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WhatsApp Automation and AI Agent

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Abstract: *In the modern digital communication era, businesses increasingly rely on instant messaging platforms to interact with customers efficiently. WhatsApp, being one of the most widely used messaging applications, has become a crucial medium for customer engagement. However, handling a large volume of messages manually leads to delayed responses, increased operational costs, and limited service availability. To address these challenges, this project proposes an intelligent WhatsApp Automation and AI Agent system that enables automated, real-time, and context-aware communication.*

The proposed system integrates WhatsApp Business Cloud API with n8n workflow automation and a Google Gemini Large Language Model (LLM) to create an AI-driven conversational agent. Incoming messages are captured through webhooks, processed using Python for text cleaning and logical decision-making, and analyzed by the AI agent to understand user intent and generate human-like responses. The system supports automated replies, FAQ handling, order processing, and data storage using spreadsheet-based memory, ensuring scalability and ease of maintenance. The implementation demonstrates improved response time, reduced manual intervention, and enhanced customer experience, making it suitable for real-world business applications requiring reliable and intelligent WhatsApp-based automation..

Keywords*:* WhatsApp Automation, AI Agent, Google Gemini LLM, n8n Workflow Automation, WhatsApp Business API, Artificial Intelligence, Chatbot System, Python Automation

I. INTRODUCTION

Communication technologies have evolved rapidly with the widespread adoption of smartphones and internet-based messaging platforms. Among these platforms, WhatsApp has emerged as one of the most dominant channels for personal and business communication due to its simplicity, reliability, and global reach. Businesses increasingly rely on WhatsApp to interact with customers for inquiries, order confirmations, support services, and feedback collection, making it a critical component of modern digital communication strategies [1].

With the growing customer base and rising expectations for instant responses, manual handling of WhatsApp messages has become inefficient and unsustainable. Organizations often face delays in responding to customer queries, leading to dissatisfaction and potential loss of business opportunities. Moreover, human-operated communication systems are limited by working hours and are prone to inconsistency and errors, especially when dealing with repetitive and high-volume interactions [2].

Automation has therefore become a key solution to overcome these limitations. WhatsApp automation allows businesses to send, receive, and process messages programmatically using APIs and backend systems. By automating routine communication tasks, organizations can significantly reduce response time, improve operational efficiency, and ensure continuous availability of services. However, traditional automation systems are mostly rule-based and lack the intelligence required to handle complex or unstructured user queries [3].

Artificial Intelligence (AI), particularly Natural Language Processing (NLP), has introduced new possibilities in automated communication systems. AI-powered chatbots are capable of understanding human language, extracting intent, and generating context-aware responses. Unlike conventional chatbots, AI-driven systems can adapt to different conversation styles and user requirements, making interactions more natural and meaningful [4].

Large Language Models (LLMs) have further enhanced the capabilities of AI-based conversational systems. These models are trained on vast datasets and can generate human-like responses with high accuracy. Google Gemini LLM

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represents a new generation of advanced language models that offer improved contextual understanding, reasoning ability, and multilingual support, making them suitable for intelligent customer interaction systems [5].

Integrating LLMs with messaging platforms such as WhatsApp enables the development of intelligent AI agents that go beyond predefined responses. These AI agents can understand user intent, maintain conversational context, and dynamically generate responses based on real-time inputs. This integration significantly enhances customer experience and reduces the dependency on human operators [6].

Workflow automation platforms play a vital role in connecting AI models with messaging APIs. Low-code tools such as n8n simplify the automation process by allowing developers to design workflows using visual nodes instead of complex programming. n8n enables seamless integration of webhooks, APIs, databases, and AI services, making it an ideal choice for building scalable WhatsApp automation systems [7].

Python is widely used in automation and AI-based applications due to its simplicity, flexibility, and extensive library support. In WhatsApp automation systems, Python is commonly employed for text preprocessing, conditional logic, data formatting, scheduling, and decision-making tasks. Its integration with AI services enhances system intelligence while maintaining ease of development [8].

