

Comparison Result of Hybridization of Expert System and Machine Learning Technique for Diagnosis of Diabetes in Different Countries

Emmanuel C. Omeye

Department of Computer Science, Tansian University, Umunya

Email: eminentemma@hotmail.com, eminentemma.chizoba@gmail.com

ABSTRACT

This study focused on hybridization of expert system and machine learning technique for diagnosis of diabetes. The specific objective of the study is to examine the effect of use of expert system on diagnosis diabetic patient and to determine the effect of machine learning on diabetic patient. The study was guided by two research questions and descriptive survey design was used. The data used was a primary data collected using structured questionnaire. The findings revealed that conclude that Expert system has a significant effect on diagnosis diabetic patient and that Machine learning has a significant effect on diabetic patient.

Keywords: Hybridization, Expert System, Machine, Learning Technique, Diagnosis, Diabetes

INTRODUCTION

Diabetes is a life-threatening illness that is found to be very common in our society today and its posing serious challenge to human health. Diabetes is characterized by the increase blood glucose more than the normal level, as a result of defective insulin secretion or its impaired biological effects, or both [1]. Diabetes is capable of causing chronic damage and dysfunction of various tissues and organs of the body of the patient, especially the eyes, kidneys, heart, blood vessels and nerves. Diabetes can majorly be grouped into two different categories, type 1 diabetes (T1D) and type 2 diabetes (T2D). Younger people usually suffer type 1 diabetes, mostly people under 30 years old. High rate of thirst, frequent urination, high blood glucose levels are the major typical clinical symptoms of type 1 diabetes (T1D) [2]. This type of diabetes usually resists effective cure of oral medications alone and the insulin therapy is usually applied. Type 2 diabetes occurs more commonly in middle-aged and elderly people, which is often associated with the occurrence of

obesity, hypertension, dyslipidemia, arteriosclerosis, and other diseases [3,4,5]. With the development of living standards, diabetes is increasingly common in people's daily life. Therefore, how to quickly and accurately diagnose and analyze diabetes is a topic worthy studying. In medicine, the diagnosis of diabetes is according to fasting blood glucose, glucose tolerance, and random blood glucose levels [6,7]. The earlier diagnosis is obtained, the much easier we can control it. Machine learning can help people make a preliminary judgment about diabetes mellitus according to their daily physical examination data, and it can serve as a reference for doctors [8]. A lot of works has been done on diabetes prediction and diagnosis using expert as well as some machine learning techniques. However, in this study we tend to understudy what would be the challenges and the way forward when combine the expert system and machine learning techniques in the diagnosis of diabetes.

Statement of the Problems

When you hear the word "diabetes," your first thought is likely about high blood sugar. Blood sugar is an often-underestimated component of your

health. When it's out of whack over a long period of time, it could develop into diabetes. Diabetes affects your body's ability to produce or use insulin, a

hormone that allows your body to turn glucose (sugar) into energy. Diabetes is responsible for the higher risk of developing cardiovascular disease, coronary artery disease with chest pain, heart attack, stroke and narrowing of arteries. Diabetic patient stands more of having heart disease or stroke. Excess sugar can injure capillaries which possibly can lead to the damages in some delicate organs of the body like Nerve(neuropathy), Kidney (nephropathy) and Eye (retinopathy). Excess sugar can hamper capillaries in legs which can cause tingling, numbness, burning or pain that usually begins at the tips of the toes or fingers and gradually spreads upward, nerves related to digestion when injured can lead to nausea, vomiting, diarrhea or constipation, as well as erectile dysfunction for men. Also, when the delicate filtering system in the kidney is affected can lead to kidney failure or kidney disease, which may require dialysis or a kidney transplant as the only remedy. And diabetes can damage the

AIM AND OBJECTIVES

The aim of this study is to compare the hybridization of expert system and machine learning technique for diagnosis of diabetes in different countries

Under this aim, other objectives to achieve includes:

Significance of Study

Few significances of the study have been listed out below;

- a. The system will facilitate reliable, instant and accurate diagnostic diabetes result:

This system when developed, will simulate high accuracy expert reasoning characterized by machine learning techniques, taking into consideration the clinical signs and test results. It will be able to generate accurate treatment, advice addressing and prescriptions to possible drugs presented in a user-friendly interface with ease and fast characterized by expert systems.

- b. The system will ensure security under the following principles:
 - i. Access Control,
 - ii. Privacy/Confidentiality,

Omeye blood vessels of the retina (diabetic retinopathy), which can cause blindness. It also increases the risk of developing cataracts and glaucoma. Unfortunately, diabetes also can cause Foot damage, Skin conditions and Hearing impairment. Nerve damage leads to various foot complications and not given urgent attention, cuts and blisters can develop serious infections that capable leading to toe, foot or leg amputation. Also, diabetes causes skin problems, including bacterial and fungal infections. And Hearing problems are more common in people with diabetes. Type 2 diabetes may increase the risk of dementia, such as Alzheimer's disease. The poorer your blood sugar control, the greater the risk appears to be. Although there are theories as to how these disorders might be connected, none has yet been proved. Depression symptoms are common in people with type 1 and type 2 diabetes. Depression can affect diabetes management.

