

Optimizing Efficiency and Sustainability in Real Estate: A Comprehensive Analysis of Advanced Real Estate Property Management Systems

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ABSTRACT- In response to the escalating reliance on Internet platforms for property search, there is an urgent demand for highly efficient real estate management systems. This paper proposes the development of a sophisticated Real Estate Management System (REMS) utilizing Python Flask, a versatile and scalable web application framework. The REMS will serve as a comprehensive solution, integrating a robust database architecture to facilitate the storage and management of property, tenant, and invoice data. Notable features of the system include seamless property search functionalities, streamlined online payment processing, efficient management of maintenance requests, and meticulous lease management capabilities. Moreover, property owners will be allowed to register and showcase their properties within the system, while users will enjoy a user-friendly interface for searching properties based on a diverse range of criteria. The development process will employ a holistic approach, combining HTML, CSS, and JavaScript for front-end design, while Flask orchestrates the intricate back-end operations. The paper will meticulously document the system's architecture, implementation strategy, user interface design principles, Flask application deployment, MySQL database integration, administrative dashboard functionality, user registration/authentication protocols, search functionality optimization, and rigorous security measures. This research endeavor aims to serve as a comprehensive guide for developers and industry professionals seeking to construct a cutting-edge Real Estate Management System using Python Flask, effectively addressing the dynamic needs and challenges of the modern real estate landscape. Index Terms: Python Flask, Database Management, Property Search, Online Payments, Maintenance Requests, Lease Management

KEYWORD- Optimizing Efficiency, Sustainability, Real Estate, Advanced Real Estate Property Management Systems

I. INTRODUCTION

In an era characterized by the pervasive influence of digital technology, the real estate industry is undergoing a profound transformation, propelled by the omnipresence of the internet. The paradigm shift in property search and

acquisition necessitates the evolution of efficient real estate management systems capable of meeting the escalating demands of a digitally driven marketplace. This research paper embarks on an exploratory journey into the development of a cutting-edge Real Estate Management System (REMS), leveraging the prowess of Python Flask, a lightweight yet robust web application framework. Rooted in the premise of enhancing user experience and streamlining transactions, the REMS aims to redefine conventional practices, offering a comprehensive solution to the myriad challenges confronting modern property management. As the digital landscape becomes increasingly intertwined with real estate transactions, the need for standardized sharing mechanisms becomes apparent. Whether facilitated by traditional real estate agents, local newspapers, or specialized online platforms, the process of disseminating property information is characterized by a uniform framework. Prospective buyers and renters navigate through a vast array of listings using intuitive interfaces, facilitated by user-friendly portals designed to cater to diverse preferences and requirements. At the heart of this digital ecosystem lies the search page, serving as a dynamic gateway through which visitors refine their search criteria based on an array of parameters, including price range, property size, location, and amenities. Furthermore, the online realm offers an unparalleled breadth of property options, ranging from flats for rent or lease to properties available for sale, each accompanied by a suite of functionalities aimed at empowering users to make informed decisions.

II. LITERATURE REVIEW

In the realm of real estate management, a multitude of studies have explored various facets of the industry, shedding light on key trends, challenges, and technological advancements. Emil Janulewicz McGill and Liu (Dave) Liu McGill University (2000) delve into the analysis of Chinese real estate company websites, offering insights into information architecture and content dissemination strategies employed by industry players.

Jia Sheng, Ying Zhou, and Shuqun Li (2014) examine the localization of real estate project markets, emphasizing the importance of adapting marketing strategies to regional

