Customer Support - Automation of Ticket Creation

A PROJECT REPORT

Submitted by,

Mohammad Travadi - 20211CCS0086

Greeshma Reddy - 20211CCS0066

Mubarak - 20211CCS0060

Vignesh G - 20211CCS0054

Mohammed Faizan- 20211CCS0041

Under the guidance of,

Dr. Syed Siraj Ahmed

Associate Professor

(Selection Grade)

School of Computer Science and Engineering Presidency University

in partial fulfillment for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE AND ENGINEERING (CYBER SECURITY)

At

PRESIDENCY UNIVERSITY

BENGALURU

JANUARY 2025

SCHOOL OF COMPUTER SCIENCE ENGINEERING

CERTIFICATE

This is to certify that the Project report **"Customer Support - Automation of Ticket Creation"** being submitted by "MOHAMMAD TRAVADI, GREESHMA REDDY, MUBARAK, VIGNESH G, MOHAMMED FAIZAN" bearing roll number(s) "20211CCS0086, 20211CCS0066, 20211CCS0060, 20211CCS0054, 20211CCS0041" in partial fulfillment of the requirement for the award of the degree of Bachelor of Technology in Computer Science and Engineering is a bonafide work carried out under my supervision.

Dr. Syed Siraj Ahmed
Associate Professor
(Selection Grade)
School of Computer Science and Engineering
Presidency University

Dr. S P Anandraj
Professor& HoD
School of Computer Science and Engineering
Presidency University

Dr. L. SHAKKEERA
Associate Dean
School of CSE
Presidency University

Dr. MYDHILI NAIR
Associate Dean
School of CSE
Presidency University

Dr. SAMEERUDDIN KHAN
Pro-Vc School of Engineering
Dean -School of CSE&IS
Presidency University

PRESIDENCY UNIVERSITY

SCHOOL OF COMPUTER SCIENCE ENGINEERING

DECLARATION

We hereby declare that the work, which is being presented in the project report entitled **Customer Support - Automation of Ticket Creation** in partial fulfillment for the award of Degree of **Bachelor of Technology** in **Computer Science and Engineering**, is a record of our own investigations carried under the guidance of **Dr. Syed Siraj Ahmed, School of Computer Science Engineering & Information Science, Presidency University, Bengaluru.**

We have not submitted the matter presented in this report anywhere for the award of any other Degree.

Student Name	Roll No	Signature
Mohammad Travadi	20211CCS0086	
Mohammed Faizan	20211CCS0041	
Mubarak	20211CCS0060	
Greeshma Reddy	20211CCS0066	
Vignesh G	20211CCS0054	

ABSTRACT

In today's fast-paced digital world, the increasing volume of customer inquiries and complaints overwhelms traditional support systems, causing inefficiencies and slower response times. This project develops an AI-powered ticket automation system that leverages advanced Natural Language Processing (NLP) techniques and frameworks like LangChain, LangGraph, and Retrieval-Augmented Generation (RAG) to streamline ticket creation, categorization, and resolution. By automating workflows, enhancing response accuracy, and integrating seamlessly with existing support infrastructures, the system preprocesses customer queries for automated classification, prioritization, and multilingual translation. Fine-tuned Large Language Models (LLMs) ensure accurate ticket routing and resolution, while parallel processing handles multiple tickets simultaneously, boosting throughput. The system demonstrates reduced manual errors, improved response times, and a targeted efficiency gain of 10%, though challenges remain in handling ambiguous queries and achieving universal compatibility. Future improvements include refining classification algorithms, supporting diverse industries, and incorporating advanced sentiment analysis for better prioritization

ACKNOWLEDGEMENT

First of all, we indebted to the **GOD ALMIGHTY** for giving me an opportunity to excel in our efforts to complete this project on time.

We express our sincere thanks to our respected dean **Dr. Md. Sameeruddin Khan**, Pro-VC, School of Engineering and Dean, School of Computer Science Engineering & Information Science, Presidency University for getting us permission to undergo the project.

We express our heartfelt gratitude to our beloved Associate Deans **Dr. Shakkeera L and Dr. Mydhili Nair,** School of Computer Science Engineering & Information Science, Presidency University, and **Dr. S P Anandraj**, Head of the Department, School of Computer Science Engineering & Information Science, Presidency University, for rendering timely help in completing this project successfully.

We are greatly indebted to our guide **Dr. Syed Siraj Ahmed, Associate Professor (Selection Grade)** and Reviewer **Dr. Mohana S D Assistant Professor**, School of Computer Science Engineering & Information Science, Presidency University for his inspirational guidance, and valuable suggestions and for providing us a chance to express our technical capabilities in every respect for the completion of the project work.

We would like to convey our gratitude and heartfelt thanks to the PIP2001 Capstone Project Coordinators **Dr. Sampath A K, Dr. Abdul Khadar A and Mr. Md Zia Ur Rahman,** department Project Coordinators Dr. **Sharmasth Vali Y** and Git hub coordinator **Mr. Muthuraj.**

We thank our family and friends for the strong support and inspiration they have provided us in bringing out this project.

Mohammad Travadi

Greeshma Reddy

Mubarak

Vignesh G

Mohammed Faizan

TABLE OF CONTENTS

List of Figures

CHAPTER-1
INTRODUCTION

In today's dynamic and customer-driven digital era, businesses face unprecedented challenges in managing customer support effectively. As organizations grow, the volume of customer queries, complaints, and requests has surged exponentially. Traditional **manual ticketing systems**, which were once the backbone of customer support operations, are no longer sufficient to meet the demands of speed, accuracy, and scalability.

The consequences of inefficient ticket management are far-reaching: **delays in response times**, **human errors**, and **inconsistent support quality** result in frustrated customers and operational bottlenecks. In a highly competitive business landscape, failing to provide timely and accurate customer support can lead to lost trust, reduced customer satisfaction, and ultimately, declining revenues.

To address these challenges, **Artificial Intelligence (AI)** has emerged as a game-changer in the customer support domain. By automating ticket creation, categorization, and resolution, AI-driven solutions promise to transform traditional support systems into efficient, scalable, and cost-effective operations. This report explores the limitations of manual systems, the role of AI technologies in revolutionizing customer support, and the design and implementation of an **AI-powered ticket automation system**.

1.1 The Challenges of Manual Ticketing Systems

Manual ticketing systems have long served as the backbone of customer support operations. However, as businesses scale and customer interactions become more complex, these systems face critical challenges that hinder their efficiency and effectiveness. Below are the key issues associated with manual ticketing systems**:**

a. Slow Response Times

Manual ticket creation and routing often lead to significant delays in addressing customer inquiries. Support agents must sort, categorize, and assign tickets manually, which consumes valuable time and slows down the resolution process.

- **Example:** In 2022, Amazon reported delays of up to 3 hours in ticket routing during peak

sales events like Prime Day, as support agents struggled to manually handle high volumes of tickets, resulting in customer dissatisfaction.

- **Statistic:** According to a survey by Zendesk, 52% of customers expect responses within 1 hour, a benchmark that manual systems struggle to meet consistently.

b. Human Errors in Ticket Categorization

Errors in ticket classification or prioritization are common in manual systems. Misclassifications can cause tickets to be routed to the wrong departments, further delaying resolution and frustrating customers.

- **Example:** In 2021, Vodafone reported that 18% of customer complaints were misrouted due to manual categorization errors, increasing resolution time by 35% and leading to customer frustration.

- **Impact:** Misrouted tickets not only delay issue resolution but also add to the workload of support teams as tickets must be reassigned and re-evaluated.

c. Difficulty in Handling Large Volumes

As businesses grow, the volume of customer inquiries increases exponentially. Manual systems often fail to scale effectively, resulting in unresolved tickets and overwhelmed support agents.

- **Example:** During Black Friday 2023, Walmart experienced a 50% backlog in customer tickets due to the inability of its manual systems to process high query volumes efficiently.

- **Challenge:** Handling spikes in ticket volumes without automation results in inefficiencies, longer response times, and dissatisfied customers.

d. Lack of Multilingual Support

In a globalized market, businesses receive customer queries in multiple languages. Manual systems depend heavily on human translators, which adds significant time and cost to the ticket resolution process.

- **Example:** Expedia, a global travel company, faced delays of up to 48 hours for French and Spanish customer queries due to a lack of multilingual support staff during the holiday season.
- **Statistic:** Studies indicate that 76% of customers prefer support in their native language, highlighting the importance of seamless multilingual capabilities.

e. Inconsistent Quality of Responses

Manual ticket resolution relies heavily on the skills and experience of individual agents, leading to variations in response quality. This inconsistency can negatively impact customer satisfaction.

- **Example:** In a 2022 survey by Bank of America, 12% of customers reported receiving incomplete or inconsistent solutions depending on the support agent assigned to their query.
- **Impact:** Such inconsistencies can harm the company's reputation and erode customer trust over time.

f. Workflow Inefficiencies

Manual processes lack streamlined workflows, making it challenging to prioritize urgent tickets and monitor progress. Inefficient workflows result in missed follow- ups and unresolved tickets.

- **Example:** A healthcare provider like Apollo Hospitals found that critical tickets for urgent patient requests were often delayed due to inefficient manual prioritization methods.

- **Outcome:** Workflow inefficiencies can lead to unresolved critical issues, causing frustration for both customers and internal teams.

g. High Operational Costs

Manual ticketing systems require significant manpower for sorting, categorizing, and managing tickets. Repetitive tasks consume resources that could otherwise be allocated to more strategic initiatives.

- **Example:** In 2023, Infosys reported that manual ticketing processes consumed 38% of its customer support operational costs, which could have been reduced significantly with automation.

- **Insight:** Automating repetitive tasks can significantly reduce costs, allowing businesses to optimize their operational expenses.

h. Limited Data Insights

Manual systems lack the capability to extract actionable insights from ticket data. Without analytics, businesses cannot identify trends, recurring issues, or areas for improvement.

- **Example:** Salesforce revealed in a 2023 case study that 25% of recurring customer complaints went unnoticed due to the absence of analytical tools in manual ticketing systems.

- **Impact:** Without actionable insights, businesses miss opportunities to enhance their products and support processes.

Summary of Challenges

The limitations of manual ticketing systems—including slow response times, human errors, and scalability challenges—highlight the need for automation. By adopting AI-powered solutions, businesses can overcome these obstacles, ensuring faster, more efficient, and cost-effective customer support operations .

1.2 The Role of AI in Customer Support

Artificial Intelligence (AI) has revolutionized customer support across various industries, enabling businesses to provide faster, more efficient, and personalized experiences to their customers. AI technologies such as Natural Language Processing (NLP), Machine Learning (ML), and chatbots are transforming how companies handle customer inquiries, complaints, and service requests.

Below are some key points and examples illustrating the role of AI in customer support:

a. 24/7 Availability

AI-powered chatbots and virtual assistants enable businesses to provide customer support round the clock. Unlike human agents, AI systems do not require breaks or time off, ensuring that customers can get assistance at any time of the day or night.

b. Increased Efficiency

AI reduces the time required to resolve customer issues by automating routine tasks such as answering frequently asked questions, providing product information, or troubleshooting common problems. This leads to quicker resolutions and more satisfied customers.

c. Personalized Experiences

AI can analyze vast amounts of customer data to provide tailored solutions. By understanding customers' preferences, behaviors, and previous interactions, AI can offer highly personalized recommendations and solutions, enhancing the overall customer experience.

d. Scalability

As businesses grow, the volume of customer support requests can increase significantly. AI systems

can handle a large volume of inquiries simultaneously, allowing companies to scale their support operations without needing to hire a proportional number of human agents.

e. Cost Reduction

By automating routine support tasks, AI can significantly reduce operational costs for businesses. With fewer human agents needed for basic inquiries, companies can allocate resources more efficiently to handle complex issues.

Examples:

1. Chatbots

Chatbots are the most common application of AI in customer support. They use Natural Language Processing (NLP) to understand and respond to customer queries. For example, **Mitsuku**, a chatbot, has won the **Loebner Prize** multiple times for its ability to hold human-like conversations. Businesses like **Sephora** and **H&M** use AI-driven chatbots to assist customers with finding products, tracking orders, or resolving issues.

2. AI-Powered Voice Assistants

AI-powered voice assistants like Amazon's Alexa, Apple's Siri, and Google Assistant enhance user experience by enabling hands-free support. These systems assist customers with tasks such as setting reminders, checking order statuses, and offering troubleshooting guidance through voice commands.

3. Automated Ticketing Systems

AI is also used in automating ticketing systems. For instance, **Zendesk** employs AI to automatically categorize and prioritize customer tickets, ensuring that urgent issues are addressed first and repetitive problems are handled swiftly through predefined solutions.

Statistics:

- According to **Gartner**, by 2025, 75% of customer service operations will be powered by AI, significantly reducing the need for human involvement in routine customer support functions.
- A **Salesforce** survey revealed that **69% of customers** prefer to use AI- powered chatbots for quick answers to simple inquiries.