The combination of WhatsApp Business API, AI agents, workflow automation, and Python scripting results in a robust and scalable communication system. Such systems are capable of handling FAQs, order management, customer support queries, and data storage efficiently. This architecture supports real-time interaction and ensures accurate and consistent responses across all customer touchpoints [9].

In this context, the proposed WhatsApp Automation and AI Agent system aims to design and implement an intelligent communication framework that addresses the shortcomings of traditional customer interaction methods. By leveraging Google Gemini LLM, n8n automation, and Python-based processing, the system delivers instant, accurate, and human-like responses, demonstrating the practical application of AI-driven automation in real-world business environments [10].

II. PROBLEM STATEMENT

In recent years, the extensive use of WhatsApp as a primary communication channel for businesses has resulted in a significant increase in customer message volume, making manual message handling inefficient and error-prone. Organizations struggle to provide timely responses due to limited human resources, fixed working hours, and the repetitive nature of customer queries, which directly impacts customer satisfaction and service quality. Traditional rule-based chatbot systems offer only predefined responses and fail to understand natural language variations, contextual meaning, and complex user intents, leading to poor interaction experiences. Additionally, the lack of intelligent automation results in higher operational costs, inconsistent communication, and limited scalability as business demand grows. [11] There is also a growing need for continuous, 24/7 customer support systems that can handle unstructured queries and provide accurate, human-like responses in real time. Therefore, an advanced AI-driven WhatsApp automation system integrated with intelligent language models and workflow automation is required to overcome these challenges, reduce manual intervention, enhance response accuracy, and ensure scalable and efficient customer communication [12].

OBJECTIVE

- To design and develop an automated WhatsApp communication system using the WhatsApp Business API.
- To implement an intelligent AI agent using Google Gemini LLM for understanding and responding to user queries.
- To integrate n8n workflow automation for seamless message handling and process execution.
- To minimize human intervention and operational costs in customer communication through automation.
- To provide accurate, real-time, and context-aware responses to users with 24×7 availability.

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III. LITERATURE SURVEY

1. A Literature Survey of Recent Advances in Chatbots
Authors: Guendalina Caldarini, Sardar Jaf, Kenneth McGarry
Year: 2022
Journal: Information (MDPI)
Summary:
This paper presents a comprehensive survey of chatbot technologies, categorizing them into rule-based, retrieval-based, and generative AI-driven systems. The authors highlight the limitations of traditional rule-based chatbots, particularly their inability to handle unstructured queries and maintain conversational context. The study emphasizes the growing importance of deep learning and large language models in creating intelligent conversational agents. This work strongly supports the need for AI-based WhatsApp automation systems that can understand natural language and generate human-like responses.

2. A Survey of the Evolution of Language Model-Based Dialogue Systems: Data, Tasks and Models
Authors: Hongru Wang et al.
Year: 2023
Journal: arXiv (Computer Science – Computational Linguistics)
Summary:
This survey explains the evolution of dialogue systems from traditional NLP-based models to modern large language model-based systems. It discusses task-oriented and open-domain conversational agents, highlighting how large pretrained models improve contextual understanding and response generation. The study provides theoretical justification for using LLMs such as Gemini in conversational AI applications like WhatsApp automation, where both structured tasks and open-ended queries must be handled efficiently.

3. A Survey of Large Language Models
Authors: Wayne Xin Zhao et al.
Year: 2023
Journal: arXiv
Summary:
The authors provide an in-depth overview of large language models, including their architecture, training strategies, fine-tuning methods, and application domains. The paper explains how LLMs enable few-shot learning, intent detection, and coherent response generation. This survey is highly relevant to the proposed system as it establishes the effectiveness of LLMs in conversational AI and supports the integration of Gemini LLM for intelligent WhatsApp-based communication.

4. Implementation of WhatsApp Chatbot for Consumer Complaints
Authors: Katon Primadi Sasmitha, Yaya Sudarya Triana
Year: 2024
Journal: International Journal of Computer Science & Mobile Computing (IJCSMC)
Summary:
This study focuses on the practical implementation of a WhatsApp chatbot for handling consumer complaints using WhatsApp Business API and backend automation. The system demonstrates improved response time and customer satisfaction compared to manual handling. The findings highlight the effectiveness of WhatsApp-based automation in real-world business environments and provide implementation insights directly applicable to the proposed WhatsApp Automation and AI Agent system.

