

An Enhanced Hybridized Model for Recommender System in Healthcare

Ejiofor C.I., Ruth Ofoh

Department of Computer Sciences, University of Port Harcourt, Choba, Nigeria.

Abstract

One of the concerns patients have when confronted with a medical condition is which physician to trust. There are several people in need of healthcare all over the world that does not know who to call and where to go. Patients in different hospitals had sorted for specialist Doctors in wrong places and hospitals. This has cost several patients a waste of time, money, and even lost of life. The involvement of modern technology is necessary to guide people to find a Specialist with whom they can build confidence and reliable relationships leading to a good healthcare system in Nigeria. The purpose of this project is to develop a Doctors-to-Patients Recommender system using a Content-based filtering and Success credibility score model. Object-Oriented Analysis and Design Methodology was used and was implemented with PHP programming language with the Apache web server to manage the Database developed using MySQL. The system was able to give credible and accurate recommendations.

Keywords: Matchmaking, Credibility

1. INTRODUCTION

The ability to meet with the right people in life can give a speedy solution to every problem. Healthcare system in Nigeria lacks systems for matching and making recommendation between Patient and various care providers such as Audiologist, Allergist, Anesthesiologist, Cardiologist, Dentist, Dermatologist, Endocrinologist, Epidemiologist, Gynecologist, Immunologist, Infectious Disease Specialist, Internal Medicine Specialist, Medical Geneticist, Microbiologist, Neonatologist, Neurologist, Neurosurgeon and others.

Matchmaking is the process of matching a patient and a Specialist doctor by a matchmaker Adachi (2003) defined it as the process of searching the space of possible matches between demand and supplies. For the purpose of this work, we look at matchmaking in the area of Healthcare in Nigeria.

Patients in different hospitals in Nigeria have sort for doctors and specialist in wrong places and hospitals. And this has cost several patients a waste of time, money, and even lost of life in the process of searching for specialist. The involvement of modern technology is necessary to guide people to find a

Specialist with whom they can build a confidence and reliable relationships leading to a good healthcare system in Nigeria.

2. LITERATURE REVIEW

Mo et al (2013) proposed a filtering method to match heterosexual users in online matchmaking which can be represented as an $N \times M$ contact matrix. A node is a user, also an edge in the network for socializing will always links a female and a male user. A row in the matrix signifies a service users' actions in initiating contacts and can reflect his/her desires. The model describes a way of matchmaking which matches users based on initial contact only creating a scenario of matches where both user preference are not considered.

Chung-Wei Yeh (2015). From the study of his work, achieved a rule-based technology academic electronic-advising services that is modified to offer every one person that is learning for recommending courses for the college students in the place called Taiwan. As academic counseling for receiving courses is frequently done by counselors to help students to get educational, profession, as well as individual goals, that has brought about significance in the higher learning system. For him to increase the counseling efficiency for counselors to help students to have a right choice into their specialized area and get better on their educational knowledge, he proposed the application system and called it a Course-Recommendation-Intelligent-System. The system consist of six tasks: academic profile outlook, academic interest investigation, career as well as syllabus matchmaking, suggest-courses investigation, department-suggested investigation and record assessment. The research offers the answer into three level; data level, processing level and solution level, using four steps: the first is database design and data transfer, the second is student profile analysis, the third is a customized academic advising generation and the fourth is answer analysis. The test result displays that those college students ascertain that it was of help to their adjustment to the university and it improved their achievement at the university.

3. MATERIALS AND METHODS

We are concerned with Patient-to-Doctors matching to enhance a reliable Healthcare system in Nigeria.

We shall develop a content-based and a success credibility score model to implement it

3.1 Analysis of the System

The proposed system aims at creating matches based on Content-based Filtering and the Credibility Score Algorithm. The Content-based Filtering recommends Doctors from an assessment of the content of their profile. In our proposed system, Credibility Score is a good algorithm to use. It is fast, easy and performs pretty well.

Using the two recommenders, we derive algorithms which perform the matches. The algorithm is applied after the Doctors have registered, based on their area of specialization (match criteria). The users (Patients) will specify their ailment and the system will filter the corresponding Doctors specialist in that area (this will be done by content-based filtering), and secondly the system will do a recommendation of the best Doctors from the list displayed (this will be done by the Credibility Score recommender). Thus the system aids the users (Patients) in getting the right Doctor for the treatment of their ailment

3.2 Content-based Model

In our proposed model, the content-based algorithm is used to filter all registered Specialist Doctors.

