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| RESEARCH ARTICLE

UC CCS CAMPUSCORE: A Secure Digital Repository as Knowledge Management System

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| ABSTRACT

The UC-CCS CampusCore is a secure and centralized digital repository designed to address the challenges faced by students and faculty members in managing their course and research deliverables at the University of Cebu - Main Campus. This study aims to validate the problems faced by students and faculty members and assess the feasibility of the proposed solution. The research methodology involves problem and solution validation through surveys and interviews. The results indicate a high level of favorability for the proposed system among both students and faculty members, emphasizing the need for a secure and accessible platform. The findings will inform the development of the UC-CCS CampusCore system, ensuring its alignment with user needs and requirements.

| KEYWORDS

Digital Repository, Knowledge Management System, TCPDF, Digital Signature, Hashing, Salting

| ARTICLE INFORMATION

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1. Introduction

College repositories play a critical role in supporting academic institutions' research and teaching missions, and they are essential to be secure. Repositories may contain confidential or proprietary information, such as research data, personal information, and intellectual property, which must be protected from unauthorized access and theft. To protect sensitive information, college repositories must have robust security systems in place, including firewalls, encryption, and access controls. By protecting sensitive data, the repository's integrity, users' privacy, and the repository's security, the college can ensure that its warehouses are secure, reliable, and trustworthy. This is essential for supporting academic institutions' research and teaching missions, and it is a crucial factor in ensuring the preservation and dissemination of knowledge.

The College of Computer Studies at the University of Cebu Main Campus offers various courses requiring students to submit document deliverables. This includes courses in Systems Analysis and Design, Software Engineering, Information Management 1 and 2, Project Management, Research Communication, Technopreneurship, and Capstone Project 41 and 42. Despite the importance of these courses and the significant effort students put into their deliverables, the college currently needs a proper repository and secure platform to store them. Another concern is the security of the document deliverables. With the rise of cyber threats and data breaches, the college must have secure data storage platforms. With a secure platform, the document deliverables submitted by students are protected from theft or unauthorized access, which can have serious consequences. This includes losing sensitive information, intellectual property, and personal data. The College of Computer Studies at the University of Cebu Main Campus needs help with its repository system. The courses offered by the college require students to submit document deliverables, but the college currently needs a proper repository and secure platform to store these deliverables. This lack of

adequate repository not only puts valuable knowledge and resources at risk of being lost but it also affects students' academic and professional development, leaving their deliverables vulnerable to theft or unauthorized access.

Given these challenges, the researchers must develop a digital repository to address the college's repository problem. By creating a secure and accessible platform for storing document deliverables, researchers and students can help ensure that valuable knowledge and resources are preserved and protected and that students can access and use their deliverables for academic and professional purposes. This will benefit the college, its students, and the wider academic community, and it will help to ensure the continued growth and success of the College of Computer Studies at the University of Cebu Main Campus.

1.1 Objectives of the Study

The primary objective of this study is to provide a secure and accessible digital repository as a knowledge management system for student and teacher courses and research deliverables for the UC Main College of Computer Studies.

Specifically, the proposed study aims to:

1. Assess the current repository system including its weaknesses and the challenges it faces.
2. Design a secure and accessible digital repository that can store document deliverables.
3. Develop a secure and user-friendly platform that can store document deliverables and is designed to meet the needs and requirements of the UC Main College of Computer Studies by implementing the approved designed components.
4. Test the digital repository to ensure that it meets the needs and requirements of the university and provides a secure and accessible platform for storing document deliverables.

2. Literature Review

2.1 Digital Repository

Several studies have emphasized the importance of digital repositories in knowledge management, specifically in academic institutions. According to Hakopov (2016), a modern digital information repository may help users in a much more comprehensive range of ways and provide its primary role of gathering and preserving records. It is more than simply an electronic archive; when coupled with expert categorization systems like ontologies and propelled by contemporary semantic technology, it constitutes a whole Knowledge Organization System (KOS). The help of digital repositories can facilitate collaboration among individuals and enhance the dissemination and preservation of digital outputs.

According to González-Pérez et al. (2021), technical capabilities, user standards that specify what can and cannot be published in open access, and training programs for institutional repository use are all necessary to encourage an academic community to use a repository. Providing an intuitive and flexible user experience on digital platforms is essential to enhance user satisfaction.

Furthermore, catalogs were gradually transitioning from analog to digital as bibliographic archives changed along with the advancement and development of information technology. However, their sole function remained unchanged: to allow information retrieval and serve as storage (archival) (Hakopov, 2016). Typically content can include research outputs such as journal articles or research data, e-theses, e-learning objects and teaching materials, and administrative data. Some repositories only include particular items (such as theses or journal papers). In contrast, others seek to gather any credible scholarly work the institution produces, limited only by each author's retained rights from publishers (Krishnan, 2016). Given that most of them developed from traditional library practices, it is not surprising that the organization of repository workflow resembles library operation structures. Repositories have advanced and offer highly technical digital information storage options with many potent capabilities to gather, organize, index, format, and retrieve information.

Shoeb (2009) states that access management is one of the essential services for the network infrastructure of digital repository operations for a variety of audiences. One of the main issues for the Internet's authority over digital material is access management and control. With an efficient access management mechanism, information confidentiality and integrity can be guaranteed. Local repositories or digital libraries require better security and authenticity, even though most institutional repositories or open-access repositories are happy with the current methods of the open-source software they use to establish the repositories.

These studies demonstrate the potential benefits of digital repositories as knowledge management systems in academic institutions and other organizations. They highlight the importance of ensuring the security and confidentiality of the repository, as well as effective metadata management and interoperability. Additionally, the studies underscore the potential benefits of digital repositories in facilitating collaboration, knowledge sharing, and decision-making processes.

2.2 Knowledge Management System

According to the knowledge-based theory of the company, knowledge is the organizational resource that permits sustained competitive advantage in situations with intense competition. The focus on knowledge in modern companies depends on the idea that barriers to knowledge transmission and replication give it strategic significance. Many businesses are creating information systems that are intended to make it easier to share and combine knowledge. Knowledge Management System (KMS) is the term used to describe such systems (Alavi & Leidner, 2001). Through this implementation of the Knowledge Management System, companies or schools can aim to foster a culture of knowledge sharing and collaboration, enabling employees, students, and teachers and allowing them to draw on the organization's combined knowledge and experience.

Advancements in technology have led to the emergence of new trends in knowledge management systems. Recent studies have explored the integration of artificial intelligence, machine learning, and natural language processing techniques to enhance knowledge retrieval, automated knowledge extraction, and personalized knowledge recommendations (Alavi & Tiwana, 2002; Hlupic et al., 2002; Wang & Noe, 2010).

Additionally, the rise of social media and collaboration platforms has influenced how organizations create, share, and access knowledge (Emerging Trends in Knowledge Management Systems, Leonardi, 2013; Wasko & Faraj, 2005).

2.3 Digital Security (E-Sign)

According to Turner (2017), a digital signature can be a valid substitute for a handwritten signature or official stamp, assuring the signature's legitimacy. This makes its use advantageous for many governments, businesses, and organizations for signing correspondence or documents linked to electronic commerce, regulatory filings, banking, and contracts, in addition to many other situations where a verifiable signature is necessary. This technology can also promote openness and accountability by generating an audit trail of signed documents, which can prevent fraud and tampering. Overall, the advantages of digital signatures make them an excellent tool for companies wishing to expedite their operations while ensuring document security and integrity.

Electronic signatures offer many benefits over traditional signatures but also present technical challenges that must be addressed. Chichernea (2010) states that the electronic signature is based on a sophisticated and intricate technology that consists of the following parts:hash-code, private key, public key, the mechanism of creating the electronic signature, the mechanism of verifying the electronic signature, and the secured mechanism of creating the electronic signature. The successful implementation of electronic signatures relies on proper understanding, adoption, and adherence to the appropriate technical standards and protocols.

