

CCERMS: A multi-platform Research Management System for the College of Computing Education with Research Progress Monitoring

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1. INTRODUCTION

1.1 Project Context

The University of Mindanao College of Computing Education (CCE) Software Development Laboratory and Research Center (SDLRC) is a place where capstone and thesis outputs are storing. Likewise, such a center is where students who are taking up their research courses get ideas on what projects they could be proposed and do. The SDLRC is management by a custodian who is in charge of monitoring the different assets inside the center. Likewise, a Research Coordinator who is also a member of the faculty of the college is assigned to monitor activities and assets all related to research. These include hardbound documents and progress reports of the students who are taking up their capstone/ thesis course.

Most of the CCE students who are taking up Capstone/Thesis courses going to the SDLRC to gather or research pertinent data needed for their research. Based on interviews and random talks with capstone/ thesis students under the college, the following problems were identified. Research proposal of the student researchers has almost the same idea of the present study, and this problem may lead to the decline of the research proposal of the student. Another problem is some comments, the suggestion of the research coordinator or adviser is too broad, and the researchers are having a difficulty to understand the comments and suggestion. There are times when a student researcher schedules conflict with the availability of the center. Likewise, if the students are also available, the student assistant is not around due to their respective classes; because of this, student

researchers will having a hard time accessing needed data for their research. Another problem encountered is the availability of the assigned research personnel, student researcher stated that they have difficulty in looking for their research personnel assigned since they are also busy with their corresponding classes and assigned tasks given by the college. Proponents were given a chance to interview some members of the research personnel, and the following problems were stated. There is difficulty in monitoring students' research progress from approval of the title to the final submission of final documents. Another is that student researchers consultation conflict with the availability of the research personnel assigned, there is also a problem in terms of communication, some members of the research personnel assigned have difficulty in communicating with their advisees.

With the given problem stated, the researchers produce a "CCERMS" that enables the student to access the research archive everywhere and can view the abstract of the previous study so that they did not need to go the SDLRC to gather some data. The students can submit their requirements online. Also, the research coordinator can evaluate the submitted documents. The students can also communicate with their respective advisers or research coordinator online, so this is the medium for them to communicate with each other. The Research Coordinator(RC) can also monitor the students who are taking up the Capstone/Thesis course to make an important announcement and Capstone and Thesis defense schedule. The RC can also generate a report for the progress of the student

1.2 Purpose and Description

The purpose of this study is aiming to solve or ease the problems of the students and members of the research personnel within the CCE RPC by developing web and mobile applications.

Using this application, the students can search the previous study in the research archive that might help them with their research. Still, the research paper is only readable by the help of PDF.js and not downloadable, and if the student wants to get the whole research, they must contact the author of the said research. The CCERMS allow the student to submit their documents online instead of printing out the documents. Also, this function helps the student to lessen the expenses. The adviser or research coordinator can evaluate the document submitted by the student.

The students can communicate with their respective advisers by using a real-time chat feature. The research coordinator is only authorized to create an account for the adviser and assign it to a designated group. The CCERMS also help the research coordinator to track the student's progress by displaying it with the help of Chart JS. By displaying the students' progress, this helps the students to put some more effort into doing their research. The research coordinator or adviser can evaluate the submitted documents of the student.

1.3 Objectives

1.3.1 General Objectives

The main objective of the study is to create a multiplatform Research Management System for the College of Computing Education.

1.3.2 Specific Objectives

1.3.2.1 To create a repository of research outputs using MySQL for students to access anytime and anywhere and using Eloquent ORM for searching and filtering.

1.3.2.2 To monitor student progress in terms of document submission and student's status through line graph using ChartJS.

1.3.2.3 To create a module for students to submit their outputs using Axios V-Form

1.3.2.4 To create a medium where members of the research personnel and students' advisers communicate real-time using Laravel Echo.

1.3.2.5 To notify students for important announcements and defense schedule using Laravel Echo and Pusher.

1.3.2.6 To create a module to generate reports, such as student progress.

1.4 Scope and Limitation

The proposed study is to build a mobile and web application for the Research Center of College of Computing Education of the University of Mindanao.

