Project Title:

AI-Driven Real Estate Document Verification & Intelligence System

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GitHub:

https://github.com/Sharan-Muthu-Krishna/AI-Powered-Real-Estate-Management

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1. Introduction

The real estate industry heavily depends on legal documents such as property agreements, identity proofs, contracts, and ownership records. These documents are often vulnerable to forgery, manipulation, and fraud, which can lead to major financial and legal losses.

This project presents an **AI-powered Real Estate Management System** that ensures:

- **Authenticity of uploaded documents**
- **Intelligent querying of legal records**
- **Secure handling of property data**

The system combines **Spring Boot enterprise backend** with **AI-driven Python microservices** for document verification and smart question answering.

2. Project Objective

The main goals of this project are:

- To detect forged or tampered images using CNN-based forgery detection
- To allow users to ask natural language questions about legal documents
- To retrieve accurate answers using Retrieval-Augmented Generation (RAG)
- To manage users and properties using a secure backend

3. System Overview

The system consists of three major components:

1. **Spring Boot Backend**
    - Handles users, properties, authentication, and API routing
2. **Forgery Detection Service (Flask)**
    - Uses CNN + Error Level Analysis (ELA) to detect image manipulation
3. **RAG Query Service (FastAPI)**
    - Allows intelligent search and question answering over uploaded documents

Together, they form a **secure, AI-driven real estate platform**.

4. AI & Machine Learning Modules

Image Forgery Detection

The system uses:

- **Error Level Analysis (ELA)** to expose manipulation patterns
- A **MobileNet-based Convolutional Neural Network** fine-tuned on real and forged document images

The CNN learns to distinguish:

- Authentic documents
- Digitally manipulated or altered documents

The model outputs:

- Probability of authenticity
- Probability of forgery

This allows automated verification of legal and property images.

5. Retrieval-Augmented Generation (RAG) System

The RAG pipeline enables users to **query documents using natural language**.

It works in four stages:

1. **Document Chunking**
    - Uploaded documents are split into small meaningful parts
2. **Embedding**
    - Each chunk is converted into a vector representation
3. **Vector Database**
    - Embeddings are stored for semantic search
4. **Answer Generation**
    - Relevant chunks are retrieved
    - The Gemma 3N model generates a human-like answer

This allows users to ask:

“What is the owner name?”
“What is the policy duration?”
“What are the payment terms?”

and receive intelligent answers.

6. Backend & Microservice Design

Spring Boot (Core System)

It manages:

- Users and roles (Admin, Agent, Customer)
- Property listings
- API communication with AI services

Flask (Forgery Detection)

- Receives images
- Applies ELA
- Runs CNN model
- Returns authenticity and forged score

FastAPI (RAG Engine)

- Stores document embeddings
- Runs semantic search
- Calls Gemma 3N API
- Returns AI-generated answers

7. Technology Stack

Layer	Technology
Backend	Java 17, Spring Boot, JPA, Hibernate
Frontend	HTML, CSS, JavaScript, Thymeleaf

Forgery Detection	Python, Flask, TensorFlow/Keras
RAG System	Python, FastAPI, LangChain
LLM	Gemma 3N API
Database	MySQL
Vector Store	FAISS

8. Performance & Evaluation

Forgery Detection

- CNN correctly identifies manipulated document images
- ELA improves visibility of tampered regions
- Processing time: **2–10 seconds per document (CPU)**

RAG Querying

- Query response time: **5–12 seconds**
- Depends on:
    - Document size
    - Number of chunks
    - External LLM API

Vector search is optimized using FAISS, keeping retrieval under **1 second**.