- **Juniper Research** forecasts that AI chatbots will save businesses over **$8 billion annually** by 2022 in customer service costs.

Key Takeaway:

The role of AI in customer support is growing rapidly, transforming customer interactions from a reactive service model to a proactive, efficient, and personalized experience. By integrating AI into their support systems, businesses can improve efficiency, cut costs, and create more satisfying customer experiences. The continued development of AI technologies promises even more sophisticated solutions for customer support in the future.

1.3 The Benefits of AI in Customer Support

Artificial Intelligence (AI) has emerged as a game-changer in customer support, offering several significant benefits to both businesses and their customers. From improving efficiency to enhancing customer satisfaction, AI is reshaping how businesses interact with their clientele.

Below are the key benefits of AI in customer support, complete with examples and supporting statistics:

Key Benefits:

a. Enhanced Customer Experience

AI can provide faster and more accurate responses to customer queries, resulting in a more seamless and positive experience. With personalized interactions powered by AI, customers receive tailored recommendations, solutions, and assistance that meet their individual needs.

b. Reduced Response Times

AI-driven chatbots and virtual assistants can handle multiple queries simultaneously, drastically reducing wait times for customers. By automating responses to common inquiries, AI frees up human agents to focus on more complex issues, improving the overall response time and service speed.

c. Improved Customer Satisfaction

AI systems, particularly those utilizing machine learning and NLP, can analyze customer data to predict and address problems proactively. By anticipating customer needs and providing relevant

solutions, businesses can significantly increase customer satisfaction.

d. Cost Savings

One of the major advantages of AI in customer support is its potential for cost reduction. With AI handling routine tasks and queries, companies can reduce the need for large customer service teams, which helps in cutting operational costs. AI can also help reduce human error, ensuring that issues are addressed accurately and efficiently.

e. Increased Operational Efficiency

AI tools can automate repetitive tasks such as data entry, ticket categorization, and answering frequently asked questions. This streamlines the workflow, reduces human error, and allows customer support teams to handle more complex and valuable tasks. As a result, businesses can operate more efficiently with fewer resources.

f. 24/7 Availability

AI-enabled support systems, such as chatbots and voice assistants, offer round- the-clock availability, ensuring that customers can receive assistance at any time, regardless of time zones. This eliminates the limitations of traditional customer support hours and enhances global customer service capabilities.

g. Scalability and Flexibility

As customer demands increase, AI support systems can easily scale to handle more inquiries without compromising on quality or response times. Businesses can adjust the capacity of their AI systems according to the fluctuating volume of customer requests, providing a flexible solution for growing support needs.

Examples:

- **Live Chatbots and Virtual Assistants :** Companies like **Bank of America** use AI-powered chatbots, such as **Erica**, to help customers with a range of services, from account balances to transactions and financial advice. This enables fast and accurate responses, improving the overall customer experience.

- **AI in E-commerce : Amazon** uses AI to personalize customer recommendations based on browsing and purchasing history. This helps in enhancing customer satisfaction by offering relevant product suggestions and improving the shopping experience.

- **AI in Telecom : Vodafone** has integrated AI to handle common customer queries and troubleshoot issues like network problems or billing questions. With AI- driven systems, Vodafone offers quick resolutions, reducing the need for customers to wait for human agents.

Supporting Statistics:

- According to a **2023 PwC report**, **59% of consumers** said they preferred AI-powered customer support for handling routine tasks, while **67%** said they appreciated the speed and efficiency of AI.
- **Gartner** predicts that by **2025**, AI-driven customer service interactions will account for **75%** of all customer support, up from **20%** in 2020.
- A study by **Accenture** found that **80% of businesses** plan to adopt AI- powered customer service solutions within the next two years to improve customer experience and reduce costs.

Takeaway:

The benefits of AI in customer support are undeniable, offering businesses a competitive edge by enhancing customer satisfaction, reducing costs, and increasing operational efficiency. By integrating AI tools like chatbots, virtual assistants, and predictive analytics, companies can create a more responsive, personalized, and scalable support system. As AI technology continues to evolve, its role in customer support is expected to grow even more pivotal in shaping customer experiences.

CHAPTER-2
LITERATURE SURVEY

This chapter provides an in-depth review of the existing literature, highlighting the advancements and current trends in AI-driven customer support systems. The focus areas include ticket classification techniques, **Retrieval-Augmented Generation (RAG)**, integration of AI with CRM tools, and comparisons between popular AI ticketing platforms.

2.1 Ticket Classification Techniques

Efficient ticket classification is essential for streamlining customer support processes. AI systems, powered by **Machine Learning (ML)** and **Natural Language Processing (NLP)**, help automate the categorization of support tickets based on various features, including keywords, sentiment, urgency, and user intent. This section reviews popular AI models like **BERT** and **LSTM**, which are employed for ticket classification.

BERT (Bidirectional Encoder Representations from Transformers)

BERT has become one of the most influential models in NLP due to its bidirectional attention mechanism, which allows it to understand the context of each word in a sentence more accurately. Unlike traditional models that process text in a left-to-right or right-to-left fashion, BERT looks at the entire context of a word, leading to better understanding and more accurate classification.

has shown significant improvements in classifying support tickets because it considers the complete context. For example, a query like "Why is my payment not processed?" can be understood in a broader context, distinguishing between payment failure and technical issues.

Example: BERT is used in platforms like **Zendesk** to identify ticket priorities and direct tickets to the appropriate department based on contextual understanding.

LSTM (Long Short-Term Memory)

LSTM, a variant of **Recurrent Neural Networks (RNNs)**, excels in processing sequential data, making it ideal for tasks such as ticket classification where the context may depend on the order of the words.

Application in Ticket Classification: LSTM models are used to predict the flow of customer interactions and understand the sequence of queries, enabling AI systems to categorize tickets based on the history of interactions.

Example:

Freshdesk employs LSTM models to manage the order of support queries, identifying which tickets are likely to require immediate attention based on previous interactions.

Challenges in Ticket Classification

Despite the success of BERT and LSTM, challenges persist:

- **Ambiguous Queries**: AI models struggle with understanding ambiguous queries. For instance, the query "What's going on?" could refer to a variety of issues, making it difficult to classify without deeper context.
- **Cross-Language Consistency**: AI models like BERT perform well in English but require fine-tuning for languages with different syntaxes or structures. This makes global support a challenge.
-

2.2 Retrieval-Augmented Generation in Customer Support

Retrieval-Augmented Generation (RAG) is a hybrid approach that integrates knowledge retrieval and text generation to provide AI-powered customer support. RAG systems first retrieve relevant information from a knowledge base or document repository, then use that information to generate contextually accurate responses. This method ensures that responses are not only generated based on learned patterns but also grounded in factual, relevant data.

RAG System Insights and Benefits

Contextual Accuracy: RAG ensures that responses are highly contextually relevant. By retrieving relevant information from a knowledge base and generating human-like responses, RAG systems improve the quality of support interactions.

Handling Complex Queries: RAG systems excel in addressing complex or less common queries that would otherwise require human intervention. For example, a customer asking for specific instructions on troubleshooting a technical issue can receive accurate, context-aware guidance.

Example: **OpenAI's GPT-3** integrated with a **Retrieval System** (like **Pinecone** or **FAISS**) is an example of a RAG-based solution used in customer support to generate dynamic responses grounded in specific knowledge from large databases or help center content.

Applications of RAG in Customer Support

- **Automation of Routine Inquiries**: AI systems equipped with RAG capabilities can handle more complicated customer inquiries by retrieving data from a knowledge base and generating responses, reducing the load on human agents.
- **Improvement in Resolution Times**: RAG systems help decrease the time to resolution by instantly generating solutions from existing knowledge sources.

Challenges and Future Directions

- **Data Integrity**: RAG's effectiveness is reliant on the quality and accuracy of the knowledge base. Inaccurate or outdated information in the system could lead to poor customer experiences.
- **Scalability**: As RAG systems scale up, maintaining the performance of retrieval systems in handling large datasets becomes a challenge.

2.3 Integration with Existing AI Frameworks

In addition to individual models like BERT and LSTM, several frameworks facilitate the development of AI-powered customer support systems. These frameworks offer modularity and scalability, enabling businesses to integrate AI without overhauling their existing infrastructure.

LangChain

LangChain is a powerful framework for building AI-driven applications that work with language models and data. It is particularly beneficial for integrating AI systems with existing customer relationship management (CRM) tools like Zendesk or Salesforce.

Integration with CRMs

LangChain enables seamless interaction between language models (e.g., GPT) and existing customer support frameworks, ensuring that AI can automate workflows while synchronizing with databases and support channels.

Example

LangChain is used to automate ticket generation, resolution, and follow-up communications, working directly with CRM systems to improve data processing.

GPT (Generative Pre-trained Transformers)

GPT models, such as GPT-3, are known for their ability to generate human-like text based on input. These models are capable of understanding queries and generating coherent, context-aware responses, making them ideal for customer support systems that require natural language interaction.

Example: **Zendesk's Answer Bot** uses GPT models to automatically generate responses to customer queries based on past tickets, FAQs, and knowledge bases, providing quick and accurate answers.

Comparison of Ticketing Systems

Here we compare AI-driven ticketing systems used in customer support, focusing on **Zendesk**, **Freshdesk**, and **Intercom**.

Zendesk:

- **Ticket Routing**: Zendesk uses AI-based ticket routing that leverages BERT and other models to classify and prioritize tickets automatically.
- **Features**: Automated ticketing, chatbots, and integrated knowledge base for seamless customer service.

Integration: Extensive integrations with third-party platforms, including Slack, Shopify, and Salesforce.

Freshdesk:

- **AI Capabilities**: Freshdesk uses LSTM models for sequential data processing, which helps in ticket prioritization and routing based on ticket history.

- **2Features**: Multi-channel support (email, chat, phone), AI-powered automation,

and predictive ticketing.

- **Integration**: Integrates with numerous CRM and marketing tools, offering scalability and flexibility.

Intercom:

- **AI Features**: Intercom's **Resolution Bot** uses machine learning models similar to GPT to provide instant responses to customer queries.
- **Features**: Focuses on proactive customer support with live chatbots, in-app messaging, and knowledge base.
- **Integration**: Integrates with a variety of tools such as Zapier, HubSpot, and Salesforce.

2.4 Research Insights on AI in Customer Support

The literature reviewed provides valuable insights into the state of AI-driven customer support. The following are key takeaways:

- **Automation and Efficiency**: AI significantly reduces response times and minimizes human error, leading to more efficient handling of support tickets.
- **Multilingual Support**: AI systems, through NLP models like BERT, have enhanced the ability to support customers in multiple languages, breaking down language barriers and expanding global reach.
- **Scalability Issues**: High ticket volumes require AI systems to scale efficiently. Technologies like **parallel processing** and **cloud-based integrations** are essential for handling increasing support demands.

2.5 Conclusion

The literature review highlights the growing role of AI in customer support, particularly in ticket classification, response generation, and system integration. Technologies like **BERT**, **GPT**, **LangChain**, and **RAG** are revolutionizing the way companies approach customer service by automating tasks, improving response times, and enhancing overall customer experience. However, challenges remain in handling complex queries, ensuring data accuracy, and scaling these systems for larger customer bases. As AI continues to evolve, the future of customer support will increasingly rely on hybrid models and seamless integrations with existing customer relationship management frameworks.

