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Development Of QR Code-Based Data Sharing Web Application Using System Development Life Cycle Method

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Abstract

The purpose of this thesis is to study the capabilities and limitations of QR codes as a data sharing media. For this study, author has developed a web application to provide QR code management for users. The web application is implemented in a website named Quick Save which provides data storage, sharing, and QR code generator service. With this website, author can analyze problems and methods of sharing encrypted data in a quick and effective way. The encrypted data is written into the QR code which serves as a link between users and the data or file stored in the web application storage. The method that is used in this thesis study is the System Development Life Cycle method. Based the on the result of the thesis study, author concludes that the implementation of data sharing web application can provide encrypted data sharing, file storing and downloading service for user by using a QR code scanner from their mobile device. The web application has also fulfilled author's need in researching the capabilities of QR code.

Keywords: web application, QR code, sharing.

1. Introduction

1.1. Background

Humans, as a social intelligent creatures, have the needs to hoard and share information. Along with the development of new technologies, the world is going digital. Because of this, many users use the advantage of these new technologies in order to store large volume of information. The information can be included in the form of text document, images, or videos. Therefore with various kind of information, the process of information sharing can also be done in various ways [1].

The technology that has been notably evolving in rapid speed and has become crucial in a part of our life is smartphones. Cell phones have evolved from being a simple calling device into a portable powerful device as a smartphone. Smartphones have become a minicomputer which are able to withstand storing an increasing amount of data [2]. Sharing files such as high-resolution image through mobile devices at the same time is becoming a popular application. Smartphones are always used to upload and download the shared files through WiFi, 3G, or LTE, but these ways will naturally incur high expense and security threat when large scale data needs to be shared. The things that must be focused when sharing files with many users are sharing efficiency and security [3]

The challenging problem in data sharing is figuring out the way to effectively share sensitive data through encryption. Encrypted data that has been downloaded from storage can be decrypted and sent to others again for sharing, but by doing so loses the value and meaning of data storage itself. In data sharing, users should be able to give the access rights of the data to others. That way users can access data directly from the server without the need to process them again [4].

One of the efficient and quick method of file sharing is the use of QR (Quick Response) codes as a medium between client and stored data. This sharing medium can be read, scanned, and parsed by utilizing the camera of a smartphone which will display a string of text or a link that can be redirected. QR codes can only be read by a machine therefore the contents inside the QR codes cannot be determined by human eyes. There are many ways that QR codes can be used such as business marketing, providing detailed information on a product, sharing website URL, contact informations, emailing service, and even provide Wi-Fi access [5].

Based on these statements, the author is eager to analyze and produce solutions for these problems. Thus, the author conducted a thesis study entitled "Development of QR Code-based Data Sharing

Web Application using System Development Life Cycle Method".

The research purposes to be achieved in this study are stated as follows:

1. Provide an overview about the practice of generating QR codes and its capabilities in terms of data sharing.
2. Apply and implement education that has been taught in the field of computer science.
3. Meet one of the requirements in achieving bachelor's degree in information system study program.
4. Further increase author's knowledge as an academic reference about data sharing functionality and security.

2. Literature Review

2.1. System Development Life Cycle Method

System development life cycle (SDLC) is a software development method which are implemented within given time and expectations given by the client. SDLC processes consists of various phases such as requirements gathering and analysis, system analysis, system design, coding, testing, implementation [6].

The SDLC method consists of several work model such as waterfall, V model, iterative, spiral, and agile model. Although these model have different approach to it, there are 5 phases of SDLC which are conducted in every model which are: [7]

1. Requirement analysis
   In this phase, software developer will discuss with the client the needs and expectation regarding the software development.
2. Design
   Developers together with technical architects proceed to design the software and system to fulfill each requirement.
3. Implementation
   In these phases, system scope is developed by coding as required by the client. In this phase team member proceed with their given role. Position such as database administrator will start making database's structure.
4. Testing
   Testing is conducted before the software is completed and delivered to client. Developers will review and make sure that the software works without any fault and fulfills client's expectation.
5. Deployment and Maintenance
   In this final phase, software can be deployed for client use and a dedicated maintenance team will be assigned to check for post-production errors.