9. How to Run the System

1. **Start Spring Boot**

   ```
   mvn spring-boot:run
   ```

2. **Start RAG Service**

   ```
   cd rag
   venv\Scripts\activate
   uvicorn app.main:app --reload
   ```

3. **Start Forgery Detection**

   cd forgery_detection_api

   venv\Scripts\activate

   python app.py

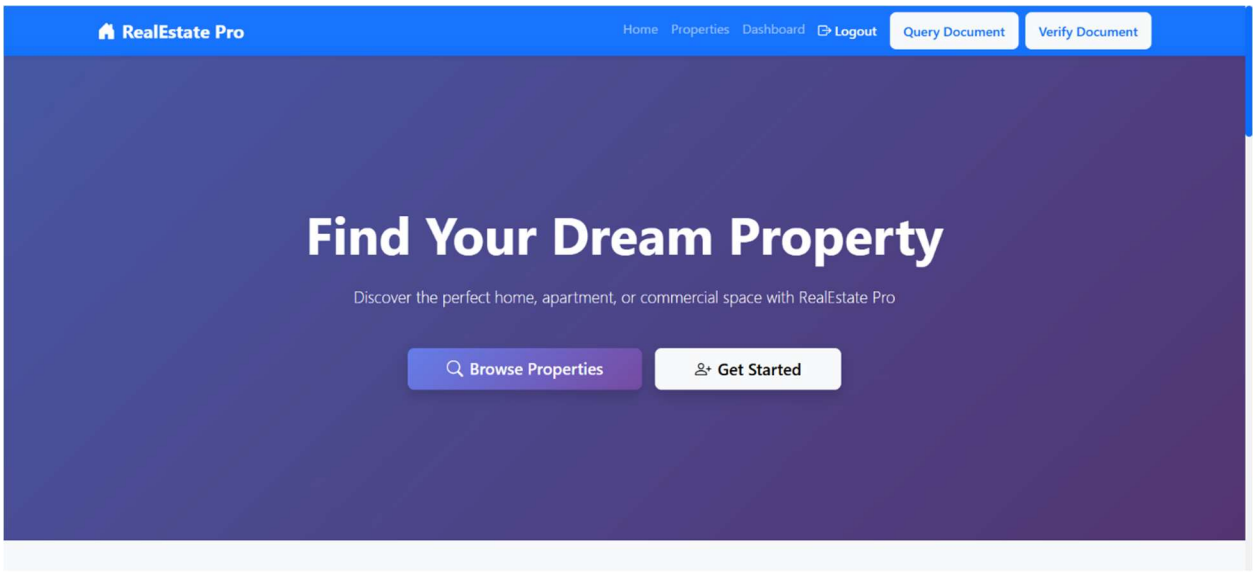
4. **Start MySQL**

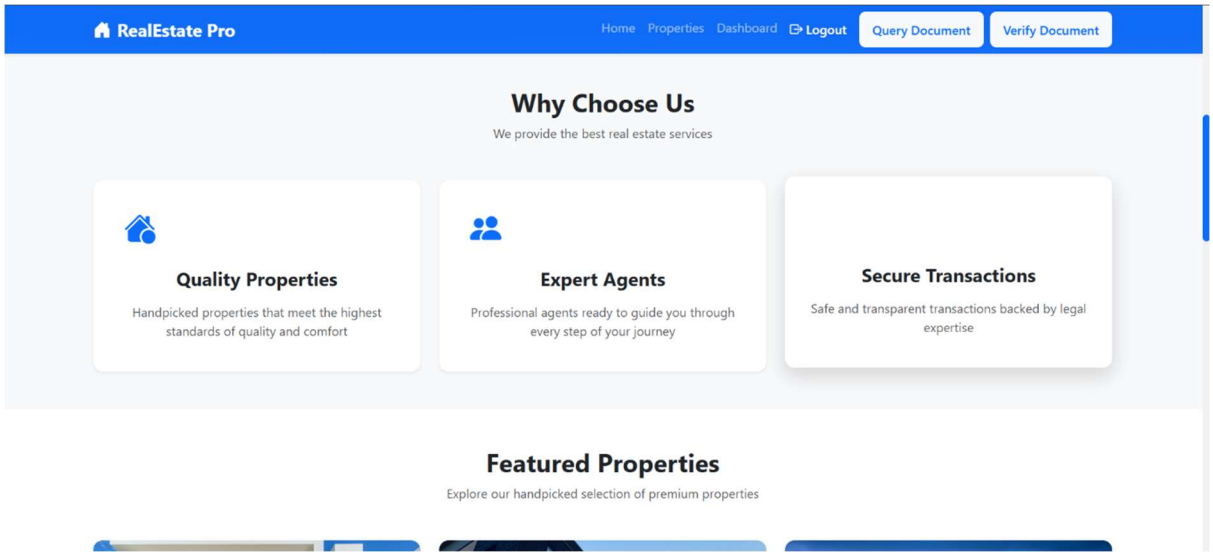
   mysql -u root -p

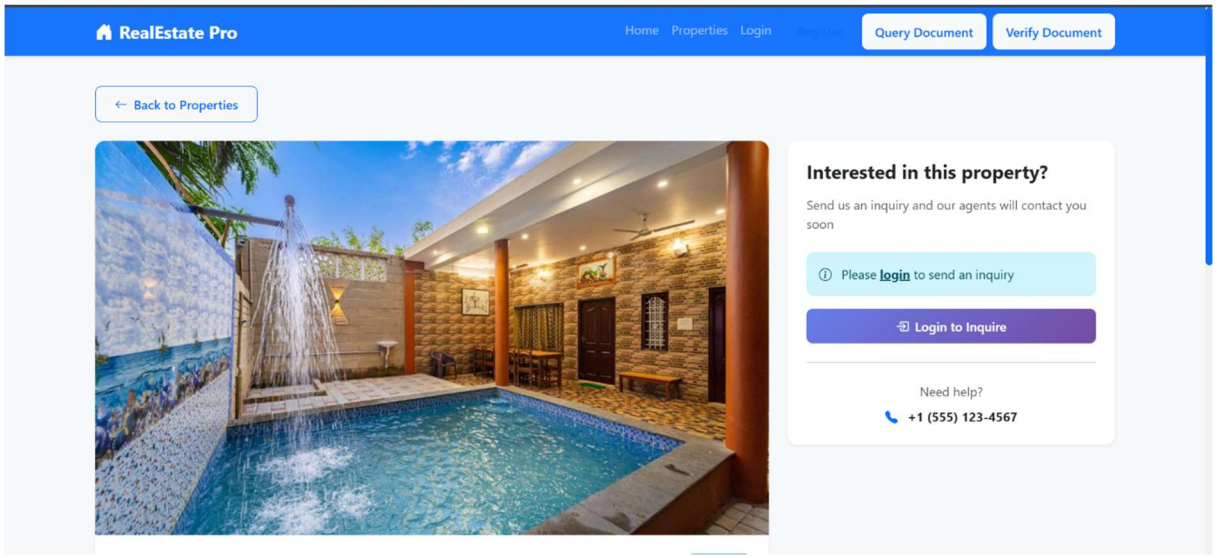
10. Screenshots

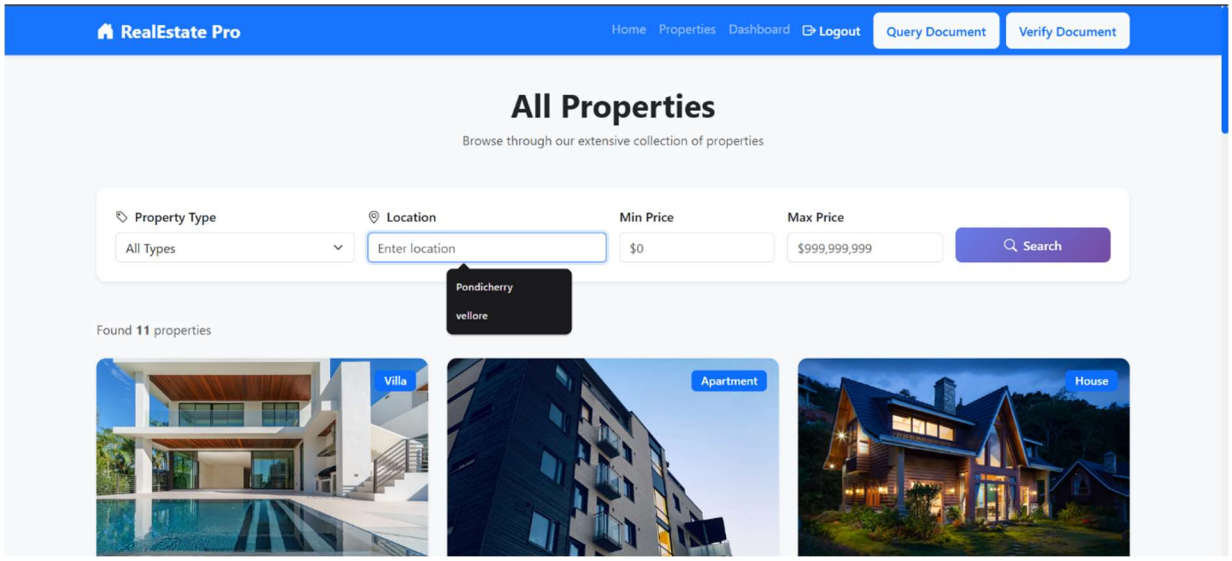
10.1 Public Home Page & Property Browsing

This screenshot shows the public home page of the Real Estate platform.
Users can browse property listings, view featured properties, and navigate through different pages without logging in. This ensures open access for visitors to explore available properties before creating an account.