This web application allows the student to submit their documents online, and the research coordinator or adviser can evaluate or give a comment to the submitted documents by the student. The Research Coordinator can assign an adviser for each group who are taking up Capstone/Thesis. Furthermore, the RC can track the progress of the student and also can announce the defense schedule of the students. The students can also search from the repository for the present study that helps them with their research. This study aims to help the student to lessen the expenses instead of printing the documents. They submit their docs online. Moreover, the researchers aim to finish the proposed within the given duration of ten months to produce the expected output.

Though, the proposed study has its limitations, which include calculation of the grade of the student.

2. REVIEW OF RELATED LITERATURE AND SYSTEM

This section includes schemes and articles on conflicting ideas and methods related to the suggested research, which was usually focused on the development of CCERMS and its associated implementation. The schemes and articles quoted in this section have significant implications for the research component.

2.1 REVIEW RELATED LITERATURE

2.1.1 Hybrid Mobile Application Based on Ionic Framework Technologies

In this study, we center our design on a new hybrid mobile application frontend framework, "Ionic." This framework is

designed for developers to quickly build more interactive hybrid mobile applications on top of the existing mobile application components developed with native apps (Weiß, 2016). The technology has a relatively low learning curve (Phan and Hartington, 2015) and can be combined with other web technologies such as HTML5, CSS3, and JavaScript [1].

Since the research is also running in a mobile application, the researchers decided to use the Ionic Framework for developing the CCERMS Mobile application because it is easy to develop using HTML5, CSS, JAVASCRIPT, ANGULAR JS, and TYPESCRIPT. The developer of the system research has the background of all the requirements for developing mobile applications using the ionic framework. It would be an advantage to develop it on time since the range of time in developing the system is only a couple of months.

2.1.2 Defining Single Page Application

Single Page Architecture (SPA) may be a sort of net application or web site that dynamically reloads designated page components in line with user interactions to avoid winning entire new pages from a server. It may dramatically improve the speed and overall flow of digital expertise. Randolph Morris described SPAs as follows: "A single page application is when a single page is modified dynamically as the user interacts with the page elements. You might have noticed there are sites where the entire content of the site is on a single page and the navigation at the top anchors to sections on this page, this would be an example of a SPA [2]."

For the better performance of the website, since the research run on the web, the researchers be implementing the single page application into the system of CCERMS. Single-page applications give a big help in developing the research system, and the web page run and load faster. It gives more advantages than developing a multiple-page application. The research system did not load every request that made since the researchers implementing a single page application render all the data into its components.

2.1.3 Research Management System

Research Management System or RMS, is a tool to make the administrative job easier. It is usually used to sort research works in a particular department and makes all records available for anyone needing it. Furthermore, this would greatly help, especially for an institution that deals most of the time with researches. In the article show how RMS (Research Management System) increases efficiency, it said, "benefit of an RMS is improving efficiency. Not only are investment managers searching for new sources of alpha, but they are also interested in decreasing the time from idea to trade execution" [3].

Therefore, CCERMS is an excellent help to the College of Computing Education to sort all research works of their students and for the teachers to be able to know whether research has been useful or not. The students of the College of Computing Education did not hustle to go to Software Development Office to search if the proposed title has already been conducted or not. The system also manages all the documents submitted by the students that want to propose their study or ongoing research that submit to their assigned advisor.

2.1.4 Web-Based Information System

A web-based Information System is an information system that provides data and services to consumers using Internet web technologies. This technology is a software system that is used by the principle of hypertext to publish and retain information. A web-based information system is a combination of one or more web applications, particular parts based on functionality. A web

browser is used as a front end in this sort of information system, and all databases are used as a back end [4].

CCERMS running a web-based platform and has an attribute of Web-Based Information System wherein the abstract pdf file of done research of the students in the University of Mindanao, College of Computing Education are stored online. Web-Based Information System is a big help for the students of the University of Mindanao, College of Computing Education; they can easily view the file anytime as long as they have internet.

