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A CASE STUDY–DRIVEN MODULAR ARCHITECTURE FOR SMART RETAIL MARKETING AUTOMATION IN SRI LANKAN SMES

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ABSTRACT: Retail small and medium-sized enterprises in Sri Lanka often face challenges in obtaining competitive advantages against large-scale businesses due to poor market automation strategies and technologies suited to their landscape. This paper presents the modular architectural design of a smart retail and marketing automation system developed as a case study for May Fashion, a mid-sized garment retailer. The research follows a design science methodology incorporating stakeholder interviews, observations, and comparative analysis as a qualitative study. Results indicate a proposed modular architecture that can be adapted to similar SMEs across developing economies, based on the May Fashion case study. The architecture is informed by system requirements derived including data driven , behaviour-based segmentation, automated campaign schduling and execution, PoS integration, dynamic analytical dashboard and CRM features from challenges identified through qualitative methods. The proposed modular architecture consists of distinct components such as customer segmentation, campaign automation, and analytics dashboards. Findings from the May Fashion case study suggest that the system design can significantly reduce manual effort in campaign execution, improve personalization, and enable SMEs to integrate POS data for data-driven marketing.

Keywords: smart retail, marketing automation, small and medium enterprises , modular system architecture

1 INTRODUCTION

In today's highly competitive retail environment, small and medium enterprises (SMEs) face significant challenges in delivering personalized and data-driven marketing strategies that enable smart growth, customer loyalty, and competitiveness in a digital world. Many SMEs still rely on traditional and manual marketing strategies without focused customer insights or personalization (Nazir et al., 2024). A major challenge is that despite having access to Point-of-Sale (POS) data, most SMEs lack the technical capacity to analyze purchasing behavior and use it effectively in marketing campaigns. This research study explores the opportunity to bridge the gap in the adoption of technology-driven retail and marketing automation solutions. Furthermore, it aims to address the technological gap by providing a modular, intelligent system capable of integrating with existing POS data and deriving requirements for the design of a modular architecture to automate customer segmentation and execute personalized campaigns using rule-based and machine learning (ML) logic.

1.1 Background Study

Pangriya and Singh (2020) emphasized the importance of fostering emotional relationships with customers, contributing to higher revenue and retention. Bhatt and Nagvadia (2021) highlighted

poor analysis of customer behavior and market trends, which results in missed opportunities for customer engagement and long-term revenue growth. Nuseir et al. (2023) stressed the need to introduce technology-driven market automation approaches to enhance customer retention, optimize marketing strategies, and improve sales efficiency.

1.2 Problem Statement and Motivation

Most SMEs use typical transaction processing systems (TPS), such as point-of-sale systems, to store day-to-day transaction records. However, many lack motivation to adopt modern digital technologies due to limited awareness, knowledge, or funds for implementation. Cadden et al. (2023) noted that the majority of SMEs are unaware of the advantages of using big data analytics to identify customer segments and derive actionable marketing insights. Currently, most marketing initiatives are primarily manual, impersonal, and not aligned with actual customer actions. Lim et al. (2021) emphasized the importance of aligning market automation solutions with real customer behavior, noting that most open-source solutions are unsuitable for diverse enterprise scenarios. Customization through subscription packages can be costly. Payam Boozary et al. (2024) also highlighted the importance of implementing case study–based solutions.

1.3 Research Aim

The aim of this research is to propose a practical, scalable solution tailored to the SME context by deriving common market automation requirements from a real-world case study in the Sri Lankan retail sector.

1.3.1 Research Questions

RQ1: What are the key challenges faced in conventional marketing strategies by SMEs, as identified through a case study of a Sri Lankan retail business?
RQ2: What user and system requirements can be derived from these challenges to inform the design of a smart retail marketing automation system?
RQ3: How can a modular system architecture be designed to address these requirements while ensuring scalability, cost-effectiveness, and ease of adoption for SMEs?

1.3.2 Research Objectives

Objective 1: To identify key marketing and engagement challenges in SME retail settings through stakeholder interviews, direct observation, and comparative system analysis.
Objective 2: To derive a set of validated user and system requirements from these challenges and structure them into a modular architecture for a smart retail marketing automation system.
Objective 3: To propose a modular system architecture that maps these requirements into functional components suitable for incremental development and deployment.