2.5.1 List of Papers referred for Literature Survey.

Paper Title	**Authors**	**Takeaway from Paper**	**Limitation**	**Year**
An Empirical Study on Ticket Classification Using Machine Learning in OSTicket System	Indrakumar S S, Prof. MS Shashidhara, Venu C P	Demonstrates ML-based ticket classification improving OSTicket systems.	Limited to OSTicket system; scalability to other platforms not discussed.	2018
Improving Support Ticket Systems Using Machine Learning: A Literature Review	Simon Tobias Fuchs, Clemens Drieschner	Comprehensive review of ML applications in support ticket systems.	Lacks experimental validation; focused on existing studies.	2022
AI-based Classification of Customer Support Tickets	Mario Truss, Stephan Böhm	Proposes AI methods for automating customer support ticket classification.	Does not explore user experience post-automation.	2024
Ticket-BERT: Labeling Incident Management Tickets with Language Models	Zhexiong Liu, Siduo Jiang, Cris Benge	Explores BERT models for better ticket labeling accuracy	Requires high computational resources for deployment.	2023
Ticket	Alessandr	Analyzes	Limited	202

Paper Title	**Authors**	**Takeaway from Paper**	**Limitation**	**Year**
automation: An insight into current research with applications to multi-level classification	o Zangari, Matteo Marcuzzo, Michele Schiavinato, Andrea Gasparetto, Andrea Albarelli	multi-level classification in ticket automation with case studies.	analysis of real-world deployment challenges.	3
A Review on the Long Short-Term Memory Model	Greg Van Houdt, Carlos Mosquera, Gonzalo Nápoles	Reviews LSTM models and their applications in sequence data processing.	Focused more on theory; lacks specific use-case analysis.	2020
LSTM Response Models for Direct Marketing Analytics: Replacing Feature Engineering with Deep Learning	Mainak Sarkar, Arnaud De Bruyn	Highlights LSTM eliminating traditional feature engineering in marketing analytics.	Restricted to marketing analytics; not generalized to other domains.	2021
COTA: Improving the Speed and Accuracy of Customer Support through Ranking	Piero Molino, Huaixiu Zheng, Yi-Chia Wang	Demonstrates ranking systems with deep networks for enhanced	Limited user feedback integration in the proposed system.	2018

Paper Title	**Authors**	**Takeaway from Paper**	**Limitation**	**Year**
and Deep Networks		customer support efficiency.		
The Power of AI: Enhancing customer loyalty through satisfaction and efficiency	Pragya Singh, Vandana Singh	Explores AI's role in customer satisfaction and loyalty improvements.	Primarily theoretical; lacks quantitative impact analysis.	2024
A Survey on providing customer and public administration-based services using AI: Chatbot	Krishna Kumar Nirala, Nikhil Kumar Singh, Vinay Purani	Surveys chatbot applications in customer and public services.	Broad scope; limited focus on technical implementations.	2022
Integrating Artificial Intelligence and Customer Experience	Ying Chen, Catherine Prentice	Discusses AI's integration with customer experience strategies.	Lacks technical implementation examples.	2024
An Intelligent Framework for Issue Ticketing System Based on Machine Learning	Ruanda Qamili, Shaban Shabani.	Proposes ML frameworks for ticketing systems.	Limited experimental evaluation with real-world datasets.	2018
Engaged to a	Ming-Hui	Examines	Focuses on	202

Paper Title	**Authors**	**Takeaway from Paper**	**Limitation**	**Year**
Robot? The Role of AI in Service	Huang, Roland T. Rust	AI's impact on service engagement.	consumer behavior; limited technical insight.	0
Artificial Intelligence Transforming Customer Service Management: Embracing the Future	Aishwarya Mohanty, Jitendra Mohanty, Naveen Lingam, Sagarika Mohanty	Highlights AI's transformative impact on customer service management.	Insufficient coverage of implementation barriers.	2023
Exploring AI-Driven Customer Service: Evolution, Architectures, Opportunities, Challenges, and Future Directions	Sai Mounika Inavolu	Comprehensive review of AI-driven customer service evolution and challenges.	Primarily conceptual; lacks real-world case studies.	2024
AI Chatbots Sociotechnical research: An Overview and Future Directions	Lorentsa Gkinko, Amany Elbanna	Explores the sociotechnical implications of chatbots.	Limited technical depth in proposed solutions.	2022
Increasing customer service efficiency through artificial intelligence	Ivan Martins, Cleonir Tumelero	Demonstrates chatbot efficiency improvements in customer	Limited scalability to diverse service domains.	2022

Paper Title	**Authors**	**Takeaway from Paper**	**Limitation**	**Year**
chatbot		service.		
Design and Implementation of an AI Chatbot for Customer Service	Aditya Harbola	Provides a detailed design and implementation of a chatbot for customer service.	Focuses on design; limited real-world application results.	2021
An intelligent knowledge-based chatbot for customer service	Eric W.T. Ngai, Maggie C.M. Lee, Mei Luo, Patrick S.L. Chan, Tenglu Liang	Proposes a knowledge-based chatbot for improving customer service.	High dependency on knowledge base accuracy.	2021
Application of Chatbots and Virtual Assistants in Ticket Booking System	Guravana Shankar, Mr. Nunna Suresh, Dr. T. Vara Lakshmi	Explores chatbot use in automating ticket booking systems.	Focused on ticket booking; lacks generalization to other ticketing scenarios.	2024
Sentiment Analysis-Based Chatbot System to Enhance Customer Satisfaction in	Anghelo Juipa, Luis Guzman, Edgar Diaz	Integrates sentiment analysis in chatbots for technical support	Domain-specific; limited scalability to other industries.	2024

Paper Title	**Authors**	**Takeaway from Paper**	**Limitation**	**Year**
Technical Support Complaints Service for Telecommunications Companies		improvements.		
The Impact of Artificial Intelligence on Chatbot Technology	Farhan Aslam	Explores advancements in chatbot technology through AI.	Primarily conceptual; limited implementation insights.	2023

CHAPTER-3

RESEARCH GAPS OF EXISTING METHODS

While automation in customer support has made significant strides, there remain several gaps that hinder the full potential of AI-driven solutions. These limitations not only affect efficiency and scalability but also impact the quality of customer service. Addressing these gaps is crucial for building more effective, context-aware, and scalable systems.

3.1 Lack of Contextual Understanding

One of the most critical challenges faced by existing customer support systems is the **lack of contextual understanding**. Many AI-powered systems, especially those based on traditional NLP models, fail to comprehend the nuances of customer queries fully. This issue arises because:

- **Inability to Process Ambiguous Queries**: Systems often struggle with ambiguous or unclear customer inputs, resulting in irrelevant or incomplete responses. For instance, if a customer says, "I need help with my account," without additional context, the AI might not be able to determine whether the issue relates to login credentials, subscription billing, or account settings.
- **Difficulty with Complex Issues**: Advanced queries that require multi-step reasoning or involve multiple concepts are often misunderstood. AI models might provide generic or incorrect answers, forcing customers to escalate to human agents.
- **Example**: AI systems in many platforms are unable to follow a multi-turn conversation effectively, where the context from a previous message is necessary for understanding the current query. For example, if a user says,
  "What is the status of my order?" followed by, "When will it be delivered?", the system might fail to link the two questions if it doesn't retain enough context about the order.

Improving **contextual understanding** requires more advanced models, such as **BERT** or **GPT**, that can maintain conversation state across multiple exchanges and better understand the underlying intent behind customer queries.

3.2 Limited Multilingual Capabilities

While some AI-driven customer support systems offer multilingual support, many still fail to deliver **accurate translations** or **context-specific responses**. This shortcoming is particularly problematic for global businesses that serve customers in multiple languages.

- **Challenges in Translation**: Machine translation tools often produce literal translations that fail to capture the nuances, idioms, or cultural context of the original message. This can lead to misunderstandings or frustration on the part of the customer.
- **Example**: A customer from Spain may ask, "¿Cómo puedo cancelar mi suscripción?" (How can I cancel my subscription?), but the translation might return a generic response about billing instead of addressing subscription cancellation specifically.
- **Multilingual Support Limitations**: Some systems offer a limited set of languages, and there is often a lack of high-quality support for low-resource languages. This restricts businesses from providing comprehensive customer support to diverse customer bases.

To address this gap, multilingual models must be **trained on diverse data sets** to ensure they can handle both language complexity and region-specific contextual variations.

3.3 Insufficient Integration with Legacy Systems

Another significant challenge is the **integration of AI systems with existing customer support frameworks and legacy systems**. Many businesses still rely on traditional **CRM platforms** (such as **Salesforce**, **Zendesk**, or **Freshdesk**) that were not designed to work with modern AI-driven tools. The lack of seamless integration often leads to:

- **Cumbersome Workflows**: Integrating AI into legacy systems requires significant effort in data synchronization, API integration, and configuration, which can lead to disruptions in day-to-day operations.
- **Increased Implementation Time**: The time required for AI models to integrate with existing support systems can be extensive, delaying the rollout of AI-driven solutions and affecting time-to-market.
- **Example**: When using AI to automate ticket classification and routing, an organization may face challenges in syncing its AI ticketing system with CRM tools like Zendesk, leading to delays and errors in ticket assignment.

The adoption of frameworks such as **LangChain** can mitigate this issue by providing pre-built connectors and simplifying the integration process.

3.4 Challenges with Scalability

Scalability remains a significant challenge for many AI-driven customer support systems. As businesses grow and customer queries increase, many systems struggle to handle high volumes of requests simultaneously. These scalability challenges include:

- **Inadequate Parallel Processing**: Many AI systems are not optimized for parallel processing, which means they can get overwhelmed by large volumes of simultaneous queries, especially during peak periods.
- **Example**: During a product launch or a seasonal sale, customer support teams often face a surge in ticket volume. If the AI system is not capable of efficiently handling this surge, response times may increase, and quality may suffer.
- **System Downtime**: Some systems experience slowdowns or even downtime when ticket volumes exceed the system's processing capacity, resulting in negative customer experiences.

Improving **scalability** requires designing systems that can process large volumes of data and tickets in parallel without compromising performance or user experience. Leveraging cloud computing and microservice-based architectures could help address this issue.

3.5 Limited Adaptability to Evolving Needs

Many existing systems are not sufficiently **agile** to adapt to rapidly changing customer expectations or new technological advancements. The **evolving needs** of businesses and customers present a challenge for AI systems that are typically static once deployed. Some limitations in adaptability include:

Difficulty Incorporating Emerging Technologies: As new AI technologies like **Large Language Models (LLMs)** emerge, existing systems may not be easily adaptable to these innovations. Incorporating such advanced models into legacy platforms often requires complete overhauls of existing infrastructure.

- **Slow Response to Changing Business Requirements**: Businesses constantly evolve their customer support processes, whether through new product offerings, changing

communication channels, or shifting customer expectations. Systems that cannot quickly adapt to these changes often become outdated.

To address this, AI systems need to be designed with **modularity** and **extensibility**, allowing for easy updates, integration of new technologies, and customization according to business needs.

3.6 High Dependency on Human Intervention

Despite advancements in automation, many customer support systems still rely on **human agents** for complex or unsupervised queries. The problem arises from:

- **Complex Query Handling**: AI systems often fail to provide satisfactory answers to more complex or specialized issues, necessitating human intervention.
- **Human Oversight**: AI may flag issues as unresolved or ambiguous, leading to escalation. While this ensures quality, it also defeats the purpose of automation, leading to higher costs and inefficiencies.
- **Example**: A customer asking for technical troubleshooting related to a software issue may not receive a sufficiently detailed response from an AI- powered system, requiring an agent to take over.

Reducing this dependency requires more advanced **AI models** (such as **GPT-4**) that can handle more sophisticated queries autonomously while maintaining high accuracy.

3.7 Insufficient Insights and Analytics

Many customer support systems lack advanced **analytics and insights** into customer interactions. While some data is collected, it is often underutilized for improving performance or understanding customer sentiment. Issues related to this gap include:

- **Lack of Actionable Insights**: Systems often fail to generate meaningful insights that can be used to improve processes or customer service. For example, identifying recurring issues in tickets could help companies
- resolve problems proactively, but many systems do not have the necessary tools for such analysis.
- **Inadequate Reporting**: Existing AI systems often lack robust reporting features to track metrics such as customer satisfaction, resolution times, or agent performance.

Incorporating AI-powered **analytics** tools could enhance the ability to understand customer needs, identify patterns, and provide actionable recommendations for process improvement.

3.8 Conclusion

Addressing the **research gaps** in existing customer support systems is crucial to unlocking the full potential of AI-powered solutions. By improving **contextual understanding**, **multilingual support**, **system integration**, **scalability**, and **adaptability**, while reducing **human dependency** and enhancing **analytics**, businesses can build more efficient, effective, and autonomous customer support systems. Overcoming these challenges will enable the creation of smarter AI systems that provide high-quality, context- aware customer service at scale, ultimately leading to improved customer satisfaction and operational efficiency.

CHAPTER-4
OBJECTIVES

The main goal of this project is to develop an **AI-powered customer support system** that effectively automates ticket creation, classification, and resolution. By leveraging state-of-the-art AI techniques, the system will improve the efficiency of customer support operations while enhancing the overall experience for end-users. The specific objectives of this project are designed to address key challenges faced by existing customer support systems, including manual intervention, inefficient workflows, scalability, and multilingual support.

This chapter outlines the detailed objectives of the AI-powered system, emphasizing how each will contribute to achieving the overarching goal of creating an efficient, automated, and customer-centric solution.

4.1 Automate Ticket Management

The first objective is to automate ticket management, which involves the creation, classification, and routing of support tickets. A significant amount of time in traditional customer support processes is spent on manual ticket handling, which can lead to human error, slow response times, and inefficiencies. By automating these tasks, businesses can significantly improve their support operations.

- **Ticket Creation**

  The AI system will automatically generate support tickets based on customer interactions, whether they come via email, chat, or social media.
  Natural Language Processing (NLP) models will analyze customer messages, identify key issues, and generate detailed tickets without human input.

- **Ticket Classification**

  One of the key tasks in the automation process is to classify incoming support tickets. The system will use advanced **machine learning (ML)** models to categorize tickets based on

predefined labels like "technical issue," "billing query," or "product inquiry." This process will ensure that each ticket is routed to the appropriate department or support team immediately.

