CSOL Connect: Hardware Device Monitoring System

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OVERVIEW

Hardware device monitoring systems are essential tools in computer laboratories as they enable administrators to monitor the statuses of hardware components in real-time. The study utilized an approach involving a laboratory network in Cavite School of Life (CSOL) located at Dasmariñas, Cavite, through developing a system. This lessened the load of work of the IT technicians in the place where the proposal had been implemented. Hardware device monitoring systems are crucial for keeping the performance of the computers, making sure it detects potential issues before they cause unusual errors. Additionally, the system contained a mapping feature that provides a visual representation of the network, allowing the administrator to manage and optimize network resources effectively.

Categories and Subject Descriptors

Networks>Network Services>Network Monitoring.

General Terms

Management, Security

Keywords

Real Time Monitoring, Network Mapping, LAN, Computer Ports, Management, Computer Laboratory

1. THE PROBLEM AND ITS BACKGROUND

This chapter introduced the system's background on what it is about, what its use, who will benefit from it, and its purpose. It indicated all the information about the system along with the terms and objectives that were used and achieved within the system.

1.1 Project Context

1.1.1 Introduction[1]

Network monitoring is the act of using specialized tools or software to track the overall reliability and health of a computer network [1]. Network monitoring tools can provide its users an image or idea regarding the condition of the network, through collecting and analyzing data from active devices in the network [2]. The data being fetched varies from the devices' availability, status, errors, physical information like the temperature of its CPU, etc. [2]. Network administrators need network monitoring tools, especially when the network they are responsible for grows bigger. In general, aside from compliance, network monitoring systems possess purposes such as providing network visibility, preventing downtimes, discovering network problems quickly, monitoring security threats, watching bandwidth utilization, network capacity planning, etc. [3]. Network mapping is the technique of finding devices which are connected in a particular network [4]. As the system collects and analyzes data about the network being monitored, the network mapping feature is tasked to notify admins about network issues like excessive traffic or strange behavior, through easy-to-read visuals [4]. It is a must have feature for network monitoring solutions, as they help network administrators to possibly identify and act on a network problem quickly by automatically providing a real-time picture of the changes that occurred in the network [4]. As good as it sounds, there's also risk involved in the development and implementation of network monitoring systems. An incident dated back in December 2020; a network monitoring system owned by SolarWinds gets compromised by cybercriminals. The attackers made it inside the system of SolarWinds and tampered the next update/patch of the said network monitoring system [5]. The clients of SolarWinds, which include several government organizations and large US corporations, updated their software without knowing that the update had been compromised, causing their networks to be at risk. The attackers gained access to private information and could potentially carry out additional attacks to the affected parties [5]. The incident will serve as a lesson to all companies that offer network monitoring systems, and to those who are going to develop one, including the proponents of the project.

The system is entitled Hardware Device Monitoring System, CSOL Connect in short. The system falls under the umbrella of Network monitoring solutions, as it is a software developed for the network admin/technicians of CSOL who are responsible for maintaining the wellness of the computer laboratories. The system was based on a client-server set up, wherein the admin computer is the server,

while the computers in the lab are the clients. The client-server setup involves multiple computers connected together, where the client computers request and receive resources from a powerful centralized server computer, through the use of LAN [6]. The system was mainly focused on monitoring the different physical ports of a computer within the LAN, and on creating a map for each computer laboratory as required, for better visibility and usability. To discuss Network LANs' Port monitoring, LAN and Ports have to be defined. According to CompTIA [n.d.], Local Area Network (LAN) is a network made up of a number of computers that are connected in a certain region [7]. TCP/IP ethernet or Wi-Fi is used in a LAN to link the computers to one another [7]. Moreover, LAN is composed of computers within the same network and subnetwork. On the other note, computer ports are vital features of any computing device because they provide the basic input and output interfaces that are needed so that the computer can connect to peripherals and networks [8]. In a usual desktop PC, computer ports can be seen in the front and in the back panel of the system unit case, which includes Ethernet Ports, Serial Ports, USB Ports, HDMI, PS/2 (for keyboards and mice), etc. [8].

