Health Monitoring with Artificial Intelligence

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***Abstract*—Health is very important, but many people do not care about health. In developing countries, public awareness of the importance of health is minimal. This is because some people cannot easily consult a doctor about their health problems due to limited time, money, and much more. Time and money can be an obstacle for someone when they want to run routine health checks, especially for someone who has a busy schedule. We have developed an artificial intelligence-based application that can be used by people to accurately check their health from the symptoms provided by the user. People also usually did not have enough time to have a medical check-up in the hospital. What if there is a place where we can find about health problem just by entering symptoms or just scanning an ECG or you can check whether the prescribed medicine is supposed to be used the way you are told to. Such a problem can be solved by using medical chatbot by giving proper guidance regarding healthy living. This application is also designed to be easy to use anywhere and anytime with the hope that public awareness about health will get better.**

Keywords—artificial intelligence, chatbot, classification, symptoms, health monitoring

I. INTRODUCTION

The background of our study because health is one of the most important aspects of social life. However, not everyone can easily consult a medical doctor about their health problems because of limited time, money, and much more. Time and cost can be an obstacle for someone when they want to run routine health checks, especially for someone who has a busy schedule. Many people tend not to check their health regularly to the hospital because of time and cost constraints until finally some people just check when their health condition has deteriorated.

The chatbot system focuses on messages provided by the user when starting a conversation [1], [2], [3]. The idea behind this is to detect initial symptoms and problems that users may experience. The development of Health Chatbot is highly dependent on Artificial Intelligence algorithms and training data [4], [5]. After Chatbot discovers a user's illness, the chatbot will determine the level of the disease and give treatment suggestion or it will give a medical doctor phone number to contact for further discussion. It can be predicted that the chatbot applications will be useful to help people to get information related to their questions and problems. Therefore health chatbots have broad future coverage [6]. The chatbot does not depend on how far a person from health facilities to have a healthy discussion. A person just need a device to connect to the internet such as smartphone, laptop or tablet. Chatbot efficiency can be increased by updating the number of words and their word combination and it will lead to increase database usage. This will make the health chatbot can answer and give information about more a lot of diseases. Even voice conversations could be developed to the health chatbot system that will be easier for using it.

We developed a python-based chatbot because the python language has many libraries that support machine learning processes such as TensorFlow, Scikit-learn, NumPy, Pandas, SciPy, Seaborn, and so on [7], [8], [9]. Bots will be trained first with a dataset about symptoms and health problems using machine learning algorithms, one of which is classification. The training process is to provide some symptoms and a label that shows the disease that may be suffered based on the symptoms given [10], [11]. Then, we will calibrate the data so that the bot will produce accurate results according to the symptoms of the disease entered by the user. The bot will ask users several questions, and then the bot will use the user's answers based on the questions asked to classify the disease, then the drug used [12], [13]. This application is expected to help reduce the cost of health consultations and increase the user knowledge in the health sector. The chatbot can also be a medical reference that can help patients learn more about their illness [14]. The purpose of our research are (a) People could check their health conditions anytime and anywhere. (b) Detect and analyze diseases more accurately with the help of data and artificial intelligence. (c) Increasing public awareness of the importance of health. With our system, people do not have to spend a lot of time and money to check their health, and people are more aware of the importance of health.

II. THEORETICAL BASIS

The first implementation of Artificial Intelligence technology in the area of medical was introduced by Gunn in 1976 [15]. Gunn discuss about the potential to analyze acute abdominal pain by the computer program. Modern medicine is challenged to solve complex clinical problems by analyzing and applying artificial intelligence methods [16], [17]. The artificial intelligence technology could help clinicians in the formulation of diagnoses and decisions about the illness of the patient. The AI was developed to help health workers in their daily tasks, supporting tasks that depend on data and knowledge manipulation. The AI was developed to help health workers in their daily tasks, supporting tasks that depend on data and knowledge manipulation such as Artificial Neural Networks (ANN)

methods, hybrid intelligent systems, fuzzy expert systems, and evolutionary computing [18], [19], [20].