2.1.5 Web-Based Information and Monitoring System of Cagayan de Oro City Academy for International Education

In Cagayan de Oro Academy, they seek for web-based information and monitoring system that is suitable for International Education. Tubongbanua et al. suggested a system wherein data such as viewing or posting of grades, class schedules, students, guardians, staff profiling, and other essential data needed in the system. In the research, they define the Web-based Information and Monitoring System as an extension of the necessary information system achieved through the system design of enhanced or broader capabilities by functionally or technically involving two or more information systems. With this, the Academy be able to provide high-quality service to its learners. This section includes schemes and articles on conflicting ideas and methods related to the suggested research, which is usually focused on the development of CCERMS and its associated implementation. The schemes and articles quoted in this section have significant implications for the research component [5].

Just like in CCERMS (the research), give information about done research online. CCE students of the University of Mindanao easily search or browse of completed research. With this, they are able to identify whether their preferred title is available or not. Also, this study helps the Research Coordinator of CCE to access and monitor the students who are enrolled in this subject.

2.1.6 Chart.js – A JavaScript Library for Easy Graphs for Designers & Developers

Chart.js is a JavaScript library that allows you to create client-side graphs using an object-oriented approach easily. Chart.js provides six ways to represent your data, each of which is animated and fully customizable. Chart.js is capable of displaying your information in line charts, bar charts, radar charts, pie charts, polar region charts, and donut charts. The library utilizes HTML5 canvas to show the chart and has IE7/8 polyfills. Chart.js is easy to use for the developers to show a graphical design. Also, easy to integrate into a project, they can add the Chart.js via CDN (Content Delivery Network) or via Node to add to your package [6].

Since the research display the progress of the students via graphs, the researchers decided to use Chart.js. The capability of Chart.js is suitable for the research. The researchers can easily display the progress of the student in different kinds of graphs. With the help of Chart.js, the progress of the students or the user's target of the system are easy to monitor by representing progress via graphs.

2.2 REVIEW OF RELATED SYSTEM

2.2.1 PCHRD Project Management System

The Philippine Council for Health Research and Development (PCHRD) is an online web-based submission, review, approval, and monitoring platform for health research proposals/projects. Applicants interested in applying for a research grant may submit proposals through the system. Also, they provide a mobile application for the user to track the submitted proposals into their site. PCHRD funds research proposals that are aligned with the

research priority themes of the National Unified Health Research Agenda (NUHRA). NUHRA guides the health research sector to health research that addresses the country's most pressing health concerns. [7].

There goes the same as our research; the only difference is that PCHRD focuses on health research submission while this study ponders more on CCE related researches in the University of Mindanao. PCHRD has multiple users, not just like the CCERMS the only users of the system are the students of the University of Mindanao, College of Computing Education. The users of PCHRD can upload their research paper into their server to identify their availability; this goes the same concept of the CCERMS system, But CCERMS also manages the student's research progress that displays via graphs.

2.2.2 Online Public Access Catalog OPAC

OPAC is the modern word library catalog. It is an online database of all of the resources held in the library. You can search for OPAC to locate books in the library. It lists the number of items, whether they are in the library or out on loan, and their call number. OPAC is an Information System of different kinds of books or articles, the students or the users of the system can easily search or find the specific book or article that they want to read or borrow. [8].

Just like our research, that categorizes students' researches on an online database. The main variance is that OPAC only stores library data and that our study is more on storing student researches. The OPAC only store and search library data and its information; just like CCERMS (the research), all the information on doing research and student's information store online. However, the CCERMS has also a Management System wherein the system manages the student's research progress.

2.2.3 Blackboard Learn

Blackboard is a multiplatform application wherein it is available for all platforms. Blackboard is online teaching, and learning application wherein the students can join a school or university that already registered to the blackboard. The students can join a course that has been open or create by the professor. In the website of blackboard, it stated, "students and instructors have instantaneous or 'real-time' interaction." In blackboard, the students can take an exam or quizzes given by their professor in the course. Blackboard Application has a lot of functionality, and it depends on the School or University if they enable it or not. Also, the students and professors can upload a file on the blackboard if they have a file that needs to upload [9].

