Artificial Intelligence– Electronic Medical Records Framework to predict COVID-19 by using Wearable IoT Devices

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Abstract: ***Corona virus is an infectious disease that causes respiratory infections, producing fever, difficulty breathing, and dry cough, which may be more dangerous for people who suffer from chronic diseases. Wearable Devices (WD) have been recently adopted in a wide range of areas to show distinct potentials in the healthcare field. The different types of WDs can be one of the important steps towards improving patient care while reducing the cost based on artificial intelligence (AI) applications. These applications work on big data that arise from WDs despite the existence of various challenges such as user acceptance, security, ethics issues, big data, AI and interoperability. The purpose of this study is to drawthe possibility of utilizing the big data arising from integrating WDs with the electronic Medical records (EMR) through applying AI technologies which in turn will lead to the possibility of employing all of these technologies in predicting COVID-19 infection.***

Keywords: Wearable IoT Devices, Artificial Intelligence, EMR, COVID-19, deep learning, big data.

I.INTRODUCTION

COVID-19 is an infectious disease initiated by a newly discovered coronavirus. There is a large family of viruses called coronaviruses that may infect humans or animals, most recently COVID-19**[1]**. This family may cause infections in the respiratory system and the most common symptoms of this virus are dry cough, fever, and difficulty breathing **[2] [3]**. These symptoms usually start lightly and then become more severe. Those who are most susceptible to this virus are those who suffer from chronic diseases such as diabetes, high blood pressure and heart problems**[4]**.Wearable technology is a general term for a group of devices that can be worn as accessories and powered by microprocessors and sensors to give it the ability to send and receive data through the Internet, as well as the ability to link it to smart phones. Wearable IoT devices are among the most noticeable examples of Internet of Things (IoT) technology **[5].** These devices have been recently adopted in a wide range of areas to show distinct potentials in the healthcare industry.They can monitor many vital activities and behaviors including blood pressure, body temperature, Respiration rate (rate of breathing), and pulse rate **[6]**.These devices may come to monitor physical activity, manage patients, or influence clinical decision-making **[7]**. Vital signs can be considered as symptoms of Corona virus. One of the most recent studies in this area is on the University of California San Francisco (UCSF) and San Francisco General Hospital (SFGH) to diagnose and monitor COVID-19 infections.

As this study seeks to wearmore than 2,000 doctors, nurses and emergency responders a wearable ring that has the ability to measure continuous temperature readings as the fever is most common symptoms for COVID-19**[8].**If thistestsucceeds in givingan indicationof theopportunityof infection, thenthose WDs may beutilized bythefirst-ratehuman beingsinvolvedwithprotectingpeoples such ashealthcare staff,internalsafetyandmilitaryforces,as itisdifficultto beutilized byallhuman beingsbecause ofcost-associatedpurposes. Most countries have had to use several tools that allow to fully measuring the individuals' temperature manually or by using remote temperature sensors. Likewise, countries have also to isolate individuals likely to be infected with COVID-19 for a period of at least 14 days initially, as it is the lowest virus incubation period, and during this period many clinical crews were recruited to examine this category as well. Here, the importance of AIlies in the ability to analyze this data and determine the most concentrated ages and places of disease, then some areas can be isolated and focused on, rather than using traditional statistical tools to determine the possibility of isolation.Country practices have demonstrated the ability to predict coronavirus infection by measuring temperature as the best indication known so far since the first COVID-19 case was discovered in China on Nov. 17, 2019.The main Benefits of using AI on WD dataset may include quickly identify cases suspected of being infected with the virus, the ability to make a decision on self-quarantine or self-isolation, the ability to better determine the infected areas, and in quick identification of the number of suspected cases. The increasing size and type of data requires higher processing rate. Therefore, the importance of AI appears in analyzing and processing this huge amount of data, which is difficult to process it using traditional methods. Neural Network (N) methods demonstrated superior ability to handle the processing of modern application requirements, especially this kind of sensitive **[9].** This paper is structured as follows: Wearable devices and EMR are discussed in Sect. 2; Sect. 3 illustrates the NN and EMR; and Sect. 4 presents the conclusions. Despite the progress in the field of Internet of things and WDs, there are still various challenges represented in the exchange of data and communication gaps between health service providers and payers. One of the best ways to do this is to integrate WDs with EMR databases to obtain the ability to track the patient and know the level of progress that has been made to maintain optimal patient health with a safe and secure consideration.

