Headache and Migraine Diagnosis Using Neural Networks

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Abstract - The society today goes through a fast-moving world, resulting to stress, illnesses, and bad life-styles. Consequently, many experience times of headaches and migraines in various chapters of their lives. Currently, there are several online headache and migraine diagnosis systems available in the market, However, these available systems often require an amount of payment to generate the diagnosis, if not, it contains too many questions, which takes up too much time of the users. Online Headache and Migraine Diagnosis is targeted to the common society in the world. This prototype is an online system, providing users an easy-to-use platform to find out the type of headache or migraine that they have. It contains sixteen (16) questions which the user has to answer, by selecting the options available, and it will generate a report of the diagnosis based on the answers that they provide, which also contains a list of treatment options. The questions mainly help to find out the existence of various symptoms for the diagnosis of a particular type of headache or migraine. It applies the Artificial Neural Network technique to find the most suitable answer (diagnosis) for the user. It will help users to better understand their illness easily and conveniently.

INTRODUCTION

In the world this day, humans go through a much higher level of stress, workload, exertion, and exposure to a not-so-conducive environment. One major illness that is very common, especially among working people and schooling youths is headache or migraine. Very often, these two illnesses have been used too loosely until there is a misconception that all pains in the head is either a headache or in more severe conditions, a migraine. People will usually treat their pain with common pain-killers, which if overdose, may cause further problems to one's health.

From the observations and an interview conducted, even with the availability of physicians and online systems for headache and migraine diagnosis, people have to go through a lot of hassle to obtain the diagnosis itself. The patient will have to take time off work or school to see a physician and pay a hefty sum just for consultation, while the online systems available at present take too much time to fill in the diagnosis-prediction form (too many questions) to get the diagnosis in the end. Even so, the diagnosis given online is very general.

Thus, the Online Headache and Migraine Diagnosis System (OHMDS) is a free-of-charge online system, developed to assist the public (not so much for the medical professionals) to understand the type of headache or migraine that they suffer from, through the symptoms given by the user of the system. The user shall answer several questions to generate a diagnosis (in a form of a report) and the user shall also gain better understanding of his/her problem before taking any incorrect actions to treat the illness. Treatment options provided by the system shall allow the user to take further actions, which are appropriate and necessary.

BACKGROUND

There are many diagnosis systems available online, but not many are solely dedicated to the diagnosis of headaches and migraines. In this section, two (2) online diagnosis systems will be studied and reviewed to be compared to the OHMDS that has been developed.

YourDiagnosis was developed by a group of web and medical experts from the online health group WWW MacHealth Pty Ltd, a subsidiary of the Australian Macquarie Health Corporation. MacHealth's vision is to improve the quality and safety of health care by empowering individuals to have a greater understanding and involvement in their medical information. The purpose of YourDiagnosis is to provide people with the power to successfully obtain and manage their own diagnosis. YourDiagnosis was developed as a repository tool that enables individuals to manage and store health and personal information in a logical and organized format [1]

This online diagnosis system is very comprehensive, as it covers all types of illnesses. Due to its wholeness in diagnosing, very general questions are

asked first. Then only more specific questions are given to the patient to answer. It is believed that the artificial neural network technique is applied to the diagnosis system since it scopes down questions and is trained to be more specific after each answer is input. The questions come one by one, one question per page. The module to diagnose headache and/ migraine has almost 64 questions, taking around 40 minutes to answer all of them. There is the hassle of waiting for the page to load and for the answers to be processed.

National Medical Society Online Medical Diagnosis is said to be an accurate online medical diagnosis of symptoms, illnesses, diseases, and psychiatric disorders, created by The National Medical Society. This site is actually an online medical reference library. Its online medical diagnosis is monitored by Helen T. Rosenthal, MD; Sarah J. Thompson, MD; David Mann, MD; Joanne F. Masterson, MD. [2]. The site offers two types of diagnosis for users who want to diagnose if they have headache or migraine. One is the online diagnosis of headache and migraine based on the patient's symptoms, while the other is the online diagnosis of headache based on the patient's symptoms. All of the site's new treatments are updated every now and then.

