Engineering and Technology Journal

A Proposed WoT System for Diagnosing the Infection of Coronavirus (Covid-19)

Dalal M. Thair*, Akbas E. Ali [iD]

Computer Science Dept., University of Technology-Iraq, Alsina'a street, 10066 Baghdad, Iraq.
*Corresponding author Email: Cs.19.09@gard.uotechnology.edu.iq

H I G H L I G H T S

- A comprehensive WoT system for COVID-19 Virus Detection (CVD) was presented. In addition, the most important needs of the infected people were provided.
- The use of a collection of programming languages such as (Python, HTML5, CSS3, and JavaScript) was employed in the design of the proposed system under the notion of the web of things. In addition to interactive graphic interfaces.
- We used algorithms of k-nearest neighbors (KNN) and Support Vector Machine (SVM) to classify and determine whether the patient was infected by the virus.

A R T I C L E   I N F O

A B S T R A C T

Coronavirus is one of the viruses that have broadly affected humans and the health system in general. The problem is that there is no treatment for the virus yet, and the virus spreads very quickly through coughing or touching. Therefore, patients infected with this virus must be isolated in their homes or designated care places. Therefore, the research aims to find appropriate methods to diagnose people with the virus remotely to avoid "mixing and trying to determine the virus's focus spread by presenting a new framework for e-health to identify Coronavirus patients. Since the web of things (WoT) is helpful in many areas of medical applications, it will be used as a technique to build a complete system for diagnosing those infected with the virus. Such an approach will provide advice for prevention and isolation. It is very important to check that you have the virus or if you only have a fever, to distance yourself from others who have been affected by Covid-19 when you go to the hospital. Therefore, you can check your health status remotely without going to the hospital. It will present a comprehensive WoT system for COVID-19 Virus Detection (CVD), which provides the most important needs of the infected people. Some of these vital needs are finding an easy way to detect infection by virus, contacting specialized doctors to provide consultations, contacting pharmacies to deliver treatment to the home, contacting Laboratories, mapping the spread of the virus over the world, and educating the citizen at home. In addition, it assists in articles related to the virus that will help the researchers and patients reach the newest details about the pandemic. In designing this system, a group of web design languages was used under the principle of the web of things, such as (HTML, HTML5, CSS, CSS3, JavaScript, Bootstrap) in addition to interactive graphic interfaces.

1. Introduction

One of the factors that led to the spread of the Covid-19 pandemic was a late diagnosis or confusion with normal flu-like symptoms [1]. Therefore, a reliable free tool for early and more accurate diagnoses that can distinguish between different respiratory diseases is required. Secondly, an infection that gained from the health care places. A study in one of the hospitals in London location that 15 percent of in-patient coronavirus status were certainly or possibly gained from the hospital asymptomatic team members was found to be a potential exporter of contagions [2]. Traditional health monitoring systems have significant disadvantages compared to IoT-aided remote health monitoring systems[3]. The Web is the most popular hypermedia system currently [4]. The internet is no longer just a compute cluster but successfully includes billions of smart things with embedded systems. Web of Things (WoT) will significantly increase the size and scope of the current internet and offer new design options and challenges. The Web of Things (WoT) is the Internet of Things (IoT) sub-sub-section that is becoming a big influence in many aspects of our everyday lifestyle [5]. It is one of the recent technical and social developments that will have a major effect on healthcare delivery. The Internet of Things (IoT) revolution is reshaping modern health care with exciting technological, economic, and social implications [6]. WoT would make it possible for the patient to live at home longer and safer. Also, the patient will be relieved from the hassle of repetitive checks. In emergencies, using websites to store health records could save the life of a patient [7]. The usability of the web makes it a good option for the interoperable and friendly exchange of health

information with the patient and the clinicians involved in their treatment [8]. The WoT will offer benefits to a vast number to our newfangled society. As we have shown, there is a great deal of room for citizens and organizations to link artifacts to the WoT.

The smart-cities vision that allows productivity with maximum rate is in the foreground of WoT examples. The WoT was coined before the millennium turn of. Many APIs with open source can be used if you want to link some entity to the WoT [9]. With WoT, websites can be created using known technologies and web languages. Besides, smart stuff will benefit from processes that have made the Web scalable and competitive, like load balancing, caching, searching, and indexing [10]. Nowadays, COVID-19 has been declared a pandemic by the World Health Organization (WHO) that the whole world suffers from [11]. Many methods have dealt with this problem, such as suppression and mitigation strategies [12].

