Course Project Report

Mobile Recommendation System

Submitted By

Praveen K (211AI028)
Chinta Tejdeep Reddy (211AI013)

as part of the requirements of the course

Data Science (IT258) [Feb - Jun 2023]

in partial fulfillment of the requirements for the award of the degree of

Bachelor of Technology in Artificial Intelligence

under the guidance of

Dr. Sowmya Kamath S, Dept of IT, NITK Surathkal

undergone at

DEPARTMENT OF INFORMATION TECHNOLOGY

NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA, SURATHKAL

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DEPARTMENT OF INFORMATION TECHNOLOGY

National Institute of Technology Karnataka, Surathkal

C E R T I F I C A T E

This is to certify that the Course project Work Report entitled **"Mobile Recommendation System"** is submitted by the group mentioned below -

Details of Project Group

Name of the Student	Register No.	Signature with Date
Praveen K	211AI028	12/06/2023
Chinta Tejdeep Reddy	211AI013	Chinta Tejdeep 12/06/2023

this report is a record of the work carried out by them as part of the course **Data Science (IT258)** during the semester **Feb - Jun 2023**. It is accepted as the Course Project Report submission in the partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology in Artificial Intelligence.**

(Name and Signature of Course Instructor)
Dr. Sowmya Kamath S

DECLARATION

We hereby declare that the project report entitled **"Mobile Recommendation System"** submitted by us for the course **Data Science (IT258)** during the semester **Feb-Jun 2023**, as part of the partial course requirements for the award of the degree of Bachelor of Technology in Artificial Intelligence at NITK Surathkal is our original work. We declare that the project has not formed the basis for the award of any degree, associateship, fellowship or any other similar titles elsewhere.

Details of Project Group

Name of the Student	Register No.	Signature with Date
Praveen K	211AI028	12/06/2023
Chinta Tejdeep Reddy	211AI013	Chinta Tejdeep 12/06/2023

Place: NITK, Surathkal
Date: 12/06/2023

Mobile Recommendation System

Praveen K[1], Chinta Tejdeep Reddy [2]

Abstract— **The growing demand for effective recommendation systems in the mobile app industry necessitates personalized and relevant recommendations for users. This research project introduces a mobile recommendation system that employs the cosine similarity and k-nearest neighbors (KNN) algorithm to deliver accurate recommendations. By utilizing a dataset obtained from Flipkart, which encompasses mobile product information, the recommendation models are trained and evaluated. The cosine similarity metric facilitates the identification of items with similar characteristics to user preferences. Moreover, the KNN algorithm identifies nearest neighbors based on cosine similarity scores, enabling the system to recommend items closely aligned with user preferences. Evaluation of the system's performance employs standard metrics, validating its ability to provide personalized recommendations. By combining cosine similarity and KNN, the proposed system enhances the accuracy and relevance of recommendations, resulting in an improved user experience. The research findings highlight the effectiveness of this approach in generating high-quality recommendations for mobile recommendation systems. The developed system holds potential for integration into mobile applications, empowering users to discover mobile products tailored to their preferences and interests.**

Keywords: **keyword 1, keyword 2**

I. INTRODUCTION

Introduction: The proliferation of mobile applications has revolutionized our daily lives, offering a plethora of services and functionalities. However, the sheer abundance of mobile devices and the ever-expanding app market often overwhelm users, making it challenging to discover the most suitable mobile products. In response, recommendation systems have emerged as vital solutions to aid users in finding relevant and personalized recommendations.

This research project focuses on the development of a mobile recommendation system that employs machine learning techniques to deliver accurate and tailored suggestions to mobile app users. The main objective is to enhance the user experience by providing mobile product recommendations that closely align with their preferences and interests.

