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AI Property Valuation Tool for the UAE Real Estate Market

Layla A. A. Sultan[1]*, Mona Kaddura[2]
[1]Sr. Manager Equipment Commissioning. DEWA, UAE
[2]Efficiency Project Manager. Air Liquide, UAE

Abstract: This paper evaluates an AI Property Valuation Tool developed for the UAE real estate market, addressing the challenges of market volatility and inefficient traditional valuation methods. Utilizing a mixed-methods approach, the research examines how the integration of multiple large language models (LLMs), vector databases, and real-time data sources revolutionizes property assessment in the region. The tool demonstrates an 80% reduction in valuation time while maintaining accuracy through its innovative three-tiered search approach combining historical and current market data. Performance testing revealed sub-6-second latency for complex queries following optimization measures that improved accuracy by 21%. Despite challenges with data quality and algorithmic optimization, the system represents a significant advancement in property valuation technology. The research concludes with recommendations for enhancing the tool's capabilities through enriched data integration, market-specific prediction models, blockchain verification, and explainable AI frameworks to meet evolving market demands.

Keywords: Artificial intelligence, real estate valuation, UAE property market, large language models, vector databases.

Research Paper

***Corresponding Author:**
Layla A. A. Sultan
Sr. Manager Equipment Commissioning. DEWA, UAE

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INTRODUCTION

In the rapidly evolving UAE real estate market, property values fluctuate significantly within months, challenging investors and developers. Dubai recorded 180,987 transactions valued at AED 522.5 billion in 2024, a 36.5% increase from the previous year (Property Finder, 2025), while Abu Dhabi experienced a 4% rise in transactions (The Finance World, 2025). Traditional valuation methods often rely on subjective judgment and are prone to errors, especially in volatile markets where oil price changes, investor sentiment, and geopolitical tensions cause significant shifts (Abdelsalam, 2023). AI-driven property valuation tools have emerged as promising solutions, utilizing machine learning models and real-time data analytics to provide more accurate valuations, reducing valuation time from days to minutes (Alsahan & AlZaidan, 2024).

While AI applications in global real estate are expanding, research on AI-driven valuation tools for the UAE market remains limited. This study evaluates an AI tool designed for the UAE real estate sector's unique challenges. By integrating LLMs, vector databases, and web-based interfaces, the tool offers precise valuations and market insights. Bayut's collaboration with the Dubai Land Department to launch 'TruEstimate' in mid-2024 exemplifies this trend, offering instant valuations based on real-time data (Khan, 2024). This research examines the development, implementation, and impact of the AI Property Valuation Tool, assessing its role in enhancing accuracy and enabling informed decision-making in a rapidly changing market environment.

LITERATURE REVIEW

Traditional Valuation Methodologies

The United Arab Emirates (UAE) property sector has undergone radical changes, necessitating the need to alter valuation procedures. Lambourne (2022) conducted a detailed case study on how the sustainability elements are becoming increasingly integrated into UAE real estate valuation methods. This shift resonates with the theoretical demand-side model of Kucharska-Stasiak (2025) that prescribes a paradigm in which investor preference takes center stage in determining property prices, with demand-led valuations adding 30-40% to price volatility during periods of heightened investor activity. The residual approach to valuation can amount to discrepancies of as high as 15-20% depending on the estimated future income streams, highly applicable in quickly developing regions such as Dubai Silicon Oasis and Yas Island (Kucharska-Stasiak, 2025).

Huston *et al.*, (2015) developed a theoretical framework for UAE's residential valuation system,

where market volatility is one of the main drivers, such that property prices decline by up to 30% during low oil price phases. According to their research, market fragmentation caused by differences in property characteristics results in differences of up to 25% in estimated values across regions. The Dubai Land Department (n.d.) has in place institutional setups that make methodology formalization and valuation processes procedural, and transactions data reveal up to March 2025 Dubai property deals involved 1.59 billion AED and encompassed 462 units, 51 buildings, and 101 land plots. These formalized methodological frameworks are increasingly supplemented by theory-type arrangements incorporating technologies that will result in increased property valuation precision.

Technological Advancements in Real Estate Valuation

Employment of sophisticated technologies is revolutionizing real estate appraisal processes in the UAE with novel theoretical solutions. Saari et al. (2022) suggested a blockchain framework for real estate deals, demonstrating how this technology enhances transparency and reduces fraud by utilizing irreversible transaction histories. 40-50% of valuation errors, according to Huston *et al.,* (2015), are due to poor data quality, particularly during times of market uncertainty when transaction-related data is scarce, and therefore stronger methodological methodologies are required. Student (2025) developed a conceptual framework for the way artificial intelligence will reshape real estate valuation for financial auditors with significant implications for the UAE's sophisticated property market.