preferences and cultural nuances. Lv Jianliang (2012) presents e-commerce research applied in real estate enterprises, highlighting the potential of online platforms to streamline transactions and enhance customer engagement. Moreover, M. Kiruthika, Smita Dange, Swati Kinhekar, Girish B., Trupti G., and Sushant R. (2012) discuss real estate applications utilizing spatial databases, showcasing the utilization of advanced technologies to enhance data management and analysis. Mingyuan Yu, Donghui Yu, Lei Ye, and Xiwei Liu (2012) propose a visualization method based on cloud computing for real estate information, offering insights into innovative approaches for data visualization and analysis. Nissan Pow McGill University (2011) provides insights into the preliminary planning of real estate development projects, emphasizing strategic planning and feasibility assessments. Timothy H. Greer and Mirza B. Murtaza explore technologies to improve the decision-making process of real estate appraisers, highlighting the potential of XML, intelligent agents, and web services in enhancing appraisal accuracy and efficiency. Furthermore, Xu Wei, Lu Guiying, Jade Ling Qing, and Xiong Yanfu (2011) examine new e-business models in modern enterprise applications, drawing insights from the example of the Guangxi Sugar Network Social Survey. These studies collectively contribute to the body of knowledge in real estate management, offering valuable insights into industry trends, technological advancements, and strategic considerations for stakeholders in the real estate ecosystem. Additionally, empirical studies such as the one conducted by Deepika S., Jeyabharathi G., and Mrs. S. Kulandai Teresa (2022) provide practical insights into the development and implementation of real estate management systems, further enriching the literature in this field.

III. METHODOLOGY

Developing a real estate management system begins with project initiation, involving the definition of scope, objectives, and stakeholder requirements. A comprehensive market research phase analyses current trends, competitor systems, and user feedback. Requirements analysis follows, prioritizing and detailing functional and non-functional aspects through use cases and user stories. System design includes database architecture, system modules, and user interface mock-ups. The technology stack is carefully selected with considerations for scalability, security, and integration capabilities. The development phase implements the system, following agile or iterative approaches, with rigorous testing including unit, integration, and system testing. Deployment involves careful planning and execution, ensuring a smooth transition from any existing system. Training and documentation support user adoption, while ongoing maintenance addresses issues and updates. Feedback from users and stakeholders informs continuous improvement, with regular iterations to meet evolving needs. This comprehensive approach ensures the systematic and successful development of a real estate management system, meeting both current market demands and future requirements. In developing a real estate property management system, the technology stack plays a pivotal role in ensuring the efficiency, security, and scalability of the application. For backend development, languages such as Python, Ruby, or Java coupled with frameworks like Django, Ruby on Rails, or Spring provide a robust

foundation. PostgreSQL or MySQL may be selected for relational databases, while MongoDB could be chosen for NoSQL flexibility. Frontend development can leverage React.js or Angular.js for dynamic user interfaces, complemented by HTML5 and CSS3 for structuring and styling. Mobile application development, if applicable, may employ React Native or Flutter for cross-platform compatibility. APIs, including RESTful or GraphQL, facilitate communication between frontend and backend components. Hosting on cloud platforms like AWS, Azure, or Google Cloud ensures scalability, while Docker aids in server containerization for deployment and scaling. Authentication and authorization can be managed using JWT, and payment integration may involve gateways such as Stripe or PayPal. For geolocation features, the Google Maps API can be integrated. Security measures include SSL/TLS for secure communication and OAuth 2.0 for user authentication. Git serves as the version control system, and tools like ELK Stack enable logging and monitoring. Testing frameworks like Jest or PyTest, coupled with CI/CD pipelines such as Jenkins or GitLab CI, ensure robust testing and deployment processes. Regular reassessment and updates of the technology stack are essential to adapt to evolving project requirements and emerging technologies, aligning with the development team's expertise and the overall goals of the project. The research approach for a real estate management system involves a systematic and comprehensive strategy. It begins with an extensive literature review to understand existing challenges, trends, and best practices in property management and related technologies. Engaging with key stakeholders through interviews and surveys provides valuable insights into their needs and expectations. A competitive analysis assesses strengths and weaknesses in existing systems, while a market analysis examines current trends and potential target demographics. Regulatory and compliance research ensures alignment with legal standards, and a thorough technology assessment evaluates the latest frameworks. Prototyping and user feedback collection refine the system's design, while a feasibility study considers technical, financial, and organizational factors. Risk analysis and pilot testing precede the development of a detailed implementation plan, including training and change management strategies. Post-implementation evaluation and feedback gathering ensure continuous improvement and user satisfaction. This holistic research approach ensures that the real estate management system is well-informed, responsive to industry needs, and positioned for success in a dynamic market. User feedback holds immense importance in the realm of real estate management systems, serving as a key driver for system refinement and success. In the dynamic and complex landscape of the real estate industry, such feedback is invaluable for tailoring management systems to evolving needs. It plays a pivotal role in optimizing the user experience, identifying and addressing specific challenges faced by property managers, and ensuring the accuracy and relevance of data within the system. By actively seeking user insights, developers can enhance communication and collaboration features, adapt to regulatory changes, and facilitate remote property management. The iterative process of incorporating feedback not only increases user satisfaction and adoption rates but also contributes to the development of robust reporting tools, analytics features, and security measures.

