Chapter 2

CONCEPTUAL FRAMEWORK

This chapter presents the review of related literature and studies underlying the framework of the study. It includes the conceptual model of the study and the operational definition of terms.

Review of Related Literature

Queue Management System

As stated in an article "The Definitive Guide to Queue Management Systems," Hyun Lee (2017) defined queue management system as a set of tools developed to manage and analyze the flow of visitors. Ideally, a queue management system exists to prevent the formation of queues altogether, though its use is not limited to queue managing. In a way, a queue management system can be considered CRM, or at least one aspect of it. Joining a queue is one of the first parts of a customer's interaction with the business. By taking care of this interaction, queue management steps into the realm of customer service. In other words, queue management system optimizes customer experience.

The basic principle behind queue management systems is to quantify queue demand at any given time and inform your staff in real-time. Sensors placed above each checkout count the number of people waiting, giving you a total number of those being served, those still waiting, how long they have been waiting, and giving you alerts at predetermined points. This gives you the chance to react to customer demand as quickly as possible, keeping the checkouts running efficiently, reducing the waiting time for your

customers and improving their shopping experience. (How does Queue Management work?, n.d.)

Furthermore, Kirill Tsernov (2017) stated that queue management — and, therefore, queuing solutions — rests on three main principles of queuing. These are fairness, engaging queuing, and explained waiting.

Queuing System

According to Kirill Tšernov (2017), queuing system as its name implies, is a system which purpose is to help with queuing. He said that queue systems have come a long way. They went from simple physical barriers to state-of-the-art digital applications. There are many types of queuing solutions to choose from, but their most simple cases are also the least effective. He stated the principles of queuing system: Fair Queuing, Engaging Queuing, and Explained Waiting.

In addition, Hossein Arsham (n.d) stated that Queuing is the study of waiting lines, or queues. The objective of queuing analysis is to design systems that enable organizations to perform optimally according to some criterion. Analyzing queuing systems requires a clear understanding of the appropriate service measurement. The Possible service measurements are average time a customer spends in line, average length of the waiting line, and the probability that an arriving customer must wait for service.

In a customer-facing environment, effective queue management procedures are crucial. The importance of queuing systems is two-fold. From an operational perspective, poor queuing systems can lead to a drop in productivity from staff as they spend time trying to organize the queue. From a monetary perspective, if customers decide to leave

the queue, or are put off from even joining, this leads to a loss of profits. In some instances, a customer will not consider returning to a business that has poor, unmanaged queues. Putting good queue management systems in place helps to automate the queuing process whilst improving service and gaining customer loyalty (The Importance of Queuing Systems, 2018).

QR Code

According to Liane Cassavoy (2017), the "QR" in QR codes stands for "quick response," as the codes are designed to be read quickly. QR codes can be read by dedicated QR code readers and by some cell phones.

As Christensson (2015) stated in his article, all QR codes have a square shape and include three square outlines in the bottom-left, top-left, and top-right corners. These square outlines define the orientation of the code. The dots within the QR code contain format and version information as well as the content itself. QR codes also include a certain level of error correction, defined as L, M, Q, or H. A low amount of error correction (L) allows the QR code to contain more content, while higher error correction (H) makes the code easier to scan.

In this study, the reason for using QR code instead of a barcode is that Mark O'Neill (2015) said that the QR code has many advantages over a conventional barcode. The main advantage is that you can store up to a hundred times more information on a QR code than on a conventional horizontal barcode. In addition, QR codes can be scanned from any direction for 360 degrees. This makes them easier for devices to read and lessens the possibility of background interference.

Point-of-Sale Scanner

According to Margaret Rouse (2011), a barcode reader, also called a price scanner or point-of-sale (POS) scanner, is a hand-held or stationary input device used to capture and read information contained in a bar code. A barcode reader consists of a scanner , a decoder (either built-in or external), and a cable used to connect the reader with a computer. Because a barcode reader merely captures and translates the barcode into numbers and/or letters, the data must be sent to a computer so that a software application can make sense of the data. Barcode scanners can be connected to a computer through a serial port , keyboard port , or an interface device called a wedge . A barcode reader works by directing a beam of light across the bar code and measuring the amount of light that is reflected back. (The dark bars on a barcode reflect less light than the white spaces between them.) The scanner converts the light energy into electrical energy, which is then converted into data by the decoder and forwarded to a computer.

Jay Schofield (2015) stated the different types of scanner. Some scanners use lasers, while others use lights or cameras, to capture the barcode image and turn it into an electronic code. There are pen readers, which have no moving parts, just a light source and a photodiode to measure the lines and spaces on the 1D barcode. Laser scanners use lasers as the light source, and have fewer errors scanning from a greater distance than pen readers (thanks to mirrors and lenses). CCD readers measure ambient light rather than self-reflected light, and take several readings per scan to reduce errors. Camera-based readers take a photo of the barcode in order to read and decode it, and they are a decent, cheaper option. The most advanced scanner of all is the omni-directional scanner, which is a laser scanner with more mirrors and lenses to reduce errors. An omni-directional

scanner can read ripped, crumpled or otherwise damaged barcodes at a faster rate than other, lesser laser scanners.

Margaret Rouse (2011) stated that a laser scanner, either hand-held or stationary, does not have to be close to the bar code in order to do its job. It uses a system of mirrors and lenses to allow the scanner to read the bar code regardless of orientation, and can easily read a bar code up to 24 inches away. To reduce the possibility of errors, a laser scanning may perform up to 500 scans per second. Specialized long-range laser scanners are capable of reading a bar code up to 30 feet away. It is for this reason that the researchers will use a laser scanner for this study.

In addition, Savio Fernandes (2015) stated the importance of barcode scanners. To ensure maximum usage from your stock and 100% efficiency, you need to have an accurate data collection system for your inventory. Adopting a barcode scanner feature, you can find your inventory data quickly and efficiently, which automatically eliminates costly mistakes. Being able to track an amazing amount of information, this inventory management solution will allow you increases productivity and efficiency while managing stock for your business.

Integrated Development Environment

Margaret Rouse and Valerie Silverthorne (2016) stated that an integrated development environment (IDE) is a software suite that centralizes basic tools of developers needed to write and test software. Usually, an IDE has a compiler or interpreter, debugger and a code editor of course. It is access by a developer in a single graphical user interface

(GUI). An IDE may be included as part of one or more existing and compatible applications, either may be standalone.

In addition, Marie Christiano (2015) said that instead of doing all the instructions of unrelated individual tasks required to create an executable programs, in just one application and workspace an IDE gives all the tools needed. Each of the tools has a sensible of the environment and they work together to present an absolute development for the developer. Furthermore, IDE's are available from vendors, open source communities, and software companies. Price range is from free up to high pricing depending on the number of required license. There is no standard for IDEs because each has its own capabilities, together with their strengths and weaknesses. Generally, an IDE supports an easy-to-use interface and allows developers to run and debug programs in all one screen.

Furthermore, Christensson (2015) stated that some IDEs provide a runtime environment (RTE) for testing software programs. When a program is run within the RTE, the developer can track each event that takes place within the application being tested. This can be useful for finding and fixing bugs and locating the source of memory leaks. Because IDEs provide a centralized user interface for writing code and testing programs, a programmer can make a quick change, recompile the program, and run the program again. Programming is still hard work, but IDE software helps streamline the development process.

Android Studio

Android Studio is an integrated development environment (IDE) released by Google during the Google I/O developers' event on May 2013. This brand new IDE is made exclusively for Android development and is intended to be an alternative support for application creation (Overview of the Android Studio, 2014).

In addition, Matthew David (2015) stated in his article that Android Studio is intended to be used by development teams as small as one person or as large as global teams. The Android Studio IDE can be linked to larger teams with GIT or similar version control services for larger teams. Mature Android developers will find tools that are necessary for large teams to deliver solutions rapidly to their customers. Android solutions can be developed using either Java or C++ in Android Studio. The workflow for Android Studio is built around the concept of continuous integration. Continuous Integration allows for teams to test their code each and every time a developer checks in their work. Issues can be captured and reported to the team immediately. The concept of continuously checking code provides actionable feedback to the developers with the goal of releasing versions of a mobile solution faster to the Google Play App Store. To this end, there is rigorous support for LINT tools, Pro-Guard and App Signing tools.

In this study, the researchers will use Android Studio version 3.1 for it is the latest version of Android Studio. Furthermore, Paul Krill (2018) stated that Google's Android Studio 3.1 IDE, released in late March 2018, has added improvements for C++ and Kotlin coders and for SQLite database users. A beta version of Android Studio 3.2 was also made available in May 2018.

