

**ARC-HIVE: AN INNOVATIVE DOCUMENT ARCHIVAL SYSTEM
FOR EFFICIENT RECORD MANAGEMENT**

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INTRODUCTION

Background of the Study

Efficient information management is crucial for the operational success of universities and educational institutions. As the volume of both physical and digital records increases, traditional methods of record-keeping are proving insufficient. The complexity and scale of modern academic environments necessitate the implementation of advanced document management systems. Without such systems, educational institutions often face challenges such as difficulties in document retrieval, risks of data loss, and delays in decision-making processes. These inefficiencies underscore the urgent need for innovative solutions to streamline record management and improve institutional performance.

At Tarlac Agricultural University (TAU), the current document management system primarily relies on manual and paper-based processes, which could benefit from modernization. While these practices support the institution's basic operations, they pose challenges in terms of scalability, efficiency, and accessibility. Processes such as document retrieval and organization are labor-intensive and time-consuming, creating potential bottlenecks as the institution grows. A transition to a centralized, digitalized document management system would streamline workflows, enhance accessibility, and ensure that both academic and administrative tasks are performed more efficiently. This improvement aligns with TAU's strategic goals of optimizing operational processes and providing seamless support to all stakeholders.

Globally, educational institutions are increasingly adopting digital solutions to overcome the limitations of traditional record-keeping systems. Al-Azawi (2012) highlights that digital archiving improves data accessibility and safeguards against data loss, particularly in institutions handling large volumes of records. Similarly, ElBakry and Mohammed (2015) emphasize how advanced search functionalities and intelligent tagging systems enhance workflow efficiency by minimizing delays in document retrieval. These findings illustrate the transformative potential of digital technologies in improving institutional effectiveness and addressing the challenges associated with traditional methods of record management.

In the Philippines, the adoption of Electronic Document Management Systems (EDMS) is gaining traction in various sectors, including education. Cuevas and Casauay (2022) report the successful implementation of an Electronic Document Archival System (EDAS) in a local high school, which resolved issues such as unsecured storage, data duplication, and prolonged retrieval times. Similarly, Gamido et al. (2023) document the benefits of digitized records in LAN-based organizations, including reduced operational costs, real-time access to information, and streamlined workflows. These examples demonstrate the growing relevance and effectiveness of EDMS in addressing the challenges faced by institutions in the Philippines.

Despite these advancements, TAU has yet to fully adopt a centralized and digitalized document management system, limiting its ability to achieve operational efficiency. The current system, while functional, is not optimized for scalability and

modernization, which are crucial as the institution grows. This lack of a robust digital solution hinders the seamless execution of academic and administrative activities. Addressing these gaps is vital to ensuring the university's ability to support its stakeholders effectively and align with global trends in digital transformation.

This Capstone Project intends to develop Arc-Hive, an innovative Document Archival System for Efficient Record Management. Arc-Hive will feature a smart document tagging system that assigns unique identifiers and contextual tags to records, improving organization and searchability. The system will also incorporate intelligent suggestion capabilities to streamline retrieval processes and enhance workflow efficiency across TAU's departments and offices. By leveraging advanced technologies, Arc-Hive aims to modernize the university's document management, ensuring greater scalability, security, and operational effectiveness.

Significance of the Study

This Capstone Project will help in achieving **SDG 9: Industry, Innovation, and Infrastructure** because it fosters innovation and sustainability by integrating advanced technologies into the educational and administrative processes at Tarlac Agricultural University (TAU).

For **Tarlac Agricultural University**, this IT Solution will help in improving operational efficiency through streamlined workflows and reduced manual effort. It will also enhance data security by mitigating risks associated with physical document storage and support decision-making processes by ensuring real-time data

accessibility.

For the **department and offices**, this will aid them in simplifying workflows via intelligent tagging and retrieval systems, as well as fostering collaboration through secure role-based access controls.

For the **end-users**, such as staff and faculty, this will benefit them when it saves time by providing tailored document suggestions and ensures data privacy with robust security measures.

Objectives of the Study

The main objective of the study is to develop Arc-Hive, a document archival system tailored for Tarlac Agricultural University (TAU) to improve record management processes and operational efficiency.

