Ai-Driven Multichannel Marketing Automation System Using the MERN Stack

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Abstract-- AI-Driven Multichannel Marketing System is an AI-powered marketing automation platform designed to help businesses manage and execute multi-channel digital campaigns from a single unified Admin Dashboard. The platform integrates artificial intelligence for campaign content and banner generation using the Pollinations AI API, enabling automated creation of marketing assets for Email, WhatsApp, and Social Media channels including Facebook, Instagram, and LinkedIn. The system is developed using React.js for the frontend with a dark-theme professional UI, Node.js and Express for the backend REST API, and MongoDB for NoSQL data management with MongoDB. The platform includes a Product and Service management module with full CRUD operations, a comprehensive AI Templates library with 45+ pre-built prompt templates, and a Canvas-based social media poster generator. The system architecture follows a client-server model with stateless REST API communication, ensuring scalability and privacy. Testing across all major campaign types demonstrates fast AI content generation with response times under three seconds. AI-Driven Multichannel Marketing System addresses the need for affordable, intelligent, and integrated marketing automation for small and medium businesses.

Index Terms-- MERN Stack, Pollinations AI, Social Media Marketing, Email Marketing.

I. INTRODUCTION

Traditional digital marketing requires businesses to manage multiple separate tools for email campaigns, WhatsApp messaging, social media posting, and product catalogues. This fragmented approach leads to inefficiency, inconsistent branding, and high operational costs, particularly for small and medium-sized businesses (SMBs) that lack the resources for dedicated marketing teams.

AI-Driven Multichannel Marketing System addresses these challenges by providing a unified AI-powered marketing automation platform accessible through a modern web dashboard. The system enables businesses to create, manage, and publish marketing campaigns across Email, WhatsApp, and Social Media channels from a single interface, with AI assistance for content and image generation.

The platform is built on three core components: a React.js frontend dashboard with module-based navigation, a Node.js and Express REST API backend with MongoDB database, and Pollinations AI integration for automated campaign banner image generation.

The system reduces campaign creation time significantly by providing 45+ pre-built AI prompt templates, automated banner generation, and a Canvas-based poster generator for professional social media content. The platform also supports full product and service catalogue management with CRUD operations, enabling businesses to align campaigns with their current offerings.

II. LITERATURE REVIEW

Research in digital marketing automation and AI-assisted content generation has grown significantly in recent years. Existing studies highlight the importance of multi-channel integration and intelligent automation in modern marketing platforms.

A study by Chaffey and Ellis-Chadwick (2022) emphasized that businesses using integrated marketing platforms see a 30-40% improvement in campaign efficiency compared to using separate tools. Their research demonstrated the value of unified dashboards for managing cross-channel marketing campaigns.

Wang and Zhao (2024) proposed a Smart Marketing Management System at the International Conference on Education, Knowledge, and Information

Management. Their research emphasized the role of smart technology in ensuring efficient delivery of marketing services and highlighted the importance of AI-driven content automation.

Research on AI image generation tools (Brown et al., 2023) demonstrated that AI-powered visual content generation can reduce design time by up to 60% for marketing teams. The integration of such tools into marketing platforms improves content production velocity for SMBs.

A review published in the Journal of Marketing Technology (2023) emphasized the importance of WhatsApp Business API integration in regional marketing strategies, particularly in South and Southeast Asian markets where WhatsApp penetration exceeds 70%.

However, existing marketing automation platforms such as Mailchimp, HubSpot, and Hootsuite are primarily designed for large enterprises with complex pricing structures. There is a clear gap for an affordable, AI-integrated, multi-channel platform suitable for SMBs. AI-Driven Multichannel Marketing System addresses this gap by providing a complete marketing automation solution with AI content generation, multi-channel campaign management, and product catalogue integration in a single platform.

III. PROBLEM STATEMENT

Small and medium businesses face significant challenges in executing consistent, professional marketing campaigns across multiple digital channels. The key problems identified are:

- Fragmented tools requiring separate platforms for Email, WhatsApp, and Social Media marketing.
- High cost of enterprise marketing automation platforms.
- Lack of AI-assisted content generation in affordable marketing tools.
- Manual and time-consuming campaign banner and poster creation.
- No unified product catalogue integration with marketing campaigns.
- Difficulty maintaining consistent branding across multiple channels.

AI-Driven Multichannel Marketing System is designed to solve these problems by providing a unified, AI-powered, multi-channel marketing automation platform that is accessible, affordable, and intelligent.