Data Format

A data format is the arrangement of data fields for a specific shape. After you arrange data fields on a shape, you can save the data format as default or custom(What is a data format? n.d).

The format of the data refers to the organization of digital information that is read and processed through computer software. The format and software of the research data are typically determined by how researchers choose to collect and analyze their data or by standard norms practiced within a scientific field (Data and File Formats, n.d).

A critical part of a communications protocol that enables the receiving device to logically determine what is to be done with the data and how to go about doing it, a data format generally involves a header, text field, and a trailer. Although the header and trailer are overhead, they serve critical functions in support of the successful transfer of the data content. In total, the header, text, and trailer compose what is known variously as a packet, block, frame, or cell, with the specific terminology being sensitive to the specific protocol involved (data format - Computer Definition, n.d).

JSON

In an article "What is JSON? JavaScript Object Notation explained", Jonathan Freeman (2017) defined JavaScript Object Notation as a schema-less, text-based representation of structured data that is based on key-value pairs and ordered lists. Although JSON is derived from JavaScript, it is supported either natively or through libraries in most major programming languages. JSON is commonly, but not exclusively, used to exchange information between web clients and web servers.

As stated by Louis Lazaris (2017), JSON originated in association with JavaScript and client-side scripting. Douglas Crockford is the inventor of JSON and he maintains the official JSON.org website where it's discussed in great technical detail. The earliest official specification for JSON is the ECMA-404 standard from 2013. But JSON goes back much further than that. The JSON website was officially launched in 2002 (where it was originally redirecting to Crockford's website). Yahoo and Google began using JSON as early as 2005 and 2006, respectively, and JSON took off in the years following.

In addition, Joel Lee (2014) said that JSON is recognized natively by JavaScript, which is one of the most popular languages in the world. Since JSON is a subset of JavaScript, there's very little extra learning you have to do once you know JavaScript. Another reason is that JSON is more readable than XML. It's easy to get used to XML when it has been used for a while, but glancing at an XML file can be overwhelming with all of its tags and verbosity. JSON is cleaner, easier for newbies to understand, and quite flexible with its basic data types.

Programming Language

In an article of Christensson (2011), he defined programming language as a set of commands, instructions, and other syntax use to create a software program. Languages that programmers use to write a code are called "high-level languages." This code can be compiled into a "low-level language," which is recognized directly by the computer hardware.

According to Mahmood Alam (2015), there are two types of programming languages which are low-level and high-level languages. Low-level languages are near to computer

hardware and far from human languages. Computer can understand these languages easily. Machine and assembly languages are under the low-level language. A machine language is a computer language in which instructions are written in binary form (0 and 1). It is the only language that is directly understood by the computer. Machine language is the native language of computer. In assembly language, symbols are used instead of binary code. These symbols are easy to remember. For example, the Add instruction is used to add two numbers. Assembly language is also known as second generation language. High-level languages are close to human languages and are easy to understand. Instructions of these languages are written in English-like words e.g. Print, Display, Write, etc.

Vijay Sharma (2018) stated the importance of programming languages in his article. Programming is important for learning to innovate, create eco-friendly solutions for global problems. It is also important in our daily lives to enhance and increase the power of computers and Internet. It is important for speeding up the input and output processes in a machine. Programming is important to automate, collect, manage, calculate, and analyze processing of data and information accurately. Programming is important to create software and applications that help computer and mobile users in daily life. Due to all these reasons, it's really important to learn how to use programming languages.

Java Language

According to Paul Leahy (2018), Java is a computer programming language that enables programmers to write computer instructions using English-based commands instead of having to write in numeric codes. It's known as a high-level language because

it can be read and written easily by humans. Like English, Java has a set of rules that determine how the instructions are written. These rules are known as its syntax. Once a program has been written, the high-level instructions are translated into numeric codes that computers can understand and execute.

Christensson (2012) stated that the Java syntax is similar to C++, but is strictly an object-oriented programming language. For example, most Java programs contain classes, which are used to define objects, and methods, which are assigned to individual classes. Java is also known for being stricter than C++, meaning variables and functions must be explicitly defined. This means Java source code may produce errors or "exceptions" more easily than other languages, but it also limits other types of errors that may be caused by undefined variables or unassigned types.

In this study, the researchers will use Java 8 for Vamsi Tallapudi (2017) said that previously, to use Java 8 Features, it was needed to add Jack Toolchain to a project. But now, support for Jack Toolchain was deprecated as announced by Google since they were integrating the support for Java 8 features straight ahead into default toolchain. Now, Java 8 can be used in the project by switching to Latest Preview version of Android Studio. However, to use Java 8 features directly into stable version of Android Studio, one should continue to use Jack Toolchain.

Client-Side Scripting Language

Client-side scripting, like JavaScript, can be embedded into the page on the client's browser. This script will allow the client's browser to alleviate some of the burden on the web server when running a web application. Client-side scripting is source code that is

executed on the client's browser instead of the web-server, and allows for the creation of faster and more responsive web applications (Segue Technologies, 2013).

Furthermore, Carey Wodehouse (2015) stated that Client-end scripts are embedded in a website's HTML markup code, which is housed on the server in a language that's compatible with, or compiled to communicate with, the browser. The browser temporarily downloads that code, and then, apart from the server, processes it. If it needs to request additional information in response to user clicks, mouse-overs, etc. (called "events"), a request is sent back to the server. Client-side scripting is always evolving— it's growing simpler, more nimble, and easier to use. As a result, sites are faster, more efficient, and less work is left up to the server.

In addition, Martin Matthews (2011) said that client-side scripting is used to make Web pages change after they arrive at the browser. It is useful for making pages a bit more interesting and user-friendly. It can also provide useful gadgets such as calculators, clocks etc., but on the whole is used for appearance and interaction. Client-side scripts rely on the user's computer. If that computer is slow they may run slowly. They may not run at all if the browser does not understand the scripting language. As they have to run on the user's system the code which makes up the script is there in the HTML for the user to look at (and copy or change).

HTML

According to an article "HTML" (2017), Html was first developed by Tim Berners-Lee in 1990. It is short for HyperText Markup Language. HTML is used to create electronic documents (called pages) that are displayed on the World Wide Web. Each

page contains a series of connections to other pages called hyperlinks. Every web page

seen on the Internet is written using one version of HTML code or another.

Rose Shannon (2012) stated that HTML consists of a series of short codes typed into a

text-file by the site author — these are the tags. The text is then saved as an html file,

and viewed through a browser, like Internet Explorer or Netscape Navigator. This

browser reads the file and translates the text into a visible form, hopefully rendering the

page as the author had intended. Writing one's own HTML entails using tags correctly to

create vision. One can use anything from a rudimentary text-editor to a powerful

graphical editor to create HTML pages.

Furthermore, in an article of Yoshitaka Shiotsu (2017), he said that HTML is typically

used for the client-side, and PHP is used for server-side programming which means it's

likely they'll both be used on the same project. HTML is all about organizing and

controlling how the content on your website is displayed, while PHP works on the back

end to provide the logic that powers and populates the content your HTML is displaying.

With this in mind, it's safe to assume your site will require some HTML no matter what,

and, if you have a PHP backend, the two technologies will interface to bring your

dynamic website to life.

According to Cody Arsenault (2017), HTML5 is the result of a collaboration between

the World Wide Web Consortium, or W3C, and the Web Hypertext Application

Technology Working Group, or WHATWG. The organizations teamed up in 2006 to

reduce reliance on plugins, improve error handling and replace scripting with more

markups. Consequently, HTML5 has greatly simplified the process of creating web

applications. Thanks to HTML5, web pages can now store data locally on the user's

browser, which eliminates the need for HTTP cookies. As a result, content can be delivered faster and more securely. HTML5 has also made it easier to ensure consistency across all browsers. Since browsers have traditionally relied upon different plugins to play multimedia files, native support of video and audio allows developers to avoid compatibility issues. New attributes also allow for video controls including play, pause, and volume options. It is for these reason that the researchers will use HTML5 in this study.

CSS

Jennifer Kyrnin (2017) stated that CSS was first developed in 1997 as a way for web developers to define the visual appearance of the web pages that they were creating. It was intended to allow web professionals to separate the content and structure of a website's code from the visual design, something that had not been possible prior to this time.

Furthermore, it is said in an article in the website https://developer.mozilla.org/ that web browsers apply CSS rules to a document to affect how they are displayed. A CSS rule is formed from:

- A set of properties, which have values set to update how the HTML content is displayed, for example I want my element's width to be 50% of its parent element, and its background to be red.