Ultimately, user feedback in a real estate management system is a strategic asset that guides the system's evolution, aligning it with industry requirements and empowering users in their property management endeavors.

IV. SYSTEM ARCHITECTURE

The Real Estate Management System (REMS) architecture is designed to seamlessly handle various aspects of property management. At the front end, users interact with a web interface or mobile app, where they can search for properties, view listings, and manage their accounts. Behind the scenes, the application layer manages user authentication, property listings, search functionalities, and transactions. The business logic layer orchestrates workflows and handles notifications, ensuring smooth interactions. The data access layer stores information in a database and the integration layer connects with third-party services like payment gateways and mapping services. Security measures such as authentication, authorization, and data encryption are implemented to protect user data. The infrastructure layer takes care of server hosting, load balancing, and scalability while monitoring and analytics tools track system activities and user behavior. Backup and recovery services, as well as compliance with regulations, are also integral parts of the architecture. Overall, the system aims to provide a secure, scalable, and user-friendly experience for property owners and potential buyers or renters, adapting to market changes and technological trends. In a Real Estate Management System (REMS), you have different parts that make the whole system work smoothly. First off, there's the User Management module, where users can register, create accounts, and securely access the system. Then, you've got the Property Management module, which lets users add, edit, or delete property listings, complete with details like descriptions, images, amenities, and pricing. The Booking and Transaction module handles the booking process and financial transactions related to property reservations. Communication is key, so there's a module for automated notifications, keeping users in the loop about property updates, booking confirmations, and reminders. Behind the scenes, the Workflow Management module coordinates processes within the system, ensuring everything flows seamlessly. Reporting and Analytics provide tools to analyze user behavior, property popularity, and overall system usage, generating reports for stakeholders. Integration is crucial, with a module that connects the system to third-party services like payment gateways, mapping tools, and social media platforms. Security is a priority, with a module managing user authentication, authorization, and data encryption to keep sensitive information safe. Backing up data is handled by the Backup and Recovery module, which regularly saves system data to prevent loss in case of failures, and there's a disaster recovery plan in place for emergencies. The User Interface module is the part users directly interact with, whether through a web interface or a mobile app. It provides an easy-to-use platform for property searches, listing views, and account management. Compliance and regulations are addressed through a module ensuring that the system follows industry standards, data protection laws, and other legal requirements. The infrastructure module takes care of server hosting, deploying the application on servers, and maintaining optimal