The Network LANs' Port monitoring subtopic of the system means that some of the physical ports of all computers defined to be a member of the LAN will be monitored. The system watches in real-time what is happening to the ports of the computers covered in the LAN. The system checks for peripherals being plugged or unplugged and generates reports correspondingly. On the other hand, the Mapping of the Laboratories subtopic of the system means that the network admins have to add, edit, or delete computer laboratories or computers within the LAN to manage and visualize each laboratory in real-time. The mapping contains a user-friendly UI and UX, so that the administrator can perform their duties efficiently. Other features that the system has are Login and account creation with 2FA, Dashboard, Logs, Different user levels, Notifications, and a Lab Scheduler The proponents utilized the AI technology ChatGPT in developing the system in terms of generating ideas and code logic.

1.1.2 Background of the Study[2]

The system was created to implement network monitoring and mapping in the computer laboratory specifically to monitor the disconnection of ports of the computer in the laboratory and identify the status of the computers. The users who will benefit from this system are the students of the CSOL who use the computer laboratories for their class and the technician who handles the management of the computers in the laboratory. Whenever the students who use the laboratories experience any problem with their computer, which causes a delay in the lecture, a technician has to be called to fix the problem. The technician could only act on the problem and accommodate the issues once there was a report forwarded to him. There were also problems with the use of the network and other peripherals in the laboratory (ex. mouse, keyboard), wherein the students unplugged them for their personal use, like plugging them in their own devices without the permission from the technician or their supervisor.

By implementing the system in the computer laboratory of CSOL, the issues regarding the monitoring of the status and disconnections on the computer can be easily accessed by the technician even without the reports. The technician can navigate the computer from his side and check the status of each one of them. If a problem had occurred on one of the computers, the technician could assess the problem to see if it could be fixed from his side or he needed to go to the laboratory to manually fix the problem on the computer. There were other studies that had created a similar way of integrating the system of monitoring computers. In a related study by Zapanta & Talirogan, it incorporated a LAN setup, in which the monitoring PC sends students information to the server. The system also makes use of PHP in order to store the information in a database. Moreover, the system aimed to integrate a monitoring feature that sends information to the admin, through a LAN setup [9]. It also made use of .PHP to store the information of the PCs from a computer laboratory to the PC the admin used. The system was an integral part of maintaining the status and operation of the computer in the laboratories.

1.2 Purpose and Description[3]

The system helps the network admins/technicians of CSOL in monitoring their network through the various features that the system offers. The Real-time LANs' Port monitoring was a feature that was effective in monitoring the physical ports of the computers in the computer laboratory. The admin is alerted whenever network cables and peripherals are unplugged. The mapping of the laboratories features in the system improved the usability for the admins, as they were provided with a module to view, add, edit, and delete laboratories or computers within a laboratory in real time. The network admins' time and effort were reduced when doing monitoring and maintenance, as they can easily assess the situation happening within the peripherals that are connected within the computer, so there is no need for them to go to all the computers to repeatedly check the computers. The user authentication of the system is good because 2-factor authentication was utilized. The system has an account creation feature on the side of the super admin user, so they could create multiple accounts with different user levels for authorized personnel who could access the system and perform monitoring duties. The network admins of CSOL can also use the Scheduler feature wherein they could input information regarding the schedule of the computer laboratories, from day, time, what section, and to who was the instructor in charge. In such a way, the network admins are given extra information for monitoring purposes. The network admins of CSOL might discover security issues and act on them quickly, since the system has a dashboard and notifications feature that informs them of useful information in real time. And finally, the data that was generated and collected in the system was going to be in a log.

1.3 Objectives of the Study

1.3.1 General Objective[4]

The general objective of this study was to develop a system, which was a hardware device monitoring system for the computer laboratories of CSOL. The goal was to help the technician of Cavite School of Life in managing and maintaining the PCs in the school's computer laboratories. The system helped the technicians identify which computer had problems regarding physical computer port connections. Moreover, this was for the technician to be aware of the problems right away without anyone telling them.