Steps in Content-based Filtering Algorithm

Step1: Set $D (D_1, D_2, \dots, D_n) =$ Doctors

$P (P_1, P_2, \dots, P_n) =$ Patients

Step2: For every $P (P_1, P_2, \dots, P_n)$ interested in $D (D_1, D_2, \dots, D_n)$ make a contact

$C, c_{dp} = 0$ when there is no match

$C, c_{dp} = 1$ when there is a match

Step 3: Record contact in $D \times P$ matrix for all D 's (M_1, M_2, \dots, M_n)

Step 4: Record total contact details

Step 5: Match all D 's with their contact.

Step 6: End Match.

From the algorithm in step 1, we define the system users, which in this case are Doctors(D) and Patients(P). Unlike other recommender systems which may be items. This content based algorithm ensures all Patients (P) make contact with all Doctors (D) and records all the contacts in a matrix table represented in figure 3.4

	P1	P2	P3	P4	P5	P6	.	.	Pn
D1	1	0	0	1	0	1	.	.	.
D2	0	1	0	0	1	0	.	.	.
D3	1	1	0	0	0	0	.	.	.
D4	1	0	0	0	1	0	.	.	.

Figure 3.4: P x D contact Matrix

Where : D_1, D_2, \dots, D_n = Doctors
 P_1, P_2, \dots, P_n = Patients
 0 = no match
 1 = match

3.3 Success Credibility Score Model

We formulated this algorithm to determine the credibility of each Doctor, base on their years of Experience and the number of successful cases handled. This will determine the level of the Doctors recommendation. The higher the credibility score, the higher the recommendation.

In this model, the formula to calculate the Credibility score is:

$$SCS = \left(\frac{NSCH}{TNCH} * \frac{100}{1} \right) * \left(\frac{1}{YE} \right) \dots\dots\dots \text{equation 1}$$

Where:

SCS = the Credibility Score

NSCH = the number of successful cases handled

TNCH = Total number of cases handled

YE = Years of Experience

Note:

