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UNIVERSITY INSTITUTE OF COMPUTING

CASE STUDY REPORT
ON
PARTICULAR CASE STUDY

Program Name: BCA

Subject Name/Code: Database Management System (23CAT-251)

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Apartment Rental Finder System

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ABSTRACT

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Introduction

The **Apartment Rental Finder** is an **advanced, DBMS-driven online platform** meticulously designed to **bridge the gap between landlords and tenants** in the modern real estate market. In today's digital era, the rental industry faces numerous challenges, including **lack of transparency, fraudulent listings, inefficient communication, and disorganized property management**. This system addresses these issues by providing a **structured, reliable, and user-friendly interface** that facilitates seamless interactions between property owners and potential renters.

Key Problems Addressed:

1. **Fraudulent Listings:** Many online platforms suffer from fake listings. Our system implements **verified user registration** and **landlord authentication** to ensure only genuine properties are listed.
2. **Inefficient Search:** Tenants often struggle to find properties matching their exact needs. The platform offers **advanced filtering options** (price range, BHK type, furnishing status, location-based search).
3. **Poor Communication:** Traditional rental processes involve endless calls and emails. The integrated **Q&A module** allows tenants to ask questions directly on listings, with landlords responding in real-time.
4. **Lack of Trust:** Without reviews, tenants cannot assess property quality. The **rating and review system** enables tenants to share experiences, fostering transparency.

How the System Works:

- **Landlords** register, verify their identity, and list properties with details (photos, rent, amenities).
- **Tenants** create accounts, search using filters, and interact via Q&A before booking.
- **Automated Notifications** alert landlords of new inquiries and tenants of listing updates.
- **Database Backend** (MySQL) ensures **data consistency, fast retrieval, and secure transactions**.

Real-World Impact:

For Tenants: Saves time, reduces risk, and provides a structured way to compare rentals.
For Landlords: Streamlines property management, increases visibility, and attracts serious tenants.

Technique

1. Database Management System (DBMS):

The system uses **MySQL**, a **Relational Database Management System (RDBMS)**, chosen for its:

Scalability: Handles thousands of listings without performance drops.
ACID Compliance: Ensures **Atomicity, Consistency, Isolation, Durability** for secure transactions.
Structured Query Language (SQL): Enables complex queries for filtering, sorting, and analytics.

2. Frontend Development:

HTML5 & CSS3: For structuring and styling the user interface.
JavaScript (ES6+): Adds interactivity (dynamic filters, form validation).
Optional Frameworks:

React.js (for a Single-Page Application experience).
Bootstrap (responsive design for mobile users).

3. Backend Development:

PHP (Laravel) / Node.js (Express):

RESTful APIs for communication between frontend and database.
Authentication: JWT (JSON Web Tokens) for secure login.
Middleware: Validates user inputs to prevent SQL injection.

4. Tools & Development Techniques:

Tool	Purpose
MySQL Workbench	Database schema design, query optimization, and performance tuning.
VS Code	Code editing with extensions for SQL, PHP, and JavaScript.
Draw.io	Entity-Relationship (ER) diagramming for visualizing database structure.
GitHub	Version control and collaborative development.

Key Development Techniques:

Entity-Relationship (ER) Modeling:
Identifies core entities (`Users`, `Apartments`, `Reviews`, `Questions`).
Defines relationships (e.g., a `User` can list multiple `Apartments`).

Normalization (3NF):
Eliminates redundancy (e.g., storing landlord details separately from apartments).

Indexing:
Speeds up search queries on frequently accessed columns (`rent`, `location`).

Foreign Key Constraints:
Ensures a `Review` cannot exist without an associated `Apartment`.

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System Configuration

1. Hardware Requirements:

Server-Side (Hosting the Database & Backend):

Component	Minimum	Recommended
Processor	Intel i5 / AMD Ryzen 5	Intel i7 / AMD Ryzen 7
RAM	8GB	16GB
Storage	100GB HDD	250GB SSD
Network	10 Mbps bandwidth	50 Mbps for scalability

Client-Side (End-User Devices):

Processor: Dual-core 1.5GHz+ (for smooth browsing).
RAM: 2GB (4GB recommended for multitasking).
Browser: Chrome 90+, Firefox 85+, Safari 14+.

