

## OVERVIEW OF THE DESIGN PROJECT

Efficient communication between students and faculty remains a long-standing difficulty in academic institutions, often hindered by outdated scheduling methods and inconsistent faculty availability. Thus, the study proposes ConsultEase, an IoT (Internet of Things) integrated consultation system that leverages RFID/NFC technology, Raspberry Pi, ESP32 microcontrollers, and Bluetooth Low Energy (BLE) to enhance real-time interaction and secure student verification within university campuses. Using a touchscreen interface and BLE – enabled presence detection, the system provides students up-to-date faculty availability and allows secure messaging for consultation requests. The study employs the Rapid Application Development model and ISO/IEC 25010 quality metrics to assess the systems' performance in terms of functionality, reliability, usability, maintainability, and security. Evaluated by students and faculty at National University Baliwag, the results reveal that ConsultEase significantly improves the efficiency, accuracy, and convenience of the consultation process, offering a scalable model for smart campus communication systems.

Keywords – Academic Communication, Consultation System, ESP32, IoT, Raspberry Pi, RFID, Student - Faculty Interaction

## DEDICATION

This capstone project, *ConsultEase: IoT Integrated Consultation System for Enhanced Student-Faculty Interaction*, is dedicated to those who supported, guided, and inspired us throughout this journey.

To our **friends and classmates**, thank you for being with us through the ups and downs. Your support, ideas, and encouragement gave us the strength to move forward, especially during difficult times. We are grateful for your help, patience, and shared efforts.

To our **parents, families, and loved ones**, thank you for your love, sacrifices, and belief in us. Your support, both emotional and financial, helped us focus on our work. This achievement is as much yours as ours.

To the **students and faculty members** who took part in our survey and system testing, your input added value to our project. Your participation helped us improve our system and better understand its impact.

And to **everyone who helped us** in any way through advice, prayers, or simple gestures of kindness, this project is for you. Your support made all the difference.

## ACKNOWLEDGEMENT

This capstone project would not have been possible without the guidance, support, and encouragement of many individuals and institutions.

First and foremost, we offer our deepest gratitude to the **Lord Almighty** for His divine guidance, strength, and blessings throughout the course of this capstone project.

To **Engr. Meizl Ann F. Manlupig**, our Capstone Subject Adviser, we thank you for your valuable support, constructive feedback, and guiding us throughout this journey. Without your guidance and dedication, this project would not have reached its full potential.

Our heartfelt thanks go to **Engr. Robert Justine S. Chavez**, our Project Adviser, for his technical expertise, patience, and encouragement, which helped us overcome numerous challenges and improved the quality of our work.

We are deeply grateful to all the **students and faculty members** who participated in our survey and system evaluation. Your feedback was essential in shaping the effectiveness of our project.

We also wish to acknowledge our **instructors and mentors** at the School of Engineering and Technology – National University Baliwag, whose teachings and guidance provided us with the knowledge and confidence to pursue this project.

Lastly, we extend our utmost gratitude to our **groupmates and beloved families**, whose unwavering support, sacrifices, and encouragement kept us strong and motivated throughout this endeavour. We appreciate everyone who contributed to this journey. Your presence made this journey worthwhile.

Table of Contents	
APPROVAL SHEET .....	<b>Error! Bookmark not defined.</b>
ACTION PLAN .....	<b>Error! Bookmark not defined.</b>
OVERVIEW OF THE DESIGN PROJECT.....	i
DEDICATION .....	ii
ACKNOWLEDGEMENT .....	iii
CHAPTER 1: THE PROBLEM AND ITS BACKGROUND .....	8
1.1 Introduction.....	<b>Error! Bookmark not defined.</b>
1.2 Statement of the Problem .....	8
1.3 Objective of the Study .....	10
1.4 Significance of the Study .....	11
1.5 Scope and Delimitation of the Study .....	12
1.5.1 Scope .....	13
1.5.2 Delimitation .....	14
1.6 Definition of Terms .....	14
CHAPTER 2: REVIEW OF LITERATURE AND STATE OF THE ART .....	16
2.1 Overview of the Review Process .....	16
2.2 Review of Related Literature .....	16
2.3 Review of Related Studies .....	19
2.3.1 <i>International Studies</i> .....	19
2.3.2 <i>Local Studies</i> .....	23
2.4 Framework of the Project.....	25
2.4.1 <i>Conceptual Framework</i> .....	25
2.4.2 <i>Operational Framework</i> .....	<b>Error! Bookmark not defined.</b>
2.5 Hypothesis of the Study .....	29
2.5.1 <i>Null Hypothesis</i> .....	29
2.5.2 <i>Alternative Hypothesis</i> .....	29
CHAPTER 3: RESEARCH METHODOLOGY .....	30
3.1 Population of the Study .....	30
3.1.1 <i>Design Requirements and Specifications</i> .....	30
3.2 Methods and Techniques of the Study .....	31
3.3 Research Instrument.....	34
3.4 Data Gathering Procedure.....	34
3.5 Data Processing and Statistical Treatment.....	35
3.6 Project Management Plan .....	36

CHAPTER 4: DESIGN RESULTS AND DISCUSSION.....	38
4.1 Result of Project Development and Implementation .....	39
4.1.1 E-Book Reading Device Full Model .....	39
4.1.2 System Architecture of EMCER.....	Error! Bookmark not defined.
4.1.3 Flowchart of the System .....	40
4.1.4 Device Interface .....	41
4.1.5 Source Code.....	Error! Bookmark not defined.
4.1.6 Final Prototype Overview .....	Error! Bookmark not defined.
4.1.7 Hardware Integration.....	43
4.1.8 Software Integration.....	44
4.2 Result of Tests.....	49
4.2.1 Accuracy of Eye Movement .....	49
4.2.2 Per-Class Metric Table.....	50
4.2.3 Addressing the Statement of the Problem.....	50
4.3 Result of Evaluations .....	53
4.3.1 Functional Suitability of EMCER.....	53
4.3.2 Performance Efficiency of EMCER.....	54
4.3.3 Interaction Capability of EMCER .....	55
4.3.4 Reliability of EMCER .....	56
4.3.5 Maintainability of EMCER.....	57
4.4 Challenges and Opportunities for Improvement of Design .....	59
4.4.1 Challenges .....	59
4.4.2 Opportunities for Improvement of Design .....	59
APPENDICES .....	Error! Bookmark not defined.
REFERENCES: .....	64

## List of Figures

<b>Figure 1</b>	Conceptual Framework .....	25
<b>Figure 2</b>	Independent and Dependent Variables.....	28
<b>Figure 3</b>	Operational Framework.....	<b>Error! Bookmark not defined.</b>
<b>Figure 4</b>	Development Methodology.....	<b>Error! Bookmark not defined.</b>
<b>Figure 5</b>	Development Methodology .....	32
<b>Figure 6</b>	Front and Side View of EMCER.....	39
<b>Figure 7</b>	EMCER System Architecture .....	40
<b>Figure 8</b>	EMCER Whole System Flowchart.....	40
<b>Figure 9</b>	EMCER Graphical User Interface .....	41
<b>Figure 10</b>	EMCER Source Code .....	42
<b>Figure 11</b>	Overview of the EMCER Device .....	42

## List of Tables

<b>Table 1</b>	Timeline of Activities for Capstone Design Project 1.....	36
<b>Table 2</b>	Timeline of Activities for Capstone Design Project 2.....	36
<b>Table 3</b>	Timeline of Activities for Capstone Design Project 3.....	37
<b>Table 4</b>	Hardware Components of the EMCER Device.....	44
<b>Table 5</b>	Software Components of the EMCER Device.....	44
<b>Table 6</b>	Confusion Matrix of EMCER .....	49
<b>Table 7</b>	Per-Class Performance Metrics for EMCER Command Recognition.....	50
<b>Table 8</b>	EMCER in terms of Functional Stability.....	53
<b>Table 9</b>	EMCER in terms of Performance Efficiency .....	54
<b>Table 10</b>	EMCER in terms of Interaction Capability .....	55
<b>Table 11</b>	EMCER in terms of Reliability.....	56
<b>Table 12</b>	EMCER in terms of Maintainability.....	57

## CHAPTER 1: THE PROBLEM AND ITS BACKGROUND

### 1.1 Introduction

The integration of technology in academic institutions has revolutionized administrative and communication processes, significantly improving the efficiency and accessibility of student-faculty interactions. Universities worldwide have adopted digital tools such as Learning Management Systems (LMS) and student information systems to streamline academic workflows and enhance communication channels (Selwyn, 2022). While these advancements have improved many aspects of academic life, face-to-face communication between students and faculty remains a persistent challenge that affects educational outcomes and institutional efficiency.

As technology continues to evolve, the application of Radio Frequency Identification (RFID) technology and Internet of Things (IoT) devices utilizing microcontrollers has seen increased integration into educational institutions. These technologies have demonstrated considerable potential in addressing communication barriers and enhancing operational efficiency across campus environments. RFID has proven particularly effective in student identification and attendance tracking, while IoT devices facilitate real-time data exchange, making processes like classroom management and student engagement more streamlined and responsive (Wahi, 2024; Mahmood et al., 2019). Globally, universities are increasingly adopting these technologies as integral components of their initiatives to create smart campuses that better serve the needs of students and faculty (Muhamad et al., 2017).

Despite these technological advancements, communication between students and faculty members in many academic institutions remains inefficient and fragmented. Current communication methods, such as messaging applications or in-person visits, frequently lead to delays, confusion, or missed opportunities for timely academic support. For students, locating specific faculty members can be



particularly challenging, especially when professors are not consistently present at their designated workstations or when office hours are not clearly communicated (Nandwani et al., 2012; Mukhriya & Saini, 2021). Additionally, there is a notable absence of systems that securely verify the identity of students requesting appointments or assistance, raising concerns about privacy and security. This persistent gap in communication infrastructure negatively impacts both faculty productivity and student satisfaction, highlighting the critical need for more streamlined, secure, and efficient communication solutions in academic settings.

A significant gap in current research is the limited focus on systems that integrate real-time communication and faculty presence tracking to improve consultations, particularly through automation using IoT and RFID technologies. While various smart campus solutions exist, they often concentrate primarily on automating administrative tasks, leaving the critical area of faculty-student interactions underserved and reliant on outdated communication methods. This research gap presents an opportunity to develop innovative solutions that specifically address the unique challenges of student-faculty communication in contemporary academic environments.

### **1.2 Statement of the Problem**

The general problem of this study is: How can the ConsultEase system improve communication between students and faculty members?

Specifically, this study will find answers to the following questions:

1. How can the integration of RFID/NFC technology ensure secure and accurate verification of students using the ConsultEase system?
2. How can real-time status updates of faculty availability be effectively displayed on the touchscreen interface to streamline student requests for meetings or consultations?

3. How will the system be developed by integrating Raspberry Pi, ESP32 and Bluetooth Module?
4. How will the developed system be assessed based on modified ISO/IEC 25010 quality model?

4.1 Functional Sustainability

4.2 Interaction Capability

4.3 Reliability

4.4 Maintainability

4.5 Security

### **1.3 Objective of the Study**

The general objective of this study is to improve communication between students and faculty members by developing and implementing an integrated real-time information and meeting request system that addresses current communication challenges in academic environments.

1. To develop a secure student verification system using RFID/NFC technology that ensures only authorized students can access the ConsultEase system for faculty consultations.
2. To implement a real-time faculty availability tracking and display system that provides students with accurate, up-to-date information on faculty presence and availability.
3. To design and integrate a comprehensive system architecture that effectively combines Raspberry Pi, ESP32, and Bluetooth technologies to create a seamless communication platform.
4. To evaluate the effectiveness and performance of the ConsultEase system using the modified ISO/IEC 25010 quality model, focusing on functional suitability, interaction capability, reliability, maintainability, and security.

5. To provide real-time information that displays faculty member availability to students, thereby reducing waiting times and improving overall student satisfaction with the consultation process.
6. To enhance student-professor interaction by facilitating timely and efficient communication, creating a more collaborative and dynamic learning environment that benefits both students and faculty.

#### 1.4 Significance of the Study

This study explores the impact of a communication system utilizing IoT technology, RFID, and microcontrollers on student-faculty interactions at National University Baliwag. The integration of these technologies aims to address existing communication barriers, enhancing the overall academic experience for students and faculty. By examining the effectiveness of this system, the study provides insights into how educational institutions can improve administrative processes and foster better engagement within the academic community.

The results of this study could offer valuable insights and would be beneficial to the following:

**Students:** will gain an enhanced method to communicate with faculty members, minimizing the time and effort needed to locate or wait for them. The system guarantees that students' requests or appointments are securely processed through RFID verification, significantly improving their academic experience and access to faculty support. By providing real-time information about faculty availability, students can make more informed decisions about when to seek consultations, reducing frustration and wasting time.

**Faculty Members:** will benefit from a more structured and effective approach to managing interactions with students. This reduces unnecessary disruptions and enables better time allocation, which increases productivity and responsiveness to student needs. The automated presence tracking

system allows faculty to focus on their primary responsibilities while remaining accessible to students who genuinely need assistance, creating a more balanced and efficient work environment.

**Administrative and Support Staffs:** will experience improved efficiency as the system helps manage faculty schedules and availability, reducing the need for manual coordination and tracking of appointments. With students checking faculty availability and sending messages through the system, there is less physical foot traffic in faculty offices, making it easier for support staff to maintain a more organized and quieter environment conducive to administrative tasks.

**Academic Institutions:** The project will assist academic institutions such as National University Baliwag in enhancing their administrative and operational efficiency through the integration of advanced IoT technology. It will also establish the institution as a leader in adopting smart technology, enhancing its reputation.

**Future Researchers:** The study will offer important data and insights for future research on technology-driven communication systems in academic environments, enriching the expanding body of knowledge on IoT and RFID applications in education.

### 1.5 Scope and Delimitation of the Study

This study aims to develop an IoT Integrated Consultation System that utilizes RFID for student verification, Bluetooth for wireless communication between devices, and a Raspberry Pi powered interface to automate faculty presence updates. When a student taps their ID on the RFID reader integrated into the system, it displays a list of the department professors and their availability status (e.g., available or unavailable). If the professor is not from the student's department, they can search for the professor using a built-in search feature.