In this online medical diagnosis, the user has only one page of questions. Depending on the illness, the number of questions varies. For just diagnosing headache, there are seven (7) questions, while for the headache and migraine; there are eight (8) questions. The user needs to type in the answer to two general questions and select the appropriate symptoms for the rest of the questionnaire.

METHODOLOGY

Artificial neural networks (ANN) is very commonly used in the medical field these days. Among the many areas of the medical field that applies the technique of Artificial Neural network are clinical medicine, medical image processing, and signal processing and interpretation [3]. According to [4], neural network approach can diagnose disease using the patient's medical data such as breast cancer, heart failure, medical images, acidosis diseases, and lung cancer.

Here, we can see the pattern of how ANN works to help in medical diagnosis. [4] also stated that making prognosis for patients with congestive heart failure is difficult due to the complex nature of this multi-system disease. There are many possibilities of symptoms that relate to the disease. Different combination of symptoms would mean different things, and a combination of several predictive parameters is suggested. ANN is a self-learning technique that could map out a particular pattern of input and its relationships to generate an output that best suits the inputs. [5] identified that classification is the best result for this cases. Therefore, the ANN is best applied into medical areas that would need a diagnosis based on a combination of inputs. Different input and output pattern for headache and migrane will be used to build and train the networks.

There are two main types of migraine (with aura and without aura), and two common types of headache (cluster and chronic). Common migraine is a type of migraine that is generally not preceded by an aura, although there may be a variety of symptoms prior to its onset [6]. The medical centre stated that patients suffering from this migraine may have mental "fuzziness", mood changes, fatigue, unusual retention of fluids, and diarrhea and increased urination. According to [7], this type of migraine attacks lasts for 4-27 hours (untreated or successfully treated). Usually, this type of migraine has characteristics like unilateral, pulsating, and/ or aggravated by movement. Some patients may also suffer from nausea or vomiting, photophobia, and phonophobia.

The Gutheran Lutheran Medical Centre [6] defined classic migraine as a type of migraine that involves appearance of neurological symptoms, called an aura (flashing lights or zigzag lines, or temporary loss of vision) ten to thirty minutes before an attack. Other classic migraine symptoms may include difficulty with speech, weakness of an arm of leg, tingling of the face or hands, and confusion.Aura symptoms last four to sixty minutes; usually occurring at alternating body sides in different attacks. Headache usually follows or accompanies aura within an hour (up to 42% of patient may have attacks of migraine attacks without headache) [7].

Cluster headache sufferers experience extremely severe headaches near on eye or the temple that lasts for fifteen minutes to three hours. Such headaches are usually unilateral and occasionally change sides. Patients may have symptoms such as drooping eyelids, conjunctival injection (which results in red, watery eyes), tearing, constricted pupil, nasal congestion, runny nose, sweating on the affected side of face, stiff or tender neck, jaw and teeth pain, restlessness, photophobia/sensitivity to light and vomiting. Cluster headaches are occasionally referred to as "alarm clock headache" as its regularity and timing of occurrence could wake a person from sleep. Such headaches could occur as often as once or more daily for a period of several weeks, followed by a headache-free period lasting for as long as years before attacking again [8].

According to [7], chronic headaches are frequent headache attacks. An average headache frequency could be at least fifteen days per month for at least six months a year. This type of headache is usually bilateral, mild to moderate severity, pressing, tightening quality, and not aggravated by physical activities. Patients with chronic headache do not suffer from vomiting and no more than a nausea, photophobia or phonophobia

Fig. 1. Overall System Design

IMPLEMENTATION

The overall system design for the OHMDS is shown in Figure 1. The basic flow of the user shall be that the user logs on to the internet. After that, the user opens the website of the OHMDS. The user shall select the symptoms that he/she has and select the 'Submit' button to generate a diagnosis and treatment option for the headache or migraine. There is no need for login since it is an online diagnosis system. The User has to answer the questionnaire by selecting the radio buttons (symptoms) and click on the 'Submit' button to generate a diagnosis report. The User can print out the report by printing out the web page of the system. Only the Admin can update the database containing the symptoms for the use of generating the diagnosis.