The blackboard application and the research system have a few similarities, like the multiplatform, real-time, uploading files. The University of Mindanao started to use the Blackboard application this year (2019). Also, the research system is implemented at the University of Mindanao. Still, it focuses on the department of CCE. Both Blackboard and research systems have a real-time function. Still, the Blackboard application they implemented the real-time into the interaction of the students and the professor, while the research system focuses on real-time chat. The Difference between Blackboard and the research system is the Blackboard is an Online Teaching and Learning Application, while the research system is an Online Monitoring and Information System.

2.2.4 Google Scholar

Google Scholar Web-Based Application, Wherein it offers an easy way to search for academic literature broadly. You can browse across multiple disciplines and sources from one place: papers, theses, books, abstracts, and court opinions, from scholarly publishers, professional associations, digital archives, universities, and other websites. Google Scholar helps you find

relevant work in the academic research environment. Google Scholar, you can search specific topics or articles that you want; also, you can choose or sort the published date of the articles that you search [10].

The Google Scholar Website is somewhat similar to the research wherein the repository of theses or articles is stored in the database and display it on the website. The difference between Google Scholar and the research is Google Scholar is a bibliographic database, and organized online literature sources include journal and newspaper articles, conference proceedings, documents, policy and legal journals, patents, books, etc. while the research is research repository in the College of Computing Education in the University of Mindanao.

Table 1: Checklist Feature

	CCERMS	PCHRD	OPAC	Blackboard Learn	Google Scholar
Single Page Architecture	✓				
Search Module	✓	✓	✓	✓	✓
Multi-platform	✓	✓		✓	
Real-time Notification	✓	✓		✓	
Display Progress	✓				✓
Store File Module	✓	✓	✓	✓	✓
Scheduling	✓				

Table 1 shows the common feature that is present in CCERMS (the study), PCHRD, Google Drive, OPAC, and Blackboard: Learn. It demonstrates the assortment of highlights that are available in the CCERMS application as well as to some related framework that has been referred to upon this research. Some system, even the study, has both Android and Web-based application. Additionally there likewise some component that is available in the study that are not available to some related application, just like PCHRD, Google Drive and Opac that doesn't have a function like a school portal that the user can enter in the web page of the University and can access them all their privilege of being student into their school. Table 1 additionally demonstrates some featured highlights that be available not exclusively to this report yet in addition to the real yield of the study.

3.) TECHNICAL BACKGROUND

This chapter mainly focuses on the technical side of the proposed study. This chapter also discusses how the researchers achieve the expected features of the proposed study. It also includes Frameworks that use for the development stage of the proposed study. Besides, development tools also included in this chapter, which is part of the development of the system.

3.1 Conceptual Framework

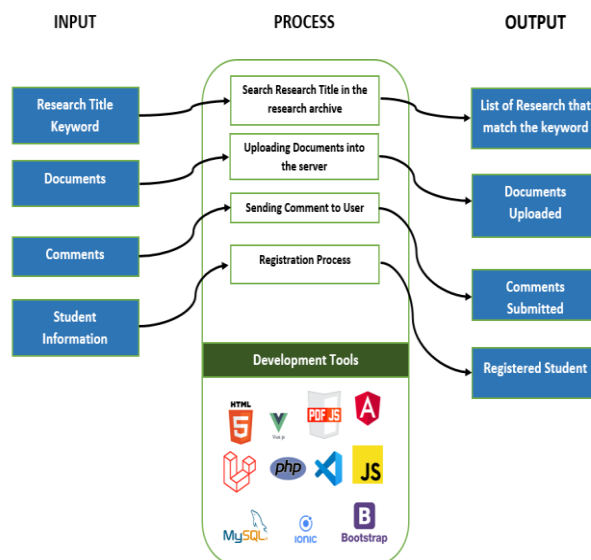


Figure 1: Conceptual Framework

Figure 1 shows the conceptual framework of CCERMS. The application behaves two different platforms that be developed into different platform Ionic Framework for mobile and Laravel Framework for the web. Moreover, most of the features and functionality are the same. But for the mobile version, the admin cannot add a research paper in the repository but only for the web version only. Both versions of the application need an account to be able to use it. The student must create an account first for him/her to able to use the application. After the student has been registered, he/she can now view/search the research paper in the repository and submit documents. Moreover, the researcher coordinator has only the privileged to make an account for the adviser/consultant. The adviser can modify the account given by the research coordinator