- A selector, which selects the element(s) you want to apply the updated property values to. For example, I want to apply my CSS rule to all the paragraphs in my HTML document.

In addition, Carey Wodehouse (2015) said in her article that once CSS is applied to a site, "cascading" pages come into play. In CSS, sheets are layered onto one another, adding more complexity without disrupting one another. A base page can dictate the site-wide color scheme, background, and font, letting developers "set it and forget it." The flexibility comes in with the sheets they can layer on to that, adding more complexity and page-specific designs that can be turned on or off without changing any other aspects of the site's design.

JavaScript

The website developer.mozilla.org defines JavaScript (often shortened to JS) as a lightweight, interpreted, object-oriented language with first-class functions, and is best known as the scripting language for Web pages, but it's used in many non-browser environments as well. It is a prototype-based, multi-paradigm scripting language that is dynamic, and supports object-oriented, imperative, and functional programming styles (About JavaScript, n.d.).

Furthermore, the article "JavaScript" (n.d.) says that JavaScript was first known as LiveScript, but Netscape changed its name to JavaScript, possibly because of the excitement being generated by Java. JavaScript made its first appearance in Netscape 2.0 in 1995 with the name LiveScript. The general-purpose core of the language has been embedded in Netscape, Internet Explorer, and other web browsers.

According to Stephen Chapman (2017), the great thing about JavaScript is that you don't need to know how to write it in order to use it in your web code. You can find

plenty of pre-written JavaScripts for free online. All you need to know to be able to use such scripts is how to paste the supplied code into the right places on your web page.

Server-Side Scripting Language

Server-side scripting is a method of designing websites so that the process or user request is run on the originating server. Server-side scripts provide an interface to the user and are used to limit access to proprietary data and help keep control of the script source code. (Computer Hope, 2017)

According to Carey Wodehouse (2015), server-side scripts are used by back-end web developers to build the back-end software of a website—the mechanics we don't see, but that make a site's usability and functionality possible. These languages create the communication channel between user, server, and database. Anything that isn't explicitly written into the text markup of a site is front-end or back-end software. Any data that a user requests in the browser (e.g., the fields in drop-down menus, photos, or user profiles) is delivered via server-side scripts, which create a channel between server and end user that requests, edits, and deletes things in the database.

Segue Technologies (2013) stated that the disadvantage of server-side processing is the page post back: it can introduce processing overhead that can decrease performance and force the user to wait for the page to be processed and recreated. Once the page is posted back to the server, the client must wait for the server to process the request and send the page back to the client.

SQL

As defined in an article of Brewster Knowlton (2015), SQL

(Structured Query Language) is the primary language responsible for managing data and

data structures contained within a relational database management system (RDBMS). Put

simply, SQL is the language uses to interact with a database. There are four basic

operations that SQL can perform: INSERTs, SELECTs, UPDATEs, and DELETEs (these

are sometimes referred to as CRUD operations - create, read, update, and delete).

In addition, Chad Brooks (2014) stated that the SQL programming language was first

developed in the 1970s by IBM researchers Raymond Boyce and Donald Chamberlin.

The programming language, known then as SEQUEL, was created following the

publishing of Edgar Frank Todd's paper, "A Relational Model of Data for Large Shared

Data Banks," in 1970.

According to Margaret Rouse and Jessica Sirkin (2016), SQL became the de facto

standard programming language for relational databases after they emerged in the late

1970s and early 1980s. Also known as SQL databases, relational systems comprise a set

of tables containing data in rows and columns. Each column in a table corresponds to a

category of data -- for example, customer name or address -- while each row contains a

data value for the intersecting column.

PHP

According to an article "What is PHP?" (n.d.), PHP (recursive acronym for PHP:

Hypertext Preprocessor) is a widely-used open source general-purpose scripting language

that is especially suited for web development and can be embedded into HTML.

Furthermore, in her article "What Is PHP Used For?" Angela Bradley (2016) explained that PHP is a popular server-side scripting language for the web. Generally speaking, PHP is used to add a functionality to websites that HTML alone can't achieve.

In addition, Yoshitaka Shiotsu (2017) stated that PHP is like the machinery behind a dynamic website. PHP (Hypertext Preprocessor) is a general purpose scripting language that became the de facto server-side language of choice for web developers since 1995. Today, a majority of sites on the web run on PHP, due in large part to its popularity as the language of choice for back-end of content management systems (CMS) like WordPress, Drupal, and Joomla. Whether it's for a simple blog or a small business owner looking to set up a professional landing page, a CMS is usually the quickest, cheapest way to set up an online presence, so PHP developers are often in high demand. A PHP script will be linked to from an HTML file, which serves as the foundation of a site. It's also most commonly known as the P in the LAMP software stack.

Framework

According to the website Christensson (2017), a framework is a platform for developing software applications which serves as the foundation for programming. It may include predefined classes and functions, code libraries, compiler and other programs used in the software development process. This helps the development process faster and easier since the programmers don't need to start from a scratch every time they develop a new application.

In the article "What Is a Framework?", Carey Wodehouse (2015) stated that framework can be used to create most applications on the back end, including web

services, web applications and software. There are types of framework, software frameworks and web application frameworks. Software framework refers to reusable environment that is part of a larger software platforms. They facilitate the development of software applications which include components such as libraries of codes, support programs, compiler, tool sets and specific API's that facilitates the flow of data while web application framework are software used to simplify web app and website development, web services and web resources. One of the popular type of web app framework is the Model-View-Controller (MVC) architecture, known for it separates the code for each application component into modules.

Additionally, in the article "Frameworks, programming languages: Coding from scratch vs. using a framework", Brooke Campbell (2017) said that a framework is the collection of programs set up together to accomplish a certain task which makes coding more efficient and generally make the lives of programmer easier. By using a framework, it makes things simpler for since there's no need to worry about other aspects of the code from general design to security concerns. Also, this lessens the time consumed and saves one from making human errors. Basically, dealing with frameworks makes life easier.

CodeIgniter

CodeIgniter was created by EllisLab. This is an application development framework that can be used to develop websites, using PHP. It is an Open Source framework that has many sets of functionality which increase the speed of developing a website. Also, the website made in CodeIgniter is secured because it can prevent various attacks that happens through websites (CodeIgniter – Overview, n.d).

In the article of Yogini Joshi (2011), CodeIgniter is explained as commanding and one of the efficient PHP frameworks in terms of creating web applications with advanced feature as it makes web application always ready and learning becomes easier due to the usual PHP coding. It makes the code portable compared to other frameworks. This was derived from the Model-View-Controller (MVC) development pattern where model represent data and all its functions retrieve, insert and restructure the database information as model contains data logic and represent classes, data structures, etc. while view is the general information in web page that is accessible by user and controller is mainly act through between the model, the view and any other resources essential for processing the HTTP and generating web page. Moreover, there are the advantages of using Code Igniter such as: it is easy to adopt and deploy; there is easy handling and customizing; it is hassle-free from migration of server hosting to dedicated server hosting; it offers flexibility and easy management with MVC based framework; and it also offers good collection of possessed libraries and has lightweight file. On the other hand, the benefits of using it makes you free from complex structures and development, the configuration and normal coding rules are not required, and it has a small track and amazing presentation.

In this study, the researchers will use CodeIgniter version 3 for it is the latest version of CodeIgniter. Furthermore, Ben Edmunds (2017) stated that with a community driven team in place, version 3 was soon finished and released. Version 3 was an incremental release so development was quickly mapped out for a truly new version of CodeIgniter. This version would have the latest PHP features but still allow you to develop a simple app end to end.

Bootstrap

According to Kira (2017), Bootstrap is a front-end framework for HTML, CSS and JavaScript that is notable for developing mobile-first and responsive websites. With some basic knowledge of HTML and CSS, you can create Bootstrap forms, tables, buttons, typography, navigation, modals, image carousels and optional JavaScript plugins by using the premade templates Bootstrap provides you.

Alexandre Ouellette (2017) stated the advantages of bootstrap. Bootstrap's responsive grid, responsive images, components, JavaScript, documentation, customizability, community, and external templates are the things that make bootstrap advantageous.

Furthermore, Param Chahal (2017) explained that Bootstrap 3 framework is no less than a progeny of the Bootstrap team. It was released as one of the earliest "mobile-first" frameworks. This version was charged with responsiveness. It was mainly designed to be aptly adjustable on any screen size. Its device-friendliness acted as a game changer, thus providing it with an edge over other available frameworks in the web market. Bootstrap's most stable version in the recent past has been Bootstrap 3. All the websites deserve to be decently exhibited on all major web browsers. In fact, Bootstrap 3 framework's familiarity also plays a major role. Since it is a well-known Responsive Web Design (RWD) framework, it becomes easy-going to even get newbies on the work. This can result in an enhanced speed of the entire project as well. It is for these reason that the researchers will use Bootstrap 3 in this study.