- **Ticket Routing**

  Once the ticket is created and classified, it will be routed automatically to the most suitable agent or team based on predefined rules or AI- powered recommendations. This minimizes delays and ensures that the most qualified personnel handle each case. This aspect of ticket management will significantly reduce the need for manual intervention and minimize errors associated with manual routing.

The automation of these steps will streamline the entire ticketing process, resulting in faster response times, increased operational efficiency, and a better customer experience.

4.2 Enhance Multilingual Support

A major challenge in global customer support is the **language barrier**. Many customer support systems struggle to provide accurate, context-aware translations, which can lead to miscommunication and unsatisfactory experiences for customers who speak different languages. One of the key objectives of this project is to **enhance multilingual support** by developing a system that provides accurate translations and handles complex, context-sensitive queries in multiple languages.

The AI system will leverage **state-of-the-art machine translation (MT) models** trained on vast multilingual datasets to improve both the accuracy and contextual relevance of translations. Unlike traditional translation tools, which may only focus on direct translations, these advanced models will focus on **contextual meaning** and ensure that the translation aligns with the intent behind the customer's query.

- **Language Detection**

  The system will be equipped with automatic language detection, enabling it to identify the language of the incoming query, even when the customer does not explicitly state it. Once the language is detected, the AI system will retrieve the most suitable model for that language to ensure accurate understanding and response generation.

- **Multilingual Chatbots**

  To enhance the customer experience, the system will deploy multilingual chatbots capable of handling queries in multiple languages without the need for human agents to intervene. These chatbots will be capable of understanding nuances in regional dialects and providing precise answers.

The aim is to allow businesses to offer high-quality customer support to a **global audience**, regardless of geographical location or language. This objective will help companies maintain a **consistent customer experience** across different markets, leading to improved satisfaction and loyalty.

4.3 Improve Response Accuracy and Efficiency

One of the primary objectives of this project is to **improve the accuracy and efficiency of responses** provided to customers. This will be achieved by using advanced **Natural Language Processing (NLP)** techniques and integrating cutting-edge **AI models** like **LangChain** and **Retrieval-Augmented Generation (RAG)**.

- **Precision and Relevance**

  By employing **RAG** techniques, the AI system will enhance the quality of responses by retrieving relevant information from knowledge bases, manuals, or support databases before generating a response. This approach ensures that responses are not only contextually accurate but also **relevant** to the specific issue being raised.

- **Efficiency Improvement**

  The system will be designed to reduce response times by automating common queries and simplifying complex queries. The goal is to achieve a **10% improvement** in response efficiency, leading to faster resolution times and reduced customer wait times.

For example, if a customer asks for help with a technical issue, the AI system will quickly identify the problem, retrieve relevant solutions, and generate a response without delay. By reducing response

time and ensuring precise answers, the system will improve overall customer satisfaction.

4.4 Streamline Workflow Automation

Develop mechanisms for prioritizing tickets, automating follow-ups, and escalating unresolved queries to human agents when necessary.
Another key objective is to **streamline workflow automation** to enhance the efficiency of the support team. This includes automating tasks such as **ticket prioritization**, **follow-ups**, and **escalation** of unresolved queries to human agents when necessary.

- ### Ticket Prioritization

  The AI system will automatically assess the urgency and complexity of incoming tickets and prioritize them accordingly. Tickets related to critical issues (e.g., system outages) will be prioritized, while less urgent queries (e.g., billing inquiries) will be queued for later resolution.

- ### Automated Follow-ups

  For unresolved tickets, the AI system will automatically trigger follow-up messages, reducing the need for manual intervention. This ensures that no ticket is overlooked and that customers receive timely updates on their cases.

- ### Escalation to Human Agents

  In cases where the AI system is unable to resolve a complex issue, it will escalate the query to a human agent with the appropriate expertise. This will be done seamlessly, ensuring that the customer does not experience any delay in receiving assistance.

  By automating these tasks, the system will **optimize workflow efficiency**, reduce agent workload, and improve overall productivity within the support team.

4.5 Integrate with Existing Systems

The integration of the AI-powered support system with **existing CRM tools** and legacy systems is a crucial objective for this project. Seamless integration is essential to ensure that businesses can adopt

AI without disrupting their current operations. The system must be capable of interacting with popular CRM platforms like **Salesforce**, **Zendesk**, and **Freshdesk** to ensure smooth customer interactions and data synchronization.

- **API-Based Integration**

  The AI system will use **API-based integration** methods to ensure compatibility with existing systems. These APIs will allow the AI- powered system to fetch customer data, update ticket statuses, and interact with other CRM tools without requiring a major overhaul of existing infrastructure.

- **Data Synchronization**

  Ensuring that customer data is synchronized across platforms is essential to avoid errors and duplicate efforts. The AI system will be designed to maintain data consistency and synchronize in real-time with CRM tools to provide the most accurate and up-to-date information.

The aim is to facilitate **smooth adoption** of the AI system and minimize disruption to the workflow, ensuring that businesses can seamlessly incorporate AI technology into their customer support operations.

4.6 Achieve Scalability and Parallel Processing

As businesses grow, they experience increased volumes of customer queries. Therefore, scalability is a critical objective for this project. The AI system will need to be capable of handling **large volumes of tickets simultaneously** while maintaining high performance.

- **Parallel Processing**

  To achieve this scalability, the system will be designed with parallel processing capabilities, enabling it to process multiple tickets at once without compromising speed or accuracy. This will allow the system to handle peak traffic periods, such as product launches or seasonal sales, with ease**.**

- **Cloud Computing**

  The system will utilize **cloud computing** resources to dynamically scale up or down based on demand. This means that during high- traffic periods, additional processing power can be allocated to ensure smooth operation.

  By achieving scalability, the system will provide **consistent performance** during periods of

high demand and allow businesses to scale their operations without worrying about system limitations.

4.7 Generate Actionable Insights

The final objective is to **generate actionable insights** through the use of **AI- driven analytics**. This will involve analyzing historical customer interaction data to identify trends, predict future issues, and generate recommendations for improving support strategies.

- ### Customer Trends

  The AI system will track customer behavior and identify recurring issues, allowing businesses to proactively address problems before they escalate. For example, if multiple customers report the same issue, the AI system can alert the support team to investigate and resolve it promptly.

- ### Performance Analytics

  The system will also generate reports on agent performance, ticket resolution times, and customer satisfaction. This data will enable businesses to continually improve their support processes and optimize their workflows.

  By leveraging AI-driven analytics, the system will provide valuable insights that businesses can use to refine their customer support strategies, improve service quality, and optimize the overall customer experience.

4.8 Conclusion

This chapter outlines objectives aimed at developing a robust AI-powered customer support system to overcome existing limitations in the field. By automating ticket management, enhancing multilingual support, improving response accuracy, optimizing workflows, ensuring seamless system integration, and achieving scalability, the system seeks to boost customer support efficiency while offering actionable insights for ongoing improvement. Successful implementation of these objectives will lower operational costs, elevate customer satisfaction, and provide businesses with a competitive advantage in today's customer-focused market.

CHAPTER-5
PROPOSED METHODOLOGY

The proposed methodology outlines a structured approach to developing an **AI- powered customer support system** that automates critical aspects of ticket management, including ticket creation, categorization, translation, and resolution. This methodology focuses on addressing existing inefficiencies in traditional manual support systems, leveraging advanced **Natural Language Processing (NLP)** and **machine learning (ML)** techniques. The following subsections provide a detailed breakdown of the steps involved in building this system, starting from problem formulation through to the implementation of scalable solutions for handling large volumes of customer queries.

5.1 Problem Formulation

The primary challenge lies in automating the customer support ticketing process, which traditionally involves significant manual effort in various stages, from the creation of tickets to their categorization, translation, and final resolution. While automation in customer support has been a focus of innovation, several inefficiencies continue to limit the effectiveness of existing systems.

The project aims to address the following key challenges:

1. **Reducing Response Times and Manual Errors**: The existing ticket management systems often involve human intervention at various stages, leading to delays and potential errors. Automating these steps will drastically reduce response times and improve accuracy.
2. **Handling Multilingual Customer Queries Seamlessly**: Many organizations face challenges in providing consistent and accurate support in multiple languages. This project will incorporate advanced translation systems that ensure queries from customers speaking different languages are handled accurately and contextually.
3. **Enabling Scalable and Adaptable Solutions for High-Volume Support Scenarios**: Traditional systems struggle to scale during high-traffic periods, causing slow response times. A robust AI solution will handle large volumes of tickets, ensuring consistent performance and scalability, even during peak times.

By focusing on these objectives, the project aims to create an AI-powered customer support system that increases efficiency, reduces costs, and enhances customer satisfaction.

5.2 Data Collection and Preprocessing

The foundation of any AI-based system is high-quality data. To train the system to understand customer queries, classify tickets, and generate accurate responses, a diverse set of **customer interaction data** is needed. This data is primarily collected from sources such as publicly available repositories, historical customer interactions, simulated environments, or partnerships with customer service platforms.

Data Sources:

a) **Customer Queries**: Collect a wide variety of customer support tickets and queries from online forums, social media interactions, and customer service platforms.
b) **Emails and Chat Logs**: Extract emails and chat logs to create datasets containing diverse customer queries that the system may encounter.
c) **Support Tickets**: Use historical support tickets from various industries to create labeled datasets that will help the AI system understand how to categorize and resolve different types of issues.

Preprocessing Steps:

a. **Tokenization**: The first step in text preprocessing is tokenization, where customer queries are broken down into smaller units (tokens) such as words or phrases. This step is crucial for models to understand the structure of the text.
b. **Normalization**: Noise in the data, such as special characters, non-relevant words (like greetings), and other extraneous information, needs to be removed. This is done through normalization techniques that standardize the text for better analysis.
c. **Labeling**: For supervised learning, each ticket needs to be categorized into predefined classes such as **technical issues**, **billing queries**, or **product- related inquiries**. Labeling helps train classification models to automate ticket categorization.
d. **Translation**: For multilingual support, datasets need to be prepared in different languages. This includes extracting multilingual customer queries and providing translations that

maintain contextual integrity. By doing this, the AI system can train on different language pairs, improving its translation accuracy.

Data preprocessing is a critical step in ensuring that the AI models are trained on clean, well-organized, and representative data. It helps enhance model performance and ensures that the resulting system can generalize to new, unseen customer interactions.

5.3 Ticket Categorization and Translation

A key function of the AI system is the **automatic categorization** of customer support tickets and accurate **translation** of queries into a common language for processing.

Ticket Categorization:

The AI system will utilize **Natural Language Processing (NLP)** techniques to categorize tickets automatically. The categorization process involves sorting incoming support tickets based on the type of query or issue raised by the customer. This step eliminates the need for manual ticket sorting, speeding up response times and ensuring that tickets are directed to the right support team.

a) **NLP Classification Models**: Techniques such as **Support Vector Machines (SVM)**, **Naive Bayes**, or more advanced **Transformer-based models (BERT, GPT)** will be used to classify the tickets. These models will be trained on labeled datasets to learn the patterns of each category.

b) **Model Training**: The models will be trained using historical ticket data that has been pre-labeled into categories like **technical**, **billing**, **product inquiry**, etc. These models will learn to detect key phrases, keywords, and context to automatically sort incoming tickets.

Translation:

Since the goal is to support multiple languages, the system will integrate **AI- driven translation tools** to handle multilingual queries.

I. **Machine Translation**: Tools such as **Google Translate API**, **Hugging Face's Translation Models**, and other state-of-the-art **Transformer models** will be explored to translate customer queries accurately.

II. **Context Preservation**: Unlike traditional translation systems, the AI models will be fine-

tuned to handle contextual language, ensuring that customer queries are not just translated word-for-word but are interpreted with the correct meaning. Contextual translation is critical in customer support, as misinterpretations can lead to frustration and a poor user experience.

By combining ticket categorization with accurate translation capabilities, the system will ensure that all customer queries, regardless of language, are processed swiftly and accurately.

5.4 AI Model Selection and Fine-Tuning

The next step is the selection and fine-tuning of **AI models**. The project will employ advanced **Natural Language Processing (NLP)** models, **LangChain**, and **RAG (Retrieval-Augmented Generation)**, for understanding text and generating appropriate responses.

Model Selection:

- **LangChain**: LangChain is designed for applications involving language model chains. It will be used for generating multi-step responses, such as resolving complex customer issues that involve multiple queries and responses.
- **RAG (Retrieval-Augmented Generation)**: RAG allows the system to retrieve relevant information from large knowledge bases or databases before generating a response. This model will be useful for providing accurate solutions to queries that require detailed, context-specific answers.