The health and economy of the rest of the world were greatly affected. This healthcare crisis has put an immense burden on society and challenged healthcare organizations' ability to provide quality care[13]. There are fears that Coronavirus could over-whelm health care systems worldwide. A lot of countries have informed a lack of ventilators [14]. Coronavirus is one of the main viruses affecting mainly the human respiratory system, wherein current pneumonia pandemic of corona-virus illness, resulting from the (SARS) SEVERE ACUTE RESPIRATORY SYNDROME corona-virus [15] is spread out universally at a quickened rate. The doctors mentioned that one of the most trendy things about illness people with the virus that has been noticed is the way they catch their breath when they are speaking, likewise a dry cough, and the periods of their breathing patterns [16]. As a result, persons will be infected by another sick person. A grave emergency for public health in vulnerable populations and societies where healthcare providers are not trained enough to treat infection is especially lethal [17]. Governments worldwide are responding to coronavirus disease with unprecedented strategies to slow the growth rate of infections—many measures, such as closing schools and restricting people to their homes [18].

Clinical evidence on the voices of the respiratory of Coronavirus contaminated pneumonia is little. Health services are inadequate. Establishing a simple and reliable screening procedure for mild or asymptomatic suspect patients is highly challenging. Therefore, the site will be used to collect additional information to increase the accuracy of the diagnosis. Detecting suspicious patients is currently largely focused on epidemiological evidence and clinical symptoms. A more convenient and accurate approach is urgently required to classify suspicious patients. Nucleic acid monitoring and chest imaging are the primary methods of laboratory analysis. But the former is a diagnostic examination, which could be a priority after primary screening for suspicious patients. In most nations, the latter is costly and hard to obtain. At the same time, the interval time waiting for results is needed for both of them, which increases the time to take steps such as isolation [19].

2. Related work

There is no previous research on the detection and treatment of the Corona pandemic in the field of the web of things, except for a few. In 2021 research was done by a group of students and academics from the UK, Cambridge University, the computer science, and technology department. Analytical data on a widely crowd-sourced dataset of the sound of the respiratory system is collected to assist the diagnosis of COVID-19 is mentioned in this paper[20]. To understand how to discern the COVID-19 voices from those with healthy controls and asthma by using coughs and breathing. As a result, they have a range of users who could study the evolution of the respiratory voices in the sense of the illness. For COVID-19, this is quite important. Since the epidemic is new, the findings appear even an unpretentious binary classifier of machine learning can correctly distinguish safe sounds and COVID-19 sounds. Across all functions, models reach an accuracy (AUC) of over 80 percent. These findings are preliminary and just scotch the roof of the possibility of this data form and machine learning audio-based.

COVID-19 is detected using RT-PCR on a nasopharyngeal swab, and COVID-positive patients are tracked before they conclude. Each patient's demographic and clinical data will be obtained and lung auscultation using a digital stethoscope at six thoracic sites. On these audio recordings, a deep learning algorithm (Deep Breath) with a (CNN) and (SVM) classifier will be trained to derive an automatic diagnostic prediction (positive vs. negative). On a random subset of lung sounds, the output of this model will be compared to a human prediction baseline, in which blinded physicians are asked to classify the audios into the same categories. This method can standardize the assessment of COVID-19 lung auscultation at various levels of healthcare, especially in the context of decentralized triage and monitoring. This means it describes the lung auscultation in COVID-19 into an intelligent autonomous stethoscope benchmarked against the human expert perception[21].

Through analyzed MFCC features, data analysis over a large-scale dataset of respiratory sounds was collected to help diagnose COVID-19. Logistic Regression (LR), Gradient Boosting Trees, and Support Vector Machines were all checked classifiers (SVMs). Furthermore, based on their distinct audio characteristics, they use convolutional neural networks (CNNs) to detect coughs and diagnose potential illnesses. Relevant details and a brief medical history, and a recording of respiratory sounds are required of the user. Every two days, the app asks users to add more sounds and symptoms, giving researchers a rare opportunity to track the progression...and a position sample is collected with permission [22].

3. Proposed system overview

The proposed system is the Web of Things, which helps manage the COVID-19 pandemic due to an urgent need to find appropriate methods to diagnose people with the virus remotely to avoid mixing and determining the focus of the virus spread. Further, diagnose and provide medical services to patients at the time of the spread of the Corona pandemic by using the voice of the respiratory system to diagnose whether the user has occurred from an epidemic or not, using the microphone as a sensor. The system consists of a group of pages that provide services of importance to the user, such as:

- Check Page
- Doctor Page
- Pharmacy Page
- Laboratory Page
- Instructions Page (Isolation and prevention)
- Articles Page
- Map of Spread Page

It suggests a remote examination of individuals to ensure continued isolation and social distancing of citizens at home to prevent the spread of the pandemic. Where the citizen can use the internet from home, operate the site, examine himself by the following steps:

1) The first step is the Visitation phase which involves visiting the website and applying complete information about the patient by filling in a form for the demographic patient information such as name, age, gender, approximate location. After that, the patient information will be saved in the Database of the website.
2) Then, he/she should record his breathing and submits his information to check it and wait for the result. Then, the patient will be notified.
3) If the result is negative, show preventive instructions. And if the result is positive, Guide the user on how to contact Doctors, pharmacies, Laboratory and show isolation instructions to teach the patient how to isolate himself from the rest who live at home. The system continues to direct the patient to the next step stage that they should be followed to keep his life safe.
4) Then the next stage is classification to identify the obtained data and assign it to a given classifier.
5) After the classification process, the final result, the personal information, and the analysis result are infected by the virus or not will be displayed to the patient on his page. In addition, all the previous information will be saved in the website database.

This paper proposes an end-to-end WoT site that can capture data from symptomatic patients, including coughs (voluntary or involuntary), and convert them into diagnostic health data. Then, with the help of machine learning, identify them as ill or not. Without the need to go to their places or the hospital, they would provide more protection for people from being infected by someone in the hospital. The WoT site will be available in one language (English) and other languages in the future.

With continuous efforts to turn off the prevalence of corona disease everywhere today and avoid similar diseases in the future, our proposed approach will play a reliable, low-cost, and easy-to-use role in the early diagnosis of this virus. It can be considered a safe and successful way to break the constraints to diagnose the Coronavirus from a distance and without contact with the patient to prevent the spread of the pandemic further. as shown in Figure 1.

4. Wot architecture

The CVD website, in particular, is a very good starting point since it offers a free forum for a check-up and data knowledge. especially in existing of many important obstacles that exist in the Coronavirus like:

- A confusion with usual flu-like symptoms.
- Infections that obtained through the health care establishments.
- There is currently no treatment for the infection.
- Coughing or touching spreads the virus extremely quickly.
- Infected patients must be isolated in their homes or authorized care facilities.

In addition to many limitations such as:

- The scarcity of previous Arab, foreign and local studies on Corona Virus.
- The difficulty in obtaining data directly from patients due to quarantine prevents transmission of infection.
- The difficulty in finding clinical respiratory data used in system training infection is due to the mixing of people in places of examination and diagnosis. Therefore, this site is designed to be an "integrated" site in terms of ten pages that provide the following:

1) Diagnose with a combination of optional and audio input.
2) Provide the possibility to communicate with a group of specialized doctors.
3) Provide the ability to communicate with a group of pharmacists.
4) Isolate and prevention Instructions.
5) Provide a 24-hour statistical map of the spread of the virus worldwide.
6) Provide a set of articles related to the epidemic, which helps researchers to find the most recent updated information about the virus.
7) Coordination with the laboratory and reservation of analyzes through special teams at home.

According to these obstacles and limitations, this WoT site is designed to assist in the remote diagnosis of the Corona epidemic, which reduces the number of infections resulting from the spread.

Therefore, a reliable free tool for early and more accurate diagnoses that can distinguish between different respiratory diseases is very much required, without the possibility of mixing or contact, which helps limit the spread of the virus. Therefore,