The neural network for the OHMDS was designed in such a way that it has sixteen (16) input layers represented by 'X1'-'X16', two (2) hidden layers represented by 'V1-V4' and 'Z1-Z2', and one (1) output layer represented by 'Y'. It depicts the sixteen (16) answers of the OHMDS questionnaire, which at the end will generate one (1) diagnosis of headache or migraine shown in Figure 2.

The process flow shows the flow of the system. The flow starts when the questionnaire is answered. There is a counter to keep count of the questions, to check if the questions are answered or not. The database connection will be opened and the values of the radio buttons will be retrieved. If the connection is not established, an error message will appear, stating that the 'Database is not found'. The system will check if all questions are answered. If all the questions are answered, the database connection will close, and the system will enter the neural network calculation. If not, an error message will appear, stating '*Error* You did not click on question #' If the output 'Y' of the neural network calculation is within the specified range, then the diagnosis report will be generated, and the process flow will end. If not, no diagnosis report will be generated, and the process flow will end. Details of the process flow are shown in Figure 3.

RESULT

The results obtained from the testing of the system can be evaluated by the functionality of the system. The system serves its purpose like a survey form, but with an answer generated for the user at the end of the process.

The Online Headache and Migraine Diagnosis System (OHMDS) contains sixteen (16) questions comprising of symptoms relating to four (4) different types of headaches and migraines, of which the user have to select (input) according to how he/she feels (the user's own symptoms). The selection is done by clicking on one radio button (choice answer) for each question (Figure 4). The user is able to generate a report of the diagnosis (or prediction) after answering all sixteen (16) questions and clicking on the 'Submit' button at the end of the form. There is no need for the user of the system to login to the system to use it. In terms of interfaces, radio button functions, and generation of output, the OHMDS meets its objectives to produce a prototype for diagnosing the 4 types of headaches and migraines, produce a report based on the answers, and provide treatment options for the user shown in Figure 5.