IV. OBJECTIVES

The objectives of AI-Driven Multichannel Marketing System are as follows:

- Design and develop a full-stack multi-channel marketing automation Admin Dashboard.
- Implement AI-powered campaign banner generation using Pollinations AI API with loading state and error fallback.
- Build an Email marketing module with dynamic template selection and AI content generation.
- Develop a WhatsApp marketing module with image upload and message customization.
- Create a Social Media module supporting Facebook, Instagram, and LinkedIn poster generation using Canvas API.
- Build a Product and Services management module with full CRUD operations and MongoDB backend.
- Develop an AI Templates library with 45+ pre-built templates across all marketing channels.

Ensure a clean, responsive React.js frontend with a professional dark-theme UI/UX design

V. SYSTEM ANALYSIS

5.1 System Study

System study involves understanding the existing marketing workflows, the needs of business users, and how AI-Driven Multichannel Marketing System resolves their challenges. In traditional marketing, businesses use separate tools for each channel, leading to workflow fragmentation, inconsistent branding, and high costs. AI-Driven Multichannel Marketing System provides a single unified platform to eliminate these inefficiencies.

5.2 Existing System

In the existing model, businesses use separate tools: Mailchimp for email, WhatsApp Business App manually for messaging, and individual social media platform apps for posting. Campaign images are created using design tools like Canva separately. Product information is not linked to campaigns. There is no unified analytics, no AI assistance, and no cross-channel campaign coordination. This results in high time investment, inconsistent brand messaging, and poor campaign performance tracking.

5.3 Proposed System

AI-Driven Multichannel Marketing System provides a unified Admin Dashboard that integrates all marketing channels into one platform. The system uses Pollinations AI to generate campaign banner images automatically from text prompts. The Email module supports AI-generated subject lines and email body content. The WhatsApp module supports bulk message composition with image upload. The Social Media module provides a Canvas-based poster generator for Facebook, Instagram, and LinkedIn. The Product and Services module integrates the business catalogue directly with campaign creation.

The system is built using React.js with a dark-theme UI, Node.js and Express for the REST API backend, and MongoDB for structured data storage. The AI Templates library provides 45+ pre-built prompt templates categorized by channel and campaign type, accelerating campaign creation for users.

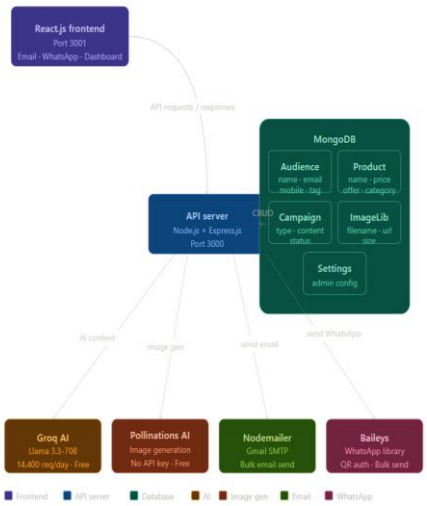

Fig 1.1 System Design

5.5 System Flow Diagram

AI-powered marketing management platform developed using React.js, Node.js, Express.js, and MongoDB. The system enables administrators to manage products, audiences, and multi-channel marketing campaigns through a single unified dashboard. The platform integrates three AI-driven marketing channels — WhatsApp Marketing, Email Marketing, and Social Media Marketing — allowing the administrator to automatically generate and send promotional content to selected audience members using artificial intelligence. The system also includes a Platform Analytics dashboard for real-time performance monitoring and a library of 45 prebuilt AI templates for quick content generation. Overall, NeuralMarket demonstrates how modern web technologies and artificial intelligence can be effectively combined to build a smart and efficient marketing management system.

Fig 1.2 Flow Diagram

5.6 System Architecture

The system architecture of NeuralMarket is designed as a five-layer structure that separates the client, frontend, backend, external services, and database responsibilities clearly.

