CHEDROXI-CAV: A Web-based Certification, Authentication, and Verification (CAV) Issuance Application Utilizing Advanced Encryption Standard (AES) for Data Security

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1. INTRODUCTION

1.1 Project Context
Technological advancement in today's world is improving fast. **63**% of us use the internet around the world. In addition to that, the growth rate of people that use the internet has risen by 4% since 2021. This growth seems to keep on increasing day by day and with that many organizations aim to improve their productivity by automating their current manual processes. However, there is still organization that seems to be having a manual processing and evaluation of their works, such as Certification Authentication and Verification, though it takes a lot of time to process this Verification issuance there is still room for it to improve and to be more efficient. Utilizing the internet helps a lot of individuals and businesses in the Philippines [1]. The utilization of digital technologies**,** for example e-commerce, digital payments, and online education, to name a few. Is steadily being used throughout the Philippines to cope with the pandemic issue. Overall embracing technological advancement by improving manual processes will prove useful in supporting the Philippine digital economy [2].

Commission on Higher Education Region 11 Office offers a lot of services from Scholarship grants, Special orders, Certifications, etc. Their services are needed by a lot of students and schools and currently only one CHED office caters for the whole region 11 in terms of said services. With that in mind the

proponents decided to try and find some problems that the CHED Region 11 office currently faces.

The proponents then did an interview meeting with the CHED Region11 office to ask for current problems and services that might have some problems or possible improvements on it. After several meetings the proponents found out about the Certification, Authentication, Verification Issuance system of the CHED and its current process. Their current process with CAV is that schools needed to submit documents by visiting the CHED office physically and turn it in. After that CHED moderators would then encode and check the submitted documents for any errors and lack of documents. It takes about 2-3 business days for the CHED moderators to finish checking the submitted documents for any errors that it might have. Then if there are errors or lacking documents CHED moderators would then contact the schools especially school registrars since they are the one who collects all the CAV applications to be submitted at the CHED office. They would then physically visit CHED again to correct or submit any lacking documents they have and would then wait for another 2-3 business days for it to be checked by the CHED moderators. In addition to that CHED Region 11 Office caters for the whole region 11, meaning a lot of applications are being submitted simultaneously making it much harder for them to process it with their current system. They also added that they would like to have a way to show reports or a dashboard to show the percentage of approved applications because although currently utilized a system it does not have dashboard function which shows what they need for their reports. So, with that we find that their current system does not meet their needs and still have problems and can be improved, that is why the proponents found out the major problems that if solved or aided would make their processes a lot easier.

The first thing that the proponents notice was how their current system is localized and does not utilize the web which would make their transaction a lot easier because it would eliminate the

need to physically go to the CHED office to submit the required documents. Also, their current system will make them encode the data within the document and save it and if there are any changes to it they can change it. To solve that problem the proponents proposed a web-base application that would then allow School registrars and CHED office to have a way to do transactions electronically and eliminate the need for the CHED moderators to encode the data because before submitting the school registrar would already fill the necessary data and just submit other supporting documents for CAV application. To achieve that the proponents will use Laravel for back-end together with Vue.Js as its front-end for the proposed project.

The second problem which is also aligned with the first problem is that the proponents noticed was how the process takes a lot of time to complete. 2-3 business days is a normal transaction time for most transactions but, factoring the day that the school registrar would go to the office physically and wait in line it would take them longer than that to finish their transactions not to mention School registrars submit applications in bulk, so they bring a lot of documents physically to the office to aid with that. Using the proposed project, it would make it possible for them to cut the total time of transaction because there is no need to physically visit the office itself and submit the documents.

The third problem was how their current local system does not utilize any sort of added security to their database. Currently they just use MySQL database to save the data inputs without doing any sort of security measures and with that the proponents decided to add Advance Encryption Standard (AES) which is the capstone element of the project. With this it will make sure that the data saved on the proposed project would be safe and secure from attacks. To further understand how AES works and implemented on the proposed system the proponents discuss it on *2.2.4 Technical tools* section of the paper.

The fourth problem is that the current system does not have a way to enable school registrars and CHED moderators to communicate with each other easily for them to have status update about the transaction. With that the proposed project implements an Email and SMS notification by utilizing MailJet and ITEXTMO Api that would aid CHED on notifying school registrar about errors. To add the proponents also plan to develop a thread posting feature to be able to make announcements easily and spread information regarding CAV applications.

The last problem that we needed resolve was to enable them to find an easier way to keep track and make reports about CAV application activities. So, with that in mind the proponents plan to make a dashboard that would allow them to see percentage of CAV applications its status and number of accepted and rejected documents in the system so it would allow them to have a general idea on how things are doing and make a report about it a whole lot easier for them.

With all of that laid out and planned the proponent proposed the CHEDROXI-CAV which is a web-based certification, authentication, and verification issuance application that utilizes AES for data security. To add details for this to be set up on the internet CHED stated that they would provide the webserver if the system were ready for deployment.

The proponents are also able to research existing systems that are related to the proposed system. It is called EBSU-SIMS a Web-Based Application for Monitoring Online Application Scholarship Program, it has some similar features to the proposed system, Students who wants to have a scholarship will be able to pass their requirements through a web-based transaction to be stored in the database and can be soon evaluated and verified. They also have a SMS notification that would notify applicants and users about the status and announcement regarding their transactions. They used native PHP and MySQL for their web application development; they seem to have no type of database security used in their system [3].

There is also a study titled *A Generic Certificate Verification System for Nigerian Universities. It is* a web-based system that is used to check and store graduate's information for future use. Their web application uses native PHP together with NoSql, it is also quite confusing on how to navigate on their web app because it has some unnecessary fields and buttons that would make the user get overwhelmed by it. It also does not show any type of security that would ensure that the users' data will not leak or get stolen by other people [4].

An Enhanced web base Certificate Verification System is another study that is also related to our proposed system. It is a website that allows schools to confirm the validity and originality of the students' credentials and records. They used HTML5 for front-end and PHP5 and MYSQL for back-end. The only security measure they utilized is with a use of a secret pin which they called (TOKEN) that is generated only by the organization, for clients and users to utilize their website [5].

The study *A Web Service Based Database access for Nigerian Universities' Certificate Verification System.* It is a web-server-based remote database access that makes it possible for Nigerian universities to have a way to verify certificates and check for its originality and improving its security to avoid any attacks because it makes it impossible to have a direct access to the documents sent by clients of the Nigerian University it also has a search method for them to search for documents sent in their webservice application.[6] The main concern with this is that although it is used by the Nigerian Universities it is still not theirs entirely it is just a third-party web server, so the owner of this study still has the capability of selling the information to anyone who is willing to pay. Another concern is that if this study stops operating the Nigerian university will not be able to utilize it anymore.

Lastly, the study *Design and Implementation of Web- Based Certificate Verification System (Case Study Adamawa State University Mubi)* is a web certificate verification system that allows the university to have a site which allows them to store and collect certificates and verify it electronically. [7] Although it has the same idea with the proponents proposed project the main concern is that the only security measure that they implemented is log in function using HTML and PHP which can easily be targeted by hackers. Their database also does not present any way of security, which would also be a target since documents sent to them might leak in public. Although they have a user-friendly interface it still vulnerable to attacks.

