



An Ontological Model for Physician Recommender System for Patients with Intricate Ailments

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ABSTRACT

The National Health Insurance Scheme (NHIS) is a body established by the Federal Government of Nigeria to achieve many objectives, one of which is providing easy and affordable access to quality healthcare services to all Nigerians. However, at the moment, Nigerian health authorities does not have a single harmonized repository of data for hospitals, and having this harmonized hospital data would have availed the relevant health authorities a mechanism to enhance their quality of service, and also significantly meliorate the management and oversight of these hospitals. Patients that are presented with a specific kind of sickness may have problem finding a specialist Doctor. Furthermore, patients are limited by the lack of skills in selecting keywords to use when searching for a hospital to register for their health Insurance. In addition, locating a specialist doctor for a particular intricate ailment is a daunting task. This work proposes an ontological approach that addresses the problem of lack of skills in selecting the right keyword in heath domain on the part of the patients which may engenders a better and more efficient recommendation of the specialist doctors using standard performance metrics.

Keywords: Healthcare, ailment, recommender, patient, ontology

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1. INTRODUCTION

Health Recommender System (HRS) has proven to be of great importance in overcoming some of the challenges faced by patients in hospitals [1]. In line with this, HRS has successfully been used in recommending healthy food that will reduce the chance of contracting chronic diseases[2], disease recognition and treatment [3], amongst others. The National Health Insurance Scheme (NHIS) is a body in Nigeria that was established to accomplish various objectives in healthcare system, for example, giving access to reliable healthcare services to all civil servants with a small charge of 5% and ensure the availability of funds within the sector [4]. One main objective of NHIS is to advance and ensure private sector partnerships in the more proper system of medicinal services administrations. In other to achieve the aforementioned objectives by NHIS, there is a need for some sort of report of who has been treated, what was prescribed, or what kind of service was administered to the patients.

Not exclusively confined to that yet but further checkmating the Quality of Service (QoS) and ensure healthy lives that will promote the well-being of citizens of all ages[5]. It may not be easy to track the movement of doctors who are employed to work with a particular hospital because of their busy schedule as such patients can be engaged in determining a professional physician for a specific illness online using some standard vocabularies. However, these vocabularies as used in healthcare may not be understood by patients to even assist them while searching for a specialist.

This work presents a model to harmonize all hospital data in Nigeria and builds a recommender system to assist patients in recognizing professional physicians from various parts of the country. The paper is divided into five sections. Section II present the review of related literature, section III is the proposed recommender system model, section IV presents the proposed harmonized hospital system architecture while section V concludes the paper.

1.1 Technology Acceptance Model

Technology Acceptance Model (TAM) is an important aspect and mostly put into consideration before adopting any new technology. Swearingen and Sinha [6] proposed and evaluated a model that is specific to health information systems, to identify the cause and effect in connection to factors affecting the utilization of information system in the health sectors that have or not all the necessary equipment to evaluate, improve, and plan for a more effective system. The effectiveness of a recommender system relies upon factors that past beyond the quality of the prediction algorithm. Many models were used to address this issue by predicting the use of a system.

However, in the recent state-of-the-art, TAM has been the most appropriate and adopted model with the information Systems community [7]. [8] carried empirical research considering a movie recommender system as a testbed, in addition to a questionnaire relevant to any recommender system in the various domains, such as music, movies, etc.. The results prove that the two principal factors influencing on user acceptance are perceived usefulness and perceived ease of use, which is also affected by assumed talents in the use of recommender systems. Presumably, this suggests that the proposed ontological model for physician recommender system is in no doubt it be adopted if all the factors aforementioned put into consideration to ensure full utilization. Figure 1.0 shows the technology acceptance model.