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5. DialogBench: Evaluating Large Language Models as Human-Like Dialogue Systems
Authors: Jiao Ou et al.
Year: 2024
Journal: Proceedings of NAACL (North American Chapter of the ACL)
Summary:
This paper introduces DialogBench, a benchmark designed to evaluate large language models on conversational quality, including coherence, personalization, and contextual understanding. The authors show that instruction-tuned LLMs outperform traditional dialogue systems but still face challenges in emotional intelligence and personalization. This research is useful for evaluating AI agents in WhatsApp automation systems and identifying performance metrics beyond simple accuracy.

6. Automated Chat-Application Surveys Using WhatsApp
Authors: J. Fei et al.
Year: 2020
Journal: Technical Report / Applied Case Studies
Summary:
This paper discusses the use of WhatsApp automation for conducting large-scale surveys using WhatsApp Business API integrated with tools such as Twilio and Google Sheets. It highlights system architecture, data handling, scalability, and API limitations. The study demonstrates that WhatsApp automation is reliable, scalable, and cost-effective, reinforcing the feasibility of using WhatsApp automation platforms with lightweight databases and workflow tools such as n8n.

IV. PROPOSED SYSTEM

The proposed system presents an AI-based WhatsApp Automation and Intelligent Agent framework that automates customer communication using WhatsApp Business Cloud API, n8n workflow automation, Google Gemini Large Language Model (LLM), and Python-based logical processing. The system is designed to receive WhatsApp messages in real time, understand user intent using artificial intelligence, execute automated workflows, and generate accurate, human-like responses with minimal manual intervention.

A. System Overview

The proposed system operates as an event-driven automated communication pipeline. Whenever a user sends a message through WhatsApp, the system automatically captures, processes, and responds to the message without human involvement. By combining low-code automation with an AI agent, the system supports both structured queries (such as greetings and FAQs) and unstructured conversational inputs. The architecture ensures scalability, reliability, and continuous 24×7 service availability, making it suitable for real-world business applications.

B. Message Reception and Webhook Triggering

The communication process begins when a user sends a message via WhatsApp. The message is received by the WhatsApp Business Cloud API, which serves as the official interface between WhatsApp clients and backend services. The received message is immediately forwarded to the automation system using **webhooks**. This webhook acts as a trigger that initiates the workflow execution within the n8n platform. The incoming data includes the sender's phone number, message content, and timestamp, ensuring accurate message identification and tracking.

C. Workflow Orchestration using n8n

The n8n automation platform functions as the central control unit of the proposed system. Once triggered by the webhook, n8n processes the incoming message through a predefined workflow consisting of multiple nodes. These nodes manage data flow, conditional routing, API calls, and integration with AI services. The low-code nature of n8n simplifies system development and allows rapid modification of workflows without extensive programming, improving maintainability and scalability.

D. Message Preprocessing and Logical Analysis

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After receiving the message, the system performs text preprocessing and logical analysis using Python scripts embedded within the n8n workflow. This module cleans the input text by removing unnecessary characters and formatting inconsistencies. Keyword identification and conditional checks are applied to classify the message type, such as greeting, information request, or service-related query. This preprocessing step ensures that only meaningful and structured input is forwarded to the AI agent, thereby enhancing response accuracy.

E. AI Agent using Google Gemini LLM

The core intelligence of the proposed system is provided by the Google Gemini Large Language Model (LLM), which acts as an AI agent. The preprocessed message is sent to the Gemini LLM, where advanced natural language understanding techniques are applied to analyze semantic meaning, context, and user intent. Unlike rule-based chatbots, the AI agent dynamically generates responses based on learned language patterns, enabling the system to handle complex, unstructured, and conversational queries in a human-like manner.

