# Introduction

The Building Management System (BMS) is a web-based application developed to streamline the day-to-day operations of residential and commercial buildings. With the growing complexity of building management in modern cities, the need for a digital system that can oversee various administrative tasks has become critical. The BMS simplifies operations by enabling digital rent collection, tracking tenant information, monitoring building status, and handling complaints, all through a unified platform. It promotes transparency, reduces manual errors, and enhances the user experience for both tenants and managers.

The system is ideal for landlords, tenants, and building administrators who wish to automate and digitize their property management process. Whether it's handling multiple tenants, processing monthly rents, or resolving tenant queries, the BMS provides a centralized solution for efficient management.

# Technologies Used

The Building Management System leverages the modern MERN stack technology, which ensures high performance, scalability, and ease of development:

1. \*\*MongoDB\*\*: A NoSQL database used to store data in a flexible, JSON-like format. It handles collections such as users, buildings, rent records, and more.
2. \*\*Express.js\*\*: A lightweight web framework used on the server-side to manage routing, APIs, and business logic.
3. \*\*React.js\*\*: A powerful frontend library for creating dynamic user interfaces. Users interact with forms, dashboards, and notification systems.
4. \*\*Node.js\*\*: Handles the server environment and runs Express.js. It allows non-blocking operations and fast server-side execution.

Additionally, third-party tools and services were integrated:

* + \*\*Stripe API\*\* for secure rent payments.
  + \*\*JWT (JSON Web Tokens)\*\* for authentication and authorization.
  + \*\*Google OAuth 2.0\*\* for quick login and account linking.
  + \*\*Tailwind CSS\*\* for fast and responsive UI development.

# Key Features

The BMS offers numerous features that are critical for building and tenant management:

1. \*\*Digital Rent Collection\*\*: Tenants can pay their rent online through an integrated payment gateway.

Payments are secure and instant.

1. \*\*Role-Based Dashboard\*\*: The system offers different dashboards based on user roles:
   * Admin: Full system access with analytics and user control.
   * User: Access to their own rent records and payment system.
   * Member: View of their profile and building notices.
2. \*\*Real-Time Notifications\*\*: Tenants and admins receive alerts for due rent, successful payments, complaints, and important notices.
3. \*\*Multi-Language Support\*\*: The UI supports multiple languages to cater to diverse users.
4. \*\*User Profile Management\*\*: Users can update their information, including contact, password, and profile image.
5. \*\*Complaint Handling System\*\*: Tenants can submit complaints or issues, which admins can track and resolve.
6. \*\*Tenant History and Reports\*\*: Admins can view tenant rent histories and generate reports for records.

# Role Management

Role-based access is one of the core features of the BMS, ensuring that each user only sees and interacts with the data relevant to them:

* + \*\*Admin\*\*:
    - Full access to all parts of the system.
    - Can view and manage all users, buildings, rent transactions, and complaints.
    - Access to analytics, such as rent collection trends, overdue payments, and user activity.
  + \*\*User (Tenant)\*\*:
    - Can view their rent history and make payments online.
    - Able to submit complaints and track their resolution status.
    - Receive notifications and notices from the building authority.
  + \*\*Member\*\*:
    - Limited access role, mostly read-only.
    - Can view personal data, assigned buildings, and community announcements.

This layered structure ensures data security and proper delegation of responsibilities, making the system scalable and easier to manage.

# Payment System

The integration of Stripe Payment Gateway ensures that rent collection is fast, secure, and reliable. Here's how it works:

1. \*\*Secure Payment\*\*: Stripe uses encrypted channels for financial transactions, ensuring no sensitive data is exposed.
2. \*\*Real-Time Confirmation\*\*: Once the payment is successful, both the user and admin receive confirmation through email or in-app notification.
3. \*\*Transaction Logs\*\*: All transactions are stored in the database with timestamps, amount, and user ID for future reference.
4. \*\*Payment History\*\*: Users can view their monthly payment history, check for dues, and print receipts.
5. \*\*Failed Payment Handling\*\*: The system is capable of detecting and reporting failed payments, allowing users to retry.

By automating this process, the system eliminates the need for manual handling and reduces the chance of discrepancies.

# Security and Authentication

Security is a top priority in any management system, especially one that handles sensitive user data and payments. This BMS includes:

* \*\*JWT (JSON Web Tokens)\*\*: Used for secure, token-based session handling. After login, the server issues a token which is stored in the browser and used for subsequent requests.
* \*\*Google OAuth Login\*\*: Allows users to sign in with their Google account, providing both convenience and added security.
* \*\*Role-based Access Control (RBAC)\*\*: Ensures that users can only perform actions permitted for their role.
* \*\*Form Validations\*\*: All forms include both frontend and backend validation to prevent SQL injection, XSS,

and other attacks.

* \*\*HTTPS Deployment\*\*: Ensures all data is transmitted over secure channels.

These measures ensure that data integrity, confidentiality, and availability are maintained throughout the user experience.

# Conclusion

In conclusion, the Building Management System serves as a robust solution for digital property management. By incorporating features like secure payments, user role differentiation, automated notifications, and tenant support, it reduces administrative burden while improving tenant satisfaction.

With the power of the MERN stack, the system is both scalable and responsive, making it suitable for small buildings as well as large apartment complexes. The inclusion of modern technologies ensures it remains secure, user-friendly, and future-proof.

As more buildings and property owners move towards digital solutions, platforms like this will become essential tools in everyday management.