International Journal of Future Generation Communication and Networking
Vol. 13, No. 3s, (2020), pp. 811–818

Device Model Recommendation System Using Machine Learning

Jagruti Deshpande[1], Deepshree Kadus[2], Seema Pawar[3], Krutika Padeer[4], Sakshi Mandke[5]

[1]Computer Department, CCOEW, Pune, India,[2]Computer Department, CCOEW, Pune, India,
[3]Computer Department, CCOEW, Pune, India, [4]Computer Department, CCOEW, Pune, India,
[5]Computer Department, CCOEW, Pune, India

[1]deshpande.jag19@gmail.com

[2]kadusdeepshree5499@gmail.com

[3]seema.1891998@gmail.com

[4]krutikapadeer2018@gmail.com

[5]sakshi.mandke@cumminscollege.in

Abstract

Recommendation systems are used to suggest relevant items to users. Recommendation system is a relatively new area of research in machine learning and is playing an important role in business growth. Today, every organizations have their IT administration teams to monitor and maintain the company's computer infrastructure. There is requirement of suitable computer models for the company employees depending on the applications that they are working on and the memory usage that is required. The consequences of less suitable computer systems causes slow performance and inefficient work. Hence, there is a need of using appropriate computer systems to enhance work quality of the IT workforce. This paper proposes an idea to build recommendation system to recommend right model of devices to the IT team according to the running applications and memory usage using machine learning algorithms like K Nearest Neighbor, K means clustering and collaborative filtering approach. Analysis is done on the result to help the organizations for cost predictability of devices. This system can help organizations to get the suitable model of laptop or desktop with adequate computing power to increase IT efficiency and user productivity.

Keywords— Recommendation system, machine learning, K Nearest Neighbor, Kmeans clustering, collaborative filtering.

I. INTRODUCTION

Recommendation system is a model that is used for filtering of information to give suitable preference to the user. Recommendation system have become increasingly popular today because of the business value they provide. Recommendation systems can be used in different areas like recommendation of movies, books, music, videos, places and other utilities. Many companies are nowadays making use of recommendation systems for customer satisfaction and increase their revenue.

Some Benefits for the business by using recommendation systems are [1]:

1) Revenue – Industries can attract more customers as a result of suitable recommendations to the customers.

2) Personalization – The customers can get personalized recommendations based on their browsing or product usage.

There are four types of Recommendation systems that are 'content' based recommendations, 'collaborative' based recommendations, 'Demographic' recommendations and 'hybrid' approaches [1],[3],[4].

ISSN: 2233-7857 IJFGCN

1) Content based recommendations – In this technique, filtering is done based on the customers interested items or using only the data pertaining to that customer.
2) Collaborative based recommendations – In this technique, filtering is done based on the data of different users and comparing their features to recommend suitable solution.
3) Demographic recommendations – This technique of recommendation uses user profile information.
4) Hybrid approaches – Hybrid approaches merge the two recommendation techniques that are content based technique and collaborative based technique.

In many organizations, IT infrastructure includes large number of computer systems like laptops, desktops that are used to perform their day to day industrial work. The IT team of any organization has the responsibility to monitor working of multiple computer devices but many of the devices are not capable to work according to work requirements like need of computing power for certain applications, memory usages, etc that can reduce the work efficiency. So there is emerging need of using suitable computer systems to enhance work quality and productivity of the IT workforce. This paper proposes an idea to build recommendation system to recommend appropriate model of computer systems as per running applications and memory usage using machine learning algorithms like K Nearest Neighbor and Kmeans clustering.

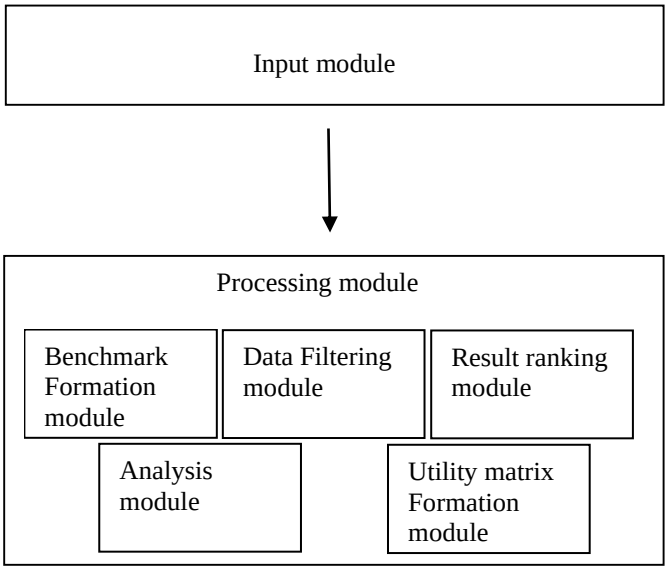
The work starts with section I as Introduction that gives basics about the recommendation system and motivation of the proposed device model recommendation system. Section II discusses the architecture and process flow of the proposed recommendation system. The Section III gives the detailed implementation aspects and Section IV describes the conclusion and future work of the proposed system.

