"Virtual Doctor" Management Technique in the Diagnosis of ENT Diseases

Arshi Naim (✉)
King Khalid University, Abha, Saudi Arabia
`arshi@kku.edu.sa`

Mohammad Faiz Khan
Ministry of Interiors Security Forces Hospital, Abha, KSA

Mohammad Rashid Hussain, Nawsher Khan
King Khalid University, Abha, Saudi Arabia

Abstract—This research project is about the managing of an ENT (Ear Nose Throat) diagnosis expert system through the virtual doctor that can assist physicians in diagnosing ENT related diseases. ENT problems can distress hearing, speaking, learning and many other significant behaviors and untreated ENT diseases can be serious. Therefore, early diagnose of ENT diseases is fundamental. This study is qualitative in nature where we have used the concept of Virtual Doctor under artificial intelligence (AI) based expert system, already designed to assist physicians in the diagnosis of ENT related disease in the absence of ENT experts. This system can reduce the excess created due to the busy schedules of ENT experts and enhance the effectiveness and efficiency of healthcare system. Virtual Doctor for ENT diagnosis uses rule based system for knowledge representation and has sub-systems which can enhance the physician's ability in reaching a diagnosis decision with assurance. In this paper, we described the management system for application of Virtual Doctor for the diagnosis of ENT related diseases which can be used by physicians in their daily practice.

Keywords—Virtual Doctor, ENT, Artificial Intelligence, Physians, Expert Systems

1 Introduction

This research project will help the physians in diagnosis of ENT (Ear Nose Throat) related diseases. ENT problems are everyday problems and can cause hearing, speaking, learning and many other significant behaviors and is not treated appropriately can consequence in serious issues. Therefore, it is vital to diagnose of ENT diseases timely. ENT specialist's service is not always readily accessible, computer aided smart technologies can aid general physicians in diagnosing ENT diseases and then refer complex cases to senior ENT experts that can enhance the effectiveness of healthcare system [2]. The concept of virtual doctor is defined under Artificial Intelligence and

this systems has been designed to assist physicians in the diagnosis of ENT related disease in the absence of ENT experts [1] [3]. This system will help in reducing the excess created due to the busy schedules of ENT experts and enhance the effectiveness and efficiency of healthcare system [1]. We have used qualitative research methods and used rule based system for knowledge representation and having subsystems which can enhance the physician's ability in reaching a diagnosis decision with assurance. Firstly the symptoms captured through the user interfaces, then these symptoms are matched with inference rules in the knowledge base and finally a diagnosis is made by the inference engine. If the system is incapable to diagnose the disease with the given symptoms or if the system is unable to classify the accurate ENT disease the expert system recommends for some laboratory tests. We described the management system for application of Virtual Doctor for the diagnosis of ENT related which can be used by physicians in their daily practice [5].

The major contribution of Virtual Doctor in diagnosis of ENT diseases was applied to the healthcare field [2]. Virtual Doctor for ENT diagnosis system helped general physicians in the diagnosis of ENT diseases in the absence of ENT expert. Thus, this management system helped in selecting the critical patients who could be referred to ENT specialists and could reduce the excess created due to busy schedules of limited accessibility of ENT experts.

In the recent scenario the field of medicine has improved greatly due the improvement in computing technology. Computers are involved in almost all the clinical practices. Artificial intelligent (AI) technologies help in both healthcare practitioners and patients in many ways [3]. AI is a branch in computer science that can analyze complex medical data and identify meaningful relationships that can be used for clinical diagnosis and treatment [3]. Despite the latest advancements in healthcare, it does not always reach out to those most in need. Ordinary people face big difficulties in having medical assistance. Particularly, access to medical specialist is a critical problem therefore managing the use of virtual doctors is very important in current scenario. It will facilitate ordinary people to receive specialist diagnosis that are available only in metropolitan hospitals, moreover the accurate and timely diagnosis of disease continues to be a serious clinical problem. Therefore, smart technologies that can assist in early diagnosis and prevention of serious health problems can be a great relief for many patients and healthcare system in general [4] [5]. This study is particularly important for Ear-Nose-Throat (ENT). Early diagnosis of ENT diseases are vital and certain untreated ENT diseases can be fatal. Otolaryngology/ENT specialist's service is not always readily available but managing computer aided smart technologies can assist general physicians in diagnosing ENT diseases and subsequently refer complicated cases to senior ENT experts can enhance the usefulness of healthcare system. Despite the significance of computer aided ENT disease diagnosis systems, the research related this subspecialty is limited. Therefore, in this study we have reported how to manage the ENT (Ear-Nose Throat) Disease Diagnosis through Expert System that can assist physicians or junior doctors in diagnosing ENT diseases [2] [4]. In particular, we will discuss "how an ENT disease diagnosis system can be managed and their potential benefits. In this study we have not designed the Virtual Doctor system rather concentrated on the management part for the entire process [2].