System development life cycle method is helpful for user in getting high quality product in dedicated time and budget. Each model of SDLC has each of their own advantages. One of the applicable SDLC model such as waterfall model which is easy to understand and good for small project. Spiral model and iterative model which enables feedback and evaluation in each iteration is good for large and complicated projects. So that user can select the best suited model as per his requirement. [8]

Application of collaborative learning with SDLC model can be used for other courses of School of Information Technology and Innovation which helps solve problem of learner to develop IT group projects. The result of this study is that learners have an opportunity to help each other in giving advice and counsel each member of the team and help them to be responsible for themselves and the team member. [9]

2.2. Web Application

Web application is a website which functions dynamically and utilizes server-side programming which connects interface of the user from the front-end and the database from the back end. There are many uses of web applications in this modern age such as online booking and reservations, e-commerce, e-banking, social media sites, content management system, and many others. [10]

An online web application is more used than their off-line version. Web applications can provide multi-user interface, centralized and organized management, thin client integration, multilingual programming, distributed processing, and platform compatibility over the internet. Most developers are converting their applications to the web platform. Which is why the web can provide wide compatibility to all kinds of applications. All kinds of application ranging from small scaled application to large enterprise software are available as web applications. [10]

2.3. Web Service

Web services is defined as an XML based framework which works as a standard for communicating between discrete application system. Web service is used in exchanges of message or document in XML format over internet standard protocol such as Simple Object Access Protocol (SOAP), Web Service Description Language (WSDL), and Universal Description, Discovery, and Integration (UDDI), Web services has an important role in the e-commerce world because it provides the interaction between applications and their heterogenous services to

fulfill user needs. One of the examples is in improving the recommender system that are used in many big e-commerce sites to help customer find the products that they would like to purchase. [11]

One of the leading web service providers is Google. Big data in Google market and cloud services is where its web service gain advantages of other web service such as Amazon Web Services (AWS) and Azure. Some of the big data services offered by Google include Cloud Big Table, Cloud Datastore, a NoSQL database for nonrelational data, and Cloud Machine Learning. Google has an advantage in search availability though lags on the BI front. In many ways, the three cloud providers are in lockstep on big data services though there several differences in performance and ease-of-use that requires hand-on testing [12].

2.4. File Sharing

File sharing works as an instantiation of accessing the common in terms of time, disk, resource and file sharing. The act of file and data sharing is to means giving accessible to remote users without the need of making copies of them. Some example of file sharing platforms that are widely popular in the internet such as MEGA (the succesor of Megaupload). Users upload their files into a repository where other user will gain access. The files that are downloaded will not be taken away as the copies of the same file are made. [13]

Web storage can give access to some files through a website and therefore is shareable to other users for downloading. These uploaded files can be accessed from anywhere where if authentication is provided. Therefore, this method is useful for large number of distributed users. Some of the popular service via consumer products Dropbox and Google Drive. [2]

2.5. QR Code

QR code or short for Quick Response Code is a type of matrix or two-dimensional barcode which was invented by an automotive industry in Japan. These barcodes are used as labels that contains information related to the item it is attached to. QR code consists of several black modules and dots that are arranged in two-dimensional pattern inside a square grid with white background. The QR code can store four types of data which are numeric, alphanumeric, Japanese kanji, and byte/binary. The contents of a QR code can be read by using a scanning device or a camera. The scanned image is then formatted by an underlying error correction software algorithmically to the point that the image can be determined by human eyes. The data is extracted from the horizontal and vertical patterns and components of the image. [14]

QR Code provides several features that has made its usage more popular and efficient compared to traditional one-dimensional barcodes. The features of QR Code are as follows: [15]