YE > 0 Years of experience must be greater than zero thus

NSCH > 0 The number of successful cases handled must be greater than zero

3.4 Architectural design of the proposed system

The architectural design of the proposed system is illustrated in figure 3.1

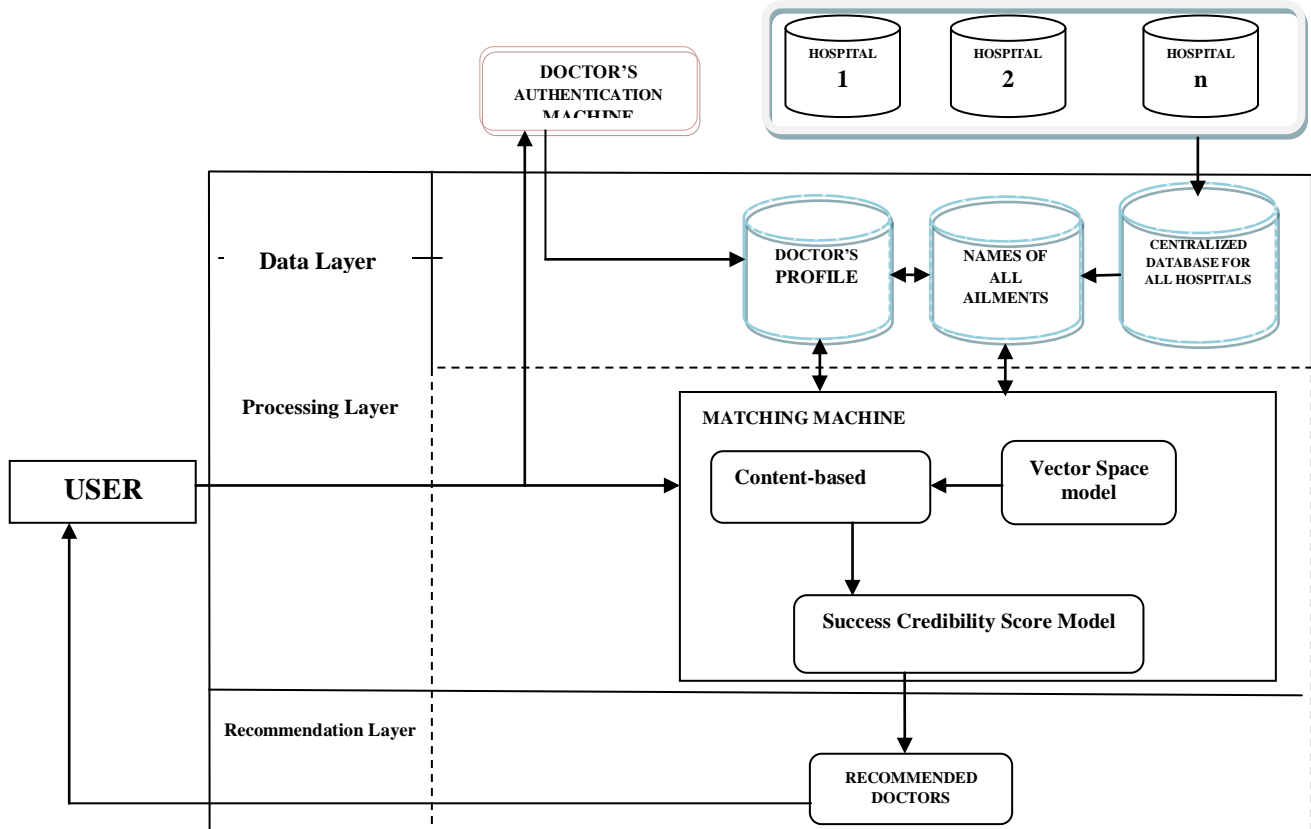


Figure 3.1: Architectural design of the proposed system

4. EXPERIMENTS, RESULTS, AND DISCUSSION.

The experiment was done by designing a website with PHP programming language. Success Credibility Score (SCS) algorithm was used for implementing the recommender system for credible recommendation.

In testing the system with a search for Specialist in heart related issues, the number of registered Cardiologist Specialist, were: Faith Wali, Wali Felix, Okoro Holly, Okoro Preye, Chinonmso Faith, Ewhos Lucky, Ikah Loveth, Edet Mabel, and Tega Iruo where

displayed from our search based on content-based filtering according to their areas of specialization, as shown in figure 4.1a

From the list of registered Doctors filtered out by content-based, the following Specialists: Okoro Preye, Wali Felix, Ikah Loveth, Okoro Holly, Ewhos Lucky, Faith Wali Edet

Mabel, and Chinonmso Faith, were recommended based on their credibility score from the number of cases they have handled and their years of experience and as illustrated in figure 4.1b.