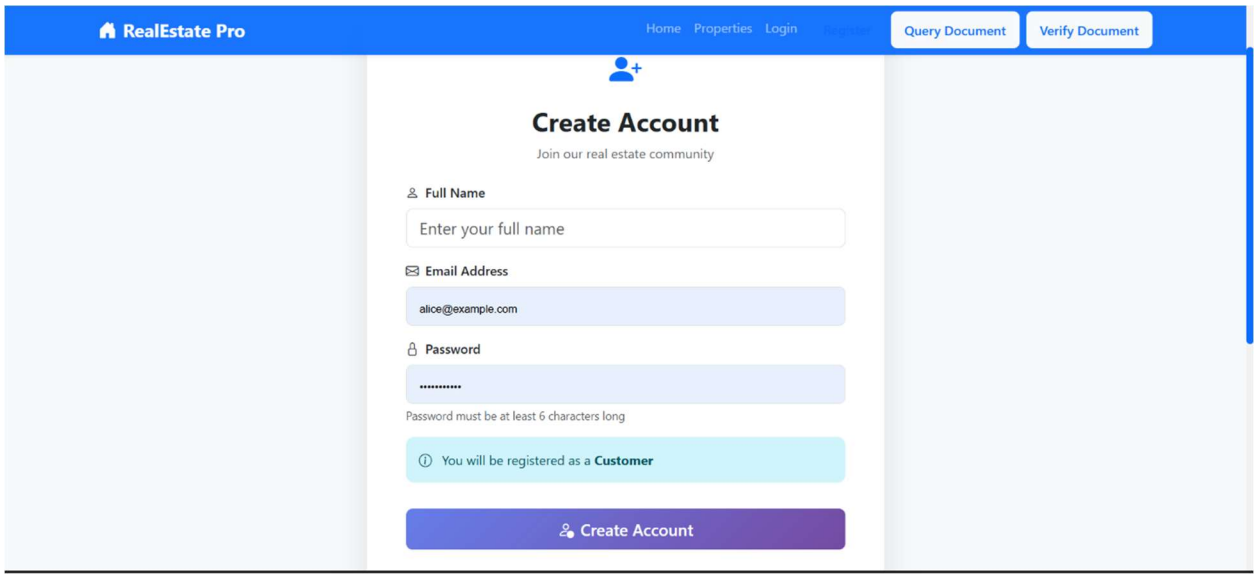

RealEstate Pro
Home
Properties
Dashboard
Logout
Query Document
Verify Document
Why Choose Us
We provide the best real estate services
Quality Properties
Handpicked properties that meet the highest standards of quality and comfort
Expert Agents
Professional agents ready to guide you through every step of your journey
Secure Transactions
Safe and transparent transactions backed by legal expertise
Featured Properties
Explore our handpicked selection of premium properties

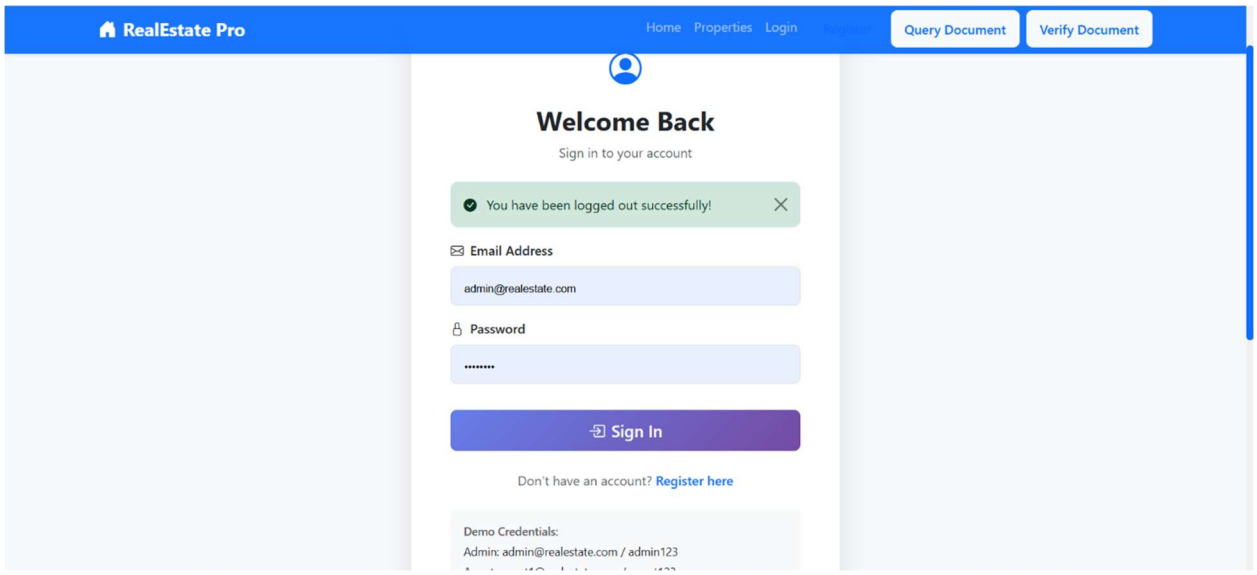

RealEstate Pro
Home
Properties
Login
Query Document
Verify Document
← Back to Properties
Interested in this property?
Send us an inquiry and our agents will contact you soon
Please login to send an inquiry
Login to Inquire
Need help?
+1 (555) 123-4567


RealEstate Pro
Home
Properties
Dashboard
Logout
Query Document
Verify Document
All Properties
Browse through our extensive collection of properties
Property Type
All Types
Location
Enter location
Pondicherry
vellore
Min Price
$0
Max Price
$999,999,999
Search
Found 11 properties
Villa
Apartment
House

10.2 User Registration & Login

This screenshot displays the user authentication system where users can create a new account and log in securely.
It verifies that the Spring Boot backend correctly handles user registration, credential validation, and role-based access control.

