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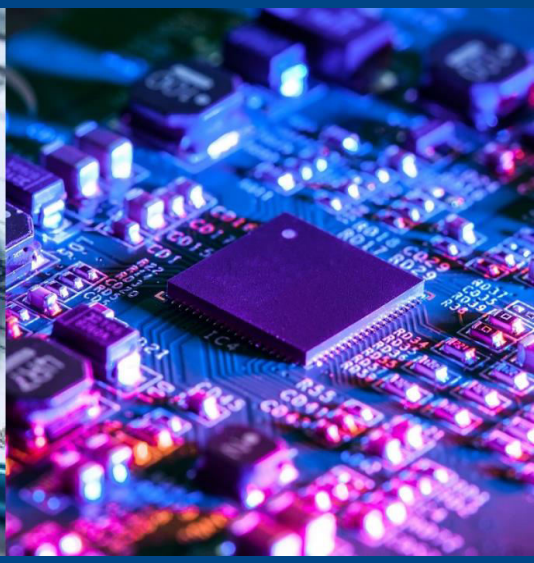

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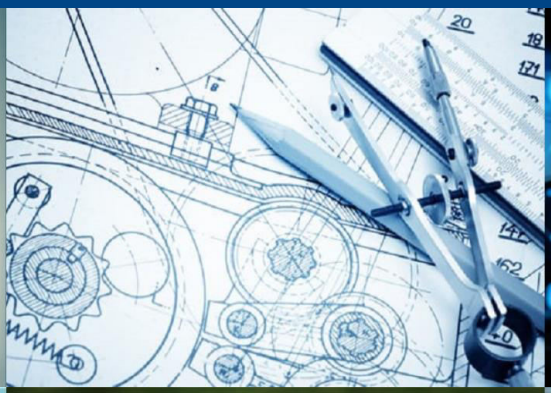

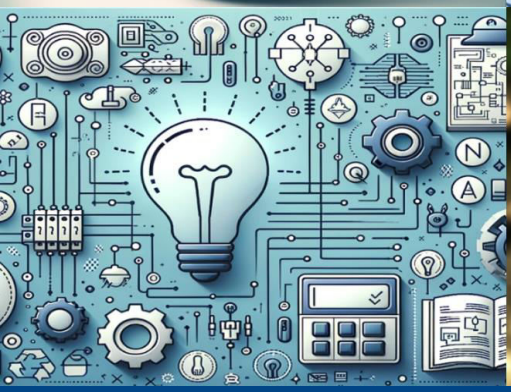

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Rental Management System using Machine Learning

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ABSTRACT: The Rental Management System Using Machine Learning is a smart tool designed to make managing rental properties easier and more efficient for landlords, property managers, and tenants. It tackles common problems in rental management like setting the right rent, finding trustworthy tenants, and handling maintenance—by using advanced machine learning technology. One of the main features of this system is rent prediction. It looks at factors like the property's location, type, market trends, and past data to recommend the best rental price. This helps property owners stay competitive, fill vacancies faster, and boost their income. The system also includes tenant profiling, which uses data to help landlords choose reliable renters. This reduces the chances of late payments or other issues. Other helpful tools include maintenance tracking and vacancy management, all designed to save time, cut down on manual work, and support better decision-making.

KEYWORDS- rent prediction, property management, predictive analytics, rental valuation, Machine Learning, location

I.INTRODUCTION

A Rental Management System using Machine Learning (ML) is designed to make property management faster, easier, and more effective. By using ML technology, the system can automate important tasks like predicting when a property might need maintenance, choosing reliable tenants, and setting the best rental prices.

This kind of system benefits both landlords and tenants. It helps landlords reduce costs, make better decisions, and offer a smoother experience for tenants. As cities grow and the rental market becomes more competitive, there's a greater need for smart, efficient ways to manage properties—and this system helps meet that need.

One of the biggest advantages of using ML is its ability to handle and learn from huge amounts of data. It can look at things like location, economic conditions, and tenant behavior to spot trends and patterns. For example, by comparing similar properties in the area, the system can recommend the most competitive rental price, helping landlords attract more tenants and earn more money.

