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Original Article

Health-Care Recommender System Using Collaborative Filtering Algorithm

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Abstract: *Presently, there are thousands of hospitals offering several types of services to patients. It becomes challenging for a patient to make an informed decision on which hospital to visit for treatment for a particular ailment. Recommender systems have been used in diverse areas to solve the problem of decision making by providing several options for users based on certain attributes of the user that are similar to that of other users with similar attributes. In this work, we design a system that will recommend hospital for sick patient using collaborative filtering algorithm. It is aimed that the system will enhance proper recommendation of hospitals for patients to get the best possible care required for presented ailments. Hence, the need to filter, prioritize and efficiently deliver relevant information using recommender systems. We design and develop a recommendation model that uses object-oriented analysis and design methodology (OOADM). The system was implemented using PHP, MYSQL and AJAX technology.*

Keywords: *Architecture, Assumptions, Content-based, Dataset, Euclidean distance, Hybrid, Interface, Manhattan distance, Recommendation.*

I. INTRODUCTION

Recommender systems are becoming ubiquitous in the society today as many e-commerce and retail companies are leveraging its power to boost sales and improve customers' patronage. A recommender system is a technology that is deployed in the environment where items (products, movies, events, articles) are to be recommended to users (customers, visitors, app users, readers) or the opposite. Typically, there are many items and many users present in the environment making the problem hard and expensive to solve. Imagine a shop. Good merchant knows personal preferences of customers. Her/his high quality recommendations make customers satisfied and increase profits.

We see the use of recommendation systems all around us. These systems are personalizing our web experience, telling us what to buy (Amazon), which movies to watch (Netflix), whom to be friends with (Facebook), which songs to listen (Spotify) etc. These recommendation systems leverage our shopping/ watching/listening patterns and predict what we could like in future based on our behavior patterns. The most basic models for recommendations systems are collaborative filtering models which are based on assumption that people like things similar to other things they like, and things that are liked by other people with similar taste.

Here is the logic behind collaborative filtering: If Prince and Nonso each visit the same dentist, "East Poly Dental Care" they now have similar histories. If Prince visits an optician, “East Poly Optician Center,” and Nonso has not yet, the system will recommend East Poly Optician Center to Nonso. Think of all the other Optical centers to visit; but the system chose one based on Nonso’s preferences in collaboration with Prince’s preferences. That is why it is called “collaborative.” It interacts with those who are similar. [8] presented an insightful study that explores various user behaviors regarding sharing location details with third parties that users are not aware of. The study shows that 65% of users exhibit a readiness to share location data for personalized healthcare services, while 72% actively manage privacy settings in healthcare-related LBS applications.

Hospitals provide good quality care when they give you the care and treatments known to get the best results for your condition. Getting quality hospital care may help with your recovery and help you avoid other problems. Not all hospitals provide the same quality of care.

Most hospitals have programs to check and improve the quality of the care they provide. They may collect and monitor information from patient charts to see where they can improve patient care. They may survey patients about their hospital experience using the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) Survey.

Several researchers have worked on recommender systems, each using different techniques to arrive at their conclusion/design. In this section, we reviewed some works that have been done on recommender system.

[1] worked on An Improved Online Book Recommender System using Collaborative Filtering Algorithm. Their system was design using object-oriented analysis and design methodology (OOADM), their aim was to improve collaborative filtering algorithm using an efficient quick sort algorithm to solve the problems of sorting. They implemented the stated model using python model-view-controller (MVC) framework known as Django Framework. Their improved system was implemented using a real-time, cloud-hosted NOSQL database called FireBase which guarantees scalability. From the result of their work, the speed and scalability of book recommendation was improved with a performance record obtained within the range of ninety (90) to ninety-five (95) per cent using the root mean square error (RMSE) of several recommendations obtained from the system [1].

[2] Proposed a general framework for content-boosted collaborative filtering. This work improved on recommendation by boosting collaborative filtering algorithms with contents. Hence with their results, it was clear that a naïve hybrid method tends to perform better than a pure content-based or collaborative filtering algorithm.

[3] Carried out a survey of collaborative filtering techniques by first identifying the collaborative filtering tasks and the challenges facing them such as data sparsity, scalability, gray sheep, shilling attacks, privacy protections etc. and possible solutions to these challenges.