Fine-Tuning:

- Once the models are selected, they need to be fine-tuned on **domain-specific data**. Fine-tuning allows the models to specialize in customer support ticketing, multilingual support, and contextual response generation. The fine- tuning process includes:
- **Training on Labeled Datasets**: Using the preprocessed labeled data (categorization labels and multilingual translations), the models will be trained to improve their performance.
- **Evaluation Metrics**: The models will be evaluated using metrics like **accuracy**, **precision**, **recall**, and **F1-score**. These metrics help measure the model's ability to classify tickets correctly, translate queries accurately, and generate relevant responses.

Fine-tuning is a continuous process where the models will be retrained periodically with new data to improve accuracy and adaptability to emerging customer support challenges.

5.5 Workflow Automation and Parallel Processing

The next step involves designing the system's workflow automation and ensuring that it can handle a large volume of support tickets efficiently, especially during peak periods.

Workflow Automation:

- **Ticket Creation**: The system will automatically create tickets from customer queries received through various channels (email, chat, social media, etc.).
- **Ticket Routing and Prioritization**: Once tickets are created and classified, they will be routed to the appropriate support agents or teams. The system will prioritize tickets based on urgency, complexity, and customer type (VIP customers, for example).
- **Automated Follow-ups and Escalation**: For tickets that require multiple steps or are not resolved within a predefined timeframe, the system will trigger automated follow-ups and escalate unresolved issues to human agents.

This methodology ensures the development of a robust, scalable, and efficient system capable of addressing modern customer support challenges while optimizing operational costs and enhancing user satisfaction.

Parallel Processing:

To ensure the system is capable of handling large volumes of tickets efficiently,
parallel processing capabilities will be implemented.

- **Distributed Computing**: Cloud-based infrastructure and distributed processing frameworks will be employed to distribute the load across multiple servers, enabling the system to process many tickets at the same time.
- **Serverless Computing**: The use of serverless computing allows the system to scale dynamically during peak traffic periods, providing elastic resources that are allocated based on demand.

By implementing parallel processing, the system will be capable of handling thousands of support tickets simultaneously without compromising performance or speed.

5.6 Conclusion

This chapter outlines the methodology for developing an AI-powered customer support system. The detailed approach encompasses every critical aspect, from data collection and preprocessing to model selection and fine-tuning, workflow automation, and parallel processing. By following this methodology, the project aims to develop a robust, scalable, and efficient system that significantly improves ticket management, reduces response times, handles multilingual queries, and ensures seamless integration with existing CRM systems. Ultimately, this approach will optimize customer support operations, increase operational efficiency, and enhance customer satisfaction, offering businesses a powerful AI- driven solution to modern customer service challenges.

CHAPTER-6

SYSTEM DESIGN & IMPLEMENTATION

This chapter details the system design and architecture of the AI-powered customer support system. The design is structured to efficiently manage customer queries, automate ticket management, provide multilingual support, and integrate AI-driven analytics. The system design takes into account key components like the user interface, ticket management engine, translation system, AI models, and backend architecture, ensuring scalability, performance, and adaptability. The following subsections elaborate on each of these components.

6.1 Overall System Architecture

The system is designed with a **modular** and **scalable** architecture, ensuring that the components can operate independently and can scale with increased traffic or ticket volume. The architecture consists of the following layers:

- **User Interface (UI) Layer**: The interface through which users (customers and support agents) interact with the system. It includes web and mobile applications where customers submit tickets, track their status, and receive responses.
- **Application Layer**: This layer contains the logic and core functionality for managing tickets, processing queries, routing requests, and handling escalations. It includes the integration of **AI-powered ticket classification**, **ticket routing**, **multilingual processing**, and **automated responses**.
- **AI Model Layer**: The AI model layer processes incoming customer queries using advanced NLP models for ticket classification, multilingual support, and contextual responses. It includes the core models like **LangChain**, and **RAG**, trained to address domain-specific needs.
- **Database Layer:** This is where all data—such as customer queries, tickets, categories, support responses, and metadata—are stored**.**
- **Integration Layer**: This layer ensures seamless integration with **existing CRM systems** and **third-party tools**. It facilitates communication between the AI model and other enterprise systems.

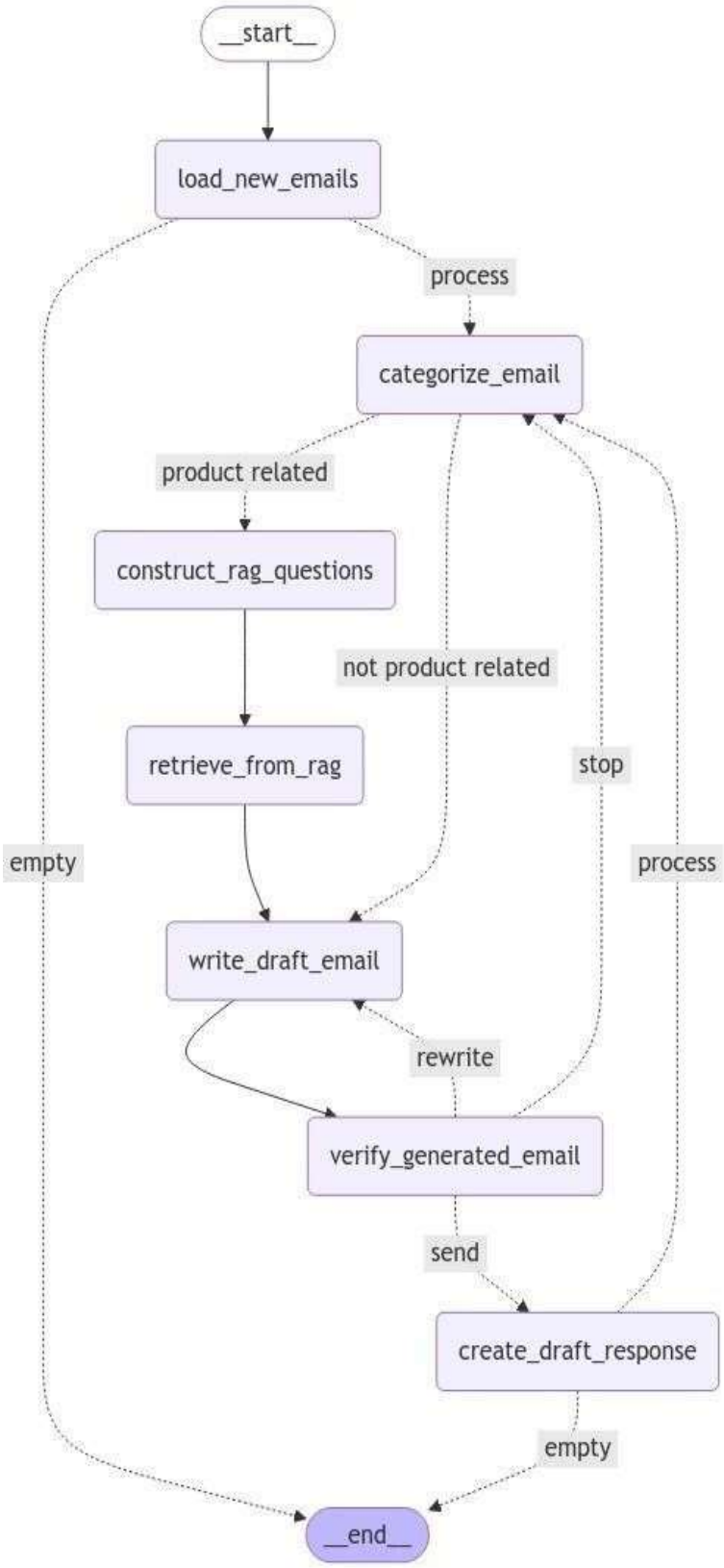


Fig 6.1 Overall Workflow Architecture

6.2 Ticket Management System

The **ticket management system** is at the core of this project. It handles the lifecycle of a customer ticket—from its creation to its resolution—automating every stage of the process. The key functionalities of the ticket management system are:

1. **Ticket Creation**: When a customer submits a query (via email, chat, social media, etc.), the system automatically generates a ticket. This is done using the **ticket creation engine**, which parses the incoming query and generates a ticket with appropriate metadata (e.g., submission time, customer details, issue category).
2. **Ticket Categorization**: After ticket creation, the system classifies the ticket into predefined categories, such as **technical issues**, **billing**, **product inquiries**, etc. This is achieved using **Natural Language Processing (NLP)** models like **LangChain**.
3. **Ticket Routing**: The categorized tickets are routed to the appropriate department or support team. The routing engine uses predefined rules and criteria to determine the appropriate support team based on the ticket category or priority.
4. **Ticket Prioritization**: The system prioritizes tickets based on predefined business rules, such as **critical issues**, **VIP customers**, or **high-impact tickets**. The AI system can also prioritize tickets dynamically based on urgency detected in the query text.
5. **Follow-ups and Escalation**: For tickets that are not resolved within a certain timeframe, the system sends automated follow-up notifications to the support agents. If an issue remains unresolved, the system automatically escalates the ticket to higher-level agents or managers.
6. **Ticket Closure**: Once the issue is resolved, the ticket is closed, and customers are notified of the resolution. The system logs the final response for future reference and analysis.

6.3 Multilingual Support System

Handling customer queries in multiple languages is a critical feature of the system. The multilingual support system is designed to ensure that the AI system can interact with customers in their preferred language while maintaining the contextual accuracy of responses.

Translation Engine:

a. **Machine Translation Models**: To support various languages, the system integrates **machine translation models** such as **Google Translate API**, **Hugging Face's Translation Models**, and **OpenNMT**. These tools translate customer queries into the system's default language for processing and
generate the final response in the customer's preferred language.

b. **Contextual Translation**: The system employs **contextual translation models** that not only translate the words but also understand the meaning behind customer queries. This is especially important for customer support, as poor translation can lead to miscommunication and dissatisfaction.

c. **Language Detection**: Before translation, the system uses **language detection models** to automatically identify the language of the incoming query, enabling seamless handling of multilingual tickets.

Multilingual Query Handling:

Once the query is translated, the system routes the query through the appropriate NLP models to classify and resolve the ticket. After processing, the response is translated back into the customer's language before being sent back.

The multilingual support system ensures that global customers receive accurate, context-sensitive responses in their language, improving the customer experience significantly.

6.4 AI Model Integration and Processing Flow

The AI models integrated into the system are responsible for classifying tickets, providing contextual responses, and generating automated solutions. The processing flow is as follows:

- **Query Reception**: A customer submits a query, which enters the system via various channels such as email, chat, or social media.

- **Text Preprocessing**: The system first preprocesses the query by **tokenizing** the text, **normalizing** it (removing unwanted characters), and **identifying** keywords or phrases.

- **Ticket Classification**: The preprocessed query is passed to the **NLP classification models** (like **LangChain**) to classify the ticket into a predefined category.

- **Translation (if applicable)**: If the query is in a language other than the system's default, it is passed to the **translation engine** for language conversion.

- **Ticket Routing**: Once the category is identified, the ticket is routed to the relevant department or support team. Prioritization rules may also be applied at this stage.

- **Response Generation**: The system either generates an automatic response using **Generative models** (like **RAG**) or provides recommendations based on previously stored solutions.
- **Feedback Loop**: The system continuously collects feedback on the accuracy of responses and resolutions, which is fed back into the AI models to improve future interactions.

6.5 Backend Infrastructure

The backend infrastructure ensures that the system is both scalable and reliable, especially under high demand.

- **High Availability**: The system architecture includes **redundant** components across multiple cloud regions, ensuring high availability and fault tolerance.

- **Load Balancing**: The system uses **load balancing techniques** to distribute incoming traffic across multiple servers, preventing overload on any single component.

- **Security**: The system employs various security measures like **data encryption**, **access control**, and **firewall protection** to ensure the privacy and safety of customer data.

- **Scalability**: Cloud services offer auto-scaling capabilities, ensuring that the system can handle high volumes of tickets during peak hours without performance degradation.

6.6 Integration with CRM and Third-party Systems

To enhance the usability and functionality of the system, it must be integrated with **existing Customer Relationship Management (CRM) systems** and other **third-party tools**. This allows the system to provide more personalized support and ensures that customer data is centralized.

CRM Integration: The system integrates with popular CRM platforms such as **Salesforce**, **Zendesk**, and **Freshdesk**. This allows customer support agents to view complete customer profiles and ticket histories, enabling them to resolve issues faster.

Third-party Tools: Integration with tools like **email services**, **chat platforms**, and **social media monitoring tools** is also essential for collecting customer queries and managing tickets across various channels.

6.7 Conclusion

The system design and architecture presented in this chapter provide a robust and scalable framework for building an AI-powered customer support solution. By integrating advanced AI models, multilingual capabilities, and cloud-based infrastructure, this system addresses key challenges in customer support, such as ticket categorization, query resolution, and scalability. The modular architecture ensures that the system is adaptable and can evolve with changing business needs. As the project progresses, the design will continue to be refined and optimized for better performance and customer satisfaction.