1.3.2. Specific Objectives

The following are the specific objectives that must be fulfilled to

attain the general objective:

- Planned and developed a network monitoring system for the school computer laboratories
- Provided a login and log out module for the system
- Integrated a Completely Automated Public Turing test to tell Computers and Humans Apart (CAPTCHA) in the system for its security.
- Made 2 user levels, Superadmin and admin (read-only rights)
- Had a dashboard that showed important information about the network being monitored.
- Made an interface wherein the admins could create a network map for the computer laboratories
- Made a module that lets the admin make a scheduler to keep in track of the time and classes who would use the labs.
- Developed a registration module that allows the superadmin to create admin with read-only rights.

1.4 Scope and Limitation[5]

The system aimed to ease the job of the technicians, who were employed in Cavite School of Life - Dasmariñas Campus, in managing and maintaining the school's computer laboratories. Likewise, the system included a Graphical User Interface (GUI), which showed the necessary information mainly for monitoring and maintenance purposes.

The system included the following features:

- The capability to monitor the LAN port and the peripherals of the Client PCs from the PC of the technician.
- A software that is separate between the Client and Server.
- A network mapping with a display that shows all the laboratories and the PCs inside it.
- Shows a list of schedules of the class/sections that would be using the computer laboratories.
- Shows a dashboard that displays a log history of the PCs from all the labs, the computer labs that are currently in use, and PCs that usually face issues.
- Login/Logout feature for the technicians

For its limitations, the focus was to identify and outline the constraints and challenges of the system to provide a comprehensive understanding during the development and implementation. The system introduced the scope and the following listed below are the limitations of the system:

- The system only consists of 2 user levels, super admin and admin.
- Other network devices are not included in the monitoring aside from LAN.
- The computer ports only monitor the keyboard, mouse, and ethernet interface.
- Applicable in Windows 10 OS.

1.5 Definition of Terms

The following terms are defined for easier understanding of the study.

Admin. Refers to the technician/network admin who monitors the computer laboratories with read-only privilege.

Client. This refers to the PCs that can be found in the computer laboratories and are used by the students of the school.

CSOL. Cavite School of Life

LAN. This refers to the computer laboratories, which accommodate PCs that are connected to a switch.

LAN Port. This refers to the physical interface of the computer, where the ethernet cable is plugged in.

Log History. This only shows information about the PC that experienced problems regarding computer ports. It also includes information regarding the computer lab, where it belonged, the issue it faced, the time and date it happened.

Maintenance. Checking the status of the computer in the laboratory and being able to maintain its working status.

Mapping. This represents the process or part of the system, where the technician can add computer laboratories and PCs.

MFA. Multi-factor Authentication

Monitoring. This is the process of observing the computers of the laboratories and the potential issues that may arise through the system.

Peripheral. This refers to the devices such as mouse, keyboards, and monitors that are plugged in the ports of a computer.

Port. This refers to the physical interface, where the mouse, keyboard, and monitors are connected and can be connected.

Server. This refers to the PC that the Technician uses to monitor the clients.

Scheduler. This refers to part of the system that stores information regarding the schedules of the classes that would be using the computer laboratories in the school.

Super Admin. A technician that has a more advanced authentication than the admin, where it has more access in using the system.[6]

Technician. is/are the target user/s of the system. They are the ones handling the server and monitoring the clients.

User Authentication. This refers to the type of access that is required for the system.

2-factor Authentication (2FA). This is the type of authentication that has been used on the system.

Dashboard. It is part of a feature of the system which contains history logs, the ongoing laboratory, and issues within the computer in the laboratory.

Notification. This is represented by a color that indicates that the peripherals have been removed from the computer.

2. REVIEW OF RELATED LITERATURE AND STUDY/SYSTEMS

This chapter was composed of studies and literature, both local and foreign, used as a reference for the system to provide the necessary information that helped create it. The studies and literature that were used in this chapter helped in justifying the research method that

was used in the system.

2.1 Local Literature

2.1.1 Computers, privacy, and the workplace (2020)[7]

The right to use the property of an organization or establishment has certain boundaries and regulations that a user must comply with. In the article by the GMA news, it shows the result of not abiding by these rules and regulations. In Romania (2017), an employee was fired after the company found out that he used his Yahoo Messenger account to send messages to family while at work. The company had instructed the employee to create that account for office work. The employee filed a case on the ground that his right to privacy had been violated. His employer countered that it was clear from company policies that office computers are for work purposes only. It also notified every one of its duties to supervise and monitor their work. The Court reasoned that while the employee was apprised of the ban on the use of the office computer and internet for personal purposes, it was not clear if he were properly informed that monitoring would take place. [10]

The article is important for the proponents, as it provides a deep and essential purpose to the project. The system was created with the purpose of monitoring the ports of the computer laboratory. With the same purpose of the article, the system werebe able to integrate the privilege of monitoring the properties of the school which are computers and peripherals that are being used by the students.