After researching and analyzing existing and different systems that are closely related to the proposed project the proponents laid

out the features that are the same with the proposed project (See Table 1 for reference).

Table 1: Comparison of Existing Applications

Features	CHEDROXI-CAV	EBSU-SIMS	A Generic Certificate Verification System for Nigerian Universities	An Enhanced web base Certificate Verification System
Online Transaction	✓	✗	✗	✓
Records Keeping	✓	✓	✓	✓
On Site Status Tracking	✓	✗	✗	✗
Thread Posting (Announcement)	✓	✗	✗	✗
Database Security	✓	✗	✗	✗
Messaging Function	✓	✗	✗	✗
Dashboard Reports	✓	✗	✗	✗
File Submission	✓	✓	✗	✗
Certification Printing	✓	✓	✓	✓
SMS Notification	✓	✓	✗	✓
Email Notification	✓	✗	✗	✗
Secret Pin (TOKEN) for user access	✗	✗	✗	✓
Online File Processing	✓	✓	✓	✓

1.2   Purpose and Description

The proponents aim to solve the underlying problems and improve the current process of the Commission on Higher Education (CHED) and for its CAV Applicants, to make things efficient and fast. The proponents proposed a web-based Certification Authentication and Verification (CAV) application that will be used to allow online document sending to lessen the time it takes to process CAV certificates. This will allow schools to send documents in advance for verification without the need to physically pass the document on to the CHED office.

To utilize the online application the registered school registrar would log in to their accounts given by the admin for them to access the website. Then it would give them an option to send CAV applications easily by filling up the required fields and attaching the necessary document for it to be then verified and processed by CHED moderators for its authenticity. The school registrar could also see the status of their application through a dashboard which is integrated in their homepage after logging in to their respective accounts. They could also check application status using the tracking option added on the login page using their OR Number.

CHEDROXI-CAV is a web-based application that uses MySql database to save users information and data. Vue.JS and Laravel are the main tools to create the application Advanced Encryption Standard (AES) is also integrated to protect the data and information given by the users.

1.3   Objectives

In this section the proponents will discuss the steps needed to achieve the desired outcome for the proposed capstone project.

1.3.1   General Objectives

The proponents aim to design, develop, and implement a web-based certification, authentication, and verification system for Commission on Higher Education Region 11 utilizing Advance Encryption Standard (AES) for data security.

1.3.2   Specific Objectives

To accomplish the desired general objective, the proponents aim to do the following:

1.3.2.1 Develop web application using Vue.JS as front-end and Laravel as back-end of the project.

1.3.2.2 Utilize MYSQL to create, store, and manage data.

1.3.2.3 Implement Advance Encryption Standard (AES) algorithm to the database records for security.

1.3.2.4 Notify and Inform users through email and SMS on the submitted application status using MailJet Api and ITEXTMO Api.

1.3.2.5 Create a dashboard, announcement with thread posting, and simple messaging using Bootstrap, Vue, and Laravel.

1.4   Scope and Limitation

This study aims and focuses on developing a web-based CAV issuance system for the CHED Region 11 Office. The proponents conducted meetings and prototype presentations together with the CHED Region 11 Office members to discuss what are the possible problems and improvements that could be done to their current system. The result was that the researchers were set in developing CHEDROXI-CAV which is a web-based application with an Advanced Encryption Standard (AES) security to keep their data and information safe from cyber-attacks.

In addition, the proponents add thread posting and message function to make things easier for School Registrar and Moderators to communicate. It also includes an email notification that would also notify them if ever they are not utilizing the website. This web application will run on Intel Pentium G4600 or higher CPU's and different web browsers.

2. METHODOLOGY

The methodology that the proponents will follow for them to achieve and make the proposed project possible is **Agile Method.** Figure 1 shows how the proponents will do multiple development and implementation tests. The first round would be starting the project and defining necessary requirements to proceed on to the next phase. The proponents find and study the current set up of the CHED Office CAV system and found out that the current process can be improved and plan a meeting to collect the data needed to start project and lay out the list of requirements that would suffice and solve the current problem. Proceeding to the second round of development and implementation test the proponents will then start to develop a prototype in accordance with the said problem then, the proponents will proceed to presenting the prototype to the CHED office for feedback and review. If there are still changes or improvement that the CHED office will suggest then we will take note of it and begin another round of development and implementation test and start building the system and with the suggestions and feedback from the CHED, it will make the development much faster. After that the proponents will then proceed to present an alpha test of the web application for another series of feedback and review, if CHED approves it then the proponents will do a final testing for bugs and errors and launch it on the internet.

Figure 1. Agile Method
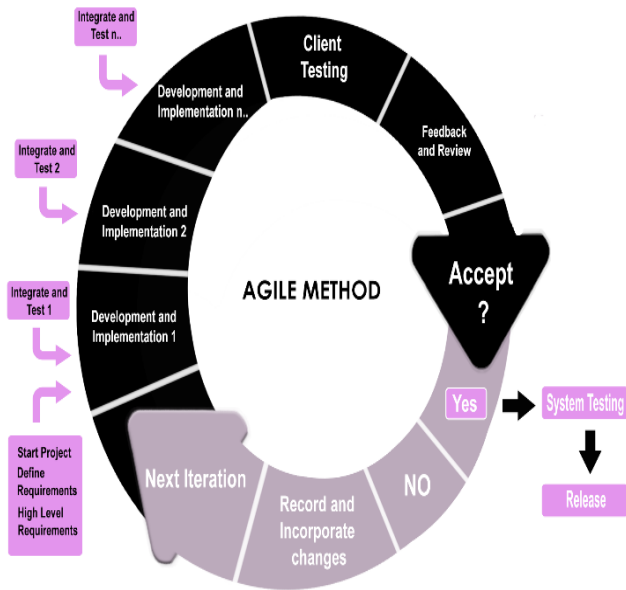
2.1 Data Gathering

The technique that the proponents used in gathering data and information is evaluation and clarification face to face interview. Proponents interviewed the staff of the Commission on Higher Education CAV team and stated the problem. The proponents gathered information and proponents found out that the Commission on Higher Education uses manual processing of applications up until now, they've been running this system for a long time manually and it's hard for them to produce numbers of CAV certificate, The current process that they follow is that school registrars would visit CHED office and physically submit the papers to the CHED moderators for it to be process. With that after 2-3 business days the verification process will be completed if there are any errors or lack of documents the CHED moderators would then contact the registrar and get those error fix by personally going to the office. Considering the numbers of colleges around region 11 the CHED office has a difficulty of catering them all and it takes up a lot of time for both Schools and CHED staffs. With that the CHED said that they would like to improve their system by investing and adopting into a web-based transaction which is what the proponents proposed after.

2.2 Requirement Analysis

2.2.1 User Requirements Definition

In this section, the proponents provide the lists of the user requirements or functions that the end-user deems necessary for every transaction procedure.

2.2.1.1 Allows the client to send a CAV application
2.2.1.2 Allows the admin to post an announcement and allow the client to comment.
2.2.1.3 To have a simple chat system.
2.2.1.4 Allows the admin to process the submitted application.

