

How Can Internet Mapping Technologies Contribute to the COVID-19 Fight?

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ABSTRACT

Corona Virus Disease 19 (Covid-19) is an infectious disease caused by the acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Attempts on the use of advanced techniques have been made in the study the COVID-19 pandemic. Particularly, the influence of Internet coverage on web-based applications may increase the crucial roles of Internet Mapping Technologies (IMTs) in the study of coronavirus disease (COVID-19). The aim of this study was to assess how can IMTs contribute to the COVID-19 fight, particularly give an overview of applications offered by IMTs to study the COVID-19 pandemic. Web of Science, Scopus, and Google scholar were searched to find relevant studies. Three different issues related to the COVID-19 pandemic is presented under three sub-sections; namely applications of IMTs on mapping COVID-19, in the fast acquisition of COVID-19-related data and on decision-making, strategic planning and response to COVID-19, respectively. The findings of this review provide an insight into how to ITMs contribute in the fight against the COVID-19 pandemic. The wide range of applications offered by IMTs affirms the value of this advanced technique to the study of the COVID-19 pandemic.

Keywords: Internet Mapping Technologies, WebGIS, Applications, COVID-19, Review.

INTRODUCTION

In December 2019, a cluster of atypical cases of pneumonia was reported in Wuhan,

China, which was later designated as Coronavirus disease 2019 (COVID-19) by the World Health Organization (WHO) on 11 Feb 2020 (1). And on 11 February, the International Committee on Taxonomy of Viruses announced that its official classification is severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (2). The global outbreak of the COVID-19 pandemic has spread worldwide, affecting almost all countries and territories (3). The WHO declared the outbreak a global pandemic (4). The latest data from WHO shows that, globally, as of 7 August 2023, there have been 768,983,095 confirmed cases of COVID-19, including 6,953,742 deaths (5). The rapidly evolving situation has drastically altered people's lives, as well as multiple aspects of the global, public, and private economy (1). Declines in tourism, aviation, agriculture, and the finance industry owing to the COVID-19 outbreak are reported as massive reductions in both supply and demand aspects of the economy were mandated by governments internationally (6). It is therefore, attempts on the use of advanced technologies to fight against the COVID-19 pandemic have been made globally.

Internet Mapping Technologies (IMTs) are software programs like WebGIS, Google Earth Engine (GEE) platform, Google map, Baidu map and web features. These technologies are changing the way geospatial data is viewed and shared. It is

therefore, these technologies have been widely applied in studies of society (7,8), economy (8), natural resources (9), environment (10), and climate change (11). With the wide range applications of IMTs, these technologies have been also widely used in studies of medicine (12), healthcare (13) and disease mapping (14). A recent study of has shown that Web map viewers are not only playing a very important role in the dissemination and provision of (official) information on COVID-19, but also are very effective for the spatial representation of the pandemic and its evolution, both for specialised and non-specialised Internet users (15). Particularly, after the global outbreak of the COVID-19 pandemic has spread worldwide, many studies have successfully applied these technologies on supporting the fight of the COVID-19.

This paper aims to investigate how IMTs contribute to the COVID-19 fight. Specifically, this paper gives an overview of applications of IMTs in the study of the COVID-19 pandemic. The content is presented under three sub-sections; namely applications of IMTs on mapping COVID-19, in the fast acquisition of COVID-19-related data and on decision-making, strategic planning and response to COVID-19, respectively.

MATERIALS & METHODS

2.1. Materials

A total of 41 scientific papers collected mainly from digital databases including Web of Science, SCOPUS, and Google scholar was used in this study. These research papers were mainly published in recent years after the COVID-19 outbreak in Wuhan China in late 2019 and chosen based on their high number of citations.

2.2. Methods

Digital databases including Web of Science, Google Scholar, and SCOPUS with different combinations of keywords were firstly queried based on three different topics including 'Internet Mapping Technologies', 'WebGIS', 'Google map',

'Baidu map', 'COVID-19', 'SARS-CoV-2', 'Applications', 'the use', and 'review' or 'overview'. Based on three different sub-topics, the combination of these keywords was then used to identify the applications of ITMs in the fight against the COVID-19 pandemic. Finally, three different types of applications offered by ITMs in the COVID-19 fight were summarised and discussed.

RESULT & DISCUSSION

Applications of Internet Mapping Technologies on mapping COVID-19

One of the main advantages is that IMTs allow deliver up to date information on the COVID-19 pandemic. It is therefore, IMTs have been widely used in the COVID-19 fight. For instance, in response to this ongoing public health emergency, an online interactive dashboard, hosted by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University, Baltimore, MD, USA, was developed to visualise and track reported cases of coronavirus disease 2019 (COVID-19) in real time (16). Web-GIS maps have been widely used for delivering public information on this fast-moving, epidemiologically complex, and geographically unbounded process (17). A WebGIS for small-scale detection and analysis of COVID-19 (SARS-CoV-2) cases based on volunteered geographic information was developed for the city of Cologne, Germany (18). When investigating geographical tracking and mapping of coronavirus disease COVID-19/SARS-CoV-2 epidemic and associated events around the world, different types of WebGIS-based mapping such as practical online/mobile GIS and mapping dashboards have been successfully used for tracking the 2019/2020 coronavirus epidemic (19). Also based on WebGIS, a visualization system for COVID-19 simulation has also been designed and developed (20). In addition, other IMTs have been also widely in the COVID-19 fight such as Google Earth Engine platform, Google map and Baidu

Map. For instances, Google Earth Engine, a web-based platform to resolve big data problems to enhance the processing of satellite images for large-scale applications (21), has been used for spatio-temporal analysis of air pollutants before and during the first wave COVID-19 outbreak over Turkey (22).