3.2 IPO Model for Mobile

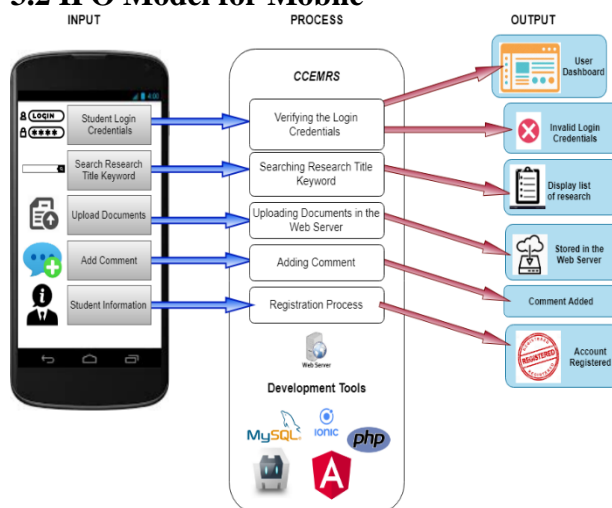


Figure 2: IPO Model for Mobile

This figure shows the Input, Process, and Output for the mobile version of the application. Upon opening the application, the first interface that the user can see is the login page. Which is composed of two input fields for the email and password. In the registration process of the mobile application in the interface of the application, there be input fields for name, email, password,

and course that they need to fill up for them to register in the application. Once they registered an account, the information that they input be stored in the MySQL server with the help of PHP for communicating the server, and they can now use it for logging in the application. In the login interface of the application, there be two input fields, which are email and password, when they log in this be processed by the PHP to request in MySQL server if the said user has existed or not. If the login credentials have existed, the user is redirected to the user dashboard, or if it is failed, they need a prompt that the login credentials do not exist or password is not correct. In searching in the repository, the user needs a keyword in the search input field, and after that, PHP gets a request to the MySQL server to display all the matches' titles in the table. Now the user can view the research paper with the help of CleverDox Viewer.

3.3 IPO Model for Web

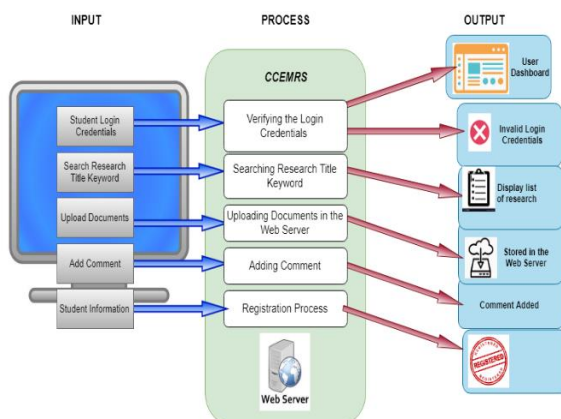


Figure 3: IPO Model for Web

This figure shows the Input, Process, and Output for the web version of the application. Upon opening the site, the user views the landing page of the site, which is introducing the CCE Research Center and a navigation bar on top. There are also two buttons in the navigation bar, which is login and register. In the registration process of the web application in the interface of the application, there be input fields for name, email, password, and course that they need to fill up for them to register in the application. Once they registered an account, the information that they input be stored in the MySQL server by the help of Laravel Query Builder and Axios V-Form for post request to the server, they can now use it for logging in the application. In the login interface of the application, there be two input fields, which are email and password when they log in; this be processed by the Eloquent ORM of Laravel, and Axios forget to request the MySQL server if the said user has existed or not. If the login credentials have existed, the user is redirected to the user dashboard, or if it is failed, they prompt that the login credentials do not exist or password is not correct. In searching in the repository, the user needs a keyword in the search input field, and after that, Laravel Query Builder gets a request to the MySQL server to display all the matches' titles in the table. The user can view the research paper with the help of PDF.js.