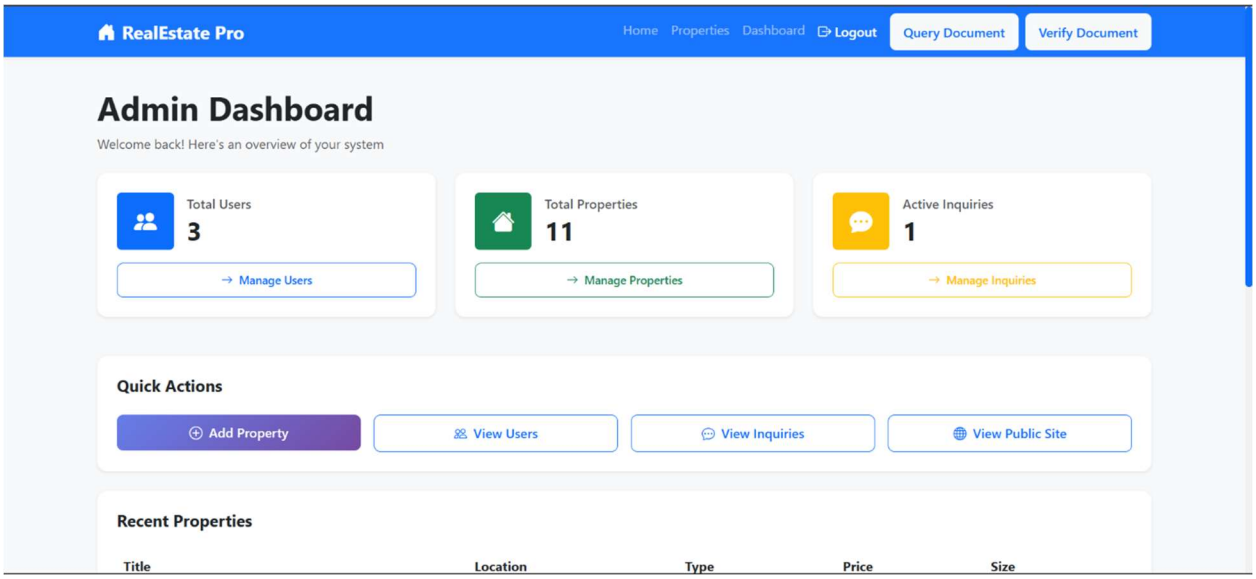


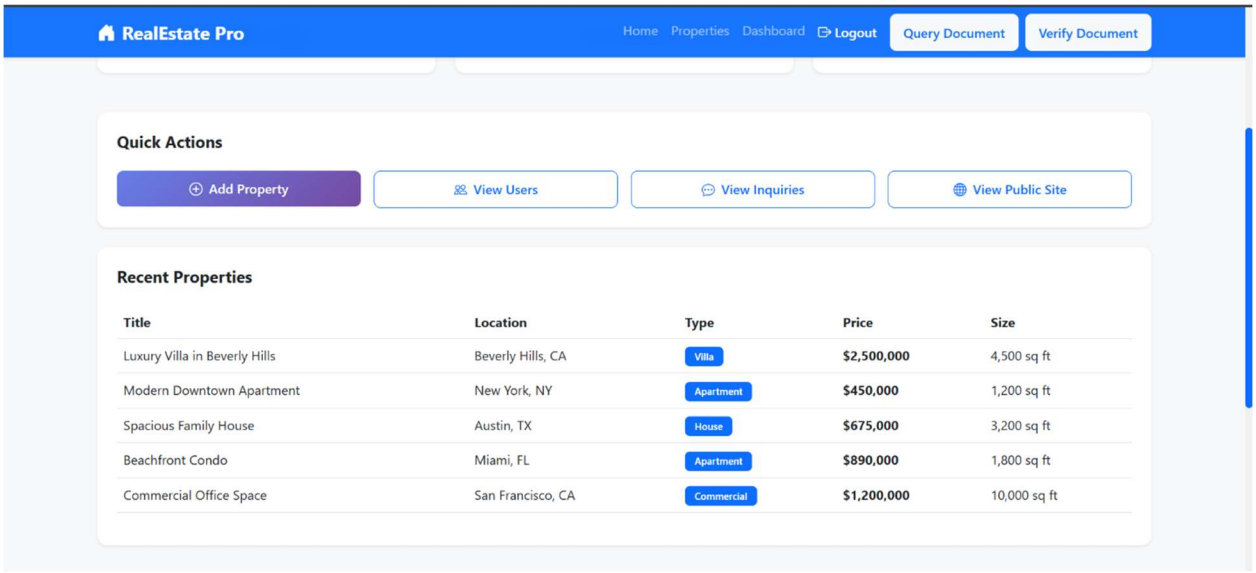


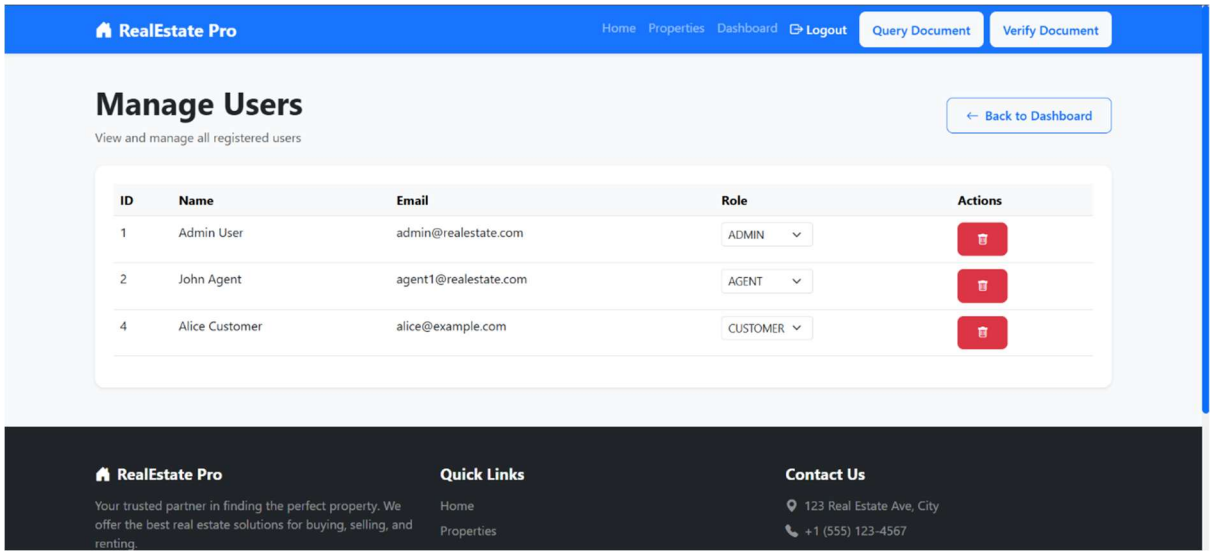
10.3 Admin Dashboard – Users, Properties & Inquiries