1. To compare the effect of use of expert system on diagnosis diabetic patient in different countries.
2. To compare the effect of machine learning on diabetic patient in different countries.
 - iii. Authentication,
 - iv. Non-Repudiation,
 - v. Integrity,
 - vi. Availability
- c. The system will guarantee the following Benefits:
 - i. Reduction in the time and cost involved in carrying out diagnosis of diabetes,
 - ii. Easier and more user-friendly platform/solution for the diagnosis of diabetes,
 - iii. Facilitate establishment of a comprehensive health electronic database,
 - iv. Complement efforts to avert to the barest minimum, the incidences of

- complications as a result of diabetes in the patient,
- v. Assist relevant health authorities in diabetes management information for decision making and

- improvement where need be,
- vi. Improve early detection and treatment of diabetes will ensure that high death rate as a result of diabetes complication is minimized.

Scope of the Study

This study focuses on the comparison of hybridization of expert system and machine learning technique for diagnosis of diabetes. The study also seeks to

examine the effect of use of expert system on diagnosis of diabetic patient and the effect of machine learning on diabetic patient.

REVIEW OF RELATED LITERATURE

Conceptual Review

Hybridization

The essence of hybrid machine learning and expert systems is that they can combine the strengths of expert system and machine learning to give an optimum result. Expert system (ES) is a sophisticated software built with the aim to possess human like features as regards to thinking and reasoning in a particular key domain area and driven by sets of rules [9]. Expert system uses its knowledge base to manipulate set of rules in a particular knowledge domain area, its inference engine to handle input request from the user interface, and matches it with the rules / facts stored in knowledge base so as to make a conclusion based on the available inference and the interface grants the user access authority to the expert system [10]. So, expert system is

capable of being more user-friendly to accept medical record data and display out the result to the user. The machine learning systems which is capable of offering automatic learning techniques to extract common patterns from realistic data and make sophisticated and accurate decisions, based on the different learning behaviors [11]. In this case, machine learning will use its trained model in the background to manipulate the data for a more accurate result. Despite the heavy dismissal of hybrid artificial intelligence by connectionists, there are plenty of examples that show the strengths of these systems at work. Several are hybrid AI systems are silently solving vital problems [12].

Artificial Intelligence (AI)

Artificial Intelligence is a coordination of designing a computer, a software that thinks logically, just the way intelligent humans think or a computer-controlled automation or robot. AI is bright by investigating how human beings brain reasons, and how humans make decisions, and work despite the fact trying to answer a problematic assignment, and then applying the results of this investigation as a root of developing intelligent software and

systems. Expert systems are the class of Artificial Intelligence system. The stated area of Artificial Intelligence (AI) study is to copy-cat the working of human intellect by computer programs or computers with the capacity to copycat or replicate the tasks of human intelligence. The area of Artificial intelligence is enormous in scope and size. While continuing, we reflect the largely common and prospering research areas in the area of AI [13].

Areas of AI includes:

- Expert systems
- Fuzzy logic systems
- Neural network systems
- Neural Language processing
 - Robotics

Artificial intelligence is used in an everyday cycle of life. AI is widely used in medicine and the healthcare sector. The main advantages of AI in the world of medicine will be discussed briefly.

1. Transforming the healthcare sector: with recent Used of artificial intelligence in medications changes the way healthcare sector collaborates with education, businesses, and industrial. It brings fresh possibilities for advancement and collaboration. The advanced in the healthcare sector is certain and its benefits should be utilized intelligently.
2. Decreasing mortality rate: Reducing the period patients spend waiting for attention from specialists, artificial intelligence in medicine lessens the mortality rate and has an optimistic effect on the

superiority of this care. Having such help, doctors have extra time for development. There wasn't any need to treat artificial intelligence in the medical arena as an effort to replace doctors. Supplementary, it's the effort to assist doctors.

3. Making diagnostics more precise: As medical artificial intelligence systems have the capacity to learn from previous cases, they offer doctors access to the information about the latest news in medicine, the healthcare sector, and some areas of study in particular. A human can't combine following the newest leanings and treating patients at the same time. There wasn't sufficient time for that processes but an AI system can. That's why it becomes a vital assistant [14].