2.2.2 Hardware Requirements

The proponents require the following hardware specifications and software requirements to start the development of Web-Based Application. **Table 2** shows the system's minimum requirements that the system needs to establish and run the system.

Table 2. Hardware Specification

Hardware	Recommended Specs
OS	Windows 10 version 1909 (minimum) or Higher (21H1).
CPU	Intel Pentium G4600 @3.60Ghz (minimum) or higher
RAM	8GB (minimum) or Higher (recommended)
Screen Resolution	1920 x 1080
Storage	SSD – 120GB (minimum) or 256GB (recommended)
Internet	Required

2.2.3 Software Requirements

In **table 3**, it displays all the software requirements that the proponents be needed to develop the proposed Web-Based Application.

Table 3. Software Specification

Software	Use
Visual Studio Code	Used as the code editor for programming both front-end and back-end of Web-Based Application.
XAMPP	Will serve as the PHP local development environment and MySQL control panel.
Web Browsers (Google Chrome, Mozilla Firefox, MS Edge, and Opera GX)	Use different web browsers for running and testing the application during development and implementation after the deployment.

Git Bash	Use as the control system for pulling and pushing source code to git hub for team collaboration. Also serve as tracking and saving changes history in every file in the source code repository.
CMD	Use for manual and testing queries. Serve as control panel for inserting, updating, reading, and deleting data from the database.

The requirements that have been mentioned in table n and table n are just minimum and can use higher specifications for better development process.

In **table 4**, the proponents established the following system requirements for end-users.

Table 4. User Hardware Specification

Type of Device	Minimum Requirements
Personal Computer (Desktop or Laptop)	OS – Windows 7 or Higher. CPU – Intel Core Celeron or Higher. RAM – at least 2GB or Higher. Browser – Google Chrome, Mozilla Firefox, MS Edge, Opera GX.
Internet	Required Speed – at least 10mbps or Higher.

The system can function properly if the device meets or exceeds the required system requirements. However, the proponents cannot guarantee that the system performance will do well with those users that cannot achieve the minimum system requirements.

2.2.4 Technical Tools
For the proponents to achieve the desired objective the following tools will be utilized to build and develop the proposed CHEDROXI-CAV web application.

2.2.4.1 Vue.JS
One of the tools that the proponents will utilize to build the proposed web application is Vue.JS. In which Vue.JS is mainly used on building the front-end of a web application. HTML extension together with JS base plus electron framework, enables it also to be used in desktop and mobile applications. In the researcher's case they will only build web applications to build the proposed capstone project [8]. The proponents also picked Vue.JS because of its small file size, its flexibility and Integration capabilities, its components are stored in different files which makes it easier to read, maintain, and fix if needed. its easy access to documentation which allows developers to learn it a lot faster, and as well as its supportive community that enables it to have a lot of activities on the internet [9].

2.2.4.2 Laravel
Taylor Otwell was the one who made Laravel possible, it is an open-source PHP web framework that was meant to give a more improved version of CodeIgniter framework. In terms of Object-relational Mapper Laravel has the upper hand compared to other frameworks on the market. Using an expressive syntax, it would allow developers to interact with database objects and database relationships. The Artisan Console also plays a huge role in making the developers coding process a lot easier which made the researchers lean on it more compared to other frameworks [10].

2.2.4.3 MySQL
MySQL is widely utilized throughout many projects that utilize databases. Some notable projects and Organizations are Twitter, Booking.com, and Facebook [11]. The reason most developers, including the researcher's utilized MySQL is that it is open-source and highly compatible with a lot of database models and programming frameworks, it is also a fast and reliable database management tool that is for free. It is also up 24/7 because of its clustered servers and data replication configurations. It also has a lot of backup and recovery options to make sure that your data is not lost if ever there is an unfortunate event like a system crash. Not just that but it also has a built-in security that makes sure that your data would not be at risk of cyberattacks which makes it more secure [12].

2.2.4.4 Advanced Encryption Standard (AES)
AES is used for securing the data that the users put and store on the proposed web application. AES utilizes a long key length option which allows it to increase the time it takes to crack open encrypted data which makes it more secure. It uses 128-bit, 192-bit, or 256-bit keys which is a lot longer compared to its counterpart DES which utilizes 56-bit keys [13]. Therefore, the researchers will utilize it to make sure that the users of the proposed project will have no fear of sensitive information being leaked.

On the other hand, AES will be the researcher's capstone element of choice. For it to be utilized and implemented on the proposed system, the researchers plan to use 256bit encryption method and a secret key that is defined by utilizing a MD5 version of a chosen word. For example, "chedroxi" plus the current year in which will be automatically updated every year since it will base on the current year and would result in something like the following. *c72e38358a32c4dabc29ed9f59318e812022*. With the secret key defined it will ensure that the data will be stored securely on the database. This process will be done on the back-end side of the project. In which all input with an exception to fields that are not necessarily need to be encrypted like date, ID, and Status (active and inactive) and will be saved as a blob data type for it to work with AES functionality.

2.2.4.5 Bootstrap CSS
Bootstrap CSS will be used to make the website more responsive and makes it a whole lot easier for web development. Bootstrap is widely used because of its ease of use and because it's free [14]. That is why it will be utilized to help make the web application more user-friendly and have a pleasing design that would make the users more comfortable using the proposed capstone project.

2.2.4.6 Material Design Icon
Material Design Icon will be utilized by the researchers to make the user interface a lot more pleasing by using their free Icons which adds a lot more indicators on how the website works and its functions.

2.2.4.7 Mailjet API
Mailjet API is utilized to send out email notifications to the corresponding school registrar that have discrepancies on their submitted documents which allows them to act as soon as possible. Mailjet API uses drag-and-drop editor to make sending and editing emails a lot easier. It also has a free version that will cater 600 emails a month which will be sufficient for informing CHED clients [15].

2.2.5 Functional and Non-Functional Requirements
To attain the general objectives, the proponents will develop web-based application to specify:
2.2.5.1 Functional Requirements
This section explains the functional requirements of CHE-DROXI-CAV application
2.2.5.1.1 Log-in users
This function will allow the CHED RO 11 Administrator, Moderator and HEI School Registrar to access the application.
2.2.5.1.2 Process and Output
This function will allow clients to comply with the said requirements and moderators to check and validate the credentials.

2.2.5.1.3 Feedback
If there's any deficiency about the credentials it will inform the clients right away, and there will be an announcement section to all the users if there's any changes in the application.

2.2.5.2 Non-functional Requirement
This section explains the Non-functional requirements of CHE-DROXI-CAV application

2.2.5.2.1 Availability
To make sure that the application is 24/7 accessible anytime and anywhere

2.2.5.2.2 Security
The proponents utilize Advanced Encryption Standard (AES) for data security ensuring no data will leak from outsiders.

2.2.5.2.3 Usability
This application aims to develop a user-friendly application which everyone can operate the system easily.

2.2.6 Feasibility Study
This section discusses the feasibility study of the proposed project. To ensure that it would be feasible, applicable, sustainable, and effective in upgrading the current process of the target client.

