditional method of maintaining library visitor records relies on manual entry, which is often time-consuming, and difficult to manage when dealing with large volumes of data. To overcome these limitations, the proposed system leverages OCR technology to automate data collection directly from student ID cards. This ensures faster registration, improved accuracy, real-time availability of records, and streamlined workflows through features like search, live visitor tracking, and data export

Aspect	**Manual Visitor Log**	**AI-Driven Library Visitor Log (Proposed System)**
Timeliness of Info	Delayed; librarians must write and later digitize records.	Real-time; records are instantly stored in the database and shown on the dashboard.
Data Accuracy	Error-prone due to handwriting issues, incomplete details, or human mistakes.	High accuracy with OCR + validation logic (regex & keyword checks).

Error & Oversight	High risk of missing/incorrect entries due to fatigue or oversight.	Low risk; system runs consistently with automated validation checks.
Workflow	Fragmented and effort-heavy; involves multiple steps like writing, storing, and tallying.	Integrated and low-effort; a single system handles capture, storage, and retrieval.
Data Retrieval	Slow; searching old records requires manual looku p in registers.	Fast; search by Student ID, Department, or Date Range from the dashboard.
Reporting	Requires manual preparation of summaries/statistics.	Automated CSV export and visualization using dashboards.

Comparative Results

Analysis of Results

The project successfully achieved its core objectives by automating the process of library visitor registration through an AI-powered system. The integration of OCR (Tesseract) with a Flask-based web application allowed for seamless extraction of student details such as Name, Registration Number, and Department from ID cards.

- **Functionality:** The system demonstrated end-to-end functionality — capturing ID card images, extracting key details, validating them, and storing them in an SQLite database. Search features (by Student ID, Department, Date Range) and export options ensured practical usability.
- **Accuracy:** Through image preprocessing (grayscale, resizing) and regex-based validation, the system achieved significantly higher OCR accuracy compared to raw extraction, reducing errors and inconsistencies.
- **Readability:** The visitor dashboard presented results in a clean and structured format, making it easy for librarians to interpret and act upon the data.
- **User Insight:** Real-time logging and live visitor tracking provided valuable insights into visitor.

CONCLUSION

The AI-Driven Library Visitor Log project successfully digitized the process of maintaining visitor records, demonstrating how automation can replace traditional manual methods in libraries. By combining OCR, database management, and a web-based dashboard, the system ensured accuracy, speed, and reliability in handling student information. Comparative analysis clearly showed the superiority of the automated system in terms of data accuracy, processing time, and workflow efficiency.

Overall, the system has proven that even with modest resources, it is possible to design a reliable and low-cost solution that addresses real-world problems in library management. By reducing manual effort, minimizing errors, and improving accessibility of visitor data, the project bridges the gap between traditional practices and modern digital systems. The successful integration of OCR, database management, and web technologies also highlights the potential of AI-driven automation in educational institutions. With continuous refinement and the incorporation of advanced features, this solution can evolve into a full-fledged smart library management platform that not only records visitors but also enhances the overall efficiency and transparency of library operations.

Key Findings:

- OCR with preprocessing and validation significantly improved accuracy (up to 95%) compared to raw OCR.
- Real-time data storage and retrieval allowed instant access to visitor information.
- The system provided librarians with actionable insights via search, live tracking, and reporting features. This work forms the foundation for a scalable solution that can be extended to more advanced functionalities such as face recognition, QR code scanning, and integration with institutional databases.

FUTURE SCOPE AND ENHANCEMENT

The current system provides a strong baseline but has considerable scope for future enhancement to make it more robust, scalable, and user-friendly:

- **Face Recognition Integration:** Adding a face-matching module will allow automated verification of visitors against their ID photos.
- **QR Code / RFID Support:** ID cards can be embedded with QR codes or RFID chips to enable instant scanning without OCR dependency.
- **Cloud Deployment:** Migrating the system to a cloud-based platform (AWS, Azure, or Google Cloud) would support multi-device access, scalability, and centralized management.
- **Advanced Database:** Transitioning from SQLite to MySQL or PostgreSQL would allow handling larger datasets and concurrent users efficiently.
- **Cross-Platform Support:** Developing a mobile-friendly app interface will enable on-the-go registration and monitoring.
- **Analytics Dashboard:** Adding advanced data analytics, visitor trend prediction, and visualization will provide richer insights for library management.

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