**COVID PULSE: A REALTIME WEB-BASED PLATFORM FOR INCLUSIVE  
DIGOS CITY COVID-19 INFORMATION CATALOG AND TRACKING**

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**COVID PULSE: A REALTIME WEB-BASED PLATFORM FOR INCLUSIVE  
DIGOS CITY COVID-19 INFORMATION CATALOG AND TRACKING**

A Science Investigatory Project

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The Faculty of Cor Jesu College, Inc.

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CHAPTER I  
INTRODUCTION

After the COVID-19 pandemic was declared, it is unequivocal that it posed a prominent challenges on the global response and management to control the crisis. Every country was expected to ensure and expand their COVID-19 preparedness, readiness, and response strategies to suppress the further transmission of the COVID-19 virus and its impacts on every sector (World Health Organization, 2016, 2021). It progressively compelled governments and communities to persistently address the pandemic through innovation and integration of digital technologies, given the enormous evidence of the impact it brings and the diversity it can be utilized for different aspects of the pandemic (Golinelli et al., 2020; United Nations, 2020; Vargo et al., 2021). Although it has long been expected prior to the COVID-19 pandemic (Herrmann et al., 2018), it was inevitable for governments to quickly favor digital solutions to their COVID-19 response and recovery plans (Golinelli et al., 2020). Adopting such technology is highly practical and necessary.

Digital solutions has proven to be a crucial approach to the COVID-19 pandemic. One of the major response strategies that are commonly scoped is the development and improvement of public health communication and information systems (Afzal et al., 2021). According to the United Nation, after the declaration of the COVID-19 pandemic, they have found that 110 countries (57%) have already utilized digital technology as a way for public health information communication (United Nations, 2020). And a month after, 167 countries have used digital technology to disseminate COVID-19 information and guidance.

Various private and government sectors have also come up with ways to integrate digital technology to improve the public communication and information system (Afzal et al., 2021; Whitelaw et al., 2020). One of which is the development of centralized information and the visualization of the epidemiological data through web-based platforms (Dixit et al., 2020; Dong et al., 2020; Whitelaw et al., 2020), which would allow the dissemination of infection prevention, consistent monitoring, and the delivery of updates to the changing situation and policies. So it certainly opened a new door to initiatives for the development of efficient COVID-19 public communication and robust information systems given the contribution and massive impact it brings (Dong et al., 2020).

Globally, the digital epidemiological tracking and surveillance technologies are one of the recurring features that were often developed (Golinelli et al., 2020; Vargo et al., 2021; Whitelaw et al., 2020). Such technologies came with various forms; however, its major function is to keeping the public aware by maintaining effective and realtime information platform (Ivanković et al., 2021). In addition, the most impactful and pervasive example of such initiatives that were established are data abstraction and visualization of the COVID-19 related data from information systems that are consistently updated by the health authorities and various initiatives.

Almost every country has the tracking and information delivery part of their COVID-19 response strategies (Dixit et al., 2020; Dong et al., 2020; Ivanković et al., 2021; World Health Organization, 2020b). Evidence showed that it was highly effective and efficient at providing a clearer picture of the epidemiology and response to the COVID-19 pandemic at a global scale (World Health Organization, 2020b). There are many COVID-19 well-established and maintained platforms 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 demonstrate its value.

In the Philippines, the Department of Health (DOH) had released its Official COVID-19 Tracker. Every critical information is comprehensible and straightforward. It is also interactive, where the users acquire a brief description of each presented data. The DOH have also released its COVID-19 data case bulletin in the regional context. However, it also brings a significant drawback to adopt case bulletin as means of delivering the COVID-19 information given the laborious maintainability, inefficiency, and the inability to deliver the crucial COVID-19 information in realtime.

This study argues that there is gap in the public communication response in the locality. Despite the rising popularity of COVID-19 platforms developed by various organizations, such as the COVID-19 Tracker Philippines from DOH, Davao Region COVID-19 Insights of Mindanao, John Hopkins Coronavirus Resource Center, the locality lacks an established COVID-19 dashboards and inclusivity of the epidemiological insights within the area of Digos city.

Although the City of Digos government-organized page from Facebook publishes COVID-19 insights. The page publishes essential COVID-19 insights with wide intervals between days, weeks, or even months, which is a major insufficiency and lacks actionability for effective COVID-19 public communication (Ivanković et al., 2021). Considering the pace of the COVID-19 situation moves at an exponential rate, the gap will arguably incapacitate Digoseños in making appropriate health-informed decisions. Hence, a realtime web-based COVID-19 platform is defined as a solution and what is needed is an actionable expansion of the present local COVID-19 information system to have an effective COVID-19 public communication.

In ways that are difficult to do conventionally, the importance of implementing COVID-19 information platforms have certainly proven in pandemic strategy and response. Therefore, as an independent academic initiative, this study will propose a project that will develop a web-based platform, namely COVID Pulse, which aims to be inclusive of the Digos City COVID-19 context. The web platform will be anchored on a web application that will have the basic data visualization features and track COVID-19 cases, deaths, recoveries, and vaccination at the global, national, regional, and local levels. The objective 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.