### 1.5.1 Scope

This study aims to develop an IoT Integrated Consultation System that utilizes RFID for student verification, Bluetooth for wireless communication between devices, and a Raspberry Pi powered interface to automate faculty presence updates. When a student taps their ID on the RFID reader integrated into the system, it displays a list of the department professors and their availability status (e.g., available or unavailable). If the professor is not from the student's department, they can search for the professor using a built-in search feature.

The project will be implemented in university faculty offices where communication challenges, such as missed notifications and outdated schedules, are prevalent. Key challenges addressed include uncertain faculty availability, delayed communication, office hours confusion, and time wastage, as students often search multiple locations to find professors.

A comprehensive analysis will be conducted, focusing on key metrics such as the system's functionality, usability, reliability, portability, security, and overall satisfaction among both students and faculty to improve communication effectiveness. The researchers will evaluate the system's performance, identifying strengths and potential areas for improvement, with particular emphasis on the needs of both faculty and students.

The duration of the study spans from the third term of the academic year 2023-2024 to the third term of the academic year 2024-2025, and it will be conducted by researchers from National University – Baliwag. The primary focus is on the faculty consultation system in a university setting, specifically targeting faculty offices to ensure that the solutions developed are tailored to the unique communication needs of academic environments.

### 1.5.2 Delimitation

The study is delimited to the implementation of the IoT Integrated Consultation System specifically within National University – Baliwag. The system is designed exclusively for use by students, faculty members, security, maintenance personnel, and other staff who assist in locating faculty members on campus. Access will be restricted to users with a valid and updated school ID, which will require identity verification. The system will not be available to external guests or visitors unless they are assisted by authorized personnel. Additionally, the study will not extend to other campuses or institutions beyond National University – Baliwag.

Despite these limitations, the study is expected to provide valuable insights into enhancing faculty-student communication through technology. By evaluating system performance, user satisfaction, and usability, the research aims to refine the system for better functionality and effectiveness. Feedback from users within the university will be crucial in understanding the system's acceptance and guiding further optimization efforts.

## 1.6 Definition of Terms

This section provides clear definitions for key terms relevant to the study. Understanding these concepts is essential for comprehending the framework and technology involved in improving communication between students and faculty members. The definitions will establish a common language for discussing the integration of IoT, RFID, and other technologies in academic settings.

- **Radio Frequency Identification (RFID)** - A technology that uses radio waves to read information stored on tags attached to objects (Lodha et al., 2022). The system includes RFID tags attached to student ID cards and RFID readers installed in key locations. When a student approaches a

reader, the device emits radio waves to communicate with the tag, allowing for quick and efficient verification of identity and attendance.

- **Bluetooth** – A short-range wireless communication protocol operating at 2.4 GHz, designed for efficient data exchange between devices. ConsultEase employs Bluetooth for low-energy connectivity between student IDs and faculty systems, enabling presence detection and status updates with minimal power consumption.
- **Raspberry Pi** – A single-board computer (SBC) with a Broadcom BCM2711 quad-core processor, used as the central processing unit (CPU) for ConsultEase. It hosts the Python backend, manages RFID authentication, and interfaces with PostgreSQL and SQLite for schedule synchronization, providing sufficient computational capacity for the system's requirements while maintaining cost-effectiveness.
- **ESP32** – A dual-core microcontroller with integrated Wi-Fi and Bluetooth, used in ConsultEase to display real-time faculty availability on cubicle screens and monitor presence via BLE signals (Darko, Owusu, & Adinyira, 2023). Its Wi-Fi capabilities enable stable communication with the Raspberry Pi, facilitating efficient data transmission and reducing the need for wired connections.
- **Embedded System** – A dedicated computing system combining hardware and software for specific functions. ConsultEase's embedded architecture integrates RFID, microcontrollers, and IoT components to streamline student-faculty interactions, creating a purpose-built solution for the specific communication challenges identified in the research problem.
- **Internet of Things (IoT)** – A network of interconnected devices communicating via the internet to automate processes. In ConsultEase, IoT enables real-time updates, RFID authentication, and Bluetooth-driven notifications (Gillis, 2023), creating an integrated system that addresses the communication barriers identified in the research problem.

## **CHAPTER 2: REVIEW OF LITERATURE AND STATE OF THE ART**

### **2.1 Overview of the Review Process**

This chapter reviews various related articles, journals, and university thesis that were collected to support this study. The gathered information was summarized to extract critical insights on the hardware and software components used, as well as the potential impact of the studies on the researchers' methodology. Additionally, the findings from each study were considered to help develop the final prototype.

### **2.2 Review of Related Literature**

#### **Internet of Things and Its Applications to Smart Campus: A Systematic Literature Review**

This study on IoT technologies for smart campuses is highly relevant to our project. As smart campuses are becoming more prevalent, they offer opportunities to enhance services and processes in universities. IoT plays a significant role in integrating technology into higher education, which aligns with our goal of improving communication through wireless solutions. By reviewing recent research on IoT in smart campuses, this study provides valuable insights into the technologies needed for such systems and highlights both the benefits and challenges that come with their implementation. Understanding these factors will guide the development and deployment of our own system. By analyzing IoT implementations in smart campuses, this study offers critical insights into the technological frameworks and infrastructure that will be essential for developing and optimizing our system. It also highlights the advantages IoT brings to enhancing user experiences and operational processes, which are key to ensuring the success of "ConsultEase".



## **Implementation of Wireless Communication using (HC-05) Bluetooth Module with MATLAB GUI**

This literature on IoT-based smart campuses is crucial to our project, for several reasons. First, it provides a foundation for understanding how IoT technologies can be effectively used to enhance communication and operational efficiency within educational institutions. Since our project aims to implement a wireless notification system, the findings of this research will guide us in selecting appropriate IoT solutions and understanding their potential benefits in a campus environment. By exploring both the opportunities and limitations of smart campus IoT systems, this literature informs key aspects of our project, from technical feasibility to practical considerations in real-world settings. It reinforces the relevance of our work in advancing modern, efficient communication solutions within the broader context of smart campus development.

### **Design and Implementation of ESP32-Based IoT Devices**

The discussion on the ESP32 highlights its suitability for developing IoT applications due to its powerful features like a dual-core processor, integrated Wi-Fi and Bluetooth, and low power consumption. Its capabilities enable multitasking and efficient communication, making it an ideal platform for educational IoT projects. The article highlights how IoT is increasingly integrated into educational systems, emphasizing the demand for IoT skills in the workforce. It provides a framework for educational tools and technologies that simplify IoT applications, focusing on student projects where they learn to design and implement IoT solutions. This is relevant because the ESP32 can handle the real-time data transmission and interactions needed for enhancing student-faculty consultations, supporting both hardware and software requirements for IoT-based communication systems. This

aligns with your research on enhancing student-faculty interaction through IoT by offering insights into how IoT can support practical learning and improve processes within educational institutions, further validating the approach of using IoT in communication systems.

### **A Review Paper on Raspberry Pi and its Applications**

Raspberry Pi, a compact yet powerful minicomputer, has transformed the landscape of embedded systems and computing. Developed by the United Kingdom's Raspberry Pi Foundation, it was designed to inspire creativity and innovation among learners. Since its launch, the device has garnered extensive support from open-source communities, contributing to a wide range of operating systems, applications, and related technologies. Raspberry Pi has become a popular tool for researchers and scholars in embedded systems, powering numerous innovative projects. Constant upgrades in both hardware and software have turned it into a "full-fledged computer" capable of handling complex tasks efficiently. This review paper provides an overview of Raspberry Pi's evolution and its applications, serving as a valuable resource for students and developers in the open-source and embedded systems communities.

### **Exploring IOT Application Using Raspberry Pi**

This article examines the application of Raspberry Pi as a server in client-server communication systems, specifically focusing on wireless communication in industries and educational settings. Traditional wired networks, while reliable, are often costly due to extensive cabling. In contrast, low-cost wireless networks are increasingly in demand for non-critical applications, such as temporary networks or areas requiring low data rates and extended battery life. By utilizing Raspberry Pi, the research explores its role as a file server, enabling multiple devices to connect, store, and manage files over a network while ensuring data security through user authentication. Additionally, the study

demonstrates how Raspberry Pi, combined with ZigBee modules, can facilitate wireless communication, providing a practical solution for low-power, mobile network applications. This research highlights the versatility of Raspberry Pi in enabling cost effective, wireless communication systems across various sectors.

## **2.3 Review of Related Studies**

### **2.3.1 International Studies**

#### **Smart Wireless Message Display: Enhancing Communication with Intelligent Technology (by Ahil et al., 2024)**

The study by aimed to enhance communication through the development of a Smart Wireless Message Display (SWMD) utilizing Raspberry Pi technology. The system incorporated a unified display with LED panels to present announcements, documents, PDFs, videos, and photographs, facilitating effective communication among students, staff, and the public. The SWMD allowed for remote content management via wireless connectivity, promoting rapid and efficient information dissemination. The hardware and software components were designed to be versatile, user-friendly, and accessible, ensuring seamless integration with existing communication infrastructures.

Like Ahil et al., the Touch-fy study aims to improve communication within educational settings but focuses specifically on faculty-student interactions. While Ahil et al.

emphasized dynamic content display and remote management to enhance overall communication, the ConsultEase study narrows its focus to automating faculty-student interactions. Both studies utilize the versatility of Raspberry Pi and wireless connectivity to create efficient and user-friendly communication systems. Ahil et al. demonstrated the effectiveness of using a unified display for broad

communication needs, whereas Touch-fy aims to streamline specific interactions within the academic environment, establishing timely and accurate updates of faculty availability.

### **RFID Based Attendance System (Ashok et al. 2022)**

The study aimed to develop an RFID-based attendance system in educational institutions, utilizing machine learning to analyze attendance trends.

RFID tags were used to identify students, while NodeMCU ESP8266 microcontrollers transmitted the data to the cloud for storage in Google Sheets. The focus of the study was on automating attendance logging, with key components including the RFID readers, which recorded attendance when students scanned their cards, and the use of time series forecasting to predict future attendance. Based on the results, the number of RFID scans was found to be a crucial factor in predicting attendance patterns, improving both accuracy and effectiveness. The study concluded that integrating RFID with machine learning could optimize attendance tracking and aid in institutional resource planning, such as for dining hall preparation. These findings could have broader applications, including workforce management.

Comparable to Ashok et al., ConsultEase uses RFID technology to automate student verification, but it specifically emphasizes interactivity and real-time updates. Ashok et al. log attendance through RFID scanning, while ConsultEase integrates a Raspberry Pi touchscreen for student interaction and automatically updates the professor's presence. ConsultEase focuses on automating faculty presence and providing real-time schedule updates, whereas Ashok et al. aimed to streamline attendance logging using machine learning and cloud storage. While both systems improved accuracy, ConsultEase aims to enhance communication between students and faculty through its interactive design.

### **Enhancing School Security System Using RFID: A Comprehensive Approach (Johnson Sirleaf Brisbane, 2024)**

The study aimed to enhance school security by utilizing RFID technology to track student movements. RFID identification cards were issued to students, and the system recorded the time and location of their entry and exit from school premises. Automatic notifications were sent to parents or guardians to improve communication and keep them informed. The study focused on the system's methodology, implementation, and integration into the school's infrastructure. Based on the results, there was a positive correlation between the adoption of RFID technology and improved security measures in educational institutions. The findings suggest that this system could help alleviate issues such as students skipping lectures and enhance overall school safety.

The study by Brisbane's and the ConsultEase both utilize RFID technology for automation and real-time updates but differ in focus and implementation. Brisbane's system aimed to enhance school security by tracking student movements and sending automatic notifications to parents. ConsultEase, on the other hand, aims to improve communication between students and faculty by integrating a Raspberry Pi with a touchscreen to provide real-time updates on the professor's schedule and presence. While both systems streamline processes using RFID, Brisbane focuses on security and attendance, whereas ConsultEase emphasizes dynamic faculty-student interaction.

### **Empowering Communication: A Raspberry Pi Based Smart Noticeboard System (Ajay et al. 2024)**

The study developed a Smart Notice Board using Internet of Things (IoT) technology and Raspberry Pi to address the limitations of traditional notice boards, such as outdated information and reliance on paper. The researchers created a web application that enables real-time updates, multimedia

integration, and remote management, employing HTML, CSS, and JavaScript for the frontend, along with Python and Flask for the backend. Results indicated that the Smart Notice Board significantly improved communication efficiency within organizations. Additionally, it promoted environmental sustainability by reducing paper waste, making this innovative solution beneficial for educational institutions, corporate settings, and public facilities.

The ConsultEase study similarly employs Raspberry Pi technology but specifically targets communication improvements between students and faculty. It automates the tracking of a professor's presence in the faculty room and provides updates to the professor's schedule on the student's touchscreen. Although both studies utilize Raspberry Pi to enhance communication, Ajay et al. concentrate on a wider scope of information dissemination, while ConsultEase prioritizes direct interaction and automation in the student-faculty relationship.

#### **Portable Biometric Attendance System Using IOT (Jadhav et al., 2019)**

The study aimed to investigate the effectiveness of IoT-based biometric attendance systems in educational settings. The research analyzed several factors contributing to the performance of these systems, including hardware reliability, network connectivity, and data security. The study focused on real-time data transfer, biometric accuracy, and the impact of IoT integration on traditional attendance tracking methods. Based on the results, the study found that IoT-based systems achieved a 95% accuracy rate in attendance tracking, with fingerprint recognition emerging as the most reliable method. Issues such as hardware limitations and network connectivity posed challenges, but overall, the system demonstrated significant improvements in accuracy and efficiency compared to manual attendance methods. The study concluded that these findings may be helpful for educational institutions aiming to modernize their attendance tracking systems.

Like the ConsultEase system, this study focuses on automation and real-time updates.

While Jadhav et al. emphasize attendance accuracy through biometric systems, ConsultEase enhances student-faculty communication with wireless touchscreen notifications. Both systems improve institutional processes by automating verification and leveraging wireless connectivity, though they address different academic needs.

### **2.3.2 Local Studies**

#### **System Design for Automating Smart Internet of Things Devices Using Bluetooth Localization (Uy et al. 2022)**

Internet of Things (IoT) automation to monitor employee presence and optimize energy consumption in workplaces. The system uses Bluetooth Low Energy (BLE) beacons and ESP32 mesh networks to gather real-time occupancy data and control smart devices accordingly. The data is processed via a Raspberry Pi server using Node-RED, which automates the control of devices such as lights and plugs based on the presence of individuals. This research highlights the scalability and flexibility of IoT solutions for both indoor and outdoor environments, demonstrating how Bluetooth localization can be used to automate processes and improve operational efficiency (Uy et al., 2022).