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As shown in **Fig. 1**. TheWDs apps may receive the results of real-time vital characteristics of the WD holder, which in terns sent to the hospital's EMR through the Smart phone EMR apps. In the case of large number of WDs holders then we will have a big data, so the EMR systems can invoke a prediction alarm by applying NN technique over potential infected suspects by the virus. By this kind of integration the WDs are fully efficient to provide interoperable care. This requires providing standards for determining interoperability **[10].** The benefits of analyzing the big data may include:

1. The ability to determine the number and location of the suspected cases.
2. The possibility of sending alert messages to the suspected category.
3. The ability to focus on the most effected category or location.
4. The ability to determine the closesthealth centers that may provide help.
5. The ability to make a decision on self-quarantine or self-isolation
6. The ability to apply this kind of analysis to all types of diseases or viruses.

The progress that has been made in dealing with big data, the available solutions for integrating WDs with EMR, in addition to the presence of AI technologies such as NN provided the opportunity to deal with this huge amount of data and give the opportunity to classify the patients as suspected or not suspected as shown in **Fig. 1[11].**

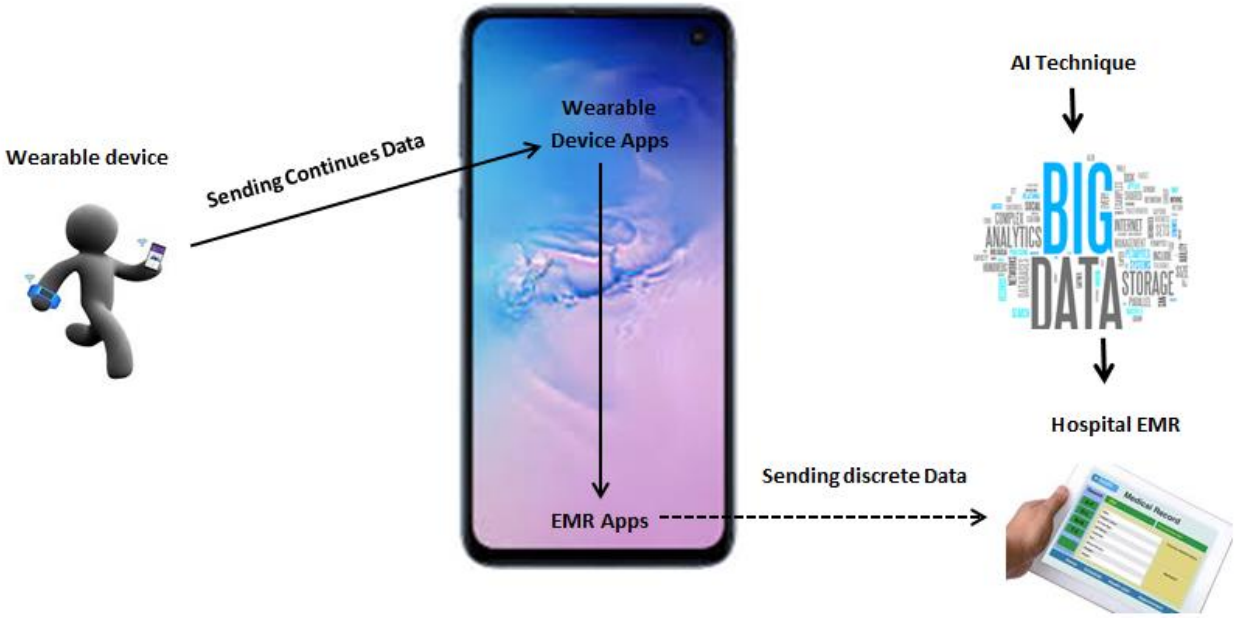

Figure 1: Wearable Devices and EMR databases connection

A data synchronization routine should be followed so as to overcome the burden on communication challenges comes from storage problems and high size of loaded information.