Specifically, the study aims to achieve the following objectives:

- a. to develop a document archival system with the following components:
 - a.1 user interface (UI) to be used in tagging, retrieval, and management of records efficiently;
 - a.2 administrator's interface to manage user roles, monitor system operations, update records, and access audit trails;
 - a.3 report generation module use to generate summaries and retrieval histories on a weekly, monthly, and annual basis, tailored to institutional needs;

- a.4 intelligent tagging System use to categorize information efficiently using context and automation for streamlined organization and quick retrieval;
- a.5 a feature that analyzes document content and user search patterns to provide intelligent recommendations for records or tags, enabling faster and more accurate file retrieval and organization;
- a.6 role-based access control use to assigns specific access permissions to end-users, administrators to ensure data security and prevent unauthorized access;
- b. to evaluate the proposed IT solution based on ISO/IEC 25010 standards through the following respondents:
 - b.1 End User
 - b.1.1 Usability and
 - b.1.2 Functionality

Scope and Delimitations

This study focuses on developing and implementing Arc-Hive, a document archival system designed for Tarlac Agricultural University (TAU). The system aims to enhance the management of administrative and faculty records by providing a structured and efficient digital platform. The research will cover the development, deployment, and evaluation of the system to ensure its effectiveness in streamlining document storage and retrieval.

The project includes the development of key system components such as a user-friendly interface, an administrator dashboard, intelligent tagging, intelligent recommendation features and role-based access control. These features will improve accessibility and organization within the university's archival system. The system will be deployed in a controlled environment at TAU, focusing on administrative and faculty records to test its efficiency and usability.

Testing and evaluation will be conducted within the university's administrative operations to assess the system's functionality and overall performance. The study will analyze user feedback, system response times and security measures to refine and optimize Arc-Hive. This process ensures that the system meets TAU's specific archival needs before wider implementation.

However, the study has certain limitations. It will not integrate with external platforms. Meaning Arc-Hive will operate exclusively with TAU's existing databases. External databases or third-party tools outside TAU's infrastructure are not included

in this project. Additionally, the study assumes that all records are already digitized, and the process of scanning or converting physical documents is beyond its scope.

In summary, this study focuses on designing, implementing and evaluating a digital archival system tailored for TAU. It will ensure efficient record management through key features such as intelligent tagging, Smart Search, and role-based access control. While the system will be tested within the university's administrative environment, its use will be limited to TAU databases, excluding external integrations and document digitization. Through this research, Arc-Hive aims to provide a reliable and effective solution for TAU's document management needs.

Definition of Terms

Accuracy The ability of an algorithm to carry out its intended duty and generate the right or anticipated output is known as accuracy.

Administrator Interface A management console enabling administrators to oversee roles, monitor activities, and maintain the system.

Arc-Hive The document management solution developed in this study integrates intelligent tagging and suggestion features for improved archival processes.

Digitization The conversion of physical records into digital formats. This study assumes all records are pre-digitized.

Functionality The variety of tasks that a software program or component can carry out is referred to as software functionality. It is the actual application or practical usage of software in a real-world setting. The set of features or capabilities that the software provides to its users determines its functionality.

Smart Search A system functionality that leverages document content analysis and user behavior to deliver intelligent suggestions for records or tags, streamlining file organization and retrieval processes.

Intelligent Tagging System An automation-based categorization tool for efficient record organization and retrieval.

ISO/IEC 25010 Standards A framework for evaluating software quality, emphasizing usability, security, functionality, and other metrics.

Report Generation Module A system component for generating customized summaries and retrieval histories to support institutional requirements.

Role-Based Access Control A security mechanism restricting system access based on user roles.

Scalability The system can accommodate increased users or records without compromising performance.

Time Complexity The computational complexity known as "time complexity" refers to how long it takes a computer to execute an algorithm.

Usability Software usability is the regulated aspect of user experience design that ensures consumers don't encounter issues when utilizing a product or

user interface. It gauges how happy end customers are with what they can do with the interface.

REVIEW OF RELATED LITERATURE AND STUDIES

The demand for efficient and secure document management systems has grown dramatically in various industries particularly academic institutions. Over the years, research investigations have provided insights into novel solutions that solve the issues of manual filing systems, data security, and document retrieval inefficiencies.

Universities have long grappled with the preservation of physical and digital documents. Traditional systems, while functional, frequently fail to fulfill the evolving institutional needs. Digital solutions based on modern technologies have been proposed to address these difficulties, with systems such as EDAMS enhancing document retrieval and storage efficiency (B. Caluza, 2017).

Montalban & Antiquera (2023) designed an online thesis archiving and profiling system for the ISAT U Miagao Campus that aligns with ISO 25010 software quality standards. Their approach significantly improved document retrieval accessibility, usability and speed showing the positive impact a well-structured digital repository can have on academic operations. Their findings highlighted the importance of integrating systems that adhere to recognized software quality guidelines to ensure long-term sustainability and effectiveness.