2.2.6.1 Operational Feasibility
The Commission on higher education is currently using manual processing for the CAV issuance, they collect all the hard copy of credentials by the respective HEI's representative that went to CHED office and turnover it. CHED manually checks all the papers they collected and validate it to make sure that there's no deficiency information. Based on the conducted evaluation they prefer switching to web-based transactions, wherein the focal personnel in each HEI will just encode the data and the moderators from CHED will just accept documents for validation or reject if the submitted documents is lacking. With the help of the proposed application, they will switch from a local to an online method to process the CAV issuance. The intended users are also open to training and participation to use the application. In addition, the CHED and HEI will have a faster, secure, reliable, and efficient mode of transaction.

2.2.6.2 Technical Feasibility
The Commission on Higher Education has their own sets of personal computers to encode and validate all the data that is given to them. Technically, The CHEDROXI-CAV Application is feasible. It will work with both phones, personal computers, and laptops. It requires Windows 7 in the OS, Intel Core Celeron in CPU and at least 2GB of RAM for you to utilize the application. Hence, they are willing to use an automated application and it would be a good reason to utilize the web-based CAV as soon as it is deployed. To use it you must have an internet connection as well, at least 10mbps.

2.2.6.3 Economic Feasibility
The Commission on Higher Education was established for a very long time, but they need to improve their current system on how they process the CAV issuance from local to an online application, based on the conducted evaluation. CHEDROXI-CAV is feasible because it can be used even without installing the application because the users can use it thru web browsers.

2.2.6.4 Schedule Feasibility
In this section it shows the targeted schedule and research duration of the proposed CHEDROXI-CAV application which is shown in the appendix figure 2.

2.3 Design
2.3.1 Conceptual Framework
In this section, the proponents will provide a road map that will show how the users will interact with the proposed system which is shown in figure 3 at the appendix section. This includes the *Input, Output, and Process* of the proposed system.

2.3.1.2 Input
The target users of the project are the Commission on Higher Education (CHED) Moderators and the respective Higher Educational Institution (HEI's) School registrar. The school registrar uses accounts given by CHED to access the application. CHED moderators can access the application using the account given by the Admin. They will have different access controls and features of the application. The school registrar will be able to add CAV applications and submit the necessary documents for checking and verification. They are also able to interact and view announcements posted by CHED. While the CHED Moderators can process the CAV applications by checking for errors and verifying that the submitted documents are complete and with no errors. They can also print out the CAV applications after

checking and verifying the clients' submitted documents. Moderators can also add and update CAV signatories and prices. The admin will be able to add and register a list of schools, manage user access controls, add moderators, and school registrar accounts and with CHED request both moderator and admin are able to add and update CAV Signatories and prices.

2.3.1.3 Process
The application will let the CHED Moderators keep track and manage records submitted by the respective school registrar for processing. They can accept and reject documents and keep track of their status and search for specific students or schools for filtering. This will enable them to have a much easier way of handling requests from schools. The moderators are also able to print out the CAV output via the application for an easier process. They will also have reports in their dashboard to keep track of things While the school registrar will be able to submit their documents electronically for verification and checking and look at announcements for any news and updates. The admin will manage the registration for both moderator and client and manage access controls and have a report in their dashboard for tracking the process of CAV applicants. For this project the researcher will utilize Laravel framework for back-end and VueJS for front-end together with MySQL for database management. AES is also utilized for a more secure database.

2.3.1.4 Output
The output of the application is records management, ability to search for client's records, Announcement posting, reports generation for monthly reports, submission of documents electronically and printing out CAV certificates for the accepted and verified applicants. Figure 3.1 shown in the appendix is the reports generation of the proposed project. It shows the total percentage of the accepted and disapproved applications to easily keep track of it and make reports out of it. Figure 3.2 shown in the appendix is the sample CAV certificate that would be printed and given out by the CHED moderator to the School Registrar to indicate that the transaction is complete and without any errors.

2.3.2 Data Models – Database Design
In this section, the proponents will show and present different figures that will depict how data moves throughout the system and how it interacts with one another.

2.3.2.1 Use Case Diagram
Figure 4, shown on the appendix section lets us see the whole process of the system. There are three (3) users that will be utilizing the proposed web application, the school registrar, Moderators, and Admin. All users could log on to the website using their accounts given by the admin. Different users have different accessibility. The school registrar could only use the website to fill up and submit CAV applications, reply to threads and messages, and view their application status. The moderator on the other hand could process CAV applications by verifying it and check for any discrepancy it may have and inform the school registrar about it via thread posting, messaging function, or email. They can print CAV certificates output once the verification process is complete. They could view schools and students' information regarding their submitted documents and view reports that will be used to generate monthly reports. They also

utilized the Security Paper (SecPa) counter to keep track of its numbers and inventory. Lastly, the admin could add system users, schools, programs, and CAV signatories to the application so that the moderators could have the necessary data they need to produce a CAV certificate. CAV certificate does not come for free, so the admin can add or update the current asking price for a CAV certificate.

2.3.2.2 Entity Relationship Diagram
Entity Relationship Diagram (ERD) shown in figure 5 at the appendix section, shows how different tables are related to one another and how different data interacts with the proposed web application.

2.3.2.4 Data Dictionary
The proponents provide data dictionaries to present the metadata and description of each attribute in the database. Table 5 shows the user's instance. Please refer to the Appendix to read the other set of data dictionaries.

Table 5. Users

Field Name	Data Type	LENGTH	Description
userID	INT	11	Represents the unique ID for the system user, auto increment and primary key.
lastname	VARCHAR	30	Represents the last name of the system user.
firstname	VARCHAR	50	Represents the first name of the system user.
username	VARCHAR	30	Represents the nickname and account name of the system user.
password	VARCHAR	30	Represents the secret key of the system user.
emailAddress	VARCHAR	50	Represents the emailing address of the system user for notification.
roleID	INT	11	Represents the roleID from table roles, foreign key.
picture	BLOB		Represents the profile picture of the system user.
active	VARCHAR	3	Represents if the system user is active or inactive. Yes – When the user is active. No - When the user is inactive.

2.3.4 Architectural Design
Figure 6 represents the design of the software and the process behind every interaction. It will also explain the process of request and response of the system. The user will interact with the front-end, while accessing through the internet it will contact the web server. The web server will make requests to the database and give responses back to the web server. From the web server

it will send back the data through the internet using SSL and contact the API and the front-end. The front-end will display all the data from the response of the back end.
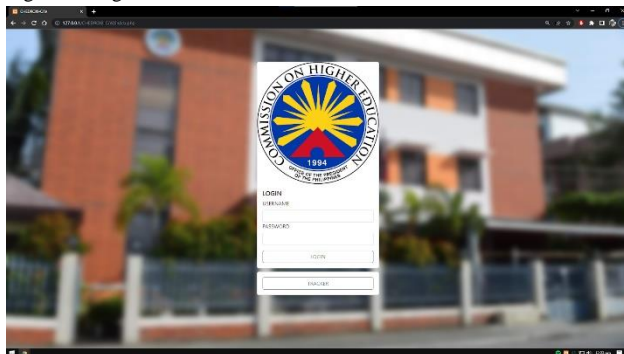
Figure 6 Architectural Design
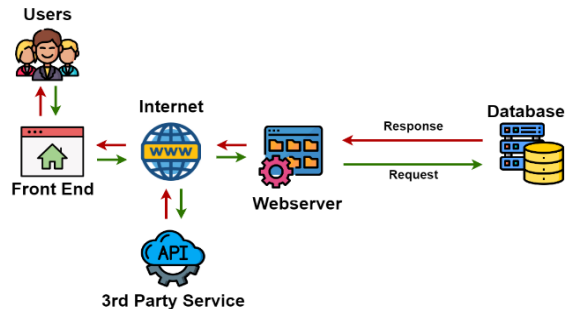
2.3.5 Sample Prototype
The following figures depict the initial design or prototype of the application.