Contributing to improve the local COVID-19 information systems and public communication make it easier to prioritize proper response for Digoseños by making it possible to access COVID-19 data immediately and in a coordinated manner. It provides essential empirical support for making the most informed decisions feasible and improving awareness of safety measures for Digoseños. 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

This study will be anchored on a viewpoint developed by Whitelaw et al. (2020). This viewpoint, which also comes with a framework, was developed for the purpose of highlighting the various ways digital technology could be integrated with a pandemic management and response, which in this case, the COVID-19 pandemic. The COVID-19 pandemic had catalysed efforts in various nations for controlling and mitigation (Fauzi & Paiman, 2020). However, according to (Whitelaw et al., 2020), the outcome of the response on the COVID-19 pandemic have been distinctive. Oftentimes, outcomes changes particularly relies on the strategies that were adopted to contain and mitigate the situation. Apart from the quick response, mass testing, contact tracing, and strict imposition of COVID-19 policies various efforts exerted on the COVID-19 pandemic, the viewpoint emphasized that the countries that have successfully flattened the incidence curves and maintained a low mortality rate are usually those who have resorted to adopting digital technology and made it part of their COVID-19 pandemic policy and overall response (Whitelaw et al., 2020). Hence, the viewpoint argued that countries with successful outcomes on the COVID-19 response and mitigation strategies are mostly those who have digital applications integrated in their COVID-19 strategic plans.

Additionally, the viewpoint stressed that there are many ways digital technology can be used as an initiative to pandemic preparedness and response. This can be utilized as a contact tracing, quarantine and self-isolation, screening for infection, clinical management, planning and tracking, and medical supplies, with each having its functions, advantages, and disadvantages (Whitelaw et al., 2020). The research project is implementing 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 research had acknowledged the viewpoint postulate that tracking technology may be advantageous 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 viewpoint also asserted 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. Nevertheless, it will be considered on the pre-development feasibility analysis. This framework was chosen specifically since it clearly supports the rationale for the development of COVID Pulse project. Moreover, the importance of digital applications has been emphasized as one of the key strategies in appropriately controlling the COVID-19 situation, which further renders the project relevant and necessary.

This research will also provide a rationalization for the development process of COVID Pulse project based on the theoretical model called Input-Process-Output (IPO) model (Brown & Svenson, 1988). The framework is often used in system analysis and computer programming as a way for characterizing the architecture of a software application and perhaps other systems. The IPO is one of the simplest way to explain the protocol of a project. The framework can divided the stages into four categories: input, process, and output, as shown in Figure 1.

The input stage will contain many of the requirement from the environment , in this case, the Research Problem, Review of Related Literature (RRL), Review of Related System (RRS), Programming Knowledge, Software Requirements, and Hardware Requirements. The process stage will technically be the activity that will occur in the COVID Pulse project itself. In other words, this is where the components of the input stage will be processed into outputs. This process or activity can also be the research process, proposal writing, and each of the development life cycle of the COVID Pulse project such as planning and analysis, designing, development, testing, and deployment process.

For the output, this stage will deliver the results of the processing of the input. The output stage is essential since it reflects the overall product of the input and output process, which is the COVID Pulse web application. Lastly, for the outcome stage, this reflects the expected behaviour and upshot of the COVID Pulse web application. The outcome stage components are produced after the implementation, utilization, and maintenance of the COVID Pulse web application is accomplished. Additionally, it can also be extended with an impact stage, where it can contain the implementation of border restrictions as an impact and proactive COVID-19 response.

Output

Implementation

Utilization

Maintenance

Input

Research Problem Identification

Review of Related Literature (RRL)

Review of Related  
System (RRS)

Programming Knowledge

Software Requirements

Hardware Requirements

Process

Software Development Life Cycle (SDLC)

Planning and Analysis

Designing

Development

Testing

Deployment

***Figure x.*** The IPOO Model Conceptual Framework

of the COVID Pulse Web-based Application.

## Objectives of the Study

This 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:

1. To gather the necessary requirements and its method to be employed in developing the COVID Pulse web-based application.
2. To develop the COVID Pulse web application frontend, middleware, and backend.
3. To embed and visualize the COVID-19 data from COVID-19APIs and resources.
4. To develop an accessible Digos City COVID-19 web-based application that provides:
   1. A dynamic and real-time comprehensible epidemiological indicators
   2. A user-friendly interactive user experience and interface
   3. Brief narratives to summarize and interpret displayed data
   4. Relevant news updates related to COVID-19 situation

## 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 web application name of the COVID-19 realtime web-based application. The name was inspired by the Official School Publication of Cor Jesu College Basic Education Department called “Pulse”.

**Realtime.** It refers to the feature of the COVID Pulse web application that delivers information in the time during it was requested. In other words, it can be describe as a mechanism of the system where it is available and immediately provides the necessary COVID-19 related information. This could also mean that the information that is delivered is up-to-date according to the COVID-19 dataset reports. So COVID Pulse can be called realtime if it delivered the data relative to the newly reported data from the primary source.

**Web-based Application.** It refers to the type of which the COVID Pulse application program was designed. Unlike the software applications where it is stored in the client’s device, COVID Pulse is designed to be accessed through the internet and stored in a remote server, and can be used using a web browser.

**Inclusive.** It refers to the main aspect of the COVID Pulse web-based application where it also delivers COVID-19 information and insights relative to the locality for Digoseños. Unlike the other COVID-19 web applications where it either is abstract, excludes, or lacks the coverage of the necessary and relevant COVID-19 data in the locality.

**Digos City.** It refers to the aimed locality of which the COVID Pulse will be specifically deployed. The City of Digos is located in Davao Del Sur, Philippines, and the demonym for the citizens living in the city are called Digoseño.