II.LITERATURE REVIEW

1. Toward Effective Planning and Management Using Predictive Analytics Based on Rental Book Data of Academic Libraries

Naeem Iqbal, Faisal Jamil, Shabir Ahmad, Dohyeun Kim (2020) This study presents a significant contribution to academic data mining by leveraging a large-scale real-world dataset from Jeju National University to enhance decision-making in academic libraries. The research addresses practical challenges such as predicting future book demands, optimizing book arrangement, and improving operational efficiency and user engagement. The proposed hybrid prediction model, which integrates Deep Neural Networks (DNN), Support Vector Regression (SVR), and Random Forest (RF), is a strong methodological choice and is evaluated using appropriate metrics like MAE, MSE, and RMSE. However, the paper would benefit from clearer structure and language, more detailed explanations of feature selection and preprocessing, and a stronger justification for the model choices. Additionally, discussing the generalizability and scalability of the proposed approach to other academic settings would enhance its broader applicability. Overall, this is a valuable and timely research effort that effectively applies data mining and machine learning to improve academic library services.[1]

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2. Management System Based on SSM Framework: Design and Implementation of House Rental Center

Dequan Xu, Shuangyun Peng, and Yuanyuan Du (2022) propose a housing lease management system leveraging the SSM framework, MySQL database, and JSP technology to enhance operational efficiency. The system enables remote data access, replacing traditional record-keeping methods with a networked platform that facilitates seamless information sharing with tenants. By integrating modern technologies, this approach ensures a scalable and efficient rental management system, reducing administrative overhead and improving resource utilization.[2]

3. Design and Development of Smart House Rental Management System

Monica Kalband and Prateek Verma (2023) address the challenges of rental property management by proposing a smart house rental management system. The system eliminates manual processes, reducing paperwork and data loss risks. It features an interactive dashboard with functionalities for user management, tenant tracking, payments, and reports. The main goal is to streamline property management, making it more efficient and user-friendly for landlords and property managers. Future advancements may include integration with IoT for real-time property monitoring.[3]

4. Real Estate Prediction System Using ML

Hardik Summ, Lakshya Sehgal, Aryaman Choudhary, Mrunalee Dhone (2023) present a real estate price prediction system leveraging machine learning techniques such as Convolutional Neural Networks (CNN) and Natural Language Processing (NLP). The system considers variables like building area, age of construction, and available floors to forecast future property prices. The primary objective is to help users predict market trends and make informed investment decisions by analyzing historical and real-time data.[4]

5. Effective Predictive Planning and Management Analytics Based on Rental Academic Libraries

Faisal Jamil, Shabir Ahmad, and Dohyeun Kim (2022) address academic library resource management challenges through predictive analytics and data mining. The study utilizes Deep Neural Networks (DNN), Support Vector Regressor (SVR), and Random Forest (RF) to analyze rental book data from Jeju National University's library. The proposed model enables better resource planning and enhances library operations, with DNN outperforming other models in accuracy.[5]

6. Machine Learning Algorithms for Property Value Prediction

Shazlina Abdul-Rahman and Sofianita Mutalih (2023) explore the application of machine learning models like XGBoost and LightGBM in predicting urban property values. By analyzing location, size, and amenities, the study demonstrates that ML-based models outperform traditional regression techniques in predicting real estate prices. The findings highlight the benefits for investors, buyers, and real estate professionals in making data-driven property valuation decisions..[6]

7. House Price Prediction Using Machine Learning

MS. A. Vidhyavani, O. Bhargav Sathwik, Hemanth T., and Vishnu Vardhan Yadav M (2024) present a house price prediction model built using Python libraries such as scikit-learn. The model emphasizes Linear Regression as a primary method, employing data pre-processing techniques to enhance prediction accuracy. The study highlights the importance of supervised learning in determining optimal house prices based on regional datasets.[7]

8. Property Rental Management System

Kartik Buradkar, Santoshi Kori, Sakshi Ruikar, Vipul Galfat, Dr. Dipti Patil, and Prof. Rajesh Nasare (2022) introduce a Property Rental Management System that digitizes the traditional rental process. The system includes a consumer application and backend storage, supporting cash flow management and regulatory compliance. Using Flutter, Dart, Python, and JavaScript, the system streamlines rental management and enhances communication between landlords and tenants.[8]

9. House Price Prediction Using Machine Learning

MS. A. Vidhyavani, O. Bhargav Sathwik, Hemanth T., and Vishnu Vardhan Yadav M (2024) present a house price prediction model built using Python libraries such as scikit-learn. The model emphasizes Linear Regression as a primary method, employing data pre-processing techniques to enhance prediction accuracy. The study highlights the importance of supervised learning in determining optimal house prices based on regional datasets.[9]

