The Role of Digital Technologies in Healthcare During the Pandemic COVID-19

Khadija El Massi and Hicham Mohamed Hamri

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Khadija EL MASSI
ENCG AGADIR
Khadija.el.massi@gmail.com

Hicham Mohamed HAMRI
ENCG AGADIR
H.m.hamri@gmail.com

Abstract :

The ongoing pandemic of COVID-19 has forced governments to impose a lockdown « follow stringent containment measures, such as quarantine and social distancing », and many people have suddenly found themselves having to reduce their movement and social relations in order to slow down the spread of COVID-19.

While Various technology innovations and applications have been developed to fight the coronavirus pandemic and have played a vital role in tackling the covid-19 pandemic, the pandemic also presents a significant opportunity for digital technologies and has implications for the design, development, and use of technologies

There is an urgent need for a greater understanding of what roles information systems and technology researchers can play in this global pandemic. This article examines emerging technologies used in healthcare field to mitigate the threats of COVID-19 pandemic and to fight it. It also helps promote future research and technology development to produce better solutions for tackling the COVID-19 pandemic and future pandemics.

Keywords : Technology, COVID-19 pandemic, Telehealth, 3D Printing, Artificial Intelligence, Internet Of Things.

Introduction :

The COVID-19, an acronym for « Coronavirus Disease2019 », is a respiratory illness caused by the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), it is a contagious virus that was identified in December 2019 in China and declared a global pandemic by the WHO on 11 March 2020. In the problematic current pandemic situation, the number of infected patients is increasing day by day globally, the pandemic has devastated many aspects of daily life where governments across the world have needed to
lockdown, necessitating the cessation of almost all forms of human in person contact outside the immediate family. to slow down the spread of the covid-19.

At a time when everyone needs better information, including epidemic disease modellers, state authorities, international organisations and people in quarantine or maintaining social distancing, technological applications and initiatives are multiplying in an attempt to stop the spread of the disease, treat patients, collect data and reliable evidence to support public health decision-making, and take the pressure off overworked healthcare workers, while also developing a effective vaccines. The government leaders and decision makers are implementing policies to deliver health care services using technology and more so in response to the novel COVID-19 pandemic.

In this article we aim to provide awareness of this innovative technology and its significant applications for COVID-19 pandemic by exploring the use of technologies such as the three-dimensional printing (3D printing), the Artificial Intelligence (AI), and the Internet of Things (IoT), to help mitigate the impact of COVID-19 outbreak.

Artificial intelligence, robots and drones are being deployed to help track the disease and enforce restrictive measures. Furthermore, 3D printing and open-source technologies seem capable of sustaining the effort of governments and hospitals around the world to meet the increasing need for medical hardware (e.g. facemasks, ventilators and breathing filters) and optimise the supply of the necessary medical equipment. At the same time, IoT devices are helping The diagnosis, tracking, and control of this crisisis carried out in real-time, imroving health service delivery and contributing to telehealth that allowed to slow the spread of the virus and to maintain hospital capacity by operating as a possible filter, keeping those with moderate symptoms at home and routing more severe cases to hospitals.

The 3D PRINTING "THREE-DIMENSIONAL PRINTING"

Since the beginning of the COVID-19 pandemic 3D printing has played an important role in medicalaid and support improvedhealth care. It has helped to overcome the lack of equipment and addressingthisshortage of medical supplies for the COVID-19 battle. 3D printing allows three-dimensional renderings to berealized as physical objects with the use of a printer. The printing of **face shield**, **nasopharyngeal (NP) swab, ventilator, face mask, and temporary emergency dwelling** have become very common during this pandemic.

- **Face shield**

Face shields ia a type of personal protective equipment (PPE), it is a protective device that completely protect and cover the face, eyes, nose and mouth together.
It consist of a cap that can be printed with 3D printers and a transparent layer attached to this cap. Considering its plain design, it is accessible to print with 3D devices. In addition, due to the limitation of the PPE during the pandemic, Prusa Research and some companies shared their face shield designs to be printed with a 3D printer for free[1].

