

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

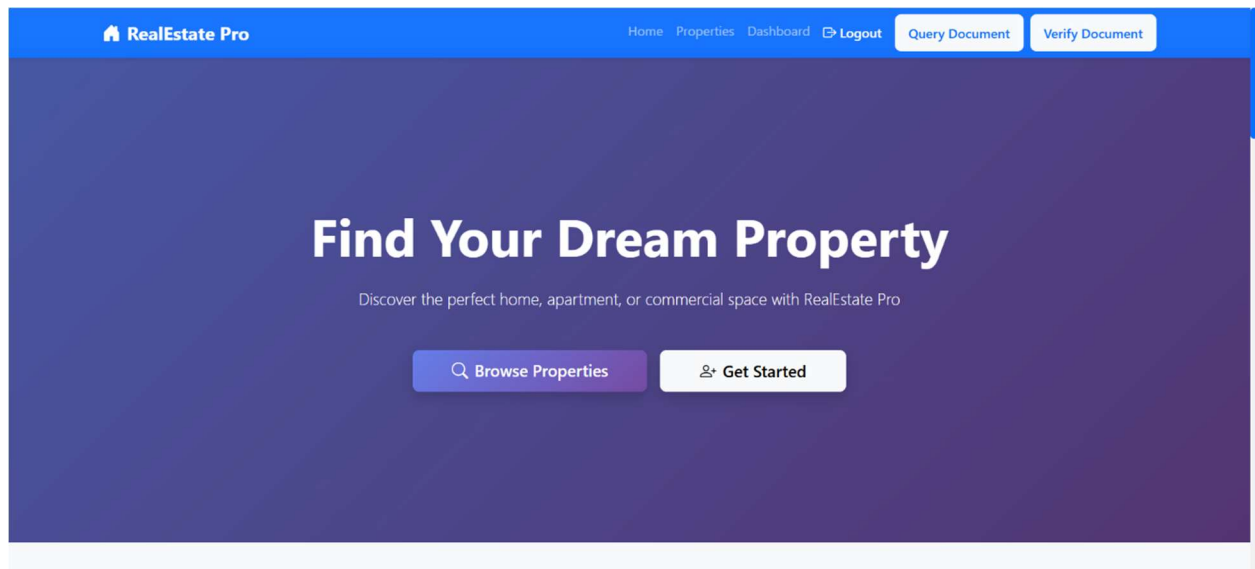
```
mysql -u root -p
```

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

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[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

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[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

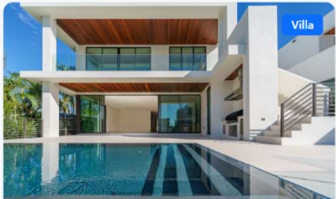
\$0

Max Price

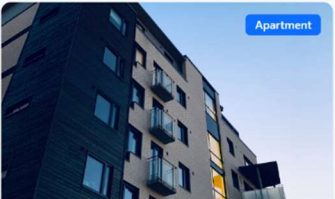
\$999,999,999

Search


Found 11 properties



Villa



Apartment



House

7 | Page

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.

The screenshot shows the 'Create Account' page of the RealEstate Pro application. The page has a blue header with the logo and navigation links: Home, Properties, Login, and a dropdown menu. On the right side of the header, there are buttons for 'Query Document' and 'Verify Document'. The main content area is white and features a 'Create Account' heading with the subtext 'Join our real estate community'. Below this, there are three input fields: 'Full Name' (placeholder: 'Enter your full name'), 'Email Address' (placeholder: 'alice@example.com'), and 'Password' (placeholder: '*****'). A note below the password field states 'Password must be at least 6 characters long'. A light blue box indicates 'You will be registered as a Customer'. At the bottom, there is a purple 'Create Account' button.

The screenshot shows the 'Welcome Back' login page of the RealEstate Pro application. The page has a blue header with the logo and navigation links: Home, Properties, Login, and a dropdown menu. On the right side of the header, there are buttons for 'Query Document' and 'Verify Document'. The main content area is white and features a 'Welcome Back' heading with the subtext 'Sign in to your account'. Below this, there is a green notification box that says 'You have been logged out successfully!'. There are two input fields: 'Email Address' (placeholder: 'admin@realestate.com') and 'Password' (placeholder: '*****'). A purple 'Sign In' button is located below the password field. At the bottom, there is a link 'Don't have an account? Register here'. A 'Demo Credentials' section at the bottom left shows 'Admin: admin@realestate.com / admin123'.

