# **CHAPTER I**

## **INTRODUCTION**

Covid-19 was declared an epidemic disease by the World Health Organization (WHO) on March 11, 2020 [1]. The management of this crisis requires policy-making, coordination, and coherence in implementation, centralized information, organization, continuous monitoring, and management of crisis medicine [2]. Crisis management in this area requires reliable information for appropriate decision-making. Providing accurate and reliable information is one of the most important policy strategies for control and preventive measures concerning the disease [3].

Information is crucial for people to make appropriate health decision-making processes given the unprecedented measures given by the COVID-19 pandemic. As the COVID-19 virus continued to spread, adequate, reliable, timely, and relevant information became a highly essential resource for people to be consistently informed and safe. Getting informed is one of the ways to make rational decisions in the context of the COVID-19 pandemic. COVID-19 information is mainly delivered through the information systems, which is why it plays a crucial part in controlling the COVID-19 pandemic (Pan American Health Organization, 2020a). Moreover, health authorities have developed many approaches to improve the COVID-19 information system and effective public communication. One of the ways healthcare authorities have accomplished effective public health communication is through the adoption of the internet (World Health Organization, 2020b). In such conditions of isolation, the adoption of technology is no coincidence. That is because it conveniently allowed people to have an accessible source of relevant and reliable COVID-19 related information.

COVID-19 information systems are more critical than at any other time for handling data and information at the pace required by the ambiguity of the COVID-19 situation. Information systems allow quick, expeditious, and coordinated information accessibility and sharing, and they promote the prioritization of care, access, and response, particularly for individuals in contexts of susceptibility. With appropriately disaggregated COVID-19 insights, it is feasible to develop a mechanism that minimizes potential health disparities at all levels of care and facilitates the execution of initiatives to tackle such inefficiencies. So, integrating technology to promote advanced and digital health information became an option for improving a robust health information system. What is needed is an actionable expansion of the present COVID-19 information system to have an effective COVID-19 public communication.

COVID-19 information systems can be expanded by implementing a web-based application, such as dashboards, that provides COVID-19 insights. It is apparent that COVID-19 dashboards are one of the essential ways to communicate the COVID-19 situation to the public effectively. Even though the Government Health Departments already has its COVID-19 data that is publicly accessible, organization and academic-based repositories, such as the JHU CSSE COVID-19 repository, became the de-facto standard. Not only that, despite the availability of these data, it needs to be extracted and processed to be displayed through dashboards. That is why real-time dashboard visualization of COVID-19 data became an effective technique to fulfill the public health needs for essential COVID-19-related information.

Dashboards can promptly present actual or real-time data changes, unlike static reporting modalities such as articles or reports. That is why multiple governments and organizations from various nations have developed an accessible dashboard specifically to highlight the situation in their nation. One of the recurring features of these dashboards is that it provides a comprehensible summary of the cumulative data about the COVID-19 cases, deaths, recoveries, and the overview of the COVID-19 vaccination insights, and these numerical data are then visualized. People with no technical knowledge could benefit from a real-time COVID-19 tracking dashboard, which can contain a plethora of information on a web application. Furthermore, this can be meaningfully utilized by individuals in need of COVID-19 related information. Digital dashboards allow COVID-19 epidemiological data to record and report individual data points from various levels, allowing for a more precise assessment of the COVID-19 pandemic context. Consequently, an overview of the scenario is provided in an accessible and convenient way.

However, in the locality, the lack of COVID-19 dashboards inclusive of the epidemiological insights within the area of Digos city is a problem. Despite the rising popularity of COVID-19 dashboards developed by various organizations, such as the COVID-19 Tracker Philippines from DOH, Davao RegionCOVID-19 Insights of Mindanao, John Hopkins Coronavirus Resource Center, there is a lack of inclusivity for specific insights from the locality. Although the City of Digos government-organized page from Facebook publishes COVID-19 insights (Figure 1), it is published only with long intervals between days, weeks, or even months, which is a major insufficiency for effective COVID-19 public communication. Thus, considering the pace of the COVID-19 situation moves at an exponential rate, the gap will surely incapacitate Digoseños in making the best health-informed decisions. Hence, a real-time web-based COVID-19 dashboard is defined as a solution to the problem.

