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Original Article

AI-Driven Multi-Agent System for Automated Social Media Marketing Campaigns

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Abstract

Multi-Agent Marketing System is put forth to automate the entire campaign lifecycle of digital strategic development, personalization, content creation, poster generation, scheduling, and platform-specific posting. Human coordination is predominantly needed for traditional marketing practices, resulting in scalability challenges and varied delivery. Gemini generative models for ideation and text generation, Stable Diffusion for poster generation using automated design, and APIs for distribution across platforms such as Twitter, LinkedIn, and Telegram are used in the system. Each agent works autonomously with a specific role, orchestrated by a central agent to make seamless execution and data exchange possible. Experimental deployment indicates significant improvements in campaign execution time and accuracy of tailored content, all with little human intervention. The architecture illustrates how Large Language Models and Generative AI, when placed within an agentic framework, can provide scalable, consistent, and adaptive marketing automation.

Introduction

With the advent of the digital age, social media marketing has emerged as one of the most potent means of building brands, engaging customers, and promoting products. Yet, conceptualizing and implementing a successful marketing campaign is still a multifaceted process that entails a number of creative and strategic activities — such as campaign thinking, audience research, content creation, poster creation, scheduling, and publishing. All of these activities may need human involvement, coordination, and considerable time. With recent breakthroughs in Artificial Intelligence(AI), specifically Generative AI and Large Language Models (LLMs), most of these activities can now be automated or enhanced. Generative AI has demonstrated tremendous ability in generating top- quality textual and visual content, making creative aspects of marketing automatable. Meanwhile, multi-agent systems (MAS) have been effective in controlling distributed workflows, decision-making, and task automation with the coordination of independent agents. Together, the two paradigms provide the possibility of constructing intelligent cooperative systems able to carry out end- to-end marketing workflows.

There have been some existing systems and research works that have applied AI for marketing and task automation. But few of these projects consider isolated tasks e.g., sentiment analysis, engagement prediction, or generating ad copy — and fail to put them together in an end- to-end pipeline. The baseline paper, which introduced a multi-agent architecture for automating marketing campaigns, considered workflow scheduling and resource allocation as the core contributions but left out generative content generation and intelligent scheduling for engagement on social media.

In order to fill this lacuna, the current work suggests a Generative Multi-Agent Marketing Framework, an agent- based AI system that is able to autonomously generate, structure, and schedule entire marketing campaigns. The framework consists of dedicated campaign strategy generation, content generation, poster generation, scheduling, and posting simulation agents, all working together to provide an integrated marketing plan. As opposed to conventional workflow scheduling, the suggested system makes use of time-based scheduling in order to identify optimal posting times, implying greater potential audience involvement.

The contributions of this work are discussed as follows:

- Multi-agent architecture design incorporating generative AI for autonomous campaign generation.
- Agent implementation to carry out campaign strategy generation, content generation, poster generation, scheduling, and simulated posting.

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- Utilizing time-triggered scheduling in place of workflow scheduling for maximizing post timing to achieve optimum reach and engagement.
- End-to-end demonstration of how Generative AI can improve creative marketing processes in a multi- agent system.

This strategy looks forward to giving marketers and researchers a scalable, smart framework for automating end-to- end social media marketing campaigns with the synergy of multi-agent coordination and generative AI.

Related work

Marketing campaign automation has progressed from human coordination to standardized workflow-based management systems. The conventional methods tended to use human decision- making for content planning, scheduling, and deployment, which introduced inefficiencies and inconsistencies in the various channels. To address these shortcomings, a few researchers have sought to leverage the usage of workflow management systems and multi- agent architectures to facilitate the coordination of marketing processes.

The foundational work by Pop et al. proposed a multi- agent workflow management system for marketing campaigns on the WADE (Workflow and Agent Development Environment) platform. Their framework modeled campaign processes formally as a process definition language and ran them through smart agents that coordinated heterogeneous resources like people, software applications, and organizational resources. The scheduling relied on workflow scheduling algorithms and the agent brokering paradigm, enabling dynamic allocation of campaign tasks to available agents. While this solution was very effective in enhancing process. automation and parallel management of multiple campaigns, it focused mainly on process-level automation and not content- level intelligence — leaving behind features such as campaign ideation, creation of creative content, and adaptive timing.

Later research widened multi-agent systems in marketing to customer segmentation, recommendation, and market analysis. Such systems used intelligent agents for making decisions but did not include creative automation or generation. More recently, developments in Generative AI models, such as Large Language Models (LLMs) and diffusion- based image generators, have allowed for automatic creation of marketing texts, images, and slogans.

