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Development of AI-Based Framework for COVID-19 Patient Tracking System in Modern Smart Cities

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Research Article

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Abstract

COVID-19 has thrown a wrench in the works, forcing people, organizations, and governments to rethink their policies, objectives, and actions. These shifts are acting as a spur for technological advancement and creativity. Artificial intelligence (AI) has become more prevalent in the health field, especially COVID-19. To address pandemic responses, this article presents the development of COVID-19 patient tracking system based on the AI. ANN based approach was utilized to develop the proposed system with the aid of wearable sensor data and questionnaire-based data.

Introduction

The coronavirus illness 2019 (COVID-19) pandemic has wreaked havoc on healthcare infrastructures, global health infrastructure, and the economies of several nations. It was brought on by the novel coronavirus 2 that causes severe acute respiratory syndrome (SARS-CoV-2). Droplets sprayed by COVID-19 individuals were the most prevalent route of coronavirus transmission whether they were talking, coughing, or sneezing. SARS-CoV-2 is an enclosed, single-stranded, positive-sense RNA virus that is the eighth coronavirus that may be transferred from person to person. Bats have been identified as potential important reservoirs of coronavirus in China. Bats are reservoir hosts for a variety of zoonotic viruses, including the Hendra and Nipah viruses. The SARS-CoV-2 shares almost 50% of its genetic sequence with the MERS-CoV and 79% with the SARS-CoV, respectively. In addition, SARS-CoV-2 and SARS-CoV have the same receptor-binding domain structure [1, 2, 3]. As of Feb 202, the World Health Organization had received reports of 393M confirmed cases of COVID-19, with 5.73M deaths. There were 223 nations, regions, or territories impacted. To avoid SARS-CoV-2, almost a billion individuals stayed at home. At the same time, a slew of other issues arose. Figure 1 shows the COVID-19 confirmed cases as of Feb 2022.

Artificial intelligence (AI) is an area of computer science that may be used to create intelligent systems and is frequently implemented as a software program. Artificial intelligence (AI) has re-emerged into scientific consciousness, with new findings being published at an incredible rate. The use of artificial intelligence (AI) in healthcare is fast growing. AI entails the creation of advanced algorithms that can efficiently and effectively carry out complicated tasks. The basic goal of AI in healthcare is to uncover hidden information from massive data and assist policymakers and physicians in making successful therapeutic decisions [4, 5, 6]. The medical sector is seeking innovative tools to monitor and manage the spread of the COVID-19 (Coronavirus) pandemic in this global health disaster.

Artificial intelligence (AI) is one such tool that may readily track the transmission of this virus, identify high-risk individuals, and aid in real-time infection management. It may also forecast mortality risk by thoroughly evaluating the patients' historical data. AI has been shown to be valuable in healthcare, therefore researchers believe it might be useful in the battle against COVID-19. AI has triggered a paradigm change in health care, from pandemic predictions to creating anti-viral-replication chemicals. Recent COVID-19 AI research suggests that it can help detect COVID-19 infection and affected populations, anticipate the next epidemic, identify the attack pattern, and potentially develop a treatment.

Literature Review

Literature Review

This section discusses and briefs the AI applications in medical fields for the early recognition of COVID-19 patients. AI can aid in the battle against this virus by providing population screening, medical assistance, notification, and infection control recommendations. The aim of this study is to develop a COVID-19 patient tracking system based on the AI.