3.3 IPO Model (Overall Progress)

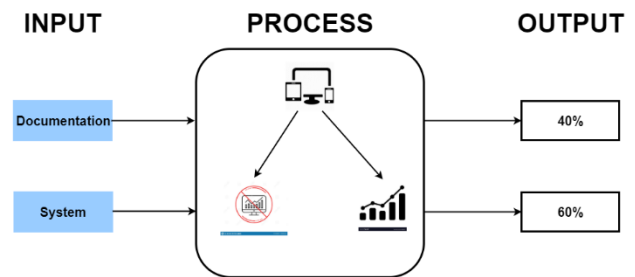


Figure 4: IPO Model for Overall Progress

In this figure discuss on how to display the progress of the student. The progress of the student divided into two (2) stages: the Documentation stage that equivalents to 40% and the System stage that equivalent to 60% so overall of 100%. The research coordinator (RC) is able to set the percentage of the stages. This figure shows that if the researchers or group of students are able to comply with all the documentation, it displays in their progress as 40% of their overall progress, the dissection of the documents is on figure 5. Also, in the system, if the researchers are able to comply with the hundred percent, it displays in their progress as 60% of their overall progress. If the researchers were able to complete the two stages, their overall progress would be 100%, else the progress of the researchers still be the same.

3.4 IPO Model (Researchers Progress/ Documentation)

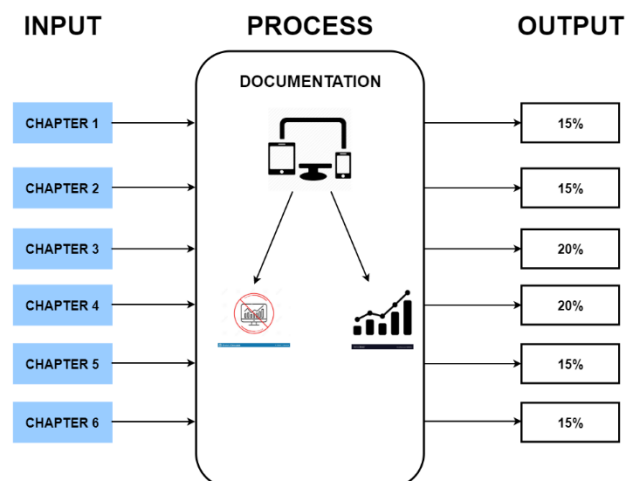


Figure 5: IPO Model (Researchers Progress/ Documentation)

This figure demonstrates the dissection of the Documentation stage in the researcher's progress. The percentage given above was given by the research coordinator. In this figure, the Documentation stage is dissecting into six (6) parts, which are the chapters of the capstone documentation. The six chapters have a corresponding percentage for the research progress of the documentation. The students should comply first with the stages before they can go to the second stage, and so on. If their advisor approves the submitted documents of the students, the student progress rises up by its corresponding percentage.

3.5 IPO Model (Researchers Progress/ System)

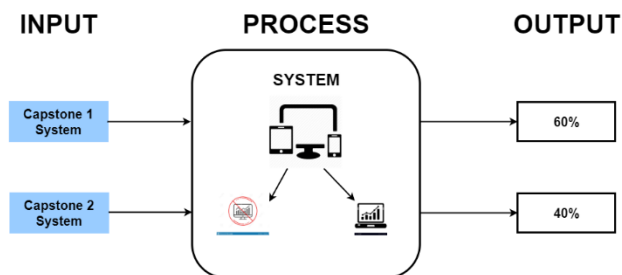


Figure 6: IPO Model (Researchers Progress/ System)

This figure demonstrates the dissection of the system development stage in the researcher's progress. In Capstone 1, the students should complete 60% of the system. If the student complies 60% of the system, it reflects the students' progress; the same goes for Capstone 2.

3.6 IPO Model Generating Reports

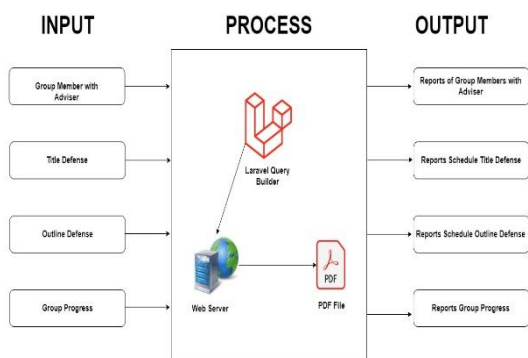


Figure 7: IPO Model Generating Reports

In this figure, the system produces reports depending on what the administrator or research coordinator (RC) needs. As the RC feedback is a group member with an advisor that be processed in the system using the Laravel Query Builder on the webserver. The web server returns the report data in the system, and the system views the report, and the RC access the pdf file and print it. The system can generate reports such as student progress and student task report.