2.1.2 Local Area Network (2023)[8]

Local Area Network is referred to as LAN. A local area network, or LAN, is a set of computers and related devices that share a common communications line or wireless link that spans a relatively limited area (such as an office building, school, etc.). It is mainly used in sharing resources, which is the major purpose of LANs. The purpose of the LAN is to create a connection within the network where equipment like CD/ROM drives and laser printers may be shared by a number of users. [11]

The use of the LAN in the computer laboratory is to connect the pc with one another through the internet using a cable like the ethernet. By using LAN, the information from the devices can be shared and transmitted from one another.

2.1.3 Loss of Signal: What is LOS and how to fix it? (2022)[9]

Having a disconnection from the internet can be a hassle to all users. So how does the disconnection mainly come from, in essence, many logical and physical aspects function as cogs in a complex wheel that is your Internet service. A loss of signal may result from an issue with any of these gears. Physical damage might include frayed wires, broken cable pins, or, if you have Fiber internet, twisted optic cables. The disconnection from the internet on the computer has different aspects that may be able to be fixed by the users and there are instances that it can only be fixed by a professional. [12]

The disconnection of networks on the computer laboratories that can happen are probabilities that the technician should handle in terms of the issue that may arise. Identifying the problem that has arisen in the computer can produce a more efficient way of solving the problem.

2.1.4 Setting Up Server for Computer Laboratory at Bestlink College of the Philippines, MV Campus (2020)[10]

As the students used the computer in the laboratory, there may be some cases that students may access files and information that they do not need and launch additional apps that are not required. The Information and Communication Technology students of Bestlink College of the Philippines come up with a solution to the problem, the students came up with a solution to having a server for the computer lab would make it easier for the facilitator to manage and maintain the security of the clients' PCs, including monitoring apps, appropriate file sharing, and data archiving for better administration of the computer lab. The facilitator of the computer lab was interviewed by the students to collect qualitative data. The students also conducted a survey of several ICT teachers on their usage of various Microsoft Office programs and provided answers to a series of semi-structured inquiries regarding students' use of the computer lab. By using this method for the computer laboratories users cannot access closed apps since the server will be controlling them and locking them prevents users from using them. The kids will become more focused on the assignment provided by the topic instructor as a result of this procedure. To control and safeguard the apps that the PCs have installed on them, the students built up a server for the computer lab. [13]

The system also seeks to answer the same category of problem for students, where they are using the computer in the laboratories where in this case, the connections on the computers. Having to prevent this kind of thing from happening, with the same method that the students created, the system also seeks to answer the problem by having a main server for the computer to monitor the status of the ports that are being disconnected.

2.1.5 How to perform the wired LAN setup (Windows) (2023)[11]

The connection on the computer can be used by using a LAN setup which connects the computer locally. But how does a LAN network setup work? A LAN setup can be done by following these notes: The configuration, router functions, setup procedures and security settings of the network device vary depending on your system environment. [14]

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The setup of LAN which is used in the computer laboratory of CSOL is important on the program of the system which will be based on the monitoring of the LAN that the system will provide and on how the computers are positioned.

2.2 Foreign Literature

2.2.1 What is network monitoring? (n.d.)[12]

The article describes the basic idea of network monitoring solutions, what they are, what's their purpose, and what features shall be considered being implemented. The article defines network monitoring as the act of using a specialized system to track the

overall reliability and health of the network. It's stated as well that network monitoring tools should have topology mapper and data analytics that give insights to the network administrator.

The article is important and is related to the system because it provided the proponents an idea about what type of system the system belongs to. The article also laid some foundation by being able to state some necessary features that have to be included in the system, namely the topology mapping and data analytics.