To improve scalability, enterprises all over the world have increasingly turned to web-based and cloud-based solutions. For example, a system in Zambia used SMS reminders and timestamping to verify compliance and simplify

document processing (Mutale & Phiri, 2016). Similarly, blockchain-based technologies like ARCHAIN have enabled tamper-proof and secure document archiving by using cryptographic approaches to improve data integrity (Galiev et al., 2018). Furthermore, Noori and Al-Hashimi (2023) categorized Electronic Document Management Systems (EDMS) into client-server, web-based and cloud-based models, emphasizing the growing preference for cloud and web-based technologies in modern document management.

Document archiving has undergone tremendous development as intelligent elements such as metadata generation and tagging have been integrated. These innovations have improved document management and retrieval, solving chronic inefficiencies in traditional systems. For example, the E-Document Archiving System with SMS Support not only enabled tagging but also improved operational efficiency by enabling real-time web-based access. This innovation allowed institutions to maintain their records more effectively, minimizing delays and boosting end-user accessibility (Alpaskan, 2021).

Ergüzen & ünver (2018) proposed a distributed system that improved scalability by using serverless architectures and separating replication and data nodes. These developments not only increased efficiency but also provided solid solutions for properly managing large datasets.

The Web-Based Digital Archival Processing and Collection Management System, which uses Archives Space as an open-source tool, is consistent with the trend of open-source platforms that support metadata standards for cataloging

(Geday et al., 2024). The use of a design science research technique to iteratively enhance the system based on qualitative feedback from stakeholders emphasizes the need of continuous refinement in designing systems that are suited to user needs. This strategy is similar to iterative development found in other systems such as eDALAYON which used Agile Scrum to improve usability (III Rodriguez et al., 2024). The study emphasizes advances in accessibility and retrieval accuracy, however it also notes obstacles in user training and resource allocation—issues that must be addressed during any system's deployment phase. Similarly, the Web-Based E-Document Information System demonstrated how task efficiency and intuitive design may streamline workflows (Pratama et al., 2021).

As data breaches continue to harm businesses, experts have looked into numerous ways to improve document security. SECEDOMAS, which used AES encryption, has proven effective in protecting sensitive documents from illegal access (Justina et al., 2022).

Ghanghoria et al., (2020) addressed blockchain-based solutions which improved data integrity by providing immutability and resistance to forgery, ensuring the reliability and security of preserved information throughout time. These improvements show a rising emphasis on combining strong encryption methods with decentralized technologies to address emerging security concerns.

The research methodology involved system development in two phases: needs assessment and system design, which is a standard approach to ensuring that systems are tailored to meet specific institutional needs (Villarosa, 2021). The evaluation of

the system's ability to address deficiencies in data management aligns with the tailored approach to document management seen in customized solutions like EDAMS (Caluza, 2017).

Solutions that are tailored to certain institutional contexts have proven to be beneficial. Systems built for universities, such as EDAMS, addressed concerns of limited storage and misclassification, proving the value of personalized features (B. Caluza, 2017) The Admission and Registrar Office (ARO) Mobile Document Scanner with Archiving System was designed for cross-platform use, receiving great usability and compatibility ratings (Mallares et al., 2024). Meanwhile, the OnBase system showed the advantages of integrating archive operations within economic organizations, providing lessons for higher education (Benmakhlouf & Chouaou, 2024).

Newer approaches have introduced novel ways to handle papers successfully. To prevent unwanted access, ARCHAIN used hierarchical role structures and cryptographic hashing (Galiev et al., 2018). Similarly, environmental genomic approaches in biodiversity monitoring have shown how sophisticated sampling and storage technology can save crucial records for decades (Zizka et al., 2022) These techniques demonstrate Arc-Hive's potential to implement cutting-edge academic record management capabilities.

The seamless integration of intelligent features, usability principles and strong security mechanisms is critical to document archiving's future. The Web-Based Digital Archival Processing System used design science research to repeatedly

modify system features, resulting in considerable accessibility improvements (Geday et al., 2024). Ergüzen & ünver (2018) suggested distributed file systems, which promise scalability and performance advantages critical for developing institutions.

Arc-Hive promotes itself as a holistic solution suited to Tarlac Agricultural University's specific demands after learning from these studies.