One of the popular AI techniques in the medical field is ANN. ANN is a computational analytical tool with the concept of the biological nervous system. It is an interconnected computer processor called neuron that can do parallel computing to process data. ANN becomes an interesting tool for analyzing in the area of medical and medicine because it learns from data and information, analyzes non-linear data, handles inaccurate information and generalizes applications that allow models for independent data [21].

ANN has become increasingly popular as a tool to solve various types of problems in many disciplines such as forecasting, identification, and classification [22], [23]. The methods for training data are supervised training, unsupervised training, and combined unsupervised and supervised training. Classifiers who are trained by supervision need information or data with labels which determine the accurate class in the training process. Clustering uses unsupervised training which means using training data without labels. Classifiers who use a combination of unsupervised and supervised training usually use unsupervised training with unlabeled data to form internal groups. Labels are then assigned to cluster locations, and centroid clusters and the size is often changed using a small amount of supervised training data. Although the combination of unsupervised and supervised training can reduce the amount of labeled training data needed and reduce expensive hand labeling.

Nowadays, chatbot is not just a simple bot like the old one [24], [25]. The new chatbot now use artificial intelligence on it. Chatbot we can implement on many ways. One of those is for medical. Users who feel ill, can interact using chatbots that connected to the healthcare system, and all the information which the user interact are going to stay in the system, and that is essential for users and the healthcare provider [25], [26].

Machine Learning algorithm could be performed after the preprocessing or quality control process is appropriate when using image datasets, EP, and genetic data because it can be understood by the machine. However, most clinical information comes in the form of narrative texts, such as physical examinations, clinical laboratory reports, operating records, and return summary, which is unstructured and cannot be understood for computer programs [27], [28]. In this case, the target of NLP is to extract useful information from narrative texts to help clinical decision making. NLP itself consists of two main components namely, text processing and classification. Through text processing, NLP identifies a series of relevant diseases using keywords in clinical records based on history in the database. Then a subset of keywords is selected by examining their effect on the classification of normal and abnormal cases. Validated keywords are then entered into training data to support decision making [29].

NLP has been developed to help make clinical decisions about treatments that monitor side effects and so on. The NLP used to read chest X-ray reports will help the antibiotic assistant to warn the doctor about the possibility of anti-infectious therapy. Miller et al. use NLP to automatically monitor laboratory-based side effects. Furthermore, NLP can help diagnose the disease. For example, Castro et al. identified 14 brain aneurysms disease-related variables through the application of NLP on clinical notes. The resulting variables were successfully used to classify normal patients and patients with brains, with an accuracy rate of 95% and 86% in the training and validation samples, respectively.

Afzal et al. applied NLP to extract keywords related to peripheral arterial disease from narrative clinical records. These keywords are then used to classify normal and patients with peripheral arterial disease, which achieves more than 90% accuracy.

A Chatbot is application, website or other networks that help and assist customers to perform a particular task. It uses Natural language processing program to analyze the data and generate the results [30], [31]. A. Natural Language Processing Natural language processing (NLP) is a field of artificial intelligence that helps in designing a program to process and analyze natural language data. It allows to establish interactions between computers and humans in a natural language. The system we could use like Chatterbot, Dialog system or Machine conversation system. On the bot we could use Decision Tree Algorithm. Decision tree learning is one of the predictive modeling approaches used in data mining and machine learning and also in in statistics. It processes the data by observing an item and drawing conclusions about the item. A decision tree has internal nodes, branches and leaf nodes. The First node in a tree is referred as root of the tree.