Theoretical framework

Theory of Model of IT Implementation Process (MIIP)

The theory of Model of IT Implementation Process (MIIP) was first introduced by [15] and later extended by [16]. The model proposed a framework for directing and organizing research based on innovation, changes in organizations and technological diffusion. Kwon and Zmud's (1987) initial model proposed six stages: (i) initiation, (ii) organizational adoption, (iii) adaptation, (iv) acceptance and adoption, (v) reutilization, and (vi) diffusion. MIIP appears to be a much more embracing model than most of the models

so far considered. Apart from focusing on the six stages from adoption to diffusion of IT, it also examines intervening variables such as the technology being used, the organization, the environment, the task in focus, and the users' community characteristics. MIIP appears to be a good theoretical underpinning for ICT adoption and usage studies. However, it is doubtful if MIIP can be used to sufficiently provide a theoretical framework for a study involving expert system and machine learning technique.

Empirical Review

[17], carried out a study on the Analysis and Prediction of Diabetes Mellitus using Machine Learning Algorithm. The study was guided by two research questions. The study reviewed that Data mining techniques (DMTs) are very help full to predict the medical datasets at an early stage to safe human life. Large amount of medical datasets are open in different data sources which used to be in the real world application. Machine learning is a prediction on disease data. Currently, Diabetes Disease (DD) is the leading cause of death over all the world. To cluster and predict symptoms in medical data,

various data mining techniques were used by different researchers in different time. A total of 768 records, data set from PIDD (Pima Indian Diabetes Data Set) which is access from online source. In the proposed system most known predictive algorithms are applied SVM, Naïve Net, Decision Stump, and Proposed Ensemble method (PEM). [18], carried out a study on Soft Computing Approaches for Diabetes Disease Diagnosis. The study was guided by two research questions. The population of the study consist of 179 diabetic patients. The data used was a primary data collected through structured

questionnaire. The data collected was analyzed using simple percentage and one way analysis of variance with the aid of statistical package for social science. The study revealed that Diabetes is a chronic disease and a major public health challenge worldwide. It was also observed that Diabetes happens when a body is not

able to produce or respond properly to insulin which is needed to maintain the rate of glucose. The study revealed several approaches of Soft Computing such as Support vector machines (SVMs), Ant Colony Optimization (ACO), Rough Sets, Neural Network, Fuzzy Logic, Genetic Algorithm, etc.

Summary of Literature

This study which focused on hybridization of expert system and machine learning technique for diagnosis of diabetes examine the effect of use of expert system on diagnosis diabetic patient and the effect of machine learning on diabetic patient. The study explained the meaning of hybridization, Artificial Intelligence (AI), expert systems, applications, components machine learning techniques and supervised learning. Analysis of the above previous researches displayed that many team dissertations on the application of artificial intelligence systems like machine learning, to medicine have

brought about faster and more accurate medical diagnosis of different medical conditions due to its ability to find pattern more accurately from huge chunks of data, so also, AI systems like, expert systems provide faster and more user friendly access to diagnosis by providing patients access to web based and mobile based self-diagnosis systems. Different related literature was reviewed but none of study focused on hybridization of expert system and machine learning technique for diagnosis of diabetes which the gap the study intends to cover.

COMPARISON OF HYBRIDIZATION OF EXPERT SYSTEM AND MACHINE LEARNING TECHNIQUE FOR DIAGNOSIS OF DIABETES IN DIFFERENT COUNTRIES

Author	Possible Techniques			Diagnosis	Remarks
	Hybrid	Non-Hybrid	Traditional Approach		
Sultan, Rashad and El-Desouky (2013)	Expert system		Rulebase	Angina pectoris and Myocardial infarction	Not intelligent
Hambali, Akinyemi and Luka (2017)	Machine learning		Rule-based	Lassa fever	Not intelligent
Osaseri, Onibere and Usiobiafo (2014)	Machine learning	Fuzzy Expert Model		Diabetes mellitus	Intelligent
Ajenaghughrure, Sujatha and Akazue (2017)	Expert system	Fuzzy based approach		Diabetes mellitus	Intelligent
Ali Kara (2008)	Expert syste,			Diabetes mellitus	Intelligent
Ebru Pekel (2018)	Machine learning			Diabetes mellitus	Intelligent

Mercedes, Rigla, & Gema (2017)	Expert system			Diabetes mellitus	Intelligent
Ain Sham (2015)	Expert system			Diabetes mellitus	Intelligent

This section tries to perform a comparative analysis / evaluation of the different possible techniques or approaches that were used in the treatment of diabetic mellitus most especially expert system and machine

learning. Table 1 shows the statistical summary of the techniques used by the existingsystems classified into two major categories i.e. intelligent and non-intelligent approaches.

FINDINGS AND DISCUSSION

This research paper reviewed eight (8) articles on machine learning and expert system design methodology. The authors observed from the reviewed literature that there have been positive developments on expert system and machine learning for medical diagnosis based on the techniques used. However, based on the carefully chosen benchmark for review; the following findings were perceived:

- a) The machine learning system is perfect in treating diabetes mellitus although have some challenges.