The prevalence and rapid development of data visualization of COVID-19 COVID were inevitable. The development of dashboards for the COVID-19 pandemic with an unprecedented pace and variety of stakeholders was pervasive, given the high internet penetration, integration of digital technology with health information systems (Pan American Health Organization, 2020b), and the prevalence of web applications (Galea, 2020). COVID-19 dashboards developed by various international organizations (WHO COVID-19 Dashboard), academics (John Hopkins Coronavirus Resource Center), and industries are instances that go beyond national, regional, and local governments to show the value of data visualization. The Center for Systems Science and Engineering (CSSE) at Johns Hopkins University developed the first publicly accessible dashboard on January 2020 (Dong et al., 2020), two months prior to the declaration of the COVID-19 pandemic (World Health Organization, 2020a). Henceforth, a massive increase in the demand and popularity for COVID-19 public dashboards is evidence that it is critical.

Every COVID-19 dashboard released has its unique features but constitutes the same purpose. The World Health Organization had released its COVID-19 information dashboard (World Health Organization, 2020b). The dashboard's notable feature is its mobile-friendly responsiveness, minimalistic design, and interactivity that makes complex statistics accessible and available in a convenient way. In the Philippines, the Department of Health had released its Official COVID-19 Tracker. The COVID-19 dashboard was developed by utilizing a dashboard service called "Tableau." Every essential COVID-19 related information is comprehensible and straightforward. It is also interactive, where the users acquire a brief description of each presented data. Various governments have also released its COVID-19 data case bulletin in the regional context. However, it is a significant drawback to adopt case bulletin means of delivering the COVID-19 information because it is laborious to maintain, inefficient, and cannot deliver information in real-time.

As an independent academic initiative, the proposed project will develop a web-based interactive dashboard, namely COVID Pulse, which is inclusive of the COVID-19 context of Digos City. The web-based application will have data visualization features and track COVID-19 cases, deaths, recoveries, and vaccination at the global, national, regional, and local levels. The objective of this website should be to make COVID-19 related information more mainstream, especially in the locality, and to allow the Digoseños, the citizens of Digos City, for a much more granular assessment of the COVID-19 situation, especially considering the ambiguity of which the situation changes.

The COVID-19 pandemic had triggered a worldwide health emergency. After the pervasive outbreak of a novel coronavirus strain called the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), it triggered a public health emergency. Prior to the declaration of the COVID-19 pandemic, in February 17, 2020, the outbreak of the COVID-19 virus had catalyzed the development of COVID-19 information system. With this, the Center for Systems Science and Engineering (CSSE) and John Hopkins University had developed an interactive information system, wherein the situation of the COVID-19 outbreak can be visualized and monitored concurrently. Thereafter, many have keened on the development and application of digital based technology as part of the COVID-19 pandemic planning and response. The COVID-19 pandemic is a turbulent situation, where the effort of response must be actionable and in real-time in order for it to be relevant. However, fortunately, the advent of technological innovation allowed the concept of access to monitoring the COVID-19 situation in real-time.

The COVID-19 pandemic had demonstrated that the internet had been superseded by realizing the internet was being utilized contrary to its purpose. Moreover, the pervasiveness of the internet, especially social media as a common source of information during the COVID-19 pandemic, eventually led to a massive increase in the complexity of the COVID-19 information environment. COVID-19 infodemic is one problem that has to be addressed. Infodemic is the rapid dissemination of accurate and inaccurate information, such as misinformation and disinformation, which eventually smears the line between true and false information. In other words, the abundance of information from various sources, including the unverified sources, relayed to the public is a critical issue (Lancet, 2020).