Healthcare, and in particular eHealth, can benefit from this model since it strongly requires a human-like interaction scheme. A chatbot is an artificial entity able to autonomously hold a conversation via message exchange [32]. With progress in machine and deep learning, nowadays chatbot can be very reliable and able to provide automatic and adaptive human-like conversation behavior, getting involved in several application fields including customer services or data collection. The cluster-computing facility is provided by Databricks where a cluster of servers allows cluster-computing over the Spark framework. The chatbot application is implemented by the Watson Conversation Service, designed and trained via the Bluemix platform.

In many cases, the solutions provided by doctors would not be usable to the patients due to inclusion of medical concepts and terminologies. The answers provided by the well-trained experts may contain acronyms with multiple possible meanings and non-standardized terms. The users struggle to understand those terminologies and have an overhead [33].

Auto-generated system is a recent approach developed to overcome these problems. Automatic content generation systems are expected to be more reliable and compatible due to the presence of local medical coding and global learning approach. This system bridges the gap between health seekers and healthcare providers. Further this system provides instant and relevant replies to the queries. At earliest stage this automatic mapping medical record system uses rule based and machine learning approaches to code medical terminologies with standardized terminologies. Also, this previous work used only the simple medical dictionary to code the medical records, which may bring inappropriate terminologies.

Nowadays, more and more medical knowledge has been accumulated and made available on the web through various knowledge bases (KBs) focus on specific domain. Given the great amount of information that is available is media KBs users are experiencing an increasing difficulty to find the proper answer to questions they are looking for in a specific situation. Furthermore, users might even not know the relevant knowledge to be focused on, when the answer to a specific question is searched for [34]. Starting from these considerations, this paper proposes a knowledge-based conversational chatbot for medical question answering, aimed at supporting the formulation of factoid questions over medical KBs, the generation of more precise and contextualized dialog responses by analyzing the relations between entities in the KBs. Moreover, this system is also able to recognize ambiguous user intents, with respect to the current dialog state, and provide, as a result, some interaction hints aimed at clarifying and/or confirming their meaning.

III. METHODOLOGY

In this section, we will explain how this research process will work. We will describe the methods and techniques that will be used to manage the process when conducting research.

The medical chat-bots functioning depends on natural language processing that helps users to submit their problem about the health. It is going to advantage us to presume the issues and to confirm the answer. The proposed idea is to produce a system with AI which is meeting the requests. The AI can calculate the diseases level based on the indications and provide the list of existing healings. The system could also provide the composition of the prescriptions and their recommended uses. It assists users to decide the accurate treatment. Therefore, people could have knowledge about their health and could select the right protection.

For the data analysis we will use the classification method in artificial intelligence to predict and classify disease based on symptoms that the patient reported. Since our research project uses artificial intelligence to detect disease based on specific physical symptoms and characteristics, we will look for data on disease characteristics and symptoms on medical websites and medical journals so that we can get valid data that can be used to conduct our research.

This method is certainly not going to run perfectly because of the limitations of the data we have obtained and the algorithm that is not 100% appropriate. So that we will continue to develop in the data and algorithm so that this research methodology will run well.

IV. STATE OF THE ART

Our research with the title Artificial Intelligence Chatbot for Health explains the chat bot system to detect the presence of diseases or health concerns based on python. Health is one of the most important things in life, but not everyone is able to do health consultations because of the limited time they have, money, and other factors. Besides, not everyone knows how to treat every disease. Therefore, we want to develop a medical chat bot that is easy to use and helps others. The user simply explains how he feels and the bot will detect the symptoms of the disease and how to handle that can be done by the user. For its implementation, we rely on the AI algorithms in the form of classification and conduct training data. We use a dataset in the form of symptoms and disease names and carry out a classification process to produce accurate data based on existing symptoms. The results of our study are chat bot applications that will greatly assist users in monitoring their health.