[4] Investigates the possibilities of inclusion of association rule mining for collaborative filtering based recommendations. Since collaborative recommender exploit how similar are the customers' preferences, it is easy to make personalized recommendations.

[5] Analyzed the different item-based recommendation algorithm like the item similarity computations: cosine-based similarity, correlation-based similarity, adjusted cosine similarity and prediction computations: weighted sum, regression. Finally, results were experimentally obtained and compared with the k-NN approach. The experiment was able to show that item-based algorithms provide a more efficient performance and better quality recommendations than its user-based counterparts.

[6] Presented a comprehensive survey of neighborhood-based methods for item recommendation problem. The major benefits of neighbourhood-based recommender systems and their key characteristics were clearly described. Also, the document addressed the important decisions that must be taken in the course of implementing a recommender system using a neighborhood-based method. The document also gives practical guide on how to carry out such process. Finally, the challenges of sparsity and limited coverage, often observed in large commercial recommender systems were discussed, and a few solutions were provided to overcome these problems.

II. MATERIALS AND METHODS

System architecture or systems architecture is the abstract model that defines the makeup, activities, and more views of a system [7]. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviors of the system. The proposed system architecture is shown below.

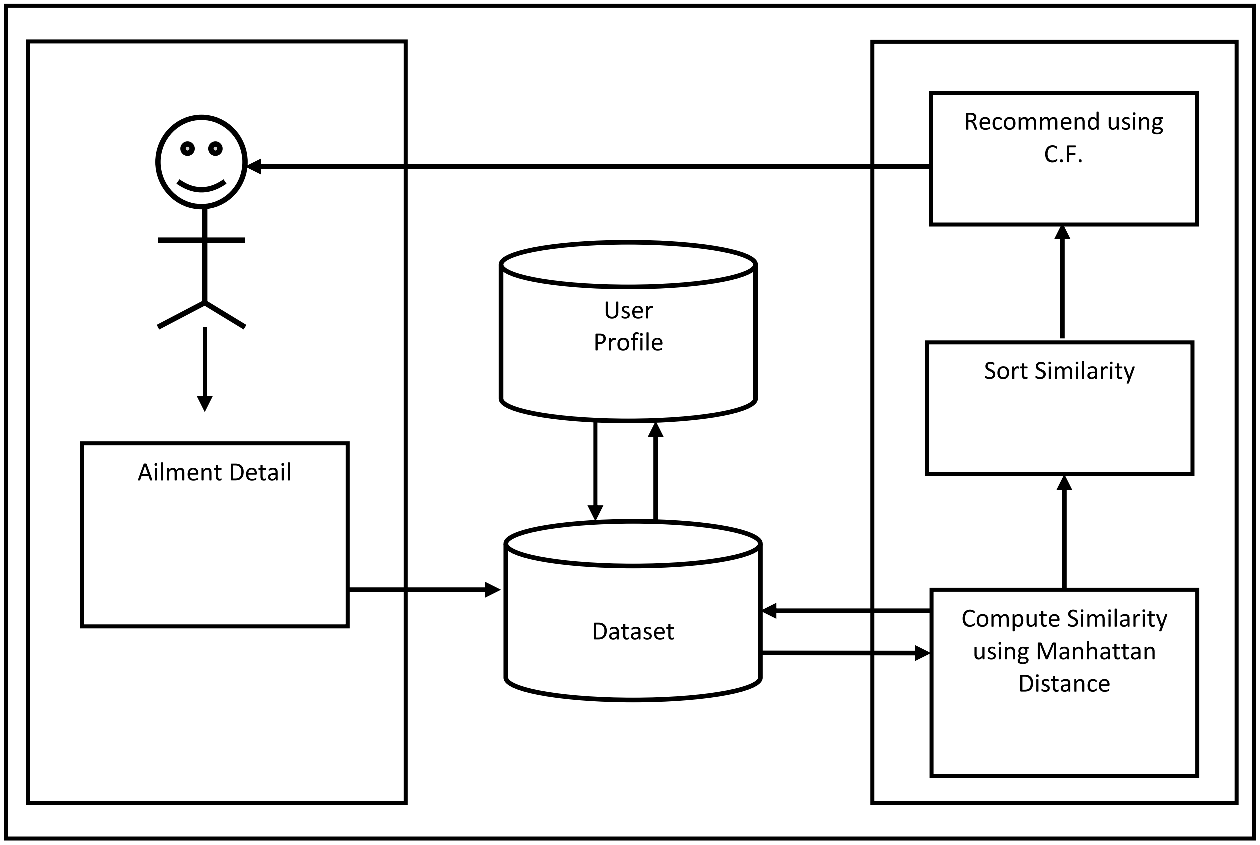

Figure 1: System Architecture

A. Finding Similarity

The first step in recommending is to find someone who is similar. Given the two dimensional (2D) table below, that shows hospitals rated after visitation by different persons on a scale of 1 - 5, we can recommend a hospital to someone else.

Table 1: Finding Similarity

Person 1 (3,4)	★★★☆☆	★★★★☆