**COVID-19 Information.** It refers to the information that is related to the COVID-19 pandemic situation, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), Coronavirus Disease 2019 (COVID-19), COVID-19 Vaccination, COVID-19 Policies, and many other COVID-19 related information that is relevant and timely. Additionally, these information can come in a form of news articles, updates, and epidemiological insights.

**Catalog.** It refers to the feature of categorization of the COVID-19 information that will be provided on the end-users of COVID Pulse web application.

**Tracking.** It refers to the feature of the COVID Pulse web application that provides a realtime and up-to-date monitor of the COVID-19 active cases, recoveries, deaths, vaccination, and the overall situation of the COVID-19 pandemic.

CHAPTER II  
REVIEW OF RELATED LITERATURE

**COVID-19 and Web-based Platform**

Information amidst the COVID-19 pandemic was crucial. That is why there was an increased urgency for public health commuincation solutions to allow people to coordinate with the authorities and have a grasp on the COVID-19 situation. Fortunately, there was an unprecedented application of digital technology owing to the diverse amounts of oppportunities it provides, which paved the way for the innovative development of strategies and solutions for addressing the COVID-19 pandemic. One prominent ways that initiatives have utilized technology is the web-based platforms given the accessiblity and availabity of the internet. Which gives the reason why web-based platforms became one of the conventional solution for addressing the crisis. Web-based dashboards have become more popular as dynamic, visual platforms for conveying COVID-19 data since the onset of the COVID-19.

In the year 2020, more than 158 public web-based dashboards that have been established. As a decision-making and behavior modification tool, dashboards became a crucial tool for responding to the COVID-19 pandemic. Since the reporting of the epidemiological indicators like as cases reported, death tolls, and testing rates has increased since the outbreak of COVID-19, there was a need for an actionable and realtime solution. And because one of the primary function of the government during the pandemic was to maintain the public's health and welfare, and it was attested that these digital technology response was a necessary for the COVID-19 response (Sbaffi & Rowley, 2017; World Health Organization, 2020a). According to Oliver Morgan, Director of the Health Emergency Information and Risk Assessment Department, (World Health Organization, 2020b), the ability of a government to report on their COVID-19 condition is a foundation in addressing the COVID-19 pandemic. And with the ubiquitous establishments of such platforms, worldwide epidemiology and response to COVID-19 are now better understood. The benefits and purposes of the application of such technologies has been well-established. However, despite the establishment of these platforms, there is a lack of inclusivity in terms of empidemiological indicators.

Fortunately, the benefits and purposes of releasing health information to the general public are well established. As a result, these web-based dashboard allowed global comparisons of the coronavirus situation (Dixit et al., 2020), healthcare effectiveness can be monitored and managed to improve (Dixit et al., 2020), government transparency and accountability can be fostered, promotion well-informed health decisions and risk-minimizing behavior changes are allowed, and the general populace can establish confidence in their government's approach. Thus, the rampant development was necessary since it would play a crucial role to address the COVID-19 pandemic.

**The Applications of COVID-19 Dashboards**

The COVID-19 platform would have some recurring feature is its mobile-friendly responsiveness, minimalistic design, and interactivity that makes complex statistics accessible and available in a convenient way. This area of study is important because effective public health information 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. 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.

CHAPTER III  
METHODS

In this chapter, the researcher will discuss the study’s devised methodology. Specifically, it will discuss the research design, materials and methods, measures, application testing and simulation, system flow, and design.

## Research Design

This study will adopt an applied research design. According to Hedrick et al., (1993), unlike basic research, applied research design is often employed to allow the researcher to build knowledge and develop practical solutions for a certain research problem. In other words, the objective of applied research is to develop a product to solve a looming issue that a society is currently dealing. Therefore, applied research design is a suitable research design to employ in this study since it aims to solve the lack of COVID-19 web-based platform in the locality.

Additionally, the project development will employ a Software Development Life Cycle (SDLC) model called Agile. For the development of softwares, it is highly necessary to adopt SDLC models for it provides a compelling foundation as well as a clearly defined strategy for the development of the software applications. The most basic SDLC model adopted is Waterfall for software and web development (Chandra, 2015; Kumar Pal, 2018). However, adopting the classical waterfall model in a real-world web application development project is impractical since it is idealistic and challenging to implement (Kumar Pal, 2018). Moreover, the sequential nature of the Waterfall SDLC made it unsuitable for this project. That is why the project development methodology will adopt another SDLC model called Agile Model. The said framework is different from the expected linear sequential life cycle of the Waterfall Model.

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***Figure 2.*** Agile Software Development Life Cycle Model

The primary purpose of the Agile Software Development model is to facilitate quick project completion adaptively. The salient nature of Agile SLDC will allow the researcher to adapt to the unexpected circumstances in the development process due to its iterative and incremental nature (Figure 1). In other words, the researcher can make it up as the project goes along with the Agile Model. Whereas the Waterfall SLDC model, the researcher will structure everything before starting the project. However, with no adaptability due to its linear sequential flow, any erroneous prospects and consequences will be disregarded and not be rectified (Chandra, 2015). That is why the researcher will adopt the Agile Model since it is the most suitable SLDC model that allows the researcher to employ the advantages such as adaptability, efficiency, flexibility, incremental and continuous iteration, the high success rate with less time requirement, risk-reduction, and the elimination of cost (Dixit et al., 2020). Thus, the research project design will also adopt the Agile Model software development cycle.

## Materials and Methods

**Pre-development Phase**

The protocol defined for the study will be strictly adhered unto the Agile Software Development Life Cycle Model. This section will include the stages of the adopted model: Planning and Analysis, Design, Develop, Test, and Development. The researcher planned and analysis the overall procedure of the development.