Figure 7. Login

The proponent's first form is shown in figure 7. It's a login module that allows users to access their accounts. It redirects the user using the specific role given. If the user is from CHED, it will redirect to the admin modules. If the user is from HEI, it will redirect to the client modules. The login form also includes a link to the tracker module.

Figure 8. Tracker
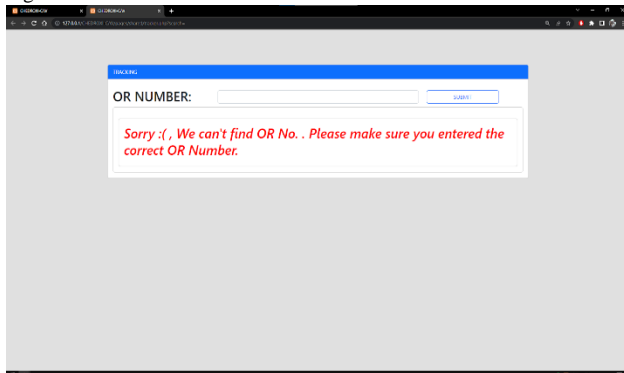
The proponents' second form is shown in figure 8. It's the tracker module mentioned in the first form. This module allows the user

to view the status of his/her submitted application by searching his/her official receipt number in the search box.

2.3.5.1 Sample Prototype: Admin Modules (CHE-DROXI)

Figure 9. Dashboard
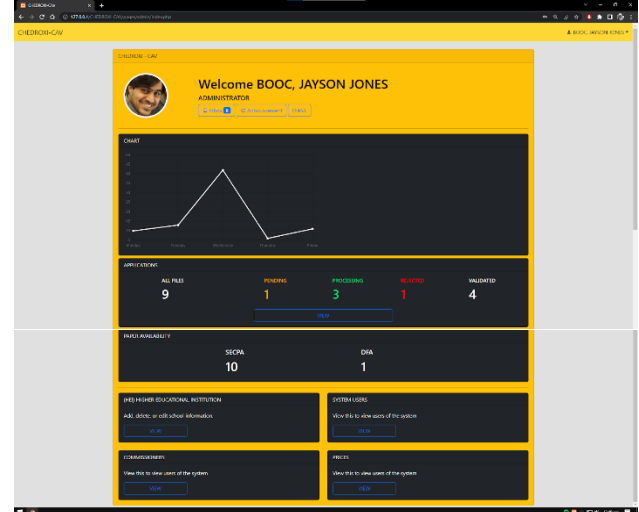
After logging in as administrator/moderator account, the user will be redirected to the administrator dashboard which is shown in figure 9. From there, the admin user can view the dashboard with the graph of current month's application approval and disapproval. The user can also view and reply to the messages sent by the clients. Can create an announcement which is shown to every HEI account. The user can also see how many applications that are currently pending, in process, rejected, and already validated. Can also view the amount of security paper available in the database. The user can view, add, update, and remove school from the database. The user can view, add, update, and delete system users. The user can view, add, update, and remove signatory personnel. Lastly, the user can also view, add, update, and remove document prices.

2.3.5.2 Sample Prototype: Application Module (Administrator)

Figure 10. Submitted Applications

Figure 10 shows the list of submitted applications sorted by Higher Educational Institution (HEI). From here, the user can

view the initial data of the submitted application.

Figure 11. View Submitted Application Details

After clicking the view button from figure 10, it will display figure 11, all the details inside the submitted application. The moderators will be the one to input the official receipt number and accept or reject the submitted application. If the submitted application is complete and no lacking information(s) the user will accept the file together with the OR number. If the submitted application is lacking or has defiance, the user will reject the file.

2.3.5.3 Sample Prototype: Messaging Module (Administrator)

Figure 12. Messages

Figure 12 represents the messages sent by the HEI account. From here, the user can view all the messages with the date of when the message was created.

Figure 13. Message Replies

After clicking a message to view, it will display the message and all the replies made by the interaction of CHEDROXI user and HEI user.

2.3.5.4 Sample Prototype: Announcement Module (Administrator)

Figure 14. Announcements

Figure 14 represents the announcement posted by the administrators. The user can post an announcement, bring down the announcement that is not visible to everyone, bring up an announcement that will be visible to everyone and allow thread posting.

2.3.5.5 Sample Prototype: HEI Module (Administrator)

Figure 15. Higher Educational Institution (HEI)

Figure 15 represents the list of all Higher Educational Institutions (HEI) all over region 11. From here, the user can add a new school that is not available from the database, can view, update, and remove.

Figure 16. Add School

After clicking the add school button, it will redirect to add school form as shown in figure 16.

2.3.5.6 Sample Prototype: System Users Module (Administrator)
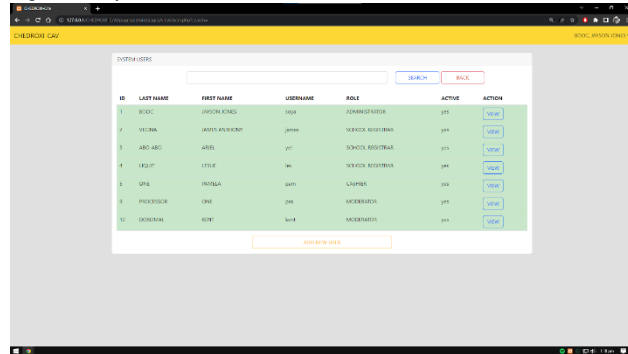
Figure 17. System Users

Figure 17 shows the list of all system users. From here, the administrator account can only view, add, update, and remove.
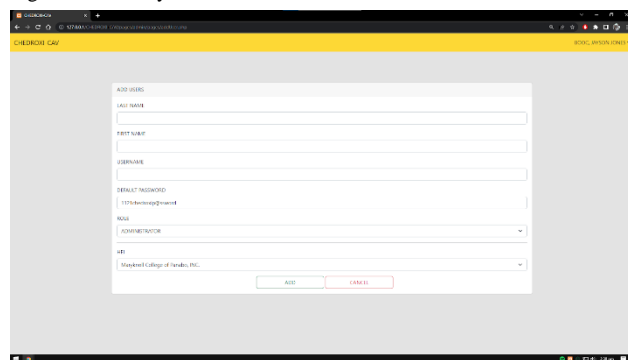
Figure 18. Add System User

Figure 18 shows the fields that are needed to fill out for system user details. Can select what role and HEI.