Yet, the majority of these publications function independently as content generators without an inbuilt decision support system for campaign planning and implementation.

Conversely, this current work introduces a multi-agent generative system that combines autonomous posting and scheduling agents with Generative AI. The system presents a group of dedicated agents—Personalisation, Campaign Strategy, Content Creation, Poster Generation, Scheduling, and Posting Agents—that all undertake the whole marketing process, from audience analysis up to post publication. Unlike workflow scheduling in the base paper, the proposed system employs time-based scheduling for social media platforms(e.g., Twitter, LinkedIn, Telegram), enabling campaign automation in real-time environments. This hybrid approach bridges the gap between workflow automation and creative intelligence, delivering a fully automated, end-to- end digital marketing system.

Literature survey

Multi-Agent Systems (MAS) have been extensively identified as a core paradigm in distributed artificial intelligence, allowing autonomous agents to interact, collaborate, and share common goals. Theoretical foundations laid down by Maes [8], Wooldridge and Jennings [7], and Franklin and Graesser [9] established the theoretical foundation of agent autonomy and interaction, while Finin et al. [10] and Huhns and Stephens [11] axiomatized agent communication and organizational structure. Jennings [12] and Weiss [14] also highlighted the applicability of MAS as a technique for designing complex, adaptive, and modular software systems.

The use of MAS in marketing and decision-support applications was first presented by Delias et al. [1], [13], who created an agent-based workflow management framework for campaign management automation purposes including task scheduling and coordination. Their framework showed how distributed agents could successfully carry out campaign actions within the WADE environment. Kazienko

[4] subsequently used MAS concepts on web advertising, facilitating real-time targeting and delivery optimization. Later research, including works by Olszak and Bartuś [6] and del Val et al. [5], generalized MAS to social customer relationship management (CRM) and social network analysis, facilitating adaptive interaction and data-driven personalization.

More recent studies have moved towards the improvement of the cognitive and reasoning capabilities of MAS. Pezeshkpour et al. [2] suggested human- inspired solutions to to reason about missing requirements for coordinating agents, while Flores et al. [3] suggested refective and memory-based mechanism to enhance relianbility for marketing-focused MAS. Dey et al. [15] have examined social media marketing automation with the help of cooperative agents to disseminate content and engage the audience. But these strategies mostly focused on automation and coordination with less concern for creativity or generative abilities.

In order to overcome this limitation, this current study proposes a Generative Multi-Agent Marketing System that combines Large Language Model (LLM)-guided agents for campaign strategy generation, content creation, and poster design. By extending the classical MAS-based campaign management approaches [1], [13] with generative intelligence and conventional agent- based coordination, the proposed system is able to achieve end-to-end automation supporting creativity, personalization, and scheduling for contemporary digital marketing workflows.

Proposed system

System Overview

The proposed system here is a multi- agent generative system for the automation of end-to-end campaign generation and deployment of digital campaigns. It combines large language models (LLMs) and image generation models within an agentic framework to execute tasks from audience analysis, campaign ideation, content generation, poster generation, scheduling, and social media posting.

Given a product name or marketing objective as input, the system produces a complete campaign package — creative theme, text updates, promotion images, and posting schedule

— automatically. Unlike typical workflow-based planning systems, this approach employs time- triggered planning optimized for social media interaction with little intervention by humans.

System Architecture

All the system involves six intelligent agents acting in a sequential manner to complete the campaign cycle:

- Personalisation Agent,
- Campaign Strategy Agent,
- Content Creation Agent,
- Poster Agent,
- Scheduling Agent, and
- Posting Agent.

Each of the agents is meant to perform a specialty role and transmit structured data outputs that serve as inputs to the succeeding agent. Figure 1 shows the system architecture of the proposed framework, with the sequential and message- based communication among agents.