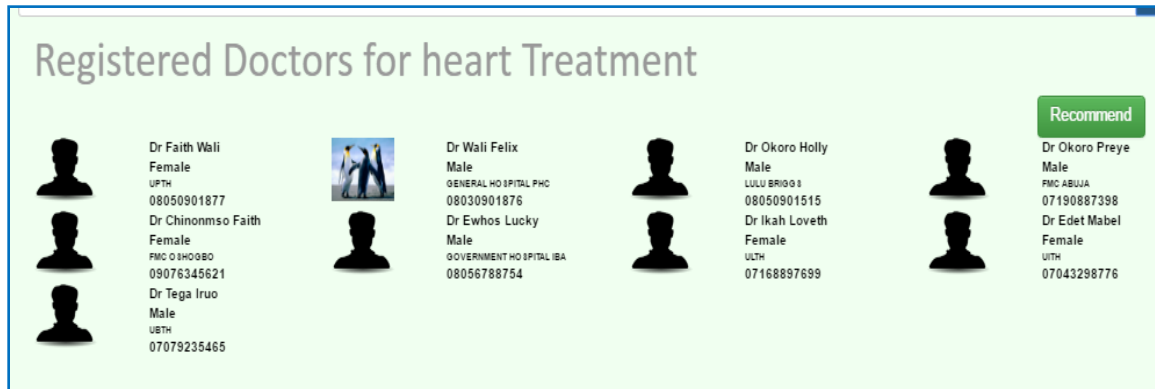


Figure 4.1a: Registered Cardiologist Specialists

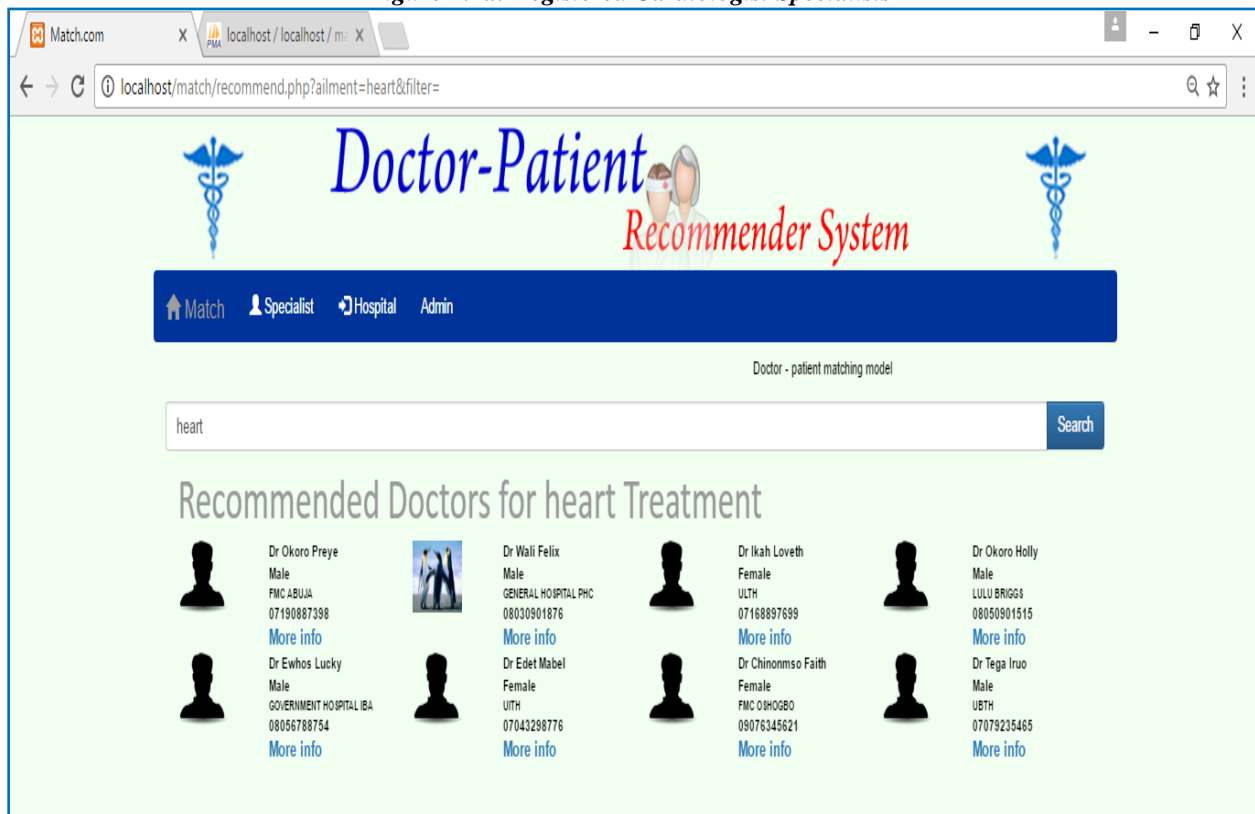


Figure 4.1b: Recommended Doctors for Heart issues treatment

Table 4.1 displays how the results were sorted according to the credibility Score of each Doctor.