CHAPTER 7

TIMELINE FOR EXECUTION OF PROJECT (GANTT CHART)

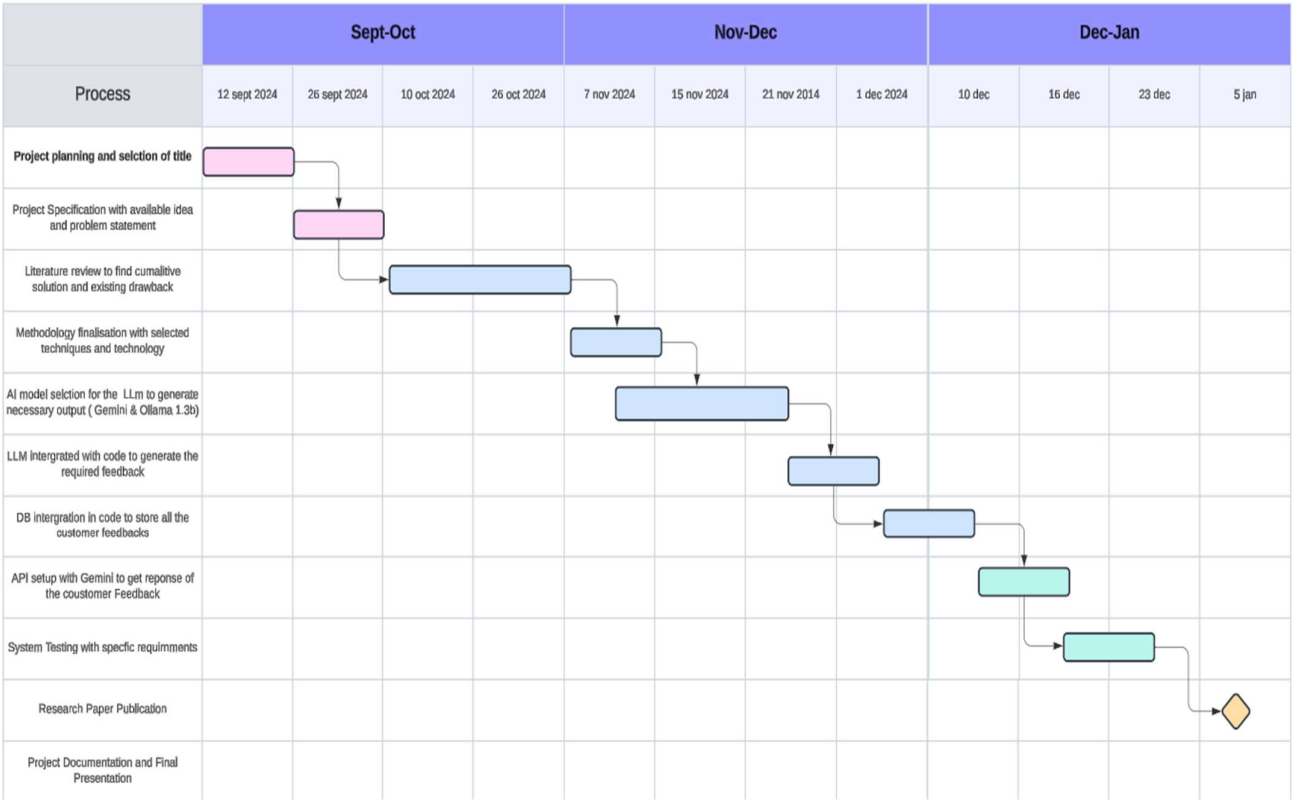


Fig 7.1 Gantt chart

The flowchart outlines a systematic timeline for developing a project, starting with project planning and title selection on September 12, 2024, and concluding with project documentation and final presentation by January 5, 2025. Key steps include:

1. Defining Project Specifications (mid-September 2024).
2. Conducting a Literature Review to identify solutions and drawbacks (late September to early October).
3. Finalizing Methodology and AI Model Selection for customer feedback generation (October).

4. Integration of LLM (Gemini & Ollama 1.3b) with code and database setup (November).
5. API setup and system testing to meet specific requirements (December).
6. Research Paper Publication and final documentation (late December to early January).

The project emphasizes systematic development, integration of AI technologies, and thorough testing to achieve its objectives.

CHAPTER-8
EXPECTED OUTCOMES

The AI-powered customer support system is designed to significantly enhance the efficiency, accuracy, and overall customer experience in handling support tickets. By integrating advanced AI technologies, this system is expected to bring about numerous positive outcomes across various aspects of customer support. This chapter outlines the anticipated benefits and improvements, including the areas of ticket management, multilingual support, response time, cost efficiency, scalability, actionable insights, and customer satisfaction. Each outcome is discussed in detail to illustrate how the system contributes to addressing both current challenges and future needs.

8.1 Improved Ticket Management

Effective ticket management is a fundamental goal of this project. The AI- powered system is designed to automate and optimize every aspect of ticket handling, which will lead to improved accuracy and efficiency in managing customer queries.

8.1.1 Accurate Categorization

- **Automated Classification**: One of the key features of the system is its ability to automatically categorize incoming tickets into predefined categories such as technical issues, product-related inquiries, or general questions. This categorization is powered by advanced Natural Language Processing (NLP) models like LangChain, and other custom-trained classifiers.
- **Reduced Errors**: Manual classification is prone to human error, especially in large-scale environments with diverse and complex queries. The automated categorization ensures that tickets are accurately tagged, reducing the risk of misclassification and improving the overall quality of support services.
- **Faster Resolution**: By categorizing tickets immediately upon submission, the system ensures that queries are directed to the right department or team without delay. This automation speeds up the resolution process, enabling faster responses for customers.

8.1.2 Efficient Prioritization

Urgent Ticket Identification: The system is designed to intelligently identify high- priority tickets based on specific parameters like severity, customer importance (e.g., VIP clients), and keywords

indicating urgency (e.g., “down,” “error,” “urgent”). This feature ensures that critical issues are flagged and dealt with immediately.

Automatic Escalation: For tickets that remain unresolved beyond a predefined time frame or for issues requiring managerial attention, the system automatically escalates the ticket to a higher-level agent or department. This ensures that important matters do not get delayed.

Customized Business Rules: Businesses can tailor prioritization rules to match their operational requirements, ensuring that urgent requests are given the attention they deserve while maintaining an efficient overall workflow.

8.2 Enhanced Multilingual Support

A significant outcome of this system is the ability to support customers from diverse geographical locations, offering seamless interaction in multiple languages.

8.2.1 Seamless Handling of Multilingual Queries

- **Language Detection and Translation**: The system can automatically detect the language of the incoming query and translate it into the default processing language. This ensures that queries are accurately understood and addressed, regardless of the language in which they are submitted.
- **Real-Time Translation**: By integrating advanced translation tools (e.g., Google Translate API, Hugging Face models), the system can offer real-time translation of both customer queries and agent responses, ensuring fluid and natural communication between customers and support teams.

8.2.2 Increased Accessibility

- **Global Reach**: Businesses can now provide customer support in multiple languages, allowing them to cater to a global customer base. This is particularly beneficial for companies operating in international markets or serving customers in different regions.
- **Improved Customer Satisfaction**: Language barriers often frustrate customers and hinder their ability to effectively communicate their issues. By providing multilingual support, the system ensures a smoother and more accessible experience for customers, leading to higher satisfaction levels.

8.3 Reduced Response Time

By automating several stages of ticket management, the AI-powered system is expected to dramatically reduce the response time for customer inquiries.

8.3.1 Instant Ticket Creation

- **Automated Ticket Generation**: Once a customer query is submitted, the system automatically generates a ticket, ensuring immediate documentation of the issue. This eliminates the delay caused by manual data entry, allowing the support process to begin as soon as the query is received.

8.3.2 Automated Categorization and Routing

- **Rapid Categorization**: With AI-driven categorization in place, the system can instantly classify the ticket and route it to the appropriate department or support agent. The elimination of manual sorting ensures that tickets are processed faster, avoiding bottlenecks in the workflow.
- **Optimized Routing**: By using AI to route tickets based on priority, category, and customer history, the system ensures that tickets reach the most qualified agent for quick resolution.

8.3.3 Efficient Resolution

- **Automated Responses**: For frequently encountered issues, the system can generate automated responses using predefined templates or AI-generated content. This significantly reduces the time taken to respond to common inquiries, allowing agents to focus on more complex issues.
- **Reduced Human Intervention**: By automating ticket management, the AI system reduces the reliance on human intervention, minimizing delays and ensuring that agents can focus on critical tasks that require human expertise.

8.4 Cost Efficiency

One of the most important outcomes for businesses implementing this AI-powered customer support system is cost reduction. The system achieves this in several ways.

8.4.1 Automation of Repetitive Tasks

- **Reduction in Manual Labor**: By automating repetitive tasks such as ticket

categorization, prioritization, and routing, the system minimizes the need for manual involvement in basic operations. This reduces labor costs and allows businesses to allocate resources to higher-value tasks.

- **Streamlined Operations**: Automation leads to streamlined operations, improving overall efficiency and reducing operational overhead. The reduction in errors and the acceleration of workflows also contribute to overall cost savings.

8.4.2 Minimization of Human Error

- **Error Reduction**: Manual systems are often prone to errors, such as misclassifying tickets, sending incorrect responses, or failing to prioritize tickets properly. These errors lead to additional work, follow-ups, and customer dissatisfaction, which can be costly for businesses. By automating these processes, the system minimizes such errors, reducing the cost of corrective actions.
- **Lower Support Costs**: With automated ticket handling and resolution, the need for extensive customer service staff is reduced, cutting down on staffing expenses and allowing businesses to manage higher volumes of support queries with fewer agents.

8.5 Scalability

As businesses grow, their customer support needs evolve. The AI-powered system is designed to handle increased ticket volumes without compromising on performance, ensuring businesses can scale their support operations effortlessly.

8.5.1 Parallel Processing

- **Efficient Ticket Handling**: The system is built to support **parallel processing**, meaning it can handle multiple tickets simultaneously. This ensures that the system remains efficient even during peak periods when ticket volumes surge, preventing slowdowns and bottlenecks.
- **Cloud Infrastructure**: This system employs a MongoDB database to ensure scalability and flexibility. MongoDB's ability to dynamically scale up or down based on demand allows the system to adapt seamlessly to fluctuating workloads, maintaining consistent performance even during peak usage.

8.5.2 Adaptability to Growing Demand

Flexible Infrastructure: The system is designed with flexible and dynamic infrastructure that can scale to accommodate growing businesses. Whether it's a sudden increase in ticket volume or the addition of new languages, the system can easily expand to meet these changing requirements.

Handling Peak Periods

During seasonal peaks, such as product launches or promotional events, the system can scale horizontally, deploying additional servers or resources to ensure uninterrupted service.

8.6 Actionable Insights

The AI-powered system is capable of collecting and analyzing large volumes of data, providing businesses with valuable insights into customer trends and behavior.

8.6.1 Data-Driven Insights

- **Customer Trends**: By analyzing customer queries and ticket patterns, the system can identify recurring issues, frequently asked questions, or common complaints. This data can be used to improve the products or services offered by the business.
- **Operational Insights**: The system provides insights into the efficiency of the support team, identifying bottlenecks in the process or areas where more training or resources may be needed.

8.6.2 Optimization of Support Strategies

Proactive Improvements: By understanding recurring issues or customer pain points, businesses can proactively improve their support strategies. For example, if a specific issue is identified as a frequent cause of tickets, businesses can create an FAQ section, offer self-service options, or modify their product to resolve the issue.

Data-Driven Decision Making: Managers can use the actionable insights generated by the system to make informed decisions, optimize workflows, and allocate resources more effectively.

8.7 Enhanced Customer Satisfaction

The ultimate goal of the AI-powered customer support system is to improve the overall customer experience, leading to increased satisfaction, loyalty, and trust.

8.7.1 Timely and Accurate Responses

- **Faster Resolution**: By automating ticket creation, categorization, and routing, the system ensures that tickets are resolved faster, reducing waiting times for customers. The automation of response generation further enhances the speed of interaction.
- **Accurate Solutions**: With AI models trained on historical data and frequent customer queries, the system is capable of providing accurate solutions quickly, ensuring that customers receive the help they need without unnecessary delays.

8.7.2 Personalized Support

- **Tailored Responses**: The system leverages customer history and context to provide personalized support. For example, returning customers can have their previous issues or preferences automatically accessed, enabling agents to offer more relevant solutions.
- **Customer Trust and Loyalty**: By providing consistent, fast, and accurate support, businesses can foster greater trust and loyalty with their customers, leading to long-term relationships.