2.2.2 What Is Network Mapping? Definition, Process, Importance, and Best Practices for 2022 (2022)[13]

The article tackles the network mapping feature that network monitoring solutions should have. It is explained that network mapping is the process of finding every entity connected to the network. Network mapping tools improve network monitoring solutions, and it makes it possible for organizations to quickly identify network problems because of its real time environment.

This article is related to our system because it emphasizes the importance of real time network mapping for a network monitoring system. With network mapping, the network monitoring system will be able to provide quicker notifications about the network changes to the admin as it shows the real time status of the computers through the virtual representation of labs and computers. The article gave the proponents the idea to include network mapping in the system, and potentially improve its usability.

2.2.3 SolarWinds hack explained: Everything you need to know (2022)[14]

The article explains a cybercrime incident that involved an IT solutions company, SolarWinds and their network monitoring software which has been compromised by hackers. The attack was identified as a supply chain attack, as the hackers infiltrated the system of SolarWinds and tampered with the next update of their network monitoring product to gain access to the networks of government organizations and large US corporations who are clients of SolarWinds.

*This article is important for the proponents because it blatantly shows the risk of developing software that monitors networks. The proponents have learnt that the entire network is compromised and at risk if the network monitoring software has been compromised. By setting up a read-only monitoring service, feature, or separate user privilege, the software's access to the managed system is being limited. It also reduces the possibility of anyone with access to the system causing unwanted effects to it intentionally or unintentionally. According to Ayusuf Ozturk of Virtual Metric as cited in the article [2022], companies should not be allowed to use full admin rights in their monitoring systems. Instead, a separate user with read-only privilege should always be created. This feature is rarely seen in monitoring solutions, so it has to be of the factors for businesses when choosing one. It also serves as a lesson for the proponents when develo*ping *and updating the system.*

2.2.4 How to get started with socket programming for beginners (2021)[15]

The article gives the proponents an idea regarding what concept had to be learnt and used when it comes to developing a system that involves networks. The article introduced the proponents to the idea of socket programming. A socket is a software endpoint that enables programs to connect with one another across a network. Socket programming allows these endpoints to transport data, making it possible for networks and programs to communicate. According to José Manuel Ortega, the author of Mastering Python for Networking and Security Second Edition [2020] as cited in the article, there are many programming languages that can be used for socket programming, but Python is a popular choice as it has a variety of tools, libraries, modules, etc. in handling packets. Ortega also mentioned that sockets can be used to implement a client-server application. [15]

The proponents find this article very important because it leads the proponents to the concepts that have to be used for the development of thesystem. The proponents have learnt that socket programming is the field of programming used for systems involving networks. Moreover, the system will be developed through the use of Python programming language, as it offers a variety of tools, libraries, modules, and more that aids in developing the said system.[16]

2.2.5 Client-Server Model (2022)[17]

The article aims to define what a client-server model is. A Client-server model is a distributed application architecture that involves 2 components; the server, who acts like the provider of resources or service, and the clients, who are the ones who request them. Clients are usually the host computers who use a particular service. Clients may send requests to use the service from the server and they also have the capability to receive them. Servers on the other hand could be a remote computer who receives and provides the service/resource being requested as long as it is within its database. [16]

The article is related to the system because the proponents would develop a network monitoring software with the concept of client-server model in mind. Clients and servers are the two fundamental parts of this architecture. The client is normally installed on the computers in the laboratory. It is programmed to gather data regarding network activity and transmit it to the server. The server receives information from the clients, processes them, and stores them in the database. The server also often offers a user interface for system administrators to watch and control network traffic, which is true in the system.

2.3 Local Study/Systems

2.3.1 Access Control and Monitoring: A System for Computer Laboratory (2021)

The study aims to create a solution for the computer laboratories of Misamis University, such that only the currently enrolled students at the stated university are eligible to use the computers of the labs. The study utilizes a barcode reader that will read the student's information before they can enter the computer laboratory and then will be converted to serve as their attendance. Moreover, the information will be stored in a database using the .PHP framework. The system also included the use of C# Forms, which .NET framework must be installed for it to work, for the Graphical User Interface (GUI). Additionally, a framework for the system's security was used, but was not disclosed.

The study incorporated a LAN setup, in which the monitoring PC sends students information to the server. The system also makes use of .PHP in order to store the information in a database. Moreover, the present system aims to integrate a monitoring feature that sends information to the admin, through a LAN setup. It also makes use of .PHP that will store the information of the PCs from a computer laboratory to the PC the admin uses.