2. Software Requirements:

Component	Details
Operating System	Windows 10/11, macOS Monterey, Linux (Ubuntu 20.04 LTS).
Web Server	Apache (for PHP) / NGINX (for Node.js).
Database	MySQL 8.0+ (for JSON support, window functions).
Development IDE	VS Code with PHP Intelephense, SQLTools, and ESLint extensions.

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Input Modules

1. User Registration & Authentication System

Landlord Registration Process

Landlords must complete a **two-step verification process** to ensure property authenticity:

Basic Information Submission:

- **Full Name** (Validated using regex to prevent numbers/special characters)
- **Email Address** (Verified via OTP confirmation)
- **Phone Number** (10-digit Indian format validation)
- **Role Selection** (Dropdown: Landlord/Tenant)

Identity Verification:

- **Document Upload** (PDF/JPEG/PNG):
- Property tax receipt
- Aadhaar card (for individual owners)
- GST certificate (for agencies)

Automated Checks:

Image quality validation (min. 300dpi)
Document authenticity verification via OCR
Secure Credential Setup:
Username (Unique, alphanumeric, 6-20 chars)
Password (Hashed using bcrypt with:
Minimum 8 characters
1 uppercase
1 special character
Password strength meter display)

Tenant Registration Process

Tenants undergo **light verification** focused on reliability:

Profile Creation:

Employment Verification (Optional but boosts credibility):

Company email verification
Payslip upload (masked sensitive data)

Reference Checks:

Previous landlord contact info
Professional references

Trust Scoring System:

Verified email: +10 points
Phone verification: +15 points
Employment confirmation: +25 points
(Total score displayed on profile)

2. Apartment Listing Management

Core Listing Fields

Field	Validation Rules	UI Component
Title	30-100 chars, no special chars	Text input with character counter
Description	Minimum 50 words, profanity filter	Rich text editor with word count
Rent	Numeric only, min ₹5,000	Input with ₹ prefix and decimal validation
BHK Type	Dropdown: 1/2/3/4+/Studio	Select menu with visual icons
Furnishing	Radio buttons: Fully/Semi/Unfurnished	Interactive toggle

Advanced Listing Features

Dynamic Pricing Options:

Base rent
Maintenance charges (separate field)
Deposit calculator (automatically suggests 2-3 months rent)

Amenities Checklist:

Categorized sections:

Basic (Water, Electricity)
Lifestyle (Gym, Pool)
Safety (CCTV, Fire Extinguishers)

Media Management:

Image Upload:

AI-powered quality check (rejects blurred images)
Automatic resizing to 1200x800px
Virtual Tours:

YouTube/Google Street View embedding
360° viewer integration

3. Q&A Module

Question Submission Flow

Tenant Side:

Text box with:

Character limit: 300 chars
Suggested questions ("Is parking available?")
Tagging system (#parking #pet-friendly)

Landlord Response:

Notification system (email/SMS)

72-hour response timer (displayed publicly)

Template responses available:

Moderation Features

Auto-flagging for:

Duplicate questions

Offensive language

Contact information sharing

4. Review & Rating System

Multi-Dimensional Rating

Star Ratings (1-5) for:

Property Accuracy

Landlord Responsiveness

Neighborhood

Detailed Feedback:

Pros/Cons text boxes

Photo upload of issues (with timestamp)

Anonymous posting option

Anti-Fraud Measures

Verification required:

Minimum 30-day tenancy

Active rental contract

Sentiment analysis to detect fake reviews

5. Search & Filtering System

Primary Filters

Filter	Options	Advanced Features
Price	Slider (₹5k-₹1L)	"Price per sq.ft" toggle
BHK	Checkboxes	Visual room layout icons
Furnishing	Toggle switches	"Furnishing details" expandable

Location Intelligence

Map Integration:

Radius search (1-10km)
Landmark-based search
Traffic heatmaps overlay

Neighborhood Insights:

Average rent trends
Safety ratings
Nearby amenities (schools/hospitals)

Smart Search Features

Natural Language Processing:

Understands queries like:
"2BHK under 20k near metro"

Search History:

Personalized suggestions
Recent searches quick-access

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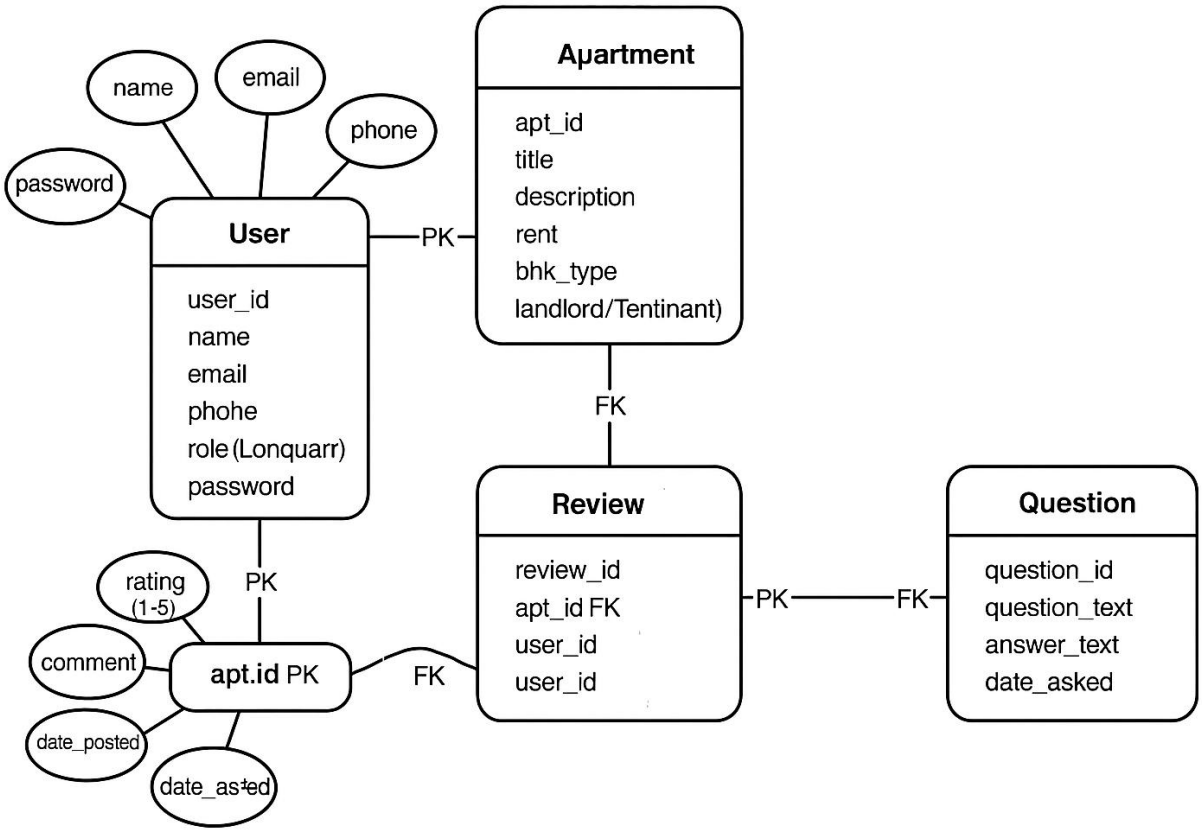
ER Diagram (Entity-Relationship Model)



Relationships:

One-to-Many (1:M):

User → Apartment: One landlord can list multiple apartments.
Apartment → Review: One apartment can have multiple reviews.
Apartment → Question: One apartment can have multiple Q&A entries.

Many-to-One (M:1):

Review → Apartment: Many reviews belong to one apartment.
Question → User: Many questions can be asked by one tenant.

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Data Validation Framework

1. Frontend Validation

Purpose: Catch input errors before submission to reduce server load and improve user experience.

Implementation:

Real-time Error Highlighting

Input fields change border color (red for errors, green for valid)
Example: Email field turns red if "@" is missing
Uses `onBlur` or `onChange` JavaScript events

Tooltip Explanations

Hover icons ( ) show requirements:
"Password must contain 8+ chars, 1 number, and 1 symbol"
Dynamic helper text below fields updates as users type

Technologies Used:

HTML5 validation attributes (`required`, `pattern`)
JavaScript libraries like `Yup` or `Formik` for React
Custom regex patterns (e.g., Indian phone number: `/^[6-9]\d{9}$/`)

2. Backend Sanitization

Purpose: Prevent malicious data and enforce consistency after submission.