WAMP

Christensson (2013) stated that WAMP stands for "Windows, Apache, MySQL, and PHP." WAMP is a variation of LAMP for Windows systems and is often installed as a software bundle (Apache, MySQL, and PHP). It is often used for web development and internal testing, but may also be used to serve live websites. The most important part of the WAMP package is Apache (or "Apache HTTP Server") which is used to run the web server within Windows. By running a local Apache web server on a Windows machine, a web developer can test webpages in a web browser without publishing them live on the Internet. WAMP also includes MySQL and PHP, which are two of the most common technologies used for creating dynamic websites.

In addition, Ajay (2012) explained that to adopt WAMP, one needs to download 'WAMPServer' which is an open-source Windows web development environment. It comes with a service manager as a tray icon. This enables an easy management of the server and easy installation of multiple releases of Apache, MySQL and PHP as add-ons. With WAMPServer the installation process is automated and you can secure your setting files while making any changes over your web servers. You can experience a great flexibility with 'WAMPServers' as enabling and disabling services of WAMPServer is just a matter of clicks.

These are some advantages of using WAMP:

1. Powerful: By combining all three powerful components (Apache, MySQL, PHP) into one solution, WAMP is indeed one of the most powerful engines ever created.

2. Free for All: WAMP was created as an open source project. It has a GNU General Public License (GNU GPL). What this means is that it is free for personal and commercial use.

3. Multiple Add-ons are Available: Multiple add-ons are available for WAMP to extend its functionalities. Current available add-ons are available to add different releases for Apache, MySQL and PHP into WAMP.

4. Flexibility: WAMP provides an interface to select different releases of Apache, MySQL or PHP. This is especially essential when needed to replicate similar versions running on the production environment (Getting Started with WAMP, 2011).

The researchers will use WAMPServer version 3.1.3 for it is the latest version of WAMPServer. It consist of Apache 2.4.33, PHP 5.6.35/7.0.29/7.1.16/7.2.4, MySQL 5.7.21, and MariaDB 10.2.14 (www.wampserver.aviatechno.net, n.d.).

XAMPP

According to the website www.apachefriends.org, XAMPP is the most popular PHP development environment. XAMPP is a completely free, easy to install Apache distribution containing MariaDB, PHP, and Perl. The XAMPP open source package has been set up to be incredibly easy to install and to use. (What is XAMPP?, n.d.)

In addition, in his article "What is XAMPP", Aman Thakral (2011) stated that, the best feature of XAMPP is ease of installation. With XAMPP you don't need to install each of the individual components of a web server individually and hence the installation

is easier and quicker. No need to worry about the PHP configuration or MySQL setup etc.

Going further, Kasia Mikoluk (2013) said that XAMPP is also cross-platform, which means it works equally well on Linux, Mac and Windows. Since most actual web server deployments use the same components as XAMPP, it makes transitioning from a local test server to a live server extremely easy as well.

LAMP

According to Christensson (2013), LAMP stands for "Linux, Apache, MySQL, and PHP." Together, these software technologies can be used to create a fully-functional web server. Linux is the most popular operating system used in web servers, primarily because many free Linux distributions are available. This means Linux-based servers are typically cheaper to set up and maintain than Windows servers. Since Linux is open source, it also works with many other popular open source web hosting software components.

As stated by the article "The Best LAMP Hosting: Who's The Best For Your Site?" of Ji Guo (2018), LAMP is generally used to run dynamic websites and servers. It is commonly called as LAMP stack simply because of the components that are stacked upon each other. LAMP stack is very useful for web development as it provides a solid and reliable foundation for web hosting. LAMP can also be called as generic software stack considering that all its components are open-source and can be replaced with alternative applications.

In the article "The Advantages of LAMP as a Web Development Platform" of Koenig Solutions (2015), it is stated that one of the most favored for web development is LAMP as it provides many advantages over other platforms like Ruby on Rails, ASP.Net and J2EE. In terms of using LAMP web application, it is said to be very simple since it uses PHP as the standard apache module and uploads the PHP files with a MySQL database to an apache server. LAMP provides an enough alternative to commercial packages and works as a group of software programs that provide the necessary platform to develop and implement web based applications and servers. It gives the most effective and popular ways of developing enterprise level web applications because of its flexibility, customization and cost effectiveness.

Database Management System

Mike Chapple (2018) stated in his article "What is Database Management System (DBMS)?" that a database management system (DBMS) is the software that allows a computer to store, retrieve, add, delete, and modify data. A DBMS manages all primary aspects of a database, including managing data manipulation, such as user authentication, as well as inserting or extracting data. A DBMS defines what's called the data schema, or the structure in which the data is stored.

As stated in the article "Database Management System (DBMS)", Craig S. Mullins and Simon Christiansen (2015) said that the DBMS manages three important things: the data, the database engine that allows data to be accessed, locked and modified -- and the database schema, which defines the database's logical structure. These three foundational

elements help provide concurrency, security, data integrity and uniform administration procedures.

In addition, Mike Chapple (2016) stated that today, multiple commercial and open source DBMSs are available — in fact, choosing which database you need is a complex task. The high end relational DBMS market is dominated by Oracle, Microsoft SQL Server and IBM DB2, all credible choices for complex and large data systems. For small organizations or home use, popular DBMSs are Microsoft Access and FileMaker Pro.

Relational Database Management System

According to Ian (2016), RDBMS stands for Relational Database Management System. An RDBMS is a particular type of DBMS that uses a relational model for its databases. An RDBMS therefore enables you to create relational databases. Relational database management systems have become the most popular type of database system. Most major database management systems are relational. Popular examples include Microsoft Access, SQL Server, Oracle Database, MySQL, FileMaker, PostgreSQL, and more. A relational database is a database that allows related data to be stored across multiple tables, and linked by establishing a relationship between the tables. This provides an efficient way to store data, as you can enter data once, then reference it from elsewhere in the database.

In addition, Christensson (2017) said that while a relational database describes the type of database an RDMBS manages, the RDBMS refers to the database program itself. It is the software that executes queries on the data, including adding, updating, and searching for values. An RDBMS may also provide a visual representation of the data.

For example, it may display data in a tables like a spreadsheet, allowing you to view and even edit individual values in the table. Some RDMBS programs allow you to create forms that can streamline entering, editing, and deleting data.

Relational database management systems (RDBMS) rely on an optimizer (or relational optimizer) that transforms SQL statements into executable code. Before any SQL statement can be run by the RDBMS, the optimizer must first analyze the SQL and determine the most efficient access paths available for satisfying the statement. It accomplishes this by parsing the SQL statement to determine which tables and columns must be accessed. The optimizer next examines statistics stored in the system catalog to determine the best method of accomplishing the tasks necessary to satisfy the SQL request (Craig S. Mullins, 2018).

MySQL

According to an article "What is MySQL" (n.d.), MySQL is a freely available open source Relational Database Management System (RDBMS) that uses Structured Query Language (SQL). SQL is the most popular language for adding, accessing and managing content in a database. It is most noted for its quick processing, proven reliability, ease and flexibility of use.

Furthermore, P. Eng and Rob McCormack (2013) stated that MySQL runs on virtually all platforms, including Linux, UNIX, and Windows. Although it can be used in a wide range of applications, MySQL is most often associated with web-based applications and online publishing and is an important component of an open source enterprise stack called LAMP. LAMP is a Web development platform that uses Linux as the operating

system, Apache as the Web server, MySQL as the relational database management

system, and PHP as the object-oriented scripting language (Sometimes Perl or Python is

used instead of PHP.)

In the article "MS SQL vs. MySQL: Which Relational Database is Right for You?",

Jennifer Marsh (2017) explained that the database used usually depends on the hosting

environment choosen. Linux hosting providers usually offer MySQL. Since MySQL is

open-source and free, one can have as many databases as needed. One can have 10 of

them to support 10 different projects if need be. Because SQL Server costs money for

licenses, Windows hosts will give one MSSQL database and additional ones must be paid

for. Overall, this makes SQL Server more costly than MySQL. However, SQL Server

works natively with .NET applications, so it's the choice for software that runs on a

Windows server or desktop. The development tools are free, but the production

environment is not free. The best way to determine the right platform is to first post your

project in the marketplace and discuss your requirements with a few developers. You will

get different opinions and preferences based on the developer's area of expertise, but

most Windows developers work with MSSQL and Linux developers work with MySQL.