V. RESULTS

In this application research, we use the K-Nearest Neighbor (KNN) algorithm to help the classification process to determine the user's health status. K-NN (K-Nearest Neighbor) is one of the lazy learning methods. To classify the unknown tuple X, K-NN will use the k-neighbor closest label (K-Nearest Neighbor) to determine the tuple label. The algorithm requires three things:

- Collection of training data
- Distance Metrics to calculate the distance between data to be calculated with each data in the specified training
- Value k, number of nearest neighbors

TABLE I. TRAINING SET

Age	Food Choice	Smoking	Obesity	Heart Attack (Label)
<= 40	Steak	No	No	No
<= 40	Steak	No	Yes	No
41..70	Steak	No	No	Yes
> 70	Fried Chicken	No	No	Yes
> 70	Fish	Yes	No	Yes
> 70	Fish	Yes	Yes	No
41..70	Fish	Yes	Yes	Yes
<= 40	Fried Chicken	No	No	No
<= 40	Fish	Yes	No	Yes
> 70	Fried Chicken	Yes	No	Yes
<= 40	Fried Chicken	Yes	Yes	Yes
41..70	Fried Chicken	No	Yes	Yes
41..70	Steak	Yes	No	Yes
> 70	Fried Chicken	No	Yes	No

Data to classified is shown in table II.

TABLE II. CLASSIFIED DATA

Age	Food Choice	Smoking	Obesity	Heart Attack (Label)
<= 40	Fried Chicken	Yes	No	?

To classify data that is not labeled:

- Calculate the distance between the data you want to verify and each data in the training set
- Identify the closest friend by taking k-objects that have the closest distance from the data to be invited
- Use the k-nearest neighbor label to determine the data label to be approved by taking the label that appears the most.

Example of a training set shown in table 1.

A. Step 1

Determine the parameter K = number of nearest neighbors. We assume K = 3.

B. Step 2

Calculate the distance between the data to be translated and each data in the training set. To calculate distances, it's easier if the data is numeric. In this case, the data is not numeric, so we have to convert non-numeric data to numeric data:

Classes for ages:

- <= 40: 0
- 41-70: 1
- > 70: 2

Grades for Food Choices:

- Fish: 0
- Fried Chicken: 1
- Steak: 2

Smoking rate:

- No: 0
- Yes: 1

Levels for Obesity:

- No: 0
- Yes: 1

The set of training results can be seen in table III and data to classified shown in table IV.

TABLE III. SET OF TRAINING RESULTS

Age	Food Choice	Smoking	Obesity	Heart Attack (Label)
0	2	0	0	No
0	2	0	1	No
1	2	0	0	Yes
2	1	0	0	Yes
2	0	1	0	Yes
2	0	1	1	No
1	0	1	1	Yes
0	1	0	0	No
0	0	1	0	Yes
2	1	1	0	Yes
0	1	1	1	Yes
1	1	0	1	Yes

Age	Food Choice	Smoking	Obesity	Heart Attack (Label)
0	1	1	0	?
1	1	1	0	Yes
2	1	0	1	No

TABLE IV. DATA TO CLASSIFIED

C. Step 3

Calculate the distance between the data to be classified and each data in the training set. Use Euclidean Distance to calculate distances:

$$d(p,q) = \sqrt{\sum_{i=0}^{t}(x_i - y_i)^2} \qquad (1)$$

d (p, q) is the distance between object p and object q
p is data that have to be classified
q is each data in training set
$\mathbf{x_i}$ is an attribute-i from object p
$\mathbf{y_i}$ is an attribute-i from object q
t is number of attribute

$$d(p,q) = \sqrt{(p_{age} - q_{age})^2 + (p_{food\ choice} - q_{food\ choice})^2 + (p_{smoking} - q_{smoking})^2 + (p_{obesity} - q_{obesity})^2}$$

