

# Healthcare Recommendation System

Urvashi Rahul Saxena<sup>1</sup>, Sanyuktaa Bajoria<sup>2</sup>, Sayinah Ali<sup>3</sup>, Ujjwal Tyagi<sup>4</sup>, Varnika Choudhary<sup>5</sup>

<sup>1</sup> Department of Computer Science and Engineering,  
JSS Academy of Technical Education, Noida, Uttar Pradesh, India.

<sup>2</sup> Department of Computer Science and Engineering,  
JSS Academy of Technical Education, Noida, Uttar Pradesh, India.

<sup>3</sup> Department of Computer Science and Engineering,  
JSS Academy of Technical Education, Noida, Uttar Pradesh, India.

<sup>4</sup> Department of Computer Science and Engineering,  
JSS Academy of Technical Education, Noida, Uttar Pradesh, India.

<sup>5</sup> Department of Computer Science and Engineering,  
JSS Academy of Technical Education, Noida, Uttar Pradesh, India.

**Abstract:** In this world of advancements, the internet has proven to be a necessity in every household. Now people prefer everything online rather than physically going. And hence people have started referring to online recommender systems for any kind of consultation. As the usage is increasing, so is the need for more advanced recommender systems with more features. An HRS\* basically analyzes a data set and using different machine learning algorithms it provides a personalized plan based on preferences. It predicts the disease by analyzing the users' lifestyle, health records and their daily activities using human expertise with computer efficiency. In this paper we will focus on the literature review of the proposed project. The main objective of the proposed Health Recommendation System is to provide a secure and a reliable platform for the user to consult a professional, and get personalized nutrition advice with a customized workout plan. This is an approach that represents a comparative analysis of various researches done in this domain.

**Keywords:** following are the abbreviations:

- 1- HRS: Healthcare Recommendation System
- 2- RS: Rapid Separation
- 3-BPS: Blockchain Privacy System
- 4- ID3: Iterative Dichotomiser 3
- 5- SCEO: Sequential Complex Estimation Optimization

## 1. Introduction

Health recommender systems are designed in a unique way which suggests the user different diet plans or a routine which they should follow. It is a subclass of information filtering system which advocates users to the items which are most fit according to their profile. While people browse on the internet for various contents such as a YouTube video, this would recommend the users related information and provide the links for the video [1]. These systems are advantageous for everyone even in hospitals or individuals. In the past years there has been an increase in the adoption of these recommender systems. Even in crucial times such as COVID-19 outbreak, recommender systems have proven to be the best device to revamp a patient [2]. These systems first analyze the health record of the patient. It then provides patients with the best solutions with the correct information according to their preference.

A survey on recommender system researched on different methods of RS\* i.e. Collaborative filtering, Content-based, demographic-based, utility bases, Knowledge-based and hybrid-based [3]. These systems have helped the medical industry with a number of advancements and recommendations at the time of emergency. In due course of time various Health Recommender Systems have been proposed using Machine Learning algorithms and this study aims to show the strength, weakness, opportunities and threat analysis. This recommender system uses the Machine Learning Algorithms i.e. Naive Bayes Classifier and Logistic Regression combined with the Web Development tools.

