ZENDS Telecom
Intelligent AI Support System

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Tools and Technologies Used

- Programming Language - Python
- Frontend / UI Framework - Streamlit
- Machine Learning Framework - PyTorch
- NLP & Transformer Models - HuggingFace Transformers, FLAN-T5 (Text Generation Model), Custom Intent Classification Model, Custom Sentiment Analysis Model
- Embedding Model - SentenceTransformer (all-MiniLM-L6-v2)
- Vector Database - ChromaDB
- Data Visualization – Plotly, Streamlit Native Charts
- Development Tools - VS Code / Jupyter Notebook

1. INTRODUCTION

The ZENDS Telecom Intelligent AI Support System is an advanced customer support automation platform developed using transformer-based deep learning models, Retrieval-Augmented Generation (RAG), and interactive analytics dashboards. The system is designed to improve customer service efficiency, reduce manual workload, and provide real-time intelligent responses to customer queries.
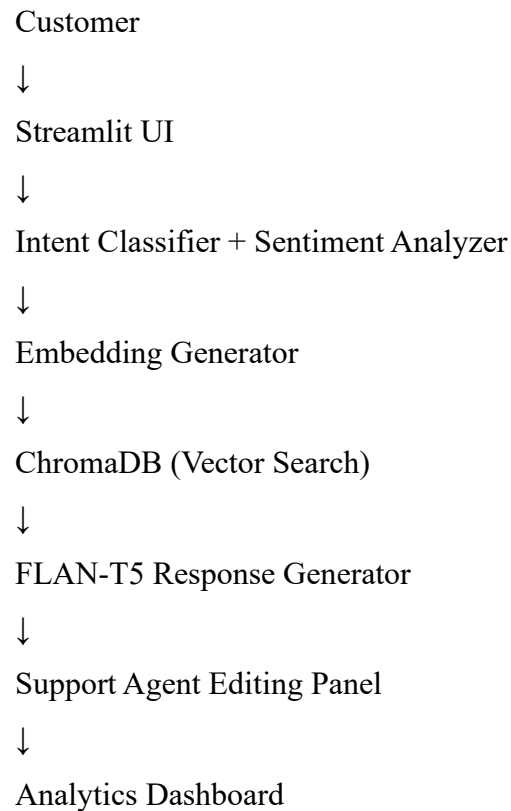
In today's telecom industry, customer satisfaction plays a crucial role in business growth. Customers expect fast, accurate, and personalized support. Traditional support systems depend heavily on human agents, leading to delays and inconsistency. To solve this problem, this project integrates Artificial Intelligence (AI) and Machine Learning (ML) techniques to automate and enhance customer service operations.

This system performs:

- Intent Classification
- Sentiment Analysis
- Context Retrieval using Vector Database

- AI-based Response Generation
- Human-in-the-loop Editing
- Analytical Dashboard Visualization

<u>Architectural Diagram Description</u>

Customer

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Streamlit UI

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Intent Classifier + Sentiment Analyzer

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Embedding Generator

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ChromaDB (Vector Search)

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FLAN-T5 Response Generator

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Support Agent Editing Panel

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Analytics Dashboard

2. PROBLEM STATEMENT

Telecom companies receive thousands of customer queries daily related to billing, connectivity issues, refunds, and product inquiries. Handling these queries manually leads to:

- Increased response time
- Inconsistent answers
- High operational costs
- Difficulty in tracking customer sentiment
- Lack of analytics insights

There is a need for an intelligent automated system that can:

- Understand customer intent
- Detect customer emotion
- Provide context-aware responses

- Allow human supervision
- Provide analytical insights for business improvement

3. OBJECTIVES

The primary objectives of this project are:

1. To build an AI-powered chatbot using transformer models.
2. To classify customer queries into predefined intents.
3. To analyze customer sentiment (Positive, Neutral, Negative).
4. To implement Retrieval-Augmented Generation (RAG) for context-based responses.
5. To allow support agents to edit any previous AI response.
6. To develop an interactive analytics dashboard.
7. To design a professional enterprise-level UI using Streamlit.