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10. House Price Prediction

K. Pavan and T. Raghul (2020) investigate house price index trends by applying regression techniques in machine learning. The study focuses on user-specific property requirements such as square footage, number of bedrooms, and bathrooms to generate personalized price predictions. The research also explores data pre-processing and feature engineering to improve forecasting precision in the real estate market.[10]

Insights from Literature Review & Identified Gaps

The literature reveals an expanding role for machine learning in the real estate sector, particularly in rental management and property valuation. Techniques such as Convolutional Neural Networks (CNNs), Natural Language Processing (NLP), XGBoost, LightGBM, Random Forests, and Gradient Boosting have all been shown to improve the precision of price estimates. Several projects have integrated automated rental workflows using technology stacks like SSM (Spring, Spring MVC, MyBatis), MySQL, JSP, and mobile frameworks (Flutter, Dart, Python, JavaScript), simplifying day-to-day tasks and strengthening communication between tenants and landlords.

Predictive analytics has also found success beyond rentals in resource allocation for apartments and even university libraries leveraging models such as Deep Neural Networks, Support Vector Regression, and Random Forests to drive operational efficiencies. Comparative studies consistently demonstrate that these advanced machine learning approaches outperform classic regression techniques in forecasting real estate values, provided that data cleaning and feature engineering are handled diligently.

Looking ahead, there is a clear opportunity to develop scalable algorithms capable of delivering reliable, market-agnostic predictions across different regions. Adding AI-driven chatbots, automated fraud detection, and tailored property suggestions can elevate platform usability and security. Finally, incorporating Explainable AI methods will help demystify how pricing decisions are made, building user confidence and transparency in automated real estate tools.

III. PROPOSED SYSTEM

Managing rental properties often involves time-consuming tasks like guessing the right rent, manually vetting tenants, and dealing with long vacancy periods. Without data to guide decisions, landlords can underprice units or end up with tenants who miss payments. This project proposes a machine-learning-powered rental management platform that automates key processes rent forecasting, tenant assessment, and property upkeep to help landlords and managers work smarter and make better decisions.

Core Capabilities:

- **Reliable Tenant Screening:** Uses predictive models to evaluate applicant risk and cut down on payment defaults.
- **Dynamic Rent Pricing:** Analyzes local market trends and property specifics to set competitive rental rates that boost income.
- **Predictive Maintenance:** Flags potential repair needs before they become emergencies, keeping properties in top condition.
- **Tenant Retention Analytics:** Tracks engagement signals and churn drivers so landlords can tailor offers and keep good tenants longer.

User Roles & Workflows:

- **Tenants (Users):** Browse available listings, submit booking requests, manage their accounts, and make payments.
- **Property Owners:** Add or remove properties, review and approve rental applications, assign units, and monitor incoming rents.
- **Administrators:** Oversee the entire system—validate user and owner identities, visualize data trends, audit transactions, and moderate feedback.

A system diagram illustrates how each role interacts with the platform: users explore and book, owners manage inventory and requests, and administrators handle oversight and analytics. This architecture ensures clear separation of duties while supporting seamless, automated rental operations.

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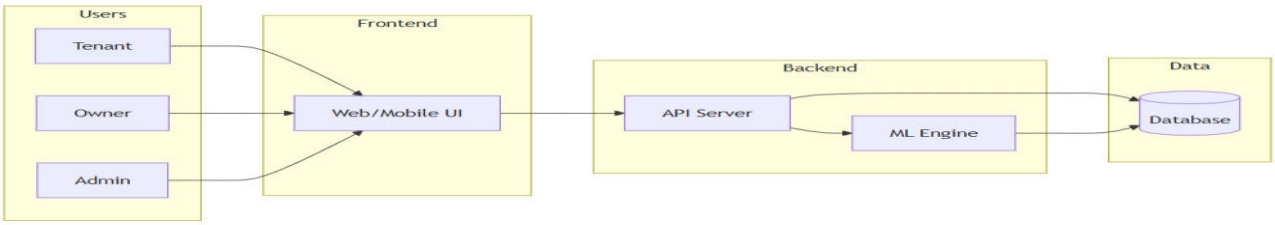