You should decide which environment you want to target, and then you can get a clearer

idea of which platform is right for you.

Conceptual Schema

According to the article of Mylopoulos and Borgida (2016), the conceptual schema is

the process of generating a description of the contents of a database in high level terms

that are natural and primary for users of the database. For the applications that will use

the database, the process takes as an input information requirements and create a schema

that shows in a conceptual modeling notation like an UML class diagrams Extended

Entity-Relationship (EER) Data Model. Addition in creating a conceptual schema

includes two challenges such as change informal requirements into a cognitive model

which describe completely and precisely the contents of the database-to-be and then

utilize the constructs of a data modeling language appropriately to result from the

cognitive model into a conceptual schema which it shows as precise as possible.

T.S. Adams (2018) added that conceptual schema is a design model used to create or

visually represent the structure of information inside the database or other computer

system entity. It works to define the specific entities in the system, together with their

attributes and even the relationships between varied entities. A conceptual schema aim to

provide a higher level order to a computing system. For a broad scale, computer systems

are tangled which needs macro-management type ordering to keep them working

efficiently and properly.

According to the website www.techopedia.com, a conceptual data model provides in-

depth coverage of business concepts and is mostly developed for a business audience. It

is never a solution model and is technology and application neutral in nature. In other

words, from a data perspective, the conceptual data model is a business model. Business

makes use of the conceptual data model for confirmation and corrections. As they are

higher-level models, attributes are usually not added to conceptual data models. They

help in establishing relationships between entities, though may not provide the null

ability and cardinality properties. Conceptual data models are often designed to be

independent of any data storage technologies or database management systems (DBMS).

Often conceptual data models are created as part of the initial requirement-gathering efforts, as these models help in exploring high-level concepts as well static business structures. Conventional teams make use of conceptual data models as precursors or as alternatives to logical data models (LDMs) (Conceptual Data Model, n.d.).

Entity Relationship Diagram

According to the website www.smartdraw.com, an entity relationship diagram (ERD) shows the relationships of entity sets stored in a database. An entity in this context is a component of data. In other words, ER diagrams illustrate the logical structure of databases (Entity Relationship Diagram, n.d.).

In addition, Laura Aberle (2014) explained that while it is useful for organizing data that can be represented by a relational structure, an entity-relationship diagram can't sufficiently represent semi-structured or unstructured data, and an ERD is unlikely to be helpful on its own in integrating data into a pre-existing information system.

Going further, in his article "Entity-Relationship Diagram", Mike Chapple (2017) ER said that diagrams often use symbols to represent three types of information: entities (or concepts), relationships and attributes. In industry standard ER diagrams, boxes are used to represent entities. Diamonds are used to represent relationships, and ovals are used to represent attributes.

Database

As stated in the article "What is Database?", Mike Chapple (2018) explained that

databases offer an organized mechanism for storing, managing and retrieving

information. They do so through the use of tables. If you're familiar with spreadsheets

like Microsoft Excel, you're probably already accustomed to storing data in tabular form.

It's not much of a stretch to make the leap from spreadsheets to databases.

Furthermore, Allan Leake and Adam Hughes (2017) explained that the data is

organized into rows, columns and tables, and it is indexed to make it easier to find

relevant information. Data gets updated, expanded and deleted as new information is

added. Databases process workloads to create and update themselves, querying the data

they contain and running applications against it.

In addition, Vangie Beal (n.d.) stated in her article "Database" that

to access information from a database, you need a *database management system (DBMS)*.

This is a collection of programs that enables you to enter, organize, and select data in a

database. Increasingly, the term *database* is used as shorthand for *database management*

system. There are many different types of DBMSs, ranging from

small systems that run on personal computers to huge systems that run on mainframes.

According to the website www.differencebetween.info, the different types of database

are Document Oriented Database, Embedded Database, Graph Database, Hypertext

Database, Operational Database, Distributed Database and Flat-File Database. In

Documented Oriented database, the data is stored in form of text records. This type of

database is free from any type of strict schema, suitable for storing dynamic data and

useful for an application which is document-based. Another type is Embedded database

that runs within the application, this database is embedded as in line code or linked library which saved time wasted on issues related to installations or maintenance. Next is Graph database which is based on the relationship of resources with each other but the resources have no importance to other, this helps in storing data for dynamic schema. Moreover, the database invented by Ted Nelson is called Hypertext-database which is used for organizing a large sum of dissimilar information where the object is linked with the other object in a hypertext type of database. Another type is Operational database that contains data related to operations going in an organization or enterprise, this type of database is updated regularly which focus on recording the current data. Aside from that is Distributed database which is a set of databases which are located on different computers but all these databases work as one database logically and with this, the data can be accessed and modified simultaneously with the help of network. Lastly, the Flat-file database holds records with no structured relationship and is useful for storing small amount of records, one example of this is a spreadsheet application like Excel (Different Types of Database, n.d.).

Operational Database

According to T.Jalaja & M.Shailaja (2015), an operational database is defined to hold data about the things that go on inside an organization or enterprise. For example, an operational database may contain fact and data describing transaction, data on customer complaints, employee information, taking order and records of order, track of payments and inventory, information and amounts from credit cards, etc. Also, it contains enterprise data which are up to date and modifiable in such a way that it includes

insertions, updates, and deletions. The name itself indicates that this type of database is currently and progressive in terms of getting the real-time data and supplying data for real time computations and other analyzing processes.

In the article "9 Examples of an Operational Database" by John Spacey (2017), an operational database is explained as database instance that creates or updates large amounts of real-time data. It can be based on any number of database technologies that support the availability levels, speed, concurrency, data integrity and recoverability required. An illustrative example of this is the record transactions in a bank such as transfers, interest payments and withdrawals using operational database with the data can get from this transaction, it can perform functions to update accounts. Another example is in the media where blogging services writes millions of blog posts and comments that is recorded in the database each day. Also, an example is an e-commerce company that records user clicks in their website. This information then is used to generate product recommendations and marketing offers by the operational database in real time.

As stated in the article "A look at the leading operational database management systems" by Craig S. Mullins (2017), operational database management systems are used to support the data persistence layer for modern applications that run transactions and other types of interactions to support enterprise-level business requirements. For the past years, the market has been dominated with the three most popular relational database management system (RDBMS) company, the Oracle, IBM and Microsoft but market dynamics have caused a major change, allowing for greater competition. Since then many competing operational DBMS products have arisen. Now, the latest leading operational

database management systems in the market that help enterprises get started are the following:

- Aerospike

- Amazon DynamoDB

- Apache Cassandra/DataStax

- EnterpriseDB/PostgreSQL

- IBM DB2

- MarkLogic Server

- Microsoft SQL Server

- MongoDB

- MySQL

- Neo4j

- Oracle Database 12c

- Redis

- Riak

- SAP HANA

Smartphones

According to Margaret Rouse and Alyssa Provazza (2018), a smartphone is a cellular telephone with an integrated computer and other features not originally associated with telephones, such as an operating system, web browsing and the ability to run software applications.

In addition, Steven Tweedie (2015) explained that people didn't start using the term "smartphone" until 1995, but the first true smartphone actually made its debut three years earlier in 1992. It was called the Simon Personal Communicator, and it was created by IBM more than 15 years before Apple released the iPhone. IBM's Simon was the first phone to meld together the functions of a cell phone and a PDA, and it launched with the price tag of $899 with a service contract ($1,435 in today's dollars), according to Byte Magazine.

In the article "Why are smartphones so important in daily life?", Jesensky John (n.d.) said that one of the reasons smartphones are so important is because of the connectivity they provide. Through a smartphone, you can access Facebook and other social networking sites easily as well as advanced connection services like Viber and Skype which act as an international call services that can save money on your phone call allowance. This requires Internet connection to work and can use WiFi to ensure it does not consume your data plan. Moreover, the efficiency of using a smartphone is it almost like a miniature of computer, you can do your task faster where it allows you to connect and collaborate with colleagues. By using the applications such as One Drive and Google Docs you can create and share information with others. In terms of functionality, you can store data such as files, information and details on your phone. You can also do online transaction in banks, searching for nearest store or find out the best places. Aside from that you can use security measure to protect your phone. Furthermore, smartphones can give you entertainment because you can now watch and listen to movies, TV and music with ease, you just have to download it. Other than that, there are number of games you

can play through app store and can get the most out of it. Smartphone has no limitation in

what you can do with it and you can use it with almost everything these days.

Android

Liane Cassavoy (2018) defined Android as a mobile operating system maintained

by Google, and is everyone else's answer to the popular iOS phones from Apple. It is

used on a range of smartphones and tablets including those manufactured by Google,

Samsung, LG, Sony, HPC, Huawei, Xiaomi, Acer and Motorola. All major cellular

carriers offer phones and tablets running Android.

