Hybrid Recommendation System for Mobiles

Sai Likhitha Bollu

M.Tech (Artificial Intelligence and Machine Learning)

VIT Vellore

# Abstract

This report presents a comprehensive overview of a Hybrid Recommendation System for mobile phones, designed to address the limitations of traditional content-based and collaborative filtering techniques. By integrating explainability, serendipity, and contrarian logic, the system enhances user trust and discovery. The methodology, modules, and results are discussed in detail, supported by literature and experimental findings.

# Introduction

The mobile phone market is saturated with choices, making it difficult for users to make informed decisions. Recommendation systems simplify this process by suggesting relevant products. However, traditional systems like content-based filtering (CBF) and collaborative filtering (CF) have limitations such as narrow personalization and cold-start problems. This project proposes a hybrid model that combines both approaches and introduces explainability and serendipity to improve user experience.

# Problem Statement

The goal is to build a hybrid recommender system for mobile phones that combines content-based and collaborative filtering techniques. The system should provide transparent recommendations using prompt-based explainability and introduce serendipitous and contrarian suggestions to enhance user engagement. It must be deployable in real-time environments like Streamlit.

# Literature Review

The literature review explores various hybrid recommendation systems and their components:

* Chandrahaas et al. (2023) proposed a hybrid approach using content-based and collaborative filtering for mobile phone recommendations.
* Biswas and Liu (2022) developed a hybrid recommender system for smartphones, emphasizing personalization.
* Caro-Martínez et al. (2021) introduced an ontological model for explainable recommender systems.
* Tokutake and Okamoto (2023) focused on serendipity-oriented systems using dynamic unexpectedness prediction.
* Smets et al. (2022) discussed serendipity beyond algorithms, emphasizing interface design and user experience.
* Hybrid models using TF-IDF, ALS, and DNN have shown improved prediction accuracy.
* Ontology-based frameworks enhance explainability and user trust.
* Cold-start problems are addressed using deep learning and hybrid techniques.
* Serendipity is influenced by UI design and content diversity.
* Contrarian logic promotes discovery by challenging user biases.

# Methodology

The methodology integrates multiple recommendation techniques to overcome individual limitations:

1. Content-Based Filtering: Uses cosine similarity and TF-IDF to match user preferences with product features.
2. Collaborative Filtering: Employs matrix factorization and nearest neighbor algorithms to identify similar users.
3. Hybridization: Combines CBF and CF using a weighted approach (CBF: 70–80%, CF: 20–30%) to balance personalization and popularity.
4. Explainability: Uses prompt-based logic and LLMs to provide human-readable justifications for recommendations.
5. Serendipity: Introduces unexpected but relevant suggestions using feature diversity and time-series reranking.
6. Contrarian Logic: Applies inverse preference modeling to challenge user biases and avoid filter bubbles.

This hybrid methodology is superior to standalone models as it addresses cold-start issues, enhances transparency, and improves user engagement through novelty and diversity.

# Modules

The system is divided into several modules, each responsible for a specific function:

## Data Handler:

Loads and preprocesses mobile datasets, handles missing values, and formats data for filtering.

## Content-Based Filtering:

Matches user preferences with phone features using TF-IDF and cosine similarity.

## Collaborative Filtering:

Analyzes user-item interaction matrices to recommend unseen but relevant phones.

## Hybrid Recommender:

Combines outputs from CBF and CF using meta-level hybridization.

## Explainability:

Provides human-readable reasons for each recommendation to build user trust.

## Serendipity & Contrarian Logic:

Introduces unexpected suggestions and challenges user biases.

## User Interface:

CLI or GUI that collects user preferences and displays top recommendations with explanations.

# Results

* High match rate with user preferences.
* Serendipitous recommendations increased user engagement.
* Contrarian logic added diversity to suggestions.
* Prompt-based explanations improved transparency.
* Real-time recommendations performed efficiently on Streamlit.

# Conclusion

The hybrid recommendation system successfully integrates content-based and collaborative filtering techniques to deliver personalized mobile phone suggestions. By incorporating explainability, serendipity, and contrarian logic, the system enhances user trust and engagement. The modular design and real-time deployment capabilities make it suitable for practical applications.

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# References

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