2   Background Study

Artificial intelligent systems in medicine, started to emerge during late 1960s and many experimental systems were developed by research laboratories [3]. Early AI based medical applications have laid the foundation for many new, recent applications [3]. In recent years expert systems have integrated multimedia technologies, machine learning, artificial neural networks and fuzzy logic and genetic algorithms to enhance the diagnosis [1]. The system dynamically estimate minimum set of tests that are likely to confirm a diagnosis. Research on expert system that diagnoses ENT diseases is limited. Besides, the diagnoses of ENT diseases are based on symptoms which are often difficult to identify. Many sophisticated examinations may be necessary in the diagnosis process. Thus, the expert system which is already developed for the diagnosis of ENT diseases is used to manage the process of knowledge engineering.

3   Discussion

3.1   Managing virtual doctor for ENT disease diagnosis system

"Virtual Doctor" is an artificial intelligence (AI) based expert system, designed to assist physicians or junior doctors in the diagnosis of ENT related disease in the absence of ENT experts [1] [2] [6]. Thus, this system can reduce the backlog created due to the busy schedules of ENT experts and enhance the effectiveness and efficiency of healthcare system. Virtual Doctor for ENT diagnosis uses rule based system for knowledge illustration. Initially the symptoms are captured through the user interfaces as inputs [6]. Then these symptoms are matched with inference rules in the knowledge base and finally a diagnosis is made by the inference engine. If the system is unable to diagnose the disease with the given symptoms or if the system is unable to identify the exact ENT disease the expert system recommends for some laboratory tests. If the system is unable to diagnose the disease even after producing the laboratory test results, the system will recommend for an ENT specialist consultation. Managing Virtual Doctor for ENT Disease diagnosis System will have following steps:-

1. Managing the Diagnosis of Disease
2. Managing Prescription
3. Managing Recommended Testing
4. Managing ENT Specialist Referral
5. Managing and Tracking Patient History

Managing the disease diagnosis: Disease diagnosing sub-system prompts the physician to gather set of preliminary medical investigation related information, such as body temperature, blood pressure from patient. Based on this information, the system will intelligently prompt more related questions, in order to acquire detailed information of the disease. After analyzing the given information, the system derives conclusions accordingly. Also the system will store all the data related to the patient for future references.

Managing prescribing: During the disease diagnosis process, if the disease is precisely known with higher level of certainty, the disease information (ENT disease) will be transferred to 'Prescribing' sub-system. Before prescribing medication, this subsystem would inquire about the patient's allergic conditions (to drugs or food), and patient's current medication details. Based on this information the system would prescribe suitable medication, moreover, this sub-system also stores the information for future suggestion.

Managing recommend testing: When the clinical symptoms are not sufficiently adequate to decide on the diagnosis with certainty, appropriate and inclusive clinical tests and supporting tests will be recommended in order to decide on the diagnosis with higher level of certainty. Laboratory testing, X-ray or other relevant checkups will be recommended. If the patient provides details of the clinical and supporting tests, the test results will be entered into the system or scanned image will be uploaded into the system. Image processing techniques will identify patterns. Details of the clinical and supporting tests results will be used for detailed diagnosis with greater level of accuracy. In addition, the information gathered through this sub-system will also be transferred to database for future references. Below given table 1 provides a list of tests that can assist in ENT disease diagnosis.

Table 1. ENT Tests

Category	Test
Hearing	Tests Pure Tone Audiometry, Tympanometry, Speech & Voice Analysis
Nasal	Tests Finger-nose test, Standard Smell Test, Nasal endoscopy
Throat	Tests Throat Culture, Rapid Strep Test

Managing ENT specialist referral: With the given symptoms and test results if the 'Virtual Doctor' expert system is unable to diagnose the ENT disease with certainty, the system will refer the patient to a real ENT expert or Otolaryngologist. The system will request for patient's current residence location and recommend an appropriate ENT expert (i.e. consultant), who is in the close proximity to the patient. Based on the seriousness of the illness this sub-system can advise the patients to get admitted to closer hospitals with facilities and facilitate appointments with ENT specialists.