2.3.5.7 Sample Prototype: Signatory Module (Administrator)
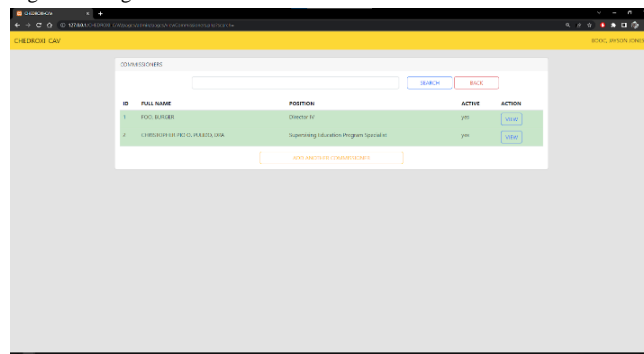
Figure 19. Signatories

Figure 19 shows the panel for viewing, adding, updating, and removing signatory personnel.
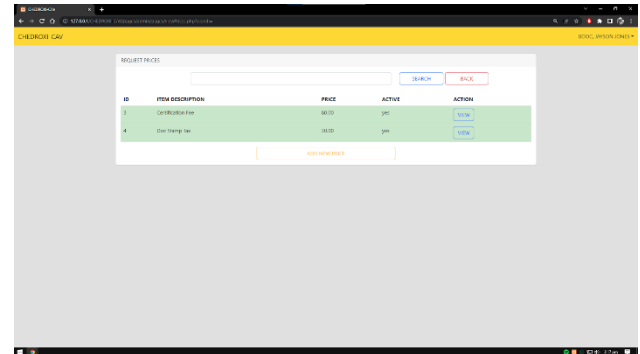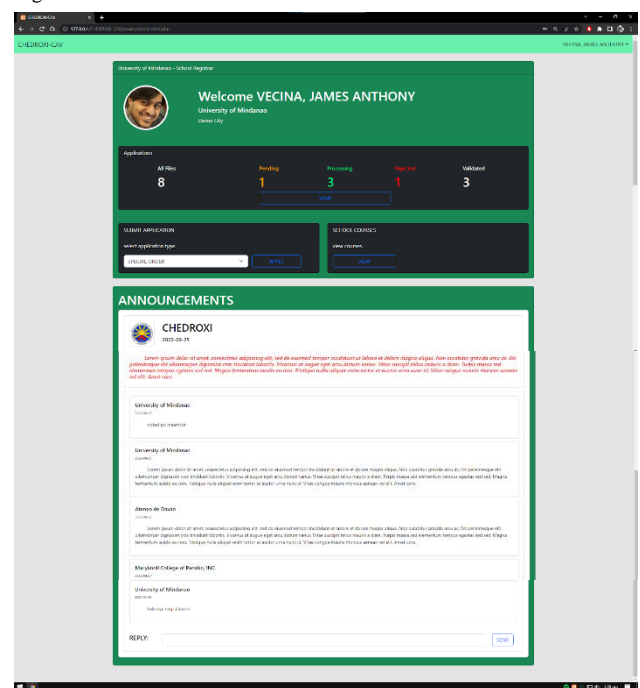
Figure 20. Document Prices

Figure 20 shows the document prices panel wherein the user can view, add, update, and remove document prices.

2.3.5.8 Sample Prototype: Client Modules (HEI)

Figure 21. Dashboard

After logging in as a client (HEI School Registrar) account, the user will be redirected to the client modules. From here, the user can see the number of submitted applications sorted by the status (Pending, Processing, Rejected, and Validated). The user can also see the announcements posted by CHED Region 11 personnel and the client can also comment on the said announcement.

2.3.5.9 Sample Prototype: Application Module

Figure 22. Submitted Applications

Figure 22 shows the list of all submitted applications from the specific HEI using the client account.

2.3.5.10 Sample Prototype: Submission Module

Figure 23. Application

Figure 23 shows the form that the client needed to input information for submission.

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APPENDIX

Figure 2. Research Schedule

PHASES	SUBPHASES	MONTHS											
		Aug 22	Sep 22	Oct 22	Nov 22	Dec 22	Jan 23	Feb 23	Mar 23	Apr 23	May 23	Jun 23	Jul 23
DEVELOPMENT CYCLE	Starting Project and Defining Requirements	■	■										
	Development and Implemtation			■	■	■							
	Development and Implemtation						■	■	■				
	Development and Implemtation									■	■		
CLIENT TESTING	Feedback and Review											■	■
	Evaluation and Deployment											■	■

Figure 3. Conceptual Framework

INPUT — Schools, Staffs, Admin — LOG IN — SUBMIT

PROCESS — CHEDROXI-CAV (The System)

OUTPUT — Records Management, Post Announcements, Generate monthly Reports base on application approval percetage, Printout CAV Certificates
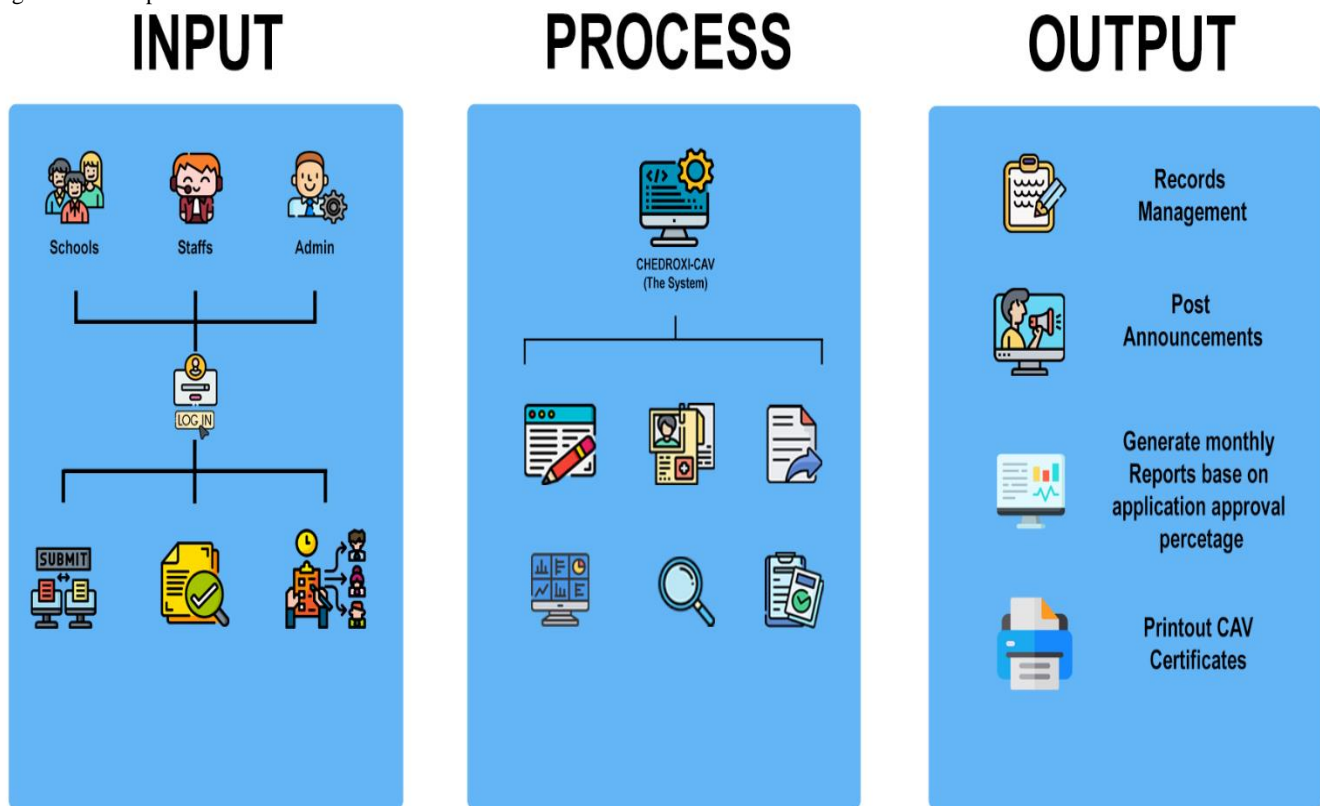
Figure 3.1. Reports Dashboard