METHODOLOGY

System Development Methodology

The Agile Development Methodology was used in this study because of its iterative, collaborative and flexible approach which allows for ongoing feedback and system refinement throughout the development process. Agile was chosen because it effectively solves the evolving demands of TAU's document management system, ensuring that the end product closely corresponds with user expectations. The iterative nature of Agile allowed the development team to detect issues early on, incorporate stakeholder feedback and gradually create and improve the system in manageable increments.

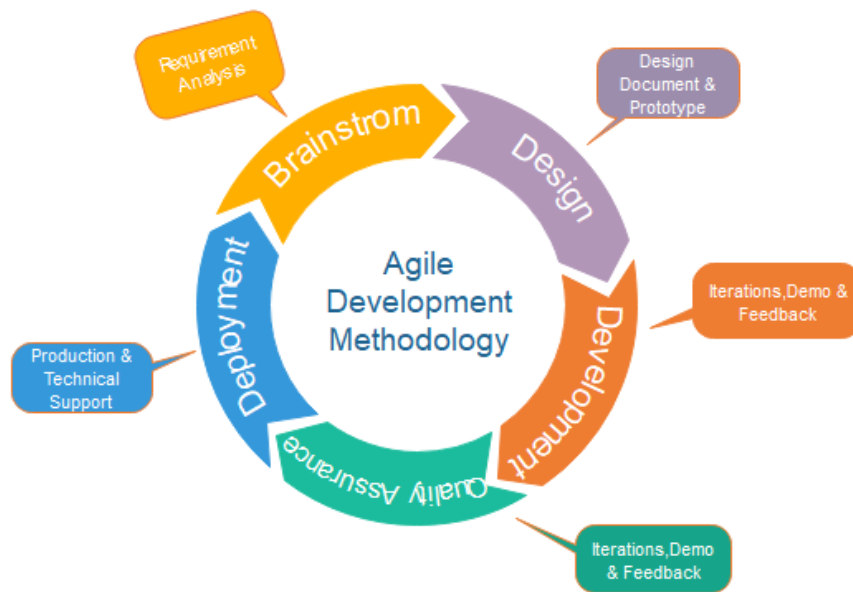


Figure 1. Agile Development Methodology Cycle

Brainstorm. Meetings and meetings with stakeholders, including personnel and administrators were held to identify the constraints of the current manual document management system. Surveys and interviews used to collect feedback on issues along with specific user requirements, resulting in a thorough list of system objectives, user requirements and project scope which served as the basis for the development process.

Design. During the design phase, the goal was to create a clear technical blueprint and user interface for the Arc-Hive system. The system architecture was created to describe how important components like the database, user access modules and tagging methods would interact efficiently and at scale. A thorough Entity Relationship Diagram (ERD) was also produced to show how the data will flow and connect. This is essential for optimizing the system's database. To ensure that the system is easy to use, interactive wireframes for the user interface were created with TAU staff and administrators in mind, ensuring that navigation was straightforward and user-friendly. These aspects offered a solid basis for balancing technical functionality and usability in order to meet the needs of the users.

Development. The Arc-Hive system was developed using an iterative method, with the researchers building and improving the system in cycles. Both the front-end and back-end were built using JavaScript, database management was handled by MySQL, and a clean, user-friendly interface was created using HTML and CSS. Each iteration focuses on improving the system's basic features.

The development process began by implementing a dynamic tagging system to increase document searchability and categorization, ensuring that users could quickly retrieve the documents they needed. A document retrieval module was also developed to simplify the search process, provide faster access to stored documents and improve the overall user experience.

Quality Assurance. The Arc-Hive system underwent thorough testing to ensure that it operates smoothly and is easy to use. During testing, end users were asked to rate the system's efficiency, dependability and overall satisfaction. Their feedback helps identify areas for improvement.

The researchers focused on ensuring that all functionality performs as planned and that the system remains user-friendly. The testing phase demonstrates that the system operates satisfactorily and meets the requirements of TAU's document management system.

Deployment. After thorough testing, the Arc-Hive technology was officially implemented at TAU. To guarantee a smooth transition, training sessions were held to enable employees and administrators get familiar with the system. The feedback from users during the initial deployment phase was carefully gathered and used to make final improvements. With these efforts, the Arc-Hive system was successfully installed, transforming TAU's document management by increasing record accessibility and overall efficiency.

Data Gathering Procedures

During the data collection phase, the researchers meticulously accessed a range of relevant literature, including academic papers, books, and articles to be informed of their study's methodology, and enhance the validity of their findings.