According to Kahled et al. (2018), a digital signature is a cryptographic method of converting data into different forms that may be read using a key. The digital signature is used to authenticate a license on an online interface. Digital signatures, compared to electronic signatures, are based on mathematical procedures. This procedure ensures that the data is secure and cannot be tampered with. As such, digital signatures provide a reliable and secure means of authenticating online transactions and communications.

2.4 Related Systems

2.4.1 Animo Repository

De La Salle University's Animo Repository is an online platform that facilitates access to a broad range of content generated by faculty, students, and researchers. This content includes scholarly works, such as academic papers, research reports, and theses, as well as creative works like poetry, fiction, and artwork. By hosting these works online, the Animo Repository makes them easily accessible to anyone who wants to read, view, or download them. In addition to scholarly and creative works, the Animo Repository also serves as a digital archive for various other materials related to De La Salle University. This could include things like photographs, videos, and audio recordings of university events, as well as diaries or personal accounts from faculty and staff. By collecting and preserving these materials in digital form, the Animo Repository helps to ensure that they can be accessed and enjoyed by future generations of students, scholars, and researchers.

Figure 1: **Animo Repository**

2.4.2 Iskomunidad

Iskomunidad is an online wiki platform the University of the Philippines Diliman created to provide a centralized knowledge base for its students, faculty, and staff. The platform offers a range of content, including articles, theses, and information about upcoming events. Users can conveniently access the specific information they require by consolidating this information in a centralized location. Iskomunidad also provides a space for users to collaborate on projects and activities, share institutional catalogs, and clarify inaccurate or incomplete information about the university. Additionally, Iskomunidad encourages the exchange of valuable materials and new ideas, creating a more collaborative and supportive environment for learning and growth.

Iskomunidad boasts a significant feature that enables users, including students, faculty, and staff, to collaborate on projects and activities. Through this platform, they can document the advancement of diverse projects and research activities while sharing their discoveries with the broader community. Iskomunidad also provides a space for users to describe their academic research, post events, and share institutional catalogs. By doing so, Iskomunidad plays a crucial role in keeping the UP community well-informed and updated regarding the latest news and events within the university. Finally, Iskomunidad aims to provide accurate and reliable information about the university by allowing users to contribute to and edit the content on the platform. This ensures that the information provided is always up-to-date and reflects current knowledge about the university.

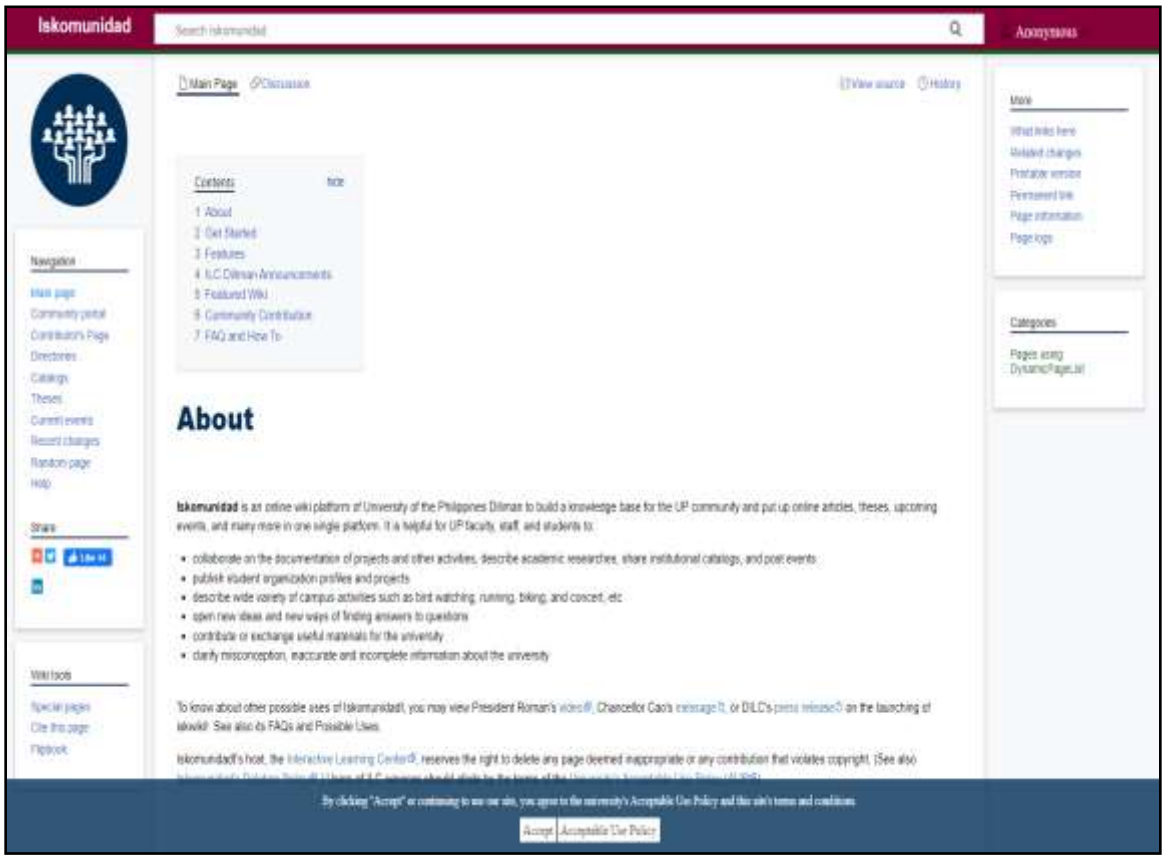


Figure 2: **Iskomunidad**

2.4.3 Philippine E-Journal

The Philippine E-Journals (PEJ) is a comprehensive online collection of academic publications that includes works from various higher education institutions and professional organizations. The collection encompasses many disciplines, spanning the humanities, social sciences, natural sciences, engineering, and more, demonstrating its inclusiveness and breadth. The PEJ database is designed to give users easy access to abstracts, full-text articles, and related research materials, making it an essential tool for scholars, researchers, and students.

The PEJ's sophisticated database is a vital feature of the platform. The user-friendly database allows easy navigation, with options to browse by subject, title, author, and date. In addition to academic publications, the PEJ hosts other research materials such as conference proceedings, technical reports, and research papers. These materials are invaluable resources for researchers who must remain abreast of the most recent advancements in their fields of study. Overall, the Philippine E-Journals offers a wealth of knowledge and information invaluable to the academic community in the Philippines and beyond.