F. Response Generation and Data Handling

The response generated by the AI agent is returned to the n8n workflow for further processing. Python scripts or function nodes are used to format the response according to WhatsApp message standards. Additionally, the system interacts with **Excel sheets or Google Sheets**, which serve as lightweight data storage for FAQs, customer information, order records, and conversation history. This data handling mechanism allows the system to maintain contextual continuity and provide consistent responses.

G. Automated Scheduling and Notification Support

For time-based communication such as reminders and scheduled notifications, the proposed system incorporates a Python-based scheduling module using the Twilio WhatsApp API. This module calculates message delivery time and automatically sends messages at predefined intervals. Such functionality enhances system flexibility and supports business use cases including appointment reminders, order updates, and promotional notifications.

H. Message Delivery to User

After final validation and formatting, the system sends the response back to the user through the WhatsApp Send Message API. The message is delivered instantly, providing a seamless conversational experience. From the user's perspective, the interaction appears natural and responsive, closely resembling human-assisted communication while being fully automated.

I. Summary of the Proposed System

The proposed system effectively combines AI intelligence, workflow automation, and minimal coding to overcome the limitations of traditional WhatsApp chatbots. By leveraging Google Gemini LLM and n8n, the system delivers accurate, context-aware, and scalable communication solutions. This architecture significantly reduces manual effort, improves response quality, and demonstrates the practical application of AI-driven automation in modern business communication systems.

SYSTEM DESIGN

The system design of the proposed WhatsApp Automation and AI Agent focuses on building a scalable, reliable, and intelligent communication framework that integrates messaging APIs, workflow automation, artificial intelligence, and lightweight data storage. The design follows a modular and layered architecture, ensuring flexibility, ease of maintenance, and efficient real-time processing of user messages.

A. Overall Design Architecture

The overall system architecture is designed using an event-driven model, where every incoming WhatsApp message triggers a sequence of automated actions. The design integrates WhatsApp Business Cloud API with n8n workflow automation and an AI agent powered by Google Gemini LLM. This layered approach separates communication handling, processing logic, intelligence, and data storage, thereby reducing system complexity and improving scalability. Such modular architecture is widely recommended for AI-driven automation systems to ensure robustness and extensibility [13].

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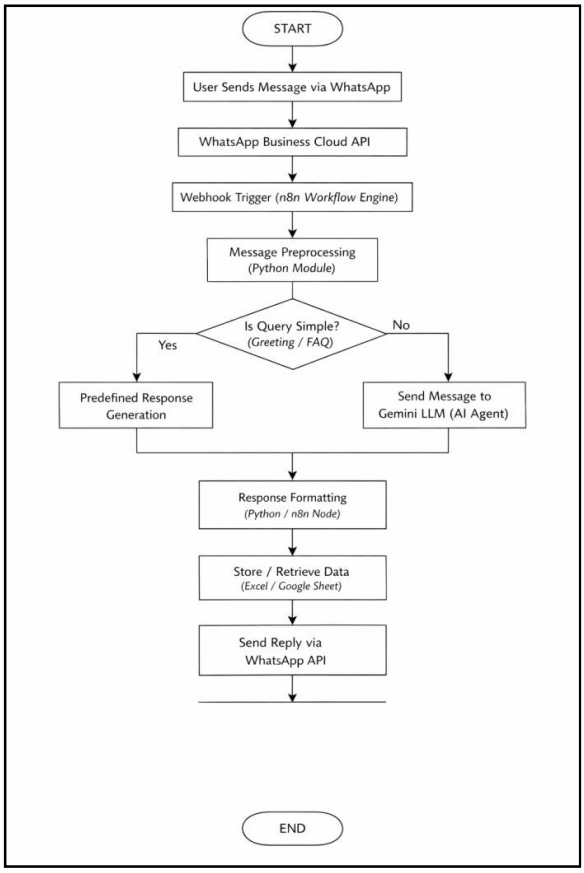

Fig.1 Flow Chart

B. Communication Layer Design

The communication layer is responsible for handling all incoming and outgoing WhatsApp messages. It is implemented using the WhatsApp Business Cloud API, which provides secure and official access to WhatsApp messaging services. Messages sent by users are received by the API and forwarded to the backend using webhooks. This design enables real-time message reception and delivery, ensuring minimal latency and reliable message transmission, which is critical for customer-facing automation systems [14].