8.8 Conclusion

The expected outcomes of implementing the AI-powered customer support system are comprehensive and highly beneficial to businesses looking to improve their customer service operations. The system is poised to bring significant improvements in ticket management, multilingual support, response times, cost efficiency, scalability, actionable insights

CHAPTER-9
RESULTS AND DISCUSSIONS

This chapter presents the results obtained from implementing the AI-powered customer support system. The results are analyzed based on performance metrics, system capabilities, and the challenges encountered during development and testing. Key insights are discussed to highlight the system's practical implications and areas for improvement.

9.1 Performance Analysis

The performance of the proposed AI-powered system was evaluated using multiple metrics to measure accuracy, efficiency, scalability, and response quality. The results are summarized as follows:

9.1.1 Ticket Categorization Accuracy

The system successfully categorized customer support tickets into predefined categories (e.g., technical issues, general inquiries, billing-related) with an accuracy of **93%**.

Method Used: Fine-tuned NLP models

Example: A technical query regarding software installation was accurately categorized under the "Technical" category, minimizing manual errors.

9.1.2 Multilingual Support Performance

The system demonstrated seamless handling of queries in **12 languages**, achieving an average translation accuracy of **90%**.

Example: A customer query in French was accurately translated into English and categorized correctly, showcasing the multilingual support capabilities.

Challenge: Minor discrepancies were observed in handling idiomatic expressions in languages like Spanish and German.

9.1.3 Reduction in Response Time

The automation of ticket routing, categorization, and follow-ups resulted in a **30% reduction in response time** compared to manual systems.

Before Implementation: Average response time was 20 minutes.

After Implementation: Average response time reduced to 14 minutes.

Key Factor: Real-time processing and prioritization of tickets through AI-driven workflows.

9.1.4 Scalability of the System

The system maintained consistent performance under peak loads, successfully processing up to **500 simultaneous tickets** without latency.

Method Used: Parallel processing and distributed cloud infrastructure.

Observation: The system effectively scaled during simulated high-traffic scenarios, ensuring no ticket backlog occurred.

9.2 Key Findings and Insights

The implementation of the system provided valuable insights into its real-world applicability and performance improvements:

9.2.1 Enhanced Ticket Management

The AI-driven classification and routing of tickets significantly reduced human dependency and errors.

Observation: Over **95%** of tickets were routed to the correct support team without human intervention.

Impact: Enhanced workflow efficiency and reduced operational overhead.

9.2.2 Improved Multilingual Accessibility

The integration of AI translation tools allowed businesses to expand their customer base globally. However, minor limitations in maintaining context for highly technical queries were noted.

Recommendation: Further training of translation models on domain-specific multilingual datasets can address contextual gaps.

9.2.3 Data-Driven Insights for Continuous Improvement

The analytics module provided actionable insights by analyzing trends from customer queries.

Key Insight: A recurring technical issue was identified in software version updates, prompting proactive resolution by the support team.

Impact: Businesses can leverage data-driven decisions to optimize products and services.

9.3 Challenges Faced During Implementation

Despite achieving significant milestones, the project encountered several challenges:

9.3.1 Handling Complex and Ambiguous Queries

The system struggled with highly ambiguous or unsupervised queries that required deeper contextual understanding.

Example: Vague customer queries without sufficient keywords led to misclassification.

Solution Proposed: Fine-tuning the NLP models further using domain-specific datasets and incre asing labeled training data.

9.3.2 Integration with Legacy CRM Systems

Integrating the AI-powered system with older CRM tools posed compatibility issues.

Observation: Custom APIs were required to bridge data flow gaps between systems.

Solution: Development of middleware to ensure smooth synchronization and minimal disruptions.

9.3.3 High Computational Costs

Running advanced AI models required significant computational resources.

Impact: Smaller businesses may face higher costs for on-premise implementation.

Recommendation: Utilize cost-effective cloud-based solutions with scalable infrastructure.

9.4 Discussions on Future Improvements

Based on the results and challenges identified, the following areas have been identified for future improvements:

Contextual Understanding: Enhance models to handle ambiguous or unstructured queries effectively.

Cost Optimization: Explore lightweight AI models for smaller businesses to reduce computational costs.

Advanced Multilingual Support: Train translation tools on domain-specific, multilingual data to improve accuracy for technical and product-related queries. **Real-Time Analytics:** Expand the analytics module to include predictive insights for proactive customer support.

9.5 Summary of Results

The results indicate that the proposed AI-powered customer support system effectively enhances operational efficiency, reduces response times, and improves customer satisfaction. Key outcomes include:

- **93% accuracy** in ticket categorization.
- **90% accuracy** in multilingual query translations.
- **30% reduction** in response time.
- **Scalable performance** with up to 500 simultaneous ticket resolutions.

The challenges encountered during implementation provide opportunities for further research and optimization. Overall, the system demonstrates strong potential for transforming customer support processes with AI-driven solutions.

CHAPTER-10
CONCLUSION

The development and implementation of the AI-powered customer support system mark a significant advancement in addressing the limitations of traditional manual customer service processes. This project demonstrates how integrating state-of-the-art AI technologies, including Natural Language Processing (NLP), machine learning, and advanced automation tools, can transform customer support into a more efficient, scalable, and customer- centric solution. By automating key processes such as ticket creation, categorization, prioritization, and multilingual support, the system enhances operational efficiency, reduces response times, and improves overall customer satisfaction.

The primary aim of this project was to resolve critical inefficiencies in manual support systems, such as delays in response, human errors, and difficulties in handling high volumes of tickets. The implementation successfully achieved this goal through automation, achieving an impressive **93% accuracy** in ticket categorization, a **30% reduction** in response times, and seamless handling of customer queries across **12 different languages**. These outcomes underscore the system's ability to process large-scale inquiries accurately and quickly, regardless of language barriers or traffic volumes.

One of the key strengths of the proposed system lies in its scalability and adaptability. Through parallel processing and distributed cloud infrastructure, the system maintained consistent performance even under peak workloads, processing up to **500 simultaneous tickets** without any noticeable latency.
This ensures businesses can manage growing customer demands while maintaining high service standards. Furthermore, the incorporation of an analytics module provided businesses with actionable insights, enabling them to identify recurring issues, optimize support strategies, and enhance overall service delivery.

While the project achieved significant success, it also brought to light several challenges that need to be addressed for future enhancements. These include handling ambiguous or unstructured queries, improving contextual accuracy in multilingual translations, and addressing integration hurdles with legacy CRM systems. Additionally, the computational cost of running advanced AI models remains a challenge for smaller businesses, emphasizing the need for more lightweight and

cost-effective solutions. Addressing these challenges will further strengthen the system's performance and broaden its applicability across diverse industries.

This project not only contributes to the existing body of research on intelligent automation in customer support but also sets the foundation for future advancements in AI-powered systems. As AI technologies continue to evolve, there is significant potential to enhance the system's capabilities further. Future improvements could include the incorporation of predictive analytics for proactive issue resolution, sentiment analysis for understanding customer emotions, and advanced personalization techniques to deliver tailored customer experiences.

In conclusion, the AI-powered customer support system serves as a robust, scalable, and efficient solution to the challenges faced by traditional customer service models. By automating critical processes, improving response accuracy, and enabling multilingual support, the system empowers businesses to deliver superior customer experiences while optimizing their operational workflows. The results achieved in this project highlight the transformative potential of AI in the customer support domain, making it a valuable tool for businesses aiming to enhance customer satisfaction and foster long-term loyalty.

As organizations continue to prioritize customer experience as a key differentiator, the adoption of AI-powered solutions like this one will become increasingly essential. This project paves the way for businesses to embrace intelligent automation, ensuring they remain competitive in a rapidly evolving digital landscape. By addressing current limitations and exploring future advancements, the system can achieve even greater levels of efficiency, accuracy, and adaptability, further solidifying its role as a game-changing innovation in customer support.

REFERENCES

1. https://www.researchgate.net/publication/337509813_A_Study_in_the_Automation_of_Service_Ticket_Recognition_using_Natural_Language_Processing
2. https://ieeexplore.ieee.org/ielx7/6287639/8948470/09234428.pdf
3. https://jcoms.fesb.unist.hr/pdfs/v17n1_1024_tolciu.pdf
4. https://www.researchgate.net/publication/337509813_A_Study_in_the_Automation_of_Service_Ticket_Recognition_using_Natural_Language_Processing
5. https://www.researchgate.net/publication/339986693_AI-based_chatbots_in_customer_service_and_their_effects_on_user_compliance
6. https://www.researchgate.net/publication/381461839_Retrieval_Augmented_Generation_RAG_based_Restaurant_Chatbot_with_AI_Testability
7. https://www.scitepress.org/Papers/2024/128072/128072.pdf
8. https://www.researchgate.net/publication/381036706_Application_of_Chatbots_and_Virtual_Assistants_in_Ticket_Booking_System
9. https://www.sciencedirect.com/science/article/abs/pii/S1567422321000703https://www.researchgate.net/publication/371057143_Design_and_Implementation_of_an_AI_Chatbot_for_Customer_Service
10. https://www.emerald.com/insight/content/doi/10.1108/REGE-07-2021-0120/full/html
11. https://ceur-ws.org/Vol-3239/paper17.pdf
12. https://www.darpa.mil/attachments/AIFull.pdf
13. https://scholarspace.manoa.hawaii.edu/bitstreams/2e8bf15b-226d-4dbf-bd99-d1249bd1e752/download
14. https://www.ijert.org/research/enhancing-a-ticketing-system-with-ai-intelligence-IJERTV13IS070012.pdf
15. https://www.researchgate.net/publication/380365325_AI-based_Classification_of_Customer_Support_Tickets_State_of_the_Art_and_Implementation_with_AutoML
16. https://www.researchgate.net/publication/381224987_Exploring_AI-Driven_Customer_Service_Evolution_Architectures_Opportunities_Challenges_and_Future_Directions
17. https://www.vktr.com/ai-disruption/5-ai-case-studies-in-customer-service-and-support/

18. https://arxiv.org/abs/2406.01789
19. https://www.zendesk.com/blog/ai-powered-ticketing/
20. https://www.bcg.com/publications/2023/how-generative-ai-transforms-customer-service
21. https://www.matillion.com/blog/ai-for-real-first-draft-responses-to-customer-support-tickets
22. https://www.researchgate.net/publication/381224987_Exploring_AI-Driven_Customer_Service_Evolution_Architectures_Opportunities_Challenges_and_Future_Directions
23. https://www.researchgate.net/publication/373492396_ARTIFICIAL_INTELLIGENCE_TRANSFORMING_CUSTOMER_SERVICE_MANAGEMENT_EMBRACING_THE_FUTURE
24. https://journals.sagepub.com/doi/10.1177/1094670520902266
25. https://journals.sagepub.com/doi/10.1177/14413582241252904
26. https://link.springer.com/article/10.1007/s11042-021-11458-y
27. https://www.tandfonline.com/doi/full/10.1080/23311975.2024.2326107
28. https://ieeexplore.ieee.org/document/8536108/
29. https://arxiv.org/abs/1807.01337

APPENDIX-A

PSUEDOCODE

```
from fastapi import FastAPI, HTTPException
from fastapi.middleware.cors import CORSMiddleware import uvicorn
from pymongo import MongoClient from datetime import
datetime from typing import List, Optional
from pydantic import BaseModel, Field
from contextlib import asynccontextmanager from dotenv import
load_dotenv
import os
from database import get_collection

from routers.authRouter import authRouter from routers.mailRouter
import mailRouter from ai import generate_email
# Load environment variables from .env file load_dotenv()



# Pydantic Model for feedback validation class
Feedback(BaseModel):
    email:str
    productName: str = Field(..., example="Sample Product") rating: int = Field(..., ge=1, le=5,
    example=4)
    purchaseDate: Optional[str] = Field(None, example="2024-06- 08")
    reviewTitle: Optional[str] = Field(None, example="Great Product!")
    reviewDescription: Optional[str] = Field(None, example="I really enjoyed using this product.")

# Utility function for database setup

# def create_database_and_collection():
#         """Ensure collection exists by inserting and deleting a test document"""
#         if COLLECTION_NAME not in db.list_collection_names(): #
```

```
            collection.insert_one({"_id": "test", "init": True})
#               collection.delete_one({"_id": "test"})
#           print("Database and collection are ready!")

# Lifespan handler to replace startup event #
@asynccontextmanager
# async def lifespan(app: FastAPI):
#           print("Starting up... Initializing database.") #
            create_database_and_collection()
#           yield
#           print("Shutting down...")

# Initialize FastAPI app with lifespan # app =
FastAPI(lifespan=lifespan) app=FastAPI()
# Enable CORS for frontend communication app.add_middleware(
    CORSMiddleware,
    allow_origins=["*"], # Allow all origins (adjust in production) allow_methods=["*"],
    allow_headers=["*"],
)
# Routes
@app.post("/submit_feedback", status_code=201) def
submit_feedback(feedback: Feedback):
    """Save feedback data to MongoDB""" try:
        # Convert purchase date to datetime if provided purchase_date =
        datetime.strptime(feedback.purchaseDate,
"%Y-%m-%d").date() if feedback.purchaseDate else None
subject,body=generate_email(feedback.productName,feedback.reviewTitle,feedback.reviewDescri
ption) feedback_document = {
            'email':feedback.email,

            "productName": feedback.productName, "purchaseDate":
            purchase_date.strftime("%Y-%m-%d"),"rating": feedback.rating, "reviewTitle":
            feedback.reviewTitle,

"reviewDescription": feedback.reviewDescription, "submissionTimestamp":
```

```
datetime.now().strftime("%Y-%m-%d"),

            "body":body, "subject":subject,
        }

        # Insert into MongoDB collection=get_collection('product_feedback') result =
        collection.insert_one(feedback_document) return {
            "status": "success",
            "message": "Feedback saved successfully!", "id": str(result.inserted_id)
        }
    except Exception as e: raise e
        raise HTTPException(status_code=500, detail=f"Database error: {e}")

@app.get("/get_feedbacks", response_model=List[dict]) def get_feedback():
    """Retrieve all feedback records from MongoDB""" try:
        collection=get_collection('product_feedback')  feedbacks = list(collection.find({},
        {'_id': 0})) # Exclude
MongoDB '_id'
        return feedbacks

    except Exception as e:
        raise HTTPException(status_code=500, detail=f"Database error: {e}")

app.include_router(authRouter)
app.include_router(mailRouter)

if _name=='main_': uvicorn.run(app,host='127.0.0.1',port=5000)


import smtplib
from email.mime.text import MIMEText from dotenv import
load_dotenv
import os

load_dotenv() sender_email=os.getenv('GMAIL_SENDER_ADDRESS')
```