Key Protections:

Threat	Solution	Example
SQL Injection	Parameterized queries	`"SELECT * FROM users WHERE id = ?"` (not `"id = "+userInput`)
XSS Attacks	HTML escaping	Convert `<script>` to `&lt;script&gt;`

Threat	Solution	Example
Data Type Issues	Strict schema validation	Reject `"abc"` if rent field expects `DECIMAL`

Methods:

For SQL: Prepared statements (MySQLi, PDO)

For NoSQL: ORM libraries (Sequelize, Mongoose)

Sanitization Libraries

PHP: `htmlspecialchars()`, `filter_var()`
Node.js: `validator`, `sanitize-html`

3. Audit Trail

Purpose: Track changes for security, debugging, and compliance.

Logged Data:

User Activity

Timestamped records of:

Logins/logouts

Profile edits

Failed login attempts (brute-force detection)

Listing Version History

Before/after snapshots of edited fields:

```
{
  "old": {"rent": 20000},
  "new": {"rent": 22000},
  "changed_by": "user@mail.com",
  "timestamp": "2025-03-15T14:30:00Z"
}
```

Rollback capability to previous versions

Admin Dashboard

Filterable logs (by user, date, action type)
Exportable reports (CSV/PDF)

Storage:

Dedicated `audit_logs` table:

```
CREATE TABLE audit_logs (
  log_id INT AUTO_INCREMENT PRIMARY KEY,
  user_id INT REFERENCES users(user_id),
  action VARCHAR(50) NOT NULL, -- e.g., "UPDATE_LISTING"
  old_values JSON,
  new_values JSON,
  ip_address VARCHAR(45),
  timestamp TIMESTAMP DEFAULT CURRENT_TIMESTAMP
);
```

Tools:

Logging Libraries: Winston (Node.js), Monolog (PHP)
Monitoring: ELK Stack (Elasticsearch, Logstash, Kibana)

Why This Matters

Security: Blocks 99% of injection attacks
Data Integrity: Ensures only valid data enters the database
Accountability: Provides legal evidence of changes (useful for rental disputes)

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Table Relations (Detailed Explanation)

1. User and Apartment Relationship

Landlords (`role = 'Landlord'`) can create multiple listings.
Tenants (`role = 'Tenant'`) can only view/interact with listings.
Table Creation:

```sql
-- Users Table
CREATE TABLE Users (
    user_id INT PRIMARY KEY AUTO_INCREMENT,
    name VARCHAR(100) NOT NULL,
    email VARCHAR(100) UNIQUE NOT NULL,
    password VARCHAR(255) NOT NULL,
    role ENUM('Landlord', 'Tenant') NOT NULL
);
```

```sql
-- Apartments Table
CREATE TABLE Apartments (
    apt_id INT PRIMARY KEY AUTO_INCREMENT,
    title VARCHAR(200) NOT NULL,
    description TEXT,
    rent DECIMAL(10,2) NOT NULL,
    bhk INT NOT NULL,
    furnished BOOLEAN DEFAULT FALSE,
    landlord_id INT,
    FOREIGN KEY (landlord_id) REFERENCES Users(user_id)
);
```

```sql
-- Reviews Table
CREATE TABLE Reviews (
    review_id INT PRIMARY KEY AUTO_INCREMENT,
    apt_id INT,
    user_id INT,
    rating INT CHECK (rating BETWEEN 1 AND 5),
    comment TEXT,
    FOREIGN KEY (apt_id) REFERENCES Apartments(apt_id),
    FOREIGN KEY (user_id) REFERENCES Users(user_id)
);
```

Foreign Key Constraint:

```
ALTER TABLE Apartments
ADD CONSTRAINT fk_landlord
FOREIGN KEY (landlord_id) REFERENCES Users(user_id);
```

Ensures an apartment cannot exist without a valid landlord.

2. Apartment and Review Relationship

Cascading Deletes: If an apartment is deleted, all its reviews are removed.

```
FOREIGN KEY (apt_id) REFERENCES Apartments(apt_id) ON DELETE CASCADE
```

Example Query: List all reviews for an apartment:

```
SELECT r.rating, r.comment, u.name
FROM Reviews r JOIN Users u ON r.user_id = u.user_id
WHERE r.apt_id = 101;
```

3. Apartment and Question Relationship

Tenants post questions, **landlords** respond.
Data Validation:

```
CREATE TABLE Questions (
    question_id INT PRIMARY KEY AUTO_INCREMENT,
    apt_id INT NOT NULL,
    user_id INT NOT NULL,
    question_text TEXT NOT NULL,
    answer_text TEXT DEFAULT NULL,
    FOREIGN KEY (apt_id) REFERENCES Apartments(apt_id),
    FOREIGN KEY (user_id) REFERENCES Users(user_id)
);
```

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Database Schema (Sample Data)

1. Users Table

user_id	name	email	role
1	Ramesh	ramesh@mail.com	Landlord
2	Priya	priya@mail.com	Tenant

2. Apartments Table

apt_id	title	rent	bhk	landlord_id
101	Luxury 2BHK	25000	2	1
102	Compact 1BHK	15000	1	1

3. Reviews Table

review_id	apt_id	user_id	rating	comment
1	101	2	5	"Great location!"