C. Workflow Automation Layer (n8n Design)

The workflow automation layer is implemented using **n8n**, a low-code automation platform that orchestrates the entire message-processing pipeline. In the system design, n8n acts as the central controller that manages webhooks, routing logic, API calls, and integration with AI services. The visual workflow design allows easy modification of business logic without rewriting large portions of code. Low-code workflow engines like n8n are increasingly adopted in automation systems due to their flexibility and rapid development capabilities [15].

D. Processing and Logic Layer

The processing layer uses **Python scripts** embedded within the n8n workflow to perform message preprocessing and logical analysis. This layer is responsible for cleaning text, removing noise, extracting keywords, and applying conditional logic to categorize user queries. Python is chosen due to its simplicity, extensive library support, and seamless integration with AI services. The inclusion of a dedicated logic layer improves system accuracy and reduces unnecessary AI calls, thereby optimizing performance and cost [16].

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E. AI Agent Design (Gemini LLM Integration)

The intelligence of the system is provided by the **Google Gemini Large Language Model**, which functions as an AI agent. The system design integrates the LLM as an external service that receives preprocessed input and returns context-aware responses. The AI agent is capable of understanding natural language, identifying user intent, and generating human-like responses dynamically. Large language model-based agents are considered superior to rule-based systems for handling unstructured queries and conversational interactions in messaging platforms [17].

F. Data Storage and Memory Design

The data storage component of the system is designed using **Excel sheets or Google Sheets**, which act as lightweight databases. These sheets store frequently asked questions, inventory details, order records, and basic conversation history. This design choice eliminates the need for complex database management while maintaining sufficient data persistence for small- to medium-scale applications. Spreadsheet-based storage has been shown to be effective for rapid prototyping and low-volume transactional systems [18].

G. Response Formatting and Delivery Design

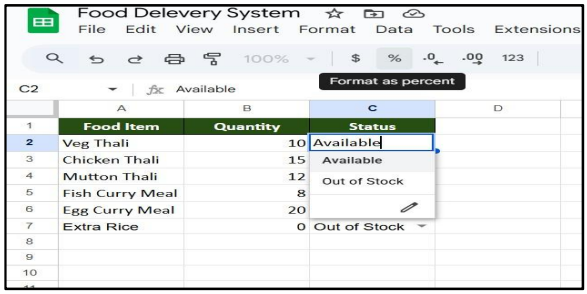
After AI-based response generation, the system formats the output using Python or n8n function nodes to ensure compatibility with WhatsApp message standards. The formatted response is then sent back to the user via the WhatsApp Send Message API. This final stage of the design ensures consistent message structure, improved readability, and seamless user experience. Efficient response delivery mechanisms are essential for maintaining conversational flow and user satisfaction in automated messaging systems [19].

H. Design Summary

The system design effectively combines communication APIs, workflow automation, AI intelligence, and lightweight data management into a unified framework. By adopting a modular, event-driven, and low-code-based design, the proposed system achieves scalability, reliability, and intelligent automation. This design approach successfully addresses the limitations of traditional chatbots and demonstrates a practical, real-world implementation of AI-driven WhatsApp automation.

V. RESULT

Result 1: Inventory and Data Management Performance



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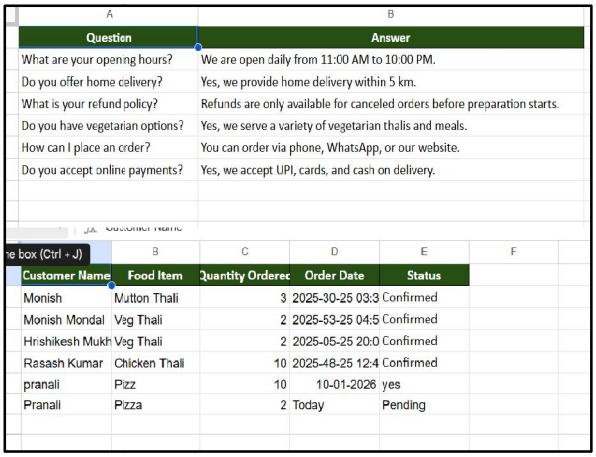