in designing the front-end of this website, a group of web design languages was used under the web of things, such as (HTML, HTML5, CSS, CSS3, JavaScript, Bootstrap) in addition to interactive graphic interfaces.
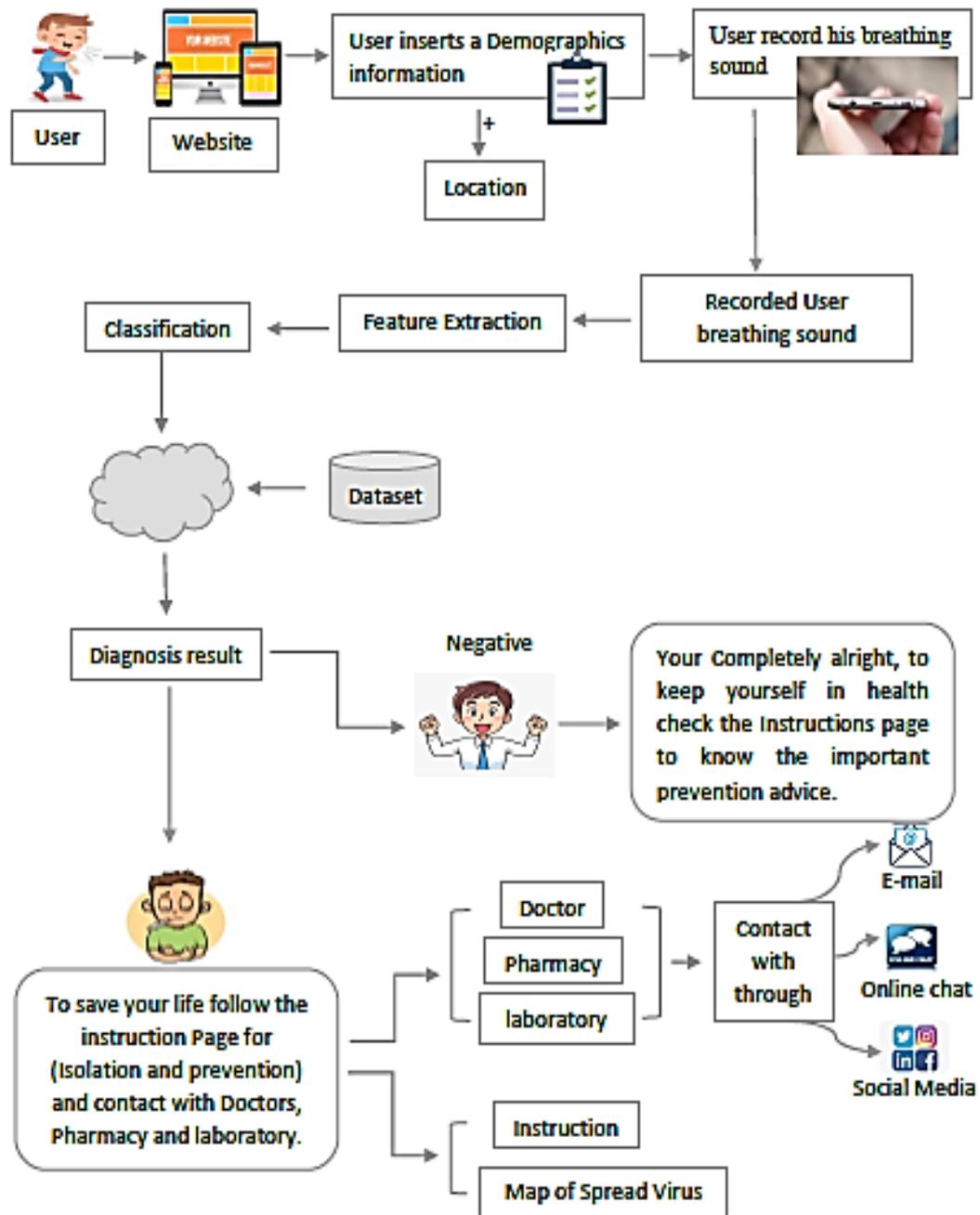

Figure 1: The proposed web of things (WoT) system

5. Proposed system pages

WoT System name (CVD) Corona Virus Detection and Logo, as clarified in Figure 2.

Figure 2: WoT System Logo (CVD)

5.1 Home page

In home page will almost contain all other main pages as a page linked together, as it is shown in Figure 3, also contain the most important PREVENTION MEASURES:

Figure 3: WoT Structure

5.2 Check page

Diagnosis with a combination of optional and audio inputs, where the patient should enter information like:

- Demographic information such as Name, Sex, Age, and approximate location.
- After that, they should record their breathing and submit the information to check it by classification algorithms. Then, they wait for the result without going outside and taking the test, as shown in Figure 4, and implementation steps are clarified in the algorithm (1).
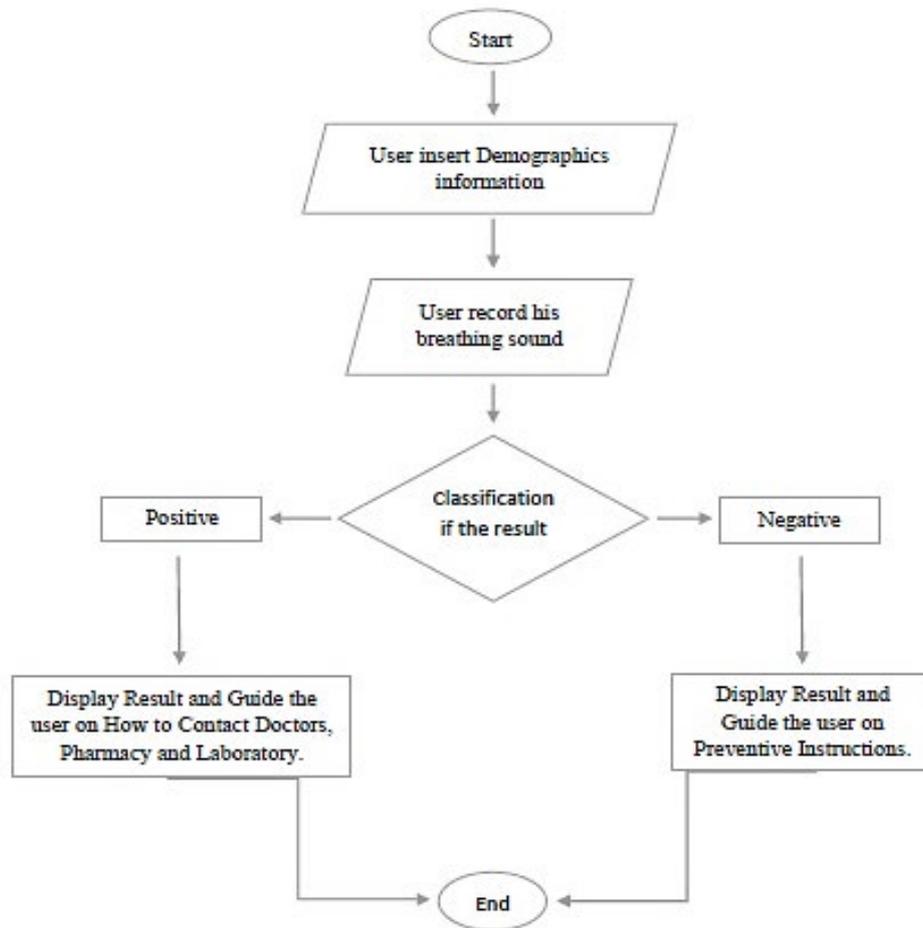
Figure 4: Flowchart of the proposed system Front End

5.3 Doctors and Pharmacies pages

To make the site completely useful, keep the concept of safe lives and helps people in their places, and completely deny the need to leave their places, CVD seeks to make quality healthcare accessible and easy for all by connecting you with online doctors.

Two pages were added, the doctor and Pharmacy pages, to help injured patients communicate with specialist doctors and ask for appropriate medical advice and instructions. In addition, they provide communication with a group of pharmacies in case the patient needs treatment. Without the need to leave his place and put others' lives at risk of catching the epidemic, the communication with these doctors and pharmacies will be done through many fields, such as social media fields like Instagram, Facebook, Twitter, LinkedIn, Mail, and Phone number, as shown in Figure 5. The CVD web of things adopts a fresh approach to primary care, providing individuals and families with complete, and totally online care through all of that.
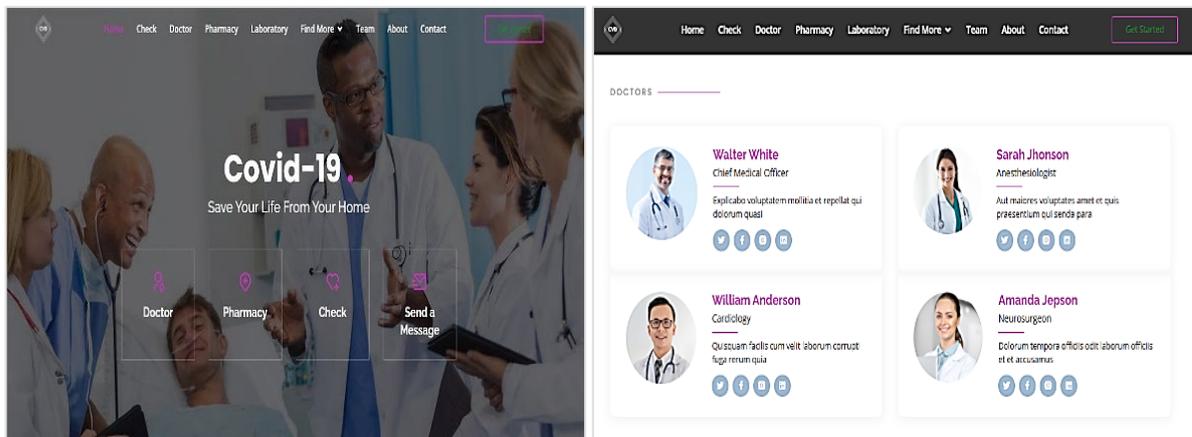