performance with load balancers and scalability measures. All these components and modules work together to create a comprehensive Real Estate Management System, offering users a seamless experience and handling various aspects of property management, transactions, and user interactions. In making a Real Estate Management System (REMS) work smoothly with existing technologies and databases, there are several key steps involved. First, there's the need to migrate existing data if transitioning from older systems smoothly, ensuring a seamless transition without any loss or duplication of crucial information. The REMS also needs to connect with existing databases, ensuring real-time access to user details, property information, and historical transactions. To broaden its capabilities, the REMS often integrates with third-party services using APIs, such as payment gateways for secure transactions or mapping services for location details. If dealing with older technologies, middleware solutions come into play, acting as bridges to facilitate communication and data flow. Cloud services like AWS or Azure are integrated to provide scalability and flexibility, allowing secure storage of data in the cloud. Seamless user authentication is achieved by integrating with existing identity providers, reducing the hassle of multiple logins through Single Sign-On (SSO). Standardizing data formats and ensuring real-time synchronization through webhooks or event-driven architecture is essential for a smooth flow of information between the REMS and other systems. Rigorous testing is performed to validate data exchange, covering various scenarios and ensuring error-free communication. All these measures aim to enhance the REMS's overall functionality, offering users a unified experience and optimizing processes through seamless collaboration with existing tools and systems.

V. MARKET ANALYSIS

In the ever-changing landscape of the real estate market, technology is reshaping how properties are bought and sold, with virtual tours and digital transactions becoming increasingly prevalent. The lasting effects of the COVID-19 pandemic are evident in the growing demand for properties in suburban or rural areas, driven by a desire for more spacious homes that can accommodate remote work setups. Sustainability has emerged as a key consideration, with buyers showing interest in eco-friendly features and communities that align with environmental values. Affordability remains a critical factor influencing market dynamics, where fluctuations in housing prices, interest rates, and overall economic conditions significantly impact accessibility for potential buyers. Demographic shifts play a crucial role, with an aging population seeking different housing needs, while millennials entering the market contribute to a demand for innovative and technology-integrated living spaces. Flexibility is becoming a hallmark of desirable homes, reflecting a desire for adaptive living spaces that can serve multiple functions, such as accommodating remote work, fitness areas, or multigenerational living arrangements. To navigate these trends successfully, staying informed through real estate market reports, and industry publications, and engaging with local experts is essential for both buyers and sellers looking to make informed decisions in this dynamic environment. In the ever-evolving realm of real estate, technology is reshaping how properties are bought and sold.

Virtual tours and digital transactions are on the rise, reflecting a shift in the market. The lasting impact of the COVID-19 pandemic is evident in the growing demand for properties in suburban or rural areas, driven by a desire for more spacious homes conducive to remote work setups. Sustainability has become a key consideration, with buyers showing interest in eco-friendly features and communities aligned with environmental values. Affordability remains a critical factor, influenced by housing prices, interest rates, and overall economic conditions. Demographic shifts, including an aging population with different housing needs and millennials entering the market, contribute to diverse demands for innovative and technology-integrated living spaces. Flexibility is increasingly valued, with a desire for adaptive living spaces accommodating remote work, fitness areas, or multigenerational living arrangements. Beyond these aspects, the real estate landscape is influenced by smart home integration, data analytics, regulatory changes, virtual and augmented reality, co-living and co-working trends, blockchain in transactions, health and wellness considerations, the impact of remote work, cultural and lifestyle trends, and global economic factors. Navigating these trends successfully requires staying informed through real estate market reports, and industry publications, and engaging with local experts for informed decision-making in this dynamic environment.

VI. SYSTEM DESIGN

Designing a Real Estate Management System (REMS) involves creating a comprehensive solution to streamline various facets of real estate operations. The system encompasses distinct user modules, including an admin dashboard for centralized control, an agent module for property listing and client management, and a client module enabling property searches and communication with agents. Property management features comprise advanced listing and search functionalities, providing users with the ability to filter properties based on diverse criteria and access detailed property information, complete with high-quality images and virtual tours where applicable. Transaction management capabilities are essential, encompassing deal tracking from initial interest to closing, as well as managing financial aspects like down payments, mortgages, and commission calculations. Robust calendar and scheduling features ensure efficient appointment management and automated reminders for critical events. Communication is facilitated through integrated messaging systems and notifications to keep users informed about property status, offers, and other relevant updates. Reporting and analytics tools generate insights into property performance, agent productivity, and broader market trends, complemented by detailed financial reports for transactions, commissions, and expenses. Security measures include role-based access control and data encryption to safeguard sensitive information such as financial transactions and client details. The system's integration prowess extends to third-party services like payment gateways, mapping tools, and Customer Relationship Management (CRM) systems, enhancing its functionality and workflow. A focus on mobile responsiveness ensures accessibility and user-friendliness across various devices, including smartphones and tablets. Scalability and future expansion considerations involve a modular architecture, allowing for seamless updates and additions, along with a scalable infrastructure,