Like ConsultEase this system used Raspberry Pi, ESP32 and Bluetooth Module for IoT application such as monitoring the presence of people. While Uy et al. focused on automating smart devices in workplaces ConsultEase applies similar principles to academic institutions.

#### **In-Classroom Faculty Attendance Monitoring System (Calo, Barbosa, and Llevado 2021)**

A study developed a faculty attendance monitoring system using Ultra High-Frequency (UHF) Radio Frequency Identification (RFID) and image cross-verification mechanisms. The system

focused on monitoring faculty presence in classrooms using UHF-RFID tags embedded in teacher IDs, providing a noncontact method for attendance logging (Calo et al., 2021).

This system also integrated Raspberry Pi for data management, which is like the ConsultEase project's aim of using Raspberry Pi for processing notifications. The use of RFID in Calo et al.'s study supports ConsultEase's approach in using RFID for verifying the identity of students before they can send notifications, ensuring accuracy and automation without manual inputs.

### **Interactive Way-Finder and E-Notices System**

Another relevant study by Ganiron Jr. et al. (2019) focused on developing an interactive way-finder and e-notices system for university campuses. The project utilized a touchscreen monitor placed in high-traffic areas like school lobbies, allowing students to access information such as schedules and announcements (Ganiron Jr. et al., 2019).

This system aimed to reduce manual inquiries and direct student requests to digital platforms. Similarly, the ConsultEase project uses a touchscreen interface to display real-time status updates and facilitate communication between students and faculty. The integration of a user-friendly interface in both studies highlights the importance of providing accessible and immediate information to users.

### **IntelliSchool: A Student Information System for Senior High School (Campanan et al. 2024)**

They developed IntelliSchool, a system designed to streamline various student information processes through a centralized platform. It aimed to improve data accuracy and facilitate communication between school administrators, students, and parents through a web-based portal (Campanan et al., 2024). Although primarily focused on managing student records and grades,



IntelliSchool emphasizes the need for efficient communication systems in academic settings, aligning with ConsultEase's objective to improve communication between students and faculty.

### **Cloud-based Real-time Bulletin Board System (Sabao et al. 2021)**

They developed a cloud-based real-time bulletin board system designed to enhance information dissemination in academic institutions. The system utilized a web-based interface where authorized personnel could post and update announcements instantly, ensuring that students and faculty received timely updates. The system was accessible from any location and highlighted the role of real-time data in improving communication in academic environments (Sabao et al., 2021).

Like ConsultEase, this system emphasizes the importance of real-time updates and efficient communication in academic institutions. However, while Sabao et al.'s study focuses on general announcement dissemination, ConsultEase aims to create a more personalized, interactive communication platform where students can securely message faculty members, ensuring direct and immediate communication in a shared faculty space. setting.

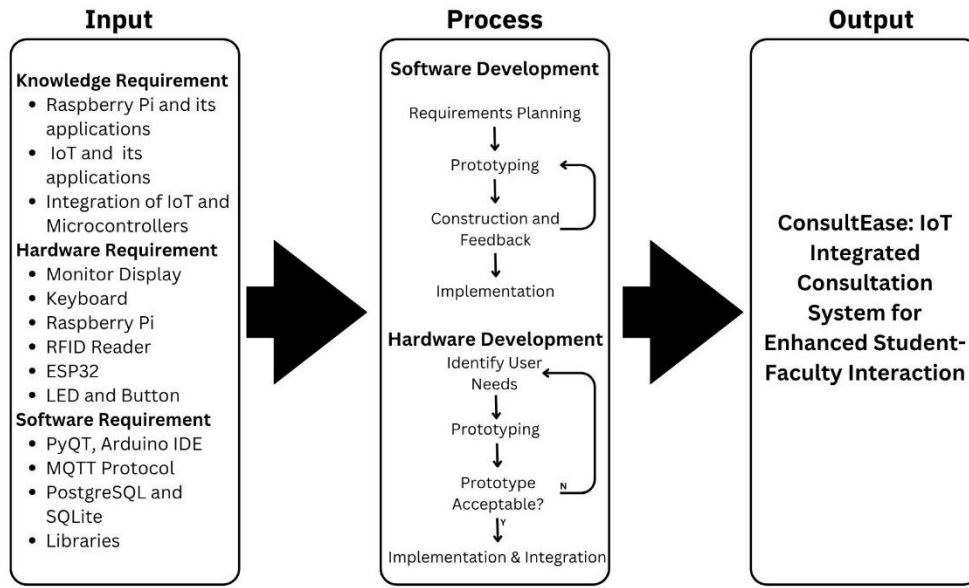
## **2.4 Framework of the Project**

The ConsultEase project employs the Input-Process-Output (IPO) model as its conceptual framework, providing a structured approach to system development that ensures comprehensive coverage of all essential components and processes. Each block of the IPO model outlines key aspects that impact the research output, creating a logical progression from theoretical foundations to practical implementation.

### **2.4.1 Conceptual Framework**

#### **Figure 1: Input-Process-Output Model**

*Conceptual Framework*



The development process begins with a thorough understanding of the background represented in the **Input block**. This encompasses not only the study's theoretical foundations but also delves deeply into the fundamental understanding of microcontrollers, programming languages, and IoT technologies that form the technical basis of the system. The hardware requirements section covers the basic elements essential to the operation of the system, including RFID readers, Raspberry Pi, ESP32 microcontrollers, and Bluetooth modules. The software requirements specify the precise programming languages, libraries, and frameworks needed to build the system, ensuring that all necessary tools are identified before development begins.

The **Process block** outlines the flow of system development from initial conception to final implementation. The project adopts the Rapid Application Development (RAD) Model for software development and the Type 1 Prototype Model for hardware development, creating a comprehensive methodology that addresses both digital and physical components of the system. Development begins with gathering detailed user requirements and quickly progresses to prototype creation, allowing for early testing and refinement.

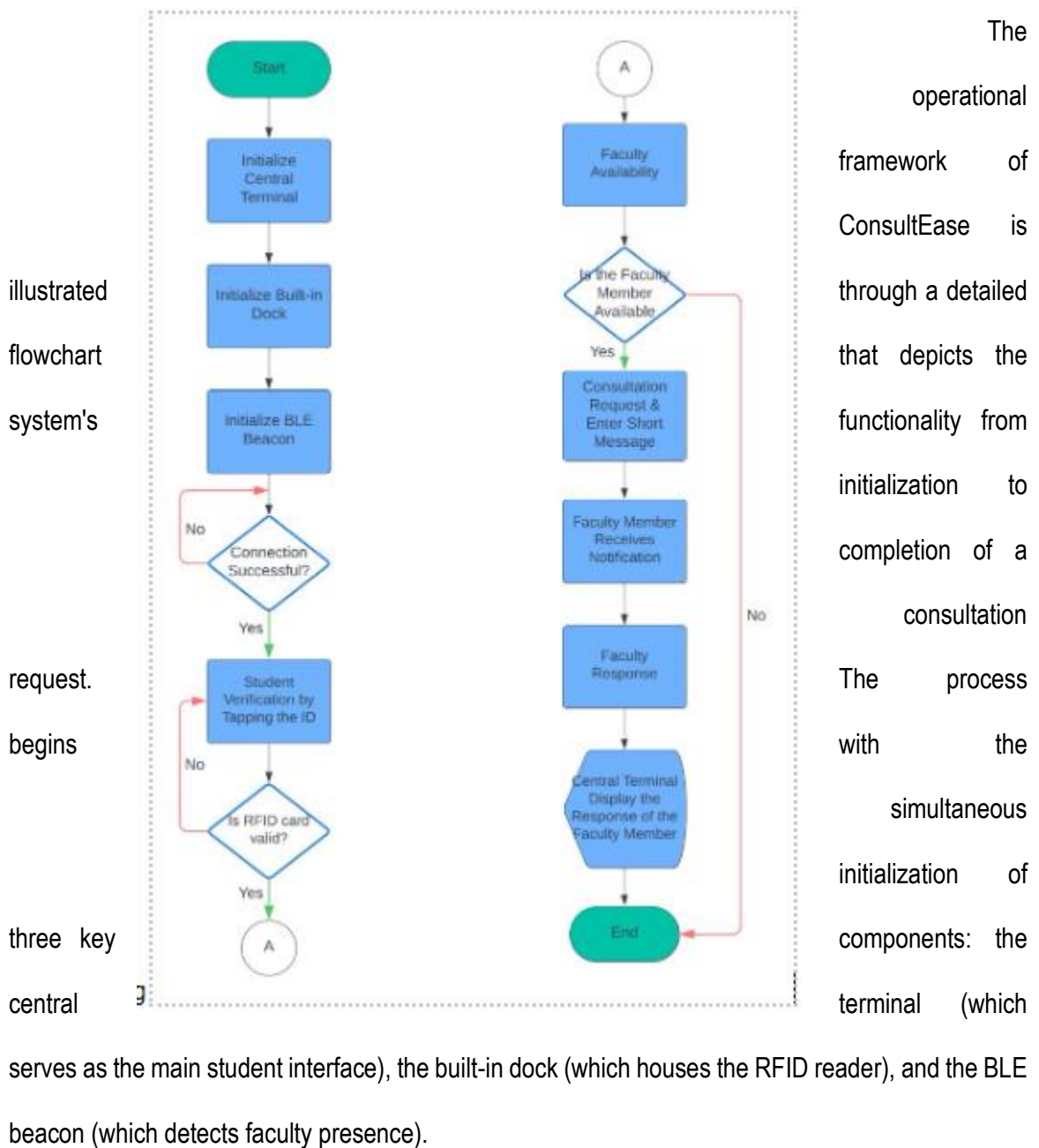
These prototypes are continuously tested and improved based on user feedback, creating an iterative development cycle that ensures the final system meets actual user needs. Rather than following a rigid, step-by-step approach, development takes place in smaller, iterative cycles that allow for adjustments and refinements throughout the process. The system is released in stages, with each component being tested, improved, and integrated with previous versions to create a cohesive whole.

User feedback plays a crucial role in shaping the system as it evolves to meet new requirements and address emerging challenges. This user-centered approach ensures that the final system addresses the actual communication needs of students and faculty rather than implementing theoretical solutions that may not align with real-world usage patterns.

The **Output block** represents the final ConsultEase system, encompassing both the physical hardware components and the software interfaces that enable student-faculty communication. This includes the central terminal with RFID verification, the faculty presence monitoring system, and the secure messaging platform that connects students with available faculty members.

This detailed description of the Input-Process-Output model emphasizes the intricate sequence of steps essential in the construction of ConsultEase. The framework ensures a logical and complete strategy capable of delivering an efficient and functional consultation system, from the integration of initial knowledge to the strategic execution of development phases and the final delivery of a comprehensive communication solution.

**Figure 2:**  
*Operational Framework*



Once these components establish a stable connection, the system prompts the student to verify their identity by tapping their ID card on the RFID reader. The system then validates the RFID card against the university database to ensure that only authorized students can access the

consultation system. If the RFID verification fails, the system returns to the prompt state, requesting the student to try again or seek assistance.

If the RFID card is successfully validated, the system proceeds to check faculty availability by querying the presence detection system. This system uses Bluetooth Low Energy (BLE) to detect whether faculty members are present at their designated locations. The availability status is then displayed on the central terminal, showing which faculty members are currently available for consultation.

When a faculty member is available, the student can submit a consultation request through the touchscreen interface, including a short message describing the purpose of the consultation. This request is transmitted to the faculty member's notification system, alerting them to pending approval.

## **2.5 Hypothesis of the Study**

### **2.5.1 Null Hypothesis**

The IoT Integrated Consultation System **does not improve** the communication process and faculty presence tracking for student consultations compared to traditional methods.

### **2.5.2 Alternative Hypothesis**

The IoT Integrated Consultation System **improves** the communication process and faculty presence tracking for student consultations compared to traditional methods

## CHAPTER 3: RESEARCH METHODOLOGY

This study employed a quantitative research methodology to assess the performance of the ConsultEase system through measurable user feedback. Using purposive sampling, data were gathered from students and faculty members at National University – Baliwag who were directly engaged with the system. A survey instrument, based on the ISO/IEC 25010 quality model, was used to evaluate key system attributes such as functional suitability, usability, reliability, maintainability, and security.

### 3.1 Population of the Study

The population of the study consists of students who often encounter challenges in locating specific faculty personnel, faculty members who face issues with communication and availability, and other staff members involved in facilitating interactions within the university. Through purposive sampling, the sample will consist of 30 students and 5 faculty members in National University Baliwag, this targeted selection guarantees a diverse and representative sample for the study, facilitating a thorough assessment of ConsultEase.

#### 3.1.1 *Design Requirements and Specifications*

The project requires in-depth knowledge in several key areas. Proficiency in MQTT communication protocols will be essential for enabling wireless connectivity between devices. Expertise in PyQt5 application development using Raspberry Pi will be vital for creating the central touchscreen interface and ensuring efficient data processing. Additionally, understanding RFID technology will be necessary for automating student verification, and BLE (Bluetooth Low Energy) beacon detection will be required for faculty presence detection.

The hardware requirements for the project include a touchscreen display for the Raspberry Pi to provide an intuitive user interface for consultation management, a Raspberry Pi to serve as

the central processing unit managing data collection and processing, and an RFID reader for student ID verification. The project also incorporates an ESP32 microcontroller that connects to the Raspberry Pi via Wi-Fi and MQTT messaging.

Additionally, BLE beacon detection using MAC address scanning will be implemented on the ESP32 to detect the presence of faculty members in their offices. A 2.4" TFT display (ST7789 SPI interface) will be included on the ESP32 for displaying consultation requests and providing visual feedback during user interactions.

For the software, the project utilizes Python with PyQt5 for the main application development, ensuring the creation of a professional touchscreen interface and backend functionality. PostgreSQL is employed as the database solution for storing and managing faculty schedules, student records, and consultation data. MQTT (Message Queuing Telemetry Transport) serves as the communication protocol between the central system and ESP32 faculty desk units. Various Python libraries including paho-mqtt, SQLAlchemy, evdev, pycopg2-binary, and bcrypt support the integration of hardware components, database operations, and security features, enabling real-time data updates and enhancing the overall capabilities of the system.