- b) The existing expert system knowledge-base for medical diagnosis diabetes mellitus were built using rule-based technique, fuzzy based technique, neural network based technique and intelligent hybrid technique. It was observed that on

- c) The rule-based techniques were seen to be inefficient based on their inability to properly learn,
- a) ineffective search strategy, and opaque relations between rules, and as such the rule-based

CONCLUSION

This review paper presented different expert systems for diagnosis of medical conditions associated with human health especially diabetes mellitus and also evaluates the methodological contributions made by the different researchers. The first set of researchers used the rule-base technique to develop their expert system; while the second set of researchers concentrated on an intelligent technique like Fuzzy Logic (FL), artificial neural network (ANN), and Genetic Algorithm (GA) to build their expert system based on the fact that the rule-based technique cannot learn properly and they might become less

efficient as the production rules in the knowledge base increases. Based on our findings, there is the third set of researchers that believes in enlarging the performances of the intelligent model used by the second set of researchers to make the expert system developed more effective and efficient by combining two or more techniques together to form a hybrid model like (Neuro-fuzzy system) that can generate a more accurate results. With this conclusion, the authors has decided to recommend the usage of hybrid models for building intelligent expert systems for probing and prognosis of medical conditions.

REFERENCES

1. Robertson, M. A., Akinyemi, A. A., and Luka, J. D. (2011). Expert System For Lassa Fever Diagnosis Using Rule Based Approach, *Annals Computer Science Series*, 15(2): 68 – 74.
2. Lonappan, B. S. (2008), *Medical Expert Systems Survey*, International Journal of Engineering and Information Systems, 1(7): 218 – 224.
3. Iancu N., Ioanni , V. & Ioanna C. (2008) "Machine learning and data mining methods in diabetes research." *Computational and*

- structural biotechnology journal*, 22-24.
4. Cox, E., & Edelman, W. (2009). A machine learning-based framework to identify type 2 diabetes through electronic health records." *International journal of medical informatics* 97-101.
5. Lee, A. & Kim, A. (2016). Risk prediction of type II diabetes based on random forest model. In *Advances in Electrical, Electronics, Information, Communication and Bio-Informatics (AEEICB), 2017 Third International Conference on*, pp. 382-386.
6. Robertson, S., Yunsheng, I. (2011). Anefficient instance selection algorithm for k nearest neighbor regression." *Neurocomputing* 26-34.
7. American Diabetes Association, 2012
8. Dhaval R. (2016). Application of data mining methods in diabetes prediction. In *Image, Vision and Computing (ICIVC), 2nd International Conference on*, pp. 1006-1010. IEEE, 2017.
9. Hambali, A. Ramiro, D., Alberto A. & Enrique L. (2017). Development of a fuzzy expert system for the nephropathy control assessment in patients with type 2 diabetes mellitus." *Expert Systems with Applications* 72 (2017): 335-343.
10. Ben Dickson, S. (2020). Performance analysis of classification algorithms under different datasets." In *Computing for Sustainable Global Development (INDIACom), 3rd International Conference on*, pp. 1584-1589. IEEE, 2016.
11. Abu-Nasser, K. R., (2000). "Predictive analysis of diabetes using J48 algorithm of classification techniques." In *Contemporary Computing and Informatics (IC3I), 2016 2nd International Conference on*, pp. 347-352. IEEE.
12. Mishkoff, K. (1985). Performance analysis of data mining classification techniques to predict diabetes." *Procedia Computer Science* 82(2016): 115-121.
13. Saadu, M. S. (2018). Padmavathi. "Application of K-means and genetic algorithms for dimension reduction by integrating SVM for diabetes diagnosis." *Procedia Computer Science* 47 76-83.
14. Siler, J. Pradeep, S. & Balamurali, S. (2005). Performance analysis of classifier models to predict diabetes mellitus." *Procedia Computer Science* 47 (2015): 45-51.
15. Luger, S., Usman, Q., & YounusJaved, H. (1998). An Efficient Rule-Based Classification of Diabetes Using ID3, C4. 5, & CART Ensembles." In *Frontiers of Information Technology (FIT), 2014 12th International Conference on*, pp. 226-231. IEEE.
16. Abdullah, S. Xue-Hui, Yi, & Xiang H, (2011). Comparison of three data mining models for predicting diabetes or prediabetes by risk factors." *The Kaohsiung journal of medical sciences* 29, no. 2 : 93-99.
17. Cho, G. (2019). Diagnosis of Diabetes Mellitus using K Nearest Neighbor Algorithm." *International Journal of Computer Science Trends And Technology (IJCST)*.