Person 2 (2,5)	★★☆☆☆	★★★★★
Person 3 (3,1)	★★★☆☆	★☆☆☆☆
Person 4 (1,4)	★☆☆☆☆	★★★★☆
Person (4,5)	★★★★☆	★★★★★

Using the dataset shown in the table above, we can recommend a hospital for Person X who rated hospital 1 a 3 star and hospital 2 a 2 star. To do this, we can make use of various distance measure. The two most commonly used is the Manhattan distance and the Euclidean distance.

B. Manhattan Distance

This distance measure is the easiest to compute. In the 2D case, each person is represented by an (x, y) point. Manhattan distance is represented as:

$$d = |x_1 - x_2| + |y_1 - y_2| \qquad (1)$$

which is the absolute value of the difference between the x values plus the absolute value of the difference between the y values.

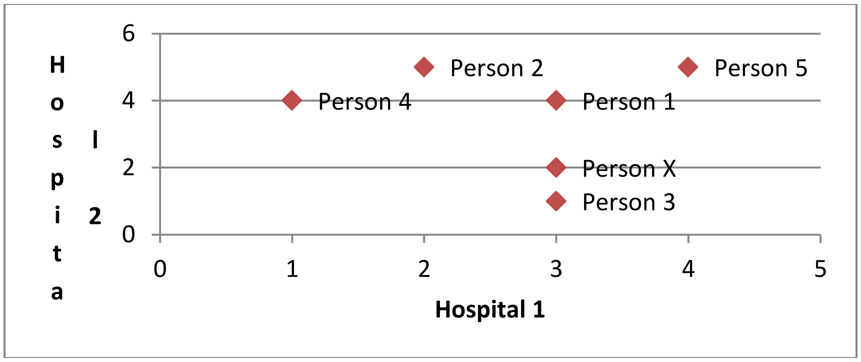

Figure 2: Distance from users

Computing the Manhattan distance between person X and all 5 users gives us:

Person 1:

Distance = $|x_1 - x_2| + |y_1 - y_2|$

Where x_1 represents person 1 rating for hospital 1 and x_2 represents person x rating for hospital 1; y_1 represents person 1 rating for hospital 2 and y_2 represents person x rating for hospital 2.

Distance = $|3 - 3| + |4 - 2|$

$= 0 + 2 = 2$

Person 2:

Distance = $|2 - 3| + |5 - 2|$

$= 1 + 3 = 4$

Person 3:

Distance = $|3 - 3| + |1 - 2|$

$= 0 + 1 = 1$

Person 4:

Distance = $|1 - 3| + |4 - 2|$

$= 2 + 2 = 4$

Person 5:

Distance = $|4 - 3| + |5 - 4|$

$= 1 + 1 = 2$

Table 2: Distance Values from Person X

	Distance from Person X
Person 1	2
Person 2	4
Person 3	1
Person 4	4
Person 5	2

Person 3 is the closest match. The system can look in person 3 history and the recommend all hospitals previously visited by person 3 for person X.

C. Computing Similarity in Multi-dimensional Dataset

In the illustration in section 3.4.2, we made use of a 2 dimensional dataset to show how the system works. In reality, real life systems are complex and do not rely solely on two features alone. There can be as many as one hundred thousand (100000) hospitals contained in the dataset that the users have visited.