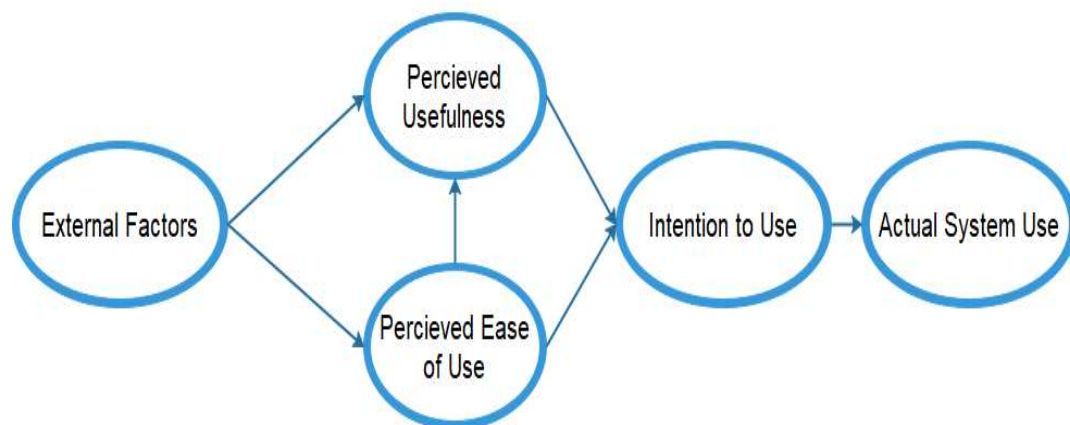


Fig.1: Technology Acceptance Model [8]

2. LITERATURE REVIEW

Recommender Systems are classified into collaborative filtering systems, content-based recommenders and hybrid recommenders. In many cases, a recommender system is built based on rating of an item's feedback collected from customers/users. This is often based on collaboration with item purchased by various customers. Furthermore, different organization uses different approach depending on the nature of the system that will determine the most appropriate. In the marketing sector, Amazon uses item-item collaborative filtering [9], which uses similarity model to find the item for recommendation.

Krishna et al. (2014) employed a model based collaborative filtering which addresses the problem in the cold start and scalability to recommend a blood donor and hospital specialization. This used K means algorithm that delivered the threshold rating for the cold start. Han et al. (2018) developed a hybrid model that recommends a physician to a family as a family consultant in the future. The approach used in building the model provides immense predictive accuracy than both a heuristic and a collaborative filtering approach, which resulted in more increase in performance. Similarly, Isma'il et al. (2020) used content based recommenders, where a course is recommended to a prospective candidate based on results from High School (O'Level), Joint Admission and Matriculation Board (JAMB), and Post University Tertiary Matriculation Examinations (PUTME).

In this work, various classification models are employed, where the system proved that out of all, Naïve Bayes Classifier (NBC) and Support Vector Machine (SVM) have outperformed with the highest accuracy of nearly 99.94%. Despite the fact that hybrid filtering approach is to overcome the disadvantages in content and collaborative approach, Isma'il et al. (2020) used content filtering approach because of the lack of feedback from prospective candidates before and after been admitted. Cold start and low or absence of user ratings are the major drawback from collaborative and content based filtering approach.

Devika and Subramaniaswamy (2018) addressed the problems associated with the collaborative and content-based approach by combining the two approaches also called hybrid. This recommends or suggests the top three hospitals to a patient based on a location, high ratings and specialty of the hospitals. It is said to assist a patient in an event of an emergency to recommend a hospital considering the location or distance between the patient and hospital. In [14], the authors used symptoms, diagnosis, treatment plan, and other information collected from patients who are treated to profile a record for future recommendations while utilizing such to build trustworthy ontology from the related information.

Considering the discussion from the literature, there is the need to have a centralized repository that will harmonize all hospitals data besides the details of the specialty of doctors with the patient's assessment of services received. In such a case, patients do not require to know the technical terms use in the health domain to assist them while searching with some keywords.

3. PROPOSED RECOMMENDER SYSTEM MODEL

Health Recommender System helps in many cases such as recommendation of drugs and diagnosis [15], which could be achieved through data mining [16]. The proposed Ontological and Intelligent Physician Recommendation (OIPR) Model (OIPR) is shown in Fig. 2.0. A patient searches on the internet to find a demanding expert physician within his location of choice. The databank comprises all records of accredited hospitals that involve the expertise of many doctors in the country.