II. ARCHITECTURE AND PROCESS FLOW

This section consists of the architecture and process flow of the proposed recommendation system. The Architecture gives the overall conceptual idea and the process flow of the system gives the detailed steps required to build the proposed recommendation system.

A. Architecture

Figure 1 shows the architecture of the proposed recommendation system. It consists of three modules that are input module, processing module and an output module. The architecture helps to give the conceptual idea of the proposed recommendation system.



ISSN: 2233-7857 IJFGCN

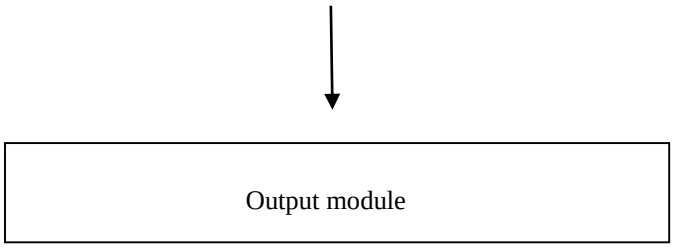


Fig. 1 Architecture of the proposed recommendation system

The three modules proposed in the architecture are Input Module, Processing Module and Output Module. The following is the description of each module.

Input Module
In this module, the input dataset is collected. The attributes considered in the dataset are device serial number, device model, device processor, number of cores, device RAM, device RAM usage, device CPU usage and running applications according to date. The collected data is passed to the processing module.

Processing Module
This module is the combination of different modules like Benchmark formation, data filtering, utility matrix formation, result ranking and analysis module. This module is dependent on the input module for the dataset. Benchmark formation module is used to from a standard data required for computation. The data filtering module focuses on filtering of data based on the conditions like filtering in the data having less device RAM usage, less device CPU usage and similarity index of the running applications. The filtered data is used by the utility matrix formation module to form a clustered utility matrix. The result ranking module uses the formed clustered matrix to find and rank the recommended models. The analysis module performs computations to analyse the result.

Output Module
In this module, best suitable device model is recommended to the user along with analysis done on the result. The output consists
of recommended model along with its attributes like device processor, device RAM, device RAM usage and device
CPU usage.

B. Process Flow

Figure 2 shows the process flow of the proposed recommendation system.

ISSN: 2233-7857 IJFGCN

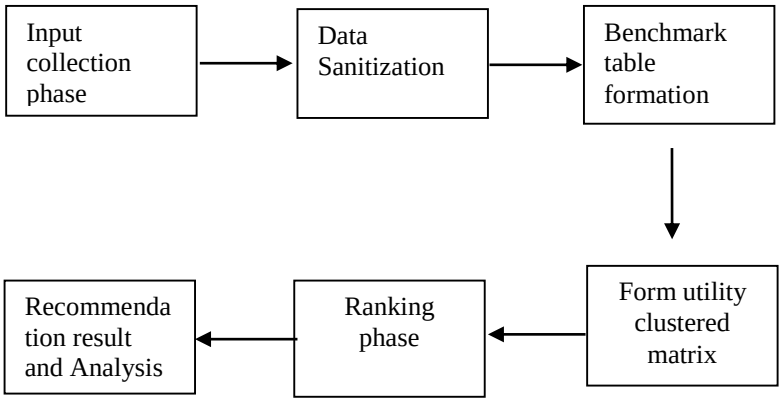


Fig. 2 Process Flow of proposed recommendation system

The diagram specifies step wise working of the entire model.
Step 1 – The data is collected to prepare the dataset for recommendation system
Step 2 – The collected data is sanitized by removing the noise and converting the data points into suitable format required for computation.
Step 3 – Benchmark table formation is used to prepare the standard data that is required for comparison and computation. It is formed by aggregating the data according to device model. The aggregated data is filtered according to conditions like device RAM usage, device CPU usage is less than that of the input device for which recommendation is to be provided, high similarity of the running applications between the input data and testing data. Consider θ_1 and θ_2 as two input data points, the mathematical representation of filtering conditions is:
CPU_usage < θ_1 ∪ RAM_usage < θ_2 ∪ | sim index | ≈ 1
Step 4 – The utility clustered matrix is prepared by applying k means clustering algorithm. Elbow method is used to find the optimal number of clusters required to apply k means clustering algorithm. The data is divided into clusters on applying the k means clustering algorithm
Step 5 – The similarity index is found on the clustered matrix by applying suitable algorithm to rank the results according to the highest similarity value.
Step 6 – The ranked recommendation result is obtained in the table format consisting of recommended model and its attributes. The Analysis is done on the recommendation result such as graph of the percentage of recommended model is obtained.