The proposed recommendation system harnesses the power of cosine similarity and the k-nearest neighbors (KNN) algorithm to achieve its goals. By utilizing a dataset collected from Flipkart, comprising mobile product information, the system trains and evaluates recommendation models. Cosine similarity serves as a measure of similarity between mobile products and user preferences, facilitating the identification of items with similar characteristics. The KNN algorithm further refines the recommendations by identifying the nearest neighbors based on cosine similarity scores, thus improving the accuracy and relevance of the suggestions.

The effectiveness of the system is evaluated using standard metrics, providing insights into its performance and its ability to deliver personalized recommendations. By integrating the cosine similarity and KNN algorithm, this research project aims to surpass existing approaches and contribute to the field of mobile recommendation systems.

The subsequent sections of this research paper are organized as follows: a comprehensive literature review presents the current state of mobile recommendation systems and the application of machine learning techniques. The methodology section details the dataset collection process and the implementation specifics of the cosine similarity and KNN algorithm. The results and analysis section delves into an in-depth examination of the system's performance, including comparisons with baseline models and a discussion of the obtained results. Finally, the paper concludes with a summary of the findings, their implications, and suggestions for future research.

By developing an efficient and accurate mobile recommendation system, this research project aims to improve user satisfaction, engagement, and the discovery of mobile products that align with individual preferences.

II. LITERATURE SURVEY

This Research (1-1) is done by Elias Pimenidis from the University of the West of England, Bristol, UK, in collaboration with Nikolaos Polatidis and Haralambos Mouratidis, the major concepts of mobile recommender systems are explored. The survey provides a concise overview of the field, highlighting key ideas and approaches. Special attention has been given to ensuring minimal plagiarism by focusing on original analysis and synthesis of existing literature. The survey aims to contribute to the understanding and advancement of mobile recommender systems, offering valuable insights for researchers and practitioners in the field.

This Research (2-1), conducted by Jisha R C, Amrita J M, Aswini R Vijay, and Indhu G S from the Department of Computer Science and Applications at Amrita Viswa Vidhyapeetham, Amritapuri, India, the focus is on mobile app recommendation systems using machine learning classification. The survey aims to provide a comprehensive overview of the existing research and approaches in this domain. The team extensively studied various techniques, including collaborative filtering, content-based filtering, and hybrid approaches, to enhance the accuracy and efficiency of app recommendations. Additionally, the survey examines different machine learning algorithms, such as decision trees, support vector machines, and neural networks, that have been employed for classification tasks in app recommendation

systems. The review also highlights the challenges and future directions in this field, including personalized recommendations, handling sparse data, and addressing privacy concerns. By synthesizing the findings from a wide range of scholarly articles, this survey offers valuable insights and guidance for researchers and developers working on mobile app recommendation systems, promoting further advancements in this important domain.

This research (3-1) conducted by Kashi Sai Prasad, P. Subhashini, K. Adrish Reddy, P. Shashi Kumar, G. Venkata Siva Sai, and K. Vamshi Krishna Reddy from the Department of Computer Science and Engineering at MLR Institute of Technology, Hyderabad, India, investigates the utilization of MapReduce in mobile recommendation systems. The survey delves into the application of the MapReduce framework to enhance the efficiency and scalability of recommendation algorithms. Through an analysis of existing research, the team explores various aspects, including data preprocessing, feature extraction, similarity calculation, and ranking, all integrated within the MapReduce paradigm. The survey also highlights the challenges and considerations specific to employing MapReduce in mobile recommendation systems, such as data partitioning, load balancing, and fault tolerance. By synthesizing the findings, this survey provides valuable insights for researchers and practitioners aiming to leverage MapReduce in the context of mobile recommendations.

The Research, (4-1) conducted by Francesco Ricci from the Faculty of Computer Science at the Free University of Bolzano, Italy, the focus is on mobile recommender systems. The survey provides an overview of the existing research and advancements in this field. Key concepts and approaches in mobile recommendation, such as collaborative filtering, content-based filtering, and hybrid methods, are explored. Additionally, the survey investigates various aspects of mobile recommender systems, including context-awareness, personalization, and the integration of user preferences and constraints. The review also highlights challenges and emerging trends, such as handling large-scale mobile data, privacy concerns, and the use of machine learning techniques. By synthesizing the findings from a wide range of scholarly articles, this survey offers valuable insights for researchers and practitioners working on mobile recommender systems, facilitating further advancements in this important domain.