The researcher first downloaded a software called Android Studio online. It is a free software designed explicitly for developing or building android applications, and the software to be used to create this study's product. The next step was setting up the Firebase account, which will provide the authentication services of the application and store the application's user data. The researcher went to the Firebase website and signed up to create the account for free. These were the two steps before starting coding and building the application

**Planning and Analysis Stage.** This is the pre-development phase. It is where the researcher will emphasize the procedures that assess the requirements of the COVID pulse web application development to satisfy the project objectives. One of the things that are initially done in this stage will be the Feasibility Analysis, wherein all the relevant factors such as the Technical, Economic, Legal, and Scheduling (TELOS) are considered (McLeod, 2021). Also, this stage consists of the consideration of the potentially conflicting needs and consequences in the development process. It also allows the researcher to document, assess, verify, and maintain the protocol of the development procedure.

**Partial Feasibility Analysis.** For the partial Feasibility Analysis in the pre-development phase, this project requires an overhaul of the web application and responsive web design for the development and setting up of the project.At present, the technical, operational, and scheduling feasibility will only be considered anchoring from the Technical, Economic, Legal, and Scheduling (TELOS) framework (McLeod, 2021). The economic, human, legal factor feasibility will be excluded from consideration since it is still equivocal or unnecessary considering the project is a straightforward web application. Furthermore, the project does not require any budget because most of the resources, apart from the physical tools and human resources needed, such as electricity and computer, are accessible and open-source. The researcher has partially determined the technical resources and applicability to the COVID Pulse development requirements.

In terms of the hardware requirements, besides two computers and an internet connection, the basic hardware requirements for the COVID Pulse project can be needless since the researcher will utilize the Google Firebase service to host the COVID pulse web application. However, the COVID Pulse project will still use another computer to test the web application. Hence, the researcher the hardware requirements to set up a server can be optional.

Additionally, the proposed project is technically possible and is an existing concept. The technology needed for the development is also available, and most of the tools are accessible and open-source. The researcher has a substantial background for some of the necessary technical requirements and has earned a Responsive Web Design certificate (Larson, 2021) for the knowledge and skills consideration. However, in some unforeseen circumstances where the requirements were beyond the researcher's aptitude, the researcher can adopt an alternative to fulfill the specific requirement. Thus, considering all of these, it is technically possible to develop the proposed project. From all the areas of TELOS, the project will be heavily scoped on the technical feasibility.Specifically, the following are the foreseen bare minimum software that is essential: Integrated Development Environment (IDE), Prototyping Tool and Graphics Editor, and Web Browser.

**Development Stage.** The researcher has defined the development phases in every part of the COVID Pulse web application. Every stages involves the development of the specific feature of COVID pulse through the implementation and coding of the designed project. In other words, this is the primary stage in the realization of the COVID Pulse web application design and translating it into a source code. Each module that will be designed in the designing stage by the researcher will be implemented and coded. After the development stage, the researcher will test the module functionality and determine whether it is appropriately working through end-to-end (E2E) testing. Each development phase will focus on the three segments: Frontend, API (Middleware), and Backend.



***Figure 4.*** COVID Pulse Website Application Sitemap Structure

**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-CoV-2 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 - T**his web page is to inform the web application visitors about the COVID Pulse's details and the web application's critical operations.

**Designing the Web Application**

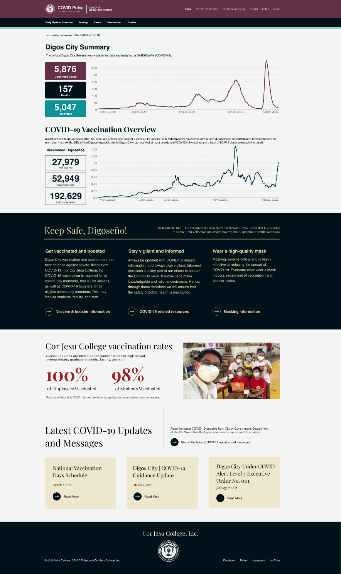
The designing stage is crucial for the development of the COVID Pulse. In this stage, the researcher will identify and describe the web application's features, operation, and specification to establish the intended objectives. The system designing of the COVID pulse will consist of various design considerations and concepts. Additionally, it conceptualizes and offers good visual and descriptive prospects about the web application and its system aspects to allow the final version to be consistent with design structures as described initially in the proposed system architecture models. Hence, this stage is necessary since it will allow the researcher to implement and code the devised and analyzed prospects in the Planning and Analysis phase through a programming language. Lastly, the web application system design of COVID Pulse will be divided into three segments: Frontend, Backend, and APIs.