Figure 5: Doctors and Pharmacies Page Screens

5.4 Laboratory page

It has been suggested to create this page for certain cases of people infected with the Coronavirus, those whose infection worsens beyond the limits of the respiratory system, reaching the stomach and causing damage, or those who contract the virus and have blood problems. As a complement to the principle of our system's work integrated into all respects to help the injured and prevent their disruption to others, as shown in Figure 6, this page was designed to provide direct communication with a group of laboratories. It is aimed to coordinate with the laboratory and reservation analyses through special teams that arrive at home to provide a home examination while adhering to prevention instructions.
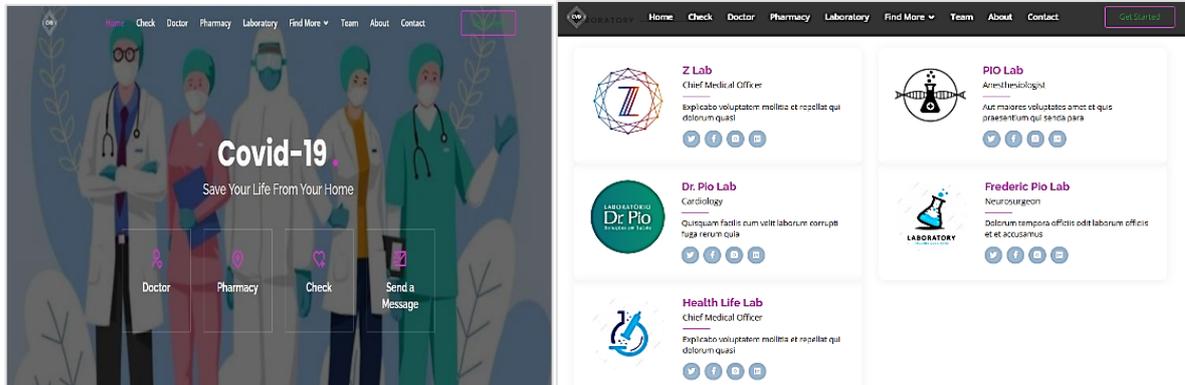

Figure 6: Laboratory Page Screen

5.5 Instructions page (isolation and prevention)

This page will provide specific and important information about Isolation and prevention Instructions. If COVID-19 is spreading in your community, taking some easy precautions will help to keep you safe. These precautions are physical distancing, wearing a muzzle, making rooms well ventilated, avoiding congestion, washing your hands continuously, and coughing into a napkin or elbow bent when required, as shown in Figure 7. Likewise, information with details is provided in the paragraphs below:

8) Isolation inside the house.
9) Know when to go to the hospital.
10) Tips for what to do if someone in your home has been infected with the COVID-19 virus.
11) How to protect yourself while caring for someone with COVID-19.
12) How to protect others if you are sick.
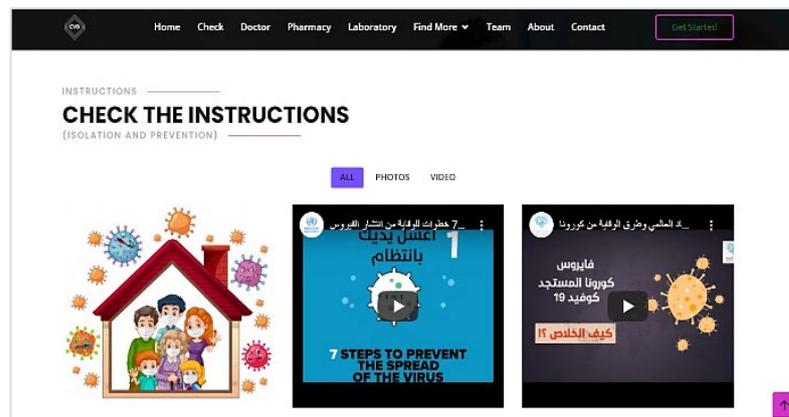13) Emergency warning signs.
14) Treatment at home.

Figure 7: Instructions Page Screen

5.6 Articles page

Recently, the number of scientific papers published on journal websites has risen about Covid-19, depending on that. With the idea of helping scientists find related research about this virus and similar diseases, we added the Articles page. This page contains several related articles about Coronavirus and respiratory system disease. This may help other students and scientists study and develop systems that help limit the virus's spread. It also helps researchers find the most recent updated information about the virus, as shown in Figure 8.
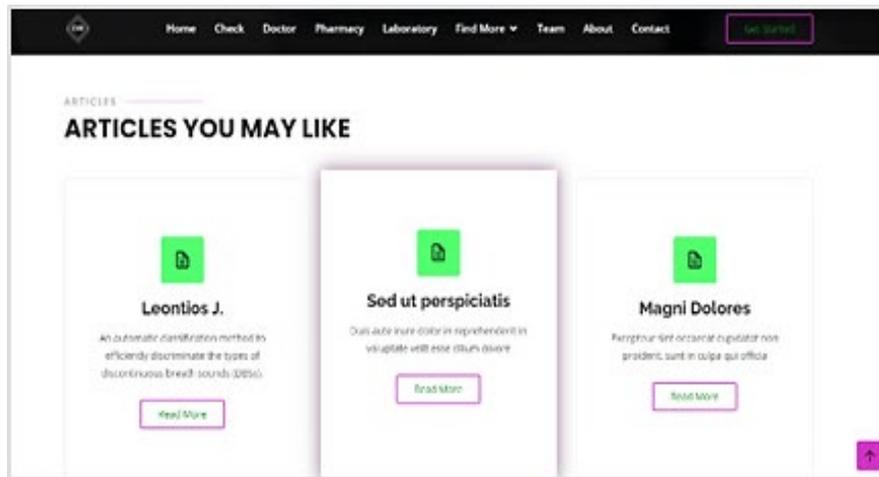
Figure 8: Articles Page Screens