### **3.2 Methods and Techniques of the Study**

The research adopts a quantitative research approach to systematically evaluate the accuracy and functionality of IoT Integrated Consultation System for Enhanced Student-Faculty Interaction. Quantitative approaches, according to the USC Libraries, emphasize objective measurements and statistical analysis of gathered data through surveys and polls, utilizing computer technology for data manipulation. The study employs a structured process that prioritizes numerical data collection and statistical analysis.

Moreover, The Rapid Application Development Model shown in Figure 3 for the software development plan and Prototyping Model shown in Figure 4 for hardware development plan will be adopted to guide their methodology. The Rapid Application Development Model encompasses distinct phases which includes Requirements Planning, Prototyping, Rapid Construction and

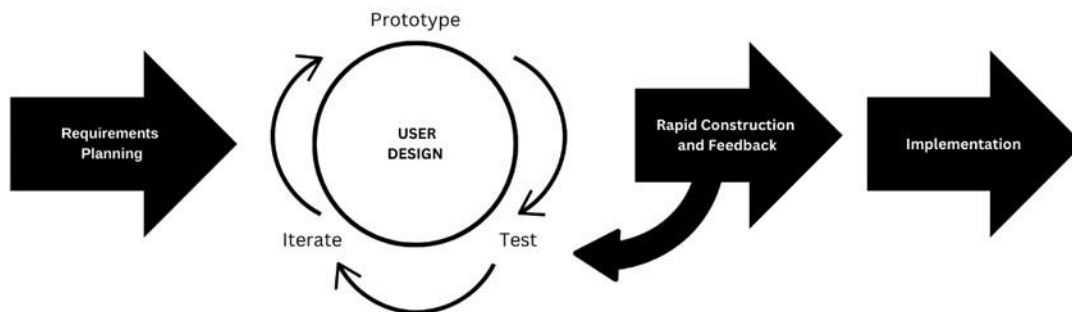
Feedback and Implementation. With Rapid Application Development Model, the researchers can quickly make multiple iterations and updates to the software without starting from scratch, which ensures that the outcome aligns with the end user's requirements.

For Hardware Development plan the researchers employed Type 1 Prototype model which includes identifying user problem then developing a prototype according to the identified problem and technical specifications and then determining if the prototype is acceptable. If yes, then the prototype will be used if not again. The loop continues from beginning. This model is iterative, focusing on continuous user feedback and prototype refinement to ensure the final prototype addresses the identified user problem effectively.

### **Figure 3**

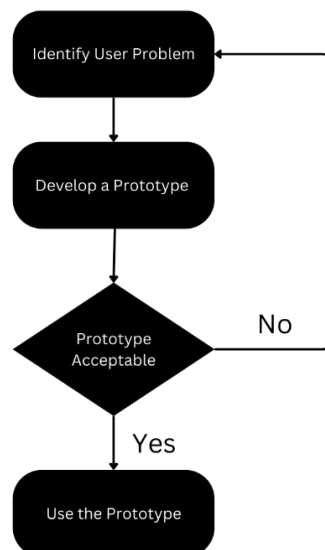
*Development Methodology*





**Figure 6**

*Type 1 Prototype Model*



### 3.3 Research Instrument

The researchers will use a survey questionnaire to collect numerical data for the ConsultEase: IoT Integrated Consultation System for Enhanced Student-Faculty Interaction and assess the quality and performance of the prototype using the ISO 25010 quality model. The questions will focus on evaluating the project in terms of its:

- Functional Suitability – Assessment of the system's intended function
- Interaction Capability - The system's ease of use, clarity of instructions, intuitiveness of the interface, and learnability
- Reliability – Assessment of the system's dependability and consistency in performance
- Maintainability – Assessment of the system's ability to be modified, updated, and repaired
- Security - Assessment of how well the system protects user data and prevents unauthorized access

The responses will be measured using a Likert scale in a scale of 1-5 where 1 is **Strongly Disagree** and 5 is **Strongly Agree** to quantify user satisfaction and performance across different metrics.

### 3.4 Data Gathering Procedure

The data for the IoT Integrated Consultation System will be collected using survey questionnaires. The sampling method used for this research will be purposive sampling, selecting participants based on their relevance and involvement with the system, including 40 students and 5 faculty members from National University Baliwag. These participants will be chosen based on their roles as primary users of the consultation system, ensuring a diverse range of user experiences.

The participants will fill out the survey questionnaire designed according to the modified ISO 25010 quality model. This survey focuses on evaluating the system's functional suitability, interaction

capability, reliability, maintainability, and security. Responses are collected using the 5-point Likert scale described in the Research Instruments section, allowing participants to quantitatively rate their satisfaction and experience with various aspects of the system.

The survey also includes open-ended questions that allow participants to provide qualitative feedback on their experience with the system. These questions address aspects such as:

1. Most valuable features of the system
2. Suggestions for additional features or functionalities
3. Recommendations for improving the user interface or interactions
4. Challenges or difficulties encountered during system use

This qualitative feedback complements the quantitative ratings, providing deeper insights into user perceptions and experiences that might not be fully captured by numerical scales alone.

### **3.5 Data Processing and Statistical Treatment**

The data from the surveys and system logs will then be analyzed using descriptive statistics, including mean scores and standard deviations, to assess the overall performance of the system. Correlation analysis will be conducted to identify relationships between the system's functionality and user satisfaction. Based on the findings, the system will be refined, addressing any issues related to usability or performance that were identified during testing.

This data gathering procedure ensures that user feedback is thoroughly collected and analyzed to guide further improvements to the IoT Integrated Consultation System.

### 3.6 Project Management Plan

**Table 1**

*Timeline of Activities for Capstone Design Project 1*

Activities	April				May				June				July			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
Lesson Proper																
Project Ideation																
Title Creation																
Titles Proposal and Approval																
Consultation with Adviser																
Drafting Introduction																
Consultation with Adviser																
Revision of Introduction																
Online Mock Defense																
Review of Related Literature & Studies																
Methodology																
Chapters 1 – 3 Mock Defense																
Possible Revisions																
Days with Classes								No Classes								
Exam Week																

Table 1 shows the timeline of activities for Capstone Design Project 1 starting from the first week of April to the last week of July. It includes the overall progress throughout the term and potential revisions for the next phases of the project.

**Table 2**

*Timeline of Activities for Capstone Design Project 2*

Activities	August				September				October				November			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th

Lesson Proper																	
Chapter 1 Revision																	
Consultation with Adviser																	
Chapter 2 Revision																	
Chapters 1 – 3 Draft																	
Consultation with Adviser																	
Chapters 1 – 3 Revision																	
Chapters 1 – 3 Submission																	
Proposal Defense Preparation																	
Project Proposal																	
Prototype Planning																	
Days with Classes																	
Exam Week																	

Table 2 shows the timeline of activities for Capstone Design Project 2 starting from first week of August to mid-week of September. The timeline represents all the activities done during the midterm period. Revisions are dominant during this period due to the newly provided research paper format and changes in the device's functionality.

**Table 3**  
*Timeline of Activities for Capstone Design Project 3*

Activities	March				April				May				June			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
Implementation																
Analyzation and Prototyping Design																
Testing of Prototype																
Iteration of Prototype																
Evaluation of Prototype																
Final Defense																
Days with Classes																
Exam Week																

Table 3 shows the timeline of activities for Capstone Design Project 3 starting from last week of March to last week of June. The timeline represents all the phases of prototyping such as implementation, design analysis, prototyping, testing, iteration, evaluation of prototype, and final defense, ensuring structured progression towards

project completion.

## **CHAPTER 4: DESIGN RESULTS AND DISCUSSION**

This chapter presents the results of the system's development and implementation. It begins with a detailed explanation of the hardware and software integration that led to the creation of a functional prototype. This is followed by a discussion of the testing outcomes and user evaluation results based on key system attributes. Lastly, the chapter addresses the challenges encountered during the development process and identifies potential areas for future improvement.

## 4.1 Result of Project Development and Implementation

In the development and implementation phase of this study, the researchers transitioned from theoretical concepts to practical applications, resulting in a fully functional system that addressed common challenges in student-faculty consultations. By integrating RFID verification, Bluetooth Low Energy (BLE) for faculty presence detection, and MQTT for real-time data synchronization, the system effectively improved availability, accessibility, and security in academic consultations. The following highlights the achieved results, demonstrating the efficacy and impact of the implemented solutions in enhancing student-faculty interaction through ConsultEase.

### 4.1.1 ConsultEase Central Terminal

**Figure 5**

*ConsultEase Central Terminal Device*

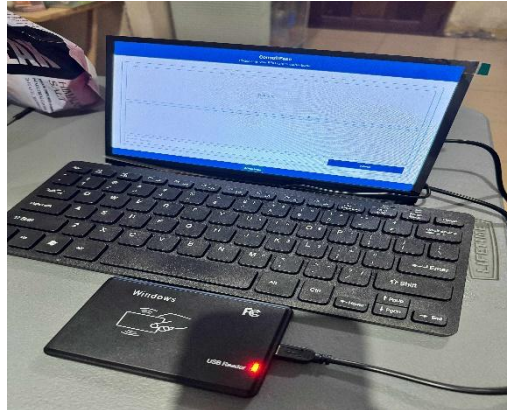


Figure 5

displays the physical setup of the

ConsultEase central terminal. The central terminal acts as the main student interface, integrating a touchscreen display with an RFID reader. It allows students to authenticate their identity, check faculty availability, and send consultation requests through an intuitive graphical user interface powered by a Raspberry Pi.

#### 4.1.2 ConsultEase Faculty Desk Unit

**Figure 6**

*Desk Unit for Faculty Personnels*

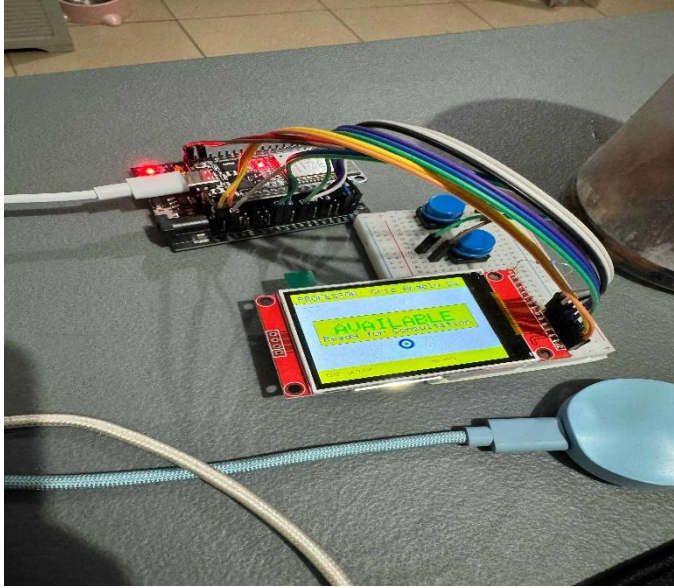


Figure 6 presents the faculty-side desk unit equipped with an ESP32 microcontroller and a 2.4" TFT screen. This device displays consultation requests sent from the central terminal in real-time. It also detects Bluetooth Low Energy (BLE) signals from a separate beacon, allowing the system to determine the faculty member's presence and update their availability status accordingly.

#### 4.1.3 Creation of ConsultEase Graphical User Interface (GUI)

**Figure 7**

*ConsultEase Graphical User Interface*



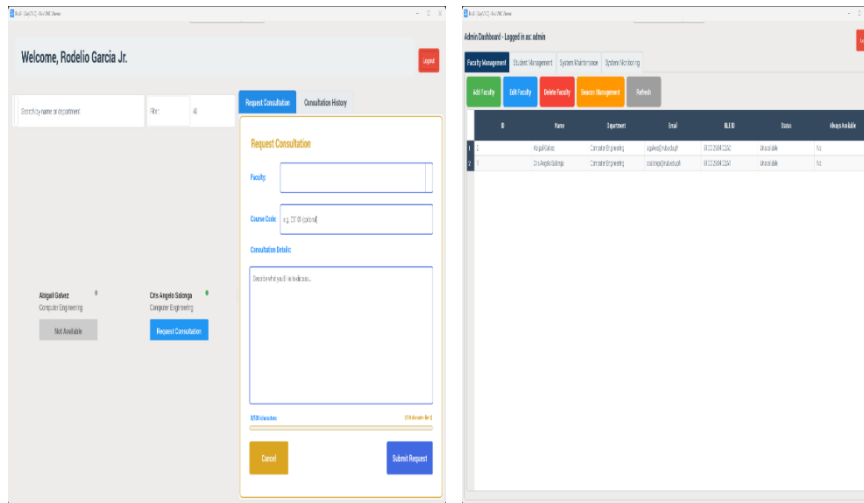


Figure 7 showcases the PyQt5-based GUI of ConsultEase, designed for seamless student interaction. The interface includes the welcome page, professor list with real-time availability, and a message submission screen. Each element is optimized for touchscreen use, ensuring students can navigate, search for faculty, and submit messages with ease.

#### 4.1.4 Source Code

Figure 8

ConsultEase Source Code

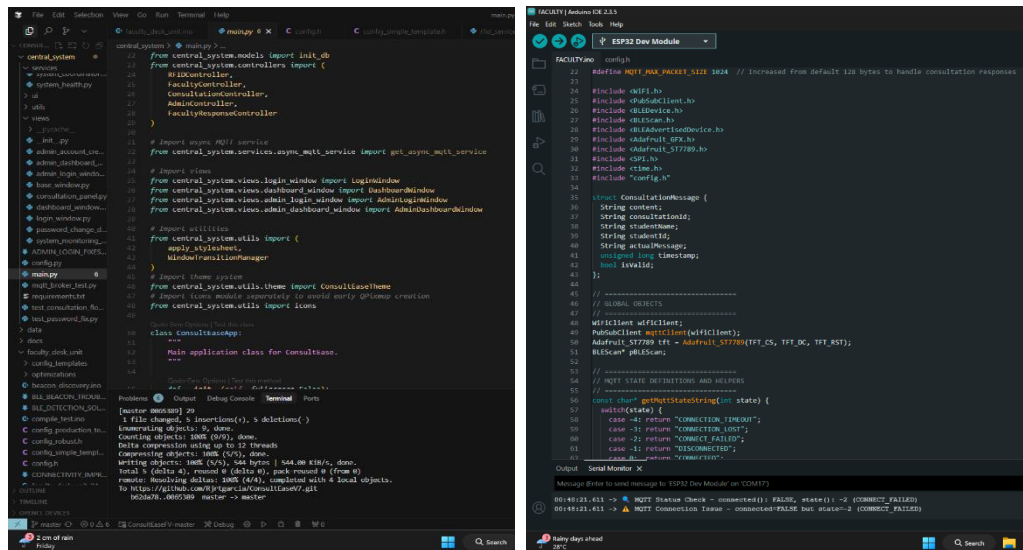


Figure 8 presents a portion of the ConsultEase system's source code. It includes key libraries and modules that enable the core functionalities such as graphical interface rendering, hardware interaction, data

communication, and system control. This source code serves as the foundation for integrating all components—ensuring seamless operation between the user interface, database, and connected devices.

