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IoT-Artificial intelligence-based disease detection using KNN in healthcare system

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***Abstract*— The two technologies of artificial intelligence and the Internet of Things have been very effective in the development of the smart city, especially in the field of medicine. ML and DL methods help to diagnose and predict the disease and treatment stages. In this article, an algorithm is proposed that can analyze and diagnose the disease in real time along with the data stream sent from IOT devices.In this method, the data is stored after initial processing and cleaning of the sent data and tested with pre-trained data by KNN method. A table of indicators of each class is arranged and the sent data is tested more quickly.**

Keywords— K-nearest neighbor (K-NN), Internet of Medical Things, Sensors, predict disease.

I. INTRODUCTION (

Nowadays, many countries are increasingly using remote smart health care to improve people's health and reduce treatment costs. According to the World Health Organization, there is a deep gap between the shortage of human resources and the high demand for medical services. Especially in underdeveloped countries, it has led to the death of thousands of people. In order to achieve this goal, the two technologies of Internet of Things and artificial intelligence help physicians to monitor and diagnose and treat acute and chronic patients [2][5] .

Internet of Medical Things (IoMT) : connects the patient to the physicianat any time and place .It receives vital signs using wearable sensors, smart watches and other gadgets and sends them to the cloud through the appropriate network. After cloud computing, the results are sent to the physician on applications or web pages to make decisions[19] The sensor network is responsible for collecting physiological data from the body surface and transferring these data to the cloud through a wireless channel. Physiological sensor include Blood pressure, Body position sensor, Body temperature sensors, ECG,EEG, Pulse sensors, Breathing rate sensors, EMG, glucometer ,Galvanic skin response sensor ,Pulse oximetry , weight[20] which generate a huge amount of data . the most produced data type are Numerical. data send to cloud and in this layer AI with data process predict and diagnose disease.

Artificial Intelligence (AI) in health care: In general, the role of artificial intelligence in the medical industry is processing and diagnosing diseases from medical images, remote patient care, medical research and medicine.discovery, rehabilitation and mental disease and psychotherapy[13]. In this process huge amount of data collect from hospitals, labs, wearable sensors (vital sign and clinical data), Medical imaging centers(Graphs, CT Scan , MRI,ECG,EEG,EMG) and other diagnostic centers. this data use for predict and diagnosis disease and treatment patient and also suggest drug in short time by AI method .after collecting patient information, needs to Pre-processing of the data that it has been carried out to fill in missing values, eliminate ambiguous and redundant data, and standardize.in last stage select suitable ml algorithm .[3].different AI methods use for define disease like logistic regression, Naïve Bayes, K-nearest

neighbor (K-NN), support vector machine (SVM), decision tree, random forest, CNN,RNN,ANN, C4.5[16,3] They are mostly used in the medical industry.

AIOT: Although at first the data received from the IOT medical device Illustrated on IOT platforms and sent for medical decisions,and this stage was done manually by the treatment staff and with human error but now artificial intelligence is able to predict and diagnose and provide treatment methods without the intervention of a physician. AI and IOT can take emergency measures to resolve the crisis and Reduce the workload of the treatment staff, increase patient satisfaction, reduce medical errors, and reduce treatment and care costs.

Related works

A. In this section, we will discuss the research done in the field of IoT-Artificial intelligence-based disease prediction in healthcare system. Areej A. Malibari et al introduced EO-LWAMCNet method for predicts heart and kidney diseases in real-time. The method was implemented in the MATLAB library The accuracy of the proposed model on two different datasets is 93.5% and 94%[1]. Md. Imam Hossain et al comparing 5 methode (logistic regression, Naïve Bayes, K-nearest neighbor (K-NN), support vector machine (SVM), decision tree, random forest, and multilayer perceptron (MLP) for heart disease and Random forest has the highest accuracy rate (90%) than other[]. A Angel Nancy et al predicting heart disease risk built around Bi-LSTM (bidirectional long short-term memory) showcases an accuracy of 98.86%, a precision of 98.9[].CNN the mostely use for variety cancers and TUMORS. Asmaa H. Rabie et al illustrate K-nearest neighbor (KNN) method could detect Covid-19 in rapid and more accurate[21]. Richa Indu et al proposed conventional kNN to detect Parkinsonian disorder with Gait, Handwriting and Voice parameters and The result obtained approximately 99%[22]. Mustafa Qays Hatem use knn to identify skin lesions and classify them as normal skin and malignant skin lesions that imply pathology. The accuracy of the system reached 98% in classifying skin lesions[23].knn is also detect diabetes ,heart disease and thyroid disease and Alzheimer. InduSaini et al using KNN for analysis ECG signals for detect disease with high accuracy [24].