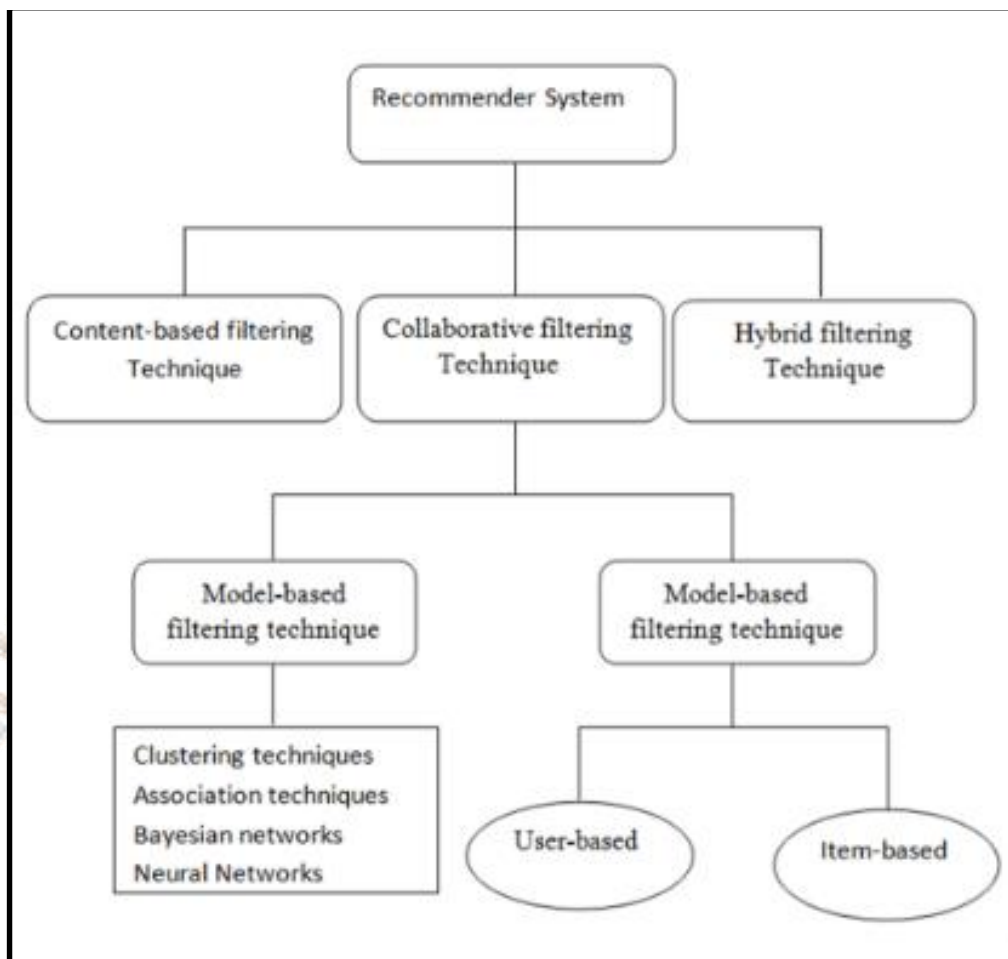


Figure 1: Types of Recommender Systems

In a study [4] authors provide a model based on deep learning algorithms which analyzes a data set, detects the dietary habits of the person and recommends the most appropriate food plan. Naive bayes classifiers combined with collaborative filtering provides the best algorithm to operate a recommender system. It helps to filter the data set and information to provide the best and the closest approach. Using naive bayes utilizes less training data and provides faster results. Additionally, using logistic regression can be used to analyze the future aspects and any other effects that can possibly affect an individual.

Hence, in the upcoming sections we will discuss a survey which allows us to provide a more compatible model for the users. Section 2 confers to the literature survey done on the related domain in the past, Section 3 represents a critical analysis based on the survey. Section 4 examines the conclusion and section 5 administers the future scope of this model. No academic titles or descriptions of academic positions should be included in the addresses.

The affiliations should consist of the author’s institution, town/city, and country.

