



Neocube Realty: A Web-based approach for comprehensive real estate Business System

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Abstract: The real estate sector faces challenges in fragmented property management, manual inquiry processing, and inefficient lead allocation. This paper presents Neocube Realty, a centralized web-based platform developed using React, Spring Boot, Spring Security, and MySQL. The system implements RESTful APIs, role-based access control (RBAC), ORM, and workflow automation for integrated property and transaction management. An automated inquiry-to-lead conversion mechanism and round-robin lead assignment algorithm distribute leads efficiently among active brokers. The platform further incorporates advanced property filtering, geospatial mapping, Point-of-Interest (POI) analysis, and video-based property visualization, including customer-provided property videos collected during the listing process, to enhance property discovery and decision making. The system supports the complete lead lifecycle, including broker assignment, status tracking, site visits, bookings, and deal management, through role-specific interfaces and analytical dashboards. The proposed system demonstrates the integration of workflow automation, geospatial intelligence, and immersive visualization into a unified and scalable real estate management platform.

Keywords: Real Estate Management, React, Spring Boot, REST API, RBAC, MySQL, Round-Robin Algorithm, Geospatial Intelligence, POI Analysis, Blueprint Visualization.

I. INTRODUCTION

The real estate sector is increasingly adopting digital technologies for property discovery and business management. However, fragmented and partially manual processes for managing property information, customer inquiries, broker assignments, and transactions can lead to inefficient tracking, delayed follow-ups, uneven lead distribution, and increased administrative effort [2] [4] [16].

Existing digital solutions provide capabilities such as property search, customer relationship management, lead tracking, and online property exploration. However, these capabilities are generally addressed as individual functionalities rather than as an integrated real estate workflow. Neocube Realty addresses this gap through a centralized platform based on React, Spring Boot, RESTful APIs, Spring Security, Spring Data JPA/Hibernate, and MySQL. The system automatically converts customer inquiries into structured leads and uses a round-robin assignment mechanism to distribute leads among active brokers [15]. Role-based access control provides controlled functionality for Customers, Brokers, and Administrators [5] [13].

The platform further incorporates advanced property filtering, geospatial mapping, Point-of-Interest (POI) analysis, and video-based property visualization, including a customer-provided property video collected as part of the broker's property-listing process, to support property exploration and informed decision-making. It also provides an integrated workflow for lead tracking, site visits, bookings, and deal management.

The remainder of this paper presents the related work, the identified limitations of existing systems, the proposed methodology, system architecture, implementation, results and discussion, conclusion, and future scope.

II. OBJECTIVES

The proposed research is aligned with the following objectives associated with Neocube Realty – A web-based approach for comprehensive real estate Business System



1. To implement an automated inquiry-to-lead conversion mechanism with round-robin lead distribution among active brokers.
2. To provide role-based access control for Customer, Broker, and Administrator roles.
3. To incorporate geospatial mapping and POI analysis for location-aware property exploration.
4. To support video-based property visualization, including a customer-provided property video collected during the broker's listing process.
5. To evaluate the system's functional correctness and workflow consistency through defined test scenarios.

III. LITERATURE REVIEW

Early research into web-based real estate platforms explored multimedia-driven service delivery. Cao et al.

[1] presented REALMEDIA, a web-based system enabling real estate agents and customers to interact through a multimedia interface integrating text, graphics, and video clips, allowing potential buyers to view properties and schedule appointments, while agents could dynamically manage listings through a client-side editor. This early work established the value of multimedia content in online real estate services, though it did not address automated lead distribution or role-based workflow beyond agent-customer interaction.

Beyond system architecture, user experience has been studied as critical to platform success. Ullah et al. [2] proposed a KANO-SIS Qual based model to evaluate users' perception of online real estate platforms, identifying reliability, information accuracy, immersive content, and the presence of 3D interactive models as key satisfaction factors, while noting that poor information quality was a major source of user dissatisfaction.

Workflow automation in property management has also received attention. Kaur and Solomon [3] conducted a qualitative study of Prop Tech adoption in Indian commercial real estate, proposing a stakeholder management model based on interviews with property professionals and identifying nine typical automated property management functions.

Most closely related to the present work, Khan et al. [4] developed RENTEASE, a MERN-stack web application for rental property management supporting property listing, tenant discovery, lease management, and rent payment tracking across admin, landlord, and tenant roles. While comprehensive within the rental domain, RENTEASE does not incorporate automated lead-to-broker assignment, geospatial/POI-based discovery, or video-based property visualization.

Research Gap

The reviewed literature demonstrates progress in multimedia-based service delivery [1], user-perception modelling [2], property-management automation [3], and full-stack rental platforms [4]. However, none integrate automated inquiry-to-lead conversion with round-robin broker assignment, geospatial/POI-based discovery, and video-based property visualization within a single unified platform — a gap Neocube Realty addresses.