II.NEURAL NETWORKS AND EMR DATASET

Machine Learning (ML) is one of the most common techniques of AI that is used in processing and analyzing big data, it is a self-adaptive algorithm and the more it experiences with fresh data the more give better analysis. NN is a subfield of machine learning in AI that has the ability to learn from different datasets**[12].**

Using NN algorithms, data stored in EMR databases can be used to predict whether an infection is possible or not[**13].** This data may contain details such as blood pressure (BP), body temperature (T) and heart rate (HR) that have been sent by the WDs and that may be used to determine the proper and required classification. NNarchitecture includes many layers which in turns contains many neurons. Each layer is activated when it receives the output of the previous layer after implementing some mathematical operations to convert the inputs into meaningful outputs as shown in **Fig.2.**

The study represents a framework for action, the results of which may be impressive, not only for following-up COVID-19, but also for monitoring all diseases of all kinds. Because of the difficulty of obtaining accurate information from different health authorities, this framework has been published and its implementation left as a future work until the required information is obtained.

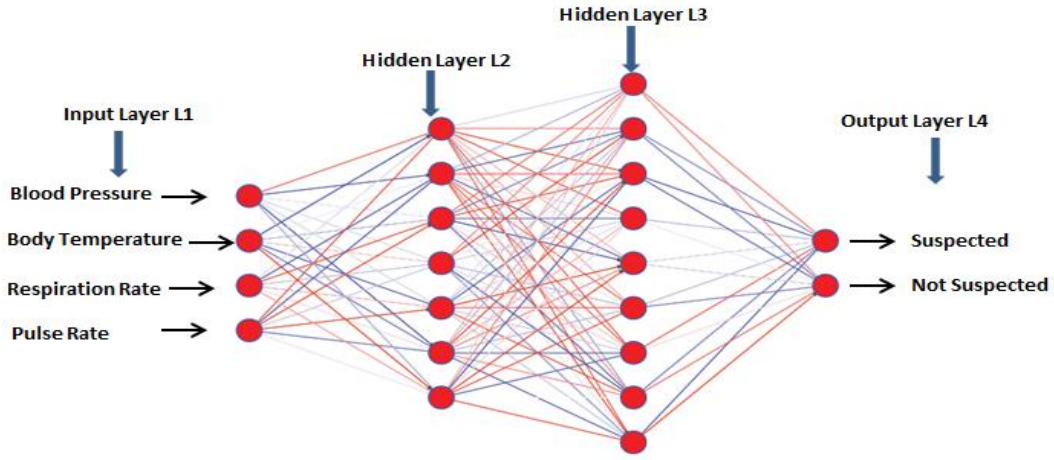

Figure 2: NN

As usual the optimal number of hidden neurons smaller than the number of inputs, one of the best way to optimize this number is by using cross-validation to test the accuracy on the test dataset**[14]**. The number of neurons in the hidden layers can be optimized by minimizing the Mean Square Error (MSE) as the default performance metric for feed-forward networks, which is the average of the squares of the errors(e^2) as shown in Equation 1**[15]**.

$$MSE = \left(1/n\right)\sum_{i=1}^{n} e^2 = \left(1/n\right)\sum_{i=1}^{n}(o_i - t_i)^2 \qquad (1)$$

III.CONCLUSIONS

Wearable IoT devices can be used to monitor and predicate the COVID-19 infections through measuring the vital signs. Integrating these devices with EMR databases can give the optimal opportunity to track the patient. NNis an AI self-adaptive technique that is can be used to analyze and process EMR big data. Despite the progress that has been made in the WDs, AI techniques and EMR applications; there are challenges facing their usability and functions such as user acceptance, security, ethics, big data and AI, and interoperability. Theoretically, this study clarified the possibility of using WDs to predict the presence of viruses of all kinds, especially Corona Virus, and the importance of that. Future work will focus on implementing this system, taking into account the challenges facing this implementation.

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