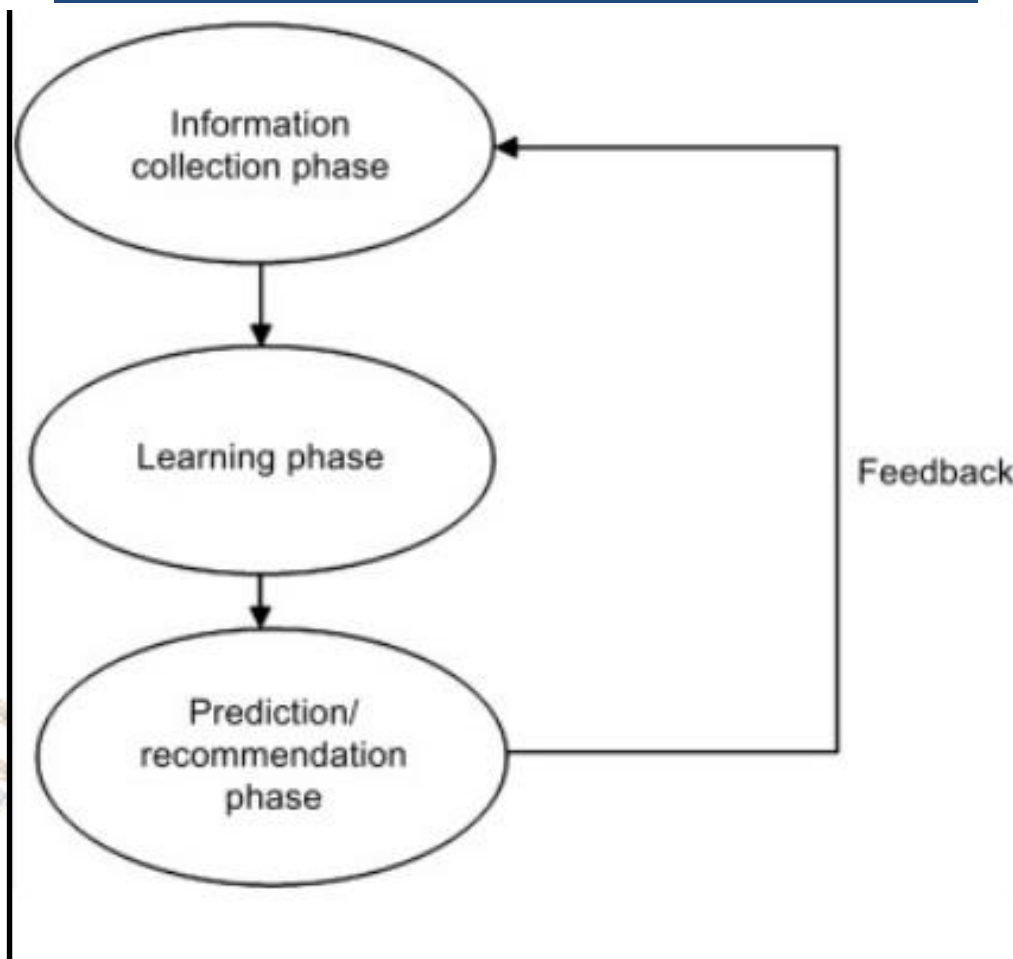


Figure 2: Mechanism of HRS

## 2. Literature Survey

Health recommendation systems are well known and popular amongst this generation and is a new field of research, the database research signifies that recent studies were showcased in seminars rather than just the specialist journals. Numerous papers on this field can be found in the above-mentioned platforms [5], thus this is a literature survey consisting of the latest information and high-quality studies while covering publications.

This survey is divided into healthcare recommendation systems from other existing models, analysis of data based on restricted features (such as only dietary recommendation/food), and security provided to the data of users.

In paper [6], we inspect how the recommendation system is used in applications of health. We have the following sections giving information about: Basics of "healthcare recommendation system" with an integrated system architecture; overview of 3 features which are diet plans, physical fitness, consultancy; requirements that will be met for good quality recommendation; express our evaluation access.

The services provided in paper [7] related to recommendation are non-confidential, and accepted medical particulars. It stated that the study was highly applicable to the medical development of the user. However, it was only restricted to the medicinal council and assistance, which was not very profitable for the users utilizing the healthcare recommendation systems. This system can be presumed to be filled with few entries- else it vanquishes its purpose. Hence the new user troubles are less critical than this existing system.

The health of a person depends on various criteria however, machine learning was used with an accuracy of 71%. Drawing out information based on a person's fasting method, gender, age and sending recommendation requests while conducting a pathological test on demographic data stored in the database.

Data was processed using an alternate of any colony approach with a graph of food to lead the optimal food set for the users. This corresponds with what specialists have stated concerning people wanting to improve their health.

In [8] paper, a review of the already known smart-food for people's health is presented. As per the paper's review, it has been examined that the Ant colony approach is a constructive and population based-approach which depends on the social behavior of ants. However, this approach is only good for analyzing the data and recommending the appropriate food to the user with no other benefits. In spite of that, there were cases where machine learning algorithms failed to withdraw a few implicit features of the user's data.

Research based on paper [9] states a recommendation strategy of food for the users in a care facility is suggested. The papers are generated on the basis of three information sources such as different ratings for menu items, feedback on the basis of the user's eating habit and the quantity consumed.

The inadequate and inappropriate intake of food can cause various health issues. This research is also concerned with detecting irregularities and focusing on the construction of a plan based on all the factors for users in need. However, a health problem is not the only factor causing disparity in the mass food that the user consumes. Significant variations might be caused by external conditions such as the temperature of the environment.

In accordance with paper [10], it is presented with a few primary investigations through a recipe recommender. It aims on educating and encouraging the users, which put together customized recommendations of well recipes. It focuses on two of the initial features such as food recommendation, they are data seizing and recipes of food and represents the study through various recommendation algorithms.