Fig 1. Proposed System

IV.METHODOLOGIES

The diagram depicts the flow of the Rental Management System across three distinct user types—Tenants (Students), Property Owners, and Administrators:

1. **Authentication**
   All users must first log in or register before accessing the system.
2. **Home Screen**
   Upon successful login, everyone lands on a centralized dashboard where they choose their next steps.
3. **Tenant (Student) Functions**
   Explore rental listings grouped by property.
   Submit booking applications for preferred units.
   Use the built-in payment gateway to finalize bookings.
4. **Owner Functions**
   Add new properties or update details for existing houses/flats.
   Review incoming tenant requests and allocate rooms or apartments.
   Confirm and track rent payments from tenants.
5. **Administrator Functions**
   View system-wide metrics and visual reports.
   Validate user and owner profiles.
   Audit financial transactions and manage user feedback.

This workflow ensures that each role follows a clear, role-specific path—starting with authentication, moving through the home page, and then into the features designed for their particular needs

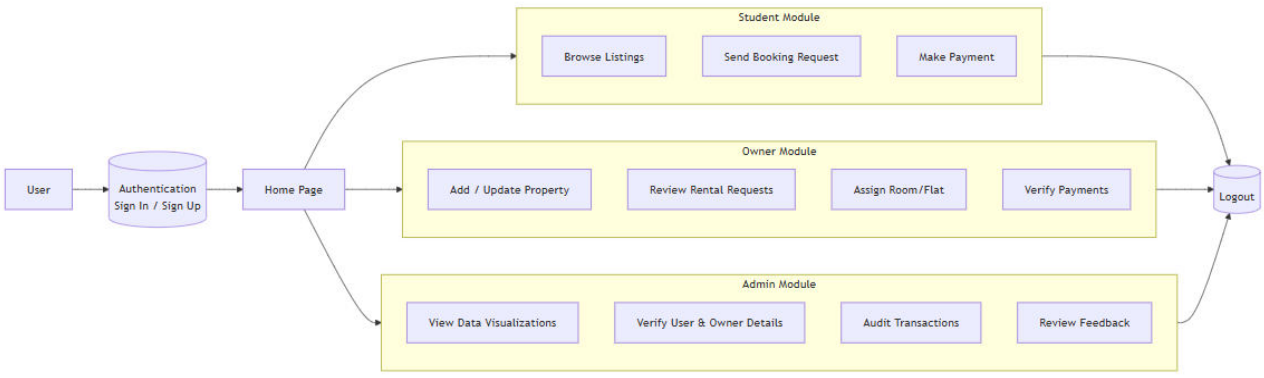

Fig 2. System Architecture

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The system's development is organized into six major stages, each ensuring a robust, scalable, and secure platform:

1. Data Gathering & Preparation

- **Sources:** Property details, pricing histories, and booking records are pulled from public real-estate APIs and open datasets, while user reviews and past transaction logs fuel predictive models.
- **Preprocessing:** Raw data undergoes cleansing to fix errors and remove duplicates. Listings are tagged by region, size, and price bracket, and transactional and feedback metrics are normalized to enable accurate analytics.

2. System Design & Role-Specific Services

- **Overall Structure:** The application separates functionality into three distinct profiles—Tenants, Owners, and Administrators—each with tailored workflows.
- **Tenant Services:** Search and filter properties, submit rental requests, and complete secure payments.
- **Owner Services:** Create or update listing details, approve or deny tenant applications, and confirm payment receipts.
- **Admin Services:** Track system-wide activity, generate visual reports on rental trends, and manage user support tickets.

3. Web Application Build

- **Client Side:** Crafted in React.js with Tailwind CSS to guarantee responsiveness across devices.
- **Server Side:** Powered by Spring Boot, offering RESTful endpoints, while MySQL stores user profiles, transactions, and property metadata.
- **Smart Features:** JWT-based login, AI-powered rent suggestions, and personalized property recommendations.

4. Security Measures

- **Access Control:** Strict role-based permissions to prevent unauthorized actions.
- **Data Protection:** End-to-end encryption safeguards payment and personal information, and media assets are securely hosted in the cloud.

5. Deployment & Lifecycle Management

- **Containerization:** Docker images enable easy scaling and environment consistency.
- **CI/CD Pipeline:** Automated testing and deployment ensure rapid, reliable updates.
- **Health Checks:** Continuous monitoring flags performance issues before they impact users.