Despite the benefits of having accessible information, its prominence also poses a significant problem. The COVID-19 pandemic had demonstrated that the internet had been superseded by realizing the internet was being utilized contrary to its purpose. Moreover, the pervasiveness of the internet, especially social media as a common source of information during the COVID-19 pandemic, eventually led to a massive increase in the complexity of the COVID-19 information environment. COVID-19 infodemic is one problem that has to be addressed. Infodemic is the rapid dissemination of accurate and inaccurate information, such as misinformation and disinformation, which eventually smears the line between true and false information. In other words, the abundance of information from various sources, including the unverified sources, relayed to the public is a critical issue (Lancet, 2020).

The emergence of the COVID-19 pandemic has given the risk of dissemination of misinformation, exacerbated by the wide use of the internet and social media platforms, proving to be a problem on the same level as the virus itself. Although misinformation is not an unprecedented issue, it certainly gained prominence after the COVID-19 pandemic was declared, owing to its virulent effect and all of the corresponding ramifications. Despite the positive impact of social media amidst the COVID-19 pandemic, it is also responsible for amplifying misinformation. Impacts of misinformation may include the exacerbation of COVID-19 vaccine hesitancy, conspiracy theories, and promotion of life-threatening health decisions.

That is also why tech companies, such as Twitter, Facebook, and Google, have implemented various strategies to combat the rapid dissemination of misinformation on social media platforms. Hence, a robust information system is necessary, if not, crucial as part of the effort to control the COVID-19 pandemic. Innovative technology and automation have the great potential to strengthen public health like never before in the history of civilization. Health authorities have developed many approaches to improve the COVID-19 information system and effective public communication. COVID-19 information systems are more critical than at any other time for handling data and information at the pace required by the ambiguity of the COVID-19 situation.

Robust information systems provide essential empirical support for making the most informed decisions feasible and improving awareness of safety measures. Information systems allow quick, expeditious, and coordinated information accessibility and sharing, and they promote the prioritization of care, access, and response, particularly for individuals in contexts of susceptibility. With appropriately disaggregated health information, it is feasible to develop a mechanism that minimizes potential health disparities at all levels of care and facilitates the execution of initiatives to tackle such inefficiencies. Integrating technology to promote advanced and digital health information became an option for improving a robust health information system. What is needed is an actionable expansion of the present COVID-19 information system to have an effective COVID-19 public communication.

This area of study is important since effective public health communication plays a crucial part in controlling the COVID-19 pandemic. As the COVID-19 virus continued to ravage the world, adequate, reliable, timely, and relevant information became a highly essential resource for people to be consistently informed. Fortunately, healthcare authorities could communicate to the public effectively by digitizing information systems (Bernardino & Bacelar Nicolau, 2020). That is why COVID-19 information systems are more critical than at any other time for handling data and information at the pace required by the ambiguity of the COVID-19 situation. Consequently, many have developed approaches to improve and expand the COVID-19 information system and public communication (Clarke et al., 2021; World Health Organization & Others, 2020). Health information systems were expanded at an unprecedented pace due to the urgency of the worldwide need for COVID-19 data and the widespread internet penetration (Ivanković et al., 2021; Max Roser & Ortiz-Ospina, 2022). That is because COVID-19 information systems may support decision-making and help individuals adapt their health behaviors to the crisis. COVID-19 information systems make it easier to prioritize healthcare, access, and response for those most in need by making it possible to access and share data immediately, expeditiously, and in a coordinated manner (World Health Organization, 2020).

Another way of expanding the information system is by adopting web-based COVID-19 dashboards as a medium for effective public communication of the data. Accessible web-based dashboards for COVID-19 data have become quite prominent and necessary. It provides essential empirical support for making the most informed decisions feasible and improving awareness of safety measures for Digoseños (World Health Organization, 2020). Hence, the primary rationale for the topic of interest is to provide an exclusive and area-specific data communication for Digoseños since there is a need for expansion of the Digos City COVID-19 Information System. Researching this topic and developing a COVID-19 dashboard that will contribute to the improvement of a robust information system in Digos city is necessary, if not, crucial as part of the effort to control the COVID-19 pandemic.