Assistance provided by the study [11] was related to showcasing the prototype of a customized advice recipe system, that allows the user to make choices about the health-aware meal based on previous selection. To restore the adaption of a healthier way of living, with customized recipe propositions applied by a goal setting technique.

Some studies provide information associated with food recommendations for patients in a nursing home. Study [12] is based on the same where many of the sufferers are incapable of expressing their own predilections, this system can aid the nurse in the choice of items in the menu that is similar to the patient's choice. Moreover, tracking the quantity of food that was consumed by every user can give awareness into an optimal amount of every food item selected and served to the user as well as locate unevenness in the eating habits of the user which could be the cause of ailment.

According to [13], the paper insists on the pioneering research to evolve a more ability to understand the dietary system for recommendation for a diabetic forbearer that incorporates main meals too. People primarily found the system functional and were content with the system. This application helped the diabetic users to improve their lifestyle by consuming more and more healthy diet plans.

Aim of different studies also infers to represent the latest models or plans about nutrition for juveniles and grownups, the analysis [14] based on nutrition was held amongst the nutritional factors as well as the status of the respective age groups on the basis of database/literature from 2005 to 2010. This study consists of shielded nutrition which should be merged with obesity avoidance, inclusive of prevalence of meals, and options of by-product in our daily dietary plans. The deployed secure nutritional system for these individuals ought not only to be favored but also the effectiveness needs to be increased by modifying different beneficiary groups.

Adequate diet full of nutrition is essential in the early ages of an individual for an appropriate growth of the body and creation of organs, as well as to have cognitive and neurological evolution and a well-built immune system. This paper was proven in [15] where malnutrition is one of the obtuse reasons in India by which youngsters are facing illness, this is generally caused because the mothers lack knowledge related to nutrition that needs to be fed to their children. To resolve this issue a dietary management system was introduced with the help of ID3\*. (java/weka tools)

In consonance with [16], several recommendation systems developments do not assure the best privacy of data provided by the users, hence to deal with this problem this paper comprises a BPS\* within the deep learning for the recommender system for users in need. This study allows the user to receive a notification and medications on the basis of their customized data without disclosing the confidential data. This task is divided into two sub-categories which are secured communication and enhanced deep learning methodologies using medical dataset.

Few studies are concerned regarding the unfit individuals due to the workload and skyrocketing competition within the adolescence, as they don't prioritize fitness in their life. as reported in [17] descriptive research was carried out to conclude the understanding of patterns based on physical works amongst the youth. It was observed that females performed relatively easier exercises than males, another observation was based on the age difference, that is the older ones had less physical fitness as compared to the younger ones. The middle-aged people were observed to have a busy schedule and hence focusing extremely less on their health and fitness. Therefore. this model was built to generate skills in individuals about the significance of physical fitness.

The author [18] suggested that the privacy and security of the physical layer has very many issues consisting of IoT, if the information needed is unavailable then it might get difficult to optimize the various features. Hence, the SCEO\* algorithm is used to alleviate the challenges as well as improve the privacy of users. It can be inferred that the algorithm can be remarkably executed with minimum complexity as compared with non-optimal features. Moreover, the rate constraints are used together with

self-interference of the full-duplex transferal at the receiving node which further helps in performing the techniques more reliably and comfortably when compared to older studies.

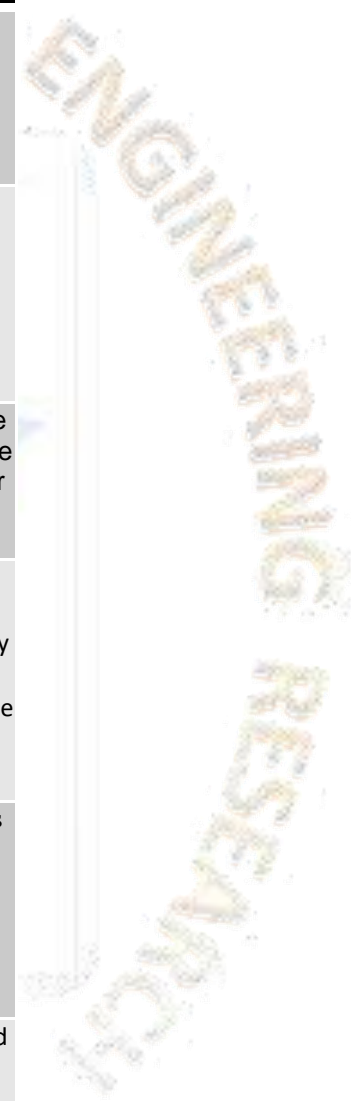
### 3. SWOT Analysis

SWOT analysis is a framework that works on the recognition and analyzing of the strength, weakness, opportunities and threats of a corporation.