2 METHODOLOGY

This research is grounded in an interpretivist philosophy (Junjie & Yingxin, 2022), recognizing that marketing challenges in SMEs are socially constructed and must be understood through

the perspectives of individuals within their organizational context. By conducting stakeholder interviews and contextual observations, the study seeks to interpret the lived experiences of users and decision-makers. Additionally, the study incorporates elements of pragmatism, aiming to develop a practical, usable solution to a real-world problem through the application of design science principles.

This study follows the Design Science Research (DSR) methodology, as outlined by Hevner et al. (2004) and Peffers et al. (2007), to propose a modular architecture for an IT support system addressing challenges identified through qualitative data collection and analysis. The research process includes problem identification through qualitative data, review of relevant literature, derivation of design requirements, and development of a modular architecture grounded in user needs.

Considering the interpretivist approach, qualitative data were collected through a single case study of the enterprise "May Fashion" using stakeholder interviews and observations in the workplace. Semi-structured interviews were conducted with owners, marketing managers, and other high-level executives to explore perceptions of current marketing practices, challenges faced, and expectations from potential technology solutions. Observational data were gathered by monitoring marketing activities and customer engagement processes, supplemented by reviewing marketing materials and sales reports. Purposive sampling targeted individuals directly involved in marketing and customer engagement to ensure relevance and depth. Data saturation determined the sample size, resulting in interviews with 8 stakeholders.

A thematic analytical approach was used to analyze the data by defining themes and codes. All interviews were transcribed into English for consistency. Seven interviews were conducted in English, while four were in Sinhala and later translated to English. During analysis, two interviews were revisited iteratively as new themes emerged and required further exploration.

3 RESULTS AND DISCUSSION

Stakeholders highlighted that conventional marketing strategies primarily rely on leaflets and posters, lacking behavior-driven personalization. SMS and email campaigns were also generic and did not ensure customer engagement: *"We just send the same SMS to everyone. There's no way to filter based on purchase or interest."* (Interviewee S2 – Stakeholder 2)

"අපි බැනර් ගහලා තියෙද්දිත් පාරිභෝගිකයෝ ඒ දෙස බලන්නේ නෑ . අපේ කඩේට එන පාරිභෝගිකයෝ කවුද කියලා අපිට ගණන් කරන්න බෑ. බැනරය නිසා ඒක බලන්න එනවද කියලා"

Translation: *Even when we put up banners, customers do not pay attention to them, and we cannot track whether a customer visits the store as a result of the banner.* (Interviewee S6)Document analysis confirmed the absence of dynamic segmentation or preference profiling. Observations showed stakeholders lacked clear understanding of segmentation and personalization, which informed the design of features such as dynamic segmentation, customer profiling, and personalized content support. Another major challenge was the overreliance on manual processes throughout the campaign lifecycle.

"PoS Machine එක බලලා Customer වෙන් කරන එක අමාරුයි. ඊට පස්සේ email යවන්න ගැලපෙන දින බලන එක ඒවට reply එවන එක බලලා respond කරන එකත් අමාරුයි."

Translation: *Manually checking the POS and filtering customers is very difficult. Scheduling*

emails is also challenging, and managing responses is even more cumbersome. (Interviewee S8. Existing open-source and commercial marketing automation systems such as HubSpot and Mailchimp offer strong campaign features but lack cost-effective POS integration and customizable segmentation for SMEs in developing regions. The proposed architecture addresses these gaps through modularity, local adaptability, and simplified user workflows. High-level executives reported difficulty understanding campaign outcomes and adjusting strategies: *"We only get static reports after the campaign ends. We can't adjust anything mid-run."* (Interviewee S1) Observations confirmed spreadsheets were used to manage email and SMS campaigns, without updating records or analyzing customer behavior post-campaign. All data sources highlighted the importance of integrating CRM components, POS integration, and digital marketing strategies.