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

The screenshot displays the 'Admin Dashboard' for 'RealEstate Pro'. The top navigation bar includes links for Home, Properties, Dashboard, Logout, Query Document, and Verify Document. The dashboard features three summary cards: 'Total Users' (3), 'Total Properties' (11), and 'Active Inquiries' (1), each with a 'Manage' link. Below these are 'Quick Actions' buttons for adding properties, viewing users, inquiries, and the public site. A 'Recent Properties' table is partially visible at the bottom.

Title	Location	Type	Price	Size
Luxury Villa in Beverly Hills	Beverly Hills, CA	Villa	\$2,500,000	4,500 sq ft
Modern Downtown Apartment	New York, NY	Apartment	\$450,000	1,200 sq ft
Spacious Family House	Austin, TX	House	\$675,000	3,200 sq ft
Beachfront Condo	Miami, FL	Apartment	\$890,000	1,800 sq ft
Commercial Office Space	San Francisco, CA	Commercial	\$1,200,000	10,000 sq ft

This screenshot provides a detailed view of the 'Recent Properties' table within the admin dashboard. The table lists five properties with their titles, locations, types, prices, and sizes. The 'Type' column uses color-coded buttons to represent different property categories.

Title	Location	Type	Price	Size
Luxury Villa in Beverly Hills	Beverly Hills, CA	Villa	\$2,500,000	4,500 sq ft
Modern Downtown Apartment	New York, NY	Apartment	\$450,000	1,200 sq ft
Spacious Family House	Austin, TX	House	\$675,000	3,200 sq ft
Beachfront Condo	Miami, FL	Apartment	\$890,000	1,800 sq ft
Commercial Office Space	San Francisco, CA	Commercial	\$1,200,000	10,000 sq ft

RealEstate Pro

HomePropertiesDashboardLogoutQuery DocumentVerify 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

HomeProperties

Contact Us

123 Real Estate Ave, City

+1 (555) 123-4567

RealEstate Pro

HomePropertiesDashboardLogoutQuery DocumentVerify Document

Manage Properties

Add, edit, or delete properties

Back to Dashboard

Add New Property

Title

Price

Size (sq ft)

Location

Type

Description

Property Image

Choose File

No file chosen

Optional: Upload a property image

RealEstate Pro

HomePropertiesDashboardLogoutQuery DocumentVerify 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

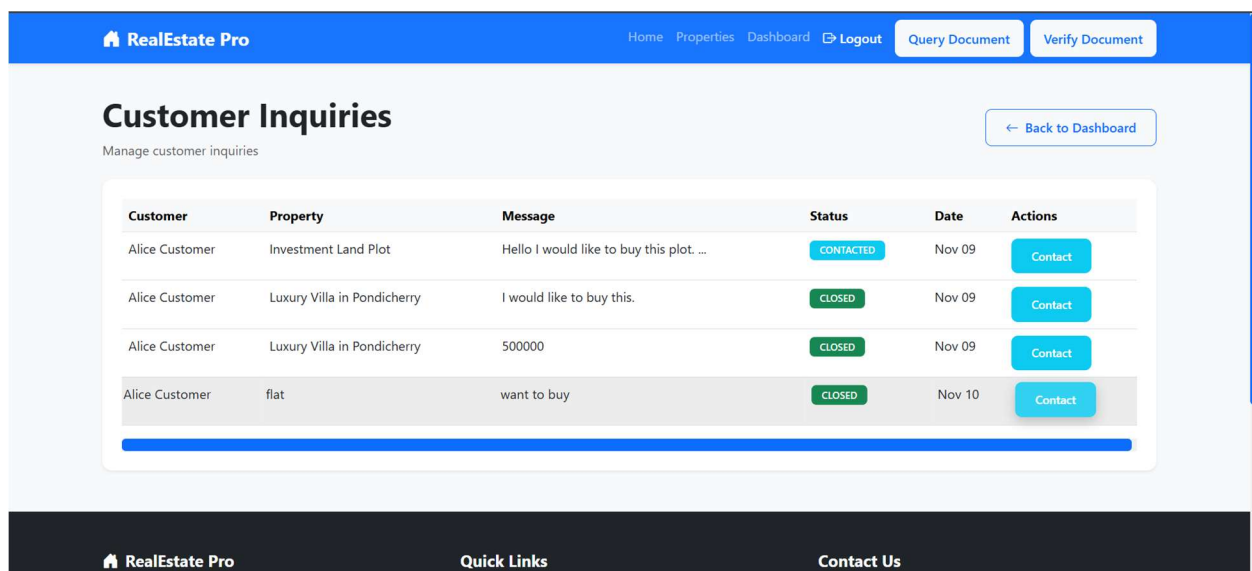
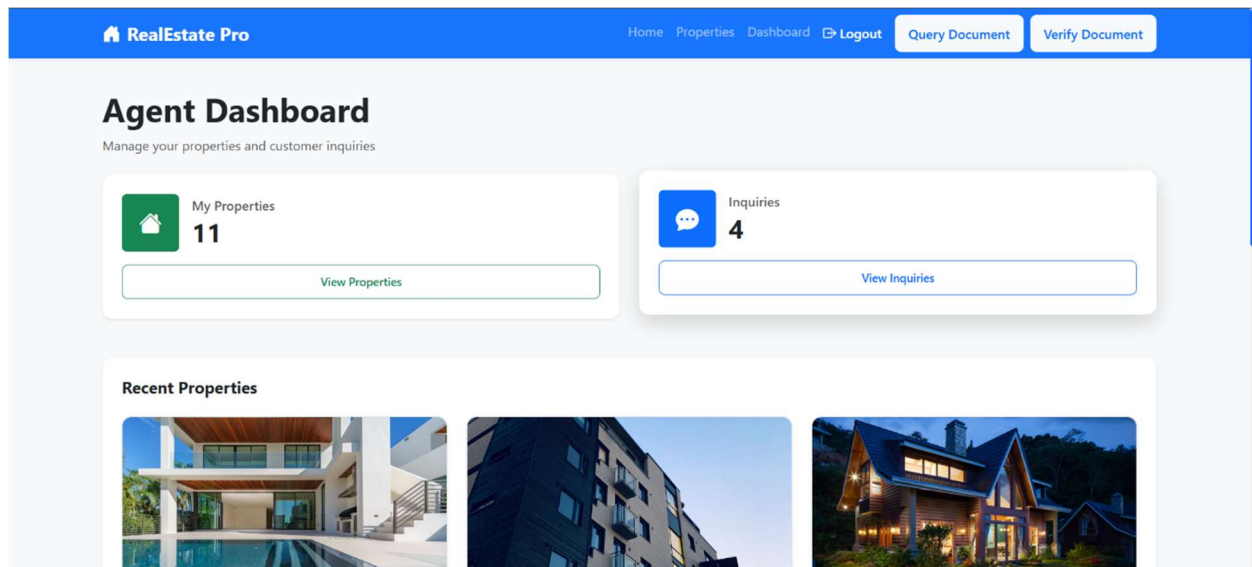
Quick Links