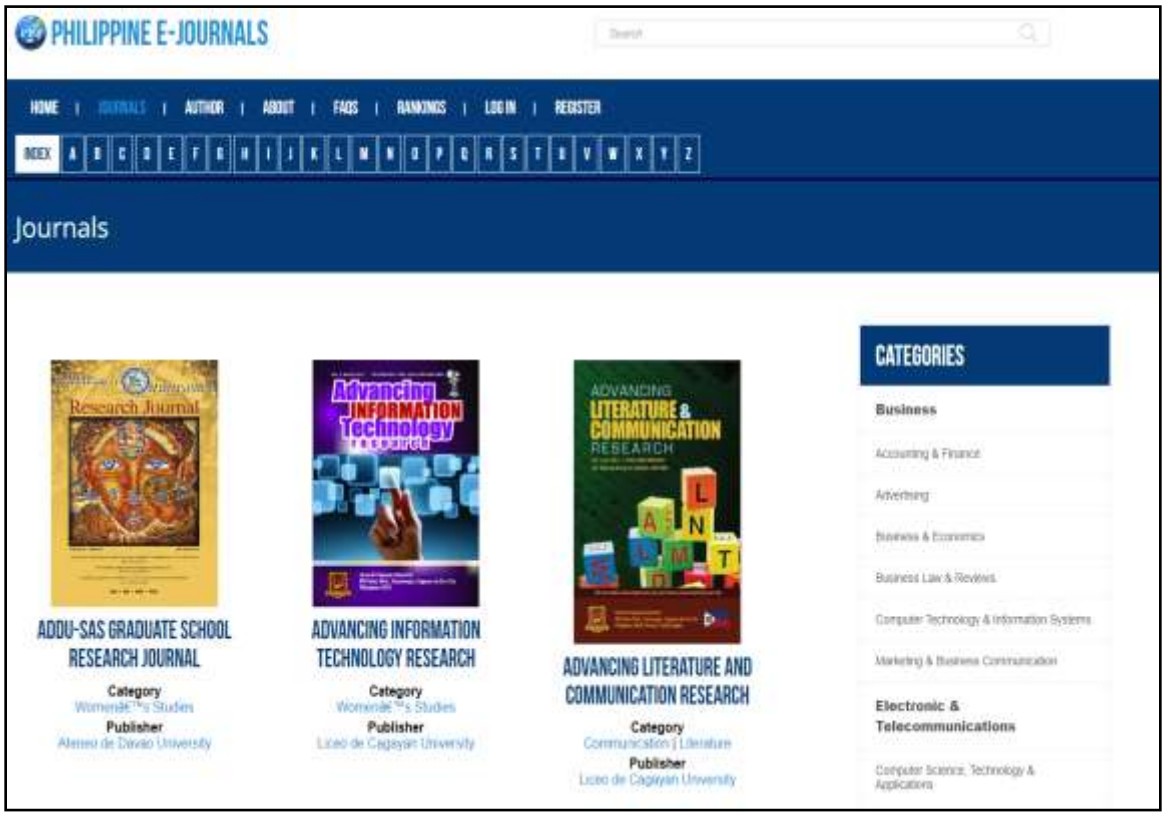


Figure 3: **Philippine E-Journal**

2.4.4 Archium

Archium Ateneo is a digital platform designed to serve as an Institutional Repository (IR) that hosts and consolidates a university's research outputs. Essentially, the platform aims to provide a centralized hub that preserves and facilitates access to a wide range of academic research outputs, including published articles, conference papers, working papers, senior theses, and other scholarly works produced by the faculty, researchers, and students of Ateneo de Manila University. IRs like Archium Ateneo offers an excellent opportunity to promote academic research, as they provide a reliable source of information for scholars and researchers who wish to discover and access relevant research materials in their fields of study. In addition to consolidating research, IRs like Archium Ateneo provide a platform for publishing other academic outputs that may not have been published elsewhere. This includes presentations, reports, and other academic materials the university's academic community has authored. IRs offer a convenient way to share and exchange knowledge within and beyond the academic community, making them a valuable tool for interdisciplinary research and collaboration.

Archium Ateneo's modern academic research components allow universities and other academic institutions to showcase their research excellence and support the dissemination of knowledge. Archium Ateneo, as an example of an IR, plays a vital role in enabling the academic community to discover and access research materials that are relevant to their research areas, thereby contributing to the advancement of knowledge and scholarship.

Figure 4: **Archium Ateneo**

2.4.5 arXiv.org

For academics and researchers who seek the best and most recent scientific articles, ArXiv is the ultimate gold mine. With over 2.2 million articles covering a wide range of subjects such as physics, math, computer science, economics, and beyond, it is a comprehensive hub for individuals seeking the latest insights and breakthroughs in their specific fields of study.

Even though the resources on ArXiv have not undergone the standard peer-review procedure demanded by many academic journals, they are nonetheless vital. ArXiv receives contributions from academics and researchers worldwide, providing a vast wealth of information for curious individuals to delve into and explore. As a result, ArXiv has something to offer everyone, whether they are looking for ideas, want to broaden their horizons or enjoy reading.

Figure 5: **arXiv.org**

2.4.6 CORE.ac.uk

Millions of scholarly articles from repositories and publications worldwide are freely accessible thanks to CORE (COnnecting REpositories), a non-profit organization with headquarters in the UK. As demand for open access to scientific articles grew, the service was established in 2013.No matter their connection with an academic institution or access to academic resources, and CORE aspires to make scholarly knowledge available to anybody, wherever in the globe. CORE collects metadata from journals and archives worldwide, making it accessible through an intuitive interface. Users can find scholarly publications by author, title, keywords, and other search criteria. The CORE.ac.uk also filters the results by date, relevancy, and other criteria.

CORE offers analytical tools that enable scholars to examine and display scholarly content, such as citation networks and author collaborations, in addition to its search functionality. Researchers, scholars, students, and the general public utilize the service to access and browse academic literature worldwide. The global dissemination of information and advancing open access to scholarly papers are two critical goals of CORE.ac.uk.

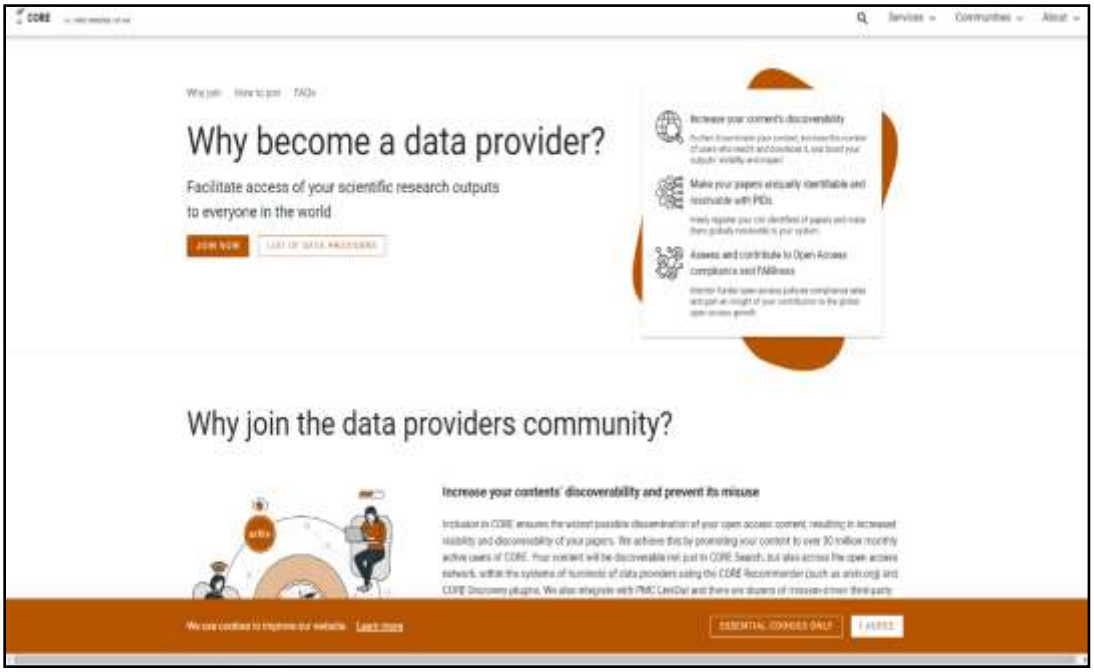


Figure 6: **CORE.ac.uk**

3. Methodology

A mixed-methods approach was employed for this research, incorporating surveys and interviews. A sample of students, faculty members, and administrators from UC-CCS participated in the research. Surveys were distributed electronically, and face-to-face or video interviews were conducted. The data collected through structured questionnaires and interview guides were analyzed using statistical methods for quantitative data and thematic analysis for qualitative data. Limitations of the research included the specific timeframe, sample size, and reliance on self-reported data.

3.1 Software Engineering Methodology

The system is developed using agile software development. Agile software development is a project management approach that emphasizes flexibility, collaboration, and rapid iteration. In the context of this research project, this methodology has several benefits. By adopting an iterative and collaborative approach, it can quickly adapt to changes and refine the system based on feedback. The flexibility of the agile methodology also allows the researchers to work more efficiently and deliver results faster. Moreover, with the use of the agile software development methodology, the researchers can break down the development process into smaller, more manageable phases. It will start by identifying and understanding the requirements of the project, which will then proceed with the design phase. Once the design has been finalized, they will proceed to the development phase, where they will begin building the system in increments. Throughout this process, they will continuously test the system to ensure that it meets the requirements and is functioning correctly. Once the development phase is complete, they will deploy the system and conduct a review to gather feedback and identify areas for improvement. By following this agile approach, the researchers can ensure that they are able to quickly adapt to changes and refine their approach as needed, ultimately leading to a more successful outcome.