2.3.2 Computer Laboratory Management with Mobile Application (CLMMA) (2016)

The study aims to create a system that will make managing the computer laboratories in Our Lady of Fatima University easier through the use of mobile technology. It also includes a LAN-based setup that features the PCs from the university's computer laboratories and a terminal, which the IT uses to monitor. The system consolidates the Information Technology Infrastructure Library or ITIL-based laboratory management framework, which can make the management of the computer laboratories easier. Through one of the benefits of ITIL, which is automation, it made the management of computer laboratories easier. [17]

In relation to this study, the purpose of the present system is to create a management system that only the IT of the school can use to monitor the PCs of the computer laboratories from a terminal, which is the PC the IT mainly uses. This study was implemented in a LAN setup as well. The features similar to the study uses that are also included in the present study are remote shutting down, restart, and log off from PCs. However, it does not have network mapping and port monitoring.

2.3.3 Computerized Maintenance Management System for the Philippine's Railway Transit (2018)

The study is aimed at creating a computerized maintenance management system that can reduce the service interruptions that are affecting the railway transits in the Philippines. Moreover, interruptions have been occurring frequently in Metro Manila transit. The stated system featured maintenance scheduling and planning, and spare parts management and performance measurement. All these features are established by the authors through their problem assessment that is important for the system. Additionally, the system provided information to its users that can speed up the process of the transits' maintenance. [18]

Its relation to the system is through providing information to the users for them to be able to do maintenance without manually checking what is needed and what is not. It also included a monitoring system that incorporates a green and red color that suggests the train part's maintenance. In the case of the system, it refers to the connection of the LAN and the peripheral's cable to the ports of a computer

2.3.4 Attendance Monitoring System of Schools in the Philippines with an Inclusion of Optimization Query Algorithm (2021)

The study was conducted in order to make supervising the attendance of the student and teacher easier using AMS Attendance Monitoring System. One of the problems that gave rise to the system is the slow manual checking of attendance. The system features easier attendance monitoring, attendance recording, and automatic report generator, which includes information such as the attendance of the student and the teacher and the seating arrangements of the students in a room. Additionally, it uses Optimization Query Algorithm that would suggest the use of databases as the algorithm helps in selecting SQL statements more efficiently. Ultimately, according to them, it would help both private and public schools in attendance monitoring and data controlling. [19]

According to the study, manual inputting or checking of data is time consuming. With regards to the system, manual checking of PCs for LAN port for internet connectivity or any peripherals is likely to be time consuming. Moreover, the computer laboratories of the school house at least not less than 30 computers. Therefore, having a monitoring system can ease the work of the technicians in identifying which PCs in the computer labs experienced problems relating to the internet and peripherals.

2.3.5 Real-time Remote Monitoring and Security System for a Local Area Network Environment (2021)

The study aims to evaluate the authors' developed real-time remote monitoring and security system as opposed to existing similar systems, which are available in the market, in terms of effectiveness, usability, functionality and design. Additionally, it consolidates a research design that is descriptive and developmental. A client/server model was adopted to the developed system for its communication protocol. The system uses .NET as its framework since the programming language used is VB .NET, which is part of .NET framework. The stated system was only tested in a LAN environment. [20]

The present system is related to the study as it is implemented on a LAN environment. The system also has separate software that is only for the clients and the server. In the case of the computer labs of CSOL, the system will also include software for

clients that will be installed on the computers inside the laboratories and another one for the PC of the technician, which works as a server. The main purpose of a client/server setup is for enabling communication or sending of information between 2 PCs, where one acts as the client and the other as the server.