AI may be used to create an intelligent platform for autonomous viral monitoring and prediction. A neural network may be created to extract the visual aspects of this condition, which would aid in the correct monitoring and treatment of those who are affected. In [7, 8] discusses the AI-based COVID-19 cluster tracking system in the notion of smart city. In [9, 10], researchers have used thermal images to detect COVID-19 patients. Moreover, they have engaged with an AI-based system to COVID-19 patients' detection through the CT scan images. In [11], authors have engaged with the TeleCOVID diagnostic system for monitoring COVID-19 patients. They have used various sensor data and ANN to predict the condition of the patient. In [12], the author has engaged with the development of a pandemic prediction model based on the data collected through the internet sources. The author has integrated AI technology (ANN) to predict possible pandemic scenarios in the city. Hurt et al. have [13] used a deep learning approach to augment radiographs with color probability to diagnosis and clinical decision making. Jiang et al. [14] have developed a tool with AI capabilities that will predict patients at risk for more severe illnesses based on clinical parameters. Srinivasa Rao and Vazquez [15] have presented a system relying on an AI algorithm that would allow for the rapid detection of infected cases, as well as danger assessment and evaluation based on symptoms and indicators associated with the new coronavirus.

Several researchers have engaged with AI-based applications in the mobile platforms. Using a mobile phone-based web survey, Rao et al. [16] have developed a novel machine learning technique to improve possibly faster case identifications of COVID-19. Meanwhile, a novel framework for detecting COVID-19 using smartphone sensors has been presented by Maghdid et al. [17]. In Bogota, Colombia, Saire and Navarro [18] have employed text mining on Twitter data to highlight the epidemiological influence of COVID-19 on news stories. Schild et al. [19] have looked at Twitter and 4Chan to

see if sinophobic behavior has changed as a result of the epidemic. Cinelli et al. [20] have used COVID-19 to examine data from Twitter, Instagram, YouTube, Reddit, and Gab. On each platform, they discover varying amounts of disinformation.

By gaining the knowledge from above research works, this study proposed methodology to detect covid-19 patients using AI. Next section of this article discusses the proposed methodology.

Methodology

The methodology of the proposed system is depicted in Fig. 2. As shown in the figure, the data acquisition was performed using wearable sensor and question-based data. Wearable sensors are used to acquire the body temperature, heart rate. Question based data was acquired from the Mobile based application which contains several COVID-19 related questionnaires. Data preprocessing was used to filter and remove unwanted data such as invalid temperature, null data from questioner, invalid heart rate. After pre-process was done, the data was passed to the both ANN model and to the training data set. The decision proposed by the ANN model define the whether patient have COVID-19 symptoms or not. Finally, data was stored and transfer records to the relevant institution.

The ANN used the eight data extracted from questioners and two data from the wearable sensors. The image from the camera is verification that the user has a sore throat. Therefore, overall ten data were fed to the proposed ANN model. ReLU activation function is proposed for the activation of each node.

Table 1 depicts the proposed wearable sensors and their uses in the study. As shown in the table body temperature was calculated to detect the fever and heart rate was used to detect abnormalities in the heart.

Table 1
Sensor based data structure

Wearable Sensor/Devices	Data
Temperature sensor	Body temperature
Heart rate sensor	Heart rate
Camera	Photograph of the throat

Table 2 depicts the questionnaires-based data and by the increasing severity patients need more care and attention.

Table 2
Questionnaire based data structure

Question	Data	Severity
Do you have a cough?	Yes/No	1
Do you feel tired?	Yes/No	1
Do you feel a loss of taste or smell?	Yes/No	1
Do you have a sore throat?	Yes/No	2
Do you have a headache?	Yes/No	2
Do you have chest pain?	Yes/No	3
Do you have difficulty breathing?	Yes/No	3
Do you have loss of speech or mobility?	Yes/No	3

Once a patient has indicated that they have a sore throat, the system will prompt them to take and submit an image. As a result, the proposed design employs the inbuilt camera of the mobile phone. After storing data, these data can be used to diagnose and predict suitable medicine related to the patient's conditions.