The below table demonstrates the analysis of the various models or projects we have worked on in the above report.

Table-1: SWOT Analysis

| Previous Work  | Objective of Previous Work   | Used Methods   | Accuracy of Result   |
|--|--|--|--|
| Health Recommender Systems and its Technical basis and Challenges. | Inspect how the recommendation system is used in applications of health.   | Bibliographic review method, collaborative filtering, clustering, decision tree, logistic regression, NLP. | The comparison of the result set shows that HRS provides more pertinent results.   |
| Food recommendation system based on age group                      | Sort out food by the user itself or helped by the caretaker to find a menu or set out the nutrients that they would wish to consume. | CRISP-DM, K-mean clustering, Visual <a href="#">basic.NET</a> , Microsoft SQL Server 2012, WEka 3.8.       | Machine learning was used with an accuracy of 71% based on the user's age, gender and eating habits.   |
| Menu recommendation system utilizing smart plates                  | Know which food youngsters' favour and recognise the nutritional deficiency in the respective meals.                                 | RFID, Weight Arduino, Raspberry pi, BMR, Clustering.   | While measuring the weight and plate size gives a relative error of 10%.   |
| Smart Food Recommendation System                                   | Lay out assistance for the diet of people suffering from ordinary illness  | Ant colony optimization, optimal food set, cloud infrastructure.   | It was seen that the concurrency time of cloud execution nearly dipped to 12 times in comparison with single node execution.   |
| Personalized recipe recommendation                                 | Educate and assist user indulgence making tailored recommendation of recipes   | Vector transformation, spearman rank correlation analysis.   | Evaluated on the basis of rating of users for the recipe of approximately 20% coverage and 81.57% FFbCf produced.  |
| Customized recipe advice system for healthful choice               | To restore the adaptation of a healthier way of living, with customized recipe propositions.   | Food database, food image API, adaptive visual interface, elicitation framework                            | Contrast the proposed Label propagation, Exponentiated Gradient, algorithm to Online Perceptron, and for selection of image method, comparison of the proposed Exploration-Exploitation algorithm to the Random Selection. |



| Previous Work   | Objective of Previous Work  | Used Methods  | Accuracy of Result   |
|---|---|---|--|
| Food Recommendation for care facility patients        | Track the cause of sickness and provide a food menu to the patient based on their previous diet and other factors.                              | Meta-Analyses extension, PRISMA-ScR, full text screening, IEEE, collaborative approach, reinforcement learning approach, hybrid approach. | 59 of 63 papers reported execution of HRSs, where two kinds of system evaluation functions were applied. Model evaluation involved users: where there were 22 studies that recruited the end users of the systems and tested the feasibility of the HRSs |
| Application for diabetic patients                     | Evolve an all-inclusive diet recommendation model for diabetics inclusive of meals too.   | BMR calculator k-mean clustering algorithm, decision tree classifier,   | K-means acquired is 93%, decision tree classifier had performed accuracy of about 87.9%, DBSCAN had it till 60% and BIRCH for about 52%.   |
| Safe nutrition for youngsters and adolescents         | Represent current nutritional systems for youngsters as well as adults based on research on prevention of obese.                                | Decision tree classifier, logistic regression, searching PubMed and Cochrane library  | The continuing growing levels of obesity among adults skyrocketed by 21% in the 10 years and by 138% later; and for overweight by 8% in the 10 years and by 51%.   |
| Dietary management system using ID3                   | Build a decision tree up until a suitable classification selects an adequate food item on the basis of food accessibility.                      | BMR calculator, visualization, decision tree classifier, food analysis.   | The decision tree learning algorithm ID3 does Competently good on any classification issues with discrete values of dataset.   |
| Blockchain -Secured Recommender System for user       | Make sure that the backend tasks of machine learning models are achieved with the help of arithmetic values before the execution.               | Machine learning, deep learning: RNN, logistic regression, MLP, on IoMT.  | Training and cross affirmation score were the same at 87.2%, however later the training score rose up to 93.7%   |
| Research on physical undertaking and fitness patterns | Lay out the data of colleges about the students of universities so that the actions can be taken appropriately.                                 | Logistic regression, k-means clustering   | Population ratio of how they think physical activity can be beneficial is: mental wellbeing-73.77%, activeness- 74.75%, improves every aspect-54.91%.  |
| Realizing efficient security by IoT                   | Attain the security features for IoT functions on the basis of WSNs by suggesting data gathering tools like SEEDGT and secure with fair energy. | Encoder, wireless channel, decoder, single antenna three node   | The sequential convex estimation optimization algorithm can help attain a more optimal outcome and intensify convergence.  |

