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Design and Implement of an Artificial Intelligence-based Mess Management System

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ABSTRACT: Smart Mess Management System is a web-based platform designed to streamline hostel and residential mess operations through digitized meal management, attendance tracking, billing, complaint handling, guest meal requests, dietary preferences, QR-based attendance, and AI-assisted forecasting. Traditional mess management often depends on manual registers and fragmented communication, which leads to billing errors, food wastage, delayed complaint resolution, and limited transparency. This project addresses these issues by providing a centralized platform built with React, Node.js/Express, MongoDB, and a Flask-based AI service. The system enables users to book or skip meals, submit complaints, update dietary preferences, request guest meals, and receive notifications, while administrators can manage menus, attendance, billing, complaints, payments, and analytics from a single dashboard. The AI module helps predict meal quantity requirements based on attendance patterns and approved members, supporting better planning and reduced waste. The proposed system demonstrates how modern web technologies and lightweight AI integration can improve operational efficiency, transparency, and user experience in mess administration.

KEYWORDS Mess Management, Meal Booking, Attendance Tracking, QR Attendance, Complaint Management, Guest Meals, Dietary Preferences, AI Forecasting, Web Application, Food Waste Reduction

I. INTRODUCTION

Mess administration in hostels and residential communities is a recurring operational challenge because it involves daily meal planning, attendance monitoring, billing, complaint resolution, and coordination between users and administrators. In many institutions, these tasks are still handled manually using registers, spreadsheets, or disconnected tools, making the process time-consuming and error-prone.

- A smart mess management platform is needed to solve problems such as:
- Manual attendance and meal booking errors
- Inaccurate billing calculations
- Delayed complaint handling
- Difficulty in tracking guest meals and special dietary needs
- Food wastage caused by poor quantity estimation
- Lack of transparent communication between users and mess administrators

Recent web technologies make it possible to build an integrated system that centralizes these tasks. In this project, we developed a Smart Mess Management System that combines role-based access, daily menu management, meal booking, attendance tracking, complaint management, dietary preferences, guest meal requests, payment tracking, notification support, QR-based attendance, and AI-assisted quantity forecasting.

The system is designed for two main user roles:

- Student/User: books meals, marks attendance, submits complaints, sets dietary preferences, requests guest meals, and checks bills.
- Admin: manages menus, members, attendance, complaints, payments, QR codes, and analytics.

This project focuses on improving mess operations through automation, transparency, and intelligent decision support.

II. LITERATURE SURVEY

Digital campus management systems have shown that web applications can significantly improve administrative workflows by reducing manual effort and improving accessibility. Meal booking and attendance systems have been studied as effective ways to streamline hostel operations, while QR-based verification methods help reduce proxy attendance and duplicate entries.

Research on complaint management systems indicates that structured issue reporting and status tracking improve response time and accountability. Similarly, dietary preference management has been recognized as important for personalizing food services and supporting student health needs.

AI-based forecasting is increasingly used in operational planning to estimate demand from historical usage patterns. In mess systems, such forecasting can help predict meal quantity requirements, thereby reducing food waste and cost. Lightweight AI services are especially useful because they can be integrated into existing web systems without requiring heavy infrastructure.

However, many existing solutions focus on only one or two aspects, such as attendance or billing. Few systems combine all major mess operations into one platform with AI-assisted meal forecasting and modern administrative dashboards. The Smart Mess Management System fills this gap by integrating all these functions into a single production-ready application.

III. SYSTEM ARCHITECTURE AND DESIGN

Architecture Overview

The Smart Mess Management System follows a modular three-tier architecture:

1. React Frontend :
 - Provides the user interface for students and administrators
 - Displays dashboards, forms, tables, cards, charts, and notifications
2. Node.js/Express Backend :
 - Handles authentication, authorization, validation, and business logic
 - Exposes REST APIs for menu, attendance, billing, complaints, guest meals, payments, notifications, dietary preferences, QR attendance, and AI forecasting
3. MongoDB Database :
 - Stores user accounts, menus, attendance, bills, complaints, guest meal requests, payments, notifications, and dietary records
4. Flask AI Service :
 - structured request data from the backend and returns predicted servings Core Flows

The system works through the following core flows:

- User Registration and Login :
Users register and log in using secure authentication. Role-based access ensures that admins and users see only their permitted sections.
- Menu Publishing :
Admins create daily breakfast, lunch, and dinner menus. Users can view the current day's menu.
- Meal Booking and Attendance :
Users can book or skip meals. Attendance records are stored and summarized for reporting.
- Billing and Payment Tracking :
Monthly bills are generated based on meal activity. Payment history is tracked for transparency.
- Complaint Reporting :
Users submit complaints related to food quality, quantity, taste, hygiene, or service. Admins can review and update complaint status.
- Guest Meal Management :
Users request guest meals and admins approve or reject them.