Figure 7: **Agile SDLC Model**

3.2 Functional Decomposition Diagram

A Functional Decomposition is a fundamental analysis technique that explains how every function in the design works and interacts together. It helps the proponents by breaking the overall system into successive layer pieces that hierarchically decompose the system into its functional components, decompose a business and transaction process into sub-process and provide a definition of all the functions and sub-functions identified as system requirements. As shown in the table below, CampusCore's functions have been dissected and structured from a high-level to a low-level procedure.

"Management" is the first main functionality of the system. This consists of sub-functionalities that manage the system. Management includes sub-functionalities, one of which is the user account management that comprises the student, faculty, dean/PRC and admin accounts. Another sub-functionality is course management consisting of course loads and assign faculty. The next sub-functionality is the repository management which consists of upload research documents and view research documents.

The second main functionality, "Transactions", consists of sub-functionalities that a user performs as he/she transacts with the system. Transactions consist of sub-functionalities: Issues, Deliverables and Account registration.

The "Notifications" functionality consists of updates of the user's transactions within the system. Here, the user is notified of any changes happening in the system following the user's interaction. Its sub-functionalities include status, comments and announcements.

Lastly, "Reports" is the fourth main functionality of the system. The sub-functionalities under it are list of approved deliverables and list of students with approved deliverables.

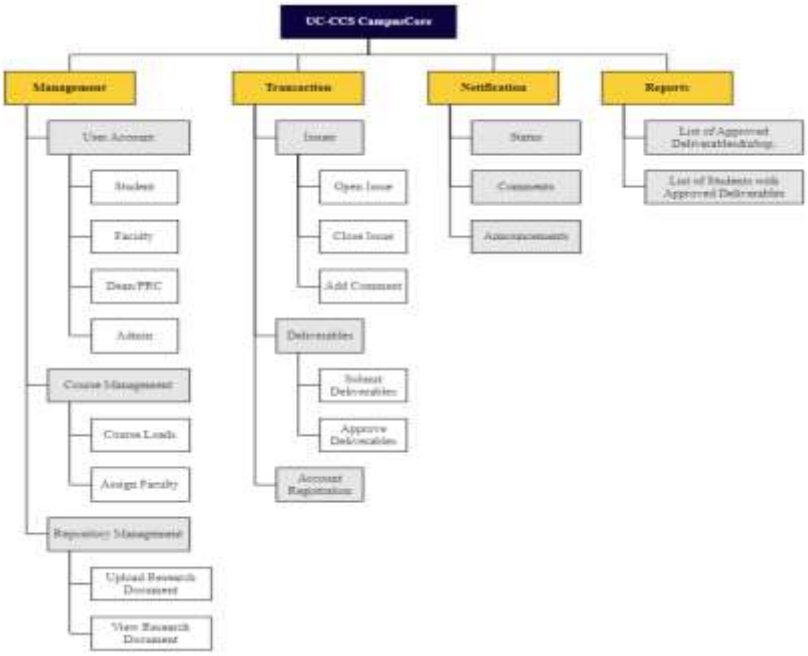


Figure 8: **CampusCore Functional Decomposition Diagram**

3.3 Analysis-Design Phase

During the analysis-design phase, the researchers formally established the system's needs by using the use case diagram, making the storyboard, and designing the database and network.

3.3.1 Use Case Diagrams

A use case diagram is a graphical visualization of a user's interaction with a system. The figures below emphasize the different types of users and their corresponding use cases in a high-level overview.

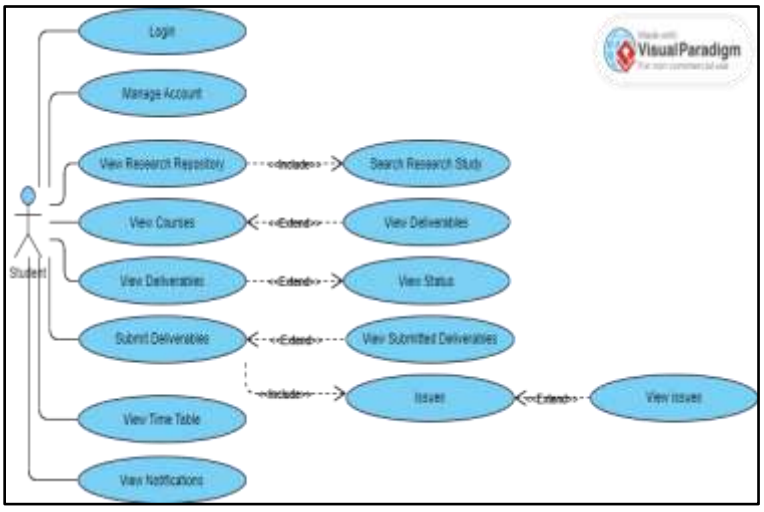


Figure 9: **Student Use Case Diagram**

Figure 9 represents how Students will use the CampusCore platform. It shows that users are given default login credentials and can change their password and add more details by managing their profile. Upon logging in, users are directed to the dashboard page, which includes the several components such as courses, research repository, issues, timetable, manage account, completion status, and deadlines. Clicking on the "courses" component will show all currently enrolled courses, and selecting a specific course will redirect the user to the course page, which includes details, deadlines, announcements, deliverables, and completion status. Clicking on a specific deliverable redirects the user to another page where they can view their submission's status, submissions, issues, and add a submission. Additionally, there is an issues page where students can view all their open issues from all courses, which can be sorted and filtered. When a specific issue is clicked, the user is redirected to the issue thread section, where they can

communicate with the reviewer to resolve the issue. The student will receive notifications for any updates to their deliverables, and they can also check their timetable on the dashboard page. Finally, approved final research papers can be submitted to the public repository with the dean's approval and e-signature authentication.

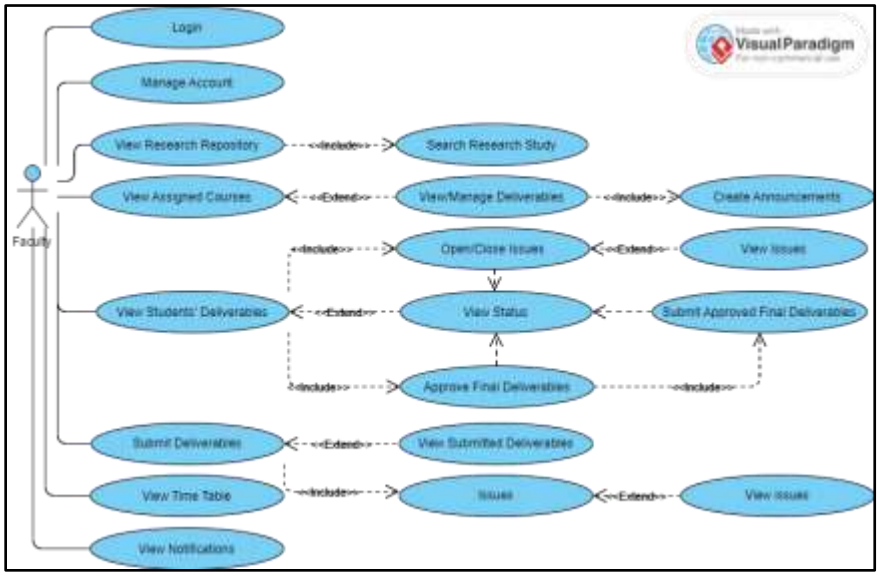


Figure 10: **Faculty Use Case Diagram**

Figure 10 shows the functionalities available to a faculty member. It represents that the user can log in to their accounts. The user is capable of managing student submissions and deliverables. The system includes a login process, dashboard for faculty, course loads page, submissions page, view submission page, issues section, and final paper approval and submission process. The dashboard includes components such as course loads, research repository, submissions, approved final papers, manage account details, completion status, deadlines, and a feed. The course loads page allows faculty to view course details, deadlines, and announcements, and add some announcements and manage the given deliverables. The submissions page allows faculty to view and search all submissions, and allows faculty to view and approve or request revisions or create issues for each submission, as well as communicate with students about issues. The faculty member can also upload their research in the deliverables section and the dean will be the one to review and approve it. The faculty will receive notifications for any updates to their deliverables and submissions from students, and they can also check their timetable on the dashboard page. They can also approve a final paper if the issues opened have been closed and submit approved papers to the dean.