ENGINEERING RESEARCH

#### 4. Conclusion

SWOT (strengths, weaknesses, opportunities, and threats) analysis is a framework used to assess the worth of a company's position and to prosper strategic planning. It is designed to facilitate a realistic, factual, data-driven look at the stability and weaknesses of a group within its industry.

Strengths refers to the prominence of a company in marketplace, specialty in the HRM consultancy at partner level, Strengths also describe the excellence of organization at what level ... and which factor isolates it from the competition: a well-built brand, genuine and loyal customer base, a sturdy balance sheet, distinctive technology.

Weakness refers to the lack of consultants at the directing level instead of partner level, also not able to deal with multifaceted tasks because of its lack of ability and size, at optimum level this factor prevents an organization from executing well. Businesses need to improve in some of the areas to remain competitive: lack of capital, high levels of debt, higher-than-average turnover, a weak brand or an inadequate supply chain.

Opportunities describe an entrenched position with a well-defined market niche and the market for consultancy in some areas other than HRM are identified, Opportunities also describe the external points that give an organization different benefit.

Threats refers to big companies which provide consultancy services operating at a minor level and small companies looking to occupy the marketplace. Threats refer to components that have the potential to harm companies. Some common threats encompass rising budgets for materials, tight labor supply, increasing competition.

In this work, we confer you a personalized healthcare diet plan and physical fitness recommendation system. The main purpose of this system is to help users to find out the personalized healthy diet and workout plans with the additional consultancy feature, through which users can get any fitness related consultancy, thus avoiding the disease caused by unhealthy eating habits and helps to revamp your posture include regular exercise and stretching and paying attention to the way your body feels. The deep model we proposed is proven to have promising performance in the actual interactions with users. In addition, the demonstration system has an artistic user interface and provides a good user experience. A survey on recommender system researched on different methods of RS i.e., Collaborative filtering, Content-based, demographic-based, utility bases, Knowledge-based and hybrid-based. Although these pre-trained models have the potential to solve most of the limitations posed by the previous methods, there are still some open Issues that need to be addressed.

#### 5. Future Scope

In future scope we propose HRS which will be focusing on all these issues. In existing HRS are client data, integrity issues were encountered. Developing trust and assurance is one of the preeminent criteria and that should be considered when evaluating recommender systems. It can be a tough task to convince patients to follow health-related recommendations through online methods. This aspect can be magnified by providing explanations for recommendations.

Swot analysis is a framework used to assess the worth of a company's position and to prosper strategic planning. It is designed to facilitate a realistic, factual, data-driven look at the stability and weaknesses of a group within its industry.

To ensure secure recommendation to users, in future this project could model potential attacks and investigate the impacts of such attacks on recommendation algorithms. We shall also incorporate the concept of multidimensionality in the secured diet recommender systems, where patients with special needs will maintain privacy after the whole process.

We envision to provide the facility of augmented reality and virtual reality enabling the way of doing workouts by delivering real-life immersive experiences to make exercising more fun, engaging and effective for the user.