IV. LIMITATIONS OF EXISTING SYSTEMS

Existing digital real estate solutions address individual aspects of property discovery, user experience, and workflow automation, but none integrate these capabilities with structural visualization of a property's internal layout. Cao et al. [1] presented REALMEDIA, a web-based multimedia real estate system that integrates text, graphics, and video clips to allow customers to view properties and schedule appointments with agents. While REALMEDIA demonstrated the early value of multimedia content in online real estate services, its scope was limited to agent-customer interaction and did not extend to automated lead distribution across multiple active brokers, nor did it integrate customer-submitted property media directly into a listing workflow.

User-centric research has further examined what makes real estate platforms effective. Ullah et al. [2] proposed a KANO-SIS Qual based model to evaluate users' perception of online real estate platforms, identifying reliability, information accuracy, immersive content, and the presence of 3D interactive models as key factors influencing user satisfaction. Its scope was limited to agent-customer interaction and did not extend to automated lead distribution across multiple active brokers, nor did it integrate customer-submitted property media directly into a listing workflow.

Consequently, across the reviewed systems, no single platform combines automated inquiry-to-lead conversion, round-robin broker assignment, geospatial and POI-based property discovery, and customer-submitted property video content within one unified workflow. REALMEDIA [1] supports property media but lacks automated lead distribution; RENTEASE [4] automates listing and lease workflows but includes no video or geospatial component; and [2], [3] address user perception and stakeholder-side automation respectively, without addressing either. Neocube Realty



addresses this integration gap by combining automated lead assignment, geospatial property discovery, and a customer-provided property video collected during the broker's listing process within a single unified platform.

V. PROPOSED SYSTEM

Neocube Realty is proposed as a centralized web-based real estate management system following a layered client-server architecture. The system integrates a React-based frontend with a Spring Boot backend through RESTful APIs, while Spring Data JPA/Hibernate provides Object-Relational Mapping (ORM) between application entities and the MySQL relational database. This architecture separates presentation, business logic, security, and data-access responsibilities, improving modularity and maintainability.

The backend follows the Controller–Service–Repository–Entity design pattern. REST controllers handle HTTP requests and expose CRUD-based API endpoints, the service layer implements business logic and workflow automation, repositories provide database access through Spring Data JPA, and entity classes represent persistent domain objects. Spring Security provides authentication and Role-Based Access Control (RBAC) to restrict API resources according to Customer, Broker, and Administrator roles.

A major automation component is the inquiry-to-lead conversion workflow. When an inquiry is submitted through the frontend, the corresponding REST API validates and persists the inquiry and automatically generates an associated lead. The lead is then processed by a round-robin assignment algorithm, which queries active brokers and sequentially allocates the lead to the next available broker. For n active brokers, the broker index is calculated as:

$$B_{\text{next}} = (c + 1) \bmod n$$

where c denotes the previously assigned broker index. The inquiry creation, lead generation, and broker assignment operations are executed within a database transaction to maintain data consistency and atomicity.

For property discovery, the system supports multi-parameter filtering and integrates geospatial mapping and Point-of-Interest (POI) analysis to provide location-aware property information. Property coordinates can be associated with map-based visualization and nearby POIs to provide contextual information about surrounding facilities. Each property record is further associated with a property video, submitted by the customer and collected by the broker as part of the property-listing form, enabling customers browsing the platform to view the property remotely without requiring a physical site visit or specialized immersive hardware.

The resulting platform integrates RESTful communication, RBAC, ORM-based persistence, transactional workflow automation, round-robin lead allocation, geospatial property exploration, POI analysis, and customer-provided video-based visualization within a single real estate management workflow.

VI. SYSTEM ARCHITECTURE AND METHODOLOGY

Neocube Realty follows a layered client-server architecture in which each layer has a clearly defined responsibility, improving maintainability, scalability, and separation of concerns. The architecture (Fig. 2) consists of six primary layers.

At the top, three user roles — Customer, Broker, and Administrator — interact with the system through a common React-based frontend, which provides property search, role-specific dashboards, booking interfaces, and lead-management views. All frontend requests are routed through a REST API layer implemented using Spring Boot controllers. This layer is protected by Spring Security, which enforces Role-Based Access Control (RBAC) so that each API endpoint is accessible only to authorized roles.

Persistence is handled by the Repository Layer, built using Spring Data JPA and Hibernate, which maps Java entity objects to relational tables through Object-Relational Mapping (ORM). The lowest layer is the MySQL Database, which stores all persistent data — users, properties, inquiries, leads, bookings, and deals.