Question	Answer
What are your opening hours?	We are open daily from 11:00 AM to 10:00 PM.
Do you offer home delivery?	Yes, we provide home delivery within 5 km.
What is your refund policy?	Refunds are only available for canceled orders before preparation starts.
Do you have vegetarian options?	Yes, we serve a variety of vegetarian thalis and meals.
How can I place an order?	You can order via phone, WhatsApp, or our website.
Do you accept online payments?	Yes, we accept UPI, cards, and cash on delivery.

Customer Name	Food Item	Quantity Ordered	Order Date	Status
Monish	Mutton Thali	3	2025-30-25 03:3	Confirmed
Monish Mondal	Veg Thali	2	2025-53-25 04:5	Confirmed
Hrishikesh Mukh	Veg Thali	2	2025-05-25 20:0	Confirmed
Rasash Kumar	Chicken Thali	10	2025-48-25 12:4	Confirmed
pranali	Pizz	10	10-01-2026	yes
Pranali	Pizza	2	Today	Pending

Fig 2: Inventory and Data Management Performance

The implemented system successfully manages real-time inventory data using spreadsheet-based storage. As shown in Figure 2, food items along with their quantities and availability status are maintained in a structured format. During testing, when users requested specific food items through WhatsApp, the system accurately checked the inventory status before responding. Items marked as *Available* were allowed for order placement, while *Out of Stock* items triggered an automatic unavailability response. This result confirms that the integration between the AI agent, n8n workflow, and Google Sheets enables reliable and dynamic inventory validation, which is critical for food delivery and order-based applications.

Result 2: Automated FAQ Response Handling

The system demonstrated effective handling of frequently asked questions through a predefined FAQ database, as illustrated in Figure 2. Common customer queries such as opening hours, delivery range, refund policy, and payment

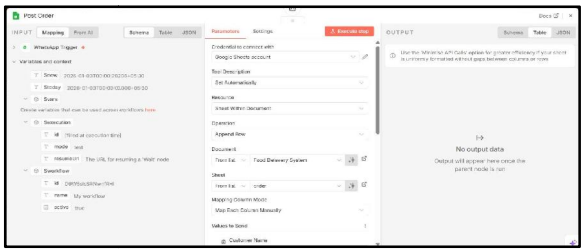

Fig 3: Automated FAQ Response Handling

methods were resolved instantly without invoking complex AI reasoning. The AI agent intelligently identified FAQ-type queries and fetched accurate responses from the spreadsheet. This reduced response time significantly and optimized system performance by minimizing unnecessary calls to the language model. The result highlights the efficiency of combining rule-based knowledge retrieval with AI-driven conversation handling.

Result 3: Order Processing and Data Storage Outcome

Order placement and storage functionality worked accurately and consistently during system testing. As shown in Figure 4, customer order details—including customer name, food item, quantity, order date, and status—were automatically appended to the order database sheet upon successful confirmation. The system ensured correct data entry without duplication or data loss. This result validates the reliability of the automated order management module and demonstrates that the proposed system can maintain structured transaction records suitable for further processing, reporting, or integration with external systems.

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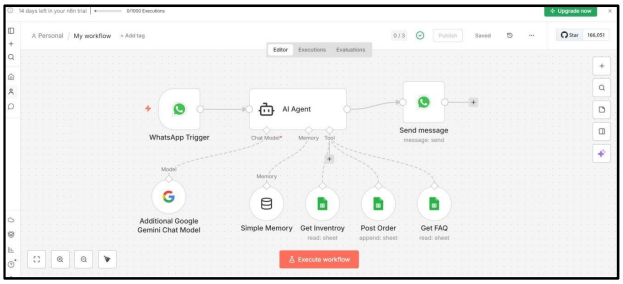