Figure 3.2. Sample CAV Certification

Figure 4. Use Case Diagram

SCHOOLS

STAFFS

UPDATE/REMOVE SCHOOLS

UPDATE/REMOVE SCHOOL PROGRAMS

UPDATE/REMOVE SYSTEM USERS

ADD/UPDATE PRICE

SEND DOCUMENTS

VIEW REPORTS

PRINT CERTIFICATES

PROCESS CAV APPLICANTS

VIEW SCHOOLS AND STUDENTS RECORDS

ADD SECURITY PAPERS
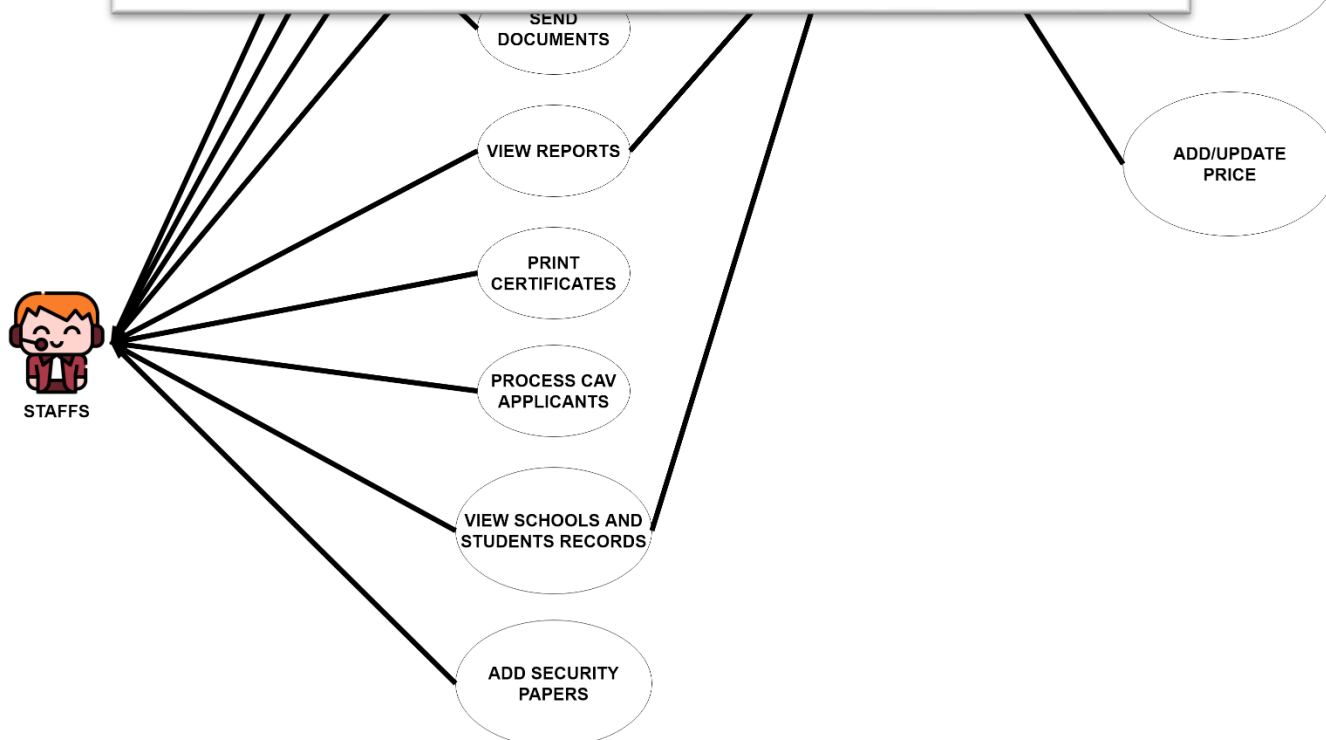
Figure 5. ERD
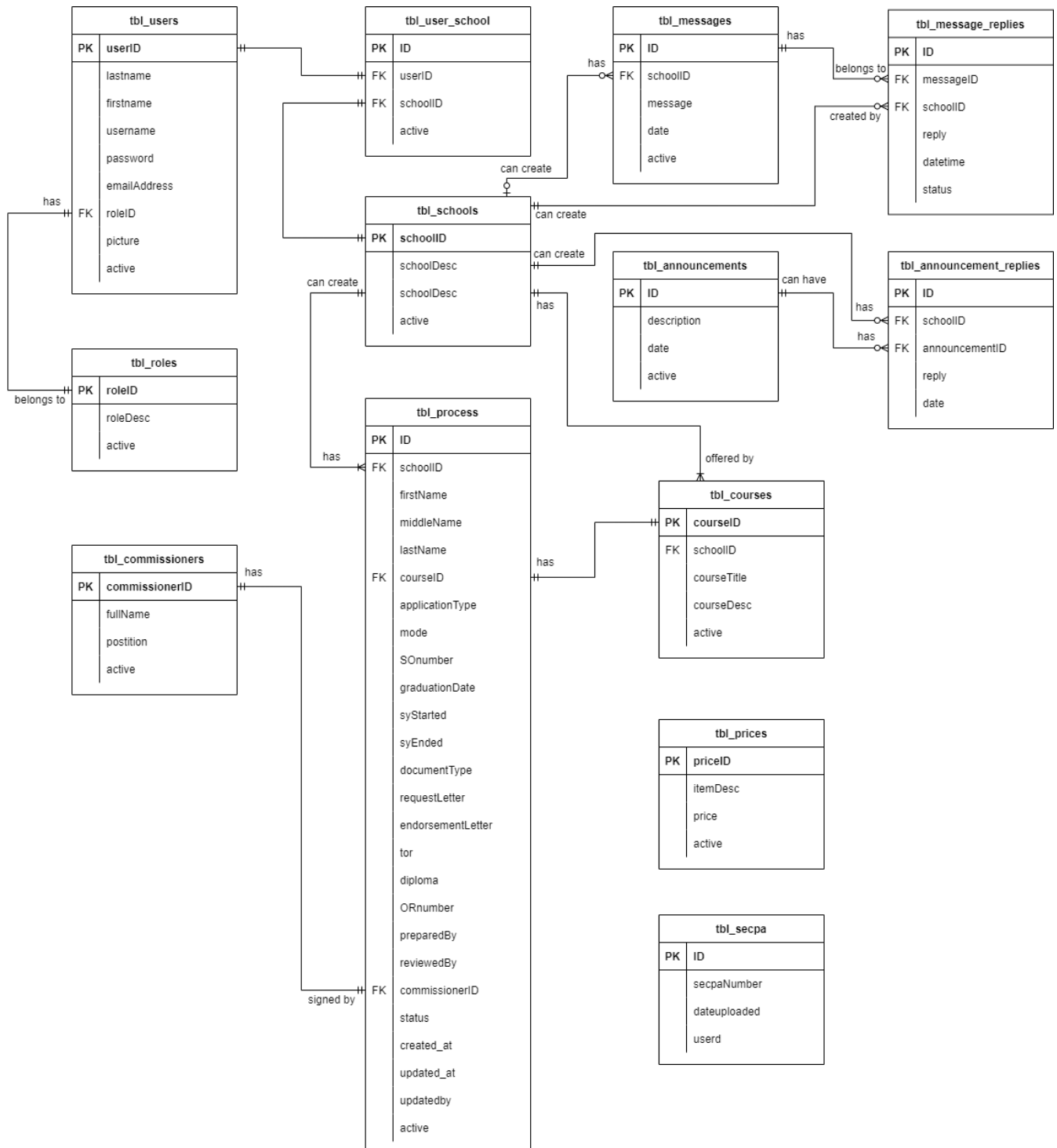
DATA DICTIONARY CONT.

