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Robotics and Artificial Intelligence in Healthcare During COVID-19 Pandemic

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Abstract: *The outrage of the COVID-19 has hit the healthcare industry tremendously. This pandemic has created a huge demand for necessary medical equipment, medicines, advanced requirement robots, and artificial intelligence-based applications. Intelligent robots have great potential to provide diagnostic risk assessment, monitoring, telehealth, disinfection, and other services other operations. The long-awaited vaccine discovery of this virus has also been greatly accelerated by the AI-enabled tool. Also, many robotic and Robotic Process Automation platforms have greatly facilitated the distribution of the vaccine. cutting edges technology have also helped brings comfort to people facing less addressed health complication. This paper investigates the use of robotics and artificial intelligence-based technology and their applications in healthcare to fight against the COVID-19 pandemic..*

Keywords: COVID-19, Robotics, Artificial intelligence, Health care, SARS-CoV-2.

I. INTRODUCTION

The COVID-19 pandemic is unarguably the biggest problem of the 21st century, It was perhaps the most important global crisis after the second world war. The ability to Spread quickly of the virus has forcedthe world population to maintain strict preventive measures. The goods of Severe Acute Respiratory Syndrome Coronavirus Disease are not just confined to claiming the lives of nearly4.5 a million people. It has a depression across all the functional aspects of mortal lives. After being characterized as Global Epidemic by the World Health Organization on 11 March 2020 The world has witnessed how this largely contagious complaint has desisted normal life and made everything get beyond control. The outrageous transmissibility of Coronavirus can be substantiated by its average reduplication number of around3.28[1] which signifies the average number of infection cases caused by a formerly infected existent has an indicator of a pathogen eventuality to beget an epidemic. This supports the exponential growth of the cases in the epicenters though it has a low casualty rate among the infected people. The crown-like appearance of the Coronavirus justifies the prefix ‘Corona’ which is a Latin word for “Crown’’ and thus has been characterized as a member of the Corona.[2] The new Coronavirus started in Wuhan City of Hubei Province of China, was transmitted through bludgeons that can host the most viral genotypes of Coronavirus. Contagions transmitted from species to species can carry developed mutations in proteins on their envelope that have substantial capacity to bind cells in different samples and acquire high possibilities through several mutations These factors have led the Coronavirus to run worldwide.[3]The health sector had faced severe vulnerabilities in the COVID-19 epidemic. The public health challenges soared up advanced than ever because of the unpreparedness of the health sectors for a global epidemic. The lack of standardized treatment protocol, guidelines, and manuals for such an extremity has made the practitioners in this field more unskillful. During the courses of this kind of extremities, health professionals are subdued to set preferences about all the aspects of their working grounds ranging from fixing disquisition to performing acts. From opinion to treatment, the caregivers are susceptible to pitfalls in every phase of the cycle. The fragile protection measures for the croakers, babysitters, and lab technicians can unhinge the light heartedness of precautionary and restorative care in due time. But hospitals are the hot spots and covering the safety rules abidance by everyone there is further complex than it seems. Safety outfit Deficiency demarcates the protective measures vastly. Beforehand discovery and precautionary measures according to it, can palliate the trouble of transmission to a lower extent.

The frightful mortality rates and mischievous health issues of the COVID-19 epidemic have stressed the need for addressingits impact on physical health so monstrously that the severe negative counteraccusations it has posed on internal health have frequently been disregarded. The annihilation created for the emergence of this got miracle has incited fear, anxiety, and trauma-related diseases. The reduced social commerce owing to preventive measures like Beleaguerment, lockdown, social distancing have executed loneliness, solitude, and other common trouble factors to internal well-being. Multitudinous studies and reports have revealed the increase in domestic violence during this period. So harbingered the consequences of internal health declination for this epidemic may spark, phobic anxiety, obsessive-compulsive complaint, depression, and other internal ails. It's easily true that the challenges for the Coronavirus Bear prompt and dynamic results. Health workers and policymakers are making constant sweats to address these challenges. Researchers around the world are applying the leading technologies with their scientific findings to find requital for AI and Robotics had been substantiated to be an implicit means for scientific disquisition and have executed the effectiveness of these studies both empirically and theoretically. We conducted a regular quest to collect the scientific records related to our compass. The Mendeley database was chosen to perform the quest on literature from January 2020 onwards with the combination of ‘‘Coronavirus’’, ‘‘COVID19 ’’, ‘‘ Healthcare ’’, ‘‘ Robotics ’’, and ‘‘ Artificial Intelligence ’’. Preprints and scientific reports were barred.