**Theoretical and Conceptual Framework**

The study that is going to be conducted could be best viewed with the Viewpoint which provided a framework developed by Whitelaw et al. (2020). This framework was developed for the purpose of highlighting the various ways digital technology could be integrated with a pandemic and management response, in this case, the COVID-19 pandemic. The viewpoint argued that those countries who have successfully flattened the incidence curves and maintained a low mortality rate have the characteristic of adopting digital technology and made it part of their COVID-19 pandemic policy and overall response (Whitelaw et al., 2020).

Additionally, the framework emphasized that there are many ways digital technology can be used as an initiative to pandemic preparedness and response. Digital technology can be utilized as a tool such as Contact Tracing, Quarantine and Self-isolation, Screening for Infection, Clinical Management, Planning and Tracking, and Medical Supplies. Furthermore, in every category of the type of utilization, it has its respective functions, advantages, and disadvantages. Therefore, the research project is adopting the Tracking technology wherein the COVID-19 Pulse, the digital technology that is integrated for the purpose of COVID-19 pandemic response, is aimed to provide epidemiological insights and monitor the COVID-19 situation in real-time. With this, the study had acknowledged the framework postulate that tracking technology may be advantages since it paves the way for an actionable and reliable COVID-19 information, visualization of the COVID-19 virus and pandemic, guides and resource allocation, and dissemination of COVID-19 forecasts. However, the framework also postulated that although tracking technology is advantageous, it is without its disadvantages. One highlighted disadvantage of integrating dashboard technology as part of the COVID-19 pandemic response is the high costs and demand for maintainability.

**Research Objectives**

The research project aims to expand the COVID-19 information system of Digos City through the development of a real-time tracking COVID-19 web-based dashboard called "COVID Pulse" for Digoseños to ensure that they are prioritized by enabling it to be feasible for them to retrieve updated COVID-19 information in real-time. Specifically, the project objectives of the study are following:

**Significance of the Study**

COVID Pulse will be developed for the general public and can be accessible through the internet. However, the significance of this project will directly benefit the following:

**Public Health Authorities.** Public health authorities, especially in the locality, need to be proposed with a real-time COVID-19 tracking dashboard to communicate the epidemiological insights in Digos City. Disseminating COVID-19 insights through social media lacks actionable and real-time qualities, rendering the COVID-19 information system for public communication insufficient. Therefore, public health authorities need a complementary means of effectively communicating the COVID-19 epidemiological data to the public. One of the ways it can be done is by developing a real-time COVID-19 dashboard that includes the context of the locality. It is through the proposal of a COVID-19 web-based dashboard that allows the public health authorities to disseminate the essential COVID-19 insights to the public.

**Digoseños.** The lack of access to real-time COVID-19 insights incapacitate the health-decision making of Digoseños in the context of the COVID-19 situation. Therefore, a real-time dashboard visualization of the COVID-19 data proposal is a useful approach to address the general public of Digos City's need for comprehensive, timely, and accurate COVID-19 related information, which will allow them to make critical health-informed decisions.

**Researchers.** Although it is improbable that this study will be published, researchers hereafter who have the same research of interest, that is the adoption of technology for pandemic response, can benefit from this research study. That is because the development journey and activity taken will provide further insights, recommendations, and implications. Furthermore, the study can also be anchored for their studies to further synthesize and support their upcoming studies. Lastly, they can also utilize this study to develop a much better methodology in developing a real-time COVID-19 dashboard prototype.

**Open-Source Community.** The will benefit the open-source community since the repository for COVID-19 Pulse will be published on GitHub, which is version-control and collaboration online platform for developers. Hence, every aspect of the project from the frontend, middleware, and backend source code as well as the manuscript and documentation will be publicly available. With that, anyone can contribute or even fork the project for further improvement of the COVID Pulse. Lastly, even though the project will be available publicly, there will be certain limitations and restrictions when it comes to the distribution and modification of the COVID Pulse project.