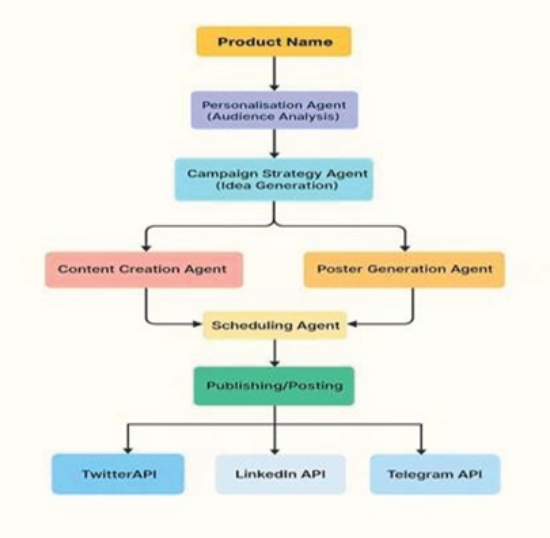

Fig 1: System Architecture of the Multi-Agent Generative Marketing Framework

The Personalisation Agent begins the process by setting target audience attributes from product information inputted. This is followed by the Campaign Strategy Agent, which designs a novel campaign idea and slogan. The Content Creation Agent produces platform-specific captions, and the Poster Agent produces respective visual content from image generation models. The Scheduling Agent determines optimal posting times for each platform, and finally, the Posting Agent posts generated content automatically via platform APIs.

Agents Description

Personalisation Agent

The Personalisation Agent uses a generative language model to infer demographic and psychographic traits of potential audiences for a given product. Depending on the category of the product and the description, it gives an audience profile with interests, age group, and consumption preferences. This is done to ensure the next campaign elements are tuned into the correct market segment.

Campaign Strategy Agent

This agent generates an interwoven marketing plan through audience comprehension and product history. According to the Gemini language model, it generates a campaign slogan, topic, and tone suitable for the audience to be targeted. The strategy generated guides downstream agents to provide message consistency across various content types.

Content Creation Agent

The Content Creation Agent generates short-form text-based content such as post titles and slogans. It leverages the generative ability of the LLM to generate creative and platform-based captions (e.g., within 280 characters for Twitter). The output products include hashtags and emojis for making the posts discoverable and engaging

Poster Agent

The Poster Agent utilizes a diffusion- based image model (Stable Diffusion) to produce attractive promotion posters. It consumes the campaign idea and caption as inputs and generates high-resolution images aligned with the textual tone and brand theme. The visual component increases campaign appeal and user interaction rates.

Scheduling Agent

In contrast to workflow-based task schedulers used in common distributed systems, the Scheduling Agent uses time- based scheduling for social media automation. It determines best-practice times to post based on empirical best times for each social network, such as 11:15 AM IST for LinkedIn or 9:00 PM IST for Twitter. The schedule exists in the form of a timestamp and automatically activates the posting function.

Posting Agent

The Posting Agent is paired with social media APIs (Twitter, LinkedIn, and Telegram) for posting the generated content. By making REST API calls and authentication tokens, it posts the article at the very moment the posting time is specified, with supportive captions and images. The agent also monitors post status for checking and analysis.

Workflow of the System

The system in question's workflow is depicted in Fig. 2 and consists of seven automated steps:

- The user inputs the product's name a selects target platforms.
- The audience profile is determined by the Personalisation Agent.
- The Campaign Strategy Agent formulates a campaign idea.
- The Content Creation Agent creates hashtags and captions.
- The Poster Agent designs corresponding visual content.
- The Scheduling Agent selects posting times that are platform-specific.
- The Posting Agent posts content automatically according to the Schedule.

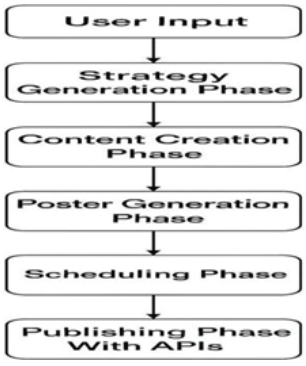

Fig 2 : Workflow of the Proposed Multi- Agent Marketing system

This sequential workflow ensures modularity, with each agent executing independently but with uniform communication through structured data exchange.

Implementation Details

The system is implemented in Python, with APIs including Google Gemini for text generation, Stable Diffusion for image generation, and Requests OAuth for API authentication. The scheduling module makes use of the datetime and time libraries in Python to schedule posts according to the Indian Standard Time (IST) zone. Supported output platforms are Twitter, LinkedIn, and Telegram. Structured output per run has a campaign theme, caption, image, scheduled timestamp, and posting log.

Advantages of the Suggested System

- Automated content creation and posting
- Integration of text and image creation with generative AI models
- Time-based scheduling and platform- level optimization
- Reduced human effort and increased scalability.
- Scalable for different marketing goals and product categories.

Comments

The proposed system replaces conventional workflow scheduling techniques with an intelligent, time-based multi-agent framework that can initiate end-to-end campaign design. By incorporating generative AI and automation logic, the system offers a scalable and efficient solution for digital marketing workflows in the modern age.

Results

TThe system successfully demonstrates an end-to-end automatic pipeline for social media marketing campaigns on various platforms. Results shown here demonstrates the outputs.