Questionnaire. Questionnaires will be distributed to the end users to help evaluate the system. The purpose of the evaluation will be explained, and the feedback collected will be used to improve the system based on their suggestions.

Literature Survey. A literature survey was conducted to find useful information for developing the system. The Internet was the main source for finding relevant materials and care was taken to ensure the information will be reliable and helpful for the project.

System Design

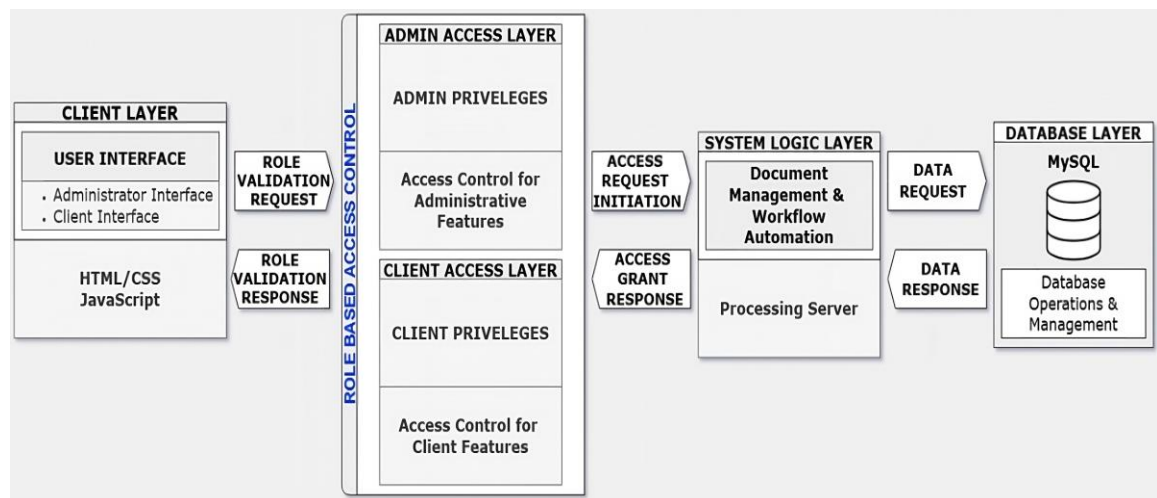


Figure 2. System Architectural Design

Figure 2 illustrates the system's architectural design, emphasizing secure interactions, efficient data processing and role-based access control (RBAC). The front-end, built with HTML, CSS, and JavaScript; serves as the entry point for administrators and clients, handling role validation requests through the RBAC framework. This framework authenticates users and assigns roles to determine access permissions.

Administrators and clients share similar functionalities but administrators have additional access to specific system areas. This hierarchical design ensures users can only access features relevant to their roles, safeguarding the system's integrity.

The core processing unit manages document workflows and automation via a dedicated server, integrating with a MySQL database for secure data storage and retrieval. This structure ensures reliable handling of user requests, maintains record accuracy, supports scalability, and allows for future system enhancements.