1. High Capacity Encoding of Data
   QR Code has the capability in encoding large quantities of data. While conventional bar codes are limited to 20 digits, QR Code can provide up to a hundred times more information than bar codes.
2. Small Printout Size
   A QR code can encode 10 times from its two-dimensional structure which can cover up more data than a one-dimensional barcode with the same size. A micro QR code that are smaller in printing size compared to a barcode.
3. Dirt and Damage Resistant Durability
   QR code could perform error correction. Even though some area of QR codes is destroyed or damaged, the data contained in it can still be recovered depending on the damage severity and the level of error correction used in a QR Code.
4. Readable from Any Direction in 360 Degrees
   QR code can be scanned from any direction in 360 degrees by checking the position detection patterns located at three corners of the QR code.
5. Structured Appending Feature
   A QR code symbol can store up to 16 smaller pieces of symbol where each of the symbol contains different unique information.

QR code can be used in any place and time. The app scanner will direct to a destination depending on the creator's choice. The usage of QR code encourages the engagement to offline customer in an artistic manner. This kind of platform has been helpful for each customer and vendor as it saves advertising cost by sharing QR code that leads to their own website URL (Universal Resource Locator). Therefore, client will be able to scan the QR code to store data for future reference. [5]

The most frequent use case of using QR codes are shortened URLs. The majority of website link and URL scanned from a QR code are shortened from several URL shortening services which are bit.ly or goo.gl. Furthermore, some QR codes are easier to scan because it contains shortened URLs that will have less data density and structure complexity. QR codes can also be used in encoding private information into a QR code. Some example for QR code with private information are wifi setup codes, two-factor authentication for web login purposes,

device pairing, and e-tickets for boarding or events. [16]

2.6. Laravel

Laravel is a PHP framework that reuses and assembles multiple existing components to provide developer with a cohesive layer to build web application in a more structure and pragmatic way. Laravel framework uses the Model-View-Controller (MVC) paradigm or design pattern which manages the project resources such as databases, data processing modules, and template. Laravel provides multiple advantages and features compared to other frameworks. It has been designed to produce expressive and simple syntax which is more readable for someone new to a project. Laravel has a fluent query builder which issues database queries with a simpler PHP syntax where you simply chain methods instead of writing the whole SQL statement. Laravel is one of the few PHP frameworks that offer true code modularity. It provides this by combining multiple drivers and its bundle system which allows you to easily change and extend caching, storage upload and download, session, and database authentication functionality. [17]

Example of Laravel use case is the general recruitment tool by considering all the activities of recruitment process. The tool is very functional, automatic and reduces paperwork. The use of Laravel framework enhanced the development process and provides security from different external attacks. Other than that, the framework also helps for fast application development. [1]

2.7. Entity Relationship Diagram

Entity relationship diagram (ERD) is defined as a blueprint of data which helps understand the complexities of a function system. ER models display the interaction among system analysis, designers, programmers, and end users. The main component of ER model are entity, attribute, relations, and cardinality. A collection of entities with more than one property is called an entity set. Some examples for entity are “shop” and “employee”. Entity is represented using a rectangle box in the ER diagram. An attribute is a property or characteristic of an entity which is represented using ellipse in the ER diagram. Some examples of attributes are “name”, “age”, “address”. Relation between entities is represented using diamond shape in the ER diagram. For example one citizen can only own one citizenship ID which implies a one-to-one relation, an author can write multiple books which implies a one-to-many relation, a hotel room can be booked by multiple customer and reversely a customer can book multiple hotel room which implies a many-to-many relation. [18]

In Chan ER notation, the cardinality between two entities is represented using a single line or double line. [19]

