Aspect-Based Product Recommendations with Explainable AI Using Amazon Reviews

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GitHub repository: https://github.com/VishnuMallampalli/NLPProjectGroup12

Motivation

The explosive rise of e-commerce has flooded customers with many product choices and user reviews, hindering their ability to find useful, actionable information. Users often struggle to interpret long and complex reviews to make purchasing decisions. This project addresses that challenge by applying BERT-based sentiment analysis to user reviews, offering personalised, real-time product recommendations that are based on the user's sentiment. All this is added with a dose of Explainable AI that makes sure recommendations are understandable to users, further works in the users' direction and makes more confident decision-making.

Significance

The main intention of this project is to develop, at the core, a more powerful e-commerce product recommendation focusing focus on BERT-based sentiment analysis and Explainable AI. Ours differs from generic recommendations of traditional systems in that it picks up feature-specific things mentioned in reviews- price, quality, or performance recommends an alternate product catered to those sentiments.

Key Impacts:
Enhanced User Experience: In this way, the recommendations to be shown to the users would be personalized, highlighting for the user important aspects such as a better-priced alternative or another one that would be more durable, therefore reducing the need for manual searches of reviews.

Increased Trust and Engagement: With the use of Explainable AI, each recommendation is justified on the grounds of the system, which helps in gaining trust and therefore enhancing user experience. The user would understand much better why a certain product has been recommended, thus increasing the rate of user engagement and conversion.

Improved Business Outcomes: It will not only help businesses by reducing the return rate of their products, but it will also increase sales by offering the users feature-specific alternatives whenever neutral or negative sentiments are detected from reviews, which directly deal with customer concerns.

This categorically places the project as one important innovation that will enhance user satisfaction along with business profitability.

Objectives

Goal 1: We will develop a BERT-based sentiment analysis model that can classify product reviews correctly as positive, neutral, or negative.

Goal 2: Improve this by considering the implementation of aspect-based sentiment analysis using BERT for unsupervised learning of sentiments about specific product features related to price, quality, and performance.

Goal 3: Engage in personalized real-time explainable product recommendations against neutral or negative sentiments. Providing clear explanations to the user for each recommendation.

Features

1. BERT for Sentiment Analysis: Users automatically review and extract their sentiments about certain attributes of the product, like price and quality. The sentiment about the product is classified into three classes: positive, negative, and neutral.

2. **Aspect-Level Sentiment Analysis:** The BERT model would first identify the feature, for instance, battery life or price, which features in this review, then give a sentiment score across these aspects.

3. Explainable AI: Provide users with personalized product recommendations along with well-substantiated and easily understandable explanations, such as "This product is recommended because it has the best reviews when it comes to battery performance."

4. Product Recommendations in Real Time: Provide users with instantaneous product recommendations according to review sentiments, and ensure they have a very seamless and smooth shopping experience.

Dataset

Dataset: Electronics dataset from the Amazon Reviews Data Repository
Size: 100,000 reviews
Type: Text
Source: Amazon Reviews – [Url](#)
Preprocessing: We will preprocess the dataset by performing tokenization, stop-word removal, and sentiment tagging based on ratings (e.g., 4-5 stars = positive, 3 stars = neutral, 1-2 stars = negative).

Visualization

This project follows a structured workflow aimed at efficiently processing user reviews, classifying sentiments, and providing explainable product recommendations:

Workflow: The system initiates by getting the user reviews and processing them to understand the overall sentiment and sentiments related to specific features of the products. If the reviews turn out to be neutral or negative, on-spot alternatives are recommended by the system, and it does explain why the alternative product is recommended.

Table 1: Dataset Attributes

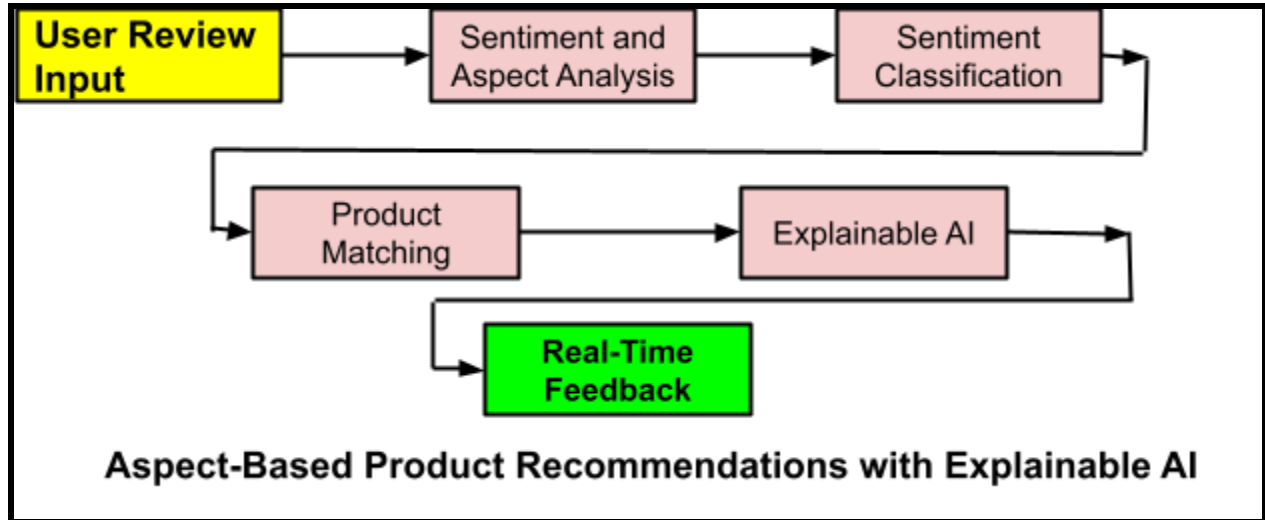| Attribute	Description
user_id	Unique identifier for the reviewer
name	Name of the reviewer
time	Time of the review (Unix timestamp)
text	Text of the review
resp	Business response to the review (Unix time and text)
gmap_id	Unique identifier for the business

Fig 1: Workflow diagram for Explainable AI for Aspect-Based Product Recommendations Using Amazon Reviews

Table 2: Workflow Breakdown

Step	Function	Description
1	**User Review Input**	The user submits a product review with text, images, and rating.
2	**Sentiment and Aspect Analysis**	The system analyzes the review to detect sentiment on specific aspects (e.g., price, quality).
3	**Sentiment Classification**	The review is classified as positive, neutral, or negative based on overall and aspect-specific sentiment.
4	**Product Matching**	If sentiment is neutral or negative, the system finds alternative products.
5	**Explainable AI**	The system explains each recommended product.
6	**Real-Time Feedback**	Users receive real-time product recommendations with explanations