potentially leveraging cloud-based solutions for efficient resource management. Collaborating with real estate professionals during the design process ensures that the resulting system addresses industry-specific needs, and incorporating regular feedback loops throughout the development and testing phases is crucial for refining the system to meet user expectations effectively.

VII. RISK ANALYSIS

When embarking on the development and implementation of a Real Estate Management System (REMS), it's crucial to be aware of potential risks that could impact the project's success. Inadequate requirements gathering poses a risk of dissatisfaction if the system doesn't meet specific user needs, while integration challenges might lead to data inconsistencies and operational disruptions. Data security and privacy concerns could result in legal consequences and damage to the system's reputation. The unpredictable nature of real estate markets introduces the risk of market volatility, affecting the relevance of certain system features. User adoption challenges may arise, impacting efficiency and productivity, and scalability issues could lead to performance issues and increased maintenance costs. Regulatory compliance risks, technological obsolescence, and dependence on external vendors or third-party services pose additional challenges. Inadequate training and support may reduce user adoption, while scope creep could result in delays and budget overruns. Insufficient testing may lead to system instability and dissatisfaction, and changes in real estate legislation could require urgent system updates. External factors such as natural disasters or cybersecurity threats add another layer of risk, potentially causing downtime and data loss. Proactively identifying and managing these risks through careful planning, regular assessments, and contingency strategies are vital to ensure the success and effectiveness of the Real Estate Management System. When embarking on the development and implementation of a Real Estate Management System (REMS), it is crucial to be aware of potential risks that could impact the project's success. One major concern is the dependency on specific vendors; relying too much on software components or services may lead to issues if those vendors face challenges or change their offerings. Integration challenges could arise when connecting with existing systems that use different technologies or data formats, affecting the smooth flow of information. Data migration risks during the transition from legacy systems to the REMS could result in data loss or inconsistencies. Ensuring mobile responsiveness is crucial, considering the diverse ways users access the system. The user interface and experience should be carefully designed to avoid dissatisfaction and low adoption rates. Cultural and geographic variations in real estate practices need to be considered, addressing unique requirements in different regions. Additionally, aligning the REMS with sustainable practices becomes increasingly important amidst growing environmental concerns. Establishing a robust business continuity plan is vital to mitigate the impact of unforeseen events like natural disasters, ensuring system availability and data recovery. Collecting user feedback throughout the development process and conducting usability testing help address usability issues and enhance overall user satisfaction. These considerations contribute to a thorough risk assessment and management strategy, increasing the

likelihood of success for the Real Estate Management System despite potential challenges.

VIII. FINDINGS AND DISCUSSION

The implications of the research findings for the real estate industry are far-reaching and hold significant potential for shaping the sector's development and efficiency. Positive findings related to operational processes within the real estate management system could lead to enhanced efficiency, offering streamlined workflows and automated tasks, ultimately resulting in time and cost savings for property managers and real estate professionals. Moreover, if the research highlights improved user experiences and satisfaction, it could contribute to the successful adoption of the system within the industry. Identifying innovative features or functionalities that set the real estate management system apart could provide a competitive advantage, attracting more clients and business opportunities. The research's insights into market trends and adaptability can guide the industry in staying responsive to evolving demands and positioning stakeholders strategically in a dynamic market. If the study ensures that the system aligns with regulatory standards, it contributes to the industry's adherence to legal frameworks, maintaining trust and credibility. Additionally, findings supporting remote property management functionalities in line with the growing trend towards remote work could significantly impact industry practices. Robust reporting and analytics features based on research findings can empower real estate professionals to make informed, data-driven decisions, enhancing strategic planning and optimizing business processes. Positive technology stack selection and system design findings may encourage broader adoption of advanced technologies, fostering innovation in real estate management solutions. Emphasizing the importance of a user-centric development approach could inspire a shift towards solutions that genuinely meet the needs of property owners, managers, and other stakeholders. Ultimately, the research findings, if effectively applied, can contribute to the long-term sustainability and growth of the real estate industry, fostering competitiveness and technological advancement.