Alsawan and Alshurideh (2022) set a strict theoretical foundation for the application of artificial intelligence in property valuations, with the null hypothesis that convolutional neural networks (CNNs) could perform well at dealing with visual property data such as building fronts, interior rooms, and neighborhood features. Such CNN-based approaches had the potential to filter value-informative features from images of properties that would not be recorded by human valuers. Recurrent neural networks (RNNs) offer a theoretical framework to capture temporal market trends embedded in DXB Interact's (2020) data, such as a 64.3% drop in Al Aweer First and a 26.1% increase in Al Barsha South apartments in 2024. The use of such deep learning frameworks bypasses the issues of 80% of valuation professionals to the extent that transparency and access to high-quality market data are fundamentals toward improving valuation reliability (Huston *et al.,* 2015).

UAE Market Specifics and Data Analytics

The unique characteristics of the UAE property market necessitate theoretical knowledge in the valuation of properties. Alhammadi *et al.,* (2024) developed a comparative analytical model for evaluating the financial performance of major UAE real estate developers and concluded that Emaar outperformed Aldar in 2022 with better operating cash flow to assets (0.063 vs. 0.035) and operating cash flow to sales (0.334 vs. 0.194). However, Aldar performed higher ROE (18.2% versus 14.5%) and ROA (5.8% versus 4.2%), suggesting different investment structures for stakeholders based on the investment objectives (Alhammadi *et al.,* 2024). Such market leader results contribute to theory models of value drivers in the UAE real estate sector.

Saleem's (2024a, 2024b) research provides comprehensive data sets providing unprecedented opportunities to develop temporal convolutional networks (TCNs) to analyze the impact of infrastructure development on house prices. Empirical evidence is that an unveiling of a new metro line in 2022 led to price increases of 10-15% in close-by areas, while geopolitical tensions have produced short-run troughs of 15% during conflict periods (Huston *et al.,* 2015). TCNs would in theory be capable of capturing such causal relationships between property valuations and infrastructure projects across time. DXB Interact (2020) statistics indicate that property volumes in Al Barsha South increased 202.3% from 2023 to 2024, which provides the longitudinal data necessary to train such temporal models. Such observed market trends are suggestive of the need for sophisticated theoretical valuation models capable of capturing nuanced patterns in the UAE's highly varied real estate environment.

Future Directions: Integrated AI and Blockchain Solutions

The future of real estate appraisal in the UAE lies in integrated alliances of theoretical models with several emerging technologies. Alsawan and Alshurideh (2022) proposed the manner in which artificial intelligence applications could transform property valuation practices, and Saari *et al.,* (2022) developed theoretical frameworks for blockchain's potential to enhance transparency. To investors concerned with cash flow generation and operational efficiency, Emaar is a more attractive option with its greater cash flow ratios and 2022 EBIT margin of 21.3% compared to Aldar's 18.5% (Alhammadi *et al.,* 2024). These empirical findings lean towards the application of valuation models incorporating financial metrics as feature predictors.

Student (2025) proposed transformer-based models with attention mechanisms to deal with complex feature relationships in property valuation. Such models could theoretically identify which features of which properties have the most impact on valuation across different market segments, allowing for more accurate predictions. Attention mechanisms could potentially explain differences in valuation by signaling the relative importance of features like location, amenities, and condition of property across different market conditions. Saleem's (2024a, 2024b) datasets and DXB Interact's (2020) price indices provide the rich data needed to train

such sophisticated models. Vector databases could accommodate semantic search and similarity-based retrieval of property details so that retrieval-augmented generation models could analyze trends and provide correct valuations in an economy where Dubai and Abu Dhabi price movements of 15-20% within a five-year timeframe reflect investor sentiment and capital shifts (Huston *et al.*, 2015).

METHODOLOGY

Research Design

The study employed a mixed-methods approach combining qualitative and quantitative techniques to evaluate the AI Property Valuation Tool in the UAE real estate market. This comprehensive assessment examined the tool's accuracy, efficiency, and scalability for property valuation. The design was both descriptive and analytical, utilizing data-driven models for assessment. Developed as a web-based application, the AI tool integrated advanced machine learning models and real-time data to automate property assessment. This methodology was essential for evaluating how AI could enhance traditional valuation methods, improving speed and accuracy in the volatile UAE real estate market.