- **Nasopharyngeal (NP) swab**

The World Health Organization (WHO) and the United State Center for Disease Control and Prevention (CDC) recommend nasopharyngeal(NP) swab as the optimal diagnostic device for COVID-19[2]. Nasopharyngeal specimens are collected with NP swabs that are FDA « Food and Drug Administration » Class 1 medical devices, 15 cm long and a nose tip diameter of 2 to 3 mm[3], a 2 to 4 mm diameter thick shaft, a thin neck with 1 to 2 mm in diameter, and 4 to 7 cm long and a break point from the head tip of 7 to 8 mm, it is designed to capture posterior nasopharynx secretions[4] for testing. Since the beginning of the pandemic the demand for the nasopharyngeal swabs is unpredictably increasing, and the 3D printing is what helped to overcome this problem, then a mass production for Nasopharyngeal swabs is rapidly fabricated[5].

- **Ventilator valves**

According to WHO, One in six COVID-19 patients has difficulty breathing. That's because lungs are the main battle ground in COVID-19 infections, which can cripple breathing functions. By this reason, ventilator that supplies sufficient oxygen into the patient's lungs and that removes the carbon dioxide support is required. 3D printing

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[1]S.T. Flanagan, D.H. Ballard, 3D printed face shields:acommunityresponse to the COVID-19 global pandemic. Acad. Radiol. 27,905–906 (2020). https://doi.org/10.1016/j.acra.2020.04.020

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technology provides an opportunity to respond to the urgent needs for more ventilators by producing ventilator valves. An independent research institute in Rome called Isinnova ,transported its FDM-type 3D printer, and printed 100 valves on one weekend[6] on the hospital in Chiari, in the Brescia area of northern Italy where the coronavirus pandemic has hit hard in order to keep patients who required oxygen alive, the valves need to be replaced for each patient.[7]

- **Face mask**

A mask, with or without a face shield, thatcovers the user's nose and mouth and may ormay not meetfluidbarrier or filtration efficiency levels. The 3D protective face mask consists can easily be done by Computer-aided design(CAD designers world wide with free down load software. It helps to produce the face mask and the filter membrance support.[8]

- **Temporary emergency dwelling**

The 3D printing dwellings compared to traditional construction methods requires shorter building times and lower labour costs it can be easily transported and deployed to areas where they are most needed. 3D printing is used to fabricate temporary emergency dwellings to isolate patients under quarantine, for relieve the overloaded hospitals.[9]

THE ARTIFICIAL INTELLIGENCE « AI »

The AI is the process of human-like intelligence which includes information, reasoning, and self-correction capability, it is simulated by using computer-controlled machines.[10]
In healthcare, AI is being used to help offer remote health checks and follow-up tools. It can analyse large amounts of data to bring insights from a large populations of patients, which can improve diagnosis and make a good predictive analysis. It has been applied with some succes to diagnosing the COVID cough from other types of coughs. AI and big data have the potential to improve health care systems by providing more accurate diagnoses, making good clinical decision and bringing higher-quality treatments at a lower cost.[11]

With so much data being generated on coronavirus everyday, the AI algorithms can help provide pertinent information on how viruses spread. It can also find important

[6]Naitove, Matthew. « Coronavirus Emergency:Ventilator Valves 3D Printed at Hospital ». Consulté le 7 août 2021.https://www.ptonline.com/blog/post/coronavirus-emergency-ventilator-valves-3d-printed-at-hospital.
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correlations between data points like the people's movement patterns who are living in the areas most affected by the virus.[12]

In the case of COVID-19, the AI successfully identified the cities where the virus would be transferred to after it surfaced in Wuhan, China. Machine learning algorithms studying travel patterns were able to forecast where the people who had contracted the virus were likely to travel.[13]