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

RealEstate Pro

Home Properties Dashboard Logout Query Document Verify Document

My Dashboard

Welcome back, Alice Customer!

My Inquiries

4

View All Inquiries

Browse Properties

Find your dream home

View Properties


Recent Inquiries

Property	Message	Status	Date
Investment Land Plot	Hello I would like to buy this plot. Let's fin...	CONTACTED	Nov 09, 2025
Luxury Villa in Pondicherry	I would like to buy this.	CLOSED	Nov 09, 2025
Luxury Villa in Pondicherry	500000	CLOSED	Nov 09, 2025
flat	want to buy	CLOSED	Nov 10, 2025

RealEstate Pro

Home Properties Dashboard Logout Query Document Verify Document

← Back to Properties



Interested in this property?

Send us an inquiry and our agents will contact you soon

Your Message

I want to buy this.

Send Inquiry

Need help?

+1 (555) 123-4567

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.

The screenshot displays a web interface for a document querying system. At the top, a green header bar shows the method 'POST' and the endpoint '/api/v1/hackrx/run'. Below this, a 'Parameters' section indicates 'No parameters'. The 'Request body' section is set to 'multipart/form-data'. It contains two required fields: 'questions' (an array of strings) with a text input containing 'Property Sale Agreement is made between whom?' and an 'Add string item' button; and 'file' (a string representing a binary) with a 'Choose File' button and a selected file 'Legal Document for Query.pdf'. At the bottom of the form are 'Execute' and 'Clear' buttons. The 'Responses' section is currently empty, showing a 'Curl' command.

This screenshot shows the response details of the document querying system. The 'Responses' section is active, displaying a 'Curl' command that includes the request body. Below the curl command, the 'Request URL' is shown as 'http://127.0.0.1:8000/api/v1/hackrx/run'. The 'Server response' section shows a '200' status code. The 'Response body' is a JSON object:

```
{  "answers": [    "The Property Sale Agreement is made between Mr. Ramesh Gupta and Mr. Arjun Kumar."  ]}
```