2.8. Flowchart

Flowchart is a graphic representation that describes the logic sequence, work or manufacturing process, organization chart, or any work structure. Flowchart is used to provide common language or reference point regarding a project or process. Flowchart is a system or process visualizer which consists of five object such as process / operation, branching / flow control, file and information storage, input output, and data processing symbols. Flowchart is a tool developed in various field to show refined form of process. The diagram is made up of boxes, diamond, and other shapes which are connected by arrows to show the operation of an algorithm. [20]

2.9. Use Case Diagram

Use case diagram is a diagram visualization used in system analysis, identify, clarify, and organize system requirements. Use case diagram models real world object and system and describes the behavioral diagrams. This diagram is used to show how a system interacts with the external entities and how those entities behave internally. [21]

2.10. Sequence Diagram

Sequence diagram models the behavior of use cases by describing interaction between group of objects to complete certain task. This diagram demonstrate how object supports the behavior such as data and message exchange and represents sequence of events that occurred in order. [22]

2.11. Activity Diagram

Activity diagram depicts the flow behavior of a system that extracts the main process contained in flowchart. The activity diagram contains activity states made up of smaller actions represented in a workflow. Activities are to be reused in the application and are typically specific. Notations in activity diagram are inspired by flowchart. Activity diagram starts with initial node and end with final node. Detail code, pre-condition, and post-condition of an activity is included in the activity diagram. The nodes represents process or process control such as action, activity, decision, swim lane, fork, join, and object. [23]

3. Research Methods

3.1. Research Methods

The methodology that has been selected for this thesis study is System Development Life Cycle (SDLC) and applied research. In this research, the author will use the applied research method. Applied research is an investigation carried out in response to immediate, direct, and obvious needs [24]. A workflow is used as the research basis to prevent any deviation from the project initial objective. The author uses the waterfall method which is simple to understand and implemented. Each phase is completed before going to next phase and is dependent on the result of the previous frame.

The figure above shows the workflow used in solving the problem stated in this research. The research phases are as follows:

1. In the planning phase, scope of the project is defined in the initial part of planning. Some basic knowledge and related studies have been done in this stage.
2. Requirements are analyzed by evaluating similar applications that are available. Important factors such as application workflow, output quality, concept, logic, function, and many other factors are analyzed to obtain basic requirements for the application that is going to be developed.
3. Application requirement is designed based on the architectural, front-end interface, database, and back-end program design. User interface design is aimed to provide simple and user friendliness display to present information to users.
4. Once all designs have been determined, application is developed in the implementation phase with the assigned equipment.
5. Repeated testing is conducted to ensure application is developed as planned without any fault and failure. This phase is repeated based on the feedback until the system is completed.
6. Once application is completed, application is deployed for client use. The completed web application is deployed in a domain named quicksave.inteljoy.com.
7. If any issue is encountered in the production, developer is informed of the bug or issue. The aim of maintenance phase is to ensure a fix patch to the application or add new feature to the existing application.

3.2. Problem Analysis

As stated in previous chapters, the author intends to develop a web application using the system development life cycle method. The web application is developed to provide user a quick and efficient data sharing method by utilizing the QR code medium. In some case where people need to share digital information, it is limited by the needs of having a dedicated application in their mobile device such as a messenger app or file storage application.

The web application provides data storing and sharing capabilities to users. This web application has a file management capability where users can manage uploaded files and their respective QR code image.

The QR code will be generated using Google web service API. The web application sends a GET request with parameters such as QR code size, error correction quality, and the message that will be encoded. The web service will return QR code image data which will be saved in the web application storage using Laravel file storage capability.

Google web service provides more than just one function and libraries that can be used other than QR code generation. One of the examples is Google Maps that provides location where the QR scan is taken. These web services are open source and secured which makes it easy to implement by developers.

