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Research Trends on the Application of Information Technologies and Digital Innovations during Covid-19 Pandemic

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Abstract: ***This paper covers the background information and research overview of application of information technologies and digital innovations during COVID-19 pandemic and puts forward the prospects of digital healthcare, business, academic and industrial stakeholders. The key concepts, information technologies (IT) development processes, and digital innovations application cases were addressed. The recent research trends on these aspects through bibliometric techniques were used to analyze the research outcomes, geographic location of published articles, discipline of studied area and number of published papers. It is seen that IT and digital innovations played important roles in human life for risk reduction from COVID-19. Technology such as Artificial Intelligence (AI), 5G, and drones were able to detect COVID patients and monitor crowd. Access to tools and continued technologic advances, including internet of things (IoT) and smartphone incorporation, will ease to control the current pandemic as well as preparedness for the next level.***

Keywords: Information technologies, Digital innovations, COVID-19, Pandemic, Health Sector

I. INTRODUCTION

The COVID-19 pandemic has caused a massive impact on hospital systems, businesses, schools, and the economy. Telemedicine, telework, and online education become essential to help society slow down the spread of the coronavirus. The pandemic has generated a rapid demand for efforts to use innovative technologies to cope with damage from COVID-19 on our life. The pandemic has not only raised opportunities to advance technology-based solutions but also provided a rare opportunity to study the research and practice of technology, including information management, work practices, and design and use of technologies [1-3]. The health informatics community in China, including clinical informatics, public health informatics, consumer health informatics, and clinical research informatics, has actively taken action to leverage health information technology for epidemic monitoring, detection, early warning, prevention and control, and other tasks. The Internet of Things (IoT) has provided platforms such as Worldometer that enable people to access data to monitor the COVID-19 epidemic; integration of big data, such as transportation data and location-based services data, is used to model viral activity and provide guide for health care policy makers, artificial intelligence (AI) and deep learning can enhance the detection and diagnosis of COVID-19 and facilitate the discovery of novel drugs. Clearly, health information technology has played meritorious roles in the battle against COVID-19 [4]. IT and digital technologies have enabled people to easily and quickly share information during the crisis. Healthcare organizations and governments are making use of information technology to improve public health by spreading news related to the COVID-19 virus to millions of people. Any breakthroughs, preventive measures, and medical advice that can help save lives are shared through networks and devices in a matter of seconds. There are various articles which describe the application of information technologies (IT) during COVID-19 pandemic. The COVID-19 pandemic is scattering around the world at an exceptional rate and has gained attraction with widespread attention from scientists from all over the world. The number of research articles with publications in the field of IT and digital innovations has increased stridently at this stage, proving the possible impact on the field of digital medicine. A variety of emerging technologies, such as cloud computing, big data, the IoT, mobile internet, AI, and fifth-generation mobile networks (5G), are being used for epidemic prevention and control. The discussion of the technological progress will concentrate mainly on virtual learning among students and scholars, online purchasing of merchandise, the use of the robotic delivery system, implementation of online entertainment, and contactless payments through cards and e-wallets [6-8]. Therefore, this article is tailored to explore the advancement of technology in this era of COVID-19 and how it has impacted individuals' lives and states in a few developed and technologically advanced countries. The aim of this study is to describe the application of IT and digital innovations that have been reported in the scientific literature to mitigate the impact of COVID-19 on individuals and several sectors and systems.

II. MATERIALS AND METHODS

The relevant data in this paper comes from the Scopus database, which has wide-ranging literature abstract and citation database. Scopus provides scientific research outcomes, outputs and results in the fields of science, technology, medicine, social sciences, art and humanities [9]. Scopus uniquely combines a comprehensive, expertly curated abstract and citation database with enriched data and linked scholarly literature across a wide variety of disciplines. Scopus quickly finds relevant and authoritative research, identifies experts and provides access to reliable data, metrics and analytical tools. To sort out the research trends and its application of IT and digital innovations, the paper carried out searches according to the search with the two themes of "Information technologies during COVID-19" and "digital Innovations during COVID-19". In this study, the information technology–related information to understand the actions taken by the all sector of community in the world during the COVID-19 outbreak has been examined and developed a digital innovation for information technology framework for epidemic response based on information technology–related measures and methods. This is one way for following the approach for data collection. International, National and regional data were extracted from the Health Network, a centralized public health data collection system and openly accessible to relevant departments. Moreover, the qualitative and qualitative data were collected through a broad approach of assessing official reports and summaries released by governmental bodies, committee meeting reports and consensus recommendations, and a comprehensive literature analysis. Research trends are seen more clearly from the 2020 onwards. Figure 1a shows the total documents related to IT during COVID-19 were around 3000. Maximum documents and articles were published during 2020 and 2021 as the pandemic soared in these years.