System Outputs

The platform generates textual and visual content tailored for every platform. It makes sure that campaign messaging is consistent, contextually aware, and ready to be scheduled, allowing effective and consistent delivery of marketing campaigns on multiple channels.

- Tweets are restricted to 280 characters, including hashtags and emojis.
- LinkedIn and Telegram posts feature automatically created poster images to improve engagement.

Fig 3: Post created by the multi-agent model on Twitter

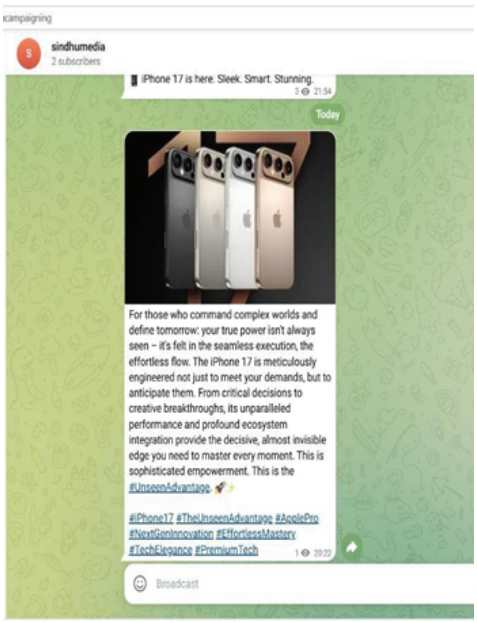

Fig 4: Post created by the multi-agent model on Telegram

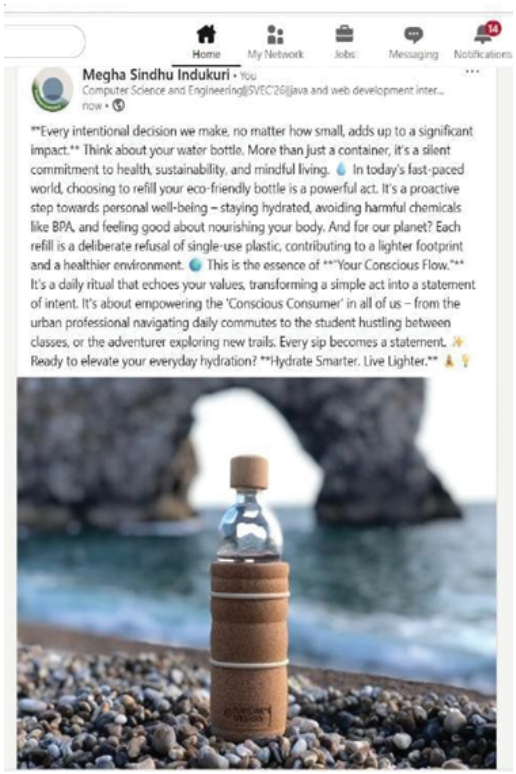

Fig 5: Post created on LinkedIn by the multi-agent model.

Multi-Agent Performance

Each agent serves the campaign as described below:

- **Personalisation Agent:** Determines the targeted audience for the product.
- **Campaign Idea Agent:** Creates an original campaign concept and slogan.
- **Content Generation Agent:** Creates premium platform-specific text posts.

- **Poster Agent:** Produces pretty pictures for media-enabled platforms.
- **Posting Schedule Agent:** Figures out best posting times in 24-hour format.
- **Poster + Caption Delivery Agent:** Posts content automatically through platform APIs.

Having these agents working together will provide smooth coordination, minimizing manual effort and allowing simultaneous handling of multiple campaigns.

Automation and Scheduling

The scheduler mechanism effectively posts content across the platforms at scheduled times. For instance:

Telegram posts are scheduled with timezone conversion from IST to UTC.

- Twitter captions get automatically truncated or recreated to honor character limits.
- Linkedin posts combine text and media effectively using asset registration APIs.
- This proves the system's strong automation capabilities in an actual social media marketing context.

Conclusion

This Paper introduced a multi-agent system for self- managed social media marketing campaigns, unifying personalization, campaign planning, content generation, poster creation, scheduling, and platform-specific posting. The system showcases end-to- end automation and generates catchy text and visual content customized to platforms like Twitter, LinkedIn, and Telegram while efficiently managing scheduling and platform constraints.

The envisioned architecture emphasizes the benefits of integrating agent-based frameworks with generative AI in order to automate marketing processes, minimizing labor while still preserving creativity and engagement-ready content. Future research will concentrate on the addition of real-time analytics, expanded platform support, and the optimisation of posting routines through engagement metrics allowing for more insightful and responsive campaign management.

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