III. IMPLEMENTATION ASPECTS

The system has been implemented using python programming language. Machine learning algorithms are implemented using scikit learn tool. The implementation of the proposed recommendation system is divided into different sub-sections which are as follows:

1) Data Collection
2) Data Pre-processing
3) Data Filtration
4) Data Training
5) Data Testing
6) Recommendation result and Analysis

ISSN: 2233-7857 IJFGCN

A. Data Collection

The first step in the process of implementation of recommendation system is data collection. In this step right dataset is generated that is required for the further computations. Figure 3 shows the screenshot of few sample data records of considered input fields. For the device model recommendation system, the dataset is manually generated using tools such as performance monitor and task manager. The data is collected in timely manner by extracting latest data records to get latest recommendations of device model. The running applications included in the dataset is based on two criteria, first criteria is frequent running applications on the device and second is RAM and CPU usage greater than the threshold. The suitable threshold is set by analysing the considered input values. The generated dataset consists of 10,000 records

B. Data Pre-processing

The second step in the process of implementation is data pre-processing. In this step, relevant data is extracted using sanitization methods by removing noise and converting the data values in appropriate format required for computation. Factorize method in python is used for suitable transformations of string data to mathematical values. Cosine similarity of the application input data and test data is calculated using vectorizer method. The mathematical formula for similarity index between two data points p and q can be given as:

$$\text{Similarity (p, q)} = \frac{\sum_{i=1}^{n} p_i \, X \, q_i}{\sqrt{\sum_{i=1}^{n} p_i^2} \, X \, \sqrt{\sum_{i=1}^{n} q_i^2}}$$

Serial Number	Device Model	RAM (GB)	Processor	No. of Cores	RAM Usage	CPU Usage	DateTime	Running Applications
1FT453OMN	HP Elite	24	CORE i9	8	51	45	13-11-2019 19:43	Eclipse,VisualStudiocode, AppManager, Pycharm, GoogleChrome, McAfeeManager, Desktopwindowsmanager, RealtekHDAudio
9KT477PGH	Dell Inspiron 15	24	CORE i5	4	50	60	14-11-2019 19:43	VisualStudiocode, McAfeeManager, MicrosoftExplorer, Pycharm, GoogleChrome, ServiceHost, Desktopwindowsmanager
7MU91EQW	HP Zbook	16	CORE i5	6	70	40	15-11-2019 19:43	McAfeeManager, GoogleChrome, ServiceHost, RealtekHDAudio, MicrosoftExplorer, MacAfeeFirewallService, SpoolerSubsystem
4FG65YUB	Dell ChromeBook	8	CORE i3	2	60	55	16-11-2019 19:43	GoogleChrome, VisualStudiocode, ServiceHost, Pycharm,MacAfeeFirewallService,Matlab, SpringBoot, RealtekHDAudio
2RG045LZ	Lenovo A6 Note	8	CORE i7	8	45	40	17-11-2019 19:43	Pycharm,GoogleChrome,ServiceHost,RealtekHDAudio,MicrosoftExplorer,SpringBoot,MacAfeeFirewallService
3JK881HH	HP Elite	16	CORE i3	8	55	50	18-11-2019 19:43	Eclipse,VisualStudiocode,AppManager,Pycharm,GoogleChrome,McAfeeManager,Desktopwindowsmanager,SpringBoot

Fig. 3 Input dataset of the proposed system

C. Data Filtering

The third step in the process of implementation is data filtering. In this step the data extracted from data pre-processing step is used. The generated data is aggregated device model wise to form benchmark table. This resultant data is considered for data filtering. The data is filtered using three steps which are as follows:

ISSN: 2233-7857 IJFGCN

Step1 – The device model has less CPU usage
Step2 – The device model has less RAM usage
Step3 – Application similarity index closer to 1

D. Data Training

The fourth step in the process of implementation is data training. The created filtered matrix is used to apply machine learning algorithms. K means clustering is applied to form utility clustered matrix. This is done by first choosing optimal number of clusters using elbow method and segregating the data into k optimal clusters forming utility clustered matrix. The clustered matrix is then trained using K nearest neighbor algorithm. Euclidean distance is considered for applying K nearest neighbor algorithm. The mathematical formula used to calculate the distance between two data points p and q for K nearest neighbor algorithm is given as:

$$d(p, q) = \sqrt{(p_1 - q_1)^2 + (p_2 - q_2) + \cdots (p_n - q_n)}$$

E. Data Testing

The fifth step in the process of implementation is data testing. In this step, the suitable model is recommended for the test users using the trained model. The result is ranked and is used for carrying out further analysis.