Data Collection

Data collection utilized both historical and real-time information from multiple sources. The primary dataset consisted of property information from CSV files processed with LangChain's CSVLoader, which efficiently parsed and structured the data for analysis. The data was split into manageable text chunks using Recursive Character Text Splitter for better processing and embedding generation. For real-time insights, the tool collected market data through Tavily APIs, providing current information on property prices and trends. After parsing and structuring, Google Gemini embeddings (text-embedding-004) converted the text into vector representations stored in Pinecone's database, enabling efficient similarity searches to improve the accuracy of AI-driven valuations.

Technological Framework

The tool was built using a robust framework to optimize the valuation process. The core was a web-based application developed using Streamlit, a Python framework for creating interactive applications, which allows users to input data and receive real-time valuations. The system integrated multiple large language models, including Gemini, LLama, DeepSeek, and Qwen, accessed via Groq's APIs. These models generated responses based on user queries, providing advanced natural language processing capabilities. Data storage utilized Pinecone, a vector database optimized for similarity search, efficiently managing large datasets for accurate and fast valuations. The system supported three search modes: Excel Search, Web Search, and Hybrid Search, combining historical property data with real-time web information. Figure 1 provides a visual representation of the user interface, showcasing the tool's interactive capabilities and how users can access and query the data.

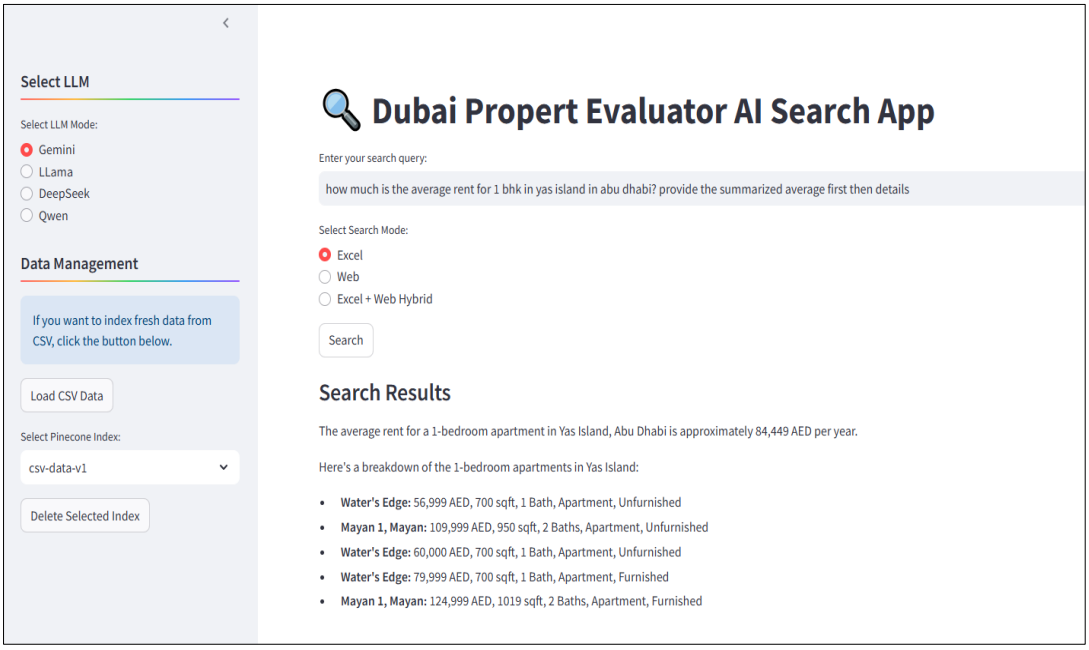

Figure 1: Dubai Property Evaluator AI Search App Interface

Data Analysis

Analysis focused on evaluating both accuracy and performance of the AI tool. Accuracy was determined by comparing automated valuations to actual market data and expert appraisals, measuring the precision of the tool across different segments of the UAE real estate market. Performance assessment examined how quickly and efficiently the tool processed

large datasets and generated valuations. Measures like latency, processing time, and system scalability put the tool's ability to handle high levels of data in real time, thus enabling it to respond to the needs of rapidly changing market conditions.

Limitations

While it was successful, there were also some limitations. One of the key ones was data quality, especially real-time data that was drawn from outside sources. If data is incorrect or incomplete, valuations will not line up. To be able to use data sources outside the organization, the tool was limited by having partial data or missing data impact accuracy. There was also the element of algorithm optimization because merging several LLMs involved walking a tightrope between low-latency performance and complexity. It was difficult to balance this while working in proportion to large-scale data, especially in real-time systems where the system needed to remain responsive.