6. Performance Tuning & Ongoing Refinement

- **Database Tuning:** Routine index maintenance and query optimization keep response times low.
- **Load Distribution:** Balanced traffic management handles usage spikes.
- **AI Model Updates:** Rental-price predictors are retrained regularly with fresh market data to maintain competitive accuracy.

V. RESULTS

A rental management system that uses machine learning algorithms can benefit from improved tenant screening accuracy and lower default rates, to mention a few advantages. Better pricing approaches increase rental income by altering prices based on market demand. Predictive maintenance reduces unexpected repair costs and minimizes property downtime. A better understanding of tenant behavior leads to higher retention rates, resulting in a more consistent source of rental money. Overall, these findings point to a more successful and efficient property management approach.

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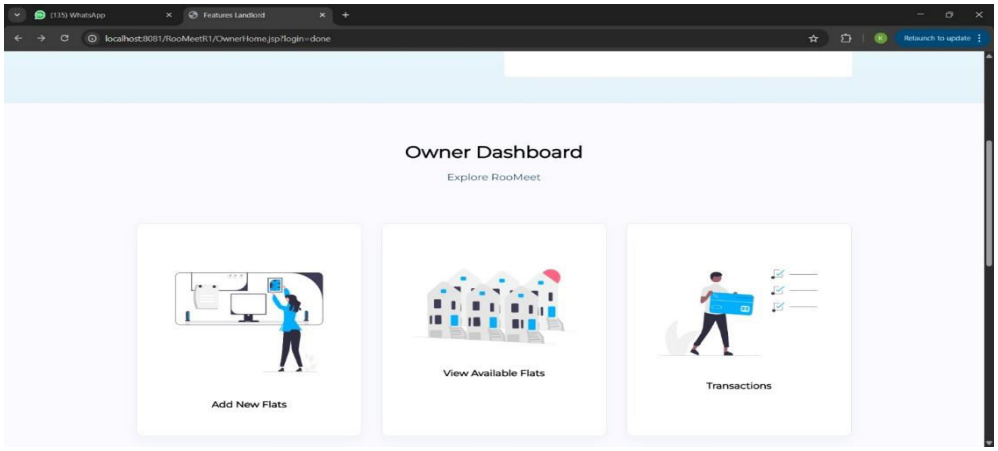
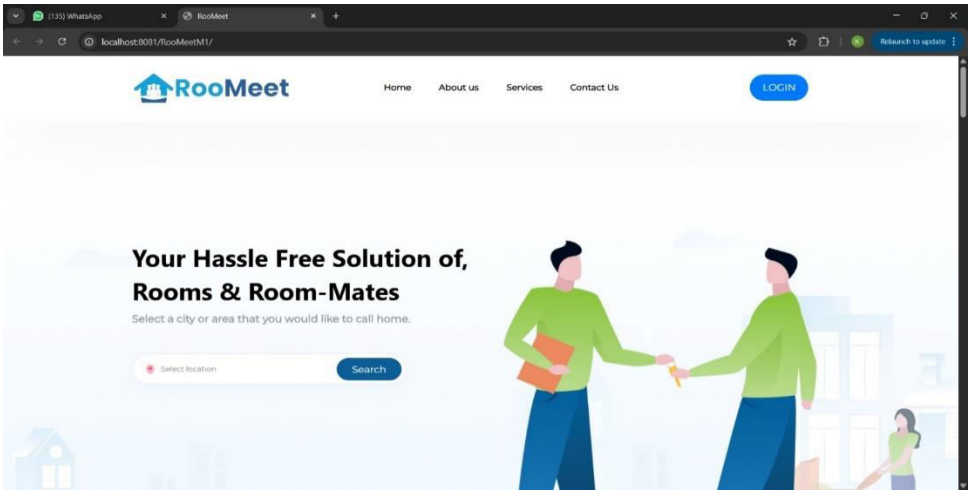