F. Recommendation result and Analysis

The sixth step in the process of implementation is the extraction of recommendation result and carrying out analysis.

IV. RESULTS

Figure 4 shows the analysis graph generated by using implemented results. Analysis graphs such as pie chart is generated to get the overall percentage of recommended models. After doing the analysis of results, the similarity coefficient of the input models and recommended models was found to be greater than 0.95 and ensured that best working models were recommended with minimum upgrade.

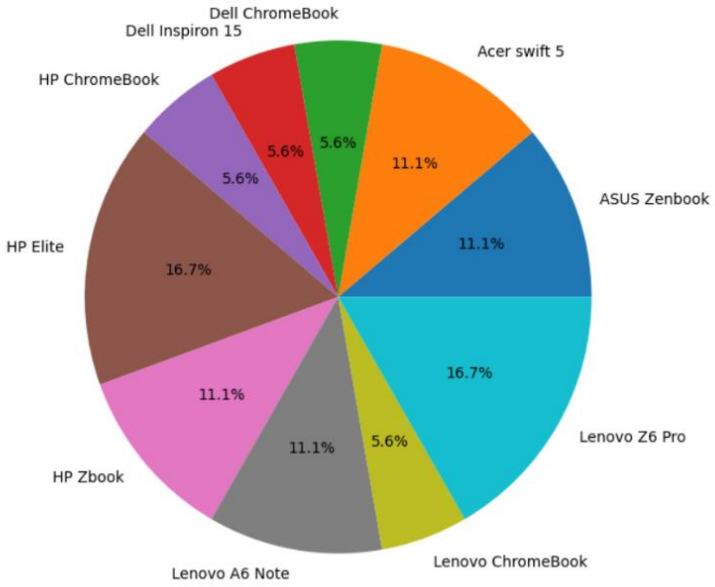


Fig. 4 Analysis chart of produced result

ISSN: 2233-7857 IJFGCN

V. CONCLUSION AND FUTURE WORK

Machine learning is the technique that automates the analytical model building. Being a branch of artificial Intelligence, the systems can learn from the data, can identify the patterns and make decisions with minimal human Intervention [2].

Recommendation systems are an important field of research today because of the rapidly increasing data as a result of growing users and the business value that they bring [1]. In this paper, we have discussed about the importance of recommendation systems, architecture, process flow and implementation aspects of the proposed system. The proposed device model recommendation system is built using machine learning techniques and is implemented in python. The application of the proposed system is in maintenance of IT infrastructure that can help IT administration team of organizations to smartly manage the IT infrastructure and ultimately increase the work efficiency and productivity of the employees. The proposed system can be improved by taking the reviews from the employees using sentimental analysis. The sentimental analysis approach can further increase the efficiency of the system.

REFERENCES

[1] Marwa Hussien Mohamed, Mohamed Helmy Khafagy, Mohamed Hasan Ibrahim, "Recommender Systems Challenges and Solutions Survey", International Conference on Innovative Trends in Computer Engineering(ITCE'2019), Aswan, Egypt, 2-4 February 2019, pp.149-155

[2] Rishabh Ahuja, Arun Solanki, Anand Nayyar, "Movie Recommender System Using K-Means Clustering AND K-Nearest Neighbor" , 9th International Conference on Cloud Computing, Data Science and Engineering, IEEE, 2019

[3] Ching-She (Mike) Wu, Deepti Gard, Unnathi Bhandary, "Movie Recommendation System Using Collaborative Filtering", 2018 IEEE 9th International Conference on Software Engineering and Service Science (ICSESS),pp.11-15

[4] Paritosh Nagarnaik, A.Thomas,"Survey on Recommendation System Methods", IEEE Sponsored 2ND International Conference on Electronics and Communication System(ICECS 2015),pp. 1603-1607

[5] Lalita Sharma and Anju Gera, "A Survey of Recommendation System Research Challenges", International Journal of Engineering Trends and Technology(IJETT),2013,pp. 1989-1992

[6] D.A Adeniyi, Z. Wei, Y. Yongquan, "Automated web usage data mining and recommendation system using K-Nrearest Neighbor(KNN) classification method", Saudi Computer Society, King Saud University, October 2014

[7] Z. Huang, D. Zeng, H. Chen A comparison of collaborative filtering algorithms for e-commerce IEEE Intell Syst,22, pp. 68-78

ISSN: 2233-7857 IJFGCN