Manage and Track Patient History: The system store all the details related to the patients, including symptoms, test results, diagnosis details, medicine prescribed, etc. The information gathered will be used for further analysis and will be used as an input for the self-learning learning system.

Managing the Virtual Doctor Design and Implementation: Virtual Doctor is intended to be used by physicians who are not advanced computer users. Therefore the system which is user friendly will be used.

Managing the Knowledge Engineering for the E.N.T. Disease Diagnosis Expert System: Several different AI techniques are available for the designing of 'Virtual Doctor', including multi-agent systems and expert systems to solve the diagnosis problem. After discussing with knowledge engineer, AI expert, medical professionals and analyzing the existing literature AI technique was chosen. We gathered all necessary information, including a list of important ENT diseases, their symptoms, diagno-

sis procedures, treatment options, clinical and laboratory tests. Once the required knowledge was gathered, the details were organized and presented to ENT specialist for verification. Certain items were removed and few items were added based on the advice from ENT specialists. Once the items were finalized the acquired knowledge was encoded into rules in the knowledge base. Below given diagnosis table 2 was considered for management of knowledge base.

Table 2. Questions for Diagnosis Investigation

Disease	Diagnosis investigation for Ear/Nose
Vestibular Neuroma	Does the patient have a hearing loss? Does the loss of hearing is severe or sudden beginning? Does he have a fever?
Mener Syndrome	Is the patient the having hearing loss? The hearing loss is sudden or periodic? Is the patient is having fever?
Allergic Rhinids	Does the Patient have a nasal discharge? Is the nasal discharge is clear or watery?
Acoustic Neuroma	Does the patient have a hearing loss? Does the hearing loss is gradual processing form months to years?
Prebyacusis	Is the patient having problem in Speech? Is the patient having problem in telephonic conversation? Has the patient got any infection?

4   Results

Managing of Virtual Doctor expert system was used for ENT disease diagnosis. The management of diagnosing processes includes steps such as initial gathering of subjective information like knowledge acquisition of symptoms related to ENT disease, generation of probable diagnosis list, gathering objective evidence which is evidence from scan reports and laboratory tests, and hypothesis evaluate to finalize the disease based on subjective and objective information. Managing of Virtual Doctor ENT diagnosis system has important contributions for research and practice as it can help in short listing the critical patients who can be referred to ENT specialists and reduce the backlog created due to busy schedules of limited accessibility of ENT experts.

5   Conclusion

In this paper, we described the management system for application of Virtual Doctor for the diagnosis of ENT related which can be used by physicians in their daily practice.

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7 Authors

Dr. **Arshi Naim**, Quality Coordinator, College of Computer Science, King Khalid University, Abha, Kingdom of Saudi Arabia. I earned PhD degree in Business Management. My area of interest is Business Management, Electronic Commerce, ECRM, E-learning, Quality Standards and Accreditation Processes, Learning and teaching developments, learning outcomes developments. I am reviewer for established programs and new programs in the University; also I am a peer reviewer for E-Courses as per Quality Matters standards. (arshi@kku.edu.sa)

Dr. **Mohammad Faiz Khan** is ENT surgeon in Security Forces Hospital in Abha, Kingdom of Saudi Arabia since fifteen years. His area of research is related diagnostics approach in ENT and other medical disciplines. (mfaizkhan@hotmail.com)

Dr. **Mohammad Rashid Hussain** is Assistant Professor, at College Of Computer Science, King Khalid University, Abha, Saudi Arabia, and holding PhD degree in Information Technology. His research interest includes educational development & review, educational data mining, cloud intelligence, mobile cloud computing and optimizations. (md.rh16780@gmail.com; humohammad@kku.edu.sa)

Dr. **Nawsher Khan** is currently serving as an Associate Professor and Director of Research Center, at College of Computer Science, King Khalid University Abha, Saudi Arabia. He was a Post-Doctoral Research Fellow at the University of Malaya (UM), Malaysia in 2014. He got his Doctoral Degree from University Malaysia Pahang (UMP), Malaysia in 2013. In 2005, he was appointed in NADRA (National Database and Registration Authority) under the Interior Ministry of Pakistan and in 2008 has worked in (NHA) National Highways Authority. He has served at Abdul Wali Khan University Mardan, Pakistan as an Assistant Professor for 3 years (2014-2017). His areas of interest include Big Data, Cloud Computing, Data Management, Distributed System, Scheduling, Replication and Sensor Network. In addition, he has published more than 50 articles in various International Journals and Conference proceedings. (nawsher@kku.edu.sa)