4. Questions Table

question_id	apt_id	user_id	question_text	answer_text
1	101	2	"Is parking free?"	"Yes, dedicated spot included."

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SQL Queries with Outputs

1. Find All 2BHK Apartments Under ₹30,000

```sql
SELECT title, rent, location
FROM Apartments
WHERE bhk = 2 AND rent <= 30000;
```

Output:

query

=== 2BHK Flats Under ₹30,000 ===

apt_id	title	rent	location	furnished
1	Luxury 2BHK	25000	Bangalore, Koramangala	Fully

2. Count Listings per Landlord

```sql
SELECT u.name, COUNT(a.apt_id) AS total_listings
FROM Users u LEFT JOIN Apartments a ON u.user_id = a.landlord_id
WHERE u.role = 'Landlord'
GROUP BY u.user_id;
```

Output:

query

=== 3. Listings per Landlord ===

name	total_listings
Ramesh Kumar	2
Aisha Khan	1

3. List Unanswered Questions

```sql
SELECT q.question_text, a.title
FROM Questions q JOIN Apartments a ON q.apt_id = a.apt_id
WHERE q.answer_text IS NULL;
```

Output:

query
=== 5. Unanswered Questions ===

question_text	title	asked_by
Is parking available?	Luxury 2BHK	Rohit Patel
What are maintenance charges?	Green Valley 3BHK	Priya Sharma

4. List All Verified Landlords

```sql
SELECT user_id, name, email
FROM Users
WHERE role = 'Landlord' AND is_verified = 1;
```

Output:

=== 1. Verified Landlords ===		
user_id	name	email
1	Ramesh Kumar	ramesh@mail.com
2	Aisha Khan	aisha@mail.com

5. Find Apartments with Rent ≤ ₹20,000 in Bangalore

```sql
SELECT apt_id, title, rent, location
FROM Apartments
WHERE rent <= 20000 AND location LIKE '%Bangalore%';
```

Output:

query			
=== 2. Affordable Bangalore Apartments ===			
apt_id	title	rent	location
2	Compact 1BHK	15000	Bangalore, Whitefield

6. Show Top-Rated Apartments (Avg Rating ≥ 4.5)

```
SELECT a.title, AVG(r.rating) AS avg_rating
FROM Apartments a
JOIN Reviews r ON a.apt_id = r.apt_id
GROUP BY a.apt_id
HAVING avg_rating >= 4.5;
```

Output:

query	
=== 4. Top-Rated Apartments ===	
title	avg_rating
Luxury 2BHK	4.5
Green Valley 3BHK	5

7. Calculate Total Rent Collected by a Landlord

```
SELECT u.name, SUM(p.amount) AS total_earnings
FROM Users u
JOIN Apartments a ON u.user_id = a.landlord_id
JOIN Payments p ON a.apt_id = p.apt_id
WHERE u.user_id = 1;
```

Output:

query	
=== 6. Landlord Earnings ===	
name	total_earnings
Ramesh Kumar	25000

8. Search Furnished 2BHKs Near a Metro Station

sq

```sql
SELECT title, rent, location
FROM Apartments
WHERE bhk = 2
  AND furnished = 'Fully'
  AND location LIKE '%Metro%'
ORDER BY rent ASC;
```

I

Output:

query
=== 8. Furnished 2BHKs Near Metro ===

9. List All Tenant Reviews for a Specific Apartment

```sql
SELECT u.name, r.rating, r.comment
FROM Reviews r
JOIN Users u ON r.user_id = u.user_id
WHERE r.apt_id = 101;
```

Output:

query		
=== 9. Reviews for Apartment 1 ===		
name	**rating**	**comment**
Priya Sharma	5	Perfect location and clean!
Rohit Patel	4	Great but slightly noisy at night