IX CONCLUSION

In conclusion, a real estate management system offers a multifaceted set of practical applications that significantly enhance the efficiency and transparency of property management. Through centralized property information, streamlined lease and tenant management, robust financial tools, and proactive maintenance tracking, the system addresses key operational aspects. Document management and communication features contribute to a more organized and collaborative property management process. Performance analytics and reporting empower users with valuable insights for strategic decision-making while ensuring regulatory compliance. Integration capabilities enable seamless connectivity with external platforms, fostering data consistency. In the context of remote work trends, the system supports remote property management through virtual viewings, digital document signing, and online collaboration tools. Collectively, these practical applications establish a comprehensive framework for optimizing property management processes, offering

benefits to property owners, managers, tenants, and other stakeholders in the real estate industry. A real estate management system is a powerhouse of tools that makes property management a breeze. Imagine having all the details about properties, leases, and tenants in one organized place. It's not just about keeping things in order – the system handles finances, keeps track of maintenance needs, and ensures everything is running like a well-oiled machine. When it comes to dealing with documents and communicating, it's got you covered, making the whole property management process smooth and collaborative. What's even more impressive is that it doesn't just manage things; it gives you insights into how everything is going. This helps with making smart decisions and, of course, making sure everything follows the rules. The cool part is that it can seamlessly connect with other platforms, making sure all your data stays consistent and up to date. In this age of working from anywhere, the system supports remote property management with virtual viewings, online signatures, and handy collaboration tools. In a nutshell, it's your all-in-one solution that not only makes life easier for property owners and managers but also improves the experience for tenants and everyone involved in the real estate scene.

X. FUTURE CONSIDERATIONS

Proposed future research and enhancements for real estate management systems encompass a range of innovative technologies. These include blockchain integration for secure and transparent transactions, AI-driven predictive analytics for informed decision-making, and IoT integration for smart building solutions. Augmented and virtual reality technologies offer immersive property tours, while Natural Language Processing enhances user interfaces. Machine learning supports dynamic pricing strategies, and digital twin technology facilitates property modeling. Strengthened cybersecurity measures, optimized cloud-based solutions, and sustainability features contribute to system robustness and scalability. Collaborative tools connect stakeholders, and biometric authentication enhances security. Overall, these advancements promise to propel real estate management systems toward greater efficiency, innovation, and alignment with industry demands. In envisioning the future of Real Estate Management Systems (REMS), several innovative technologies stand out for potential research and enhancements. Blockchain integration is a promising avenue, not just for secure transactions but also for revolutionizing property records, smart contracts, and the tokenization of assets. The application of artificial intelligence (AI)-driven predictive analytics could usher in an era of informed decision-making, while the integration of the Internet of Things (IoT) offers opportunities for smart building solutions. Augmented and virtual reality technologies could provide immersive property tours, and the incorporation of Natural Language Processing holds the potential to enhance user interfaces. Machine learning can support dynamic pricing strategies, and digital twin technology offers a fascinating approach to property modeling. Robust cybersecurity measures, optimized cloud-based solutions, and sustainability features are integral aspects that contribute to the resilience and scalability of REMS. Collaborative tools connecting stakeholders and the implementation of biometric authentication for enhanced

security are key areas for exploration. These advancements collectively promise to propel real estate management systems toward greater efficiency, innovation, and alignment with the evolving demands of the industry.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest

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