Table 4.1: Recommendation table for Heart Specialist

Names of Doctors	Credibility Score	Years of Experience	Successful cases handled	Total cases handled
Okoro Preye	25.00	2	1	2
Wali Felix	18.46	5	12	13
Ikah Loveth	16.67	3	1	2
Okoro Holly	15.00	5	3	4
Ewhos Lucky	13.33	5	2	3
Faith Wali	12.50	4	2	4
Edet Mabel	10.00	5	5	10
Chinomso Faith	8.33	4	3	9
Tega Iruo	8.00	5	4	10

The graph in figure 4.2 illustrates the recommendation graph for Heart Specialist

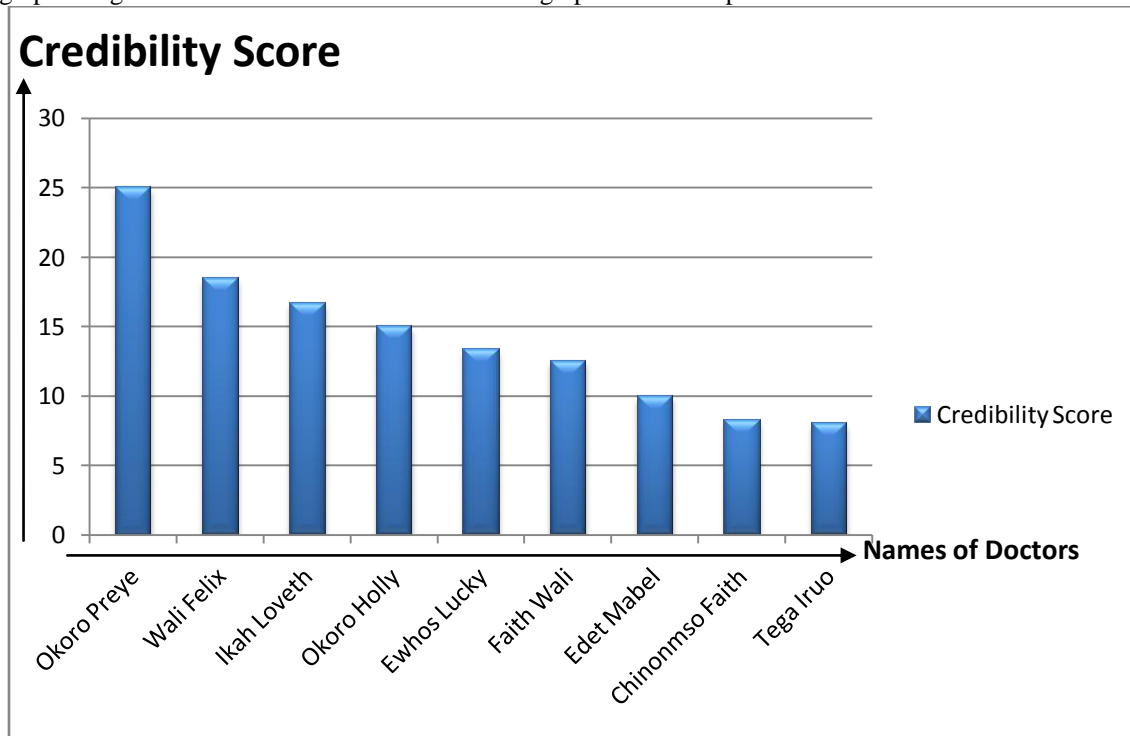


Figure 4.2: Recommendation Graph of Heart Specialist

5.0 Conclusion

This Patient-Doctors Recommender system is an exciting and efficient way to meet potential Doctors and create confidentiality among Users (Patients). This system gives users (Patient) a more flexible way to get to meet with Doctors without the burden of moving from one hospital to another in search for a Specialist

Doctor. 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.

References

- 1) Mo Y, Kang Z., John Y.,&Derek K. (2013). *Recommendation in Reciprocal and Bipartite Social Networks–A Case Study of Online Dating*.Lecture Notes in Computer Science,6th International Conference Proceedings, Volume 7812.
- 2) Adachi H. (2003). A search model of two-sided matching under non-transferable utility. *Journal of Economic Theory*, 113 (182-198).
- 3) Bandana G. (2013). *Design and development of naïve bayes classifier*. A Paper Submitted to the Graduate Faculty of the North Dakota State University of Agriculture and Applied Science.
- 4) Burke, R. (2002): “Hybrid Recommender Systems: *Survey and Experiment*. 2(4)331-370
- 5) Chung-Wei Y. (2015) CRIS: A Rule-Based Approach for Customized Academic Advising. *Journal of Systemics, Cybernetics and Informatics*. 13(2)20-24.
- 6) Cleyton V.C., Ellen S., Jorge-da S., Correia N., & Guilherme V. (2013). Recommender Systems: an Experience With GenNet Health-Care Social