#### 4.1.5 The Device's Case

**Figure 9**

*3D Model of ConsultEase Device Case*

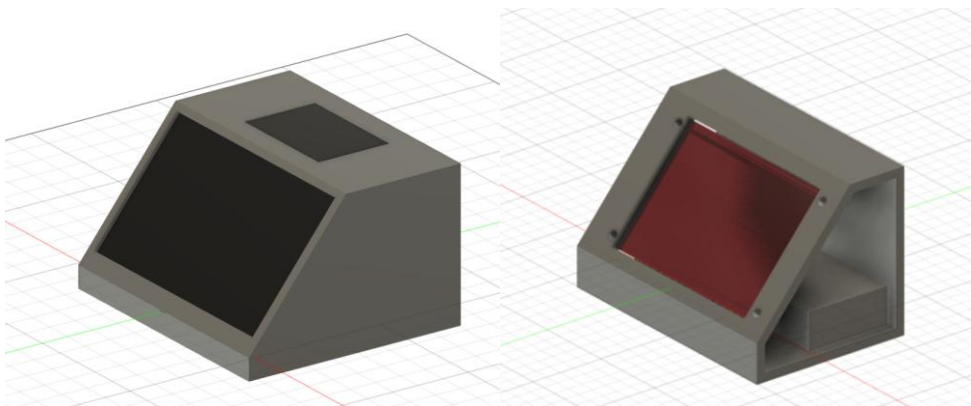


Figure 9 depicts the custom 3D-printed enclosures used for both the central terminal and faculty desk unit. The central terminal case features dedicated slots for the touchscreen, Raspberry Pi ventilation, and RFID reader placement, ensuring secure and functional integration. Meanwhile, the faculty desk unit case is designed to house the ESP32 microcontroller and 2.4" TFT screen, offering a compact and durable structure suited for office desks while protecting internal components.

#### 4.1.6 System Architecture Overview

**Figure 10**

*ConsultEase System Architecture Diagram*



Figure 10 illustrates the comprehensive system architecture of ConsultEase, showcasing the seamless integration of hardware and software components to streamline student-faculty consultations. The process begins with students authenticating their identity using RFID, which is read by the RFID reader connected to a central Raspberry Pi 4 system. This central unit runs a PyQt5 interface and acts as the database manager, handling core operations such as student verification, logging consultation requests, and managing faculty data stored in a PostgreSQL database. Once authenticated, the Raspberry Pi communicates with an MQTT broker to enable real-time messaging between the central system and the distributed ESP32-based faculty desk units. These units, installed at each faculty desk, feature TFT displays and input buttons (Accept/Busy), allowing faculty members to interact with the system directly. Each faculty member carries a Bluetooth Low Energy (BLE) beacon, which is detected by the ESP32 units to verify their presence. This presence detection mechanism ensures that only available faculty members are listed for

consultation, enhancing the system's efficiency. Connectivity across all components is maintained via a WiFi network, ensuring synchronized data transmission and system updates. Additionally, an admin dashboard allows system administrators to monitor real-time system activity and manage faculty assignments, ensuring smooth operation and oversight. This architecture not only automates the consultation queue but also reduces administrative overhead and minimizes student wait times.

#### 4.1.7 Testing of the Device and Data Gathering with the Respondents

**Figure 11**

*ConsultEase Testing and Data Gathering*







Figure 11 illustrates the actual testing phase of the ConsultEase system, showing its deployment in a university setting. During the evaluation, selected participants interacted with the system to assess its functionality, usability, and performance. Feedback was collected using a structured survey based on the ISO 25010 quality model, providing insights for further refinement and validation of the system.

#### 4.1.8 Hardware Integration

**Table 4**

*Hardware Components of the ConsultEase System*

Materials and Component	Specification	Function in the System
 <p>Raspberry Pi 4 Model B</p>	<ul style="list-style-type: none"> <li>• 4GB RAM</li> <li>• Quad-core Cortex-A72 (1.5GHz)</li> <li>• Wi-Fi, Bluetooth 5.0, HDMI, USB ports</li> </ul>	Acts as the central processing unit for the ConsultEase terminal. It handles the RFID authentication, GUI display, and MQTT communication with faculty units.
 <p>ESP32 Microcontroller</p>	<ul style="list-style-type: none"> <li>• Dual-core Xtensa LX6</li> <li>• Built-in Wi-Fi and BLE</li> <li>• GPIO support</li> </ul>	Installed in the faculty desk unit, it detects BLE beacon signals and displays consultation requests from the central terminal on its screen.
 <p>RFID Reader</p>	<ul style="list-style-type: none"> <li>• 13.56 MHz frequency</li> <li>• SPI Interface</li> </ul>	Authenticates students by scanning their ID cards, allowing only authorized users to access the system.
 <p>2.4" TFT LCD Display</p>	<ul style="list-style-type: none"> <li>• SPI Interface</li> <li>• 240×320 resolution</li> </ul>	Displays real-time consultation messages on the faculty desk unit. It provides simple, clear visuals for incoming requests.





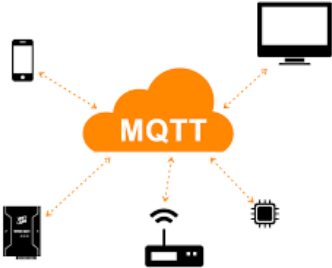
 <p>BLE Beacon</p>	<ul style="list-style-type: none"> <li>• iBeacon protocol</li> <li>• Battery-powered</li> </ul>	<p>Placed near the faculty desk to emit a BLE signal, which is detected by the ESP32 to determine the presence of a faculty member.</p>
 <p>10" Capacitive Touchscreen</p>	<ul style="list-style-type: none"> <li>• 1024×600 resolution</li> <li>• HDMI and USB interface</li> </ul>	<p>Serves as the user interface for the student terminal. It allows students to view faculty availability and send messages.</p>

Table 4 presents the hardware components used in the development of the ConsultEase system. The Raspberry Pi 4 Model B serves as the central processing unit of the student terminal. It handles critical functions such as RFID-based authentication, graphical user interface (GUI) display, and MQTT communication with the faculty-side units. An ESP32 microcontroller is embedded in the faculty desk unit, leveraging its built-in Wi-Fi and BLE capabilities to detect BLE beacon signals and display consultation messages on its dedicated screen. The system uses a 13.56 MHz RFID reader with an SPI interface to scan student ID cards and grant system access only to authorized users. A 2.4" TFT LCD display is attached to the ESP32 unit to show real-time consultation messages, offering a compact but clear visual interface for faculty members. BLE beacons, following the iBeacon protocol, are installed near faculty desks to broadcast signals, which are used to determine whether a faculty member is present. Finally, the student terminal features a 10" capacitive touchscreen with a 1024×600 resolution, connected via HDMI and USB, allowing students to navigate the system, check faculty availability, and send messages intuitively..

#### 4.1.9 Software Integration

**Table 5**

*Software Components of the ConsultEase System*

Component	Function in the System
  Python	Serves as the primary programming language for both backend logic and GUI development. It controls hardware interaction and overall system flow.
  PyQt5	Used to build and manage the graphical user interface (GUI) of the student terminal, allowing intuitive touch-based interaction.
	Enables real-time message exchange between the Raspberry Pi and ESP32 devices using a lightweight publish-subscribe protocol.



MQTT	
 PostgreSQL	Stores centralized records such as faculty schedules, RFID data, and consultation logs. Supports structured relational queries and data integrity.
 SQLite	Used as a lightweight local database for offline data storage on the Raspberry Pi, ensuring system functionality even without an internet connection.

Table 5 shows the software components used in developing the ConsultEase system. The researchers used Python as the main programming language to manage backend logic, control hardware interaction, and develop the graphical user interface. PyQt5 was used to design the touchscreen-based interface, allowing students to interact easily with the system and send consultation messages. MQTT was implemented as the communication protocol between the Raspberry Pi and ESP32, enabling real-time data exchange using a lightweight publish-subscribe model. For centralized data management, PostgreSQL was used to store faculty schedules, consultation logs, and RFID information. To support offline functionality,



SQLite was also integrated as a local database on the Raspberry Pi, allowing the system to operate even without an internet connection.

## 4.2 Result of Tests

This section presents the results of system testing conducted to evaluate the performance and accuracy of EMCER. It includes the confusion matrix used to assess the model's ability to recognize eye gestures correctly. In addition, the section provides responses to the Statement of the Problem (SOP), using test results as supporting evidence to determine how well the system met its intended objectives.

### 4.2.1 Accuracy of Eye Movement

**Table 4**

*Confusion Matrix of EMCER*

Actual	Predicted: Previous Page (Left)	Predicted: Next Page (Right)	Predicted: Bookmark (Up)	Predicted: Scroll (Wink)
Previous Page (Left)	TP	FP	FP	FP
Next Page (Right)	FP	TP	FP	FP
Bookmark (Up)	FP	FP	TP	FP
Scroll (Wink)	FP	FP	FP	TP

Table 6 shows the confusion matrix of the eye movement detection system, comparing the actual gaze with the prediction results from the model. It includes 4 classes: Previous Page for left, Next page for right, Up for bookmark and Scroll for wink. The diagonal values represent the true positive (TP) while the rest of the values indicate false positive (FP).

#### 4.2.2 Per-Class Metric Table

**Table 5**

*Per-Class Performance Metrics for EMCER Command Recognition*

	Previous Page (Left)	Next Page (Right)	Bookmark (Up)	Scroll (Wink)
Previous Page (Left)	4	1	0	0
Next Page (Right)	0	4	1	0
Bookmark (Up)	0	1	4	0
Scroll (Wink)	0	0	1	4
Total No. of Testing	20			
Total correct predictions	16 (TPs)			
Total Incorrect	4 (FPs)			
Accuracy	16/20 = 80%			

Table 7 shows the Per-Class Performance Metrics for EMCER Command Recognition. The table presents a confusion matrix that illustrates the classification performance of the system across four command classes: Previous Page (Left), Next Page (Right), Bookmark (Up), and Scroll (Wink). Each row represents the actual class, while each column indicates the predicted class. From a total of 20 test samples, the system correctly classified 16, resulting in an overall accuracy of 80%. Each command class had four correct predictions, but also one misclassification, indicating a balanced yet slightly imperfect performance.

#### 4.2.3 Addressing the Statement of the Problem

1. **How can eye movement be used for accurate bookmarking and page shifting in e-book reader through computer vision?**

The study proved that eye movement can be a reliable way to control an e-book reader.

Users were able to move between pages and bookmark content using simple eye gestures.

Specifically, wink allowed them to scroll, looking to the left turned to the previous page,

looking to the right went to the next page, and looking upward to bookmark a page. In this study, MediaPipe and OpenCV worked together to detect eye gestures in real time. This result supports the findings of Bautista and Naval (2021) who showed that deep learning models can help track eye movement effectively for interactive systems.

**2. How to integrate other functions, such as user settings – specifically allowing users to customize font type, font size, theme (light or dark), line spacing, and receive notifications based on how long they have been reading?**

The system was able to include user settings that allowed readers to change the font type, font size, theme, and line spacing. A reminder feature was also added which sent a gentle alert to users after reading for a certain amount of time. These features helped improve reading comfort and supported a long reading session. PyQt5 was used to create these features in a simple interface. According to OrCam Technologies (2023), personal setting in reading tools are important for improving the reading experience, especially for people who read for a long hour.

**3. What algorithm will be the most effective for real-time eye movement detection to ensure seamless navigation in e-book reader?**

The study used a lightweight multi-layer perceptron created using SciKit-Learn which turned out to be efficient for eye gestures detection. It was able to give results and showed accuracy in identifying movements like blinking and gaze direction. Although it wasn't the fastest or most efficient in terms of power usage it still performed enough for the system needs. This approach was inspired by the study of Baustista and Naval (2021) who also found that deep learning models such as MLP's can be effective for eye-based control system.

**4. How may the EMCER be described and rated in the terms of the modified ISO 25010 Product Quality Model?**

**a. Functional Suitability**

The EMCER was able to perform its main functions. These functions worked as expected and matched the user's needs. Based on the survey, the average mean score for functional suitability is 3.17 meaning the users agreed the system worked as it should. This matched the study of Mandal (2020) who said eye gestures can make e-books easier and the idea from "What is Eye Tracking" (2020) that eye controls help improve how people use the digital devices.

**b. Performance Efficiency**

Based on the survey the performance efficiency got an average mean of 3.27, showing that the users were happy and satisfied. This is similar to what Dostálová and Plch (2024) said about webcam eye tracking being efficient when designed properly.

**c. Usability**

Users found the EMCER easy to use, giving it an average mean of 3.42. The eye gestures were simple and natural, making the system easy to control. This agrees with Surfleet (2024), who explained that eye-controlled systems work better when gestures are easy to learn and use.

**d. Reliability**

Respondents recognized the reliability of the EMCER with an average mean of 3.15. Based on the survey, it detected eye movement in normal conditions. This connects to Gaikwad et al (2023), who state that webcam-based eye tracking can be reliable if it is tested and adjusted carefully.

**e. Maintainability**

The EMCER was made with clear and organized code using tools like Python and OpenCV.

This makes it easier to fix problems or add new features later. The survey mean is 3.08

showing it is still easy to update. This supports Dostálová and Plch (2024), who said good planning and structure help keep systems easy to maintain.

4.3 Result of Evaluations

This section presents the results of user evaluations conducted to assess the functionality, usability, reliability, maintainability, and security of the ConsultEase system. The evaluation focused on key factors such as system responsiveness, ease of use, consistency in performance, and data protection measures. Feedback was gathered through survey forms and user observations, and the responses were analyzed to identify the system’s strengths and areas that may require further enhancement.