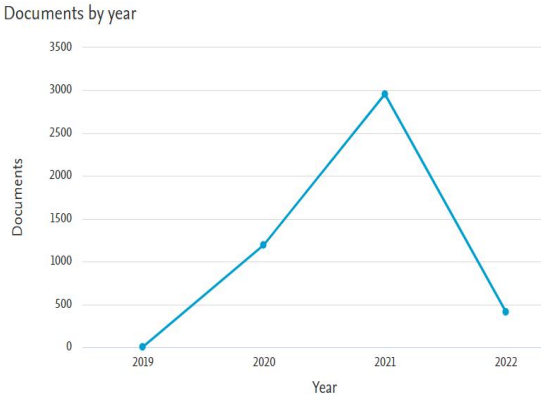

Figure 1a. Documents published during years

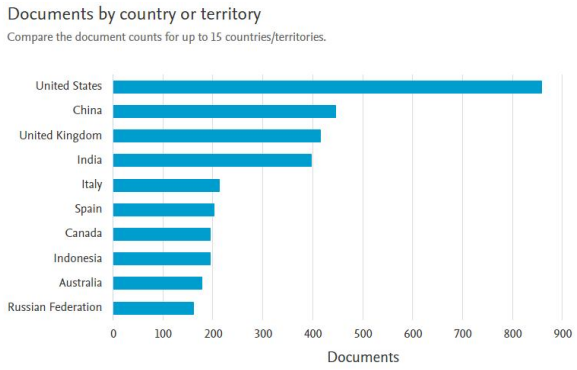

Figure 1b. Documents published by various countries

Figure 1b shows the documents published so far by various countries. It was seen that US and China are leading countries with maximum documents to be published. Similarly, the majority of documents were research articles (59.6%) followed by conference papers with around 20%. Additionally, the areas of documents type are medicine and computer science. Such trends were illustrated in figure 2a and 2b respectively.

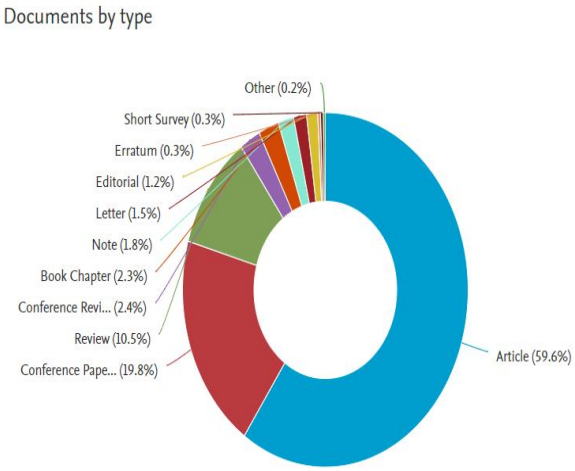

Figure 2a. Documents published with category

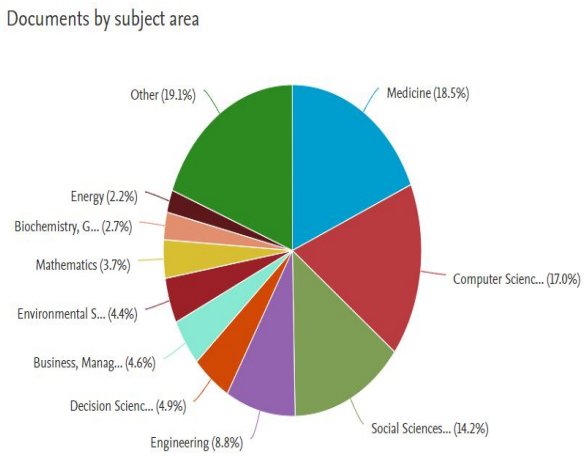

Figure 2b. Documents published by subject area

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III. RESULTS AND DISCUSSION

Upon detecting of the first COVID-19 case in March 2020, various information technologies and digital innovations has been developed in all sectors. The public and private sector, civil society, and academic institutions have developed many innovative solutions to manage public health aspects of the coronavirus disease (COVID-19) pandemic. Innovators have focused on tools for surveillance, supply chain management, clinical trials, diagnosis, communication, and developing vaccines. Digital health technology can facilitate pandemic strategy and response in ways that are difficult to achieve manually. Countries such as South Korea have integrated digital technology into government-coordinated containment and mitigation processes including surveillance, testing, contact tracing, and strict quarantine which could be associated with the early flattening of their incidence curves [10-11] Most predominantly, the health sector has been using IT based innovation in the world. Some of the innovations in various sectors are as follows:

A. Health Sector

Contact tracing (CT) is a more targeted method to control contagion. Once an infected individual is diagnosed and isolated, contact persons are identified with whom that index case had potentially infectious interactions. In the Internet era, implementation of this measure naturally means digital CT [12]. This conventional approach to contact identification and notification is time consuming and resource intensive, and can become rapidly overwhelmed when incidence is high. The Oxford teams hope the latest simulations that will keep digital contact tracing efforts focussed on core epidemiological principles, whichever technical solution is used. The different configurations of the model explore different options for quarantining contacts and offer solutions for contact tracing with different levels of testing available [13]. The model can also be adjusted to account for different speeds of epidemic growth, ensuring it can robustly respond to different predictions of epidemic progression in this rapidly evolving epidemic. Currently, the simulations are based on UK demographics and usage of mobile phones, but the model can be easily adjusted to simulate coronavirus epidemics in other countries [14]. Moreover, the study found that Germany, Singapore, and South Korea used digital bracelets and GPS tracking through digital devices in the area of contact tracing.

Table 1 Digital technology used health sector during COVID-19 Pandemic[15]

Digital Technology	Cases	Application
Artificial Intelligence	-Drones -Intelligent diagnosis	-Applied in fever detection and crowd monitoring -Helping in doctors in CT
Internet of Things(IoT)	Real time data collection	Intelligently managing the information
Cloud Computing	Use of super computers	Data for analysis and vaccine development
Big Data	-Contact tracing -Epidemic prediction	-Monitor of person for crowd and infected one -Applying model for future prediction

B. Business Sector

Online shopping is enhanced through robust logistics systems where robots are being used as the means to deliver food supplies and other commodities [7, 16]. Such changes include increased online shopping, as well as robotic delivery systems, the introduction of digital as well as contactless payment systems, remote working, 3D Printing, and online entertainment. These technological advancements have been embraced all the way during this pandemic by a few countries around the world, with its limitation in some underdeveloped and developing countries. One of the IT application is working from home was very popular and it could allow for more flexible work engagements and increase diversity in Science and Innovation, enabling greater involvement of those with care responsibilities or located in more remote areas [17]. Savings from reduced office space could also provide more resources for innovation activities but may also be used in other ways. The investment in banking and financial technology has been given utmost importance in the recent past, but COVID-19 has put it at centre stage for regulators and banks & financial institutions. There are technologies being implemented by the BFIs for customer acquisition, new product development, service delivery and improving operational efficiency. Sizeable upticks in card subscription, mobile banking, internet banking, and other similar digital instruments were seen in the pandemic [18]

C. Academic Sector

Education has hit the most by COVID-19 with schools closing down amidst fears of the coronavirus. Educational activities have been particularly hard hit during the Coronavirus pandemic, with the widespread cancellation of conferences, training courses and postgraduate examinations. By April 2020, a total of 1.6 billion students in 192 countries, representing 90 percent of all students, were not going to school, according to the UNDP Human Development Report [19]. More scientific conferences, training and research collaboration activities were held virtually, with uncertain outcomes on the productivity of Science, technology and innovation. Virtual conferences allow for larger and more diverse audiences than in-person meetings, and reduce transaction costs as well as the carbon footprint incurred by travel. Virtual training tools facilitate access to training for wider audiences and are highly flexible, making training more compatible with work commitments [20]. They could also facilitate more tailored training by pooling expertise across institutions and enabling students to participate remotely in training offered by partner institutions.

D. Digital Industrial Sector

Twitter, the most widely used social media network, WhatsApp and other social media platforms used by the public was utilized by government officials and concerned institutions to reach the population by broadcasting daily updates on confirmed cases, fatalities, and recoveries[21]. Social media were also used to spread health awareness, educational messages, and visual info-graphics to keep the public informed on current precautionary measures and encourage individuals to follow government instructions. The inventory of digital health solutions for COVID-19 consists of various solutions. The Global Coronavirus Innovation Map, Treatment and Vaccine Tracker, The COVID-19 Health Funding Tracker and many more. The large-scale application of various intervention measures was achieved by developing several digital IT applications and digital innovations with the aim of establishing a sustainable and effective method for reducing the risk of transmission and reaching optimal intervention and prevention strategies [22]. Furthermore, in the area of infection screening, artificial intelligence (AI), thermal cameras, and various smartphone applications were utilized in China, Taiwan, Singapore, and Iceland. Although the effectiveness of such measures is inconclusive, they failed to detect asymptomatic individuals [23].

IV. CONCLUSIONS

The latest new generations of information technologies have played important offerings to the fight against the COVID-19 pandemic.

The eruption of COVID-19 has geared up the development of information technology, especially the innovation of digital technologies such as AI, 5G, cloud computing technology and big data. The COVID-19 pandemic accelerated the application of information technology to the medical, business, education, industry and further developed the digital innovations in almost all sectors of human life. For inspection, digital apps have already proven their effectiveness; however, problems related to privacy and usability remain.