There is many examples of societes which has been using AI in this pandemic, for example, BlueDot which is a Canadian start-up and Amazon Web Services customer, at the beginning of the covid-19 pandemic by using AI it was one of the first to detect the outbreak of the disease of a respiratory illness in Wuhan, China.By using their machine learning algorithms, BlueDot sifts through news reports in 65 languages, along with airline data and animal disease networks to detect outbreaks and forecast how it will spread. BlueDot provides those insights to other institutions (public health officials, hospitals, …) to help them to anticipate and manage the risks.[14]

Another example is the chinese giant Baidu which developed an AI system, it uses cameras equipped with computer vision and infrared sensors to predict people's temperatures in the public areas. Those cameras can screen up to 200 people per minute and detect their temperature within a range of 0.5 degrees Celsius. The chinese firms are using drones and robots to spray disinfectants in public areas for minimizing the risk of cross-infection and to perform contactless delivery. Other robots are checking people for COVID-19 symptoms like fever and distribute free hand desinfecants. Inside hospitals, for reducing the number of required personnel robots are cooking rice without human supervision, also robots are delivering food and medicine to patients and disinfecting their rooms to minimise the risk of infection of medical staff. The doctors used a robot to communicate with and treat patients remotely to minimize the exposition to infected people.[15]

The Internet of Things (loT)

The IoT can be defined as an advanced technology that can link all smart objects to get her within a network without any human *involvement* [16]. It is also defined as a well-defined scheme of interconnected computing tactics, digital, and mechanical devices that without needing the interactions of human, which can transmet the data *over* the defined net work. [17] The IoT is also defined as a system of wireless, interrelated, and

[12]Dickson, Ben. « AI Is among Our Most Effective Tools in the Fightagainst Coronavirus ». TechTalks, 9 mars 2020. https://bdtechtalks.com/2020/03/09/artificial-intelligence-covid-19-coronavirus/.

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connected digital devices that can collect, send, and store data over a network without needing human-to-computer or human-to-human interaction. [18]

The significant applications of IoT in healthcare during Covid-19 pandemic are the diagnosis, tracking, and control of this crisisis carried out in real-time which includes daily new cases of the disease[19], self monitoring of patients of blood pressure, heart rate, glucometer and so on[20], contacting the trace of infected persons , tracking the quarantine patients and health conditions of older people, supplying of medical equipments and medicines and food items, assisting and help the medical staff, practitioners to offert heir treatments in a effective manner to the patients. [21]

Conclusion :

Technology has played an important role in responding to the COVID-19 pandemic, we have showed the role of digital technologies in healthcare, throughout this pandemic, Technologies are enhancing diagnoses of covid-19, shaping spatiotemporal visualisations of virus transmission, providing real-time information updates and facilitating communication during lockdown. They have answered the call for a new form of public health that illustrates opportunities for enhanced agility, and responsiveness. The pandemic has forced governments and decision makers to reassess how they use technology and to extend the use of technology to mitigate many of the societal impacts of the spreading virus. Telehealth offers opportunities in reducing visits to hospitals, which protects patients and othefrom the COVID-19 infection. Technology have not only a role in healthcare, but also in other fields, during the lockdown many people had to work at home, technology has performed telework, e-commerce, distance learning and online schooling.

Although calls can be encrypted for security, during the COVID-19 pandemic technologies generated new challenges in cyber risks and cyber security for different fields. Cyber risks are one of main barriers of using technology. It provide opportunities for cyber-attacks and for personal information to be captured improperly. The home network is vulnerable to security attacks.Patients privacy needs to be protected, ensuring to prevent unauthorized tracking and verification. Data security, confidentiality, and privacy should be federally implemented.

The examination reflection and academic analysis of the use of technology during this crisis is crucial for progress in the post-COVID-19 era, to ensure governments and decision makers can better understand how we got to this place and to can handle any future crisis.

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