## References

- [1] Carlos, Luis, Sanchez, Bocanegra., José, Luis, Sevillano, Ramos., Carlos, Rizo., Anton, Civet., Luis, Fernandez-Luque. "HealthRecSys: A semantic content-based recommender system to complement health videos." *BMC Medical Informatics and Decision Making*, 17 (2017):63-63. doi: 10.1186/S12911-017-0431-7
- [2] Zan, Huang., Wingyan, Chung., Thian-Huat, Ong., Hsinchun, Chen. "A graph-based recommender system for digital libraries." *null* (2002):65-73. doi: 10.1145/544220.544231
- [3] Zeshan, Fayyaz., Mahsa, Ebrahimian., Dina, Nawara., Ahmed, Ibrahim., Rasha, Kashef. "Recommendation Systems: Algorithms, Challenges, Metrics, and Business Opportunities." *Applied Sciences*, 10 (2020):7748-. doi: 10.3390/APP10217748
- [4] Samuel, Manoharan., Sathish. "Patient Diet Recommendation System Using K Clique and Deep Learning Classifiers." 2 (2020):121-130. doi: 10.36548/JAICN.2020.2.005
- [5] Thi Ngoc Trang Tran, Alexander Felfering, Christoph Trattner, Andreas Holzinger, "Recommender systems in Healthcare domains", August 2021, [https://www.researchgate.net/publication/347443039\\_Recommender\\_systems\\_in\\_the\\_healthcare\\_domain\\_state-of-the-art\\_and\\_research\\_issues](https://www.researchgate.net/publication/347443039_Recommender_systems_in_the_healthcare_domain_state-of-the-art_and_research_issues)
- [6] Martin Weisner, Daniel Pfeifer, Health Recommender Systems and it's Technical basis and Challenges , 2014 march 03, <https://www.mdpi.com/1660-4601/11/3/2580>
- [7] Supaporn Bundasak, Prasopchok Yoksuriyan, Patipan Kuntawee, Rahat Kotama, "", January, 2021, [https://www.researchgate.net/publication/352888368\\_Food\\_recommendation\\_system\\_for\\_the\\_elderly](https://www.researchgate.net/publication/352888368_Food_recommendation_system_for_the_elderly)
- [8] Kwon Namgung, Tae-Hwan Kim, Youn-Sik Hong, Shah Nazir, "Menu recommendation system utilizing smart plates", November 14, 2019, <https://www.hindawi.com/journals/wcmc/2019/7971381/>
- [9] Faisal Rehman, Osman Khalid, Nuhman Haq, Atta ur Rehman Khan, Smart Food Recommendation System, June 2017, <http://www.koreascience.kr/article/JAKO201721948859736.pdf>
- [10] Mansura A.Khan, Ellen Rushé, Barry Smyth, David Coylè, "Personalized recipe recommendation", 31 July, 2019, <https://arxiv.org/pdf/1908.00148.pdf>
- [11] Longai Yang, Cheng-Kang Hsieh, Nicola Dell, Curtis Cole, "Customized recipe advice system for healthful choice", July, 2017, <http://www.cs.cornell.edu/~ylongqi/paper/YangYumme.pdf>
- [12] Yao Cai, Fei Yu, Manish Kumar, Roderick Gladney, "Food Recommendation for care facility patient", November, 2022, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9690602/>
- [13] Vandana Chanchali, Jayesh Parsnani, Jai Mulani, Prof.Pooja Shetty, "Application for diabetic patients", July 24, 2021, [https://www.ijera.com/special\\_issue/ICAITR-2101/3,%2010-15.pdf](https://www.ijera.com/special_issue/ICAITR-2101/3,%2010-15.pdf)
- [14] Elena Fornari, Marco Brusati, Claudio Maffei, "Safe nutrition for youngsters and adolescents", June 11, 2021, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8227398/>
- [15] Ashvini Kale, Nisha Auti, "Dietary management system using ID3", jUNE, 2015, [https://www.researchgate.net/publication/276152026\\_Automated\\_Menu\\_Planning\\_Algorithm\\_for\\_Children\\_Food\\_Recommendation\\_by\\_Dietary\\_Management\\_System\\_using\\_ID3\\_for\\_Indian\\_Food\\_Databa\\_se](https://www.researchgate.net/publication/276152026_Automated_Menu_Planning_Algorithm_for_Children_Food_Recommendation_by_Dietary_Management_System_using_ID3_for_Indian_Food_Databa_se)
- [16] Eric Appiah Mantey, Conghua Zhou, Joseph Henry Anajemba, Izuchukwu M.Okalaoguchi, Onyeachonam Dominic-Mario, "Blockchain -Secured Recommender System for user", September 20, 2021, <https://www.frontiersin.org/articles/10.3389/fpubh.2021.737269/full>
- [17] Salonee Jambusaria, Sara Berry, Shivam Bhadra, Shrutika Sanghvi, "Research on physical undertaking and fitness patterns", July, 2020, <https://www.ijariit.com/manuscripts/v6i3/V6I3-1465.pdf>
- [18] Joseph Henry Anajemba, Yue Tang, Celestine Iwendi, Akpesiri Ohwoekwwo, Gautam Srivastava, Ohyun Jo, "Realizing efficient security by IoT", May 3, 2020, <https://www.mdpi.com/1424-8220/20/9/2609>