II. DURING COVID-19, HEALTHCARE SPECTRUM

COVID-19's unpredicted expansion has resulted in a large increase in operational activity in the health sector and adjacent disciplines. For operational tasks, various levels of collaborative support are necessary, and service scopes are not limited to a particular field. Rather, the health division's interrelated problems may be separated into spectra, with task force spectral units guiding the proceedings [4]. The distribution of responsibilities for distinct patient groups can be identified by dividing the point of service in healthcare departments into five spectral categories.These are briefly discussed as follows:

2.1. General Care (Primary Prevention and Healthcare Support)

Primary prevention refers to measures performed by authorities or individuals, such as social separation, wearing facial masks, handwashing, imposing city-wide lockdowns, and so on. It entails the imposition of rigorous laws for monitoring social distancing, observing people for masks, and inspecting lockdown zones, with the public obligated to comply with them. The detection of vulnerable locations with vast screening and rapid testing facilities will provide details to identify risk utilizing contact tracing information and so forecast the spread of disease in diverse areas as a primary prevention approach.

2.2. Inpatient Care (Acute and Emergency Care)

This verbal description includes the identification of the patients, analysis of the identification results, sorting them to the correct level of care, mapping out the suitable treatment strategies for the hospitalized patients, important care, and isolation support, predict the severity of the patient from initial symptoms to spot unsound and vulnerable people and shift them to ICU or CCU for correct clinical care of them and prepare telemedicine opportunities for fewer severe patients.

2.3 Non-COVID-19 Outpatient, Home, and Long-Term Care

Secondary hindrance measures and semipermanent sickness management area unit enclosed during this spectrum. Because the contagion encompasses a virus transmission chance everyplace the infected person goes, there's no difference to disinfecting the hospital areas. the security rule maintenance’s by the hospital staff is crucial for following the treatment of non-COVID-19 outpatients.

2.4. Medical Education

This category includes the steps that must be taken to empower healthcare workers by providing hands-on training in the most up-to-date treatments and technologies for COVID-19 patients. Accelerating healthcare training and education for health workers, as well as decreasing healthcare employees' workloads with new technologies, are all part of this.

2.5. Research and Development (R&D)

Research and development is a term that refers to Identifying effective current drugs, expediting research and treatment, testing prototypes, developing drugs faster, generating vaccines, and designing personal protective equipment are all part of pandemic research and development (PPE).

III. ROBOTICS AND AI TECHNOLOGIES IN COVID-19 HEALTHCARE

The technology fields of AI and Robotics have worked wonders in resolving the health sector's critical needs throughout this pandemic. Researchers and inventors are coming up with innovative ways to address the growing issues in the healthcare industry as a result of the COVID-19 outbreak. In this section, we'll go over some of the areas where robotics and artificial intelligence have had a significant impact on improving the situation during the pandemic, such as diagnosis, risk assessment, surveillance, telehealthcare, delivery and supply chain, service automation, disinfection, and speeding up research and drug development.

3.1. COVID-19 Diagnosis

Rapid testing is being prioritized during the COVID-19 pandemic to help contain the epidemic and prevent virus propagation. However, it is difficult due to a lack of medical resources and the increased risk of infection through direct contact. Robotic technology can be utilized to gather samples without having to come into contact with them. Robots are also being utilized as a tool to allow doctors to diagnose patients remotely, reducing the risk of contamination. AI algorithms help prioritize the scheduling of suspected patients and speed up the testing procedure while requiring little human intervention.

Early discovery can aid in controlling the virus's rapid spread. A comprehensive review of recent AI-powered COVID-19 detection and prediction work is presented[5]. Significant research has been done to establish relationships between early COVID-19 symptoms and test findings, which may help detect the disease from those minor symptoms [6]. A positive test for SARS-CoV-2 is used in the regular COVID-19 test. This approach, however, is time-consuming and has a larger risk of false-positive outcomes.

A temperature screening system [7]can assess whether a person is allowed to enter a region by measuring the temperature of passengers in a vehicle in a contactless and autonomous manner. Dr. Spot[8] can do a series of monitoring operations, including vital symptom evaluation, and can also be teleoperated with qualified clinical professionals based on an initial assessment, which has been used in several medical settings.

Patients with COVID-19 symptoms can also be evaluated using artificially intelligent algorithms that combine imaging techniques such as computer tomography (CT scans) [9]. Constructed an end-to-end learning-based Coronavirus classification model with CT scan pictures [10], and the training set for the model was augmented with the BigBiGAN, as well as a linear classifier and two nonlinear classifier SVM and KNN algorithms. COVID detection algorithms based on deep learning have demonstrated encouraging results and have been used in several studies. showed CNN-based COVID detection models with DenseNet-201 architecture. Several works offered their architecture for CT-image-based COVID detection, such as, which designed the architecture with 94.83 percent accuracy, and, which distinguished the COVNet model [11].