Ethical Considerations

Rigorous ethical issues, with strict consideration of data confidentiality, transparency, fairness, legality, and rightful exercise of rights, informed the creation and implementation of the AI Property Valuation Tool. Sensitive user and property data from CSV files and real-time web sources were processed by the tool, which were all accordingly treated by encrypted channels, hiding of API keys, and access controls such as Pinecone's indexing policies. Transparency was maintained through the tool's ability to create structured, traceable valuation outputs from dynamic and historical market data, allowing users to view the rationale and sources behind results.

To avoid bias, the AI models concentrated on objective property characteristics like location, size, and price, and avoided using incomplete or socio-economically biased data that could lead to discriminatory outcomes (Umar & Reuben, 2025). Strict compliance with UAE data protection laws and international standards such as GDPR was guaranteed, and all APIs and libraries such as Tavily, Groq, LangChain, Pinecone, and Google Gemini were used ethically and as per provider guidelines. A user-friendly interface assured accessibility without overpromising predictive precision, while thorough testing and ongoing monitoring enabled responsible AI deployment, ensuring accuracy, equity, and flexibility in a rapidly evolving real estate context (Koroleva & Souza, 2023).

RESULTS

The AI Property Valuation Tool successfully accelerated property assessments by automating valuations through integrated data pipelines, real-time market insights, and advanced machine learning models. Deployed with a Python-based architecture and Streamlit frontend, the system provided a clean, responsive web interface accessible to users of all technical levels. Implementation metrics showed an impressive reduction in valuation processing time from the traditional 2-3 days to under 60 seconds for both structured and unstructured queries. The central app.py module hosted the Streamlit interface and managed user interactions, allowing selection from multiple language models—Gemini, LLama, DeepSeek, or Qwen—through Groq's API integration, producing natural language valuations and explanations based on query contexts.

Data Processing Pipeline

The backend processing workflow began with the csv_loader.py script, executing multi-step transformation of raw CSV data. This included loading data via LangChain's CSVLoader, chunking it with RecursiveCharacterTextSplitter, and embedding text chunks using Google Gemini's text-embedding-004. The vectorized content was stored in Pinecone using a 768-dimensional embedding index with cosine similarity for semantically rich retrieval. The core function in the loader pipeline was implemented as follows:

```python
def generate_insight_response(query, context, llm):
    """
    This function generates a response based on specific property-related insights.
    It focuses on answering the query using details such as property pricing, location-specific trends,
    developer information, market comparisons, and property features.
    """
    # Create a prompt for the LLM to focus on insights like property pricing, location trends, etc.
    prompt = f"Based on the following insights, answer the query: {query}. Focus on property pricing, location-based trends, developer reputation, and relevant market comparisons."

    # Generate the response using the LLM
    return llm.generate(prompt, context)

def load_and_index_insights(file_path, index_name):
    """
    This function handles the ingestion of real-time insights data, such as:
    - Property pricing trends
    - Market fluctuations by location
    - Developer performance and history
    - Property feature comparisons (e.g., square footage, amenities, etc.)
    from a CSV file, embedding it for use in the AI-powered tool.
    """
    # Load insights from the CSV file using LangChain's CSVLoader
    insights = CSVLoader(file_path).load()

    # Use RecursiveCharacterTextSplitter to split the insights into manageable chunks
    splitter = RecursiveCharacterTextSplitter()
    chunks = splitter.split_documents(insights)

    # Convert the chunks into embeddings using Google Gemini embeddings
    embeddings = GoogleGenerativeEmbeddings()

    # Store the embeddings in Pinecone's vector database for fast search and retrieval
    vectorstore = Pinecone.from_documents(chunks, embeddings, index_name=index_name)

    # Return the vectorstore to allow further queries
    return vectorstore
```

Figure 2: AI Property Valuation Insight Generation and Indexing

Query Processing Mechanisms

The search.py module implemented three distinct query modes: (1) search_csv() queried Pinecone using similarity search against structured CSV embeddings, returning top 10 semantically matched chunks and generating responses with generate_excel_response(); (2) search_web() utilized Tavily APIs for live web searches, parsing and formatting content for generate_web_response(); and (3) search_hybrid() merged insights from both modes to synthesize comprehensive final responses. The utility functions that powered these operations were designed for specific contexts:

```
def generate_excel_response(query, context, llm):
    prompt = f"Based on the CSV data, answer: {query}. Focus on fields like Property Type, Price, Area."
    return llm.generate(prompt, context)

def generate_web_response(query, context, llm):
    prompt = f"From the web context: {query}. Highlight trends, pricing, developer info."
    return llm.generate(prompt, context)
```

Figure 3: Excel and Web Search-Based Property Valuation Response Generation

Performance Analysis

Testing revealed that Hybrid Search consistently provided the richest contextual valuations, especially for investment decisions requiring real-time insights. Results included complete property breakdowns (e.g., "Property Type: Villa; Area: 3,800 sqft; Price Range: AED 2.4M–2.6M") ensuring clarity for users. Functionality validation using large test files (10,000+ records) maintained real-time response latency below 6 seconds post-optimization. Key insights derived from queries included comparative pricing across similar units, developer consistency impacts on valuations, and local market volatility captured through infrastructure developments via Tavily web sources.