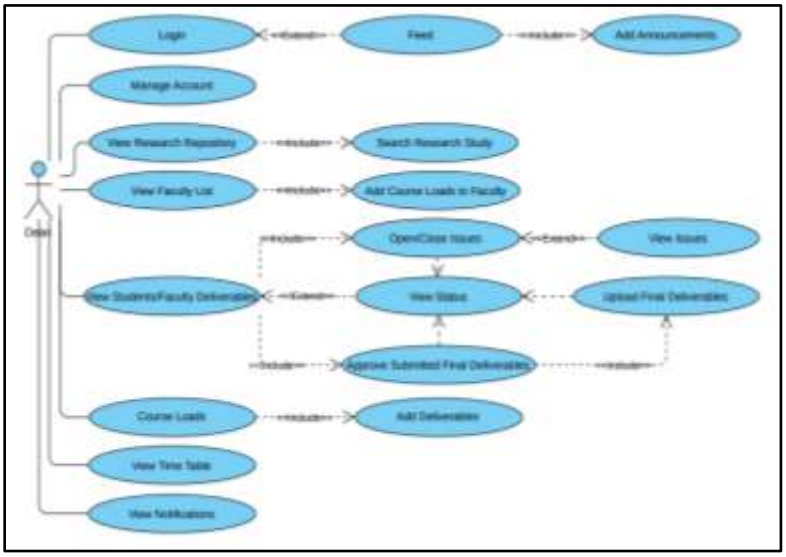


Figure 11: **Dean Use Case Diagram**

Figure 11 represents how the Dean will use the CampusCore platform. It is shown that it starts with logging in, where users are given default login credentials. Users can also add more details and manage their account. After logging in, users are redirected to the dashboard page where they can access different components such as the faculty course loads, research repository, for approval, and feed. The faculty course loads component redirects to a page where each faculty's names are shown. The dean will assign a course to the faculty and under those courses, the dean will be the one to set up some deliverables. The "for approval" component allows the dean to review submitted final papers by the faculty. The dean can approve directly or open issues that faculty and students can view in their issues page for that deliverable. The dean can also view all closed issues and affix his e-signature to the final paper, which will also be attached with the dean's digital signature. Issues can also be opened by the dean in the same submission page, which will be useful for capstone papers as the dean can suggest revisions during the defense. Issues can be resolved by the dean or the faculty/reviewer, but only the dean can approve the final paper.

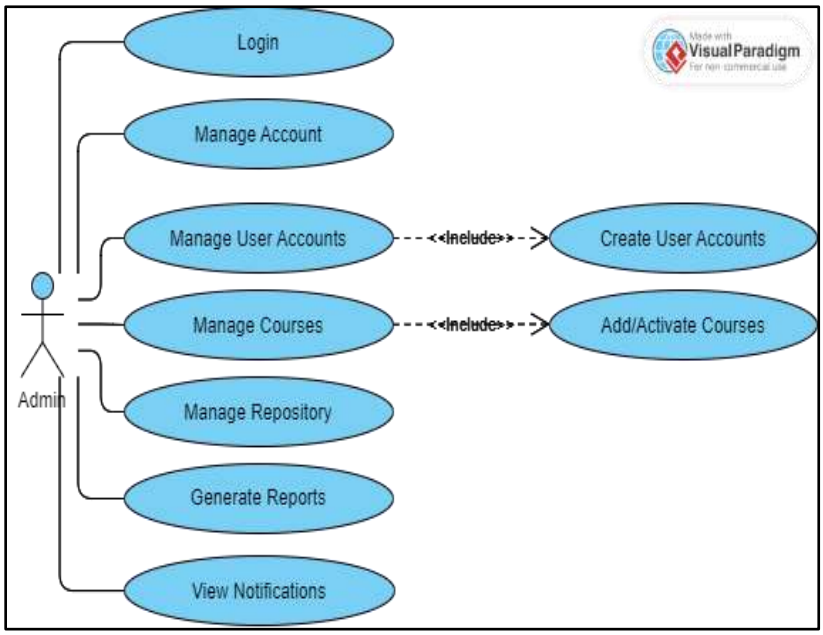


Figure 6: **Administrator Use Case Diagram**

Figure 12 shows the administrator's capabilities and how they interact with the platform. The admin can manage user accounts, can create, read, update, and delete courses and users. Each course has a status that can be changed to "inactive" if it's not offered during a particular semester. Users can be assigned a user type and their accounts can be activated or deactivated, with inactive accounts preventing the user from logging in. The admin can also filter, sort, and search for courses and users. The admin can also manage the main repository and generate reports. In addition, they can also receive notifications.

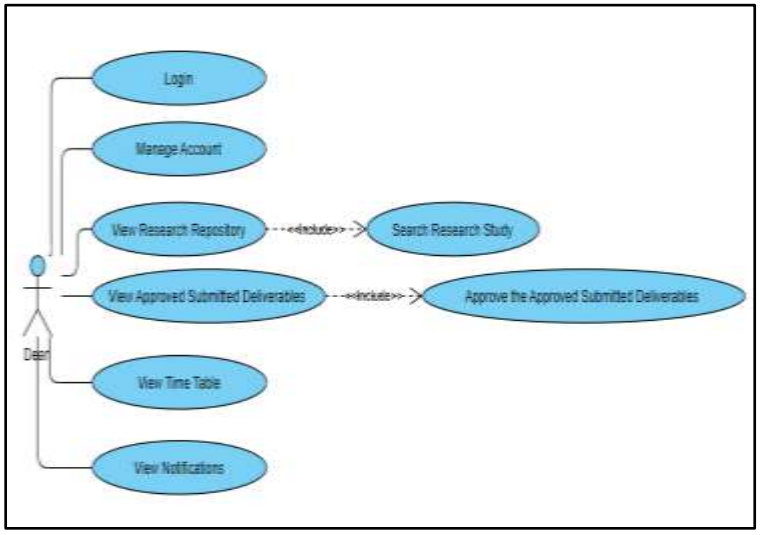


Figure 7: **PRC Use Case Diagram**

The figure 13 illustrates how the Program Research Coordinator (PRC) interacts with the platform as well as the capabilities that the PRC can do. They can login, manage their account, and can view the research repository component to access the public repository of research papers, they can also review the approved by the dean submitted deliverables and approve it in order to be uploaded to the research repository. They can also view the time table and view notifications.