In this section, we illustrate how the system handles multi-dimensional dataset and how the recommendation is done. Our system was built using the model illustrated below.

Given the sample dataset below which shows 5 users rating of 5 hospitals visited on a scale of 1 to 5:

Table 3: Multi-Dimensional Dataset

	Hospital 1	Hospital 2	Hospital 3	Hospital 4	Hospital 5
User 1	2 ☆	4 ☆	3 ☆	4 ☆	1 ☆
User 2	3 ☆	2 ☆	2 ☆	5 ☆	4 ☆
User 3	3 ☆	4 ☆	5 ☆	2 ☆	4 ☆
User 4	1 ☆	2 ☆	4 ☆	1 ☆	3 ☆
User 5	2 ☆	4 ☆	1 ☆	1 ☆	4 ☆
User X	4 ☆	3 ☆	1 ☆	2 ☆	4 ☆

To computing Manhattan distance between user X and all 5 users in order to recommend other hospitals for user x, we make use of the formula:

$$distance = \sum_{i=1}^{n} |x_i - x_u| + |y_i - y_u| + \dots + |z_n - z_u| \quad (2)$$

Table 4: Manhattan Distance between User 1 and User X

	Hospital 1	**Hospital 2**	**Hospital 3**	**Hospital 4**	**Hospital 5**	**Distance**
User 1	2	4	3	4	1	
User x	4	3	1	2	4	
Modulus Difference	2	1	2	2	3	10

= |2 - 4| + |4 - 3| + |3 - 1| + |4 - 2| + |1 - 4|
= 2 + 1 + 2 + 2 + 3
= 10

Table 5: Manhattan Distance between User 2 and User X

	Hospital 1	**Hospital 2**	**Hospital 3**	**Hospital 4**	**Hospital 5**	**Distance**
User 2	3	2	2	5	4	
User x	4	3	1	2	4	
Modulus Difference	1	1	1	3	0	6

= |3 - 4| + |2 - 3| + |2 - 1| + |5 - 2| + |4 - 4|
= 1 + 1 + 1 + 3 + 0
= 6

Table 6: Manhattan Distance between User 3 and User X

	Hospital 1	**Hospital 2**	**Hospital 3**	**Hospital 4**	**Hospital 5**	**Distance**
User 3	3	4	5	2	4	
User x	4	3	1	2	4	
Modulus Difference	1	1	4	0	0	6

Table 7: Manhattan Distance between User 4 and User X

	Hospital 1	**Hospital 2**	**Hospital 3**	**Hospital 4**	**Hospital 5**	**Distance**
User 4	1	2	4	1	3	
User x	4	3	1	2	4	
Modulus Difference	3	1	3	1	1	9

Table 8: Manhattan Distance between User 5 and User X

	Hospital 1	**Hospital 2**	**Hospital 3**	**Hospital 4**	**Hospital 5**	**Distance**
User 5	2	4	1	1	4	
User x	4	3	1	2	4	
Modulus Difference	2	1	0	1	0	4

III. SUMMARY

In this project, we have developed a system that recommends Hospital to Patient using collaborative filtering algorithm. For simplicity, we developed a graphical user interface to make the system easy to use. The database is created and administered using MySql Server, with Php as an interfacing language between the database server and the web Server.

IV. CONCLUSION

This Hospital-Patient Recommender system has emerged as an exciting and efficient way to meet potential hospitals and create confidentiality among users(patients). This system gives users (patient) a more flexible way to get to know the best hospital that can handle their case based on similarity with other patients that the hospital have treat in the past. We see that recommender systems are not only for to item-item recommendation but has applications in people-people recommendation as demonstrated in our work.

V. RECOMMENDATION

We recommend that an hybrid system be built that can make recommendation not only using the nearest neighbor approach but that can also recommend based on other criteria's like the number of specialist that the hospital have and their experiences and expertise. If this is done, the system can be more reliable and efficient.

VI. REFERENCES

[1] Uko E. O., Eke B.O., Asagba P.O. (2018). An Improved Online Book Recommender System using Collaborative Filtering Algorithm. International Journal of Computer Applications (0975 – 8887) 179(46).