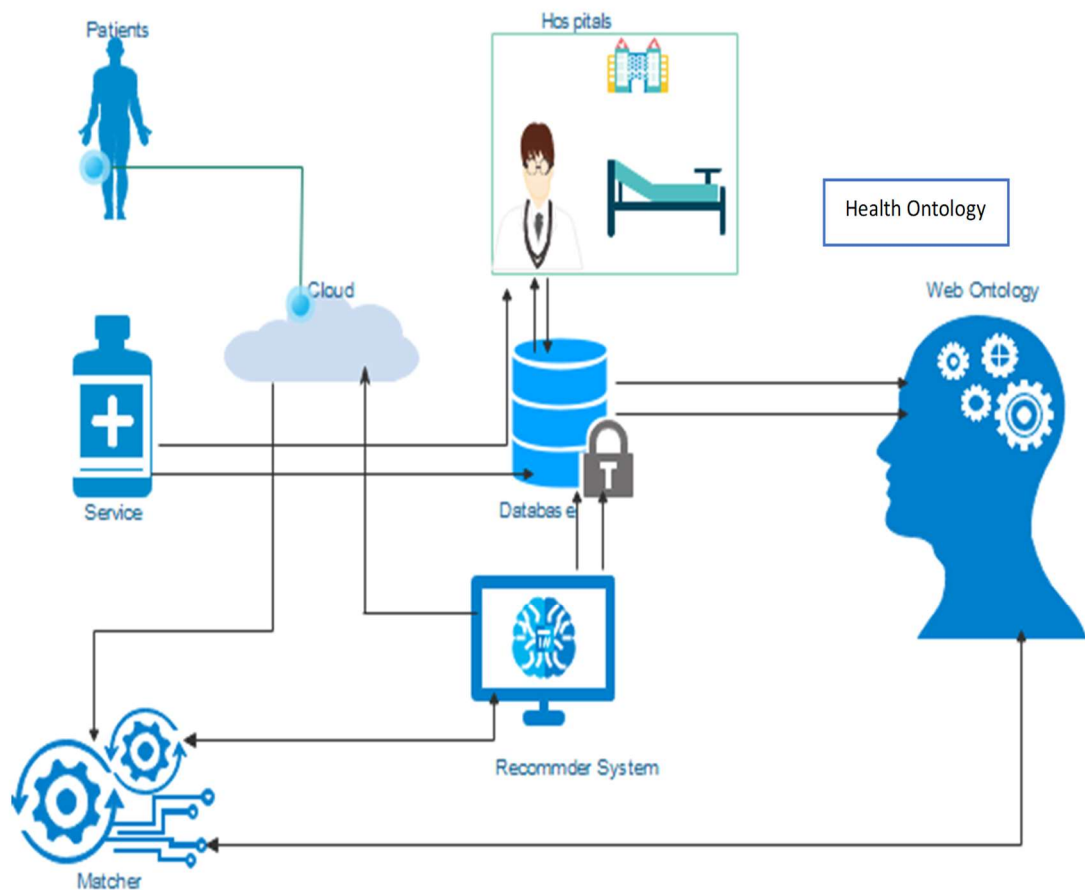


Fig. 2: Proposed System Model

The health ontology component thought in this research is to promote the precision of the recommender system to align the searched keywords with the technical terminology applied in the healthcare system. In this work, we also propose to address all the aforementioned issues by using a Deep Neural Network (DNN) to build our model. The patient's assessment of service been provided by a remarkable doctor from a hospital is required to help in the recommendation. This evaluation will be profiled and then used in the model to promote decision making.