4. SYSTEM ARCHITECTURE

The system architecture consists of the following major components:

4.1 User Interface Layer

Developed using Streamlit, providing:

- Customer Chat Interface
- Support Agent Panel
- Analytics Dashboard
- Theme Toggle (Dark/Light)

4.2 AI Processing Layer

Includes:

- Intent Classification Model (Transformer-based)
- Sentiment Analysis Model
- Embedding Model (Sentence Transformers)
- FLAN-T5 Model for Response Generation

4.3 Knowledge Base Layer

- ChromaDB Vector Database
- Document embeddings
- Context retrieval mechanism

<u>4.4 Analytics Layer</u>

- Query tracking
- Intent distribution
- Sentiment distribution
- Interactive charts (Plotly)

5. TECHNOLOGIES USED

<u>5.1 Programming Language</u>

- Python

<u>5.2 Framework</u>

- Streamlit (for UI)

<u>5.3 Deep Learning Libraries</u>

- PyTorch
- HuggingFace Transformers

<u>5.4 NLP Models</u>

- Transformer-based Intent Classifier
- Transformer-based Sentiment Classifier
- FLAN-T5 (Text Generation)
- SentenceTransformer (Embeddings)

<u>5.5 Database</u>

- ChromaDB (Vector Database)

<u>5.6 Visualization</u>

- Plotly
- Streamlit Native Charts

6. DATA PREPARATION AND MODEL TRAINING

<u>6.1 Intent Classification</u>

A labeled dataset was created with categories such as:

- Technical
- Billing

- Complaint
- Refund
- Product Inquiry

The model was trained using transformer architecture to predict the intent class.

6.2 Sentiment Analysis

Sentiment labels include:

- Positive
- Neutral
- Negative

The model analyzes emotional tone to identify customer satisfaction levels.

6.3 Embedding Generation

SentenceTransformer model converts text into vector embeddings for semantic similarity search.

7. RETRIEVAL AUGMENTED GENERATION (RAG)

RAG enhances response accuracy by retrieving relevant context from a knowledge base before generating a reply.

Working Process:

1. User query converted into embedding.
2. Similar documents retrieved from ChromaDB.
3. Retrieved context passed to FLAN-T5 model.
4. Model generates context-aware response.

Benefits:

- Reduces hallucination.
- Improves accuracy.
- Uses real company knowledge.

8. HUMAN-IN-THE-LOOP SYSTEM

To ensure response quality, a Support Agent Panel was developed.

Features:

- View all previous assistant replies.
- Select and edit any reply.

- View intent and sentiment for selected query.

- Instantly update response.
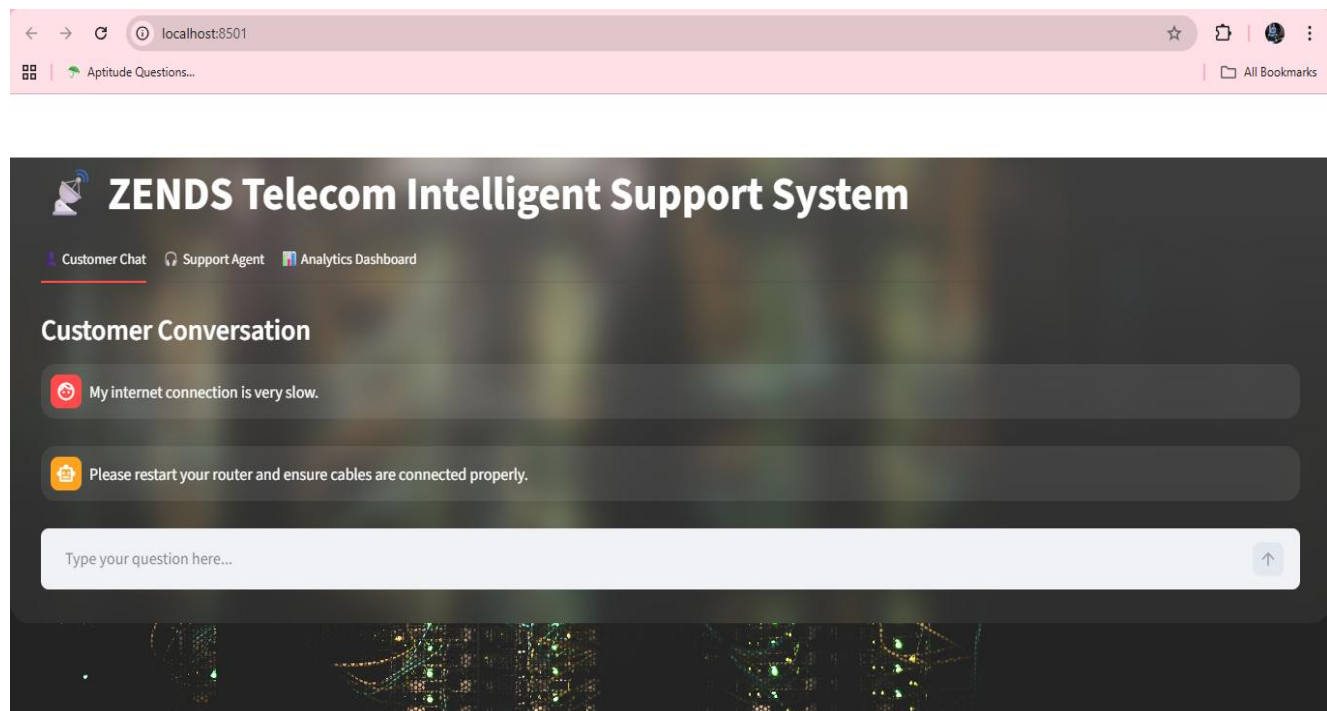
- Maintain conversation history.