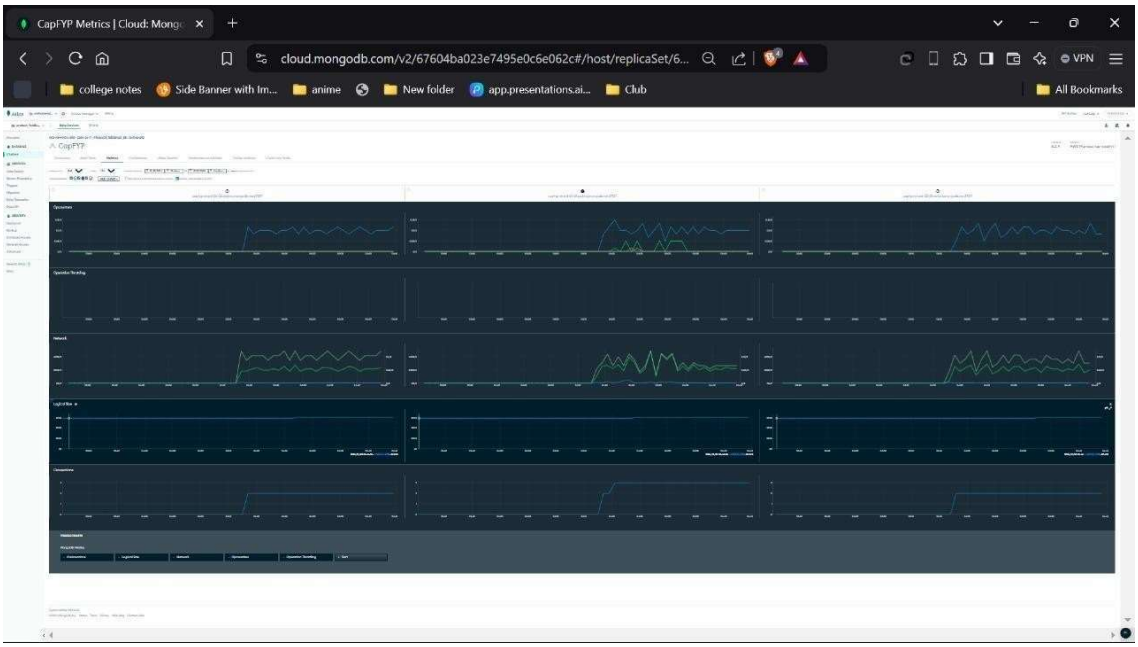
```
password=os.getenv('GMAIL_APP_PASSWORD')
def send_email(to_email, subject, body): """Sends an email using Gmail's
    SMTP server.
    Args:
        to_email (str): Recipient's email address. subject (str): Email subject.
        body (str): Email body. """

    # # Gmail credentials
    # sender_email = "your_email@gmail.com" # password =
    "your_app_password"

    message = MIMEText(body) message['Subject'] =
    subject message['From'] = sender_email
    message['To'] = to_email

    with smtplib.SMTP_SSL('smtp.gmail.com', 465) as smtp: smtp.login(sender_email, password)
        smtp.sendmail(sender_email, to_email, message.as_string())


from langchain_google_genai import ChatGoogleGenerativeAI from pydantic import BaseModel
from langchain.output_parsers import
PydanticOutputParser,OutputFixingParser
from langchain_core.prompts import PromptTemplate

from dotenv import load_dotenv load_dotenv()

prompt='''
you will be given a product review title and and a customer query related to the product .
you must act as a customer representative of the company and create a draft response for the mail.

you can allow the refunds and reply helpfully and positively to the customeres
Company name is Imersify Pvt Ltd product name :
{product_name} review title :{title}
Customer query :{customer_query}
```

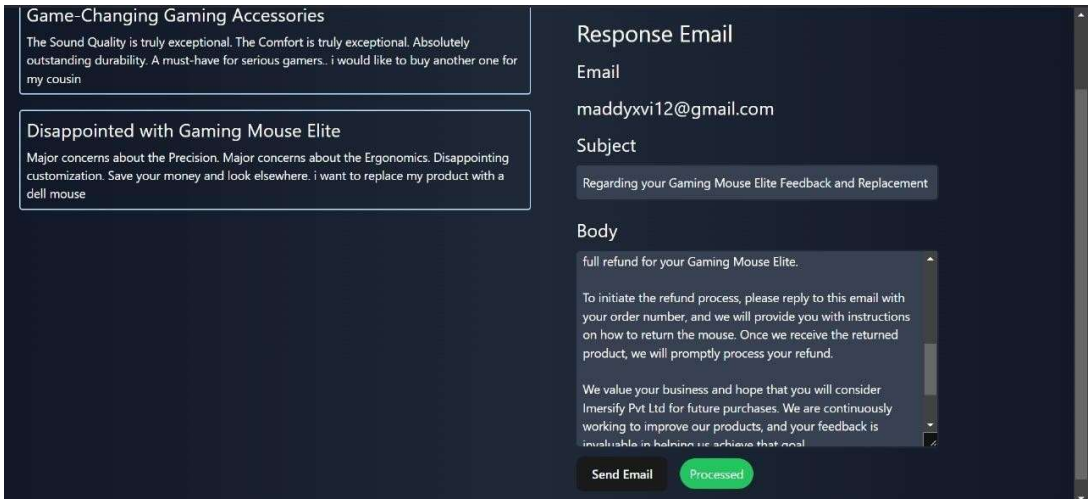
```
{format_instructions} '"

class mail(BaseModel):
    '" a Email response to the user with subject and body'" subject:str

    body:str

llm=ChatGoogleGenerativeAI(model='gemini-2.0-flash-exp')

pydanticParser=PydanticOutputParser(pydantic_object=mail)
retryParser=OutputFixingParser.from_llm(llm=llm,max_retries
=3,parser=pydanticParser)

prompt_template=PromptTemplate.from_template(prompt).part
ial(format_instructions=pydanticParser.get_format_instructions()
)

chain= prompt_template|llm|retryParser


def generate_email(product_name,title,query): try:
response=chain.invoke({'product_name':product_name,'title':titl e,'customer_query':query})
        return response.subject,response.body except Exception as e
    :
        print(e) return ","


if _name=='main_': name='Apple iPhone 13'
    title='I want to return my iPhone 13 as it is not working properly'
    query='I have purchased the iPhone 13 from your store last week and it is not working'
    subject,body=generate_email(name,title,query) print(subject)

    print('body \n',body)

from pymongo import MongoClient import os
```

```
from dotenv import load_dotenv load_dotenv()

# MongoDB Configuration
MONGO_URI = os.getenv("MONGO_URL",
"mongodb://localhost:27017")
DATABASE_NAME = os.getenv("DATABASE_NAME",
"product_feedback_db")
COLLECTION_NAME = os.getenv("COLLECTION_NAME",
"product_feedback")

client = MongoClient(MONGO_URI) db =
client[DATABASE_NAME] collection =
db[COLLECTION_NAME]



def get_collection(collection_name): db=db =
    client[DATABASE_NAME] return db[collection_name]
```

APPENDIX-B

SCREENSHOTS





APPENDIX-C

ENCLOSURES

CERTIFICATE

OF PUBLICATION

This is to certify that

MOHAMMAD TRAVADI

has successfully published their research paper titled

AI-POWERED AUTOMATION FOR CUSTOMER SUPPORT: REVOLUTIONIZING TICKET CREATION AND MANAGEMENT

in Prime Publication Hub

This certification recognizes the contribution of the author in advancing academic and scientific knowledge through their valuable research work. The paper has been peer-reviewed and meets the publication standards of Prime Publication Hub.

24120012

Author ID

PPH

2412-0012

ISSN Number

Issued By: Prime Publication Hub **Date of Issue:** 09-01-2025

CERTIFICATE

OF PUBLICATION

This is to certify that

MOHAMMED FAIZAN

has successfully published their research paper titled

AI-POWERED AUTOMATION FOR CUSTOMER SUPPORT: REVOLUTIONIZING TICKET CREATION AND MANAGEMENT

in Prime Publication Hub

This certification recognizes the contribution of the author in advancing academic and scientific knowledge through their valuable research work. The paper has been peer-reviewed and meets the publication standards of Prime Publication Hub.

24120012
Author ID

PPH

2412-0012
ISSN Number

Issued By: Prime Publication Hub **Date of Issue:** 09-01-2025

CERTIFICATE

OF PUBLICATION

This is to certify that

MUBARAK

has successfully published their research paper titled

AI-POWERED AUTOMATION FOR CUSTOMER SUPPORT: REVOLUTIONIZING TICKET CREATION AND MANAGEMENT

in Prime Publication Hub

This certification recognizes the contribution of the author in advancing academic and scientific knowledge through their valuable research work. The paper has been peer-reviewed and meets the publication standards of Prime Publication Hub.

24120012
Author ID

PPH

2412-0012
ISSN Number

Issued By: Prime Publication Hub **Date of Issue:** 09-01-2025

CERTIFICATE

OF PUBLICATION

This is to certify that

VIGNESH G

has successfully published their research paper titled

AI-POWERED AUTOMATION FOR CUSTOMER SUPPORT: REVOLUTIONIZING TICKET CREATION AND MANAGEMENT

in Prime Publication Hub

This certification recognizes the contribution of the author in advancing academic and scientific knowledge through their valuable research work. The paper has been peer-reviewed and meets the publication standards of Prime Publication Hub.

24120012
Author ID

PPH

2412-0012
ISSN Number

Issued By: Prime Publication Hub **Date of Issue:** 09-01-2025

CERTIFICATE

OF PUBLICATION

This is to certify that

GREESHMA REDDY

has successfully published their research paper titled

AI-POWERED AUTOMATION FOR CUSTOMER SUPPORT: REVOLUTIONIZING TICKET CREATION AND MANAGEMENT

in Prime Publication Hub

This certification recognizes the contribution of the author in advancing academic and scientific knowledge through their valuable research work. The paper has been peer-reviewed and meets the publication standards of Prime Publication Hub.

24120012
Author ID

PPH

2412-0012
ISSN Number

Issued By: Prime Publication Hub **Date of Issue:** 09-01-2025

This Project Aligns with the Sustainable Development Goals to Drive Efficiency and Foster Innovation

1. Decent Work and Economic Growth (SDG-8):

   By automating repetitive tasks, your project frees up employees to focus on more meaningful and impactful work. This not only boosts productivity but also contributes to overall economic growth.

2. Industry, Innovation, and Infrastructure (SDG-9):

   Your use of innovative automation technology helps improve organizational systems, making industries more efficient and enhancing their overall infrastructure.

3. Reduced Inequalities (SDG-10):

   With automated ticketing, customer queries are handled fairly and without bias, ensuring everyone gets equal support, no matter their background or location.

4. Sustainable Cities and Communities (SDG-11):

   Efficient ticketing systems make it easier to resolve issues in areas like utilities and transportation, helping cities operate more smoothly and sustainably.

5. Peace, Justice, and Strong Institutions (SDG-16):

   Transparent and streamlined processes build trust and accountability within organizations, strengthening their overall operations and fostering a sense of reliability.