2.4 Foreign Study/Systems

2.4.1 Detection and Monitoring of Unauthorized Use of Computers In The Computer Laboratory (2019)[18]

Mostly, computer-based labs are connected via LAN, but not all labs may have client-server connectivity. To address the challenge of overseeing student activities in computer labs, a lab monitoring system was developed. The study utilizes a Raspberry Pi as a central network server and employs socket programming to facilitate communication between the computers and the centralized network server. Measures have also been put in place to prevent theft of keyboards and mice to protect lab property. An add-on fire alarm system is included to detect smoke in case of a fire. Furthermore, an RFID-based data logging system is used to track the time that students enter and exit the lab, with data being stored in an Excel sheet. The system is capable of sending notifications to the lab supervisor via email with attached images and through a buzzer and LED light indicators in case of any events or issues. [21]

Supervising every student activity during laboratory sessions in schools can be challenging for computer lab supervisors. In relation to the study, the researchers a system that will address the issues associated with the project stated as well as preventing misconduct and maintaining discipline during students' practical work. The system can detect the removal of LAN ports, mouse, and keyboards from each computer.

2.4.2 Computer Laboratory Management System for Improving Teaching & Learning Methods (2020)[19]

Most educational institutions have computer labs to give students training that prepares them for careers. The computer lab is now a more key component of education and the center of activities. Each school has a computer lab with several computers connected to the local area network (LAN), but most of the time there is no client-server communication to manage the LAN [22].

The study's implementation involves a client-server model. To address the limitations of the current system, a computerized system has been wherein one PC in the Lab will function as the server and the others as clients. The server and client systems will communicate with each other. The faculty members can access the server system by using their login credentials, while students can access the client system using their own credentials. The faculty will mark the attendance, and an Excel file will be generated for them. The paper describes the idea of a computer laboratory management system, which is useful for keeping an eye on computer laboratories while classes are in session. The faculty will manage students on the server computer, which is used for monitoring students. The system is only useful for computing department students. Teachers cannot access their systems remotely; instead, they must be connected to a local area network (LAN).

2.4.3 Computer Laboratory Automation Using Internet of Things (2018)[20]

The Internet of Things (IoT) is a framework for using technologies to simplify user activities in society. Any type of laboratory in any school or institution is the focus of the automation of computer laboratory system's design. While the lab is not in use or is being used rarely, it must be looked over. Only the specific computer system and other IT components must be left on if the user is in the lab; all other devices should be switched off. In a different scenario, if the user remains inactive on the computer system for a continuous 10 minutes, the system will automatically switch to the standby mode. An IR sensor (infrared sensor) will determine if the user is present or absent in the laboratory. The IR sensor will detect any obstacles using an IR emitter and IR receiver. [23]

IoT technology can help individuals and professionals spend less time speculating and more time taking action. It is essential to adopt this technology to simplify personal and professional lifestyles. By connecting physical devices to the internet and allowing them to collect and transmit data in real-time, IoT can be utilized to establish a real-time monitoring system. Various parameters, including temperature, humidity, pressure, and location, can be monitored and tracked through IoT. By utilizing IoT, a real-time monitoring system can be established that is highly efficient and precise, which can enhance productivity, improve decision-making, and reduce costs.

2.4.4 Android Based LAN Monitoring and Controlling (2018)[21]

The study a system that involves an Android based solution that can effectively manage and monitor a LAN network. The system functions on a Wi-Fi network and serves as a communication platform between the server known as the Android phone while the client being the computer. The client sends data through commands to the communication port of the computer. Meanwhile, the server program installed on the computer reads the data from the communication port and carries out the commands specified in the data [24].

The study presented an idea for an application that can aid in monitoring a network even when the administrator is not present in the server room. The application is designed to be simple and can potentially save time and effort for the network administrator. In relation to the researchers' system, the server's device is a computer instead of an Android phone. The server computer will take place inside the ICT along with the technician. On top of that, a Wi-Fi network is not needed in order for the system to recognize if the LAN network is connected.

2.4.5 Monitoring and Alert System for Using Computer Laboratory via LINE Application (2019)[22]

The study engages Internet of Things (IoT) technology along with sensors to oversee the usage of the information technology department's computer laboratory and send alerts through the LINE application. The objective of this research is to facilitate real-time management through the utilization of Passive Infrared (PIR) motion sensors. The system uses both infrared sensors and CCTV to monitor the computer lab usage. In case there are users who are not scheduled for class, the system sends a notification to the administrators through the LINE application [25].