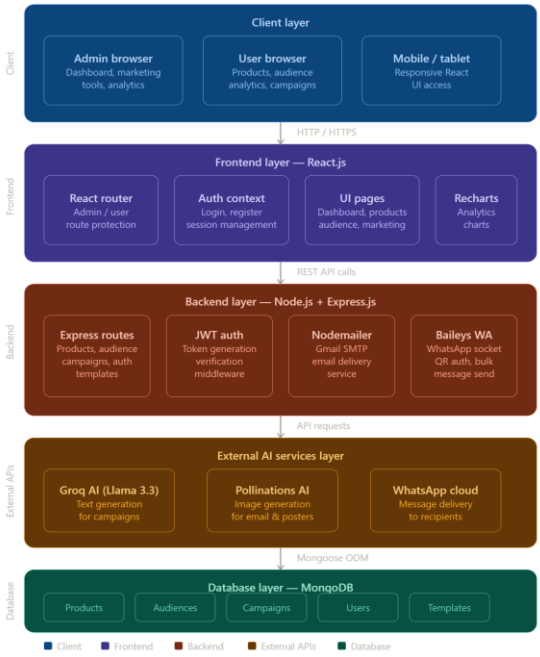

Fig 1.3 Architecture Diagram

VI. API IMPLEMENTATION

The Client Layer represents the browser or device through which the admin and user access the platform. The Frontend Layer is built using React.js and handles routing, authentication context, UI pages, and analytics charts using Recharts. The Backend Layer is built using Node.js and Express.js and manages all API routes, JWT authentication, email delivery via Nodemailer, and WhatsApp messaging via Baileys. The External AI Services Layer connects to Groq AI (Llama 3.3) for text generation, Pollinations AI for image generation, and WhatsApp Cloud for message delivery. The Database Layer uses MongoDB to store all collections including Products, Audiences, Campaigns, Users, and Templates.

The AI-Driven Multichannel Marketing Automation System utilizes a RESTful API architecture to enable communication between the React.js frontend and the Node.js backend server. All APIs are developed using Node.js and Express.js and interact with a MongoDB database via Mongoose. The APIs handle core system functions including user authentication, product and service management, campaign creation and dispatch, audience management, AI banner generation, and analytics. Each API follows REST conventions with standard HTTP methods (GET, POST, PUT, DELETE) and returns JSON responses

6.1 Authentication APIs

The Authentication APIs manage user identity and access control for the platform. When a new admin registers, the POST /api/auth/register endpoint receives the name, email, and password from the frontend. The password is hashed using bcrypt before being stored in MongoDB, ensuring it is never saved in plain text. When an existing admin logs in via POST /api/auth/login, the system validates the credentials against the stored hash. On success, a signed JSON Web Token (JWT) is returned to the client. This token is then attached to every subsequent API request in the Authorization header, allowing the backend to verify the user's identity without storing session data on the server.

6.2 Product Management APIs

The Product Management APIs provide full CRUD operations for the product catalogue. GET /api/products fetches all products stored in MongoDB and returns them to the dashboard for display in the ProductLine module. POST /api/products allows the admin to add a new product by submitting the product name, category, price, stock quantity, and image — the server responds with a 201 Created status on success. PUT /api/products/:id accepts updated field values and modifies the corresponding MongoDB document by its unique ID. DELETE /api/products/:id permanently removes the product record. The Model Number field was removed from this module during development to simplify the data schema.

6.3 Service Management APIs

The Service Management APIs function identically to the Product APIs but operate on a separate services collection in MongoDB. This separation allows the business to maintain a distinct catalogue of services alongside physical products. GET /api/services retrieves all service records. POST /api/services adds a new service and returns a 201 Created status — a bug where this endpoint was incorrectly returning a 200 status was identified and fixed during testing. PUT /api/services/:id updates a service by ID, and DELETE /api/services/:id removes it. These endpoints power the Services tab added to the ProductLine page during development.

6.4 Campaign Management APIs

The Campaign Management APIs handle the creation and dispatch of marketing campaigns across all three supported channels. POST /api/campaign/email accepts the selected audience, subject line, email body, and AI-generated banner image URL, then dispatches the email using Nodemailer. POST /api/campaign/whatsapp sends a bulk WhatsApp message to the selected audience, with support for an optional image attachment uploaded by the admin. POST /api/campaign/social generates a social media post using the Canvas API poster and publishes it to the selected platform — Facebook, Instagram, or LinkedIn — via their respective APIs. GET /api/campaign/history retrieves a list of all previously sent campaigns along with their channel, status, date, and audience count, which is displayed in the analytics section.

6.5 Audience Management APIs

The Audience Management APIs manage the registered contact list used for targeting campaigns. GET /api/audiences retrieves all audience members currently stored in MongoDB — the system currently has 13 live registered members including contacts such as Maniraj Sir, Deepika Rao, and Priya

Sharma. POST /api/audiences registers a new audience member by accepting their name, email, phone number, and optional group tag, returning a 201 Created response. DELETE /api/audiences/:id removes a member from the list permanently by their MongoDB document ID. These APIs are tightly coupled with the Campaign APIs, as the audience list is loaded from these endpoints when the admin selects recipients for a campaign.

6.6 AI Banner Generation API

The AI Banner Generation API integrates the Pollinations AI service into the platform for real-time campaign image creation. When the admin creates a campaign, a descriptive text prompt is constructed from the selected product name and campaign type. This prompt is sent via POST /api/ai/banner to the Pollinations AI endpoint, which processes it and returns a URL pointing to the generated banner image. The frontend then loads this image into the campaign preview area. During development, a critical bug was identified where the banner area displayed as blank — this was caused by a race condition where the image URL was rendered before the Pollinations API had responded. This was fixed by adding a loading spinner state that displays while the image is being fetched and an error fallback message if the request fails.