5.7 Map of Spread

This page tracked the Global Outbreak for Coronavirus and introduced reported cases, deaths, and vaccinations by country. As a result, it will show the map of the virus spread over the world by 24/24, as clarified in Figure 9. Besides that, as a general site, it contains Team Page, About Page, and Contact Page to make it easy for people to communicate with the team.

Figure 9: Map of Spread Page Screens

Implementing the system and linking it to several health institutions, hospitals, and pharmacies have devoted to remote follow-up of the injured and providing health advice for patients to recover. Also, it assisted in the transfer of severe cases to treatment, and direct supervision with isolation will achieve good results to limit the focus of the pandemic spread and reduce the number of infections.

6. Conclusion

This paper proposes a website using WoT technique that helps manage the COVID-19 pandemic. Due to an urgent need to find appropriate methods to diagnose people with the virus remotely to avoid mixing and trying to determine the focus of the virus spread.

COVID-19 Virus Detection (CVD) will meet the most basic needs of infected people. These needs are an easy way to detect virus infection, contact specialized doctors for consultations, pharmacies to deliver treatment to the home, Laboratories, a map of virus spread around the world, and isolation and prevention instructions for educating citizens at home. In addition, it will assist in virus-related papers that help researchers and patients learn the most up-to-date information regarding the pandemic.

A collection of web design languages such as (HTML, HTML5, CSS, CSS3, JavaScript, Bootstrap) were employed in the design of this system under the notion of the web of things. In addition to interactive graphic interfaces.

The results of this research are that when the system is implemented and linked to a system of doctors, pharmacies, and laboratories (i.e., a complete medical system is provided that works using the proposed system), it will work to achieve detection, follow-up, and treatment of Corona patients while maintaining isolation and social distancing. Such achievement contributes to reducing and limiting the spread of the pandemic leading to cutting the way for the virus to spread.

7. Future work

As a plan for this research, we are working on using a thermal camera to diagnose the infected and specify their names, locations, civil status identification number, and temperature. Besides, "connecting a device to measure the oxygen level in the blood to help provide a comprehensive system for diagnosing the virus in humans.

Algorithm 1. General System Algorithm

Input: User information
Output: User situation (Infected, Uninfected)
Begin
STEP 1: Register user Demographics information, such as (name, gender, age, location).
STEP 2: The user records his breathing sound.
STEP 3: The recorded breath sound will be sent to extract features and classification to determine if the user has covid-19 or not.
STEP 4: The user will be informed of the result.
If the result is negative, display preventive instructions.
Else if the result is positive, Guide the user on how to contact Doctors, Pharmacies, Laboratory and show instructions on isolating the patient from the rest who live at home.
End

Author contribution

All authors contributed equally to this work.

Funding

Data availability statement

The data that support the findings of this study are available on request from the corresponding author.

Conflicts of interest

The authors declare that there is no conflict of interest.

References

[1] N. F. Hassan, H. B. A. Wahab, Proposed a new approach for voiced / Unvoiced decision of speech file using Lagrange technique, Telecommun. Radio Eng., 72 (2013) 495–504. https://doi.org/10.1615/TelecomRadEng.v72.i6.40

[2] E. Temkin, Extremely low prevalence of asymptomatic COVID-19 among healthcare workers caring for COVID-19 patients in Israeli hospitals: a cross-sectional study, Clin. Microbiol. Infect., 27 (2021) 130.E1-130.E4. https://doi.org/10.1016/j.cmi.2020.09.040

[3] S. K. Dhar, S. S. Bhunia, N. Mukherjee, Interference aware scheduling of sensors in IoT enabled healthcare monitoring system, Int. Conf. Emerging Appl. Infor. Technol. Kolkata, India, (2014) 152-157. https://doi.org/10.1109/EAIT.2014.50

[4] E. K. Gbashi, Improvement Personalization of Website Using Database and Cookies, Eng. Technol. J., 28 (2010) 1596- 1614.