Propsed method

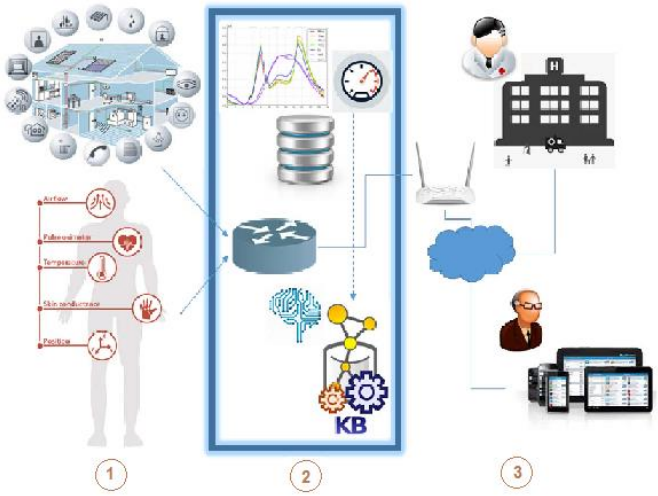


Figure 1

Figure 1 shows the architecture of the Internet of Medical Things. In the first stage, the patient's vital signs are transmitted through sensors and through the network to the second stage, which are the cloud. The vital signals are transmitted through a series of methods, such as amplification or filtering. are processed to improve signal quality and meet wireless transmission requirements. In the second step, the data is pre-processed by computing cloud and duplicate data is removed and purified. Then the appropriate algorithm is applied to the data to achieve the desired results. These algorithms can be data mining or machine learning or deep learning algorithms. The output of this stage, which is information, is sent to the third stage, which is the treatment staff, for decision-making and necessary measures.In this article, by presenting the proposed algorithm that can be done in the second stage, it tries to diagnose the disease more accurately in the shortest possible time.

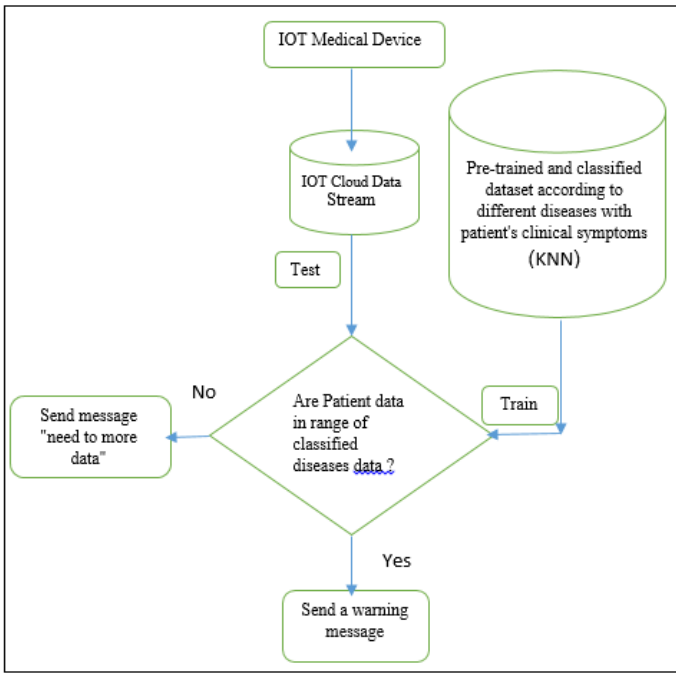
Difinition

K-Nearest Neighbors (KNN) is a popular machine learning algorithm used for classification and regression tasks. KNN method is advantageous for object classification because it requires only a few parameters to tune, such as K and the distance metric, to achieve high classification accuracy. The choice of K and distance metric is crucial for computing the nearest distance and determining the classification boundaries. This results in the highest correct classification rate. Key points include:

- KNN requires few parameters to tune for high classification accuracy.
- The choice of K and distance metric is critical for computing the nearest distance and determining classification boundaries.