Furthermore, Marziah Karch (2018) stated that android is a widely-adopted open-

source project. Google actively develops the Android platform but gives a portion of it

for free to hardware manufacturers and phone carriers who want to use Android on their

devices. Google only charges manufacturers if they also install the Google apps portion

of the OS. Many (but not all) major devices that use Android also opt for the Google apps

portion of the service. One notable exception is Amazon. Although Kindle Fire

tablets use Android, they do not use the Google portions, and Amazon maintains a

separate Android app store.

JR Raphael (2018) cited the different Android version highlights from the platform's

birth to present. Android versions 1.0 to 1.1: The early days, Android version 1.5:

Cupcake, Android version 1.6: Donut, Android versions 2.0 to 2.1: Éclair, Android

version 2.2: Froyo, Android version 2.3: Gingerbread, Android 3.0 to 3.2: Honeycomb,

Android version 4.0: Ice Cream Sandwich, Android versions 4.1 to 4.3: Jelly Bean,

Android version 4.4: KitKat, Android versions 5.0 and 5.1: Lollipop, Android version

6.0: Marshmallow, Android versions 7.0 and 7.1: Nougat, Android version 8.0 and 8.1: Oreo and Android version 9.0: Pie are the different versions of Android.

Browsers

As stated by Beal (n.d.), browser is short for *Web browser.* It is a software application used to locate, retrieve and display content on the World Wide Web, including Web pages, images, video and other files. As a client/server model, the browser is the client run on a computer that contacts the Web server and requests information. The Web server sends the information back to the browser which displays the results on the computer or other Internet-enabled device that supports a browser.

According to Christensson (2014) the primary function of a web browser is to render HTML, the code used to design or "mark up" webpages. Each time a browser loads a web page, it processes the HTML, which may include text, links, and references to images and other items, such as cascading style sheets and JavaScript functions. The browser processes these items, then renders them in the browser window.

In addition, Sandra Grauschopf (2017) stated that most browsers are available for free download. The six most popular Internet browsers today include:

- Mozilla Firefox
- Google Chrome
- Microsoft Edge (formerly Internet Explorer)
- Apple Safari
- Opera
- AOL Explorer

According to the website gs.statcounter.com, the top 6 web browser in Asia on July 2018 include:

- Chrome

- Firefox

- IE

- Safari

- UC Browser

- Edge

Google Chrome

According to the article of Michael Muchmore (2016), Chrome web browsers began to dominate the software category we use for consuming web content, just as Google also leads in searching like online video, maps, and more. Thanks to some great qualities, such as its simplicity, speed, security and top support for the new web code standard, it has reached this position among browsers. Chrome is easy to use, fast to test and still the most amenable browser. However, some browsers could entangle and even surpassit in speed and simplicity.

Ian Paul (2018), states in his article that Google Chrome is the current people's champion, it tops in the metric charts by a huge margin. Thanks again to its massive extensions library, and the fact that it is not focus on browser's trimmings, but gets your way to web content resulting to build a dedicated fan base of Google's browser. Though at first, chrome is not quite simplistic, but it's still very easy to use. There isn't much to it except for its huge URL bar and space for extensions, tabs, a bookmarking icon and

that's it. Still, Google finds a way to keep all kinds of features within the browser.

Although, people fuss about Chrome for this browser eats up available memory, and

showed that it was definitely a memory beast, a few years later it succeed well in our

tests.

According to Heba Soffar (2015), Google Chrome has a very basic, simple design ,

making it easy to use. It has start-up page that lists the most frequent pages you have

visited and allows you to click and access them with ease. It is fast, has voice search, is

the leading support for HTML 5, has good security, syncing, built-in Flash

player and PDF reader. Other browsers also feature plug-ins but none have quite as many

amazing extensions as Google Chrome. If the site crashes on one of your tabs, other

open tabs will not be affected. You may browse the internet without being logged using

Chrome's new private feature. Unlike Firefox and Safari, you can alter the color and

theme of the browser. Google Chrome also gives you the option of starting up in

any tab configuration you want, whether a custom setup or the set of tabs you had open in

your previous session. Other browsers require third-party adds-on to provide this

capability. The Chrome Store is loaded with Adds-On that let you do everything from

increasing communication abilities between your browser and your phone, to translate the

information and store it offline. Google Chrome is the safest browser out there. It had

never been hacked. It can be modified and personalized just the way you want it.

ISO 25010

In the website www.iso.org, it was stated that ISO/IEC 25010:2011 defines:

1. A quality in use model composed of five characteristics (some of which are further subdivided into subcharacteristics) that relate to the outcome of interaction when a product is used in a particular context of use. This system model is applicable to the complete human-computer system, including both computer systems in use and software products in use.

2. A product quality model composed of eight characteristics (which are further subdivided into subcharacteristics) that relate to static properties of software and dynamic properties of the computer system. The model is applicable to both computer systems and software products.

The characteristics defined by both models are relevant to all software products and computer systems. The characteristics and subcharacteristics provide consistent terminology for specifying, measuring and evaluating system and software product quality. They also provide a set of quality characteristics against which stated quality requirements can be compared for completeness. (ISO/IEC 25010, 2011)

According to an article "ISO/IEC 25010" (n.d.), the product quality model defined in ISO/IEC 25010 comprises the eight quality characteristics such as:

Functional suitability - This characteristic represents the degree to which a product or system provides functions that meet stated and implied needs when used under specified conditions. This characteristic is composed of the following subcharacteristics:

- **Functional completeness**
- **Functional correctness**
- **Functional appropriateness**

Performance efficiency - This characteristic represents the performance relative to the amount of resources used under stated conditions. This characteristic is composed of the following subcharacteristics:

- **Time behaviour**
- **Resource utilization**
- **Capacity**

Compatibility - Degree to which a product, system or component can exchange information with other products, systems or components, and/or perform its required functions, while sharing the same hardware or software environment. This characteristic is composed of the following subcharacteristics:

- **Co-existence**
- **Interoperability**

Usability - Degree to which a product or system can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use. This characteristic is composed of the following subcharacteristics:

- **Appropriateness recognizability**
- **Learnability**
- **Operability**
- **User error protection**
- **User interface aesthetics**
- **Accessibility**

Reliability - Degree to which a system, product or component performs specified functions under specified conditions for a specified period of time. This characteristic is composed of the following subcharacteristics:

- **Maturity**

- **Availability**

- **Fault tolerance**

- **Recoverability**

Security - Degree to which a product or system protects information and data so that persons or other products or systems have the degree of data access appropriate to their types and levels of authorization. This characteristic is composed of the following subcharacteristics:

- **Confidentiality**

- **Integrity**

- **Non-repudiation**

- **Accountability**

- **Authenticity**

Maintainability - This characteristic represents the degree of effectiveness and efficiency with which a product or system can be modified to improve it, correct it or adapt it to changes in environment, and in requirements. This characteristic is composed of the following subcharacteristics:

- **Modularity**

- **Reusability**

- **Analyzability**

- **Modifiability**

- **Testability**

Portability - Degree of effectiveness and efficiency with which a system, product or component can be transferred from one hardware, software or other operational or usage environment to another. This characteristic is composed of the following subcharacteristics:

- **Adaptability**

- **Installability**

- **Replaceability**

In addition, Reitsma (2011) stated that besides the software product quality model, the 25010 standard also describes another model, the model of software quality in use:

Effectiveness - The accuracy and completeness with which users achieve specified goals.

Efficiency - The resources expended in relation to the accuracy and completeness with which users achieve goals.

Satisfaction - The degree to which users are satisfied with the experience of using a product in a specified context of use.

- Likability

- Pleasure

- Comfort

- Trust

Safety - The degree to which a product or system does not, under specified conditions, lead to a state in which human life, health, property, or the environment is endangered.

- Economic damage risk

- Health and safety risk

- Environmental harm risk

Usability - The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.

- Learnability

- Flexibility

- Accessibility

- Context conformity

Related Studies

Queuing Management Using Android Application

Leena Bashier Eltayeb Bashier and Dr.Mohamed Abaker Hussein (2016) formulated this study in order to give a response to the problem in Sudan Banks. According to them, queuing in Sudan banks is an approach that entails lining up of customers in bank hall in order to be served by bank personnel at each terminal (server). Customer have to stay inside bank hall until there turn come without knowing time needed to be spent some Customers even leave bank hall before being served .This and other obstructions result to much delay in customers waiting time. This study aims to minimize waiting time in queue by proper queue management and thereby maximizing throughput. The android application that the researchers will implement includes allowing customers to join a

virtual queue via mobile phone allowing them to check their turn without the need to be present at the bank hall, also providing an estimated time that gives the customer's proper idea when their turn will start.