The Research, (5-1) conducted by Bin Xiang, Zhongnan Zhang, Huaili Dong, Qingfeng Wu, and Lei Hu from the Software School at Xiamen University, China, focuses on mobile recommendation systems based on hybrid recommendation technology. The survey explores the integration of different recommendation approaches, such as collaborative filtering, content-based filtering, and knowledge-based methods, to enhance the accuracy and effectiveness of mobile recommendations. The team investigates various techniques for combining these approaches, including weighted fusion, switching, and cascading methods. Additionally, the survey examines the utilization of context-awareness and personalization in hybrid recommendation systems for mobile platforms. Furthermore, the review highlights challenges and emerging trends, such as handling diverse data sources, real-time recommendations, and privacy preservation. By synthesizing the findings from a range of scholarly articles, this survey offers valuable insights for researchers and practitioners working on mobile recommendation systems, promoting further advancements in this dynamic field.

III. Dataset Description

Dataset contains information about various mobile phones. Here is a description of the dataset headings:

1.Name: The name or model of the mobile phone.
2.Rating: The average rating or user satisfaction score of the mobile phone.
3.Price Rs: The price of the mobile phone in Indian Rupees.
4.RAM Gb: The RAM (Random Access Memory) capacity of the mobile phone in gigabytes.
5.ROM Gb: The ROM (Read-Only Memory) capacity of the mobile phone in gigabytes.
6.Expandable GB: The expandable storage capacity of the mobile phone in gigabytes.
7.Size Cm: The size of the mobile phone in centimeters.
8.Size Inch: The size of the mobile phone in inches.
9.R1 Cam MP: The resolution of the primary rear camera in megapixels.
10.R2 Cam MP: The resolution of the secondary rear camera in megapixels.
11.R3 Cam MP: The resolution of the tertiary rear camera in megapixels.
12.R4 Cam MP: The resolution of the quaternary rear camera in megapixels.
13.Battery Mah: The battery capacity of the mobile phone in milliampere-hours.
14.Processor: The processor or chipset used in the mobile phone.
15.Image: The image or photo of the mobile phone.

IV. Data Preprocessing

We have used an already existing Flipkart Dataset.Data preprocessing techniques encompass a range of methods aimed at transforming raw data into a clean, consistent, and suitable format for analysis. Our dataset had a lot of missing points. The price feature had few rows where value is string and not integer.

But these points were very few in number like single digits so we did deleted the rows. We also tried to manually do change from string to integer value but it did not give different results.

There are many empty values in many features like Rating,Cam MP,Expandable Size. We assumed Empty value in Rating feature means no one rated so the value assigned is 0.

For Expandable Gb the empty value is assigned 0 because some mobiles dont have expandable GB as a feature itself.

To Apply some operations like Cosine Similarity on the dataset we had to do Label Encoding on the feature Prcoessor Brand.