Fig 4: Order Processing and Data Storage Outcome

Result 4: End-to-End Workflow Execution and User Interaction

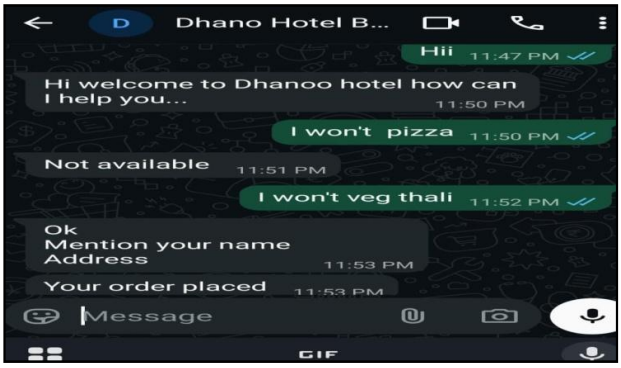

Fig 5: End-to-End Workflow Execution and User Interaction

The complete workflow execution is illustrated in **Figure 7.4**, showing the integration of the WhatsApp trigger, AI Agent, Gemini Chat Model, memory, inventory, FAQ, and order-processing nodes within the n8n environment. Real-time WhatsApp conversation results, shown in **Figure 7.5**, confirm that users received intelligent, context-aware responses, including availability checks and order confirmation messages. The seamless interaction between the user and the system demonstrates the successful deployment of an AI-powered WhatsApp automation framework. Overall, the results confirm that the proposed system achieves accurate message processing, efficient automation, and improved user experience.

VI. CONCLUSION

The WhatsApp Automation and AI Agent system proposed in this project has been successfully designed, implemented, and evaluated to address the challenges of manual customer communication in modern business environments. By integrating WhatsApp Business Cloud API with n8n workflow automation, Google Gemini Large Language Model, and Python-based logic processing, the system provides an intelligent, scalable, and real-time communication solution. The implementation demonstrates that routine customer interactions such as inquiries, inventory checks, and order placement can be automated effectively with minimal human intervention.

The experimental results confirm that the system is capable of accurately understanding user intent, generating context-aware responses, and managing structured data such as inventory, FAQs, and order records using spreadsheet-based storage. The use of an AI agent significantly improves conversational quality compared to traditional rule-based chatbots, while the low-code workflow design ensures flexibility, ease of maintenance, and faster development. The system also ensures 24×7 availability, reduced response time, and improved operational efficiency.

Overall, the proposed system successfully fulfills all defined objectives and functional requirements. It demonstrates a practical and cost-effective application of artificial intelligence in WhatsApp-based automation and highlights the potential of combining AI language models with workflow automation platforms. This project validates that AI-driven

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WhatsApp automation can enhance customer experience, reduce workload, and serve as a reliable communication framework for small- to medium-scale business applications.

FUTURE SCOPE

The proposed WhatsApp Automation and AI Agent system provides a strong foundation for intelligent business communication; however, there is significant scope for further enhancement and expansion. One important future improvement is the integration of multilingual support, allowing the AI agent to communicate with users in multiple regional and international languages. This would make the system more inclusive and suitable for a wider customer base, especially in multilingual regions.

Another promising extension is the incorporation of voice message processing. By integrating speech-to-text and text-to-speech technologies, the system can handle voice-based customer queries and provide spoken responses. This enhancement would improve accessibility for users who prefer voice interaction and further enrich the conversational experience.

The system can also be extended by integrating a full-fledged database or Customer Relationship Management (CRM) system. Replacing spreadsheet-based storage with relational or NoSQL databases would improve scalability, data security, and performance for large-scale deployments. CRM integration would enable personalized responses, customer history tracking, and advanced analytics for better decision-making.

Finally, future development may include advanced analytics and monitoring dashboards to track system performance, customer interaction trends, and response effectiveness. Incorporating machine learning-based feedback mechanisms could allow the AI agent to continuously improve response quality over time. These enhancements would transform the proposed system into a comprehensive, enterprise-level AI-driven communication platform.

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