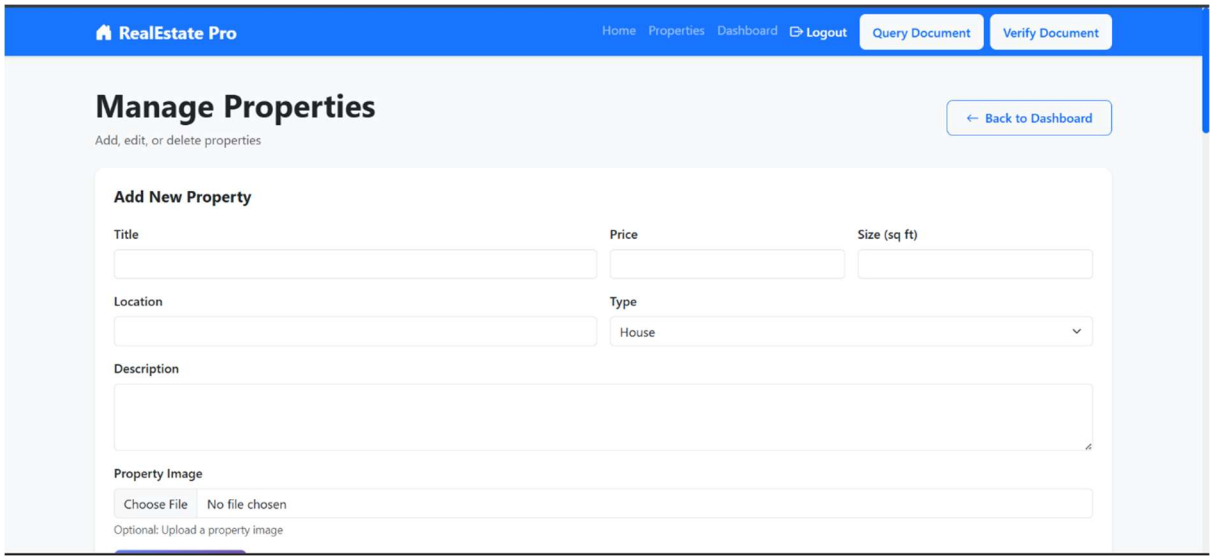
This screenshot shows the admin dashboard.
The administrator can:

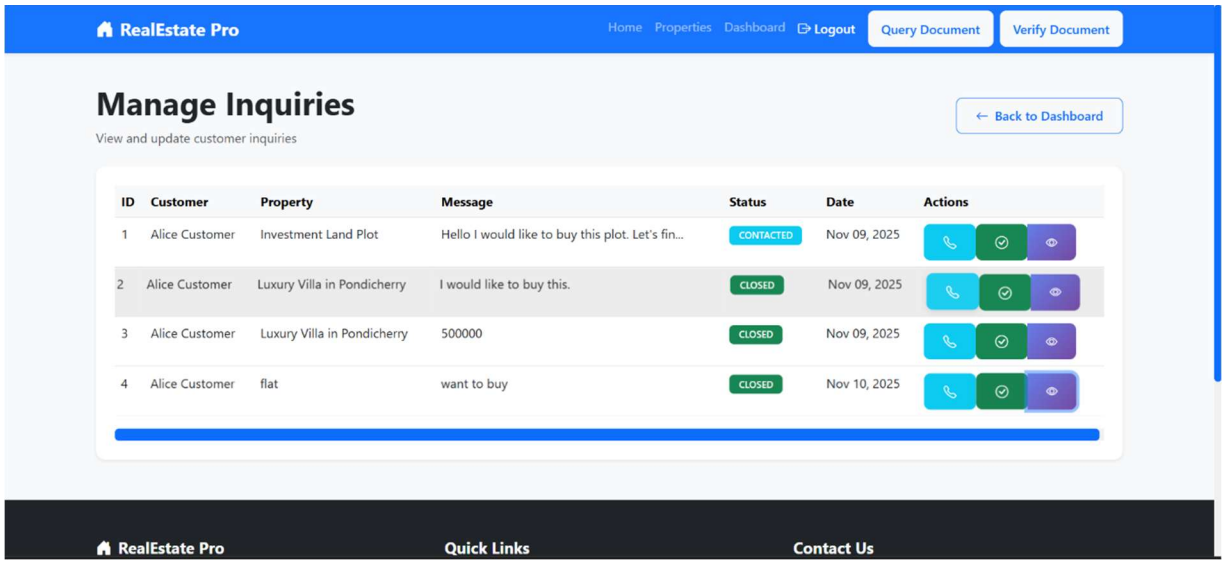
- Manage users and roles
- Add, update, and delete property listings
- View and track customer inquiries





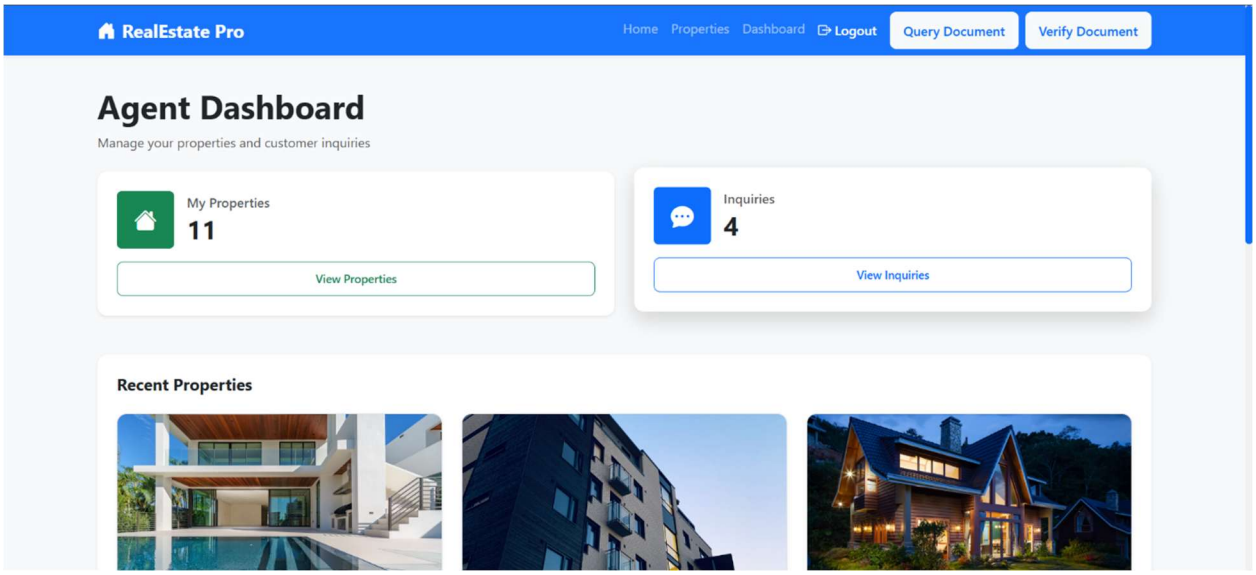

RealEstate Pro
Home Properties Dashboard Logout
Query Document
Verify Document
Manage Users
View and manage all registered users
← Back to Dashboard
ID Name Email Role Actions
1 Admin User admin@realestate.com ADMIN
2 John Agent agent1@realestate.com AGENT
4 Alice Customer alice@example.com CUSTOMER
RealEstate Pro
Your trusted partner in finding the perfect property. We offer the best real estate solutions for buying, selling, and renting.
Quick Links
Home
Properties
Contact Us
123 Real Estate Ave, City
+1 (555) 123-4567