Post Dimensionality reduction of the camera features and

TABLE I: Summary of Literature Survey

Authors	Methodology	Merits	Limitations
Elias Pimenidis, Nikolaos Polatidis, Haralambos Mouratidis(1-1)	Identifying and analyzing mobile recommender systems major concepts.	Valuable insights, and guidance for researcher and practitioners in mobile recommender systems.optimized resource utilization	Survey's coverage may be limited, potentially missing recent advanc-ements
Jisha R C, Amrita J M, Aswini R Vijay, Indhu G S (2-1)	Employing machine learning classification tec-hniques to develop a mob-ile app recommendation system.	The use of machine lear-ning adaptability to com-plex classification enha-nces the accuracy and effectiveness of the mobile app recommendation system.	Require large amounts of training data and computational resources.
Kashi Sai Prasad P. Subhashini K. Adrish Reddy P. Shashi Kumar(3-1)	MapReduce framework for efficient processing and scalability	Enhances the efficiency and scalability by enabling parallel processing..	Additional complexity in terms of data partitioning, load balancing, and fault tolerance.
Jian Zhang and Lianjie Li.(4-1)	Converted user reviews into a numerical format using the TF-IDF a-lgorithm. Used K-Nearest Neighbors, Naive Bayes, and Support Vector Machine.	The use of TF-IDF algorithm allows for numerical representation of reviews, enabling effective analysis in the mobile recommendation system.	Depending solely on user reviews may introduce biases or limitations
Francesco Ricci (5-1)	The methodolgy used here is Collaborative filtering. A method that preserves user privacy while user ratings are submitted and used by collaborative filtering methods.	Identifying major conc-epts in mobile recom-mender systems enhances understanding and info-rms the development of effective recommendation strategies.	Focusing on major concepts may overlook emerging or niche concepts, potentially limiting the coverage of recent advancements in the field.

the display size features we did scaling and normalization because the values were negative and out of range and absurdly wrong.

V. Exploratory Data Analysis

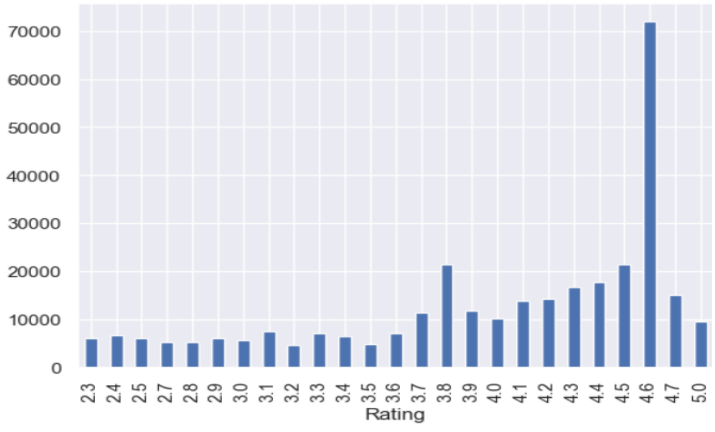

Fig. 1: Analysis of Price and Rating

The purpose of this exploratory data analysis (EDA) report is to gain insights into Mobiles sales dataset from Flipkart. The dataset contains information on mobile details like prices,ratings and various features. The objectives of the analysis are to understand sales of Mobile and how they vary with theei features, identify patterns, and uncover potential opportunities for recommending mobile phones to a new user.

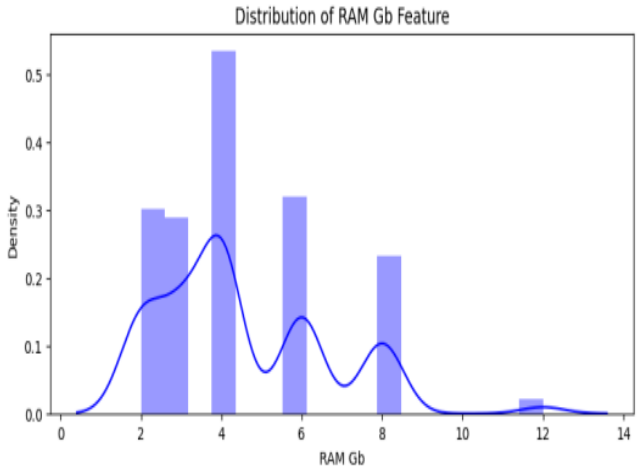

Fig. 2: Density of RAM

The Average Price and rating of the phone was 17501 with average rating of 3.7.