**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.

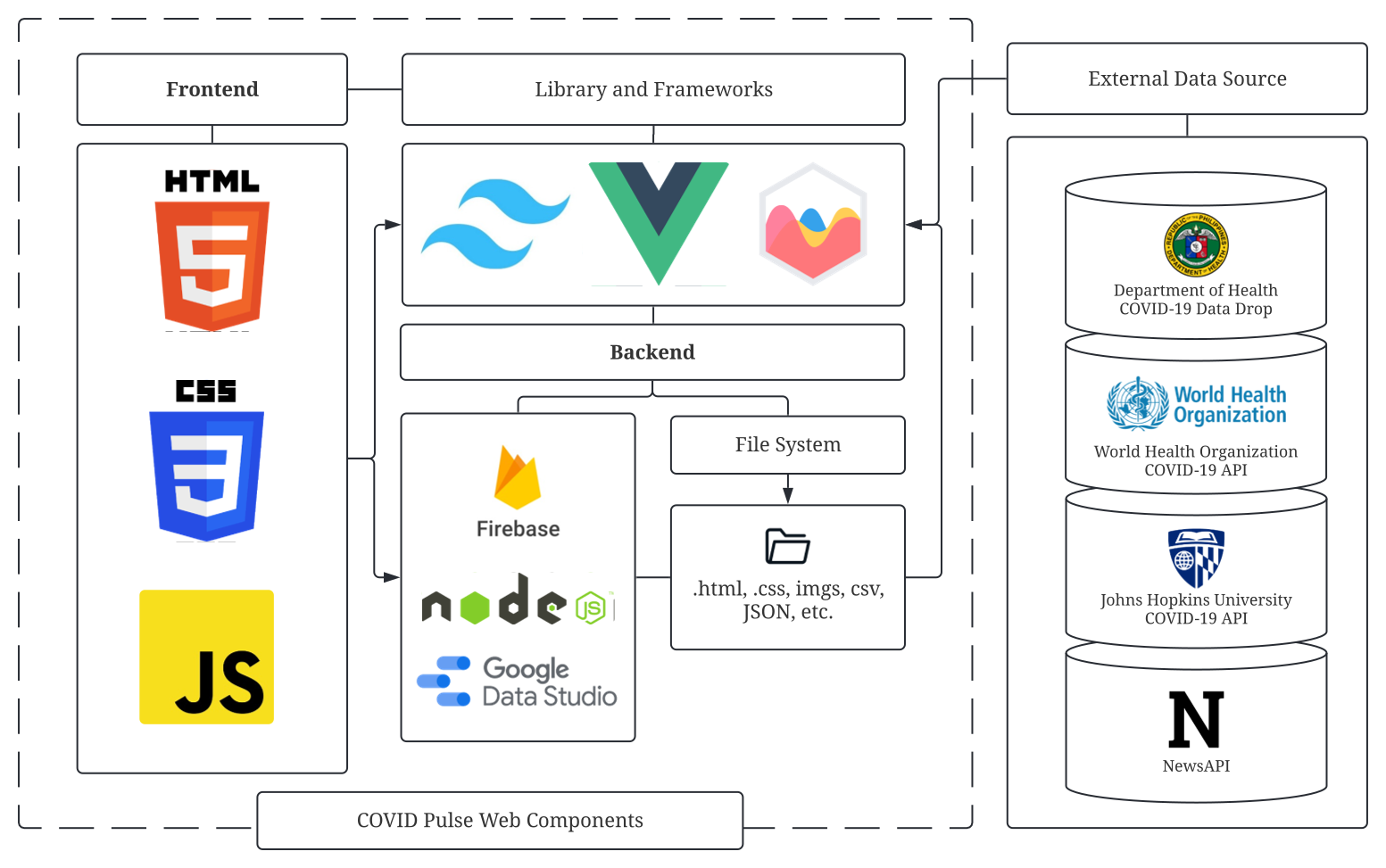
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***Figure 5.*** Low-Fidelity Sample of Provisional Wireframe: COVID Pulse  
Home [First Section] and COVID-19 Insights Webpages [Second Section]

Low-fidelity (Lo-Fi) prototyping is essential for the researcher to quickly conceptualize the COVID pulse's design features. However, the appearance design will be disregarded in low-fidelity prototyping (Figure 4). This type of prototyping technique will allow the researcher to convert the high-level design concept of the web application into a testable functional prototype and know each purpose of the components. Then, the low-fidelity prototype will be anchored to the next prototyping stage, which is the high-fidelity prototyping technique. See Figure 6 for a hi-fidelity sample of COVID Pulse.