4.3.1 Functional Sustainability

Table 6  
*ConsultEase in Terms of Functional Sustainability*

FUNCTIONAL SUSTAINABILITY	Mean	Standard Deviation	Verbal Interpretation
The system accurately verifies student identity through RFID technology.	4.66	0.54	Strongly Agree
The system correctly displays faculty availability status in real-time.	4.57	0.63	Agree
The system successfully delivers consultation requests to the appropriate faculty member.	4.51	0.75	Agree

<b>AVERAGE MEAN:</b>	<b>4.58</b>	<b>0.66</b>
----------------------	-------------	-------------

Table 8 shows the results of the evaluation in terms of functional stability. The highest mean score is **3.58** with a standard deviation of **0.54**, indicating that users strongly agreed that EMCER was able to shift pages accurately through eye movement. For bookmarking sections accurately, the mean score is **3.40** with a standard deviation of **0.63**. The device's performance in allowing users to read without frequently using hands and change to different modes both received mean scores of **2.98** with a standard deviation of **0.82**. The lowest score, with a mean of **2.93** and a standard deviation of **0.83**, reflects responses on whether the system operates without frequent errors or malfunctions. The overall average mean is **3.17**, interpreted as **Agree**, suggesting general satisfaction with the device's functional stability.

#### 4.3.2 Interaction Capability

**Table 7**

*ConsultEase in Terms of Interaction Capability*

<b>INTERACTION CAPABILITY</b>	<b>Mean</b>	<b>SD</b>	<b>Verbal Interpretation</b>
The system is easy to use and navigate.	4.49	0.54	Agree
The system provides clear instructions for completing tasks.	4.34	0.79	Agree
I was able to easily find the information I need within the system.	4.46	0.65	Agree

<b>AVERAGE MEAN:</b>	<b>4.43</b>	<b>0.73</b>
----------------------	-------------	-------------

Table 9 shows that users generally agreed on the performance efficiency of EMCER, with an overall average of **3.27** and a standard deviation of **0.61**. The highest-rated aspect was the ease of bookmarking within 5 seconds, with a mean score of **3.50** and a standard deviation of **0.59**. The system's responsiveness to flipping pages within 5 seconds was also positively rated, with a mean of **3.43** and standard deviation of **0.54**, indicating users experienced minimal delay when interacting. The speed at which the system loads content, especially when switching or opening e-books, received a mean score of **3.25** with a standard deviation of **0.62**. The ability to disable and resume eye-tracking, with a mean of **3.18**, suggests this function works reliably for most users. The lowest-rated item in this category was EMCER's power and memory efficiency, which had a mean score of **2.98** and a standard deviation of **0.61**, pointing to a potential area for technical improvement. All items were interpreted as **Agree**, indicating a favorable view of EMCER's performance efficiency.

#### **4.3.3 Reliability of the ConsultEase System**

**Table 8**

*ConsultEase in Terms of Reliability*

RELIABILITY	Mean	Standard Deviation	Verbal Interpretation
I encountered few or no technical issues while using the system.	4.14	0.72	Agree
The system is consistently available and performs as expected.	4.40	0.68	Agree
The system handles unexpected inputs or conditions gracefully.	4.37	0.68	Agree
<b>AVERAGE MEAN:</b>	<b>4.30</b>	<b>0.71</b>	

Table 10 shows how users rated the interaction capability of EMCER. The results focus on how easy it is to use, learn, and adjust the system. The highest mean score is “The EMCER interface is easy to understand” with a mean of **3.55** and a standard deviation of **0.55**. Both working well in different lighting conditions during use and the ability to adjust the settings for comfort received a mean score of **3.25** and a standard deviation of **0.55**. Reminders to take breaks and rest – the mean score is **3.40** with a standard deviation of **0.49**. The lowest score is **3.25** with a standard deviation of **0.77** which refers to the system being easy to learn. The overall mean is **3.42**, interpreted as **Agree** which means EMCER is easy to interact with and through improvement it could help increase the ease of use for first time users.

#### **4.3.4 Maintainability of the ConsultEase System**

**Table 9**

*ConsultEase in Terms of Maintainability*



MAINTAINABILITY	Mean	Standard Deviation	Verbal Interpretation
The systems hardware components are modular and can be individually replaced.	4.60	0.56	Agree
The system can be expanded to include additional faculty offices or departments.	4.57	0.74	Agree
The system provides diagnostic information that helps identify issues.	4.49	0.65	Agree
<b>AVERAGE MEAN:</b>	<b>4.55</b>	<b>0.73</b>	

Table 11 shows the results of the evaluation in terms of reliability. The highest mean score is **3.30** with a standard deviation of **0.56** and **0.51** referring to how EMCER launches quickly and closes instantly using the designated button and functions being consistently working each time they are used. EMCER processes eye movement without lag received a mean score of **3.10** and a standard deviation of **0.74**. The system works well even after continuous use is **3.05** with a standard deviation of **0.63**. The lowest mean is EMCER's stable performance. The overall mean is **3.15**, interpreted as **Agree** it shows that the EMCER is generally reliable with a good performance in responsiveness and usability.

#### 4.3.5 Security of the ConsultEase System

**Table 10**

*ConsultEase in Terms of Security*

<b>SECURITY</b>	<b>Mean</b>	<b>Standard Deviation</b>	<b>Verbal Interpretation</b>
The system securely verifies student identity before allowing access to the consultation system.	4.66	0.45	Agree
The system has sufficient security measures to prevent unauthorized access.	4.46	0.44	Agree
Sensitive data (e.g. student records) are protected and handled confidentially.	4.60	0.41	Agree
<b>AVERAGE MEAN:</b>	<b>4.57</b>	<b>0.69</b>	

Table 12 shows the results of the evaluation for maintainability, which also received positive responses with an average mean score of **3.08** and a standard deviation of **0.50**. The highest with a mean of **3.18** is the system's ability to recover quickly from the issue. Allow smooth integration of new features and adapting to future changes receives the same mean score of **3.08** with a standard deviation of **0.41** and **0.52**. Updating the system without causing new problems followed closely with a mean of **3.05** with a standard deviation of **0.45**. The lowest mean score, **3.0**, is how easy it is to troubleshoot and resolve the issue. The overall mean is **3.08**, interpreted as **Agree**. The results suggest that the EMCER is maintainable and can support future improvements.

## **4.4 Challenges and Opportunities for Improvement of Design**

### **4.4.1 Challenges**

During the development of the ConsultEase system, the researchers encountered several technical and logistical challenges that impacted both the prototype's functionality and the overall development timeline.

A primary issue involved the on-screen keyboard integrated into the central terminal's graphical user interface. Although the keyboard was designed to support full touchscreen input for students composing consultation messages, it functioned correctly only in certain parts of the interface. In other areas of the GUI, the keyboard either failed to appear or did not properly register input. This inconsistency negatively affected user experience and necessitated frequent troubleshooting, particularly during testing and demonstrations.

Another significant challenge concerned the notification method for alerting faculty members to incoming messages. The system initially utilized a buzzer installed within the desk unit as an audible alert. However, during practical use, the researchers found that the buzzer's sound could be disruptive in a shared faculty room setting. The persistent beeping—especially during periods of high student activity—had the potential to distract other faculty members and create an unprofessional atmosphere.

Managing the system's software dependencies presented an additional challenge. Several critical packages—such as paho-mqtt for message transmission, evdev for hardware input handling, and RFID-specific libraries—required precise version compatibility to function properly. Mismatched package versions and system environments frequently resulted in runtime errors or non-functional modules, necessitating extra time for troubleshooting, dependency management, and maintaining consistent environments across both development and deployment platforms.

Time management also posed a significant constraint throughout the project. As the researchers were concurrently engaged in their On-the-Job Training (OJT) while developing the device, they had limited time to devote to system design, hardware integration, and software development. Balancing internship responsibilities alongside project work led to scheduling conflicts that delayed progress on key milestones.

#### ***4.4.2 Opportunities for Improvement of Design***

Despite the challenges encountered during the development of the ConsultEase system, the researchers identified several opportunities to improve the design and functionality. To address the issue of disruptive notifications, the buzzer initially used to alert faculty members was replaced with an LED indicator light. This modification provided a quieter and less intrusive means of notification, which is more suitable for a shared faculty environment, thereby enhancing the professionalism and comfort of the workspace.

In terms of user input, the unreliable performance of the on-screen keyboard led the researchers to implement a physical keyboard as an alternative. The physical keyboard offered more consistent and accurate input, reducing errors and minimizing the need for frequent troubleshooting during system use. This change also contributed to a smoother and more user-friendly interaction for students composing consultation messages.

On the software side, the researchers recognized the importance of adopting stricter dependency management techniques. By employing methods such as containerization or virtual environments, the team aimed to ensure that software packages would remain compatible across various development and deployment platforms. This would help prevent runtime errors and improve overall system stability, making future maintenance and updates more efficient.

Lastly, the researchers acknowledged the need for extensive testing in real-world settings. Conducting usability trials within actual faculty environments would allow them to identify and address issues

that might not be apparent during controlled testing. Such feedback would be invaluable in refining the system's design and ensuring that it meets the practical needs of its users in everyday academic contexts.

## **CHAPTER 5: SUMMARY, CONCLUSION AND RECOMMENDATION**

This chapter includes a summary of the study's main findings, the conclusions made based on those results, and the researchers' recommendations for improving the system. It also suggests ideas for future development and further studies related to the project.

## **5.1 Summary**

The Eye Movement Controlled E-Book Reader (EMCER) is a modern device designed to make reading digital books easier, more comfortable, and completely hands-free. Using eye-tracking technology and computer vision, EMCER lets users turn pages by simply looking left or right, scroll by blinking, and place bookmarks by looking up. This eliminates the need for tapping or swiping for those who prefer to use natural eye movements to control reading. The device also offers options to customize font size, style, screen colors (light or dark), and line spacing to fit individual preferences. Additionally, it has a built-in timer to remind users to take breaks and reduce eye strain during long reading sessions. These features are powered by tools like MediaPipe and OpenCV for real-time eye tracking, along with a simple machine learning model that recognizes eye gestures.

During testing, EMCER showed good results in accuracy, speed, and stability. Users found it reliable and easy to use, even under different lighting conditions. The system was also found to be maintainable and simple to update when needed. Early problems like delays and tracking errors were fixed by upgrading the hardware to a better mini-PC and camera. According to the ISO 25010 quality model, EMCER scored well in key areas including functional suitability, performance efficiency, usability, reliability, and maintainability.

Looking ahead, EMCER can be improved further by adding more eye gestures and connecting with other digital systems to increase its usefulness. Its hands-free design makes it an excellent tool for anyone who wants a natural and easy way to read e-books. As eye-tracking technology continues to improve and

become more affordable, devices like EMCER have the potential to become common tools in education, assistive technology, and everyday digital life. Overall, EMCER offers a smart and practical solution that enhances digital reading by making it more interactive, convenient, and accessible for all users.

## 5.2 Conclusion

Based on the findings of the study, the researchers reached the following conclusions:

1. The Eye movement-controlled e-book reader is not acceptable in terms of functional suitability, performance efficiency, usability, reliability, and maintainability.
2. The eye movement-controlled e-book reader is acceptable in terms of functional suitability, performance efficiency, usability, reliability, and maintainability.

Therefore, the alternative hypothesis is accepted, and the null hypothesis is rejected, indicating that the eye movement-controlled e-book reader performs well and fulfills its intended purpose.

## 5.3 Recommendation

**Add More Eye Controls:** Let the system recognize more eye motions—like zooming in and out, varying screen brightness, or skipping chapters. This will enable readers to exercise more control.

**Upgrade Hardware:** Change hardware to use quicker computer components and a better camera. This will lower delays and mistakes, therefore improving the system's performance and comfortability of use.

**Make it Work on More Devices:** Change the system such that it runs on tablets, cellphones, and various screen sizes on several devices. In this sense, more individuals can make use of it regardless of the gadget they are using.

**Add Voice Help and Guides:** Put in audio directions and basic guides to enable new users to learn how to utilize the eye controls readily.

**Make a Simple Phone App:** Create a simple phone app so consumers can simply handle their books, bookmarks, and settings from their phone.

**Fix Tracking Problems:** Make the system dependable in more circumstances by means of improved performance when lighting is low or when users swiftly shift their heads.