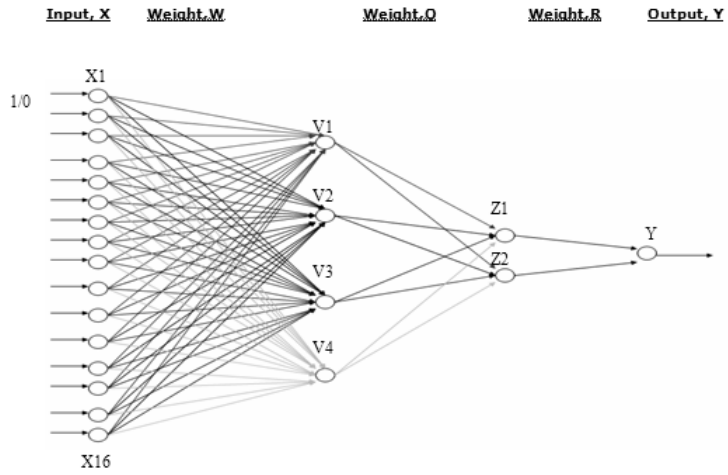

Fig. 2. Neural Network Design for OHMDS

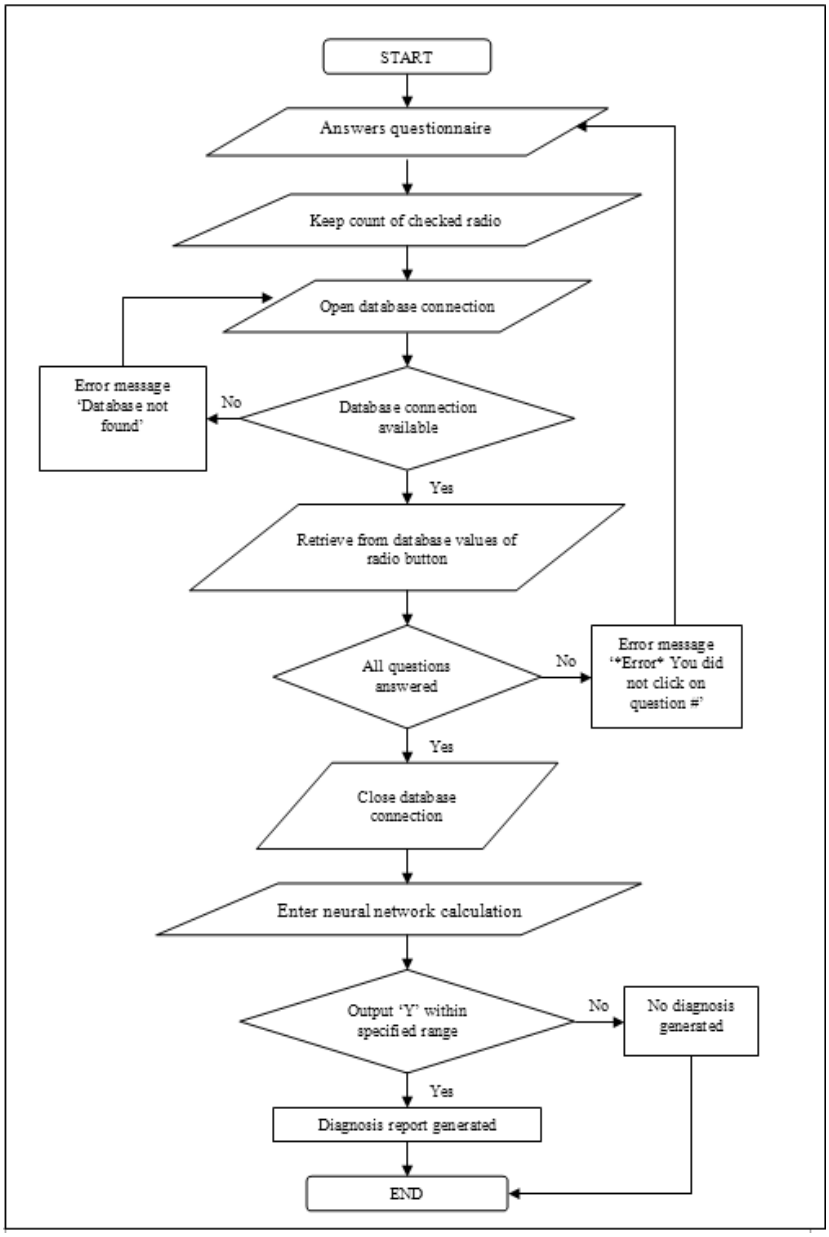

Fig.3. Flow chart of Process Flow

The artificial intelligence (AI) technique, artificial neural network (ANN) aids in generating a diagnosis quickly and accurately. This technique is applied as the engine of the system to produce a report (output) for the user. It uses a mathematical formula, which uses the inputs to generate a single output (type of headache/ migraine) that is most accurate according to the user's symptoms. The report generated shall contain three (3) things, which are:

i. the name of the diagnosis (type of headache/ migraine that the user has),
i. a brief description of the illness, and
ii. the treatment options to guide the user for further action on the illness

The OHMDS could produce a result (output), however, the issue of accurate and desired results could not be obtained. The user can click on the 'Print Report' link to print the report out for further advice and action. This function could work as desired