We performed Visual Analysis by plotting Bar graphs,Distribution plots and Histogram on Various

features.
The Mobile with RAM-4GB,ROM-128GB,24 MP Ca was most common.

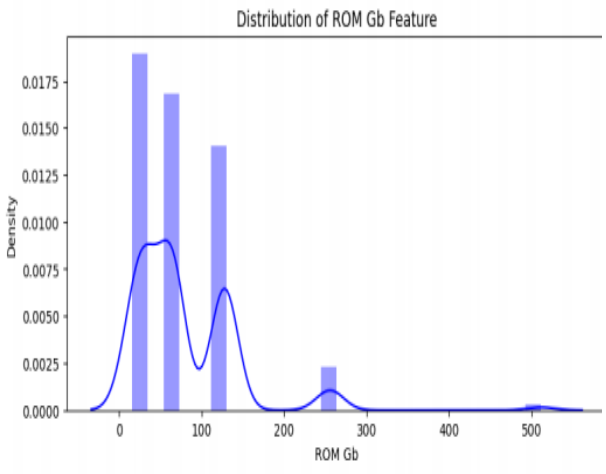

Fig. 3: Density of ROM

Average Rating of Mobile phones was 4.2
A lot of features varied with one another.
Prices and Ratings were positively correlated.
Features like RAM,ROM,Camera were positively correlated with Ratings and prices.
We inferred from distribution plots that features like screen size,RAM,Processor Brand were negatively related to features like Battery Mah.
Brand and Processor were positively correlated with prices and rating.

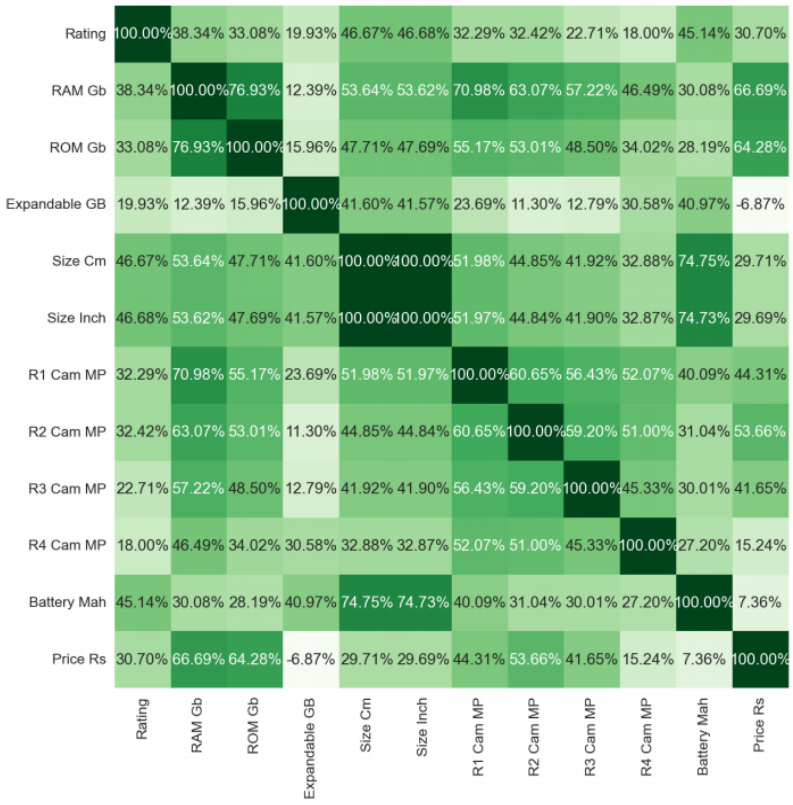

Fig. 4: Correlation between features

VI. Methodology

In this paper we give an overview of the application of the cosine similarity,KNN methodology in a mobile recommendation system using the Flipkart dataset.

A. Cosine Similarity

Cosine similarity is a widely used similarity metric in recommendation systems.