## REFERENCES:

- Ahil, S., Viswa, R. L., Rarojin, S., & Evanjalín, A. B. (2024). Smart wireless message display: Enhancing communication with intelligent technology. *Irish Interdisciplinary Journal of Science & Research*, 08(02), 94–101. Retrieved from: <https://doi.org/10.46759/ijjsr.2024.8211>
- Alexander, S. G., & Yazar, K. (2022). Ultimate IoT implementation guide for businesses. TechTarget. What is IoT (Internet of Things)? | Definition from TechTarget. Retrieved from: <https://www.techtarget.com/iotagenda/definition/Internet-of-Things-IoT>



- Ashok, S., Divya, N. D., Samuel, F., & Mande, D. U. (2022). RFID-based attendance system. *International Journal for Research in Applied Science and Engineering Technology*. Retrieved from: <https://doi.org/10.22214/ijraset.2022.48092>
- Brisbane, J. S. (2024). Enhancing school security system using RFID: A comprehensive approach. *International Scientific Journal of Engineering and Management*. Retrieved from: <https://doi.org/10.55041/isjem01380>
- Calo, A.-M. V. M., Barbosa, J. B., & Llevado, J. C. (2021). In-Classroom Faculty Attendance Monitoring System based on Ultra High Frequency (UHF) Radio Frequency Identification (RFID) with Captured Image Cross-verification Mechanism. *Indian Journal of Science and Technology*, 14(45), 3335–3343. Retrieved from: <https://doi.org/10.17485/ijst/v14i45.1782>
- Campanan, A. M., Bermejo, R. M., & Madrigal, D. (2024). Intellischool: A student information system for senior high school. *Technium: Romanian Journal of Applied Sciences and Technology*, 21, 38–55. Retrieved from: <https://doi.org/10.47577/technium.v21i.10816>
- Cavus, N., Mrwebi, S. E., Ibrahim, I., Modupeola, T., & Reeves, A. Y. (2022). Internet of things and its applications to smart campus: A systematic literature review. *International Journal of Interactive Mobile Technologies (iJIM)*, 16(23), 17–35. Retrieved from: <https://doi.org/10.3991/ijim.v16i23.36215>
- Cheah, W. Z., Jegatheesan, J., & Loon, S. C. (2023). Exploring IoT application using Raspberry Pi. *International Journal of Computer Networks and Applications (IJCNA)*, 2(1), 27–34. Retrieved from: <https://www.ijcna.org/abstract.php?id=17>
- Chennattu, S., Kelkar, A., Anthony, A., & Nagdeote, S. (2019). Portable biometric attendance system using IoT. 2019 4th International Conference on Information Systems and Computer Networks (ISCON), 245–249. Retrieved from: <https://doi.org/10.1109/ISCON47742.2019.9036275>
- Darko, H., Tone, L., Mitja, T., & Oto, T. (2023). Design and implementation of ESP32-based IoT devices. *IoT Sensors and Technologies for Education*, 23(15). Retrieved from: <https://www.mdpi.com/1424-8220/23/15/6739#metrics>

David, W. (2024). What is a Bluetooth module? Types, working, and applications. The Engineering Projects. Retrieved from: [https://www.theengineeringprojects.com/2024/02/what-is-a-bluetooth-moduletypes-working-and-applications.html#google\\_vignette](https://www.theengineeringprojects.com/2024/02/what-is-a-bluetooth-moduletypes-working-and-applications.html#google_vignette)

Dhanush, K., Ajay, B., Haricharan, P. K., Vedanth, R., & Sudheesh, K. V. (2024). Empowering communication: A Raspberry Pi-based smart noticeboard system. International Journal for Multidisciplinary Research, 6(3). Retrieved from: <https://doi.org/10.36948/ijfmr.2024.v06i03.20248>

Fazal, M. I., & Khaleeq, M. A. (2022). A survey on RFID technology and its applications in healthcare and supply chain management. CMC-Vol. 70(1), 2022. <https://techscience.com> Sreekumar, D. (2024). Independent vs Dependent Variables: Definitions & Examples. Retrieved from <https://researcher.life/blog/article/independent-vs-dependent-variables-definition-examples/>

Ganiron, T. Jr., Manlutac, K., Castro, M., & Jerusalem, C. (2019). Development of user guide on interactive way-finder and e-notices system. The Scientific World Journal, 128, 363–390. Retrieved from: [https://www.researchgate.net/publication/333024487\\_Development\\_of\\_User\\_Guide\\_on\\_Interactive\\_Way-Finder\\_and\\_E-Notices\\_System](https://www.researchgate.net/publication/333024487_Development_of_User_Guide_on_Interactive_Way-Finder_and_E-Notices_System)

Hirak, D. G., L, S., & Gaurav, A. (2020). A review paper on Raspberry Pi and its applications. International Journal of Advances in Engineering and Management (IJAEM), 2(12), 225-227. Retrieved from: [https://ijaem.net/issue\\_dcp/A%20Review%20Paper%20on%20Raspberry%20Pi%20and%20its%20Applications.pdf](https://ijaem.net/issue_dcp/A%20Review%20Paper%20on%20Raspberry%20Pi%20and%20its%20Applications.pdf)

Improving campus security and efficiency: The RFID-integrated monitoring system at Politeknik Mukah Sarawak. (2024). Proceeding of International Conference on Engineering, Technology & Social Science (ICETSS), 1, 256–260. Retrieved from: <https://icetss.pmu.edu.my/index.php/icetss2024/article/view/93>

Introduction of embedded system | Set-1. (2024). Geeks for Geeks. Retrieved from: <https://www.geeksforgeeks.org/introduction-ofembedded-systems-set-1/>

- Jiban, S., Joy, N., & Anirban, K. (2022). Implementation of wireless communication using (HC-05) Bluetooth module with MATLAB Gui. International Journal of Engineering Research & Technology (IJERT), Pane, 10(7). Retrieved from: <https://www.ijert.org/implementation-of-wireless-communication-using-hc-05-bluetooth-module-with-matlab-gui>
- Larson, G. W., Ellis, D. C., & Rivers, P. C. (1984). Essentials of chemical dependency counseling. Columbia University Press.
- Lodha, R., Gupta, S., Jain, H., & Narula, H. (2022). Hacking the RFID-based authentication system of a university: Security vulnerabilities and countermeasures. IEEE Access, 10, 79321-79335. Retrieved from: <https://doi.org/10.1109/ACCESS.2022.3190943>
- Mahmood, S., Palaniappan, R., Hasan, K. U., Sarker, A., Abass, A., & Rajegowda, P. M. (2019). Raspberry Pi and role of IoT in education. 2019 4th MEC International Conference on Big Data and Smart City (ICBDSC), 1–6. Retrieved from: <https://doi.org/10.1109/ICBDSC.2019.8645598>
- Muhamad, W., Kurniawan, N. B., Suhardi, & Yazid, S. (2017). Smart campus features, technologies, and applications: A systematic literature review. 2017 International Conference on Information Technology Systems and Innovation (ICITSI). Retrieved from: <https://doi.org/10.1109/icitsi.2017.8267975>
- Mukhriya, A., & Saini, A. (2021). Need for an integrated platform to bridge the gaps in communication of students & faculties, at an intra-college level – A survey analysis. Retrieved from: <https://www.ijariit.com/manuscripts/v7i4/V7I4-1278.pdf>
- Nandwani, A., Crane, L., Edwards, R., & Benachour, P. (2012). The magic door: Smart interactions between students and lecturers using contactless technologies. International Conference on Mobile and Contextual Learning. Retrieved from: [https://ceur-ws.org/Vol-955/papers/paper\\_62.pdf](https://ceur-ws.org/Vol-955/papers/paper_62.pdf)
- Russo, A. C., & Jiang, H. J. (2006). Hospital stays among patients with diabetes, 2004 (Statistical Brief #17). Agency for Healthcare Research & Quality. Retrieved from: <http://www.hcup-us.ahrq.gov/reports/statbriefs/sb17.jsp>
- Sabao, J. S., & Lacorte, A. (2019). Cloud-based real-time bulletin board posting using AngularJS framework. International Journal of Simulation Systems Science & Technology. Retrieved from: <https://doi.org/10.5013/ijssst.a.20.s2.21>

- Utkir, K. (2020). Introduction to microcontrollers. University of Management and Future Technologies. Retrieved from: [https://www.researchgate.net/publication/341907593\\_Introduction\\_to\\_Microcontrollers](https://www.researchgate.net/publication/341907593_Introduction_to_Microcontrollers)
- USC Libraries. (n.d.). Research guides: Organizing your social sciences research paper: Quantitative methods. University of Southern California. Retrieved from: <https://libguides.usc.edu/writingguide/quantitative#:~:text=Quantitative%20research%20designs%20are%20either,an%20experimental%20study%20establishes%20causality>
- Uy, G. E. M., Choachuy, A. C. Y., Parocha, R. C., Peña, R. A. S., & Macabebe, E. Q. B. (2022). System design for automating smart internet of things devices using Bluetooth localization. 2022 IEEE International Conference on Internet of Things and Intelligence Systems (IoTIS), 322–328. Retrieved from: <https://doi.org/10.1109/IoTIS56727.2022.9975874>
- Yuan, D., Faghri, A., & Partridge, K. (2020). A study on applications and case studies regarding Bluetooth technology for travel time measurement. Journal of Transportation Technologies, 10(1), 65–87. Retrieved from: <https://doi.org/10.4236/jtts.2020.101005>

## APPENDICES

### APPENDIX 1. FULL RESEARCH MANUSCRIPT

#### **ConsultEase: IoT Integrated Consultation System for Enhanced Student-Faculty Interaction**

Rodelio T. Garcia Jr.

School of Engineering and Technology, Department of Computer Engineering  
In Partial Fulfillment of the Requirements in Capstone Design Project 3  
Philippines, [garciaart@students.nu-baliwag.edu.ph](mailto:garciaart@students.nu-baliwag.edu.ph)

Jerome Christian V. Ibon

School of Engineering and Technology, Department of Computer Engineering  
In Partial Fulfillment of the Requirements in Capstone Design Project 3  
Philippines, [ibonjv@students.nu-baliwag.edu.ph](mailto:ibonjv@students.nu-baliwag.edu.ph)

Alaiza Denice V. Moises

School of Engineering and Technology, Department of Computer Engineering  
In Partial Fulfillment of the Requirements in Capstone Design Project 3  
Philippines, [moisesav@students.nu-baliwag.edu.ph](mailto:moisesav@students.nu-baliwag.edu.ph)

Aira Nicole P. Pili

School of Engineering and Technology, Department of Computer Engineering  
In Partial Fulfillment of the Requirements in Capstone Design Project 3

## ABSTRACT

Efficient communication between students and faculty remains a long-standing difficulty in academic institutions, often hindered by outdated scheduling methods and inconsistent faculty availability. Thus, the study proposes **ConsultEase**, an IoT (Internet of Things) integrated consultation system that leverages **RFID/NFC technology, Raspberry Pi, ESP32 microcontrollers, and Bluetooth Low Energy (BLE)** to enhance real-time interaction and secure student verification within university campuses. Using a touchscreen interface and BLE – enabled presence detection, the system provides students up-to-date faculty availability and allows secure messaging for consultation requests. The study employs the Rapid Application Development model and ISO/IEC 25010 quality metrics to assess the systems' performance in terms of functionality, reliability, usability, maintainability, and security. Evaluated by students and faculty at National University Baliwag, the results reveal that **ConsultEase** significantly improves the efficiency, accuracy, and convenience of the consultation process, offering a scalable model for smart campus communication systems.

**Keywords** – Academic Communication, Consultation System, ESP32, IoT, Raspberry Pi, RFID, Student - Faculty Interaction

## Introduction

Communication between students and faculty is a critical component of academic success. In many educational institutions, face-to-face consultations remain a key method for academic guidance and student support. However, traditional consultation methods often lead to delays, missed opportunities, and confusion due to unclear schedules and unstructured communication processes.

In recent years, the integration of smart technologies in educational institutions has significantly transformed administrative processes and student services. Tools such as Learning Management Systems (LMS), automated attendance tracking, and RFID-based access controls have become increasingly common on modern campuses. The growing adoption of Internet of Things (IoT) technologies, combined with microcontrollers like Raspberry Pi and ESP32, has opened new possibilities for developing responsive, real-time systems that address various operational challenges in the academic environment.

Despite these technological advancements, many institutions still face long-standing difficulties in facilitating seamless and structured communication between students and faculty. Students often experience frustration when trying to locate or contact professors due to inconsistent availability, unclear office hours, and the lack of a centralized platform for consultation requests. In many cases, students go from office to office only to find that the faculty member is unavailable, which leads to wasted time, missed academic support, and added stress especially when consultation is urgent or tied to deadlines. Current methods such as messaging apps, emails, or physical inquiries are prone to delays, miscommunication, and security concerns. This communication gap hinders the learning process and reduces both faculty productivity and student satisfaction.

From the faculty perspective, managing student consultations without a structured system can become overwhelming, especially during peak academic periods. Professors often face repeated and uncoordinated interruptions, missed messages, or overlapping appointments, which disrupt their workflow and reduce available time for instruction and research. Additionally, the absence of real-time tracking of their

availability can result in miscommunication and unfulfilled appointments, increasing administrative workload and frustration.

Administrative and support staff are also affected, as they frequently act as intermediaries handling student inquiries, relaying messages, and manually tracking faculty schedules. This not only diverts them from their core responsibilities but also increases the risk of human error and miscommunication. The lack of an automated, centralized system ultimately limits the institution's operational efficiency and creates bottlenecks in academic support services.

To address this issue, this study proposes **ConsultEase**, an IoT Integrated Consultation System that aims to streamline student-faculty interactions through technology. The system utilizes RFID/NFC for secure student identification, Bluetooth Low Energy (BLE) for detecting faculty presence, and a touchscreen interface powered by Raspberry Pi and ESP32 to provide real-time availability updates. Specifically, the study seeks to develop this system for deployment at National University Baliwag and evaluate its effectiveness using the ISO/IEC 25010 software quality model. Key metrics include functionality, reliability, maintainability, interaction capability, and security.

By introducing a localized, automated solution to improve communication within the academic setting, the ConsultEase system addresses a critical gap in existing university infrastructures. Its implementation is expected to reduce consultation delays, enhance user experience, and contribute to the broader movement toward smart campus technologies. Furthermore, this project serves as a foundation for future innovations in educational IoT applications, offering a scalable model that can be adapted to similar institutions seeking to modernize their student-faculty consultation processes.

## RELATED LITERATURES

This study on IoT technologies for smart campuses is highly relevant to our project. As smart campuses are becoming more prevalent, they offer opportunities to enhance services and processes in universities. IoT plays a significant role in integrating technology into higher education, which aligns with our goal of improving communication through wireless solutions. By reviewing recent research on IoT in smart campuses, this study provides valuable insights into the technologies needed for such systems and highlights both the benefits and challenges that come with their implementation. Understanding these factors will guide the development and deployment of our own system. By analyzing IoT implementations in smart campuses, this study offers critical insights into the technological frameworks and infrastructure that will be essential for developing and optimizing our system. It also highlights the advantages IoT brings to enhancing user experiences and operational processes, which are key to ensuring the success of "ConsultEase."

This literature on IoT-based smart campuses is crucial to our project, for several reasons. First, it provides a foundation for understanding how IoT technologies can be effectively used to enhance communication and operational efficiency within educational institutions. Since our project aims to implement a wireless notification system, the findings of this research will guide us in selecting appropriate IoT solutions and understanding their potential benefits in a campus environment. By exploring both the opportunities and limitations of smart campus IoT systems, this literature informs key aspects of our project, from technical feasibility to practical considerations in real-world settings. It reinforces the relevance of our work in advancing modern, efficient communication solutions within the broader context of smart campus development.

The discussion on the ESP32 highlights its suitability for developing IoT applications due to its powerful features like a dual-core processor, integrated Wi-Fi and Bluetooth, and low power consumption. Its capabilities enable multitasking and efficient communication, making it an ideal platform for educational IoT projects. The article highlights how IoT is increasingly integrated into educational systems, emphasizing the demand for IoT skills in the workforce. It provides a framework for educational tools and technologies that simplify IoT applications, focusing on student projects where they learn to design and implement IoT solutions. This is relevant because the ESP32 can handle the real-time data transmission and interactions needed for enhancing student-faculty consultations, supporting both hardware and software requirements for IoT-based communication systems. This aligns with your research on enhancing student-faculty interaction through IoT by offering insights into how IoT can support practical learning and improve processes within educational institutions, further validating the approach of using IoT in communication systems.