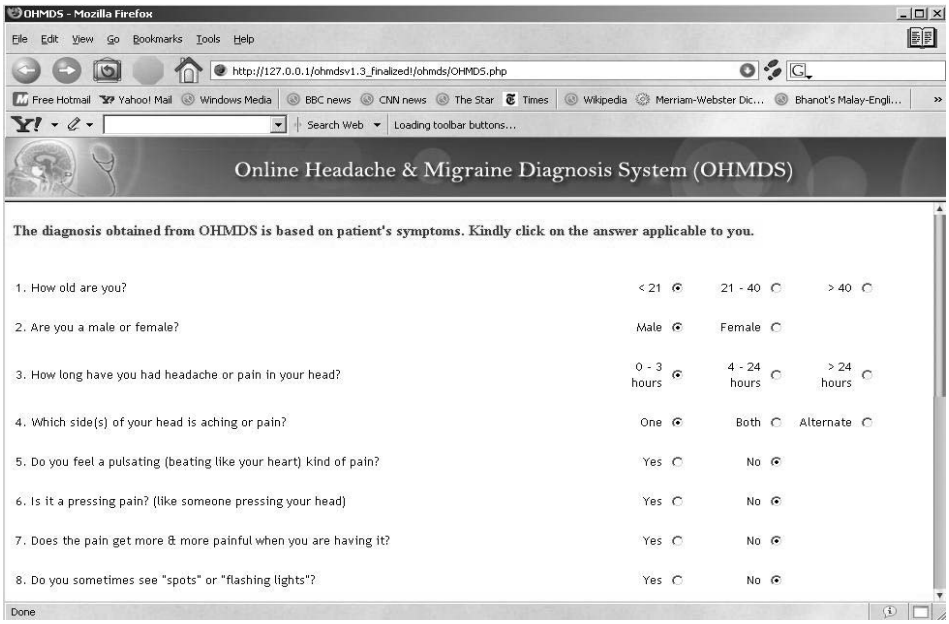

Fig. 4. Example of OHMDS Interface

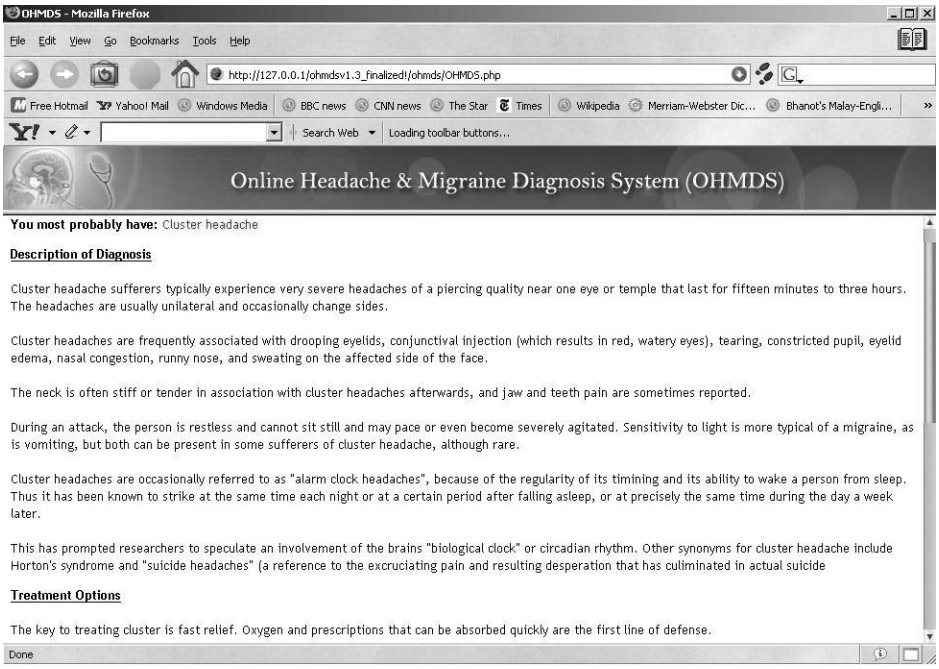

Fig. 5. Diagnosis, brief description of diagnosis, and treatment options

CONCLUSION

The OHMDS is a prototype application to diagnose two types of common headache, which are cluster headache and chronic headache, and two major types of migraine, being migraine with aura and migraine without aura. The system is an online diagnosis system, developed using the PHP scripting language, Macromedia Dreamweaver as the interface and webpage development tool, the MySQL as its database management system, the APACHE web server, and using the Artificial Neural Network (ANN) technique. Thus, this project produced a prototype of the OHMDS, which allows users to connect to the website through the internet and answer the questionnaire to generate a diagnosis for the particular type of headache or migraine. The user could then print out a copy of the generated report for information and diagnosis, plus the treatment options provided by the system for further reference. There are several constraints

of the current system, but the constraints could be overcome in future researches and development

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