Fig. 3 Output



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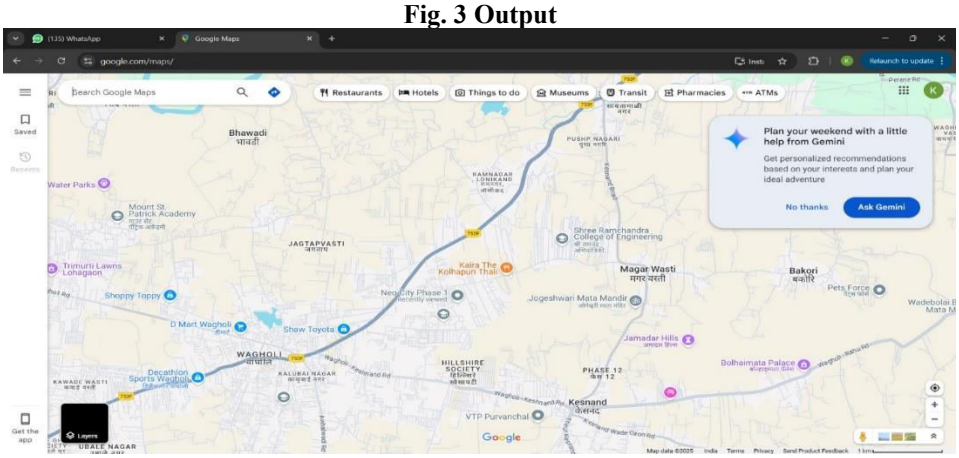

Fig. 3 Output

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VI. CONCLUSION

Integrating machine learning into a rental management platform revolutionizes how properties are overseen. By automating credit checks, setting dynamic rent prices, and predicting maintenance needs, the system cuts costs and boosts efficiency. It also analyzes tenant behavior to tailor retention efforts, leading to happier renters and lower turnover.

In today's volatile real estate market, this AI-driven, data-centric approach gives both landlords and tenants a clear edge, ensuring decisions are timely, accurate, and responsive to changing conditions.

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[3]Monica Kalbande and Prateek Verma developed the "Design and Development of Smart House Rental Management System." The publication details are not specified (please verify), but it was published in 2023 (Page 6) and discusses a smart rental management system integrating automation.

[4]Hardik Summs, Lakshya Sehgal, Aryaman Choudhary, and Mrunalee Dhone presented a paper titled "Real Estate Prediction System Using ML" at the 2023 11th International Conference on Emerging Trends in Engineering & Technology - Signal and Information Processing (ICETET - SIP). This study, published in 2023 (Page 11), examines machine learning techniques for real estate predictions.

[5]Thuraya Mohd, Muhamad Harussani, and Suraya Masrom authored "Modeling Office Rental Price in Predicting Real Estate Market Performance," published in The International Journal of Advanced Computer Science and Applications (IJACSA) in 2023 (Volume 13, Issue 12, Pages 545–546). The paper focuses on modeling rental prices for offices using machine learning techniques.

[6]A. Wandhe, L. Sehgal, H. Sumra, A. Choudhary, and M. Dhone conducted a study titled "Real Estate Prediction System Using ML." This research was presented at the 2023 11th International Conference on Emerging Trends in Engineering & Technology - Signal and Information Processing (ICETET - SIP), Nagpur, India (Pages 1-4). It investigates the application of machine learning for real estate price predictions.

[7]V. Singh Pundir, A. Dhall, A. Saxena, and P. Kaur published a paper titled "Intelligent Property and Flat Monitoring System: Leveraging Machine Learning and Data Analysis for Enhanced Security and Resource Management." This study was presented at the 2024 5th International Conference for Emerging Technology (INCET), Belgaum, India (Pages 1-6) and focuses on security and monitoring in rental systems using AI.

[8]N. Iqbal, F. Jamil, S. Ahmad, and D. Kim conducted research on "Toward Effective Planning and Management Using Predictive Analytics Based on Rental Book Data of Academic Libraries." This study was published in IEEE Access, vol. 8 in 2020 (Pages 81978-81996) and explores predictive analytics for effective rental management.

[9]Kartik Buradkar, Santoshi Kori, Sakshi Ruikar, Vipul Galfat, Dr. Dipti Patil, and Prof. Rajesh Nasare published "Property Rental Management System" in the International Journal of Computer Science and Mobile Computing (IJCSMC) in 2022 (Pages 177-179). This paper details the development of a property rental system using modern computing techniques.

[10]K Pavan and T Raghul authored a paper titled "House Price Prediction," though the journal details are not specified. This research, published in 2022, investigates various machine learning models used for predicting house prices.

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