Exploring Wireless Communication Alternatives with Android through the Implementation of a Ticket Queuing System

In the study of Francisco Narváez (2014), he introduced an Android-based ticket queuing system entitled, "Exploring Wireless Communication Alternatives with Android through the Implementation of a Ticket Queuing System". The general objective of this study is to explore different communication mechanisms supported by Android, through the implementation of a ticket queuing system. The queuing system that the researchers will implement consists of a server application acting as queue manager, and a client application capable of requesting tickets. Clients remain informed about the ticket waiting time and get alerts when they need to head to the server's physical location. In this study, a queuing mechanism has been developed, capable of running on top of different wireless communication mechanisms. It successfully implements communication through the Android's Network Service Discovery mechanism, in combination with TCP and UDP communication. This system can incorporate Wi-Fi Direct or any other communication protocols in the future.

Queue Management Optimization with Short Message System (SMS) Notification

This study is formulated by R Kanesaraj Ramasamy and Fang-Fang Chua (2012). According to the researchers, every customer has to wait for long hours to accomplish his or her transactions in banks. Banking customers face this problem every day in their daily

life. The researchers formulated this study to give solution to the said issue. This system will eventually speed up customer throughput and increase sales and profitability while improving productivity and operational efficiencies. Moreover, it minimizes prolonged customer waiting and reduces frustrations. The main objective of this study is to achieve a better quality service to customers. The researchers stated that, in its most basic form, a queue management system will issue a queue ticket to a customer and later announce the ticket number when service is available, eliminating the need to stand in line while waiting. There were a couple of interviews and questionnaires conducted to bank customers to find out their satisfaction level about the current system and acceptance of the proposed system. In this way, the queue management system helps to provide comfort as well as fairness to customers, by allowing them to maintain their position in the queue while they are seated comfortably or engaged in constructive activity. In other words, the customers still have to wait for long hours for their turn. To overcome these problems, a new way of queue management system has been introduced that is the proposed Queue Management System with SMS notification. This system is designed with a small interface, easily accessible with smart phones for a queue management with SMS notifications especially mobile users.

Hospital Service Queue Management System with Wireless Approach

Hospital Service Queue Management System with Wireless Approach is proposed by Manoon Ngorsed and Poonphon Suesaowaluk (2016). This study presents a proposed alternative system for queuing management that could reduce inconvenience to the public. The researchers' motivation in formulating this study is depicted from an

observation on the people queuing for services in the hospitals and the government offices without committing to the estimated time for their demand. Waiting for the service is counterproductive which consumes an unacceptable amount of productive time for the patients. The researchers developed the system to manage the queue without physically lining up and allow people to monitor their queue status by their wireless handheld devices. The main objective of this study is to be a tool that manages the hospital queue online where customers, patients and stakeholder can access theirs queues remotely over the Internet through a web application. The results benefit to both stakeholder to manage their time for other desire activities and hospitals in utilizing its spacious area for other business purposes.

Android – Based Queue Reservation System

Roann Bonzo, Loren De Leon and Jim Holgado (2018) formulated a study called "Android – Based Queue Reservation System" in order to reduce the waiting time of the customers in a long queue and to do things while they are on queue. The researchers used Android Studio, WAMP Server and Adobe Photoshop to develop the system. The objectives of this study are to allow the admin to add, update and delete counter, to allow the user/counter to manage their account and process the numbers, and to allow the client to choose on their transaction, view the real-time process and notify them when it is their turn. The study was evaluated by 30 respondents composed of 20 CS/IT students and 10 randomly selected people which obtained an overall rating of 56% of "Very Acceptable" based on the criteria: Functionality and Reliability. This study formulated by the researchers can be useful especially when there is a long queue.

Development of Payment Queuing System with Android Application

Leander A. Abergas Renica, Kim S. Balboa, and Nelson G. Gabrinao (2014) formulated this study in order to lessen the waiting line when enrolling in DLSU-D. According to the researchers, transactions involving basic utilities have long been universally accepted to constitute long waiting-lines. This could be observed in health services, government offices and school enrollment procedures. However, more often than not, taking DLSU-D enrollment seasons to be observed and serve as an example, the mixing of minor and major transactions not only lengthen the waiting-lines longer than is necessary, but also inconvenience students only requiring simple and non-time-consuming transactions as well as leaving them stranded. The researchers decided on pursuing "Development of Payment. Queuing System with Android Application" to help solve and alleviate these issues through transaction categorization and separation, and service time estimation functionalities. The system had 4 different types of application developed, namely: a server program; client terminal application; cashier program; and an android application. The system as a working whole was composed of a client program that accepts user input regarding transaction information, a MySQL server serves as a backend database, and a P.O.S. (point of sale) program allows the user to view and process transactions in queue. In addition, a separate notification program outputs to monitor the current transactions being serviced and its corresponding P.O.S. terminal.It also displays the current queue length of both minor and major transactions as well. The interfacing of all involved components is managed by a wireless router hosting a local area network. All components are connected through cat5 cables with the exception of the android client program which interacts wirelessly.

Automatic Queuing Model for Banking Applications

In the study of Dr. Ahmed S. A. AL-Jumaily, and Dr. Huda K. T. AL-Jobori (2011), they introduced a queuing model entitled, "Automatic Queuing Model for Banking Applications." As defined in this study, queuing is the process of moving customers in a specific sequence to a specific service according to the customer need. The term scheduling stands for the process of computing a schedule. This may be done by a queuing based scheduler. This paper focuses on the banks' lines system, the different queuing algorithms that are used in banks to serve the customers, and the average waiting time. The aim of this paper is to build automatic queuing system for organizing the banks queuing system that can analyze the queue status and take decision which customer to serve. The new queuing architecture model can switch between different scheduling algorithms according to the testing results and the factor of the average waiting time. The main innovation of this work concerns the modeling of the average waiting time is taken into processing, in addition with the process of switching to the scheduling algorithm that gives the best average waiting time.

An IoT Smart Queue Management System with Real-Time Queue Tracking

This study is formulated by Mohammed Ghazal, Rania Hamouda and Samr Ali (2015). This paper proposes a smart queue management system for delivering real-time service request updates to clients' smartphones in the form of audio and visual feedback. The proposed system aims at reducing the dissatisfaction with services with medium to long waiting times. To this end, the system allows carriers of digital tickets to leave the waiting areas and return in time for their turn to receive service. The proposed system

also improves the waiting experience of clients choosing to stay in the waiting area by connecting them to the audio signal of the often muted television sets running entertainment programs, advertisement of services, or news. The system is a web of things including connected units for registering and verifying tickets, units for capturing and streaming audio and queue management, and participating client units in the form of smartphone applications. The researchers implemented the proposed system and verified its functionality and report on their findings and areas of improvements.

High Availability Queuing System

"High Availability Queuing System" is a study of Firas Arabo (2010). According to him, queuing systems have been gaining a rapid popularity in the software industry. Web applications and web services use queuing systems to hold messages produced by a producer component of a system. These messages later will be either picked up by a consumer component or pushed by the queuing system to registered consumers. The industry offers quite a few queuing systems, some of which are open source. High availability of a queuing system is the main concern for users when using such systems. Queues and messages managed by the system must be available at all times which are hard to achieve in case of a system crash. Amazon offers a highly available queuing system called SQS. SQS assures high availability of queues and messages at all times. Amazon achieves the state of high availability by distributing the messages into multiple servers. Not all servers have the same messages. Crashing of one or more queue servers does not impact the availability of queues and messages. SQS samples a subset of servers based on random weighed distribution algorithm when retrieving a message. SQS has

some limitations resulting from inconsistency of servers. For example, a message might be returned more than once, messages are not retrieved in the order they were received and if a queue has few messages, 1000 or less, a retrieved message request might return no message and users must make consecutive retrieve requests. In this thesis project, a queuing system named "VSQS" is introduced for academic research only and it is not available for commercial use. This system is derived from Amazon SQS and uses the same mechanism of distributing a message into multiple servers to achieve high availability. However, VSQS takes a different approach in creating the subset; in that, a subset is preselected for each queue created and all messages of that queue go to the same subset. The advantage of pre-selecting a subset is to have better control over the subset and reduce the period of inconsistency between servers. This helps to overcome the limitations that appear when using SQS; the most important one is that the message will not be retrieved more than once. On the other hand, the disadvantage is that the chances of unavailability are increased when one or more servers of the pre-selected subset go down. This thesis studies the effects of pre-selecting a subset.