A part from mapping the spread of the COVID-19 pandemic, IMTs have been widely applied to map other COVID-19-related information such as COVID-19 risk, vulnerability and vaccination recipients. For instances, using the PHP and MySQL programming languages, a WebGIS-based map of the distribution of the COVID-19 vaccination which contains information on the number of vaccination recipients per sub-district was successfully developed in the Sukoharjo Regency area of Indonesia (23). Also in Indonesia, with the help of Laravel as a Framework, Leaflet as a library and MariaDB as a database, the COVID-19 vaccination WEBGIS for Banda Aceh City was also developed to provide information on vaccination achievements per sub-district and village in the form of graphs and thematic maps (24). A study on communicating the high susceptible zone of COVID-19 and its exposure to population number were carried out through a WebGIS dashboard for Indonesia cases (25). In Brazil, when investigating social vulnerability of Brazilian metropolitan schools and teachers' absence from work due to vocal and psychological symptoms, the national outcome rate, social vulnerability index, and school locations were dynamically visualized in webGIS (26).

Applications of Internet Mapping Technologies for COVID-19-related fast data acquisition

Internet Mapping Technologies have been widely used to collect COVID-19-related data in many studies. Particularly, in recent years, with the increasing availability of open-source data, more and more researchers have used Application

Programming Interface (API) of online mapping services, such as the Google Map API and Baidu map API, to acquire the estimated travel distance and time for detecting service areas of various travel modes (27). In late September 2020, Google introduced a COVID-19 layer into its mapping platform, indicating infection levels and, in some countries, also guiding users to testing centers (28). Later, Google Maps' COVID-19 layer has been used as an interface for pandemic life (29). In Poland, Google map was employed to investigate changes in regional and local mobility patterns during COVID-19 lockdown (30). Using Google Map based real-time traffic data, the effectiveness of containment strategies and local cognition to control vehicular traffic volume in Dhaka, Bangladesh was assessed during COVID-19 pandemic (31). Baidu Map was also successfully used for mapping the accessibility of medical facilities of Wuhan, China during the COVID-19 pandemic (32). In Indonesia, a web GIS portal was developed to provide a feature that allows users to check the number of COVID-19 cases reported within a radius of 3 km, 5 km, and 7 km from their locations, thus helping local commuters avoid areas with a large number of infected patients (33). It can be concluded from that these IMTs have been also widely used for COVID-19 data acquisition during the pandemic in other studies (27,34,35).

Applications of Internet Mapping Technologies for decision-making, strategic planning and response to COVID-19

Internet Mapping Technologies have been widely used for decision-making, strategic planning and response to COVID-19. For instance, to support emergency dental care triage during the COVID-19 pandemic, an attempt was made to ascertain how far patients had travelled to access emergency care by plotting their postcodes using Google Maps (36). In Germany, a Web GIS was developed for small-scale detection and

analysis of COVID-19 (SARS-CoV-2) cases based on volunteered geographic information for the city of Cologne (18). In Italy, the construction of a digital cartography tool as a WebGIS to allow local communities understanding of epidemiological spread is presented (37). In India, a user interactive webgis webpage was designed for decision making and resource allocation during COVID in the Solapur City, Maharashtra, India (38). When investigating application-based COVID-19 micro-mobility solution for safe and smart navigation in pandemics in Delhi, India, Google map mobility API data were used to study micro-mobility trends in a region (39). The WebGIS technology was also proven its effectiveness in supporting other sector. For instances, a WebGIS can help the community, government, and tourism business managers in implementing health protocols in tourist attractions (40). In response to the COVID-19 pandemic, IMTs play important roles. A recent study of has revealed that web-GIS dashboard applications aid better visualization, risk-informed forecasting, and response planning for Tenaga Nasional Berhad to cope with COVID-19 clusters and zones updated on the daily basis (41). In India, WebGIS web page and dashboard helps the government assign and allocate resources in decision-making with dynamically varying COVID-19 data (38).

CONCLUSION

The aim of this study was to assess how can IMTs contribute to the COVID-19 fight, particularly give an overview of applications offered by IMTs to study the COVID-19 pandemic. Three different issues related to the COVID-19 pandemic is presented under three sub-sections; namely applications of IMTs on mapping COVID-19, in the fast acquisition of COVID-19-related data and on decision-making, strategic planning and response to COVID-19. The findings of this review provide an insights into how to ITMs contribute in the fight against the COVID-19 pandemic.

IMTs in COVID-19 studies is valuable tools in decision-making and, more importantly, social mobilization and community responses during the COVID-19 pandemic. The wide range of uses of IMTs confirms the value of these advanced techniques to the fight against the COVID-19 pandemic.

Declaration by Authors

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