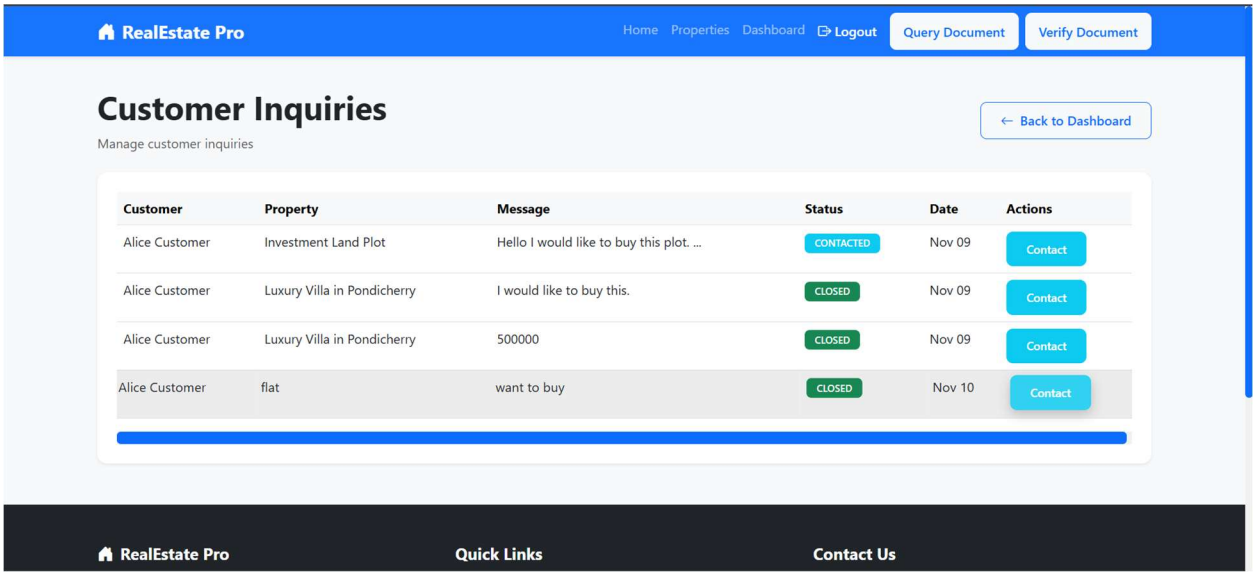

RealEstate Pro
Home Properties Dashboard Logout
Query Document
Verify Document
Manage Properties
Add, edit, or delete properties
← Back to Dashboard
Add New Property
Title
Price
Size (sq ft)
Location
Type
House
Description
Property Image
Choose File
No file chosen
Optional: Upload a property image


RealEstate Pro
Home Properties Dashboard Logout
Query Document
Verify Document
Manage Inquiries
View and update customer inquiries
← Back to Dashboard
ID Customer Property Message Status Date Actions
1 Alice Customer Investment Land Plot Hello I would like to buy this plot. Let's fin... CONTACTED Nov 09, 2025
2 Alice Customer Luxury Villa in Pondicherry I would like to buy this. CLOSED Nov 09, 2025
3 Alice Customer Luxury Villa in Pondicherry 500000 CLOSED Nov 09, 2025
4 Alice Customer flat want to buy CLOSED Nov 10, 2025
RealEstate Pro
Quick Links
Contact Us

10.4 Agent Dashboard – Customer Inquiries

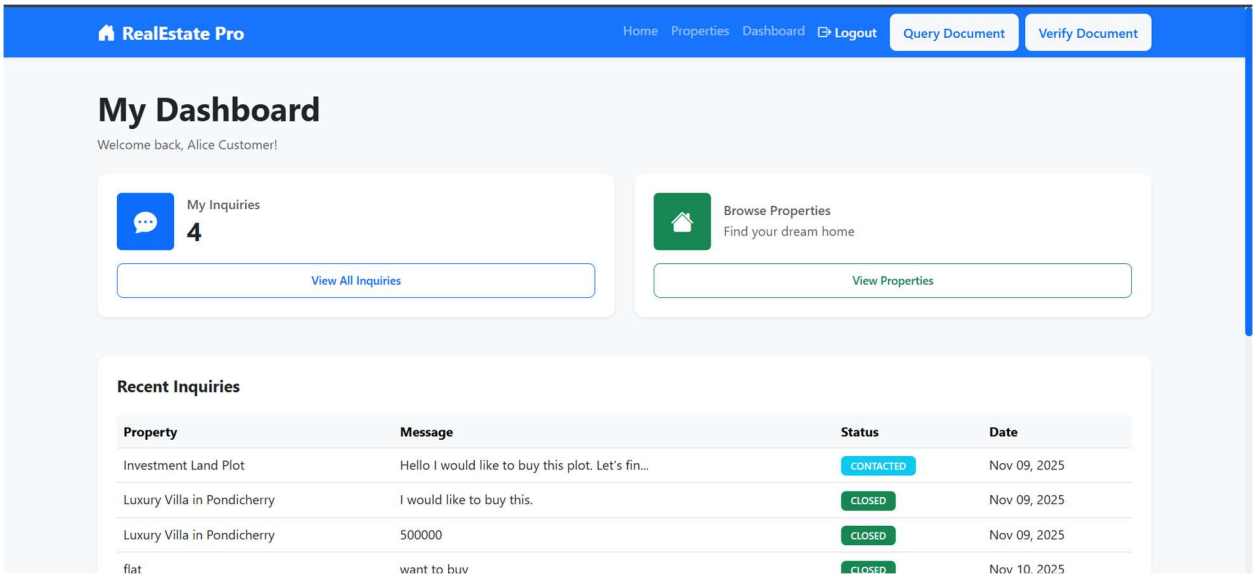
This screenshot displays the agent panel.
Agents can view customer inquiries related to assigned properties and respond to potential buyers.