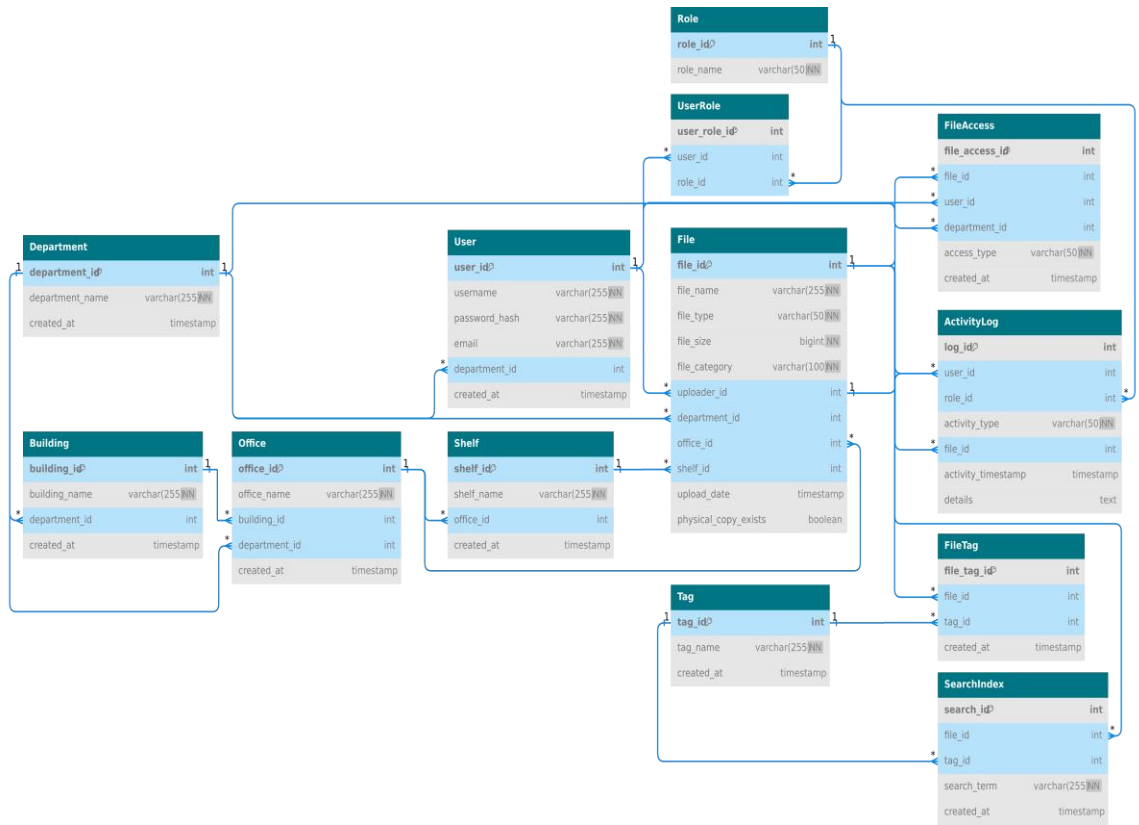


Figure 3. Entity Relationship Diagram

Figure 3 shows the Entity Relationship Diagram (ERD) of the Arc-Hive Document Archival System, designed to modernize record management at Tarlac Agricultural University (TAU). The database, named ArcHive_DB, consists of interrelated tables for document archival, tagging and user activity tracking.

The Users table stores user credentials and roles, detailed in the Roles table, to implement role-based access control for Admin, Staff, and Faculty. The Documents table serves as the main repository, storing document attributes like titles, timestamps, and tags. Metadata for categorization is managed in the Tags table, while the Document Tags table establishes a many-to-many relationship between documents and tags. User interactions are tracked in the Access Logs table, ensuring

accountability. Additional features include the Reports table for generating summaries and the Suggestions table for system improvements. This ERD ensures scalability and adaptability to meet TAU's evolving needs.

Tools used in the Development

Hardware. This part presents the devices, equipment, and other hardware used during the development and implementation of the ARC-Hive system. The table below indicates the minimum and recommended specifications of the actual devices used during the project.

Table 1. Tools used for System Development.

CLASSIFICATION	SPECIFICATION
CPU	Intel Core i5
RAM	8GB
STORAGE	256GB SSD

Software. This part indicates the software used in the development of the ARC-Hive system, including tools for the front-end and back-end.

- **Programming Language.** The system was developed using **JavaScript**, a versatile programming language used for both front-end and back-end functionalities.

- **Scripting Language.** **HTML** and **CSS** were used for designing and styling the web application interface, providing a clean and user-friendly layout.
- **DBMS.** **MySQL** was employed for database management, chosen for its robust support for relational data and efficient query processing capabilities.
- **Development Environment.** **Visual Studio Code** was utilized for writing and managing the codebase due to its extensive plugins and user-friendly interface.
- **Version Control.** **Git** and **GitHub** were used for version control to ensure collaboration and maintain code integrity.

Evaluation

Likert Scale. The evaluation process employed a Likert Scale to measure the effectiveness and user satisfaction of the ARC-Hive system. The interpretation of results is based on the weighted mean, calculated by averaging the ratings provided by the evaluators.

Table 2. Likert Scale 5-point Scale.

FIRST	LEVEL HEADING
4.50 – 5.00	Excellent
3.50 – 4.49	Very Satisfactory
2.50 – 3.49	Satisfactory
1.50 – 2.49	Satisfactory
0.00 – 1.49	Poor

Respondents to the Evaluation. The evaluators were selected from various offices at Tarlac Agricultural University to ensure a diverse range of perspectives. To make sure everyone had an equal chance of being selected, a complete enumeration sampling method was used. The researchers provided a version of the system for evaluation, and each selected evaluator agreed to use and evaluate the system, ensuring that the evaluation was consistent and objective