Some popular distance metrics used in KNN include Euclidean distance, Manhattan distance, and Minkowski distance. The distance metric plays a significant role in the algorithm's performance, and the choice of metric can impact the classification accuracy.

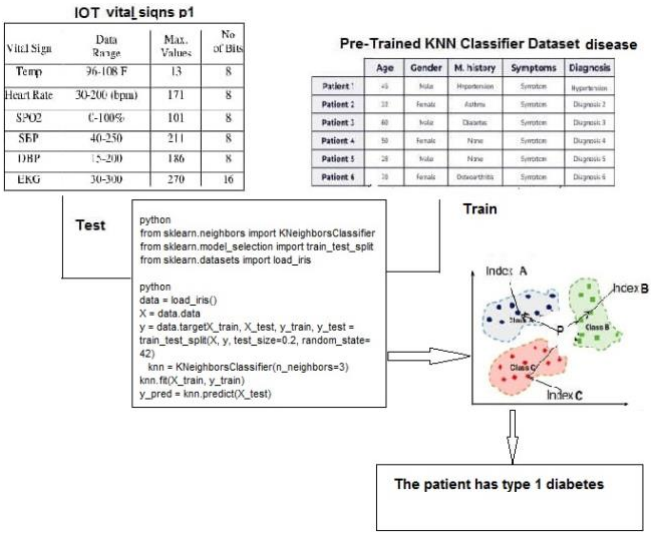
KNN method has been used in applications such as data mining, statistical pattern recognition, image processing, recognition of handwriting, ECG disease classification.[24]



a.)

Fig. 1. Example of a figure caption. (*figure caption*)

The proposed algorithm is shown in figure 2. According to the shown diagram, a dataset has been placed in the iot cloud(stage2 in figure 1), which has already been classified by KNN according to the characteristics of each disease. Each class will have an index. When the data is sent from the sensors connected to the patient's body, it first compared with these indicators. and the appropriate class is determined, then the test steps are performed. For example, if the patient's features are close to the category index of digestive patients, the test will be performed with the same category and the type of digestive disease will be determined more precisely. If the patient is not included in any of the categories, the input data from the medical devices is insufficient or missing data has occurred. In this case, a notification is sent to the patient using the Internet of Things to send his symptoms again. And if the algorithm is successfully tested and the type of disease is determined, the patient's condition will be sent to the treatment staff, the individual and his family. As stated in the previous research, KNN is used to diagnose diabetes, heart diseases, Alzheimer's, Parkinson's, covid-19, high-functioning thyroid diseases. It seems that this method is mostly used in Disease works well with non-image data that does not require complex processing. If the patient has a digital file including MRI, ECG and other medical image clinical tests, a more accurate diagnosis can be made.



Results and discussions

Time plays an important role in patient care and treatment. Since the large volume of requests for medical services and the limited availability of specialist doctors endanger the lives of patients, the presence of intelligent diagnosis systems will help doctors. In the proposed algorithm, because a pre-trained dataset is used and the new data is tested at a higher speed, we reach the desired goal. On the other hand, KNN method has been used in many researches to diagnose diseases

Conclusion

IOMT is basically a solution based on the Internet of Things, which includes a network architecture that allows communication between patients and health care facilities such as electrocardiography, etc., and has three layers, which are shown in Figure 1. The data collection layer collects the input data from the patients through the sensors and sends it to the gateway (modem) for the data management layer.The data management layer is a (clinical) server or cloud service for data processing and storage, and finally a medical server that will access the patient's clinical history in a health information system storing the individual's health records (Rodriguez et al. 2018). Many artificial intelligence algorithms, especially when processing large datasets such as medical image datasets, may take hours due to the complexity of the processing.

One of the main goals of the Internet of Medical Things is to provide medical services in the fastest time and at the lowest cost and with the highest accuracy and quality. Therefore, in order to diagnose and treat the disease on time and resolve the crisis, the time of the process should be minimized.

Since the datasets of various diseases are very voluminous and require high processing time, it is suggested in the algorithm to use pre-trained datasets. Then, the data sent from

the sensors connected to the patient are tested and the type of the disease is diagnosed. And the patient is informed

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