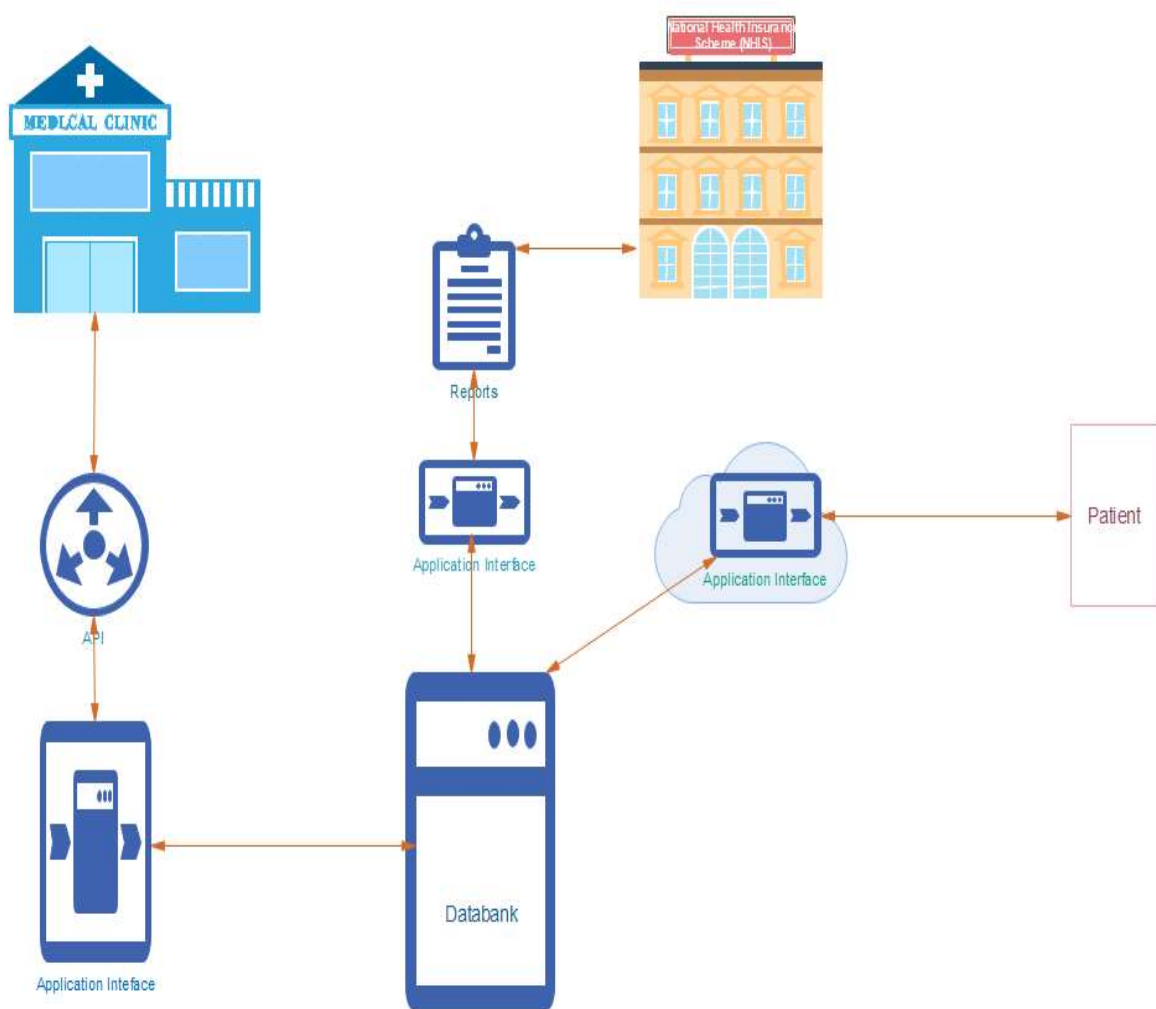


Fig 3: Proposed Harmonized Hospital System Architecture.



However, this research assumes the hospitals are harmonized. It becomes more efficient to recommend some hospitals and doctors to the patients based on specialties.

Algorithm 1: Recommender System Algorithm

```
Start
Get patient search words criteria
Load hospitals and their profile for processing
Load the corresponding doctors with their specialties
Set the number of recommended doctors to zero
Set the status of hospital to false //
Set the status of doctor to false
Set hospital rating to low
Set doctor rating to low
WHILE there is any hospital that is not visited
    Get and update hospital ratings based on profile
    IF hospital rating is high
        Update hospital status to true
        IF hospital status is true
            WHILE there is any doctor that is not visited
                Get and update doctor ratings based on profile
                IF doctor ratings is high
                    IF ontology matched patient's searched criteria
                        Update list of recommended doctors
                        Update the number of recommended
                    Else
                        Return "Not found"
                END IF
            ELSE
                Return "No doctor can be recommended now"
            END IF
        ENDWHILE
    END IF
ENDWHILE
ENDIF
END WHILE
END
```

5. CONCLUSIONS AND FUTURE WORK

It is discerned that patients with unusual intricate diseases used to be frustrated in finding an expertise physician for their ailment. This research seeks to ease the process of locating or recommending doctors based on the patient's ailment from accredited NHIS hospitals. However, the research has not taken into the cognizance the ranking of doctors and the distance between the patient and the hospital, which can save the cost of traveling each time to visit the hospital

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