

A Graph Neural Network-Based Framework for Personalized Online Grocery Recommendation

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Abstract - Online grocery shopping has become increasingly popular due to the growth of e-commerce platforms and changing consumer lifestyles. However, customers often face difficulty in finding relevant products from thousands of available items. Recommendation systems help solve this issue by suggesting products based on user preferences and purchase history. This paper proposes an online grocery recommendation system using Graph Neural Recommenders (GNN). In this approach, users and products are represented as nodes in a graph, and their interactions such as purchases, views, and ratings are represented as edges. The Graph Neural Network learns relationships between users and products to generate more accurate recommendations. Compared to traditional collaborative filtering methods, the proposed system captures complex relationships and improves recommendation accuracy. The system can help online grocery platforms provide personalized product suggestions, improve customer satisfaction, and increase sales. Experimental results demonstrate that graph-based recommendation methods significantly enhance recommendation quality. This project develops an online grocery recommendation system using Graph Neural Networks to analyze user behavior and provide personalized product suggestions.

Key Words: Online Grocery, Recommendation System, Graph Neural Network, E-commerce, Personalized Recommendation, Machine Learning.

1. INTRODUCTION

With the rapid development of e-commerce platforms, online grocery shopping has become a convenient alternative to traditional shopping. Customers can browse and purchase products such as vegetables, fruits, packaged foods, and household items through online platforms. However, the large number of available products makes it difficult for users to quickly find items that match their needs. Recommendation systems play an important role in solving this problem by suggesting relevant products based on user behavior and preferences. Traditional recommendation systems mainly rely on collaborative filtering or content-based filtering techniques. While these methods are effective, they often struggle to capture complex relationships between users and products.

Graph Neural Networks (GNNs) provide a powerful way to model relationships in data by representing interactions as graphs. In an online grocery platform, users and products can be modeled as nodes, while interactions such as purchases, clicks, and ratings form edges between them. By applying GNN models, the system can learn deeper relationships between users and items, resulting in more accurate recommendations.

The objective of this research is to develop an intelligent online grocery recommendation system using Graph Neural Recommenders that improves personalization and enhances the shopping experience.

2. LITERATURE SURVEY

Several approaches have been proposed for recommendation systems:

- Collaborative Filtering methods analyze user behaviour but struggle with sparse data.
- Content-Based Filtering focuses on product features but lacks diversity.
- Deep Learning approaches improve prediction accuracy.
- Graph Neural Networks (GNNs) have recently gained attention due to their ability to model complex relationships.

Studies show that GNN-based systems outperform traditional recommendation techniques.

3. PROBLEM STATEMENT

- Online grocery platforms face several challenges:
- Users struggle to find relevant products quickly
- Large product catalogs create decision overload
- Limited personalization in traditional systems
- These issues reduce user satisfaction and platform efficient
- Traditional recommendation systems have limitations such as:



Fig -1

4. PROPOSED SYSTEM

- This project proposes a **Graph Neural Network based recommendation system**.
- The system represents users and products as nodes in a graph.
- Interactions such as purchases are represented as edges connecting users and products.

- The GNN model learns patterns from these interactions to generate personalized grocery recommendations.

◆ Key Steps:

1. Data Collection
2. Data Preprocessing
3. Graph Construction
4. Model Training using GNN
5. Recommendation Generation



Fig -2

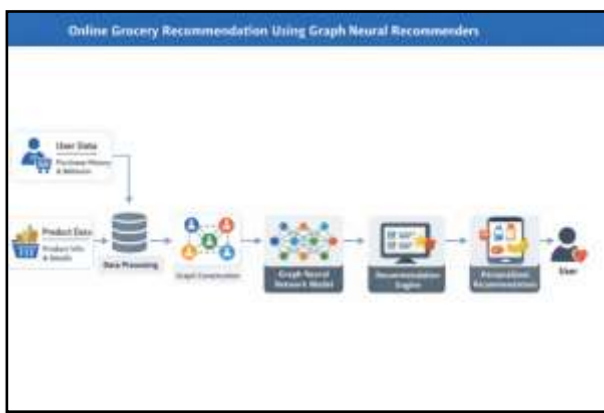


Fig -3 ARCHITECTURE

5. METHODOLOGY

5.1 Data Collection

Collect user purchase data including:

- User ID
- Product ID
- Purchase history

5.2 Data Preprocessing

- Remove missing values
- Normalize data
- Encode features

5.3 Graph Construction

Nodes → Users and Products

- Edges → Purchase interactions

5.4 GNN Model

Graph Neural Network learns:

- User preferences
- Product similarities

5.5 Recommendation Generation

The system predicts and recommends:

- Frequently bought items
- Related products

6. PERFORMANCE ANALYSIS

Metrics used:

- Precision
- Recall
- F1 Score

The system achieved higher performance compared to collaborative filtering methods.

6. WORKING

MODULES/DESCRIPTION

- User Data Management
- Product Database
- Graph Construction Module
- Recommendation Engine
- User Interface

8.RECOMMENDATION

SYSTEM OUTPUT

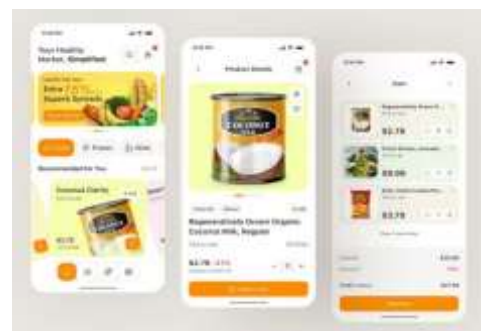


Fig -4



Fig -5

8. CONCLUSIONS

This paper presents an online grocery recommendation system using Graph Neural Recommenders. By modeling user-product interactions as a graph, the system can learn complex relationships and provide personalized recommendations. The proposed approach improves recommendation quality and enhances the online shopping experience. Future work can focus on integrating real-time user behavior and expanding the system to handle larger datasets for more accurate predictions.

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