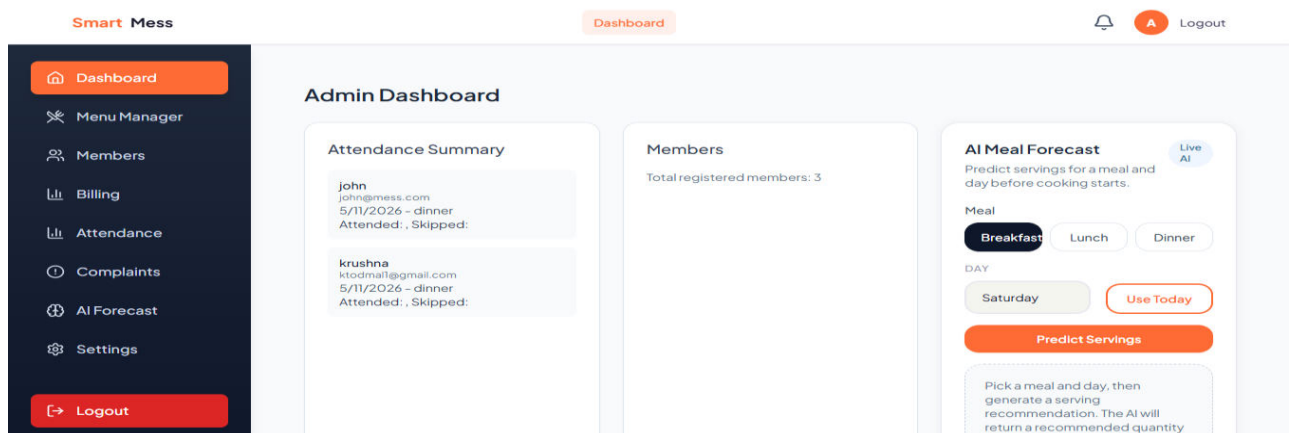
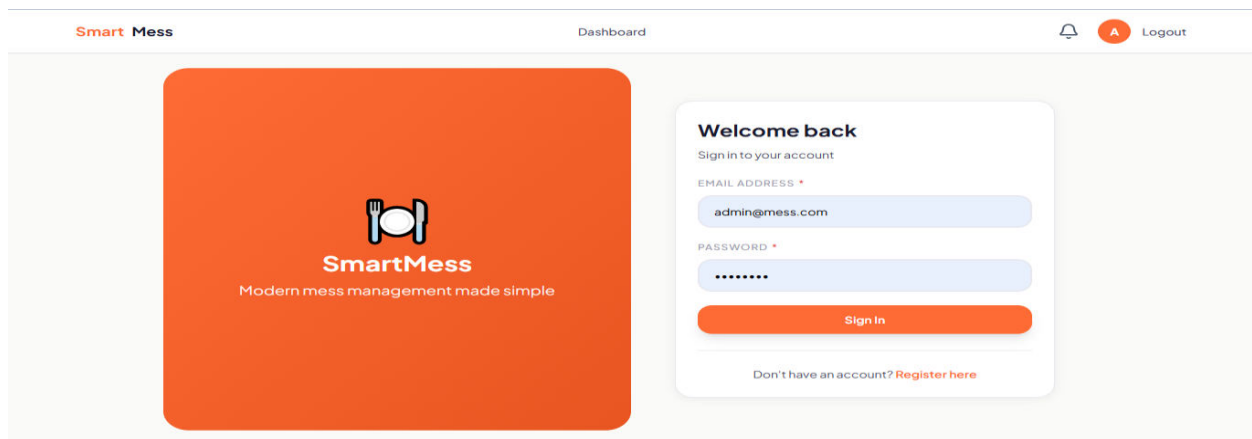
- **Dietary Preferences :**
Users can store vegetarian, vegan, gluten-free, allergy, and disliked ingredient preferences.
- **QR Attendance :**
Admins generate QR codes for secure attendance marking and proxy prevention.
- **AI Forecasting :**
The admin can estimate required food servings for a selected meal and day based on attendance history and approved member count.