$$d(p,q_1) = \sqrt{(0-0)^2 + (1-2)^2 + (1-0)^2 + (0-0)^2} = 1.41$$

$$d(p,q_2) = \sqrt{(0-0)^2 + (1-2)^2 + (1-0)^2 + (0-1)^2} = 1.73$$

$$d(p,q_3) = \sqrt{(0-1)^2 + (1-2)^2 + (1-0)^2 + (0-0)^2} = 1.73$$

$$d(p,q_4) = \sqrt{(0-2)^2 + (1-1)^2 + (1-0)^2 + (0-0)^2} = 1.73$$

$$d(p,q_5) = \sqrt{(0-2)^2 + (1-0)^2 + (1-1)^2 + (0-0)^2} = 1.73$$

$$d(p,q_6) = \sqrt{(0-2)^2 + (1-0)^2 + (1-1)^2 + (0-1)^2} = 2$$

$$d(p,q_7) = \sqrt{(0-1)^2 + (1-0)^2 + (1-1)^2 + (0-1)^2} = 1.73$$

$$d(p,q_8) = \sqrt{(0-0)^2 + (1-1)^2 + (1-0)^2 + (0-0)^2} = 1$$

$$d(p,q_9) = \sqrt{(0-0)^2 + (1-0)^2 + (1-1)^2 + (0-0)^2} = 1$$

$$d(p,q_{10}) = \sqrt{(0-2)^2 + (1-1)^2 + (1-1)^2 + (0-0)^2} = 1.41$$

$$d(p,q_{11}) = \sqrt{(0-0)^2 + (1-1)^2 + (1-1)^2 + (0-1)^2} = 1$$

$$d(p,q_{12}) = \sqrt{(0-1)^2 + (1-1)^2 + (1-0)^2 + (0-1)^2} = 1.73$$

$$d(p,q_{13}) = \sqrt{(0-1)^2 + (1-1)^2 + (1-1)^2 + (0-0)^2} = 1$$

$$d(p,q_{14}) = \sqrt{(0-2)^2 + (1-1)^2 + (1-0)^2 + (0-1)^2} = 2$$

D. Step 4

Sort the distance in *ascending* to find the nearest neighbours can be seen in table V.

TABLE V. THE DISTANCE TO FIND THE NEAEREST NEIGHBOURS

Distance	Heart Attack (Label)
$d(p,q_8) = 1$	No
$d(p,q_9) = 1$	Yes
$d(p,q_{11}) = 1$	Yes
$d(p,q_{13}) = 1$	Yes
$d(p,q_1) = 1.41$	No
$d(p,q_{10}) = 1.41$	Yes
$d(p,q_2) = 1.73$	No
$d(p,q_3) = 1.73$	Yes
$d(p,q_4) = 1.73$	Yes
$d(p,q_5) = 1.73$	Yes
$d(p,q_7) = 1.73$	Yes
$d(p,q_{12}) = 1.73$	Yes
$d(p,q_6) = 2$	No
$d(p,q_{14}) = 2$	No

E. Step 5

The 3 nearest neighbours can be seen in table VI

TABLE VI. THE 3 NEAREST NEIGHBOURS

Distance	Heart Attack (Label)
$d(p,q_8) = 1$	No
$d(p,q_9) = 1$	Yes
$d(p,q_{11}) = 1$	Yes

TABLE VII. HEART ATTACK PERCENTAGE

Heart Attack (Label)	Percentage
Yes	2 / 3 = 0.667
No	1 / 3 = 0.333

From the table above we can see that from k-nearest neighbours from the data that we want to classify with k = 3, the number of nearest neighbours with the Heart Attack = "yes" class is more than the number of nearest neighbours with the Heart Attack = "no" class. So, we can classify that the data to be classified belongs to the class Heart Attack = "yes".

VI. CONCLUSION

Health is one of the most important aspects of social life. However, not everyone can easily consult a doctor about their health problems because of limited time, money, and much more. Our medical chatbot is highly dependent on AI algorithms and training data. The system can classify and identify the treatment and also determine the right medical doctor to consul the health issues. We believe that our system will be useful for next future because people will spend more on chat application. Thus, medical chatbots have broad future coverage.

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