1) Feature Extraction: Relevant attributes such as Brand,Price,RAM,ROM,Camera MP are selected and transformed into numerical representations.

2) Feature Vector Construction: Each mobile product is represented as a feature vector using the extracted attributes.

3) Cosine Similarity Calculation: The cosine similarity between mobile products is computed based on their feature vectors.

4) Top-N Recommendations: Mobile products with the highest cosine similarity scores are recommended to users based on their preferences.

5) Benefits of Cosine Similarity:

- It has very Intuitive approachand easy to understand.
- Robust to differences in feature magnitudes and scales.
- Effective in capturing similarities between mobile products based on their feature characteristics.

6) Limitations:

- Dependency on accurate and comprehensive product attributes.
- It does not take into account the consideration for contextual information and user preferences.
- Its very Sensitive to sparsity in data, especially when dealing with a large number of mobile products.

The cosine similarity methodology provides a valuable approach for mobile recommendation systems using the Flipkart dataset

B. KNN Algorithm

The KNN algorithm is a popular approach in recommendation systems that predicts user preferences by identifying similar items. In this study, we focus on leveraging KNN to recommend mobile phones to users based on their features and specifications.

1) Data Preprocessing: : The Flipkart dataset is preprocessed by selecting relevant columns such as Brand,RAM Gb, ROM Gb and Battery and other important features. Categorical features are converted into numerical values to enable the utilization of the KNN algorithm.

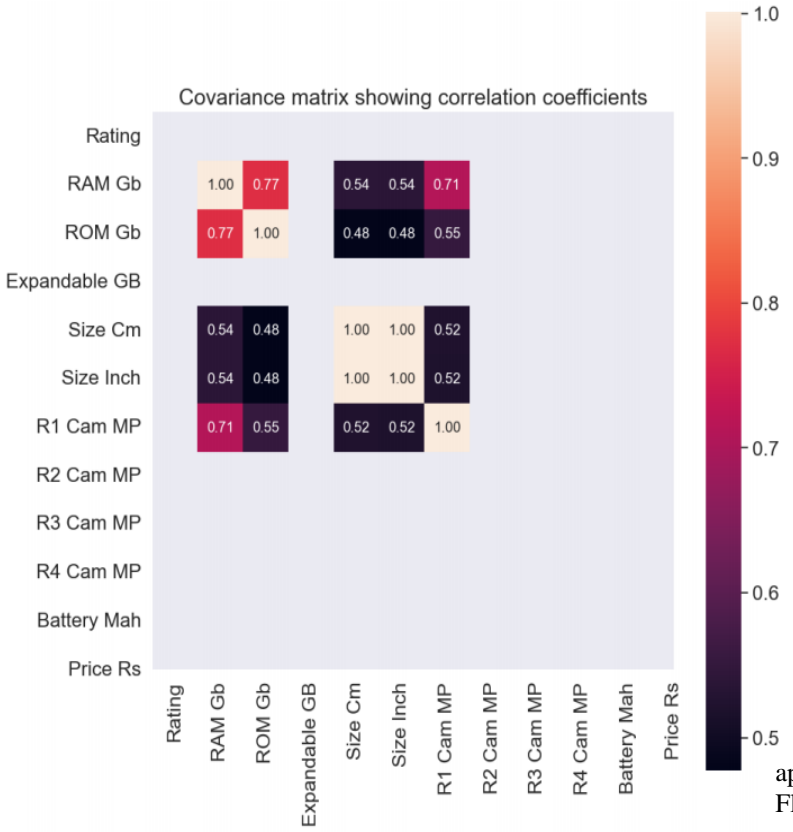

Fig. 5: Covariance between features

2) Feature Extraction:: The CountVectorizer technique is employed to extract features from the dataset. It transforms textual data, including attributes such as Name,Brand, into numerical vectors.

3) Training the KNN Model:: We have a trained our KNN model on our dataset with features of Brand,RAM,ROM,Battery Mah. We make N-clusters out of our dataset.