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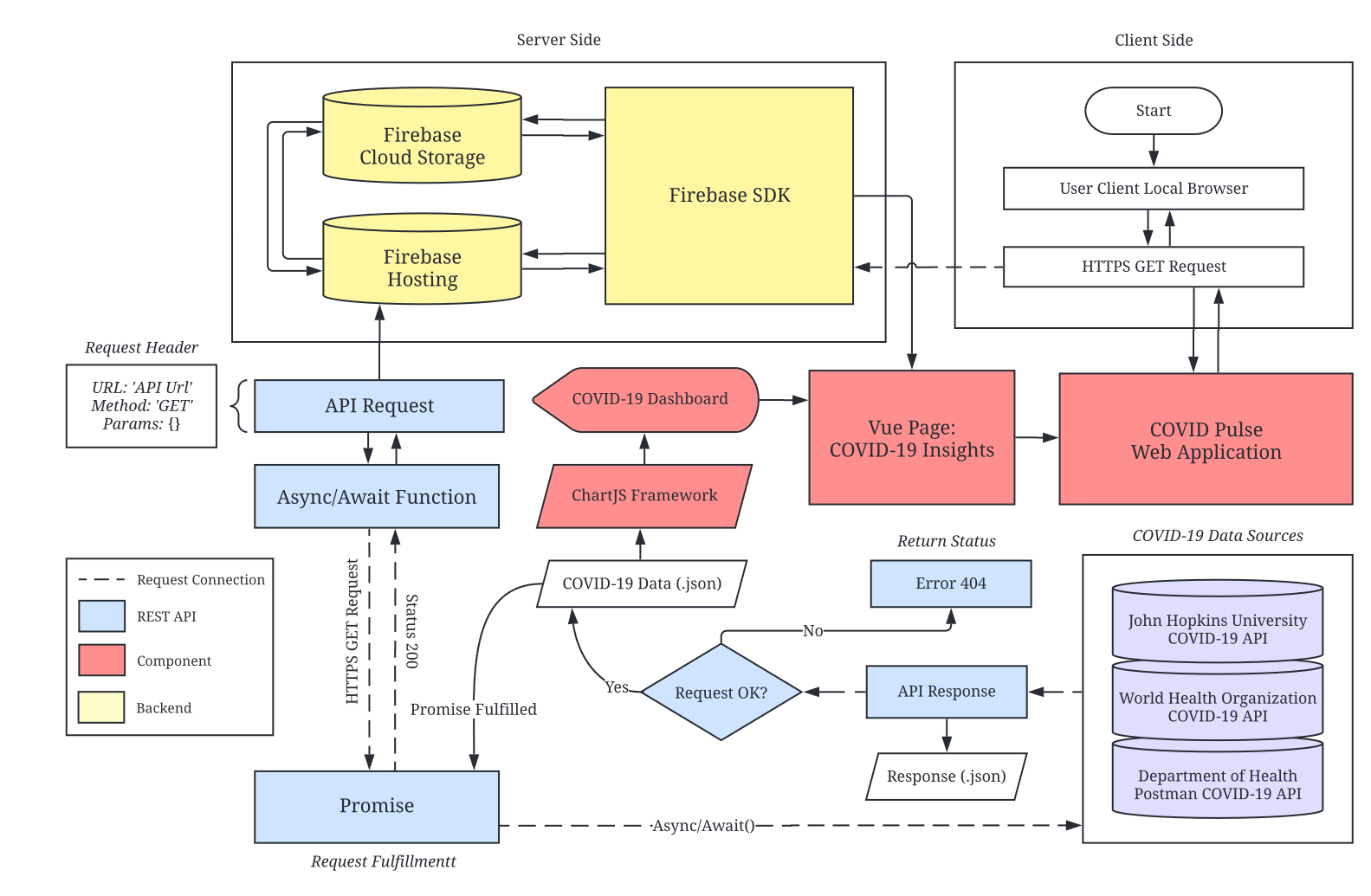
***Figure 7.*** Provisional Sample of the COVID Pulse Home Page (1920 x 3224)

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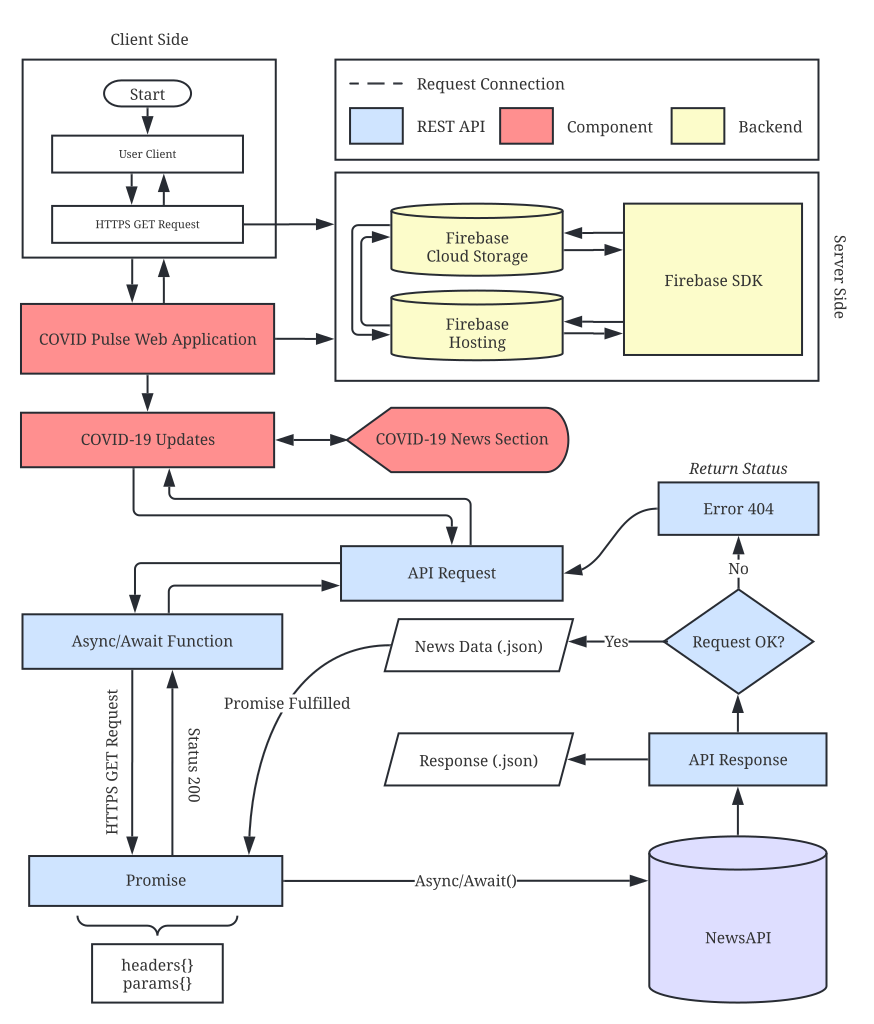
***Figure 9.*** *High Level Architecture, Frontend, Backend, and APIs components*

**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 be interacted with users.

The frontend layer will consist of the languages that are the fundamental pillars for Web Development: HTML, CSS, and JavaScript. The researcher will adopt JavaScript and other frameworks and libraries for the backend. Additionally, the researcher will implement tools, frameworks, and libraries such as Tailwind CSS, Vue.js, Chart.js, Cypress, Lighthouse and Firebase during the COVID Pulse web application development.