[5] A. H. Seno , S. A. Alshammari, A Cooperation of Fog Computing and Smart Gateways in a Secure and Efficient Architecture for IoT-Based Smart Homes, Eng. Technol. J., 37 (2019) 290–301. http://dx.doi.org/10.30684/etj.37.7A.10

[6] S. M. R. Islam, D. Kwak, M. H. Kabir, M. Hossain, K. S. Kwak, The internet of things for health care: A comprehensive survey, IEEE Access, 3 (2015) 678–708. https://doi.org/10.1109/ACCESS.2015.2437951

[7] S. Mumtaz, J. Rodriguez, M. Katz, C. Wang, A. Nascimento, Wireless Internet, Int. Conf. Lisbon, Portugal., 146, (2014) 13-14. https://doi.org/10.1007/978-3-319-18802-7

[8] M. C. Domenech, E. Comunello, M. S. Wangham, Identity management in e-Health: A case study of web of things application using OpenID connect, IEEE Int. Conf. e-Health Netw. Appl. Services (Healthcom), Natal, Brazil, (2014) 219-224. https://doi.org/10.1109/HealthCom.2014.7001844

[9] M. A. G. Maureira, D. Oldenhof, L. Teernstra, ThingSpeak – an API and Web Service for the Internet of Things, World Wide Web, (2014).

[10] , D. A. Guinard, Web of Things Application Architecture – Int. the Real-World into the Web, PhD th., ETH Zurich, 2011.

[11] A. Spinelli , G. Pellino, COVID-19 pandemic: perspectives on an unfolding crisis, Br. J. Surg., 107 (2020) 785–787. https://doi.org/10.1002/bjs.11627

[12] M. A. Hadi , H. I. Ali, Control of COVID-19 system using a novel nonlinear robust control algorithm, Biomed. Signal Process. Control, 64 (2021) 102317. https://doi.org/10.1016/j.bspc.2020.102317

[13] D. R. Lakkireddy, Guidance for Cardiac Electrophysiology During the COVID-19 Pandemic from the Heart Rhythm Society COVID-19 Task Force; Electrophysiology Section of the American College of Cardiology; and the Electrocardiography and Arrhythmias Committee of the Council on Clinical Cardiology, Am. Heart Association, Circulation ,141 (2020) E823–E831.

[14] T. K. Burki, Cancer guidelines during the COVID-19 pandemic, Lancet Oncol., 21 (2020) 629–630. https://doi.org/10.1016/S1470-2045(20)30217-5

[15] W. Reinisch, S. Danese, L. Peyrin-Biroulet, E. V. Loftus, Clinical trials for inflammatory bowel disease: Global guidance during the covid-19 pandemic, J. Crohn's Colitis, 14 (2020) S815–S819. https://doi.org/10.1093/ecco-jcc/jjaa119

[16] A. N. Belkacem, S. Ouhbi, A. Lakas, E. Benkhelifa, C. Chen, End-to-End AI-Based Point-of-Care Diagnosis System for Classifying Respiratory Illnesses and Early Detection of COVID-19, arXiv, pp. 1–11, (2020).

[17] P. Dashraath , Coronavirus disease 2019 (COVID-19) pandemic and pregnancy, Am. J. Obstet. Gynecol., 222 (2020) 521–531. https://doi.org/10.1016/j.ajog.2020.03.021

[18] S. Hsiang et al., The effect of large-scale anti-contagion policies on the COVID-19 pandemic, Nature, 584 (2020) 262–267. https://doi.org/10.1038/s41586-020-2404-8

[19] Y. Huang , The respiratory sound features of COVID-19 patients fill gaps between clinical data and screening methods, medRxiv, (2020). https://doi.org/10.1101/2020.04.07.20051060

[20] A. A. Abdulrahman, A. M. S. Rahma, Automated Analysis of Comments on Press Articles in Websites (Articles Literature as Case Study), Eng. Technol. J., 38 (2020) 74–84. https://doi.org/10.30684/etj.v38i2b.1451

[21] C. Brown et al., Exploring Automatic Diagnosis of COVID-19 from Crowdsourced Respiratory Sound Data, Proc. ACM SIGKDD Int. Conf. Knowl. Discov. Data Min., (2020) 3474–3484. https://doi.org/10.1145/3394486.3412865

[22] A. Glangetas , Deep learning diagnostic and risk-stratification pattern detection for COVID-19 in digital lung auscultations: clinical protocol for a case–control and prospective cohort study, BMC Pulm. Med., 21 (2021) 1–8. https://doi.org/10.1186/s12890-021-01467-w