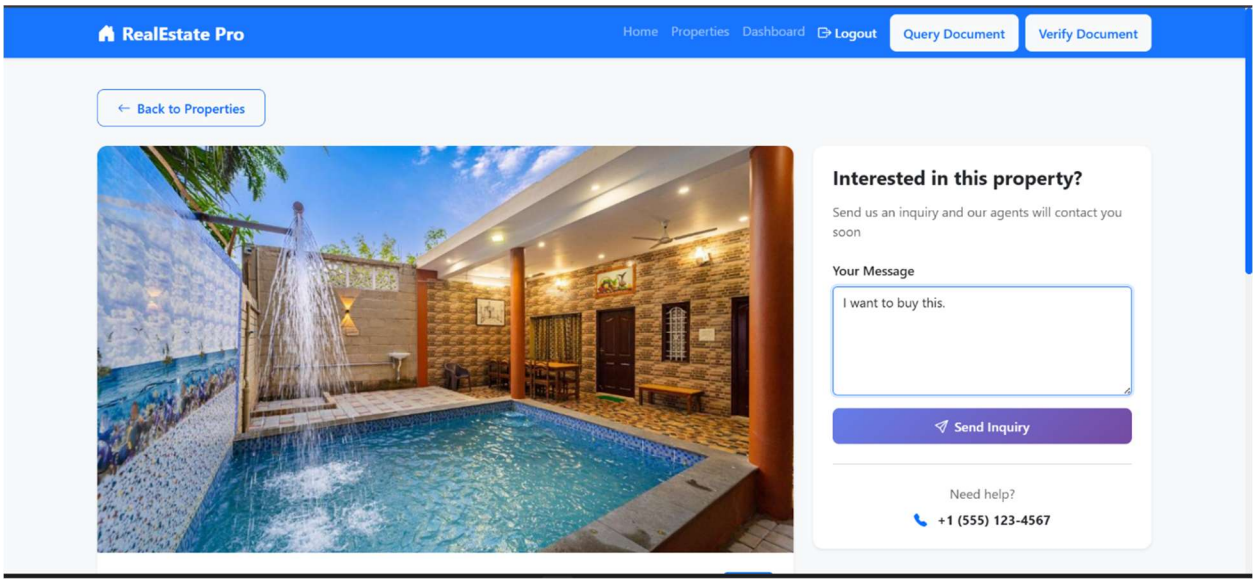




10.5 Customer Dashboard – Property Inquiry

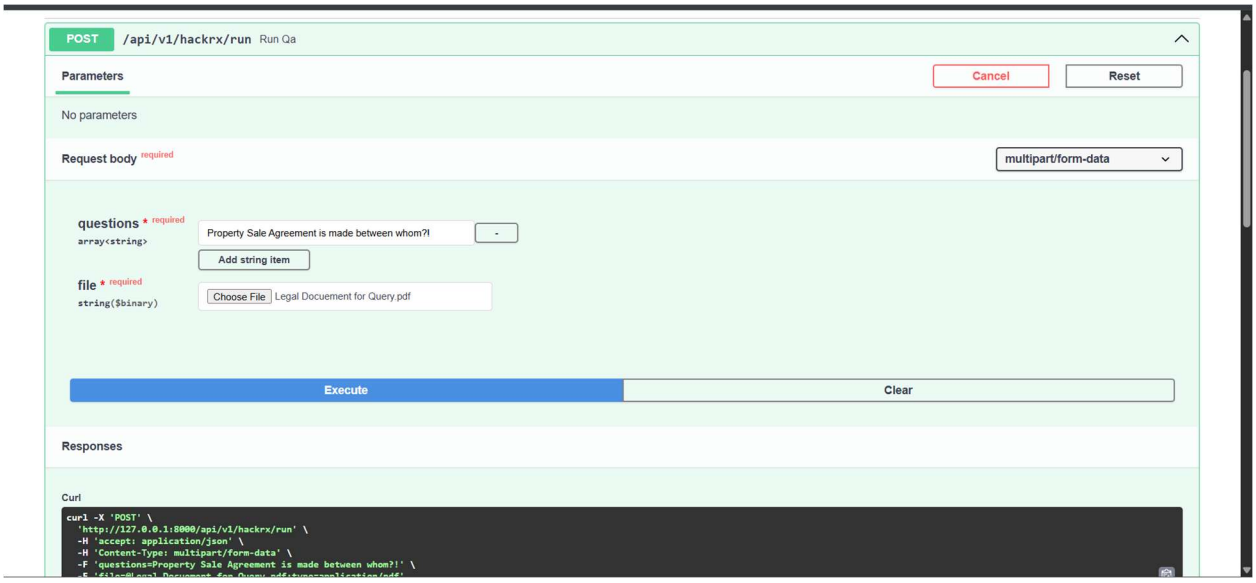
This screenshot shows the customer dashboard where a logged-in user can view property details and submit inquiries about properties they are interested in.
This connects customers directly with agents through the platform

