Development of an IoT-based and cloud-based disease prediction and diagnosis system for healthcare using machine learning algorithms

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ABSTRACT

Internet of Things (IoT) refers to the practice of designing and modeling objects connected to the Internet through computer networks. In the past few years, IoT-based health care programs have provided multidimensional features and services in real time. These programs provide hospitalization for millions of people to receive regular health updates for a healthier life. Induction of IoT devices in the healthcare environment have revitalized multiple features of these applications. In this paper, a disease diagnosis system is designed based on the Internet of Things. In this system, first, the patient's courtesy signals are recorded by wearable sensors. These signals are then transmitted to a server in the network environment. This article also presents a new hybrid decision making approach for diagnosis. In this method, a feature set of patient signals is initially created. Then these features go unnoticed on the basis of a learning model. A diagnosis is then performed using a neural fuzzy model. In order to evaluate this system, a specific diagnosis of a specific disease, such as a diagnosis of a patient's normal and unnatural pulse, or the diagnosis of diabetic problems, will be simulated.

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1. INTRODUCTION

IoT refers to the practical and functional relationship between different objects in the Internet of Things. IoT addresses the issue that it is better to have laptops and servers and stronger mobile phones rather than the less powerful but networked devices. Examples of these weaker devices can be watches, smartphones and anything else that is electronic. Frequent usable human objects such as vehicles are cleverly developed by processors, manufactured with real-world sensors and outputs, all embedded in an everyday usable object [1-4].

From this day on, electronic devices are more powerful than a black device, so they can create a smart network environment. These objects in the Internet of Things have the power of processing and decision making so that they do not need to be managed by anyone. Modifications, such as multitasking, refer to the fact that these devices are capable of doing everything. An object can receive input from a human or anything else and process it and send it to the output. For example, a machine can save the number of yarns used or anything else left over [5-8].

This can be done by sensors at no cost or anything else. "Stimulators" can be used in sensors to connect objects in the world to outputs to the human world. Some of these results are triggered by regular and aggregated data on the Internet. A sewing machine may create an alarm that is disappearing and needs to be replaced [9-12].

The Internet of Things and Claude's environment work as well as each other. The monitoring system designed by these two technologies is able to easily manage and monitor patients over a large area of land. The IoT comes with the help of Claude's environment to increase its computing power. This is done by adding small devices on the user side so that one set of computations is done first and not all server-side computations. Therefore, the combination of the IoT system and the cloud environment is intended to increase computing power [13-17].

Integrating a suite of Freeware and IoT cloud-based applications is far better in performance than in a cloud-based environment. Emerging applications such as military, medical and commerce applications can be used in this design. In particular, IoT-based cloud technologies are very applicable to the use of medical services. For example, it is used for monitoring and accessing records in any remote location. IoT-based health systems are very useful for collecting essential data, including frequent changes to timely health parameters and update the intensity of medical parameters over a standard timeframe. In addition, IoT devices and sensor readings related to medical parameters are used effectively to detect disease at the appropriate time and before severe conditions are reached [18].

Machine learning plays a key role in the decision making process. It also has the ability to control bulk data. The Data Analysis Matching Process is used to assign this data to precise areas such as estimating the speed and standard data volume for neural network modeling as well as classification and classification. Data can be generated from different sources, so it is important to analyze the program and is also important for developing methods that are capable of controlling data properties [19-22]. In IoT, a large amount of resources generate real-time data without any problems, including scalability, speed, and the best data model. These are all known as one domain, the Internet of Things. All existing issues create opportunities that create a user. In this work, we have collected a large dataset containing a variety of data such as photographs, texts and data collected by IoT devices. This data is stored in the cloud environment. In this regard, we have implemented a machine learning algorithm that continues the operation of artificial intelligence mapping the data into two classes, such as "normal" and "affected." [23-26].

The work done in the past has more to create a platform for communication between the medical and information technology field, especially the IoT. However, in these methods, the use of strong concepts in the field of computer science is not appropriate. For example, machine learning is a fascinating field for this purpose. In a scenario, if there is no medical expert available, what is the solution to help a patient? Or, in another scenario, it is possible for physicians to create medical misdiagnosis. Reasons such as fatigue, inaccuracy will cause this problem. In these scenario, the use of machine learning seems to be a good approach. The presence of a computer expert is helpful for diagnosing patients' problems. This specialist is designed by machine learning algorithms. Attractive areas such as learning approaches and Fuzzy Neural System are practical for this purpose. It is also necessary to use high-level features in signal processing to learn an expert system. Therefore, the problem that will be addressed in this thesis is how to use the machine learning algorithms to design an expert system in the context of the IoT.