Table 6. Process

Field Name	Data Type	Length	Description
ID	INT	11	Represents the unique ID of the submitted application. Primary key, auto increment.
schoolID	INT	11	Represents the sender. Foreign key.
firstName	VARCHAR	50	Represents the first name of the submitted application.
middleName	VARCHAR	50	Represents the middle name of the submitted application.
lastName	VARCHAR	50	Represents the last name of the submitted application
courseID	INT	11	Represents the program of the submitted application.
applicationType	VARCHAR	20	Represents the kind of application.
mode	VARCHAR	20	Represents the mode of application.
SOnumber	VARCHAR	20	Represents the serial number of the student.
graduationDate	VARCHAR	30	Represents the date when the applicant graduated.
syStarted	VARCHAR	30	Represents the date when the applicant started learning.
syEnded	VARCHAR	30	Represents the date when the applicant ended learning.
documentType	VARCHAR	30	Represents the type of document of the submitted application. Local – for local certification. DFA – for overseas certification.
requestLetter	BLOB		Represents the request letter of the submitted application.
endorsementLetter	BLOB		Represents the endorsement letter of the submitted application.
tor	BLOB		Represents the transcript of records of the submitted application.
diploma	BLOB		Represents the diploma of the submitted application.
ORnumber	VARCHAR	30	Represents the Official Receipt of the submitted application.
preparedBy	VARCHAR	50	Represents the name of the personnel who approve for processing of the submitted application.
reviewedBy	VARCHAR	50	Represents the name of the personnel who reviewed and validate the submitted application.
commissionerID	INT	11	Represents the unique ID of the signatory personnel. Foreign key.
status	VARCHAR	11	Represents the status of the submitted application. Accepted – when the submitted application is accepted by the moderator. Processing – when the submitted application is being processed or for review by the moderator. Rejected - When the submitted application is rejected because of document deficiency or lacking requirements. Validated – When the submitted application is already validated by the moderators and for release for certification.
created_at	DATE		Represents the date when the submitted application was created.
updated_at	DATE		Represents the date when the submitted application was updated by the moderator.
updatedby	VARCHAR	50	Represents the name of the moderator who updated the status.
active	VARCHAR	3	Represents the status of the submitted application. Yes – when the application is active. No - when the application is not active.

Table 7. Announcement

Field Name	Data Type	Length	Description
ID	INT	11	Represent the unique ID of announcement. Primary key, auto increment.

Field Name	Data Type	Length	Description
description	VARCHAR	500	Represent the description of the announcement.
date	DATE		Represents the date when the announcement was added.
active	VARCHAR	3	Represents the status of the announcement. Yes – When the announcement is up or visible to all. No - When the announcement is down or not visible to all.

Table 8. Announcement Replies

Field Name	Data Type	Length	Description
ID	INT	11	Represents the unique ID of the reply. Primary key, auto increment.
schoolID	INT	11	Represents the institution of the user. Foreign Key.
announcementID	INT	11	Represents the ID of the message to be replied. Foreign Key.
reply	VARCHAR	500	Represents the message to be replied.
date	DATE		Represents the date when the reply was made.

Table 9. Schools

Field Name	Data Type	Length	Description
schoolID	INT	11	Represents the unique ID of the Higher Educational Institution (HEI). Primary key, auto increment.
schoolDesc	VARCHAR	50	Represents the HEI description.
schoolCity	VARCHAR	30	Represents the HEI location in region 11.
active	VARCHAR	3	Represents the status of the HEI. Yes – When the HEI is available. No – When the HEI is not available.

Table 10. School of User.

Field Name	Data Type	Length	Description
ID	INT	11	Represents the unique ID of the user school. Primary key, auto increment.
userID	INT	11	Represents the ID of the user to be linked. Foreign Key.
schoolID	INT	11	Represents the ID of the HEI of the user. Foreign Key.
active	VARCHAR	3	Represents the status of the data.

Table 11. Message Replies

Field Name	Data Type	Length	Description
ID	INT	11	Represents the unique ID of the reply. Primary key, auto increment.
messageID	INT	11	Represents the id of the message to be replied.
schoolID	INT	11	Represents the sender of reply. Foreign key.
reply	VARCHAR	500	Represents the message of the reply.

datetime	DATE		Represents the date when the reply was created.
status	INT	1	Represents the status of the reply. 0 – Unread 1 - Seen

Table 12. Messages

Field Name	Data Type	Length	Description
ID	INT	11	Represents the unique ID of the message. Primary key, auto increment.
schoolID	INT	11	Represents the sender.
message	VARCHAR	500	Represents the message.
date	DATE		Represents when the message was created.
active	INT	1	Represents the status of the message. 0 - Unread 1 - Seen

Table 13. Roles

Field Name	Data Type	Length	Description
roleID	INT	11	Represents the unique ID of roles. Primary key, auto increment.
roleDesc	VARCHAR	30	Represents the description of the role.
active	VARCHAR	3	Represents the status of the role. Yes – When the role is available. No - When the role is not available.

Table 14. Signatories

Field Name	Date Type	Length	Description
commisionerID	INT	11	Represents the unique ID of the signatory personnel.
fullName	VARCHAR	100	Represents the full name of the signatory personnel.
position	VARCHAR	50	Represents the position in the CHEDROXI of the signatory personnel.
active	VARCHAR	3	Represents the status of the signatory personnel.