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*High level architechture design of API COVID Pulse  
retrieval of data from COVID-19 data sources*

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**Materials**

**Hypertext Markup Language (HTML).** It is crucial for the COVID Pulse web application since it will contain the websites' basic text and hypertext contents.

**Cascading Style Sheets (CSS).** CSS will always coincide with HTML for the researcher to style and specify how the presentation of the User Interface will look (i.e., colors, fonts, and layout) and feel of the primary contents of the COVID Pulse web application.

**JavaScript.** This programming language is a dynamic client-side scripting that will allow the researcher to make the COVID Pulse web application include more functionality, responsiveness, and dynamic features.

**Tools, Libraries, and Frameworks.** The dependencies and devDependencies that will be implemented in the COVID Pulse project can be found in the package.json file found in the repository. It contains the metadata relevant to the COVID Pulse project repository. It will be used for managing the COVID Pulse project's dependencies, devDependencies, scripts, and version.

**Node.js -** It is a server-side JavaScript run-time environment based on the Google Chrome V8 engine. It will be utilized both on the frontend and the backend side of the web application architechture. This will be one of the foundation of the web application.

**pnpm –** This will serve as an installer for the necessary dependencies and packages for the project. Although NodeJS comes with built-in support for package management (npm), for this project to be time efficient and avoid any unnecessary errors during the development phase, pnpm will be used to serve as an alternative installer, and a tool to update and remove the packages that is involved during the development process.

**Vue.js -** The main JavaScript framework used to build the COVID Pulse frontend user interface. Vue.js is anchored in the standard HTML, CSS, and Javascript while allowing the resesarcher to develop the project while integrating the declarative and reactive nature of the framework. It is chosen since it is a suitable lightweight, flexible, modular, and highly performant framework.

**Tailwind -** It is a utility-first framework of CSS that is parceled with classes, enabling faster development of the frontend layer. Other than the time-saving procedure of Tailwind during the development process, it also provides other benefits such as symmetrical layouts, high productivity, and efficiency of the development of the COVID Pulse web application.

**Chart.js -** It is an open-source JavaScript data visualization library that will be adopted. Unlike the other leading data visualization library such as D3.js, Chart.js is straightforward, requires less effort, and sufficed the bare minimum requirement of generating data graphics to develop the COVID-19 dashboard. It will also be paired with Google Data Studio as a complementary for converting the COVID-19data into reports.

**Firebase –** This is platform develop by Google that provides development services. The researcher will mainly utilize its services such as Firebase Hosting and Cloud Storage to store the necessary files and host the overall operation of the COVID Pulse web application.

**Cypress –** This is a frontend end-to-end testing framework that be used for the testing stage of the COVID Pulse application. It has a consistent architecture that allows the testing to be quick, consistent, and reliable. Additionally, it has features that enables the researcher to take snapshots during the testing process and take screenshots and record the duration of the testing process automatically. It also has debugability that allows debugging process more quick.

**Lighthouse.** It is an automated tool for testing web pages and web applications developed by Google. It will be used for acquiring performance metrics and insights for web developers to abide development practices. It will be used in the testing for it has various available features that is useful for identifying the overall aspects of the COVID Pulse web application.

**COVID Data APIs.** The data dashboard will acquire the COVID-19 aggregated epidemiological data from various APIs in terms of Local, Regional, National, and Worldwide. Specifically, the data source will be from the following repositories:

* **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 is publicly available 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.