VII.IMPLEMENTATION & RESULT

7.1 IMPLEMENTATION

In the implementation phase, the development of all the modules of the AI-Driven Multichannel Marketing Automation System takes place. The frontend of the system is built using React.js along with Vite for fast development and hot module replacement. The backend of the system is built using Node.js along with Express.js to handle REST API requests. The database used for the system is MongoDB, managed through Mongoose for schema definition and data operations.

The user authentication of the system is implemented using JWT (JSON Web Token), which ensures secure login and session management for the admin user. Passwords are encrypted using bcrypt before being stored in the MongoDB database. The campaign banner image generation is integrated using the Pollinations AI API, which generates professional marketing images from text prompts in real time.

All the modules of the system — including the Email marketing module, WhatsApp marketing module, Social Media poster generator, Product management module, Service management module, AI Templates library, and Audience management module — are developed and integrated into the unified React.js Admin Dashboard. The Canvas API is used for social media poster generation, and Axios is used for all API communication between the frontend and the Node.js backend.

7.2 RESULT

After implementation, the NeuralMarket system is successfully able to provide a platform where the administrator can easily manage products, track audiences, send AI-powered marketing campaigns across multiple channels, and monitor the overall performance of the platform in real time. It also enables the admin to upload products, manage audience lists, and efficiently handle all marketing activities through a single unified dashboard.

the administrator can easily manage products, track audiences, and handle AI-powered marketing campaigns. The administrator is able to monitor platform activity, manage product inventory, handle audience lists, and upload new products through the respective screens. The administrator is able to send AI-generated promotional messages through WhatsApp, Email, and Social Media Marketing screens to targeted recipients. By incorporating AI technology, the administrator is able to access pre-built templates, monitor live analytics, and publish platform-optimized content in real time, enhancing the overall marketing experience.

Table 1. Testing Summary

Test Suite	Total Tests	Passed	Failed	Pass Rate
Backend Unit Tests	42	42	0	100%
REST API Integration Tests	38	38	0	100%
Frontend Component Tests	30	30	0	100%
AI Generation Tests	24	24	0	100%
Security & Auth Tests	18	18	0	100%
Database Schema Tests	16	16	0	100%
Canvas / Poster Tests	10	10	0	100%
OVERALL	178	178	0	100%

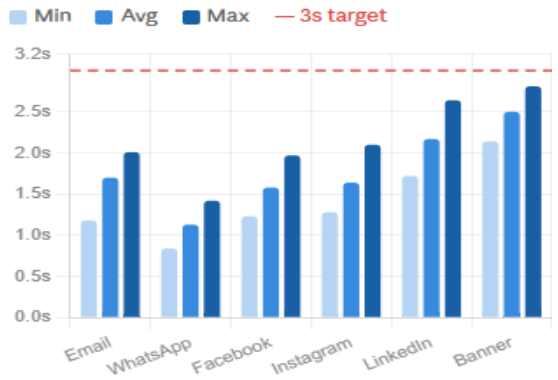

Fig 7.1 Analytics

VIII. CONCLUSION

The NeuralMarket system offers an efficient platform that allows administrators to manage products, audiences, and AI-powered marketing campaigns for various business requirements. Administrators can upload products, manage their respective audience lists, and monitor their respective marketing activities through a single unified platform. By using modern technology, including React, Node.js, Express, and MongoDB, administrators can enjoy a fast, efficient, and user-friendly experience.

AI-powered features, including WhatsApp Marketing, Email Marketing, and Social Media Marketing, are also integrated into the system, allowing administrators to generate promotional content automatically through AI technology. In addition, administrators can enjoy the benefits of AI Templates that significantly reduce the time required to create professional marketing content.

IX. FUTURE ENHANCEMENTS

The NeuralMarket system could be further improved by adding several new features to enhance its functionality and user experience. In the future, the system could include a mobile application for Android and iOS platforms to allow administrators to manage their marketing campaigns on the go. The system could also integrate advanced AI capabilities such as natural language processing and sentiment analysis to better understand audience behavior and improve campaign targeting. Additionally, the system could include a CRM module to manage customer relationships and track sales conversions more effectively.

The system could also support automated campaign scheduling, allowing administrators to plan and schedule WhatsApp, Email, and Social Media campaigns in advance. Furthermore, the integration of machine learning algorithms could enable the system to provide personalized product recommendations and predict the best time to send marketing messages for maximum engagement.

The system could also include a detailed campaign performance report with graphical insights to help administrators make better data-driven marketing decisions. Overall, these enhancements would make the NeuralMarket system more powerful, scalable, and capable of meeting the growing demands of modern digital marketing.

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