3.3. Hardware Specification Analysis

The development of this web application includes components and properties that are necessary in the implementation phase. The hardware and software requirement for this research are as follows:

1. Hardware Requirement
   The following hardware are used in developing the web application:
   1. Processor: Intel Core i3-8100U CPU
   2. RAM Memory: 2 GB
   3. Hard Disk Storage: 500 GB

2. Software Requirement
   The following software are used in developing the web application:
   1. Operating System: Windows 7
   2. Text Editor: Sublime Text 3
   3. Browser: Google Chrome and Mozilla Firefox
   4. XAMPP Control Panel

3.4. Design Process

3.4.1. Entity Relationship Diagram (ERD)

The Entity Relationship Diagram (ERD) is designed from the application's database and the relation of each entity.

3.4.2. Flowchart

1. Registration and Login Flowchart
   The following flowchart represents the workflow of member registration and login process
2. Create QR Code Flowchart
   The following flowchart represents the workflow of QR code creation.
3. Edit QR Code Flowchart
   The following flowchart represents the workflow of QR editing.
4. Decode QR Code Flowchart
   The following flowchart represents the workflow of QR decoding.
5. Scan QR Code and File Download Flowchart
   The following flowchart represents the workflow of QR scanning and file downloading

3.4.3. Use Case Diagram

The use case diagram for this web application contains two actors where each has a role in the web application which are:

1. Guest, uses the basic function of the web application such as create, decode, and scan QR codes.
2. User uses the basic function of the application whilst having the capability to store and edit created QR codes and view its scan activities.

3.4.4. Sequence Diagram

1. Registration and Login Sequence Diagram
   The following diagram represents the process that occurs when a user executes login activity.
2. Create QR Code Sequence Diagram
   The following diagram represents the process that occurs when a user executes QR creation activity.
3. Edit QR Code Sequence Diagram
   The following diagram represents the process that occurs when a user executes QR editing activity.
4. Scan QR and Download File Sequence Diagram
   The following diagram represents the process that occurs when a user executes QR scanning and file downloading activity.

3.4.5. Activity Diagram

Activity diagram represents the activity flow in the web application. These activities are executed by four components comprised of guest, user, application, and database. Activities in the application consists of login, QR creation, QR editing, QR deletion, QR decoding, and file download through the database.

3.4.6. Interface Design

1. Homepage Interface Design
   Homepage interface design which depicts the web application's homepage view and layout.
2. QR Creation Form Interface Design
   QR creation form interface design which depicts the web application's QR creation view and layout.
3. Login Page Interface Design
   Login page interface design which depicts the web application's login page view and layout.
4. Registration Page Interface Design
   Registration page interface design which depicts the web application's registration page view and layout.
5. Storage Page Interface Design
   Storage page design interface design which depicts the web application's storage page view and layout for new user.

Whereas storage page design interface design which depicts the web application's storage page view and layout with QR codes.

6. User QR Code Creation Page Interface Design
   User QR code creation page interface design which depicts the web application's QR code creation page view and layout.

User QR code creation page interface design which depicts the web application's QR code creation page view and layout after content type selection.

7. Scan Activity Page Interface Design
   Scan activity page interface design which depicts the web application's scan activity page view and layout.
8. Text Content Page Interface Design
   Text content page interface design which depicts the web application's text content page view and layout.
9. vCard Content Page Interface Design
   vCard content page interface design which depicts the web application's vCard content page view and layout.
10. File Download Page Interface Design
    File download page interface design which depicts the web application's file download page view and layout.

Whereas file download page interface design which depicts the web application's file download page view and layout.

3.5. Testing Plan

The two most important techniques that are used for finding errors are black box testing and white box testing. Black box testing is a testing technique without having reference to the internal structure of the application. This testing method examines the fundamental aspects of the application without going into detail. On the other hand, white box testing is a testing technique based on the internal structure of the application. In white box testing, it is necessary for a tester to have good programming knowledge, so to better understand the source code. White box testing can be performed any time in the life cycle after the code is developed. [25]

In this web application development, author uses black box testing in the testing phase. Testing phase consists of functional testing or input output driven testing. In black box test, tester only knows the input and what the expected outcome should be and how the application delivers those outputs. The programming code will not be examined therefore further knowledge of the web application structure is not needed.