AI Strategy:

The AI forecasting component is intentionally lightweight and practical. Instead of relying on a large external model inside the main backend, the Node.js server sends history and meal context to the Flask service. The AI module then returns:

- Estimated attendance
- Buffer servings
- Recommended servings
- Confidence score
- This design keeps the system modular and easier to maintain.

IV. EXPERIMENTAL RESULTS



Smart Mess Dashboard Logout

- Dashboard
- Menu Manager
- Members
- Billing
- Attendance
- Complaints
- AI Forecast
- Settings
- Logout

Menu Manager

Daily Menu

Monday
5/11/2026

Breakfast: pohe, vadapav
Lunch: chapati, potato bhaji and rice
Dinner: chapati rajma bhaji and dalkhichadi

[Edit](#) [Delete](#)

Select Day & Date

Day: Monday Date:

Breakfast

Add breakfast item

Save Breakfast

Lunch

Enter lunch item

Add

Dinner

Enter dinner item

Add

Smart Mess Dashboard Logout

Signed in as **john**

- Dashboard
- Book Meal
- Attendance
- My Bill
- Feedback
- Complaints
- Guest Meal
- Dietary Prefs

USER DASHBOARD

Welcome back, john

Everything you need is organized here: meal booking, attendance, bills, feedback, complaints, guest meals, and dietary preferences.

Meal Times & Deadlines

Breakfast

9:00 AM

Book by 8:00 AM
(1 hour booking buffer)

Lunch

1:00 PM

Book by 12:00 PM
(1 hour booking buffer)

Dinner

7:00 PM

Book by 6:00 PM
(1 hour booking buffer)

Quick Actions Open any feature in one click

Smart Mess Dashboard Logout

Quick Actions Open any feature in one click

Book Meal

Open book meal page

Attendance

Open attendance page

My Bill

Open my bill page

Feedback

Open feedback page

Complaints

Open complaints page

Guest Meal

Open guest meal page

Dietary Prefs

Open dietary prefs page

Weekly Menu

Open weekly menu page

Weekly Menu

Daily Menu

Today's Menu

Smart Mess Dashboard 🔔 J Logout

Signed in as john

- Dashboard
- Book Meal
- Attendance
- My Bill
- Feedback
- Complaints
- Guest Meal
- Dietary Prefs

Book a Meal

Book a Meal

Tip: Booking a meal automatically marks your attendance for that meal. No need to mark separately.

Date: 13-06-2026

Meal: Dinner - until 6:00 PM (Meal at 7:00 PM)

Book by: Breakfast 8:00 AM, Lunch 12:00 PM, Dinner 6:00 PM (1 hour before meal service).

Book Meal

Smart Mess Dashboard 🔔 J Logout

Signed in as john

- Dashboard
- Book Meal
- Attendance
- My Bill
- Feedback
- Complaints
- Guest Meal
- Dietary Prefs

Feedback

Submit Feedback

Menu Item: Select a menu

Rating: 5 Stars

Comment:

Submit Feedback

Smart Mess Dashboard 🔔 J Logout

Signed in as john

- Dashboard
- Book Meal
- Attendance
- My Bill
- Feedback
- Complaints
- Guest Meal
- Dietary Prefs

Complaints

Report an Issue

Complaint Type: Food Quality Meal Type: Lunch

Date: 13-06-2026 Rating (1-5): 3 - Average

TITLE: Brief title of your complaint

Description: Detailed description of the issue...

V. CONCLUSION

The Smart Mess Management System demonstrates how modern web technologies and lightweight AI can improve hostel mess operations. By combining meal booking, attendance tracking, billing, complaint handling, guest meals, dietary preferences, QR verification, notifications, and AI-based food quantity forecasting, the system provides a unified and practical solution for both users and administrators.

The platform improves operational efficiency, reduces manual work, increases transparency, and supports better food planning. Its modular architecture also makes it easy to extend with future features such as mobile applications, advanced analytics, automated reporting, and deeper predictive models.

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