In this work, a Cloud and IoT-based healthcare program is developed to monitor, predict and diagnose serious illnesses. In this work, a disease detection system is designed based on IoT as well as Claude. Designs a semantic framework for disease diagnosis. In addition, in the proposed method a neural fuzzy classification algorithm based on fuzzy rules is designed.

Overall, the important innovations and contributions of this article can be summarized as follows:

- IoT proposal to May in the diagnosis framework for m-health.
- Establish a server-side health diagnostics system to calculate UDR results.
- Severely handle illness using the alarm generating mechanism.
- Develop an interactive smart patient diagnostic system to predict disease.
- Appling a two-step method to obtain high-dimensional input representations for the fuzzy-neural.
- Use an decision making system to make appropriate decisions for patient conditions

The rest of this paper is organized as follows. In Section 2, different components of the proposed method are described. In Section 3, the proposed method is evaluated and the results are analyzed. Finally, the discussion and conclusions are presented in Sections 4 and 5, respectively.

2. RESEARCH METHOD

Our focus is to design low-cost, a reliable, electronic health monitoring device based an IoT-based platform architecture can measure the critical parameters of a person's health, store data security on the server, and analyze data related to generating provocative alerts. The platform also connects registered patients to doctors who will have access to patient health information. Disease parameters by a system collected using simple non-limiting sensor signals.

This platform is unique in its ability to detect and be designed to alert patients and physicians to any abnormalities. We have also developed a design approach for mobile applications on both patient and physician sides to build the platform for our proposed solution. Also, our proposal for data analysis on web server is implementation of fuzzy inference analyzer. The proposed method is described in Figure 1.

The conceptual framework of a health monitoring system is made up of three steps. Firstly, a user's health data is collected from sunglasses and devices. This data is then transmitted by the cloud system or by the local processor. In the second phase of medical measurement devices by a system diagnosis is used to make rational decisions about personal health. In addition, if the emergency situation prevails, a warning will be issued to the nearby hospital for medical emergencies.