Raspberry Pi, a compact yet powerful minicomputer, has transformed the landscape of embedded systems and computing. Developed by the United Kingdom's Raspberry Pi Foundation, it was designed to inspire creativity and innovation among learners. Since its launch, the device has garnered extensive support from open-source communities, contributing to a wide range of operating systems, applications, and related technologies. Raspberry Pi has become a popular tool for researchers and scholars in embedded systems, powering numerous innovative projects. Constant upgrades in both hardware and software have turned it into a "full-fledged computer" capable of handling complex tasks efficiently. This review paper provides an overview of Raspberry Pi's evolution and its applications, serving as a valuable resource for students and developers in the open-source and embedded systems communities.

This article examines the application of Raspberry Pi as a server in client-server communication systems, specifically focusing on wireless communication in industries and educational settings. Traditional wired networks, while reliable, are often costly due to extensive cabling. In contrast, low-cost wireless networks are increasingly in demand for non-critical applications, such as temporary networks or areas requiring low data rates and extended battery life. By utilizing Raspberry Pi, the research explores its role as a file server, enabling multiple devices to connect, store, and manage files over a network while ensuring data security through user authentication. Additionally, the study demonstrates how Raspberry Pi, combined with ZigBee modules, can facilitate wireless communication, providing a practical solution for low-power, mobile network applications. This research highlights the versatility of Raspberry Pi in enabling cost effective wireless communication systems across various sectors.

## **METHODOLOGY**

This study employed a quantitative research methodology to assess the performance of the ConsultEase system through measurable user feedback. Using purposive sampling, data were gathered from students and faculty members at National University – Baliwag who were directly engaged with the system. A survey instrument, based on the ISO/IEC 25010 quality model, was used to evaluate key system attributes such as functional suitability, usability, reliability, maintainability, and security. The system was developed using an iterative approach that combined Rapid Application Development for software and Type 1 Prototyping for hardware, integrating technologies such as Raspberry Pi, ESP32, RFID/NFC, and Bluetooth. Data analysis involves descriptive statistics and thematic review of open-ended responses to determine user satisfaction and identify areas for improvement.

## **RESULTS AND DISCUSSION**

## ACKNOWLEDGEMENT

This capstone project would not have been possible without the guidance, support, and encouragement of many individuals and institutions.

First and foremost, we offer our deepest gratitude to the **Lord Almighty** for His divine guidance, strength, and blessings throughout the course of this capstone project.

To **Engr. Meizl Ann F. Manlupig**, our Capstone Subject Adviser, we thank you for your valuable support, constructive feedback, and guiding us throughout this journey. Without your guidance and dedication, this project would not have reached its full potential.

Our heartfelt thanks go to **Engr. Robert Justine S. Chavez**, our Project Adviser, for his technical expertise, patience, and encouragement, which helped us overcome numerous challenges and improved the quality of our work.

We are deeply grateful to all the **students and faculty members** who participated in our survey and system evaluation. Your feedback was essential in shaping the effectiveness of our project.

We also wish to acknowledge our **instructors and mentors** at the School of Engineering and Technology – National University Baliwag, whose teachings and guidance provided us with the knowledge and confidence to pursue this project.

Lastly, we extend our utmost gratitude to our **groupmates and beloved families**, whose unwavering support, sacrifices, and encouragement kept us strong and motivated throughout this endeavour. We appreciate everyone who contributed to this journey. Your presence made this journey worthwhile.

## REFERENCES

1. Cavus, N., Mrwebi, S. E., Ibrahim, I., Modupeola, T., & Reeves, A. Y. (2022). Internet of things and its applications to smart campus: A systematic literature review. *International Journal of Interactive Mobile Technologies (iJIM)*, 16(23), 17–35. Retrieved from: <https://doi.org/10.3991/ijim.v16i23.36215>
2. Cheah, W. Z., Jegatheesan, J., & Loon, S. C. (2023). Exploring IoT Applications using Raspberry Pi. *International Journal of Computer Networks and Applications (IJCNA)*, 2(1), 27–34. Retrieved from: <https://www.ijcna.org/abstract.php?id=17>
3. Darko, H., Tone, L., Mitja, T., & Oto, T. (2023). Design and implementation of ESP32-based IoT devices. *IoT Sensors and Technologies for Education*, 23(15). Retrieved from: <https://www.mdpi.com/1424-8220/23/15/6739#metrics>
4. Hirak, D. G., L, S., & Gaurav, A. (2020). A review paper on Raspberry Pi and its applications. *International Journal of Advances in Engineering and Management (IJAEM)*, 2(12), 225–227. Retrieved from: [https://ijaem.net/issue\\_dcp/A%20Review%20Paper%20on%20Raspberry%20Pi%20and%20its%20Applications.pdf](https://ijaem.net/issue_dcp/A%20Review%20Paper%20on%20Raspberry%20Pi%20and%20its%20Applications.pdf)
5. Jiban, S., Joy, N., & Anirban, K. (2022). Implementation of wireless communication using (HC-05) Bluetooth module with MATLAB Gui. *International Journal of Engineering Research & Technology (IJERT)*, Pane, 10(7). Retrieved from: <https://www.ijert.org/implementationof-wireless-communication-using-hc-05-bluetooth-module-with-matlab-gui>



## **ABOUT THE AUTHORS**

Rodelio T. Garcia Jr. a 3<sup>rd</sup> year student at National University - Baliwag taking Bachelor of Science in Computer Engineering

Jerome Christian V. Ibon a 3<sup>rd</sup> year student at National University - Baliwag taking Bachelor of Science in Computer Engineering

Alaiza Denice V. Moises a 3<sup>rd</sup> year student at National University - Baliwag taking Bachelor of Science in Computer Engineering

Aira Nicole P. Pili a 3<sup>rd</sup> year student at National University - Baliwag taking Bachelor of Science in Computer Engineering

## **APPENDIX 2. AUTHOR DECLARATION FORM**

### **ConsultEase: IoT Integrated Consultation System for Enhanced Student-Faculty**

#### **Interaction**

1. We confirm that there are no known conflicts of interest associated with this paper and there has been no significant financial support for this work that could have influenced its outcome.
2. We confirm that the manuscript has been read and approved by all named authors and that there are no other people who satisfy the criteria for authorship, but the ones listed. We further confirm that the order of author listed in the manuscript has been approved by all of us.

3. We confirm that we have given due consideration to the protection of intellectual property associated with this work and that there are no impediments to publication, including the turning of publication, with respect to intellectual property.

4. We understand that the Corresponding Author is the sole contact for publication submission of this paper. He/she is responsible for communicating with the other authors about progress, submissions of revisions, and final approval of proofs.

5. We confirm that we have provided an active, correct email address which is accessible to the Corresponding Author.

Author	E-mail Address	Signature	Date
Garcia, Rodelio T. Jr.	<a href="mailto:garciart@students.nu-baliwag.edu.ph">garciart@students.nu-baliwag.edu.ph</a>		
Ibon, Jerome Christian V.	<a href="mailto:ibonjv@students.nu-baliwag.edu.ph">ibonjv@students.nu-baliwag.edu.ph</a>		
Moises, Alaiza Denice V.	<a href="mailto:moisesav@students.nu-baliwag.edu.ph">moisesav@students.nu-baliwag.edu.ph</a>		
Pili, Aira Nicole P.	<a href="mailto:piliap@students.nu-baliwag.edu.ph">piliap@students.nu-baliwag.edu.ph</a>		

### Appendix 3. Informed Consent

**Title of Research:** ConsultEase: IoT Integrated Consultation System for Enhanced Student-Faculty Interaction

**Principal Investigator:**

Garcia, Rodelio Jr. T

Contact Information: 09298990050

**Additional Investigators:**

Ibon, Jerome Christian V.

Moises, Alaiza Denice V.

Pili, Aira Nicole P.

## **Introduction and Purpose of the Study**

You are invited to participate in a research study aimed at improving communication between students and faculty. ConsultEase is an IoT-based system that lets students check if a faculty member is present in the room and enables them to request consultations and send messages directly through the device. The purpose of this study is to evaluate the system's effectiveness in providing real-time information and facilitating prompt consultation requests.

## **Description of the Research**

When you join this study, you will answer a short question about your current experiences with student faculty communication.

For Students:

Step 1: Tap your student ID card at a kiosk to confirm your identity.

Step 2: Check which professors are available in real time (e.g., "Available" or "Busy").

Step 3: Send a message or request (e.g., "Can we discuss my project?") to a professor.

For Faculty:

Step 1: Update your status (e.g., "In-office" or "Unavailable") using a desk device.

Step 2: Receive and respond to student requests on your screen.

After using ConsultEase, you'll complete a second questionnaire in which you'll evaluate the system.

## **Subject Participation**

We are inviting students and faculty who interact with the ConsultEase system. Participation requires basic familiarity with digital devices. Approximately 50 Students and 5 Faculty members will be enrolled, and your role is to use the system as intended and provide honest feedback via questionnaires.

## **Potential Risks and Discomforts**

There are no known significant risks associated with participating in this study. Some participants might experience minor discomfort with new technology or digital interfaces. Should any unexpected issues arise, support will be available from the research team.

## **Potential Benefits**

By participating, you may help improve a system that streamlines consultation processes between students and faculty. This may lead to less waiting time, faster responses, and organized consultation. As for university, it may potentially be a new tool to improve campus communication.

## **Confidentiality**

All information collected will be coded to protect your identity. No personal identifiers (such as your name or contact details) will be used in any reports or publications. Data will be securely stored in locked and/or encrypted files accessible only by the research team and will be destroyed according to institutional guidelines once the study is complete.

## **Authorization**

By signing below, you authorize the use and disclosure of the information collected during this study for research, educational, and publication purposes. Your feedback may be used in aggregated form in any resulting reports, ensuring your identity remains confidential.

## **Compensation**

There will be no compensation will be provided for participation in this study

## **Voluntary Participation and Authorization**

Your decision to participate in this study is completely voluntary. If you decide to not participate in this study, it will not affect the care, services, or benefits to which you are entitled.

### Withdrawal from the Study and/or Withdrawal of Authorization

You may withdraw from the study at any time without any penalty. If you choose to withdraw, any data collected prior to your withdrawal may still be used for research purposes, but your identity will remain confidential.

### I voluntarily agree to participate in this research program

**Yes**

**No**

I understand that I will be given a copy of this signed Consent Form.

<b>Name of Evaluator (print):</b> Signature: Date:
<b>Principal Investigator:</b> Signature: Date:

## APPENDIX 5. EVALUATION TOOL

### Overview of the Study

The general objective of this study is to design and develop ConsultEase, an IoT-based system aimed at enhancing student-faculty consultations at National University Baliwag. It allows students to check real-time faculty availability and request appointments using their ID cards. The system helps students connect with professors more efficiently while minimizing disruptions for faculty. It is evaluated using the ISO/IEC 25010 model, focusing on functional suitability, interaction capability, reliability, maintainability, and security.

*“Rest assured that it will strictly adhere to the RA 10173 “Data Privacy Act of 2012.” All the data gathered from this questionnaire will be treated with utmost confidentiality and will be solely used for research purposes.”*

Each dimension contains five criteria that are evaluated using a 5-point Likert scale, where:

5 – Strongly Agree

4 – Agree

- 3 – Neutral
- 2 – Disagree
- 1 – Strongly Agree

**Respondent Information**

Role:

Student  
Faculty

Department: \_\_\_\_\_

Use the guidelines provided:

Strongly Agree	Agree	Somewhat Agree	Disagree	Strongly Disagree
5	4	3	2	1

	5	4	3	2	1
<b>Functionality</b>					
The system accurately verifies student identity through RFID technology.					
The system correctly displays faculty availability status in real-time					
The system successfully delivers consultation requests to the appropriate faculty members.					
<b>Usability</b>					
The system is easy to use and navigate.					
The system provides clear instructions for completing tasks.					
I was able to easily find the information I needed within the system.					
<b>Reliability</b>					

I encountered few or no technical issues while using the system					
The system is consistently available and performs as expected					
The system handles unexpected inputs or conditions gracefully					
<b>Maintainability</b>					
The system's hardware components are modular and can be individually replaced.					
The system can be expanded to include additional faculty offices or departments.					
The system provides diagnostic information that helps identify issues.					
<b>Security</b>					
The system securely verifies student identity before allowing access to the consultation system.					
The system has sufficient security measures to prevent unauthorized access.					
Sensitive data (e.g., student records) are protected and handled confidentially.					



### **Additional Questions**

What aspects of the ConsultEase system do you find most valuable?

---

---

What aspects of the ConsultEase system need improvement?

---

---

Would you recommend the ConsultEase system to other departments or institutions? Why or why not?

---

---

Thank you for completing this evaluation. Your feedback is valuable for improving the ConsultEase system.

**Validated By:** \_\_\_\_\_

**Date:** \_\_\_\_\_

## APPENDIX 6. CONSULTATION LOG

<b>Title:</b>  <b>CONSULTATION LOG</b>	<b>Reference No.</b>	
	<b>DEPARTMENT</b>	COMPUTER ENGINEERING
	<b>Copies To</b>	All Concerned Units
	<b>Page</b>	Page 90 of 1
<b>This is a controlled document.</b> Photocopying or printing of this document without the controlled mark, shall make this document or uncontrolled copy.		

<b>Date</b>	<b>Activities</b>	<b>Adviser's Confirmation</b>
<b>08 – 14 - 2024</b>	Assigning Capstone Adviser	
<b>08 – 27- 2024</b>	Community Assessment	
<b>08 – 31 - 2024</b>	Checking of online evaluation	
<b>09 – 4 – 2024</b>	Consultation for SOP	
<b>09 – 16 – 2024</b>	Checking of draft chapter 1 - 3	
<b>10 – 9 - 2024</b>	Signing of forms and checking for final revision	
<b>10 – 16 – 2024</b>	Revisions and re-defense consultation	
<b>10 – 18 - 2024</b>	Consultation for revisions	
<b>10 – 19 - 2024</b>	Consultation for title	
<b>05 – 05 - 2025</b>	Checking of evaluation tool	
<b>06 – 04 - 2025</b>	Checking of chapters 1 - 5	

Reviewed by: ENGR. MEIZL ANN F. MANLUPIG

---

## Appendix 5. Evaluation Tool