[2] Melville, P., Mooney, R. J., and Nagarajan, R. (2002). Content-boosted collaborative filtering for improved recommendations. In Proceedings of the eighteenth national conference on artificial intelligence (AAAI-02), Edmonton, Alberta, 187-192.

[3] Su, X., and Khoshgoftaar T. M. (2009). A survey of collaborative filtering techniques. Advances in artificial intelligence. Hindawi publishing corporation. 1-19.

[4] Lin W. (2002), "Efficient Adaptive-Support Association Rule Mining for Recommender Systems," 83–105.

[5] Sarwar, B., Karypis, G., Konstan, J., and Reidi, J. (2001). Item-based collaborative filtering algorithms. GroupLens research group, Army HPC research center, University of Minnesota, Minneapolis, 1-11.

[6] Desrosier, C., and Karypis, G. (2012). A comprehensive survey of neighbourhood-based recommendation methods. Department of Computer Science and Engineering. University of Minnesota, Mineapolis, USA. 5-33.

[7] Jaakkola, H., & Thalheim, B. (2011). Architecture-Driven Modelling Methodologies. Conference on Information Modelling and Knowledge Bases XXII (p. 98). IOS Press.

[8] Sanjaikanth E Vadakkethil Somanathan Pillai. (2021). Balancing Precision and Privacy: Harnessing Location-Based Services in Healthcare Delivery. International Journal on Recent and Innovation Trends in Computing and Communication, 9(12), 50–56. Retrieved from https://www.ijritcc.org/index.php/ijritcc/article/view/10963

[9] S. E. V. S. Pillai, A. A. ElSaid and W. -C. Hu, "A Self-Reconfigurable System for Mobile Health Text Misinformation Detection," 2022 IEEE International Conference on Electro Information Technology (eIT), Mankato, MN, USA, 2022, pp. 242-247, doi: 10.1109/eIT53891.2022.9813840

[10] Aparna Bhat, "Comparison of Clustering Algorithms and Clustering Protocols in Heterogeneous Wireless Sensor Networks: A Survey," 2014 INTERNATIONAL JOURNAL OF SCIENTIFIC PROGRESS AND RESEARCH (IJSPR)-ISSN : 2349-4689 Volume 04- NO.1, 2014. [Link]

[11] Kalla, Dinesh, Nathan Smith, Fnu Samaah, and Kiran Polimetla. "Enhancing Early Diagnosis: Machine Learning Applications in Diabetes Prediction." Journal of Artificial Intelligence & Cloud Computing. SRC/JAICC-205. DOI: doi. org/10.47363/JAICC/2022 (1) 191 (2022): 2-7

[12] Aparna K Bhat, Rajeshwari Hegde, 2014. "Comprehensive Analysis of Acoustic Echo Cancellation Algorithms on DSP Processor", International Journal of Advance Computational Engineering and Networking (IJACEN), volume 2, Issue 9, pp.6-11. [Link]

[13] Ayyalasomayajula, Madan Mohan Tito, et al. "Proactive Scaling Strategies for Cost-Efficient Hyperparameter Optimization in Cloud-Based Machine Learning Models: A Comprehensive Review." ESP Journal of Engineering & Technology Advancements (ESP JETA) 1.2 (2021): 42-56.

[14] Naga Ramesh Palakurti, 2022. "AI Applications in Food Safety and Quality Control" ESP Journal of Engineering & Technology Advancements 2(3): 48-61.

[15] Ayyalasomayajula, Madan Mohan Tito, Srikrishna Ayyalasomayajula, and Sailaja Ayyalasomayajula. "Efficient Dental X-Ray Bone Loss Classification: Ensemble Learning With Fine-Tuned VIT-G/14 And Coatnet-7 For Detecting Localized Vs. Generalized Depleted Alveolar Bone." Educational Administration: Theory and Practice 28.02 (2022).

[16] Chanthati, Sasibhushan Rao. (2022*). A Centralized Approach To Reducing Burnouts In The It Industry Using Work Pattern Monitoring Using Artificial Intelligence.* International Journal on Soft Computing Artificial Intelligence and Applications. Sasibhushan Rao Chanthati. Volume-10, Issue-1, PP 64-69.[LINK]