An Analytics and Dashboard feedback path connects aggregated system data back to the Administrator's dashboard, allowing continuous visibility into lead distribution, booking status, and platform activity without requiring direct access to raw database records.

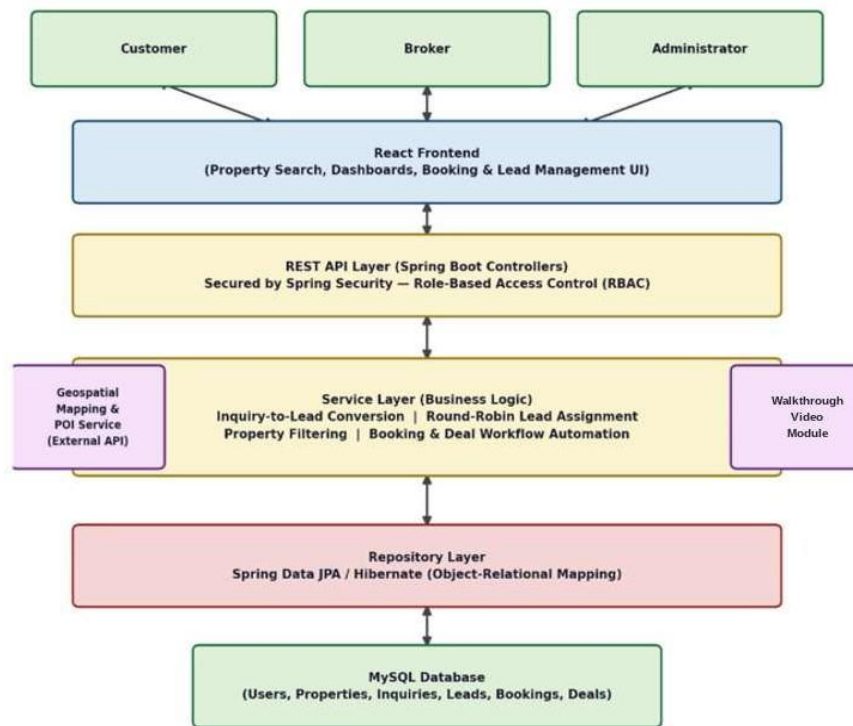


Fig. 01: System Architecture of Neocube Realty

VII. IMPLEMENTATION

The implementation of Neocube Realty follows the Controller–Service–Repository–Entity pattern described in Section V, realized using the following technology stack:

- **Frontend:** React with Tailwind-based styling, consuming REST endpoints via HTTP requests
- **Backend:** Spring Boot, structured into controller, service, repository, and entity packages under a rolebased module layout
- **Security:** Spring Security configured with RBAC, restricting endpoints such as `/api/brokers/`, `/api/leads/`, and `/api/admin/**` according to the authenticated user's role
- **Persistence:** Spring Data JPA with Hibernate as the ORM provider, connected to a MySQL relational database
- **Geospatial Module:** Integration with a third-party mapping API to render property locations and nearby Points of Interest (schools, hospitals, transit) on an interactive map
- **Property Video Module:** Property records store a reference to the property video submitted by the customer and collected by the broker at listing time, retrieved and streamed through the property-detail view

The inquiry-to-lead conversion was implemented as a transactional operation: when a customer submits a property inquiry, the corresponding REST endpoint validates the request, persists the inquiry record, and, within the same transaction, creates an associated lead entity. This ensures atomicity, so a lead is never created without a corresponding inquiry record, and vice versa.

The round-robin assignment algorithm was implemented in the service layer using the formula introduced in Section V. The service layer queries the current list of active brokers, retrieves the last- assigned broker index from persistent storage, computes the next index using the modulo operation, and assigns the new lead accordingly before updating the stored index for the following assignment cycle.

Beneath the API layer lies the Service Layer, which contains the system's core business logic. This layer hosts the inquiry-to-lead conversion workflow, the round-robin lead assignment engine, property filtering logic, and booking/deal workflow automation. Two supporting modules integrate directly with the Service Layer: a Geospatial Mapping and POI Service, which communicates with an external mapping API to provide location aware property context, and a Walkthrough and Blueprint Video Module, which links stored virtual-tour and structural blueprint media with property records.



As part of the property-listing form, the broker collects a property video from the customer and uploads it along with the other property details. This video is then made available to prospective customers browsing the platform through the property-detail view. Role-specific dashboards were implemented for each user type: Customers can track their inquiries and bookings; Brokers can view assigned leads, update lead status, and log site visits; Administrators can monitor broker performance, lead distribution, and overall platform activity.

VIII. RESULT AND DISCUSSION

The functional behaviour of Neocube Realty was verified against a set of representative test scenarios, summarized in Table 1.