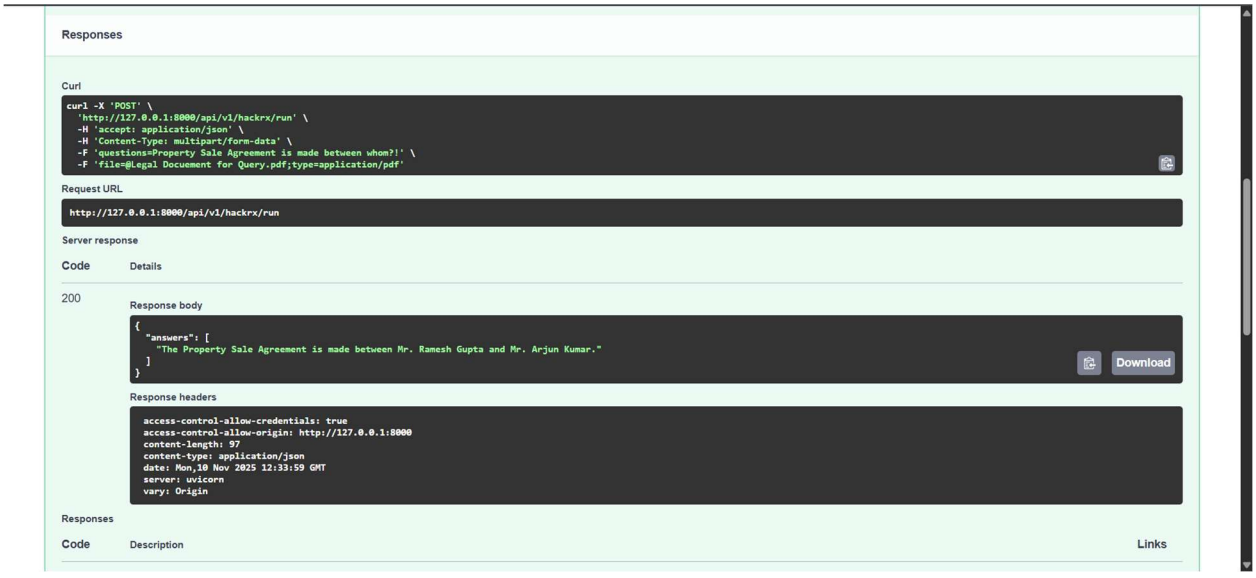




10.6 Document Query (RAG System)

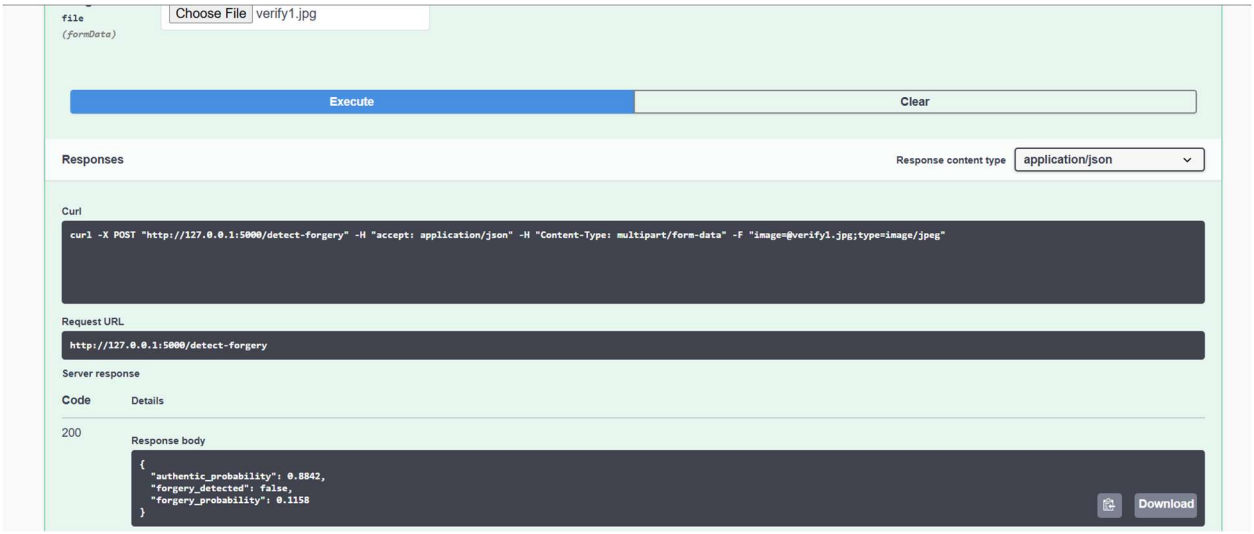
This screenshot shows the document querying interface powered by the RAG pipeline.
Users upload legal or property documents and ask questions in natural language.
The system retrieves relevant information from the documents and generates accurate answers using the Gemma 3N model.





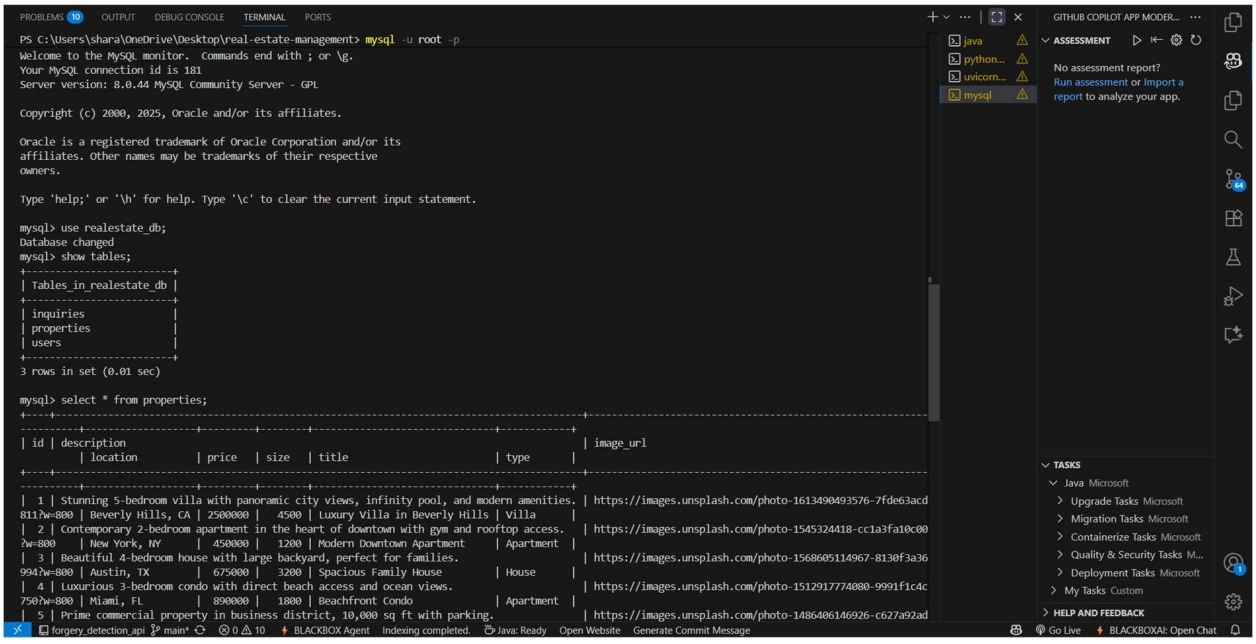
10.7 Forgery Detection

This screenshot shows the forgery detection module. An uploaded document image is processed using Error Level Analysis (ELA) and a deep learning model to determine whether the document is authentic or manipulated. The system returns the forgery probability and authenticity score.



10.8 MySQL Database View

This screenshot displays the MySQL database tables storing: User information, Property data, Inquiry records. It confirms that all system data is securely stored and managed through a relational database.



11. Conclusion

This project demonstrates how **AI, Deep Learning, and RAG** can be integrated into a **real enterprise system**.

By combining:

- **CNN-based forgery detection**
- **LLM-powered document querying**
- **Spring Boot backend**

the system delivers a **secure, intelligent, and scalable** real estate platform.

This project reflects strong skills in:

- AI system design
- Backend engineering
- Machine learning integration