4. Implementation and Discussion

4.1 Implementation

The next step that was taken after author had created the application's design was to implement the planned-out design into the project itself. After the application had been developed, author then uploaded the application in a web domain named quicksave.inteljoy.com as the active workplace.

4.1.1. Homepage

The homepage is the first thing that will be opened when users first access the quicksave.inteljoy.com website. The navigation bar contains the website logo and account login and signup button.

The homepage has a front banner which displays the website promotional image. There are two primary functions of the homepage below the banner which are the QR code creation form and QR code image preview. The creation form allows user to create QR code by selecting the content type in the tab section at the top of the form and fill the input form.

4.1.2. QR Code Creation Form

QR code creation form contains fields where user input values that are needed to be encoded into the QR code content. There are five forms that are provided where each form creates different type of content for the QR code. The content types are text, link, vCard, email, and file.

Some content type provides a dynamic way of showing their content. This method can be adjusted in the radio button below the input fields. The static radio button creates default text type QR code whereas the dynamic radio button will store Quick Save website link into the QR code which will redirect user to the page containing the message.

The label textbox is the input field for QR code labelling and listing purposes. These textboxes will only be shown to logged in user for storage uses. Below the label textbox is the image design dropdown which contains the option to change the QR code color and insert custom logo.

4.1.3. QR Code Decode Form

The QR code decode form consists of image upload area and the result box. User can upload their QR code by browsing or dragging the QR code image into the upload area. The decoded result will be pasted onto the result box below the upload area.

4.1.4. Login Page

The login page is accessed by clicking the login button located at the navigation bar of the website. The login page has a form which consists of two account input field such as email address and password field. The login button will process the account login verification.

4.1.5. Registration Page

The registration page is accessed by clicking the signup button located at the navigation bar of the website. The registration page has a form which consists of four account input field such as name, email address, password, and password confirmation field. The register button will process the account registration.

4.1.6. Storage Page

The storage page is accessed after login process has been completed. This page is the main page for user to manage their QR code data. The navigation bar consists of notification button, username label, and logout button. The sidebar consists of website logo, hide button, and storage menu. The hide button hides the sidebar for wider panel space. The menu has three parts such as All, Active, and Expired. These menus functions as a filter that will display QR code list which are still active or expired.

The main panel on the right side of the sidebar consists of breadcrumbs which shows the name of the page and its content. The storage page has functions such as create QR code button, decode QR button, sorting options, grouping toggle, and the QR code storage list.

4.1.7. User QR Code Creation Page

User QR code creation page is different from the non-user creation page from the homepage as logged in user has the capability to store created QR in Quick Save database and label them. The design does not differ much except the QR code content type selection which is displayed before the input form is displayed.

After selecting one of the content types, an input form for the corresponding type will appear. Below the form, there are two button which are the preview button and save button. The preview button allows user to preview the QR code result in the QR code image preview before storing it into the database whereas the save button submits the form result and store it into the database. Content type selection can be opened again by clicking the back arrow button located at the top of the form.

4.1.8. Scan Activity Page

The scan activity is accessed by clicking on the QR code in the list. This page displays QR code content information such as QR code image, label name, date creation, total scan, latest scan, and the content itself. The scan activity is only available for dynamic content type which has access to the website content page.

The scan activity of the QR code is presented in a form of chart and table. This graph contains the scanning activities of the current or other month and years which can be adjusted from the selection. The chart depicts the number of successful scans that happened at the course of the selected month. The table contains the date and time of each recorded scan.

4.1.9. Text Content Page

The text content page is accessed from the link provided in the content of the dynamic text QR code after being scanned. This dynamic text page displays the message stored in the text storage database corresponding to the encoded data. The name of the uploader and the creation date are shown below the text message area.