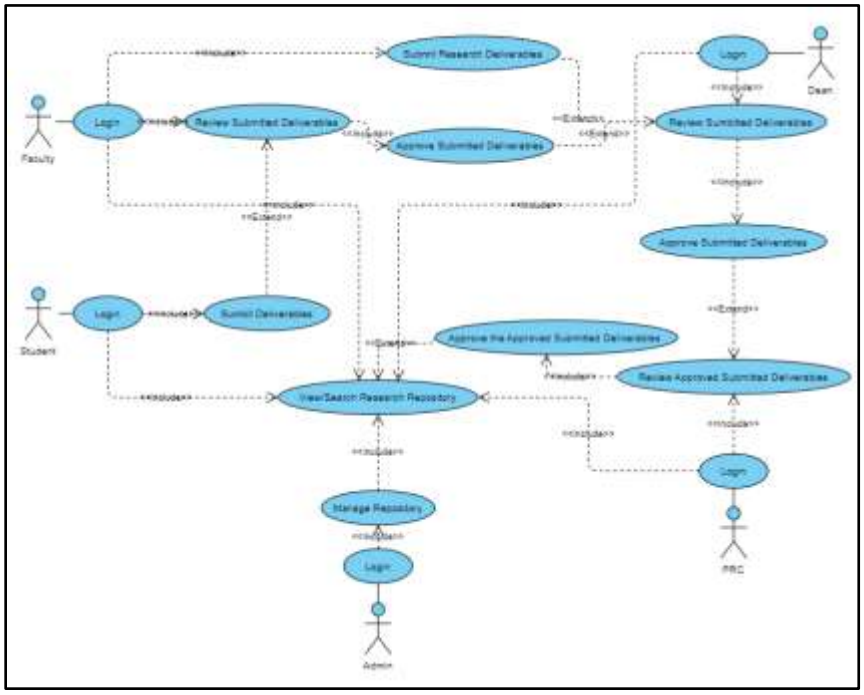


Figure 8: **Repository Management Use Case Diagram**

Figure 14 shows how the users interact with the system in the repository management. All users can login, and students and faculties can submit their deliverables. Faculties can review and approve the submitted deliverables by students. The Deans will review the submitted deliverables of the faculties as well as the submitted deliverables by students that have been approved by the faculties. After the Dean's approval, the PRC will also review and approve the approved submitted deliverables and it will be uploaded to the public repository that can be viewed by all the users. The public repository can be managed by the administrator.

3.4 Database Design

3.4.1 Entity-Relationship Diagram

An Entity-Relationship Diagram (ERD) is a data modeling technique that graphically illustrates an information system's entity and the relationships between those entities. An entity-relationship diagram serves as a high-level logical data model that proves beneficial in creating a conceptual design for databases. This diagram is deemed essential and assists the team in developing a robust database design.

Shown in Figure 15, is the ERD for CampusCore are logically structured to make certain interactions with other entities which illustrates how the system operates. This figure comprises 20 logically arranged tables to represent specific interactions with other entities, thereby demonstrating the system's functionality.

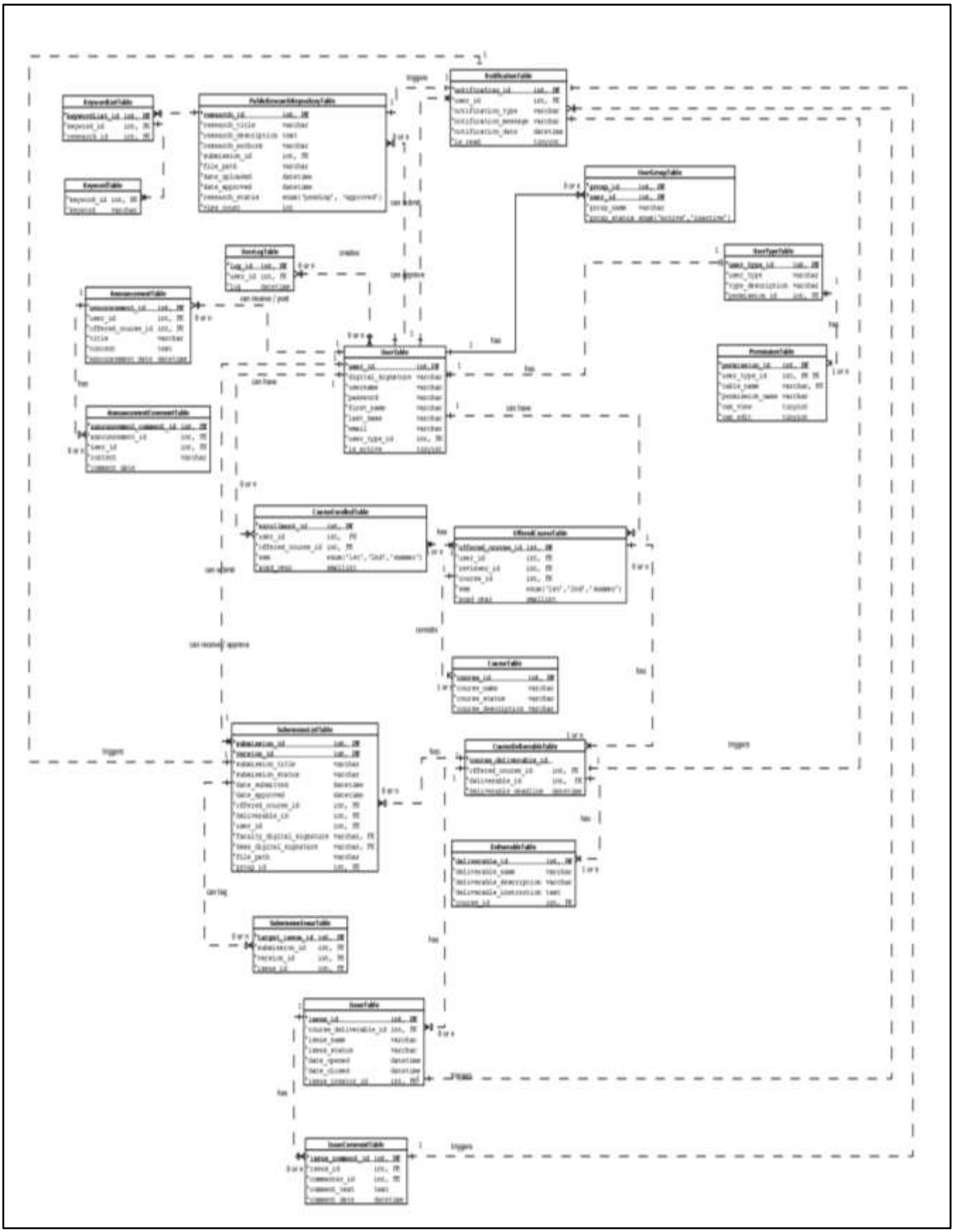


Figure 15: **CampusCore Entity-Relationship Diagram**

3.5 Development / Construction / Build Phase

3.5.1 Technology Stack Diagram

The figure 20 below visualizes CampusCore's technology stack. The developers used Visual Studio Code and XAMPP, this allows the developers to easily set up and run web applications on their own computer. It uses MySQL for the database and Apache HTTP Server for server connections, with the intention of eventually hosting the server on the cloud. Windows 10 is the primary operating system used by the developers. For the client-side, HTML5 and CSS3 with Bootstrap are utilized to construct the application interface, along with React.js library to create dynamic and interactive web applications efficiently and to improve structure of the system and manage the data flow from the database. For building the Android app, Android Studio IDE is used to develop the application along with the XML, Java, and WebView to create the GUI.

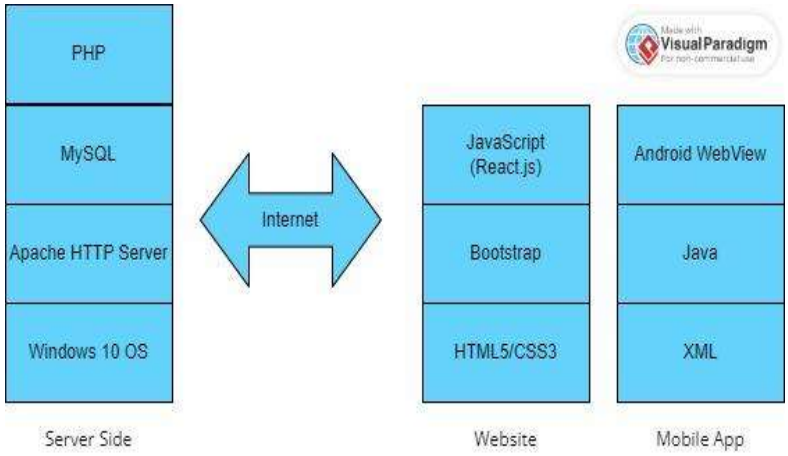


Figure 20: **CampusCore Technology Stack Diagram**

3.6 Network Design

3.6.1 Network Model

The network model of CampusCore shows how the nodes and network equipment are connected to each other. The figure shows the network design of the proposed system. All users can access the platform as long as they have an internet connection. Since the system will be locally hosted during the development phase, only the admin can access it directly. For security purposes, the system must be protected with a firewall. Additionally, it is implied that the system can support multiple user access at the same time.