This ensures:

- Quality control

- Error correction

- Compliance assurance

- Enterprise-level reliability

9. ANALYTICS DASHBOARD

The system includes a real-time analytics dashboard.

Metrics Displayed:

- Total Queries Processed

- Intent Distribution (Pie Chart)

- Sentiment Distribution (Bar Chart)

Business Benefits:

- Identify common customer problems.

- Track negative sentiment spikes.
- Improve service quality.
- Monitor system performance.

Interactive visualization allows decision-makers to gain insights instantly.
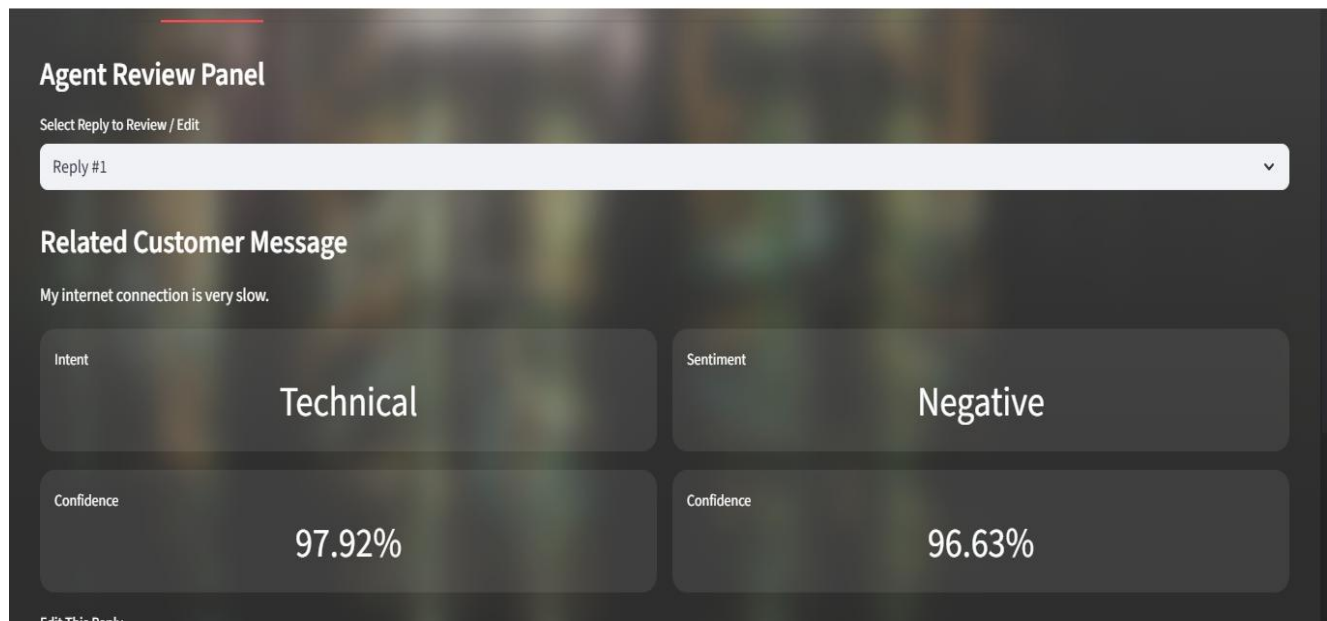
10. RESULTS AND CONCLUSION

The system successfully:

- Classified customer intents accurately.
- Detected customer sentiment.
- Generated context-based responses.
- Allowed agent-level editing.
- Displayed real-time analytics.

The UI was designed as an enterprise SaaS dashboard with:

- Animated backgrounds
- Sidebar navigation
- Dark/Light theme
- Interactive charts

11. CONCLUSION

The ZENDS Telecom Intelligent AI Support System demonstrates how modern NLP technologies can transform customer service operations. By integrating Transformer models, RAG architecture, vector databases, and interactive dashboards, the system provides an efficient, scalable, and intelligent support solution.

This project showcases practical implementation of:

- Natural Language Processing
- Deep Learning
- Human-AI collaboration
- Data Analytics
- Enterprise UI design

The system can be further enhanced with:

- Real-time deployment
- User authentication
- Cloud hosting
- Agent performance metrics
- Automated escalation handling