3.1 Derived Requirements and System Modules

Table 1. Derived Requirements and Mapped System Modules

Requirement	Mapped System Module
Data-driven, behaviour-based segmentation	Customer Segmentation Module
Automated campaign scheduling and execution	Campaign Management Module
POS integration	Integration Layer
Dynamic analytics dashboard	Analytics Dashboard
CRM features	Customer Relationship Management Module

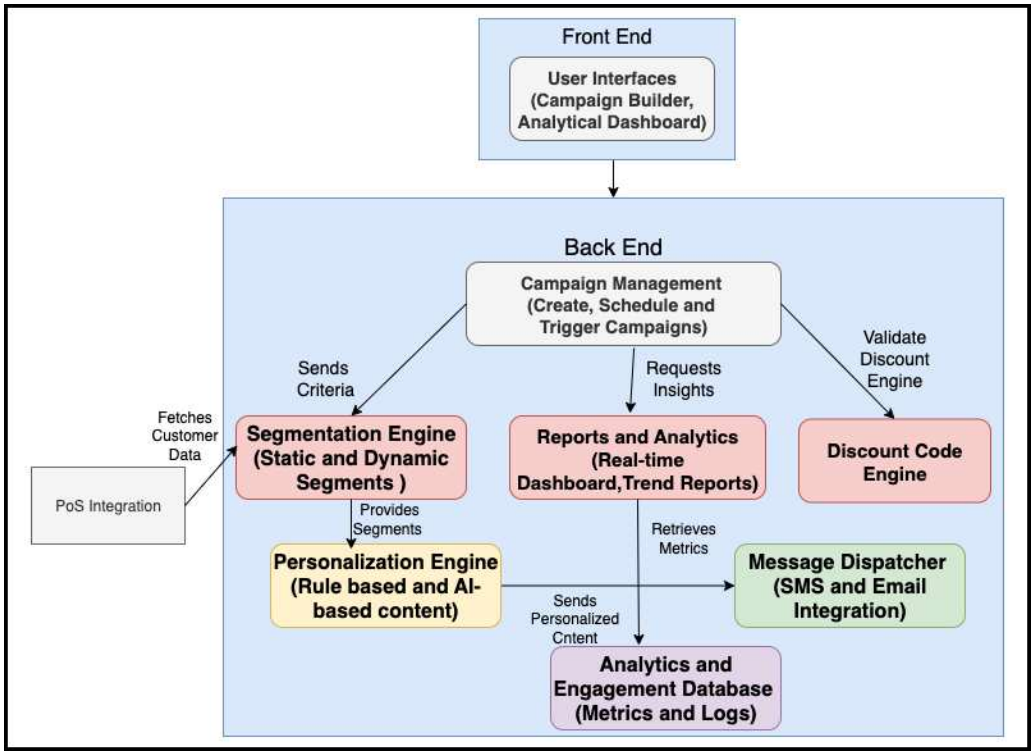

Figure 1. Modular Architecture for the proposed system

Most commercial marketing automation platforms, such as HubSpot and Mailchimp, are designed to meet the global needs of large enterprises and may not address the specific challenges faced by SMEs in local contexts. The novelty of this proposed system tailored to the Sri Lankan retail SME environment, providing a modular and lightweight solution that allows businesses to adopt only the components they need as per the customization preferences. It enables direct integration with local POS systems, supporting dynamic customer segmentation and personalized campaigns capabilities often missing in current solutions. While many small businesses rely on manual campaigns or basic automation, this system leverages rule-based logic and optional machine learning modules to deliver cost-effective, data-driven marketing automation aligned with the operational realities and workflows of SMEs.

4 CONCLUSION

This study explored the limitations of conventional marketing practices employing interviews, observations, and document reviews to uncover core challenges faced by marketing stakeholders with single case study. Key issues identified include the lack of customer segmentation automation, manual handling of campaign messages, insufficient tracking of campaign performance, and the absence of analytical tools to inform decision-making. Based on the insights gained, a set of functional requirements was developed to guide the design of a modern, user-centered marketing automation system. The proposed design supported by a modular architecture aims to address the gaps in existing workflows. The study contributes to bridging the gap between practical marketing challenges and the design of context-aware, intelligent digital marketing solutions. This study is limited by its reliance on a single case study and primarily qualitative insights, which may affect generalizability. Future work will involve implementing a functional prototype and evaluating system performance using quantitative metrics such as campaign response rates, time savings compared to manual execution, employee productivity, increases in sales, campaign conversions, and other open and click-through rates after the completion of the implementation according to the suggested modular architecture. Additionally, conducting multi-case validation to strengthen external validity and integrating search engine optimization techniques will be considered as platform improvements in future phases. The researchers also expect to implement the system and evaluate the architecture against stakeholder expectations.

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