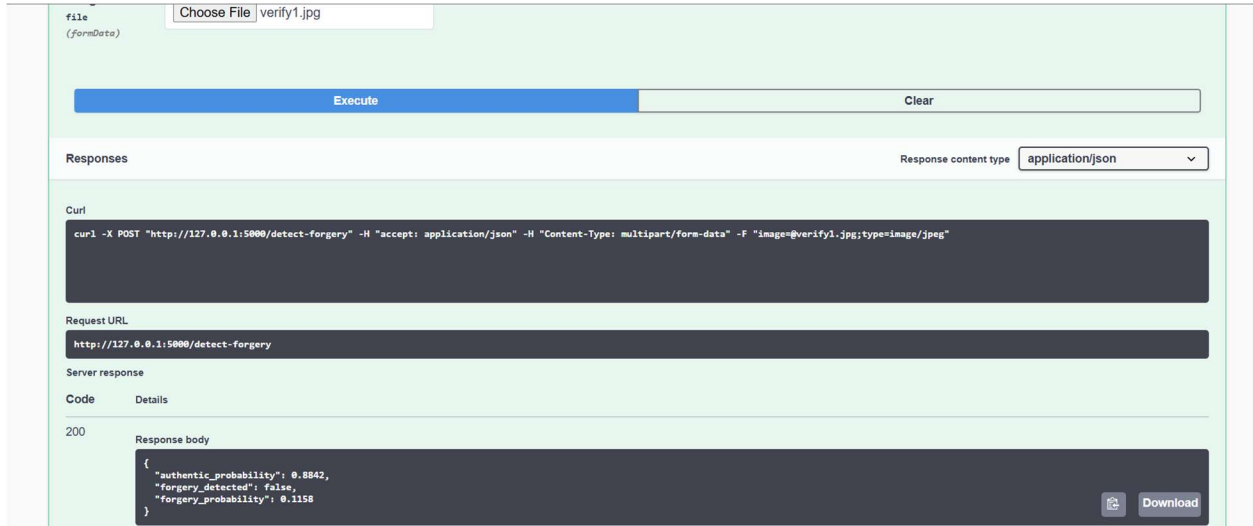
. The 'Response headers' section lists:

```
access-control-allow-credentials: true
access-control-allow-origin: http://127.0.0.1:8000
content-length: 97
content-type: application/json
date: Mon, 10 Nov 2025 12:33:59 GMT
server: uvicorn
vary: Origin
```

. At the bottom, there is a table with columns 'Code', 'Description', and 'Links'.

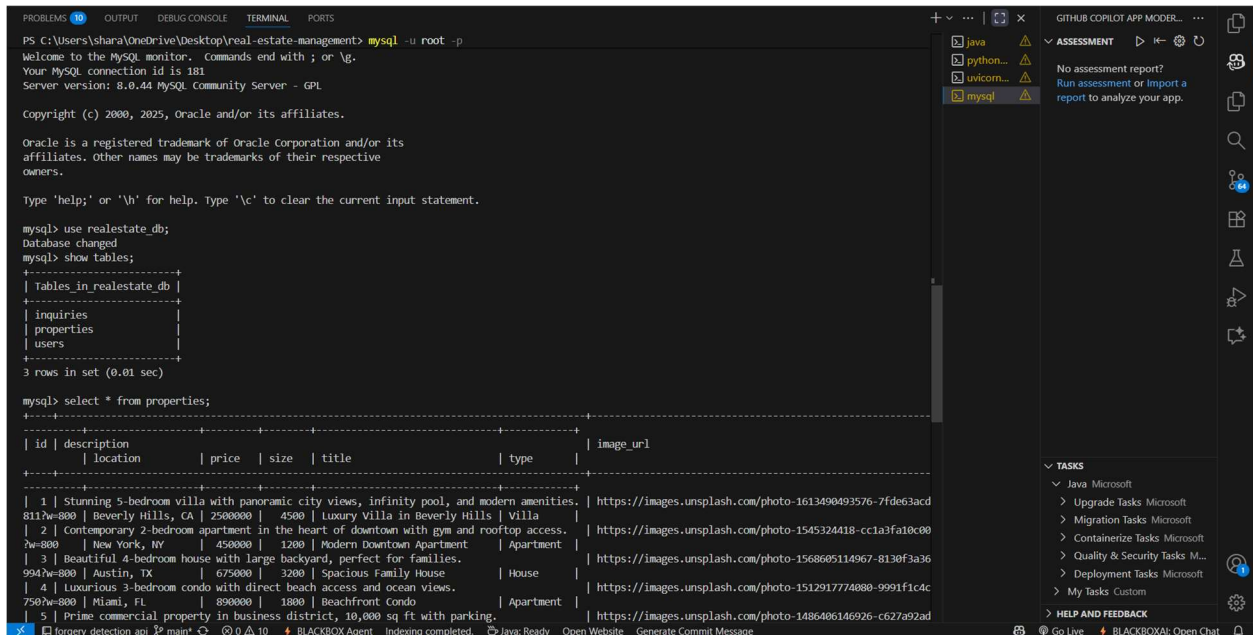
10.7 Forgery Detection

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