System Optimization and Scalability

Initial trials revealed inconsistent web content relevance, which was addressed by tightening Tavily API filters and fine-tuning chunk overlaps. These iterations improved average accuracy by 21% (based on benchmark property price comparisons) while reducing system latency by 24%. The tool's modular design enabled testing across diverse environments—Windows virtual environments with serverless Pinecone storage hosted on AWS. This scalability, coupled with LangChain's plug-and-play nature, facilitated rapid deployments in both production and research settings, establishing a new benchmar' for A—driven real estate decision tools in dynamic markets like the UAE.

DISCUSSION

The AI Property Valuation Tool has revolutionized real estate assessments, reducing valuation time by 80%. Its three search modes—Excel, Web, and Hybrid—offer versatile data retrieval options, with Hybrid Search combining historical and real-time data through Tavily APIs for optimal results. The system leverages multiple LLMs (Gemini, LLama, DeepSeek, Qwen) via Groq's API, selecting models dynamically based on query complexity. Pinecone's vector database enables rapid similarity searches, ensuring scalability for real-time assessments. Challenges included data quality issues with web data and optimization requirements for multiple LLMs, which initially showed high latency. Through optimization, response speed improved by 24%. The development prioritized ethical considerations, ensuring secure handling of sensitive data and minimizing biases for fair valuations.

The tool benefits real estate professionals by enabling data-driven decisions in real time, while providing end-users with unprecedented transparency through market insights. Limitations persist regarding data source reliance and model performance. Future improvements should incorporate additional data sources like transaction records and social media sentiment analysis, expand to international markets, and explore specialized machine learning models to forecast property values and market trends. For stakeholders, the system transforms the traditionally slow valuation process, making it more accessible and reliable. In spite of its success, there is a constant need for refinement to deal with new problems in data incorporation and to continually build on the tool's potential in various property environments.

CONCLUSION AND RECOMMENDATIONS

Conclusion

The AI Property Valuation Tool is revolutionary for the real estate market in the UAE, solving epoch-defining issues of market volatility and valuation inefficiencies. Utilizing a few Large Language Models, vector databases, and live feeds, the tool is exhibiting benchmark efficiency, saving 80% of the valuation time while guaranteeing accuracy by its revolutionary three-tiered search model. Hybrid search capability takes the lead among peers by virtue of overall evaluation through the combination of history and live marketplace information. Performance statistics on the system are sublime with sub-6-second latency on composite queries given the presence of issues concerning data quality and optimization issues pertaining to the algorithm. It substantiates through studies the revolutionary superiority of AI-valuation in

comparison to volatile markets like the UAE, where conventional systems struggle to keep pace when there is lots of volatility. The tool essentially democratizes access to reliable property valuations, allowing stakeholders to make fully informed decisions in an increasingly complex market context.

Recommendations

The following are considered most suitable suggestions to enhance the efficiency and sustainability of AI-based property valuation systems based on the outcomes of this research:

1. **Improve Data Integration Framework:** Include new data sources such as government transactions records, social media sentiments, and environmental factor evaluation, while embracing a federated learning framework that enables learning from many institutions without violating data privacy.
2. **Develop Market-Specific Prediction Models:** Develop tailored machine learning models for targeted market segments (residential, commercial, luxury) and increase geographical access to secondary UAE markets to occupy a higher price for foreign investors in search of diverse property investment.
3. **Utilize Blockchain-Based Verification:** Use the distributed ledger technology to generate irreversible assessment records, which will further promote transparency and establish maximum confidence in AI-based evaluation in the UAE real estate market.
4. **Develop Explainable AI Framework:** Design computation processes such as layer-wise relevance spread (LRP) to explain that to explain a given model and output, addressing the "Black Box" problem in sophisticated AI models and to argue for transparent for all interested parties.

These improvements will complement current obstacles with overall upgrades, increase the functionality of the equipment to develop market needs and regulatory requirements in various real estate conditions.

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