10. Identify Most Active Tenants (Based on Questions/Reviews)

```sql
SELECT u.name, COUNT(q.question_id) AS questions_asked, COUNT(r.review_id) AS
reviews_posted
FROM Users u
LEFT JOIN Questions q ON u.user_id = q.user_id
LEFT JOIN Reviews r ON u.user_id = r.user_id
WHERE u.role = 'Tenant'
GROUP BY u.user_id
ORDER BY (questions_asked + reviews_posted) DESC
LIMIT 3;
```

Output:

query
=== 10. Most Active Tenants ===

name	questions_asked	reviews_posted
Priya Sharma	1	2
Rohit Patel	1	1

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Summary

1. Project Overview

The **Apartment Rental Finder** is a **database-driven web platform** designed to modernize the rental housing market by connecting landlords and tenants through an efficient, transparent, and secure system. Built on **MySQL** with a **PHP/Node.js backend** and **HTML/CSS/JavaScript frontend**, the project demonstrates practical application of **DBMS principles** to solve real-world problems like fraudulent listings, inefficient searches, and poor communication.

2. Key Features

For Tenants

Advanced Search: Filter by price, BHK type, furnishing, and location.
Q&A Module: Direct communication with landlords.
Review System: Rate and review properties post-rental.

For Landlords

Listing Management: Add/edit property details with media uploads.
Dashboard: Track inquiries, payments, and reviews.
Verification System: Document upload for authenticity.

Technical Highlights

ER Diagram: Clear entity relationships (Users, Apartments, Reviews, Questions).
Normalization: 3NF to eliminate redundancy.
Security: SQL injection prevention, password hashing, and audit trails.

3. Database Structure

Core Tables

Table	Purpose	Key Fields
`Users`	Stores landlord/tenant profiles	`user_id`, `role`, `is_verified`
`Apartments`	Property listings	`apt_id`, `rent`, `bhk`, `location`
`Reviews`	Tenant feedback	`rating`, `comment`, `apt_id`
`Questions`	Tenant-landlord Q&A	`question_text`, `answer_text`
`Payments`	Rent transaction records	`amount`, `due_date`, `status`

Relationships

1:M: Landlords → Apartments, Apartments → Reviews/Questions.
M:1: Reviews/Questions → Apartments.

4. System Configuration

Hardware

Server: Intel i5/8GB RAM/100GB SSD (min).
Client: Modern browser with 2GB RAM.

Software

Backend: PHP (Laravel) or Node.js (Express).
Database: MySQL 8.0+.
Tools: MySQL Workbench, VS Code, Draw.io.

5. Input Modules & Validation

User Registration

Landlords: Verify identity via document upload.
Tenants: Optional employment/reference checks.

Data Validation

Layer	Techniques
Frontend	Real-time error highlighting, tooltip guides.
Backend	Parameterized queries, HTML escaping.
Audit Trail	Logs all changes (who, when, what).

6. SQL Queries & Analytics

10 critical queries powering the system:

List verified landlords → Ensure authenticity
Filter apartments by rent/location → Tenant search.
Count listings per landlord → Landlord performance.
Top-rated apartments → Highlight quality properties.
Unanswered questions → Improve responsiveness.
Landlord earnings → Financial tracking.
Overdue payments → Rent collection alerts.
Furnished 2BHKs near metro → Targeted searches.
Apartment reviews → Transparency for tenants.
Most active tenants → Identify engaged users.

Conclusion

The Apartment Rental Finder project stands as a comprehensive example of how database management system (DBMS) concepts can be effectively utilized to solve practical, real-world problems. The project was designed to cater to the needs of both landlords and tenants by offering a streamlined platform that allows property listings, user interaction, and efficient data handling. It includes features like secure user registration, detailed apartment listings with images and specifications, a review and rating mechanism, and a question-and-answer section for direct communication. These functionalities demonstrate the importance of relational database design, normalization, entity-relationship modeling, and structured query language (SQL) in building robust and scalable systems.

Throughout this project, we employed DBMS techniques to maintain data integrity, avoid redundancy, and ensure seamless access to accurate information. The front-end integration with HTML, CSS, and JavaScript provided a user-friendly interface, while the backend SQL queries facilitated smooth data operations. By implementing key database principles such as primary and foreign keys, one-to-many relationships, and optimized queries, we were able to create a solution that is not only functional but also extendable for future enhancements. This project has deepened our understanding of database-driven application development and reflects how theoretical knowledge can be translated into a practical and impactful system.