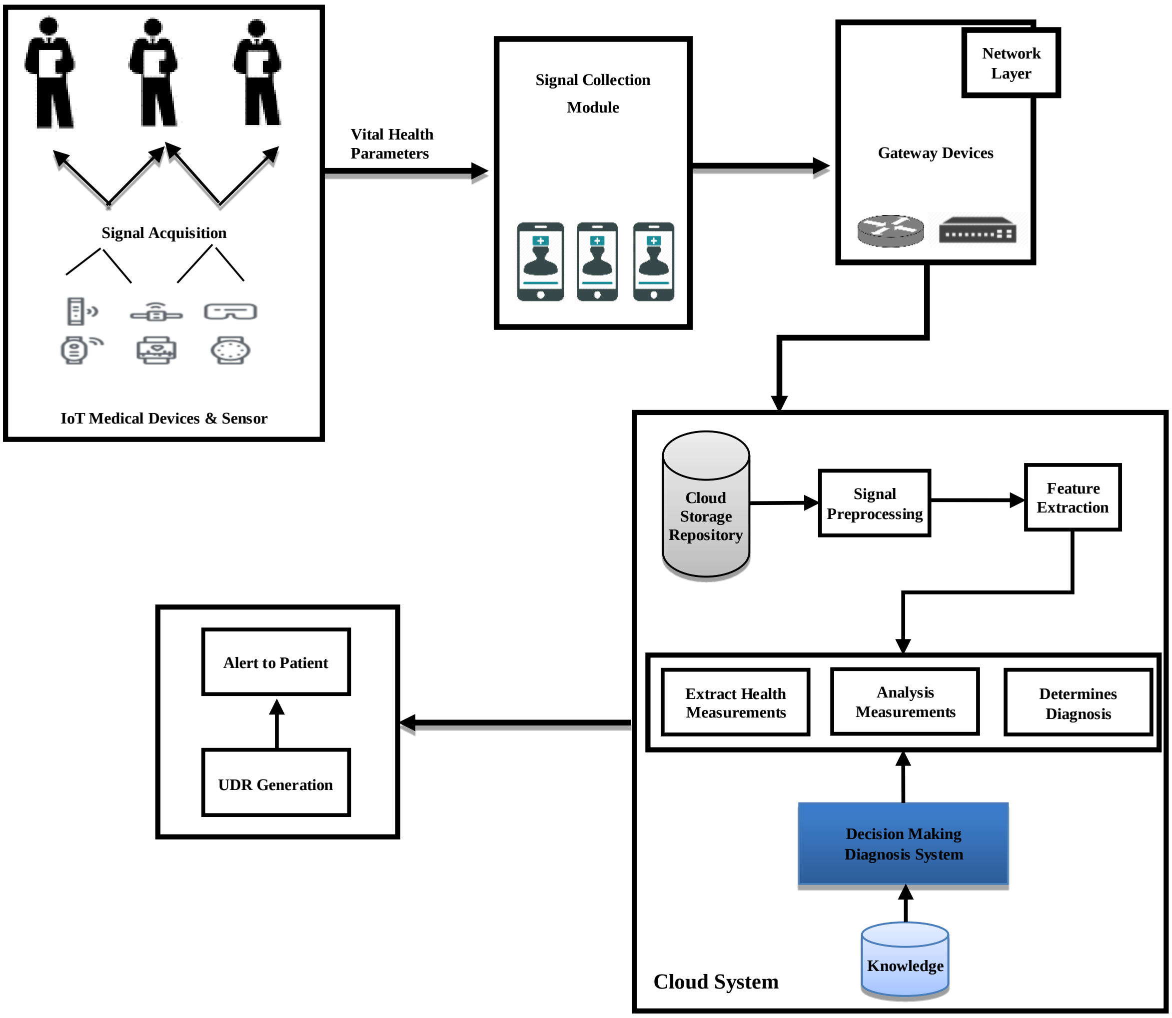

Figure 1. The overall schema of the proposed conceptual framework for IoT based m-health disease diagnosing system

3. PROPOSED SYSTEM

3.1. Signal collection and aggregation

Our IoT-based system as well as Claude's system consists of various data. This step is to collect patient data details extracted using sensor-based IoT wearable devices. These wearable devices connect to the human body continuously and at an appropriate distance to collect specific medical information or data. In our approach, the body's sensor network consists of both wearable and implantable sensors. These sensors collect the patient's physiological parameters in a structured and unstructured way, transferring them to a coordinator known as the Gateway, whether it be a portable device or a smartphone. The signal is transmitted to the cloud storage tank using wireless communication media such as 3G/4G mobile networks. Each user's health-based IoT data is stored in the cloud-based operating system.

Sensors include: pressure, accelerometer, gyroscope, humid, light, temperature and heart rate with high technology that is used in systems and calculates physical parameters such as acceleration, velocity and vital signal. Data from sensors is usually raw data that requires processes such as signal processing algorithms as well as algorithms in systems. Hence, in the present invention, an intermediate layer is designed as a middleware, which includes a software platform for the implementation of the system algorithm to record, prepare and transmit signals of sensors. Also, on the smartphone to process the high level of signals received from the wearable computer and detect the movements of the individual through these signals, a software layer with algorithms in the field of artificial intelligence based on Mobile OS implemented.

3.2. Hybrid decision making approach

A decision making diagnosis system shown in Figure 1 can be created using two components. The first is feature generation which can be used to create representative features from sensor signal directly. The two-layer feed forward network system would initially be trained on unlabeled data; desirable features would be extracted.

Once these features are extracted from the two-layer feed forward network system, they will be integrated into fuzzy neural-inference systems. These systems can incorporate both the features detected from the two-layer feed forward network as well as subjective information from an analyst as a method of biasing the system. These two pieces together can be used for diagnosis purposes. The final system would therefore be able to report both classification results and the specific features and rules that were activated for the system to arrive at its conclusion

3.3. High-level feature generation

Directly feeding the original patient signal into diagnosis system, however, may not be the best method to use the full strength of the fuzzy-neural systems. On the other hand, the dimensionality and complexity of the initial features may be too high to make the features of the fuzzy system not very good to use. On the other hand, high-level features make it possible to make good use of neural networks. Especially when the input features a lot of noise. Inspired by the deep&wide neural network [27]. We have designed a method to display high-dimensional features that this system uses for fuzzy. Initially, we designed a neural feedback network for high-level features and abstracted basic features:

$$z_i^{(0)} = x_{(q,di)}$$

$$z_i^{(l)} = elu\left(W_z^{(l-1)}.z_i^{(l-1)} + b_z^{(l-1)}\right), l = 1,2 \tag{1}$$

In this equation, $W_z^{(l)}$ and $b_z^{(l)}$W are the weights and the non-matrices are the weights and also the bias in the lth layer as well as the nonlinear function of the relay. The following variables are then linked to the values of the X attribute values and create the input value of the prime parameter. Here Alpha and Beta actually specify the X and Z dimensions that can be cached.