4.1.10. vCard Content Page

The vCard content page is accessed from the link provided in the content of the dynamic vCard QR code after being scanned. This dynamic vCard page displays contact information such as name, phone number, email address, website, company name, and address which are stored in the vCard storage database corresponding to the encoded data. A VCF (Virtual Contact File) can be downloaded by clicking the save contact button. Therefore, the VCF file can import those contact information into the user device.

4.1.11.File Download Page

The file download page is accessed from the link provided in the content of the file QR code after being scanned. File QR code which is password protected will display the password input field before accessing the download page.

If password verification is successful, the download page will be opened alongside the file preview function. The file information is displayed at the left side of the download page which consists of file name, file size, uploader name, and date of creation.

4.1.12. Web Service and File Storage Implementation

In QR code creation, the web application sends a request to Google Web Service which will return QR code image file data. The link that is used for PHP file get content usability is "https://chart.googleapis.com/chart?cht=qr&choe=UTF-8&chs={*Width x Height*}&chld={*Error_Correction_Quality*}&chl={*Message*}". The link contains parameter such as QR code height and width, error correction quality, and message. The width and height of QR code is determined by the web application which is 512px. The error correction quality determines the readability of a QR code and its data damage recovery from damaged pattern. More amounts will result in complex pattern in QR code. Therefore, the quality of error correction must be reduced to not convult the image. The message is inputted by the user to be encoded into the QR code.

By using Laravel feature in storing file, the data received from the web service will be converted into an image form with Laravel Image library which will encode it into a jpg format file. QR code image will be stored in the public folder of the web storage to make it accessible for anyone. If the content type of the QR code is file, then the uploaded file will be stored to the local folder of the web storage. Each of the file and image will be stored in the corresponding user ID folder. The code flow of web service request and file storage path.

4.2. Testing Result

To ensure that the web application functions properly, the author has conducted multiple testing on each activity that can be executed in the web application. As stated previously, the testing method that will be used is the black box testing where aspects like input and output function will be tested.

These activities are divided by two group which are guest activity and user activity. The guest activity includes activity that can be executed by non-member whereas user activity includes activity that can only be executed by logged-in member. The testing result is provided in Table 6 and Table 7.

4.2.1. Guest Activity

The conducted black box testing on guest activity, input, and output has resulted success in all activities.

4.2.2. User Activity

The conducted black box testing on user activity, input, and output has resulted success in all activities.

4.3. Implication

The implication from this implementation is that the developed web application can be used by users as a data sharing platform for generating, storing, and parsing QR code content. QR code creation can be executed quickly for guests and users. By sharing the QR code image created from the web application, data stored on the website can be accessed by dynamic method or showed instantly through the scanner by static method.

The web application is accessible in both mobile and desktop which makes it easier to open shared QR code link without having to rely on a dedicated application. Although not every device supports the capability of QR code scanning, the web application supports the feature of QR decoding by simply uploading the image taken from device camera. Therefore, any device with a camera feature can decode QR code image without having to install QR code scanner either.

5. Conclusion and Recommendation

1.1. Conclusion

After implementing the system development life cycle method in Quick Save web application development, the conclusions that can be drawn regarding the thesis study conducted by the author are:

1. Users need a way to access and share information without having to install a dedicated third-party application.
2. System development life cycle method is used in developing the QR code-based data sharing web application using Laravel PHP framework.
3. The web application serves as a data storage and QR code generator for users to share data quickly and effectively using the method of QR code image scanning.
4. Data sharing can be done effectively without the need of a dedicated third-party application by using pre-installed browser to access web application.

5.2. Recommendation

In conducting this thesis study, these are the recommendation that have been received such as:

1. The system development life cycle with waterfall workflow can be used in developing simple and linear projects.
2. Integration with other applications that utilize QR code features will increase user choice in QR code creation.
3. Several aspects in design and security can be improved to increase user experience.

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