3.7 Single Page Architecture Diagram

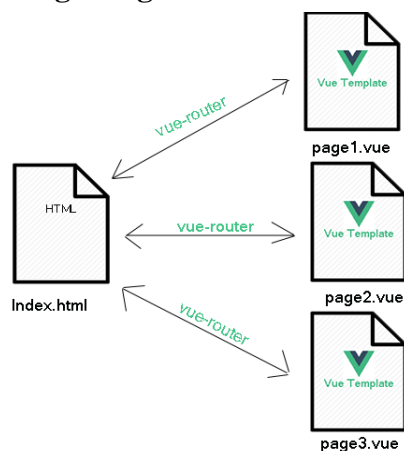


Figure 8: Single Page Architecture

Figure 2 Illustrates how the researchers accomplished the application's single-page structure by loading web page templates to a single HTML site. The researchers use the view-

router object to load view templates into the index HTML folder with the aid of the VueJS Framework. The view-router plays a significant role in this architecture based on the figure above because it manages the shuffling of the display model depending on the navigation requests of the user.

3.8 IPO Model (Search and Filtering)

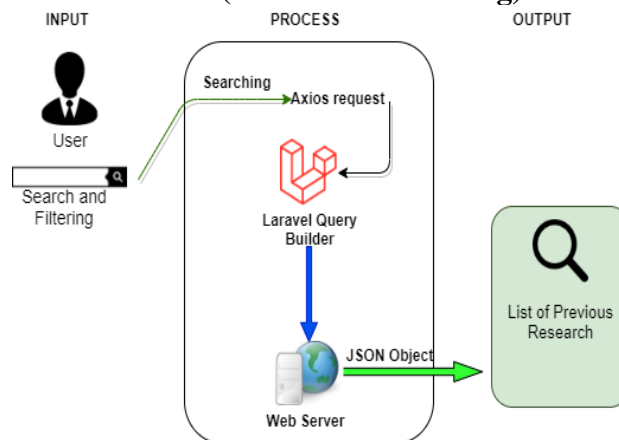


Figure 9: IPO Model for Search and Filtering

In this figure, the research adds a search and filter option where the user can filter by categories or a keyword research paper in the research archive. When the user filters it out input a keyword, this is fetched by the Axios to query to the server using the Laravel Query Builder to communicate with the Web Server, and it returns a JSON object. Then the JSON object handle by the VueJS to display in the front-end of the application. If the user or researchers search via keyword, the keyword uses to compare the existing research on the research archive. Also, the user or researchers can use the filtering option, which they can filter out by categories, android application, web application, cross-platform or multi-platform, etc. The user can search using the search keyword at the same time the filtering option. If the keyword and filtering option are matched in the database, the list of research in the archived display on the front-end of the system.

Table 2: Search and Filtering Example

Input	Comparison	Process	Output
Android Application	Compare the user's input into the MySQL DB	Query the input using Laravel Query Builder	Display the matching research
Web	Compare the user's input into the MySQL DB	Query the input using Laravel Query Builder	Display the matching research
Category+Keyword	Compare the user's input into the MySQL DB	Query the input using Laravel Query Builder	Display the matching research

Table 2 represents the example of search and filtering. The users or students choose the android application in the dropdown menu of filtering options, and all the research archived that have an android application in their title display.


```
$done_research = DB::table('done_research')
    ->where('res_title', '%value%')
    ->latest();
```

Figure 10: Example Code on How to Search and Filtering using Laravel Query Builder

This figure shows how to achieve the search and filtering option using Laravel Query Builder. Laravel has a built-in function called Query Builder to make querying more easy and readable code.