**Scope and Limitation of the Study**

The study will mainly focus on the contribution of expanding the COVID-19 information system of Digos city through the development of a COVID-19 web-application called COVID-19 Pulse. The researcher will ensure that the designed and developed prototype will meet all the designed and devised requirements. In other words, it must at least be barely functional as well as provide answers in the statement of the problem. Additionally, the researcher will consider the feasibility in terms of technical, economic, legal, and scheduling feasibility aspects of the project. This will be further analyzed in the pre-development feasibility analysis stage. Strictly speaking, the project will only adopt available technologies that is also technically and economically feasible and possible for the researcher to deal during the development of the COVID Pulse. Nevertheless, the researcher will also consider limiting the project to develop a prototype given the time constraints. Since given that the project with a scope of deploying a perfect web-application that is an efficient, accurate and error-free will make it unfeasible to conduct. Especially in the frontend development where the consensus has attested that it is an arduous process. Lastly, the researcher will set a timeframe for the development process from February 2022 to May 2022.

**Definition of Terms**

**COVID-19 Pulse.** It is the opted website name of the COVID-19 web-based dashboard. The name was inspired by the Official School Publication of Cor Jesu College Basic Education Department called Pulse.

**COVID-19 Information System.** It refers to the integrated set of components for collecting, storing, and processing COVID-19 data (e.g., epidemiological insights) that will be utilized to provide COVID-19 insights and digital services for a specific population

**COVID-19 Web-based Dashboard.** It refers to the web application dashboard developed to be a communication medium of COVID-19 epidemiological mainly. Frequently, they are a dynamic modality for reporting data visually. COVID-19 dashboards are usually built as a single screen hosted on a website to deliver users the information they need quickly and efficiently. Examples include WHO Coronavirus (COVID-19) Dashboard, Our World in Data COVID-19 Dashboard, and Department of Health COVID-19 Tracker.

**Home.** The home webpage will act as the website's beginning point. The default page loads when the target users, such as the Digoseños, visit the COVID Pulse website.

**COVID-19 Insights.** This webpage will contain the main objective of this project. The elaborated COVID-19 dashboard that visualizes the COVID-19 Cases and Vaccination per segment will be embedded in the said webpage.

**Health & Wellbeing.** This webpage will contain information about the SARS-CoV2 virus, COVID-19 safety guidelines, COVID-19 testing, and other health-related resources.

**COVID-19 Updates.** This webpage will contain the essential updates from the Digos City government, such as the Alert Level ordinance, and will also contain the COVID-19 related news articles for the Digoseños to be constantly updated and informed.

**About.** The purpose of this web page is to inform the web application visitors about the COVID Pulse's details and the web application's critical operations.

**Frontend Prototyping.** The initial but most crucial phase of the design stage of the development process is prototyping the COVID Pulse web application. The researcher will be able to ideate the reference for the end product, which allows the development process to be convenient and reduce the cost and time as it provides a comprehensive high-level reference and overview of the final output. Furthermore, the prototyping phase will allow the researcher to make quick necessary modifications and be flexible with the User Interface and

**User Experience design.** Through wire framing, the prototyping will be done through Low Fidelity and Hi-Fidelity prototypes (Figures 4 and 5). Although sketching is often part of the prototyping procedure, it was not included since it is deemed unnecessary.

**Frontend and Backend Layer.** The outer layer of the web application project that the Digoseños (Users) see and interact with is the Frontend, also known as the client-side. Specifically, it is the visual elements such as the User Interface (UI) and User Experience (UX) designing of COVID Pulse. The backend layer is scoped on the server-side of the web application, in which the primary purpose is to make sure everything of the web application is functional. Also, it is the part where the clients of the COVID Pulse will not interact and cannot interact with users.

**JHU CSSE COVID-19 Data.** It is a COVID-19 data repository collected, provided, and operated by the Center for Systems Science and Engineering from Johns Hopkins University. It was established prior to the declaration of the COVID-19 pandemic on February 19, 2020. It is publicly available for everyone to be accessed from the GitHub JHU CSSE repository.

**WHO COVID-19 Data.** It is the official COVID-19 data source aggregated by the World Health Organization and is distributed by comma-separated values (CSV) files.

**DOH COVID-19 Data.** The official COVID-19 data source aggregated by the Department of Health can be accessed through the DOH Data Drop.