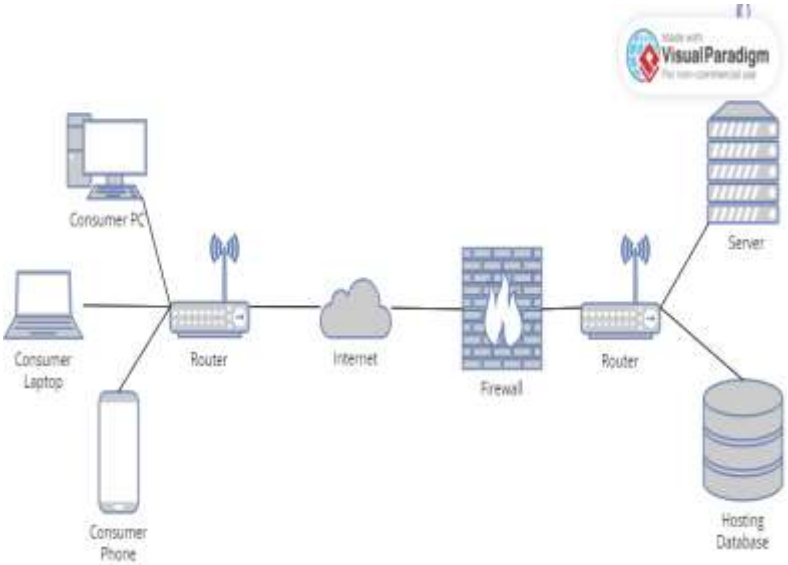


Figure 21: **Network Model**

3.6.2 Network Topology

The network design used by CampusCore is a Star topology. It is widely popular and has inexpensive startup costs. It's also simple to add new nodes to the system so the scalability of the system is much more efficient. The network is robust, meaning that if a connection between a computer and the hub fails, the remaining connections continue to operate effectively. However, there is a potential vulnerability due to the fact if the central hub fails, the network as a whole will fail or experience disruptions.

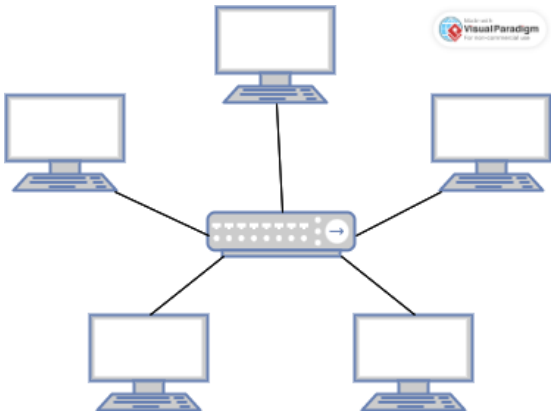


Figure 22: **Network Topology**

4. Results and Discussion

The research findings revealed that the majority of surveyed students faced challenges in securely storing and accessing document deliverables, supporting the identified problem. Faculty members also acknowledged the difficulties in managing student submissions without a centralized repository. Overall, users expressed favorability towards CampusCore as a solution.

Usage data showed high engagement with CampusCore, particularly in accessing course information, submitting deliverables, and managing accounts. The analysis identified areas of high user activity and potential areas for improvement, such as optimizing search functionality and enhancing system performance. CampusCore demonstrated satisfactory performance in terms of response time and reliability. The system effectively handled user interactions and data storage, meeting the requirements of users.

The positive feedback from users indicated a high level of satisfaction with CampusCore. Users appreciated the secure and centralized platform, clear instructions and guidelines, and improved access to reference materials. Suggestions for improvement included enhancing the security of stored deliverables and streamlining the user interface. CampusCore successfully addressed the identified challenges by providing a secure and accessible platform for document management. It streamlined processes, facilitated communication between stakeholders, and improved the overall efficiency of academic operations.

The implementation of CampusCore brought several benefits to UC-CCS, including enhanced collaboration, reduced administrative burden, and improved data organization. The system positively impacted the student experience, faculty productivity, and overall institutional effectiveness. Despite the overall success of CampusCore, some limitations and challenges were observed. These included technical issues during implementation, resistance to change among faculty, and the need for ongoing system maintenance and updates.

4.1 Algorithms

TCPDF is a widely-used PHP library designed for creating PDF documents. Additionally, it offers built-in functionality to implement digital signatures, guaranteeing the credibility and integrity of the files. Digital signatures employ cryptographic techniques to verify the document's source and detect any unauthorized modifications. TCPDF simplifies this process by providing methods for generating digital certificates and signing PDF files using private keys. To illustrate, here's a sample function to apply a digital signature using TCPDF

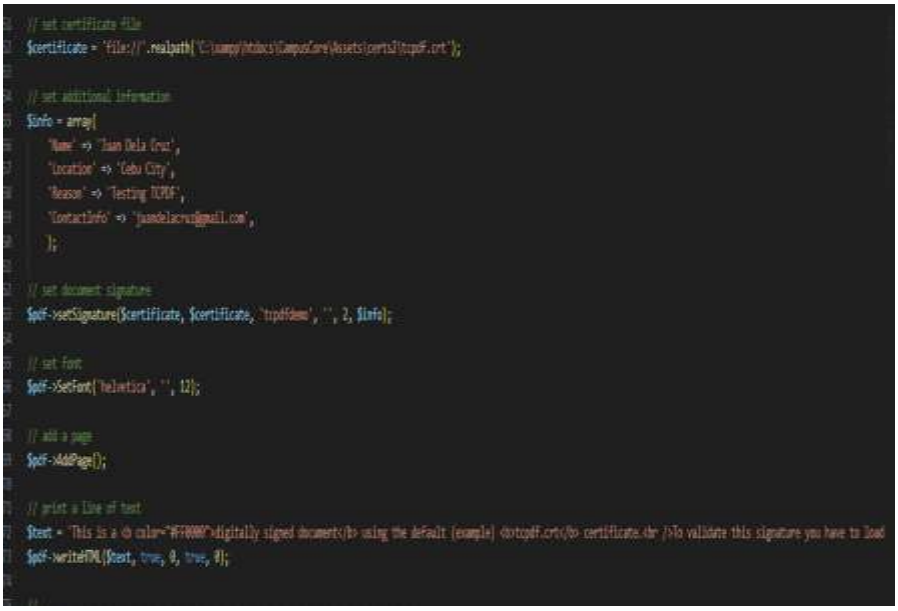
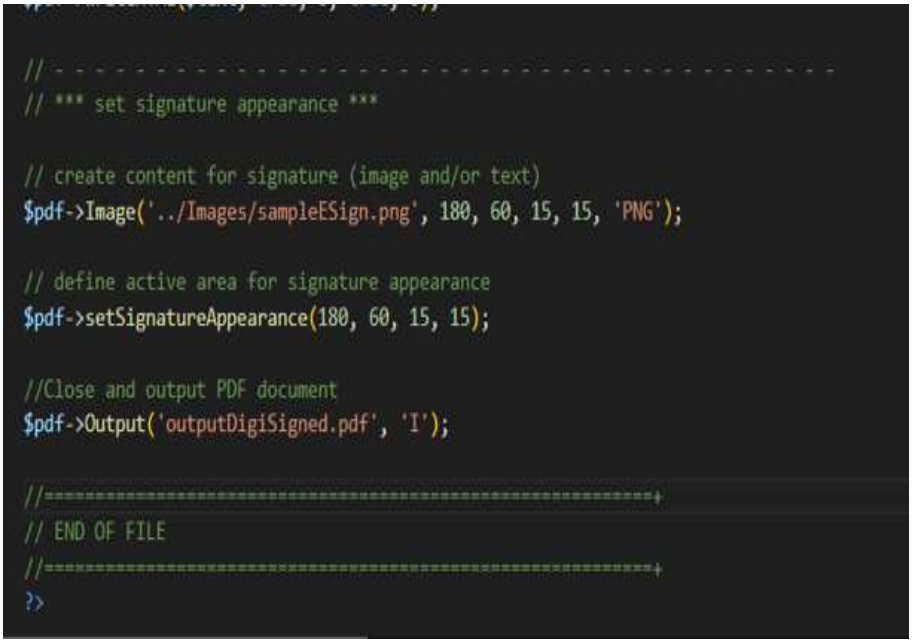