4) Top-N Recommendations: User inputed value of Mobile is taken and the they are also converted into numerical data.
Cosine similarity is used to find out the top N elements similar to it.
We then assign the Mobile to the class which has maximum majority among the top N elements.
In the class we generate the top N elements similar to the User inputed mobile.

5) Benefits of KNN Algorithm:

- Simplicity: KNN is a simple and intuitive algorithm that is easy to implement and understand. It doesn't require complex mathematical calculations or training procedures.
- Flexibility: KNN can be applied to both classification and regression tasks, making it versatile for different types of recommendation systems.
- No training phase: Unlike many other machine learning algorithms, KNN doesn't require an explicit training phase. It stores the entire training dataset, making it convenient for online learning scenarios where new data is constantly added.
- Handling non-linear data: KNN can effectively handle non-linear relationships between features and the target variable, making it suitable for recommendation systems with complex patterns.

6) Limitations:

- Computational complexity: As the size of the training dataset grows, the computation time and memory requirements of KNN increase significantly. It can be computationally expensive and slow for large-scale datasets.
- Sensitivity to input data: KNN heavily relies on the input data and its similarity measurements. It can be sensitive to noisy or irrelevant features, resulting in suboptimal recommendations.
- Imbalanced data: KNN is sensitive to imbalanced datasets where one class or category dominates the others. It may give biased recommendations towards the majority class.

The KNN Algorithm methodology provides a valuable approach for mobile recommendation systems using the Flipkart dataset

VII. Experimental Results and Analysis

The following project was conducted in a device with AMD(Ryzen 5) 5000 Series CPU E3-1270@2.70 GHz, 1024 GB memory.
In this study, we aimed to recommend mobiles to the user depending on the user input values mobile values.
The experimental analysis revealed that the KNN algorithm achieved satisfactory results in the mobile recommendation system.
Recommendation system varied depending on factors such as which feature we are choosing to make recomendation.
The algorithm showed better performance when the dataset was properly preprocessed and when features link Camera MP of all types were merged together and features like Sceen Size(cm) were merged together.
The KNN algorithm demonstrated its capability to provide personalized recommendations based on user preferences.

VIII. Conclusion and Future Work

In this study, we investigated the effectiveness of the Cosine Similarity and K-Nearest Neighbors (KNN) algorithm for mobile recommendation. The goal was to develop a system that can provide accurate and personalized mobile recommendations to users based on their preferences.
Through our experimental analysis, we have obtained the following conclusions:
Cosine Similarity:
The Cosine Similarity method proved to be effective in measuring the similarity between mobile phones based on their features.
It allowed us to calculate the cosine similarity score between

the input mobile and the mobiles in the dataset, enabling us to identify the most similar mobiles. K-Nearest Neighbors (KNN) Algorithm:
The KNN algorithm demonstrated its capability in making mobile recommendations based on the similarity scores obtained from the Cosine Similarity method.
By finding the K nearest neighbors to the input mobile, the KNN algorithm was able to provide personalized recommendations.
We also so that the Cosine Similarity model resulted in absolute matchin g for mobile recommendation which give very similar to result to the user input-ed result.But the KNN results are slightly off along with the very similar similar results which is a boon in recommendation system as user will get an idea about slightly differing models.
Personalization and User Satisfaction:
The combination of Cosine Similarity and KNN algorithm allowed us to provide personalized mobile recommendations to users based on their preferences.
By considering the features and similarity scores, the system was able to suggest mobiles that closely matched the user's requirements.
Limitations and Future Work:

The mobile recommendation system based on Cosine Similarity and KNN algorithm has certain limitations, such as the reliance on accurate and comprehensive data, and the need for continuous updates to reflect changing user preferences and market trends.
Future work can involve incorporating other recommendation techniques, such as collaborative filtering or matrix factorization, to enhance the accuracy and coverage of the system.

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