AI systems assist radiologists in analyzing patterns in radiological images and determining the likelihood of infection. VGG Convolution Neural Network was presented that can help the clinical decision support system detect the disease early. COV19NET, a DL algorithm-based model for COVID identification from chest radiographs, was proposed by the authors.

UC San Diego Health has developed a new AI-powered technique for early identification of pneumonia, a more serious COVID-19 illness, that employs a machine learning model. This model was trained using 22,000 chest X-ray images annotated by human radiologists, and it can indicate the likelihood of pneumonia in the chest X-ray region [12].

The search for the optimal methodology for detecting COVID-19 from chest X-rays using various machine learning and deep learning algorithms has been highly popular among practitioners. For COVID-19 diagnosis, architecture paired with a transfer learning technique. The work solely employed CNN to develop a prediction model with COVID-19 positive and negative X-rays as training data [13].

For COVID infection detection, the COVID detection methodology suggested included different machine learning methods such as CNN, support vector machine (SVM), and random forest (RF). The inadequacy of a proper dataset for the COVID detection study was addressed. The authors used a weekly labeled data augmentation process to increase the size of training data, and their analysis revealed that adding augmented data had a positive impact on the classification result, with the average accuracy of the model increasing by 21.04 percent when compared to non-augmented training. CVDNet, a deep convolutional neural network (CNN) model, was introduced, with an average COVID detection accuracy of 97.20 percent.

DeepCOVID-XR, a deep learning-based COVID detection algorithm for chest radiographs. A COVID-19 classification model based on VGG-16. Zhang et al. developed, verified, and tested a CV19- A net model for distinguishing Coronavirus illness from other viral pneumonia. The Fuzzy Color methodology for dataset restructuring, the Social Mimic optimization method for feature selection, and deep learning models such as MobileNetV2, SqueezeNet for dataset training were all used in the COVID-19 detection pipeline described. The model's accuracy was subsequently increased to 99.27 percent using an SVM classifier. To detect diseased regions in the lungs, researchers used CNN architecture.

3.2. COVID-19 Risk Assessment

Coronavirus has a variety of effects on the physical well-being of different people. Some patients do not require much medication or consultation; however, some groups, particularly the elderly and vulnerable, require special care and a quick and prompt response from the service provider in order to survive. However, determining the severity of this unique disease is not straightforward. AI platforms have stretched their hands to identify high-risk patients based on their current medical issues [13].

Using machine learning algorithms, the authors established a COVID-19 vulnerability index that took into account pre-existing medical issues in [14]. The Medical Home Network, a non-profit organisation based in Chicago, uses AI technologies to identify vulnerable individuals based on their respiratory.

Even though the fact that over 80% of cases appear to be minor, those who develop severe symptoms frequently require oxygen and continuous ventilation. The AI technology can reliably predict who will develop the severe respiratory disease after being infected with COVID-19. To characterize COVID-19 patterns and forecast severity, the AI model must be trained with data from severe and mild COVID patients and trained with a machine-learning method. Many machine learning models have been developed to predict COVID patient mortality using various samples.

The AI model EDRnet in [15] predicted the COVID-19 death rate with a 92 percent accuracy. To execute the in-hospital mortality prediction, the model was created using ensemble learning based on deep neural networks and random forest methods.

3.3. Surveillance during COVID-19

Coronavirus was first discovered in the Chinese city of Wuhan, in the province of Hubei. Then, when the virus expanded further, the hotspots of infection and mortality from it shifted from time to time. Several countries in Europe, North America, South America, and Asia have severe healthcare crises as a result of this unprecedented threat. The government of these states' lack of preparation had exacerbated the problem. As a result, a forecast of the virus's spread to any location would assist policymakers in acting quickly and appropriately.

AI algorithms can analyse the virus's geographical spread and pinpoint clusters and hotspots. These data can be used to identify vulnerable locations in various geographies. Individuals were tracked using AI-powered tools like contact tracing apps to identify the risk and anticipate how the sickness will progress in the future.

IV. CONCLUSION

To a large extent, AI and robotics are being deployed in numerous points of service for COVID-19. This research delves into the contributions and potential applications of these technologies during a pandemic. This report also distinguishes between the various healthcare rules. The recently discovered AI-driven methods for COVID-19 identification and diagnosis have helped to relieve the load on traditional methods. The one problem about AI-based innovative solutions is that they are producing less accurate outcomes than traditional methods. Deep learning algorithms are being utilized to develop prediction models to prognosticate patients' situations in the risk assessment and proper triaging of COVID-19 patients. Similarly, several robot-operated applications and technologies are considerably assisting social monitoring, distribution.

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