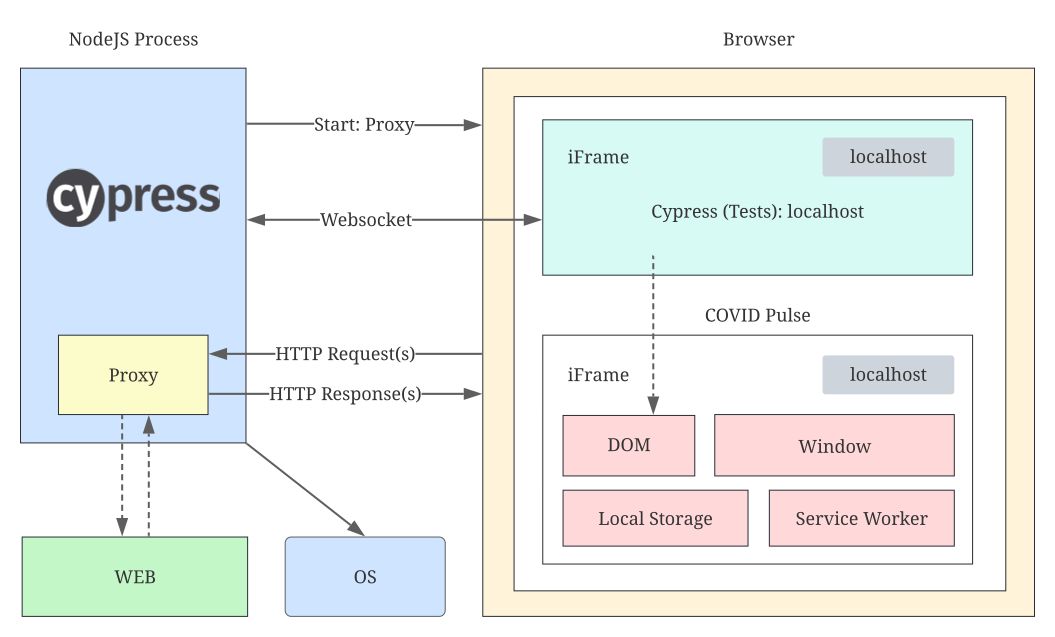
**Software Implementation**

**Web Application Testing and Simulation**

The testing stage will be part of the COVID Pulse development process. The project will adopt a type of functional test called End-to-End (E2E) testing, specifically an automated Horizontal E2E. This type of testing involves testing the entire software, or in this case, website web application, from start to end and will coincide with the user flow (Hamilton, 2019). Its primary goal is to test the developed project to validate if everything from all the integrated units is behaving as expected (Figure 4). E2E testing is mainly done from the aspect of the end-user by simulating actual real-world user experience and verifying the entire system.



***Figure 10.*** E2E Test Automation Horizontal & Vertical Scale

**

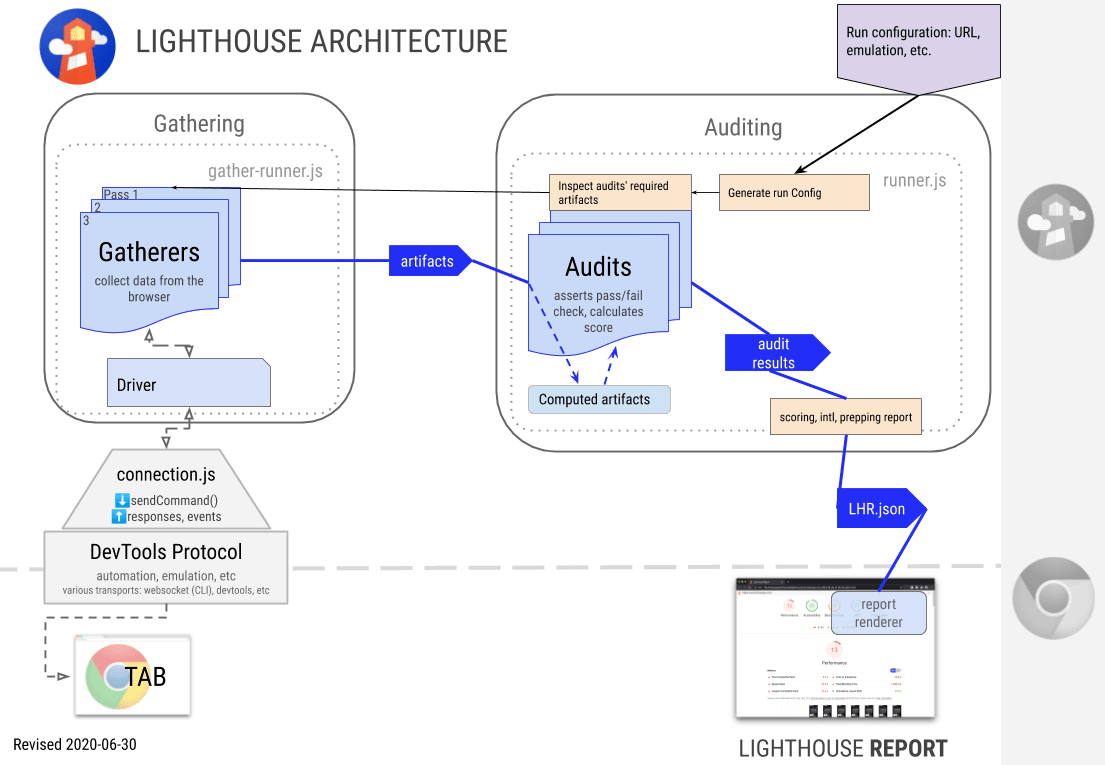
High Level Architechture Design of Cypress Testing

**CYPRESS SETUP**

Basic Script Setup

End-Goals

Components to Test

**** Basic Script Setup

End-Goals

Components to Test

## Measures

**Table 1**

*Performance Range Score (Desktop)*

|  |  |
| --- | --- |
| Audit | Weight |
| 0-49 | Poor |
| 50-89 | Needs Improvement |
| 90-100 | Good |
| TOTAL | **100%** |

**Table 2**

*Weighted Average of Performance Score (Desktop)*

|  |  |
| --- | --- |
| Audit | Weight |
| First Contentful Paint | 10% |
| Speed Index | 10% |
| Largest Contentful Paint | 25% |
| Time to Interactive | 10% |
| Total Blocking Time | 30% |
| Cumulative Layout Shift | 15% |
| TOTAL | **100%** |

## 

|  |  |
| --- | --- |
| FCP Time (in seconds) | Speed |
| 0-1.8 | Fast |
| 1.8-3 | Moderate |
| >3 | Slow |

|  |  |
| --- | --- |
| Speed Index (in seconds) | Speed |
| 0-3.4 | Fast |
| 3.4-5.8 | Moderate |
| >5.8 | Slow |

|  |  |
| --- | --- |
| TTI (in seconds) | Speed |
| 0-200 | Fast |
| 200-600 | Moderate |
| >600 | Slow |

|  |  |
| --- | --- |
| CLS (in seconds) | Speed |
| 0-0.1 | Good |
| 0.1-0.25 | Needs Improvement |
| >0.25 | Poor |

## Procedure