3.9 IPO Model (Hybrid Application)



Figure 11: IPO Model (Hybrid Application)

The researcher uses this to build a hybrid technology for an android application with the use of Ionic Framework and Apache Cordova. Ionic Project is the Ionic Team's HTML 5 project. This framework is the front-end UI to create the android application that is being proposed. It can be written in HTML, CSS, and JavaScript to build the application. The Ionic project suggests using AngularJs Project for the application's core functionality instead of using pure JavaScript. Apache Cordova, developed by Nitoby, is the software used to compile web components into the android APK directory. The Cordova command codes create the APK folder. This is the container that holds the application's running web components, naming it a native device shell or native wrapper. Cordova already has a whitelist, camera, and other plug-ins.[12]

3.10 IPO Model for RC

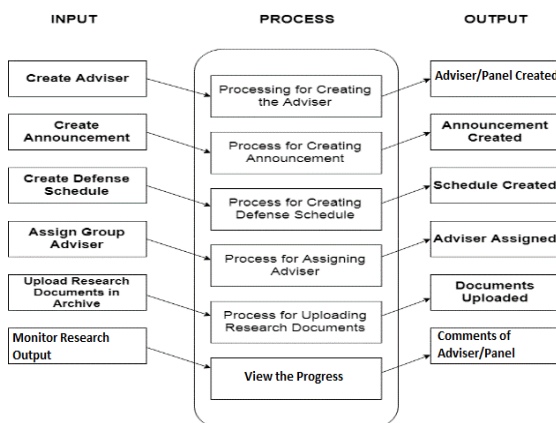


Figure 12: IPO Model for RC

Figure 11 – IPO Model for the Research Coordinator, the RC can create an adviser and panel, then assign it to the designated group, and this process by the Eloquent ORM of Laravel to save it to the MySQL Database and push it using Pusher API. The RC can create an important announcement and defense schedule, and broadcast it using Pusher Notification API and Laravel Echo. The RC can upload done research documents in the research archive using Axios V-Form. The RC can monitor the research paper of the students. If the researchers have already an approved research title, the RC can now assign an adviser, and also, the RC can monitor the research paper of the students that were submitted to their adviser.

3.11 Development Tools

3.11.1 Laravel Framework

To produce the web version of the proposed system, the researcher utilizes the Laravel Framework and prevents repetitive coding by using the Model, View, and Controller structure of the framework. With the help of this and the combination of VueJS Framework. The researcher is developing a Single Page Architecture; this can be achieved with the help of the VueJS Framework.

3.11.2 Ionic Framework

In order to produce a very interactive interface of the mobile version of the application, the researchers use the Ionic Framework. Ionic is a complete open-source SDK for a hybrid mobile app. Furthermore, the Ionic Framework provides a tool and services for developing a hybrid application.

3.11.3 VueJS Framework

To achieve the single-page architecture of the researcher, utilize this framework, and this is the front-end view of the application. And this helps the researcher to organized data structuring from HTML templates to script functions. The researchers use VueJS in creating HTML templates, HTML tags, and creating functions by coding it in JavaScript syntax and binding the two components virtually.

3.11.4 Axios

Axios be used to create an asynchronous transferring of data to the client-side to the server-side using APIs. Axios is a Promise-based HTTP client, which acts as a front-end, and this is fast and easy to send the asynchronous HTTP request to REST endpoints[11].

3.11.5 Visual Studio Code

For the development stage of the proposed study, the researchers utilize the Visual Studio Code editor. Visual Studio Code has all the needs of the researcher like debugging features, built-in Git control, and syntax highlighting. Upon the development stage of the application, VS Code is utilized as a text editor for codings like Typescript, PHP, HTML, and JavaScript.

3.11.6 PDF.js

In order to view the documents online, the researchers utilize PDF.js. PDF.js is a JavaScript Library the renders pdf files using the web standards-compliance HTML5 canvas.

3.11.7 Apache Cordova

In order to provide an android version of the application, the researchers use Apache Cordova, a mobile application development framework created initially by Nitoby, and by the year 2011, it was purchased by Adobe Systems and rebranded as PhoneGap. The researchers are using Apache Cordova as a tool to compile web components into an android APK file by coding the intended Cordova command for generating the APK file.

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