For health sector, several solutions have been anticipated, such as telemedicine or tele-health tools. In addition, for business and education sectors, digital monetization and distance learning are appropriate respectively. The COVID-19 pandemic is favoring the implementation of digital solutions with exceptional speed and impact. It is therefore suggested to keep track of the ideas and solutions being proposed today to implement best practices and models of care tomorrow and to be prepared for future national and international emergencies.

V. ACKNOWLEDGMENTS

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VI. AUTHOR'S CONTRIBUTIONS

Anup Acharya designed the work; reviewed the literature; acquired, analyzed, and interpreted the data; and wrote the final manuscript.

VII. CONFLICTS OF INTEREST

None declared.

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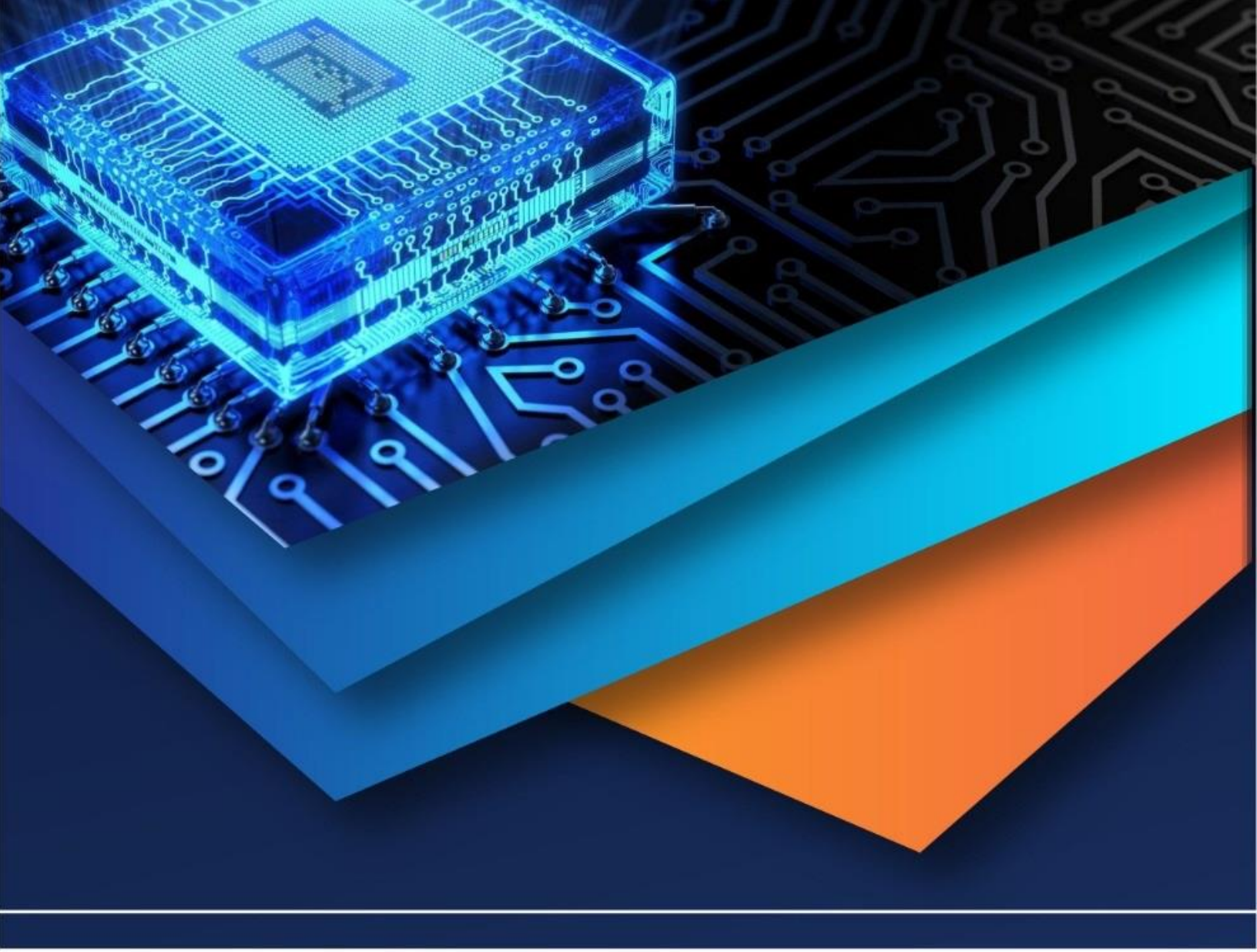

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