Applying Queuing Theory to the Study of Emergency Department Operations

As cited in the research study, "Applying Queuing Theory to the Study of Emergency Department Operations" by Xia Hu et al (2017), the important tools for the design and management of emergency departments are the queuing models. They decided to assess the strengths and limitations of the application through the contribution of queuing theory in modelling emergency departments. They include comparison and review applications, discuss data and applied associate with each method. In reviewing, they found relevant

articles that queuing models tend to oversimplify operations and under-estimate congestion levels especially for smaller systems, and obtain realistic results than comparable models. The combination of queuing and simulation is shown to be a powerful approach.

A Study of Queues and Customer Service in Retail Bank Agencies

This study is formulated by Claude Machline, Ph.D. and Fernando Mindlin Serson Ph.D (n.d.). This paper focuses on queues' lengths and customer service offered by retail banks agencies in São Paulo, the largest Brazilian and South America city. Through almost 800 instantaneous observations during one year of queues and ATM-automatic teller machines, the service level was appraised and found to be fair. The objectives of this study are to describe and comment the occurrence of customer queues in bank agencies (branches) of São Paulo, the Brazilian megalopolis. The paper also aims to debate the influence of queues upon the customer service quality. The study focuses queue at the traditional cashier front end and at the ATM – Automated Teller Machines – section. According to the researchers the results of this study conclude that there are indeed long lines in the traditional bank teller service. In some agencies, the average queue length was more than 10 people; the average waiting time is more than 20 minutes; the maximum waiting time as high as 40 minutes. The best performance was reached by the foreign bank 6. Queues are very rare in the ATM section. The average number of people in ATM queues is close to zero in most agencies and does not exceed 2. The percentage of machines 6 down never exceeds 20%. The ATM performance can be considered acceptable, though it could be improved.

Conceptual Model of the Study

On the basis of the foregoing concepts, theories, and findings of related literature,

studies presented, and insights taken from them, the conceptual model was developed as
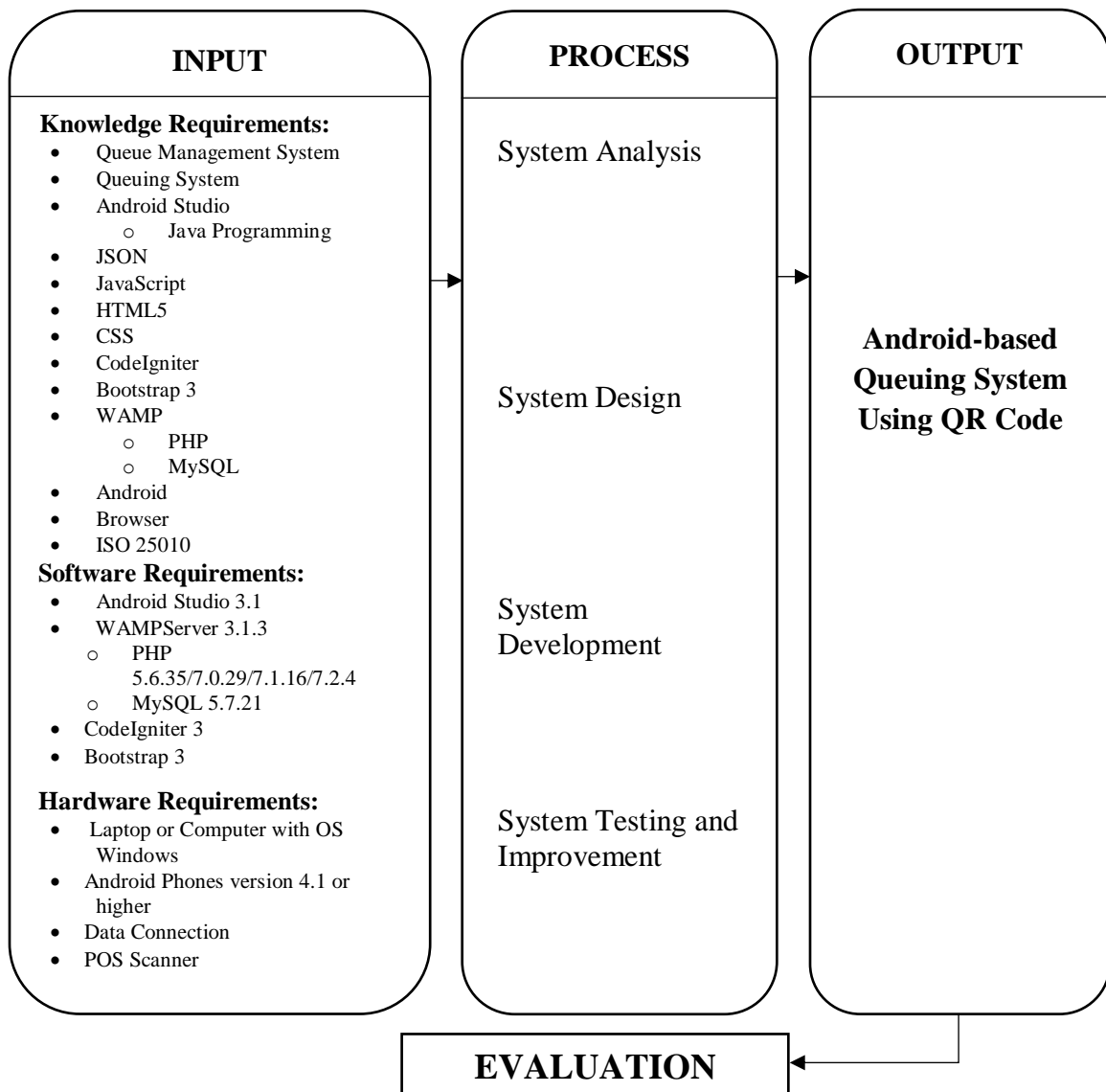
shown in Figure 1.

INPUT	PROCESS	OUTPUT

Knowledge Requirements:
• Queue Management System
• Queuing System
• Android Studio
   o Java Programming
• JSON
• JavaScript
• HTML5
• CSS
• CodeIgniter
• Bootstrap 3
• WAMP
   o PHP
   o MySQL
• Android
• Browser
• ISO 25010
Software Requirements:
• Android Studio 3.1
• WAMPServer 3.1.3
   o PHP 5.6.35/7.0.29/7.1.16/7.2.4
   o MySQL 5.7.21
• CodeIgniter 3
• Bootstrap 3
Hardware Requirements:
• Laptop or Computer with OS Windows
• Android Phones version 4.1 or higher
• Data Connection
• POS Scanner
	System Analysis
	
	System Design
	
	System Development
	
	System Testing and Improvement
		Android-based Queuing System Using QR Code

EVALUATION

Figure 1. The Conceptual Model of the Study

The input enumerates the knowledge, software, and hardware requirements. The knowledge requirement will help in the development of the system. It includes the information about queue management system, queuing system, IDE such as Android Studio, data format such as JSON, programming languages such as Java, client-side scripting languages such as JavaScript, HTML5 and CSS, server-side scripting languages such as PHP and SQL, DBMS, RDBMS such as MySQL, ERD, Operational Database, frameworks such as CodeIgniter and Bootstrap 3, WAMP, smartphones such as android devices, browsers, and ISO 25010 as the evaluation system.

The software requirements will help in the system's design and application. The software that the developer will use are Android Studio 3.1, and WAMPServer 3.1.3 (MySQL 5.7.2.1 and PHP 5.6.35/7.0.29/7.1.16/7.2.4). CodeIgniter 3 and Bootstrap 3 will be used to design / program how the web pages behave on the occurrence of an event.

The hardware requirements include laptop or computer with OS windows, android phones version 4.1 or higher, data connection and a POS scanner.

The process stage specifies the analysis, design, development, and procedures in creating the software. It consists of the Project Analysis, Project Design, Project Development, and Operation and testing Procedures using some software and data such as actual and test data as well as the evaluation of the respondents on the system that will be developed.

The output is the application of the system and the system itself. The software composition will be included in the implementation such as special function used in the program.

Operational Definition of Terms

Queue refers to the line of people waiting inside an establishment to make a transaction. The order of the line is in chronological order.

Android-based is the type of queuing system that will be used in the research study.

Administrator or Admin refers to the module that manages the data that will be used in the system. This module is responsible for organizing and managing the accounts of the companies and the customers.

Counter or Window refers to a place in an establishment where transactions are conducted.

Customer refers to the module that will use the android application.

Real-time refers to the actual time during the processing of the queue.

Splash Screen refers to the page that appears when launching the android application.