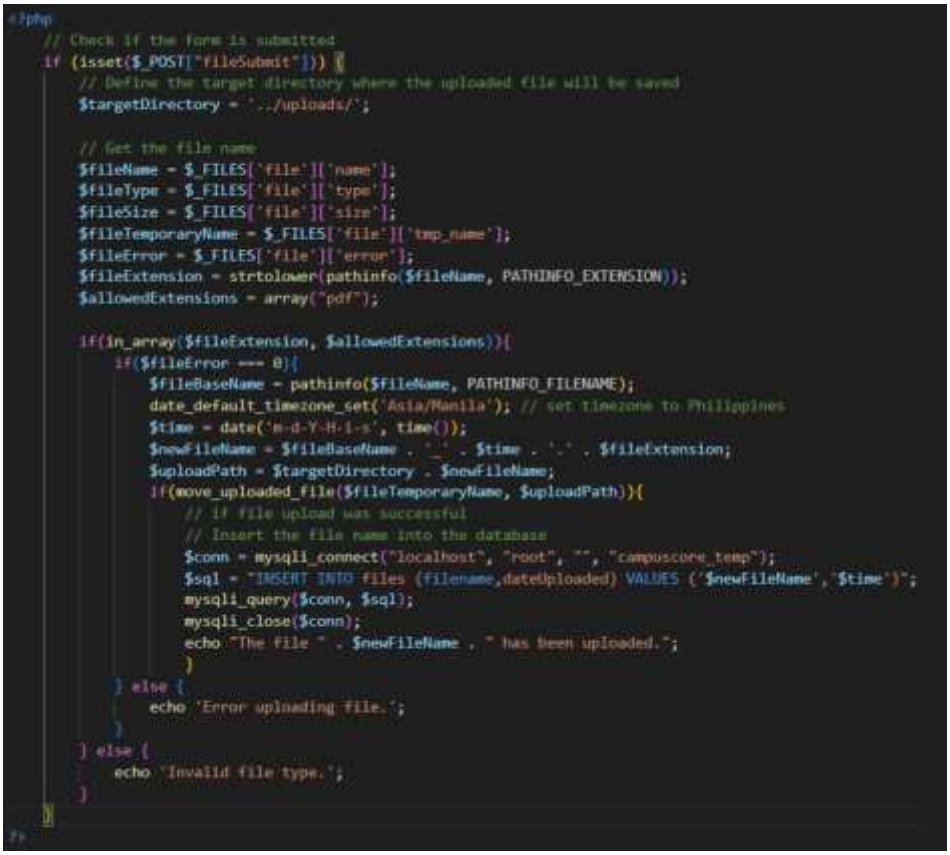
Figure 12 : **TCPDF**



```
// - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
// *** set signature appearance ***

// create content for signature (image and/or text)
$pdf->Image('../Images/sampleESign.png', 180, 60, 15, 15, 'PNG');

// define active area for signature appearance
$pdf->setSignatureAppearance(180, 60, 15, 15);

//Close and output PDF document
$pdf->Output('outputDigiSigned.pdf', 'I');

//============================================================+
// END OF FILE
//============================================================+
?>
```

Figure 13: **TCPDF**

In this example, the function setSignature() is used to apply a digital signature to the PDF document. It requires the path to the digital certificate file (certificate.p12) and the password to access the certificate. Finally, the Output() function is used to display or save the signed PDF file.



```php
<?php
    // Check if the form is submitted
    if (isset($_POST["fileSubmit"])) {
        // Define the target directory where the uploaded file will be saved
        $targetDirectory = '../uploads/';

        // Get the file name
        $fileName = $_FILES['file']['name'];
        $fileType = $_FILES['file']['type'];
        $fileSize = $_FILES['file']['size'];
        $fileTemporaryName = $_FILES['file']['tmp_name'];
        $fileError = $_FILES['file']['error'];
        $fileExtension = strtolower(pathinfo($fileName, PATHINFO_EXTENSION));
        $allowedExtensions = array("pdf");

        if(in_array($fileExtension, $allowedExtensions)){
            if($fileError === 0){
                $fileBaseName = pathinfo($fileName, PATHINFO_FILENAME);
                date_default_timezone_set('Asia/Manila'); // set timezone to Philippines
                $time = date('m-d-Y-H-i-s', time());
                $newFileName = $fileBaseName . '_' . $time . '.' . $fileExtension;
                $uploadPath = $targetDirectory . $newFileName;
                if(move_uploaded_file($fileTemporaryName, $uploadPath)){
                    // if file upload was successful
                    // Insert the file name into the database
                    $conn = mysqli_connect("localhost", "root", "", "campuscore_temp");
                    $sql = "INSERT INTO files (filename,dateUploaded) VALUES ('$newFileName','$time')";
                    mysqli_query($conn, $sql);
                    mysqli_close($conn);
                    echo "The file " . $newFileName . " has been uploaded.";
                    )
            } else {
                echo 'Error uploading file.';
            }
        } else {
            echo 'Invalid file type.';
        }
    }
?>
```

Figure 14: **User Registration Encryption**

User encryption registration in PHP involves securely storing user information, particularly passwords, by using encryption techniques. During registration, the user's password is hashed using cryptographic functions like password_hash(), which transforms the password into an irreversible hash. This hashed password is then stored in the database. When a user logs in, their entered password is compared to the stored hash using password_verify(). This approach ensures that user passwords are protected and reduces the risk of unauthorized access.

```php
// get the user input
$username = $_POST["username"];
$password = $_POST["password"];

// Prepare and execute an SQL statement to retrieve the user from the database
$query = $conn->prepare("SELECT * FROM users WHERE username = ?");
$query->bind_param("s", $username);
$query->execute();
$result = $query->get_result();
// Check if the user exists and verify the password
if ($result->num_rows === 1) {
    $row = $result->fetch_assoc();
    $hashedPassword = $row["password"];
    $salt = $row["salt"];
    $hashedInputPassword = hash('sha256', $password . $salt);

    if ($hashedInputPassword === $hashedPassword) {
        // Redirect based on user type
        $userType = $row["userType"];
        switch ($userType) {
            case "admin":
                header("Location: course.php");
                break;
            case "dean":
                header("Location: deanFileApproval.php");
```

Figure 15: **User Login - Hash & Salt Function**

In PHP, the process of hashing and salting user passwords involves enhancing the security of password storage. When a user registers, their password is combined with a randomly generated salt using a hashing algorithm, such as bcrypt. The resulting hash, along with the salt, is stored in the database.

During user authentication, the entered password is concatenated with the stored salt, and the hash is verified using the password_verify() function. If the verification succeeds, the user is granted access.

Hashing makes the password irreversible, ensuring that it cannot be easily decrypted. Salting adds an additional random value to each password, making it unique and further strengthening security. By employing these techniques, the stored passwords become more resistant to attacks and provide an extra layer of protection for user accounts.

5. Conclusion

UC-CCS CampusCore successfully addressed the challenges faced by students, faculty, and administrators in managing academic processes. The system's secure and centralized repository, along with its user-friendly interface and functionalities, significantly improved document management and communication. The successful implementation of CampusCore brought numerous benefits, enhancing collaboration, streamlining processes, and improving overall efficiency. Ongoing maintenance, user training, and continuous feedback collection are crucial for further optimizing the system. UC-CCS CampusCore serves as a promising solution for educational institutions seeking to enhance their knowledge management systems, with potential for further research and development to explore integrations, scalability, and customization options.

6. Recommendations

Based on the research findings, recommendations include strengthening the security measures for stored deliverables, conducting user training and awareness programs, and continuously seeking user feedback for iterative improvements. Further research can also explore the scalability of CampusCore and its potential integration with other systems.

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