Discussion And Conclusion

In the world of medicine, artificial intelligence (AI) is not a new concept, and numerous researches have looked at how it may be used to improve patient care. Even while the situation in some nations improves, others continue to struggle to limit the spread of COVID-19. The application of AI-driven tools to aid in diagnosis, surveillance, discovering medicines, and public health decision-making may help increase the efficiency and efficacy of human efforts to battle the pandemic in the face of mounting demand on limited health-care resources. This article presents the development of COVID-19 patient tracking system based on AI. The system used ten data to work proposed ANN and predict the severity of the patient accordingly. Based on the outcome and symptoms of the patient the proposed system has capability to predict medicine. In our future work this system will implement and predict the medicine based on the data generated.

Declarations

Competing Interests

The author declares no competing interests.

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Figures

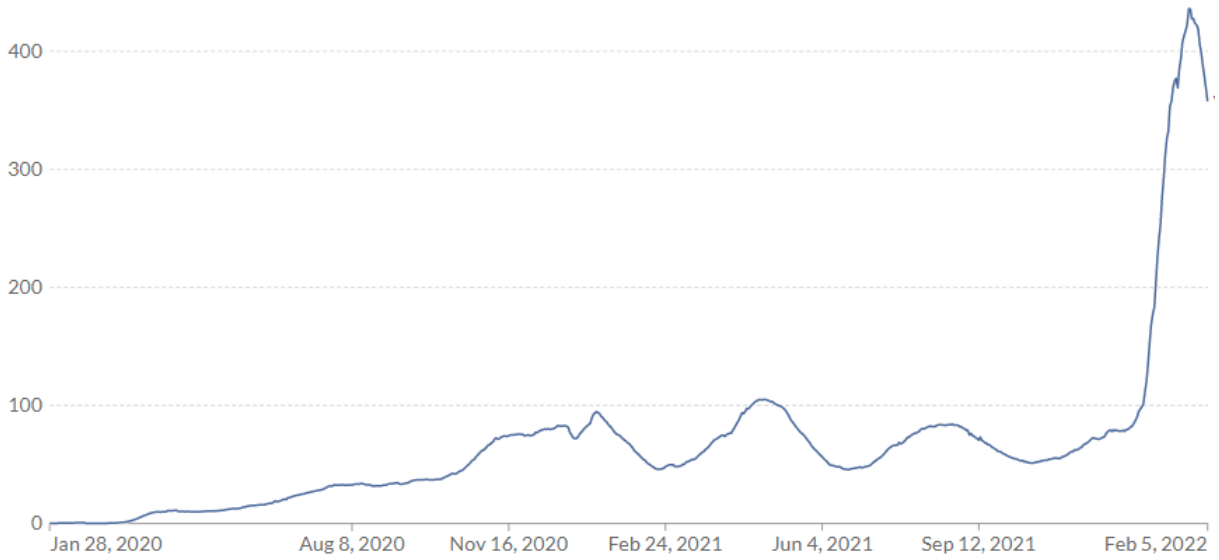

Figure 1

COVID-19 confirmed cases as of Feb 2022 *(Source: Johns Hopkins University)*.

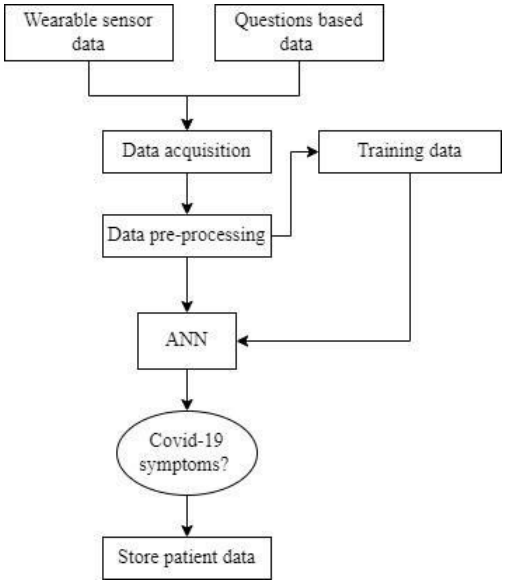

Figure 2

Proposed system architecture