3.4. Integration with fuzzy neural-inference systems

In the proposed decision system, a neural classification based on fuzzy rules is designed considering the time consumption for decision making operations on medical data. A prominent feature of the proposed method is to classify the selection of efficient features as well as to classify records according to their timing with an appropriate decision. The inputs to the fuzzy inference system are the crisp values of high level feature value. The fuzzier transforms the crisp values of input parameters into a linguistic variable according to their membership functions.

$$T(Z) = T\,(Y) = T(Z) = \{Low, Med1, Med2, High\} \tag{2}$$

$$T(Cond) = \{VL, L, M, H, VH\} \tag{3}$$

There is an X variable here that really defines the membership function. Each member variable in X actually has a value between 1 and 2. A membership variable is a function that represents the fuzzy set denoted by μA. Also the membership degree value μA(x) is an equation of the membership function represented by the x-item in the fuzzy set. Zero mean indicates that item X is not a member of the fuzzy set. Also the mean of 0 indicates that the item X is a complete member of the fuzzy set. A value between 1 and 2 represents half and half of the X item membership.

4. RESULTS

As shown in Table 1, the overall RMSE decrease for both methods is produced during the transition period due to the increase in the number of batches 3, which have low quality shares. However, the ranking method is stronger in limiting the impact of these poor partnerships and still achieves an acceptable level of RMSE. This is due to the correct learning of the questions feature. As can be seen in this table, there is an overall decrease in the total RMSE after the transition period. The reason is that when they move to the 3rd floor, they start offering low quality shares. Returning to the 1st floor, they resume their high quality services. But since the RMSE is still low, the value is lower than before, but more than the revocation threshold.

Table 1. Evolution of RMSE with proposed ranking model

#Queries						
Recommended Category	50	100	150	200	250	300
Action	0.29951	0.29991	0.31991	0.32191	0.33191	0.32191
Adventure	0.22833	0.22843	0.24843	0.24943	0.25043	0.25243
Animation	0.19603	0.19803	0.19903	0.21003	0.21103	0.32103
Children's	0.18252	0.18272	0.20272	0.22272	0.22372	0.23372
Comedy	0.17367	0.19053	0.209053	0.219053	0.219153	0.220153
Crime	0.15789	0.16216	0.18216	0.19316	0.19216	0.12016
Documentary	0.29421	0.29991	0.31991	0.32191	0.33191	0.32591
Drama	0.22346	0.24343	0.22843	0.24943	0.22043	0.26243
Fantasy	0.19764	0.16703	0.21903	0.22003	0.20003	0.39103
Film-Noir	0.18456	0.18972	0.20252	0.24372	0.22172	0.23472
Horror	0.17321	0.19763	0.20763	0.21873	0.203153	0.25053
Musical	0.29789	0.30991	0.32591	0.32191	0.32191	0.22191
Mystery	0.22456	0.21843	0.22543	0.26743	0.24043	0.25653
Romance	0.19334	0.16503	0.12003	0.25603	0.22103	0.32193
Sci-Fi	0.1880	0.18982	0.20265	0.24272	0.22372	0.23372
Thriller	0.17654	0.19323	0.209076	0.209053	0.219153	0.220153
War	0.29951	0.29991	0.31991	0.32191	0.33191	0.32191
Western	0.22833	0.22843	0.24843	0.24943	0.25043	0.25243

5. CONCLUSION

A new Cloud and IoT-based healthcare plan has been developed to monitor the level of serious illness and diagnose it severely. Here's a working framework. In this context, a semantic method for the diagnosis of diseases is presented. These diseases include diabetes as well as medical data related to the University Library of the United States. This information was collected by general sensors from patients. Who have the type of severe diabetes, a new classification algorithm based on fuzzy neural network is also presented. The results are based on a standard dataset that uses real-world record collection records for testing. This data was collected from different hospitals. The results show that the proposed method works better than current methods and systems for diagnosing diabetes. Future work in this regard could be to introduce an effective security mechanism using new cryptographic algorithms to better secure medical information in the cloud database.

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