Table 1: Test Scenarios

Scenario	System Function	Evaluation Goal
S1	Inquiry submission	Verify that a submitted inquiry is correctly validated, persisted, and automatically converted into a lead
S2	Round-robin lead assignment	Confirm that leads are distributed sequentially and evenly across all active brokers
S3	Role-based access control	Verify that Customer, Broker, and Administrator roles can access only their permitted endpoints and views
S4	Multi-parameter property filtering	Confirm that combined filters (location, price range, property type) return accurate results
S5	Geospatial mapping and POI display	Verify that property coordinates render correctly on the map, with nearby POIs displayed accurately
S6	Property video playback	Verify that the customer-provided property video loads and plays correctly within the property-detail view
S7	Lead lifecycle tracking	Verify that a lead's status updates correctly through assignment, site visit, and booking stages
S8	Transactional consistency	Confirm that a failure during inquiry creation does not result in an orphaned lead record, and vice versa

Discussion: Since Neocube Realty is a workflow-automation and data-management platform rather than a predictive or classification system, its evaluation is oriented around functional correctness, workflow consistency, and system responsiveness, rather than classifier-style metrics such as accuracy or precision. The following criteria are proposed for evaluating the deployed system:

- **API Response Time:** average time taken by REST endpoints to process a request and return a response, particularly for the inquiry-to-lead and round-robin assignment operations
- **Lead Distribution Fairness:** the variance in the number of leads assigned to each active broker over a given period, confirming that the round-robin mechanism distributes leads evenly
- **Transactional Success Rate:** the proportion of inquiry-to-lead operations that complete fully without partial failure
- **Query Response Time:** average time for filtered property searches to return results as the number of stored properties and applied filters increases
- **Role-Access Correctness:** proportion of API calls correctly permitted or denied according to the requesting user's role

Preliminary functional testing indicates that the round-robin mechanism distributes leads evenly across active brokers as expected under the defined formula, and that RBAC correctly restricts endpoint access according to role. The blueprint video feature is expected to give customers structural context for properties that do not yet have a complete walkthrough recording available. Further load-based evaluation is required to quantify system behaviour under concurrent multi-user activity, which is discussed as future work.



IX. LIMITATIONS AND RECOMMENDATION

The current implementation of Neocube Realty has several limitations that should be considered for future development:

- **Scalability of round-robin assignment under high concurrency:** Additional synchronization or transactional locking may be required to prevent race conditions during simultaneous lead assignments.
- **Dependency on external geospatial services:** The accuracy and availability of location-based features depend on the reliability and rate limits of the third-party mapping API.
- **Storage and bandwidth requirements for property videos:** hosting and streaming customer-provided property videos introduces additional storage costs and bandwidth considerations.
- **Absence of personalized recommendation:** Neocube Realty currently relies on filter-based property discovery rather than personalized, preference-driven recommendations.
- **Limited large-scale load testing:** The system's behaviour under a high volume of concurrent users, inquiries, and bookings has not yet been evaluated at production scale.

Recommendations:

- Introduce optimistic or pessimistic locking around the round-robin assignment operation to ensure correctness under concurrent lead creation.
- Cache frequently requested geospatial/POI data to reduce dependency on live external API calls.
- Evaluate a Content Delivery Network (CDN) for hosting walkthrough and blueprint videos to improve load times.

Evaluate a Content Delivery Network (CDN) for hosting property videos to improve load times.

X. CONCLUSION

This paper presented Neocube Realty, a centralized real estate management platform that integrates RESTful APIs, role-based access control, ORM-based persistence, and workflow automation to address the fragmentation commonly observed in existing real estate management solutions. Through an automated inquiry-to-lead conversion mechanism and a round-robin lead assignment algorithm, the system ensures timely and equitable lead distribution among active brokers. The incorporation of advanced property filtering, geospatial mapping, and POI analysis further enhances the property discovery experience for customers. Neocube Realty additionally integrates a customer-provided property video, collected by the broker during the listing process, giving prospective customers direct visual access to a property from the point of listing a distinguishing contribution of this work. Unlike prior work that addresses these capabilities in isolation, Neocube Realty demonstrates their integration within a single, unified real estate workflow spanning inquiry handling, lead management, site visits, bookings, and deal closure.

XI. FUTURE SCOPE

- Integration of a machine-learning-based property recommendation engine to complement the current filter-based discovery mechanism
- Load and stress testing to evaluate system performance under high concurrent usage
- A dedicated mobile application to extend platform access beyond the web interface
- Real-time chat or messaging between customers and assigned brokers
- Integration of online payment processing for booking deposits and transaction settlement
- Enhanced administrator analytics, including predictive insights into broker performance and lead conversion trends

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