The development of this study is a response to the teaching management needs of the IT department. As the system aims to address the problem of checking access in the event of an unexpected occurrence, the administrator of the computer laboratory can receive notifications through the LINE application, which will simplify real-time monitoring and alerting. As a result, this will reduce the time it takes to check and resolve problems, enabling administrators to respond quickly. To relate this study, the system has a feature that would let the IT technician in the server if there were a scheduled class section in the computer laboratory.

3. METHODOLOGY, RESULTS AND DISCUSSION

This chapter provided the detailed explanation used to conduct the research study. It aimed to evaluate the integration of hardware device monitoring in the laboratories of Cavite School of Life (CSOL). The methodology was crucial as it gives a clear understanding of how the research was conducted. The initiation involved an analysis of the methodology used in the research project, including the implementation, operations, processes, and testing of the system. To be specific, the other parts discussed the data flow, the network diagram of the system, including its network security.

3.1 Requirements Analysis

3.1.1 Software Development Life Cycle

In developing a system, managing one's time and assets is a major thing. Everyone needs a process in order to proceed to the next part of the objective. The Software Development Life Cycle (SDLC) is where it becomes relevant. SDLC is a methodology used to create software applications. Its purpose is to make sure that the software development process is structured, efficient, and produces high-quality software that satisfies the users' expectations and needs. This also ensures that the developers and participants understand the project's purpose and the direction they must take to achieve their common goal. The researchers found it necessary to apply the SDLC method as it clarifies the process had to be done from start to end. After appointing consultations and research on the system during project development, the researchers constructed the idea of using the Waterfall Model for the Software Development Life Cycle (SDLC). The decision was based on the numerous advantages provided by this model, such as clear explanations of each stage and activity in the development process benefiting the researchers. Additionally, stating and reviewing each stage could easily identify and improve the errors that might appear in the program.

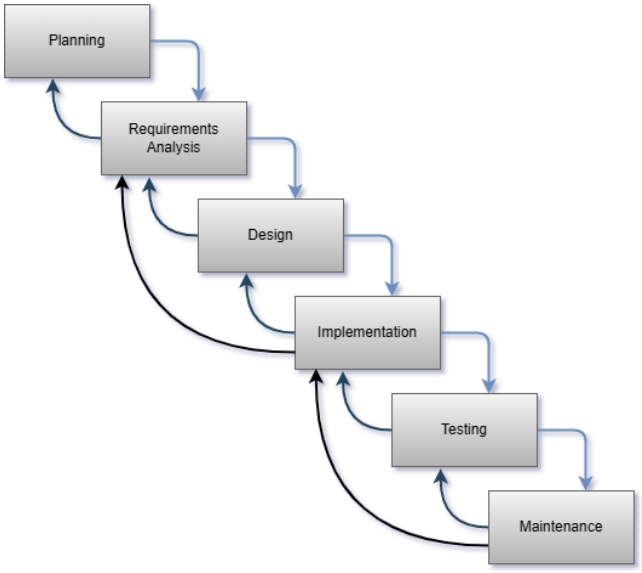

Figure 1. Software Development Life Cycle

PLANNING

In the starting phase, the researchers gathered information about how hardware monitoring device would be developed, including the functionality of the system, and performance requirements. Moreover, consulting was also significant as the developers got to know the point of view of other important individuals. In that way, knowing the opinion of others gave the developers a broader perspective.

REQUIREMENTS ANALYSIS

The analysis phase explained how the researchers organized the detailed study of system requirements and to identify the risks and limitations. Listing down the objectives and scope also gave the developers a guide to the development process. Meeting with the beneficiary was vital to the requirements as it lets the researchers examine the network layout where the system would take place.

DESIGN

For the third phase, this contained the flow of the system and user interface. With the use of Adobe XD, the researchers designed a prototype which was a visual representation of the system based on the objectives and scope of the study. This was efficient for the researchers had to visualize the software's design.

IMPLEMENTATION

During the implementation phase, the developers would make use of Visual Studio 2022 to create the source code of the system. The programming language that the developers used was C# and Window Forms for GUI. .NET 6.0 was also used for accessing the Microsoft SQL Server database.

TESTING

In the testing phase, the software was ensured to run and meet its functions properly. This phase determined the minor and major flaws found in the system allowing the developers to revise those specific errors.

MAINTENANCE

In the final phase, called maintenance, the system was complete and would be installed in the CSOL. After installing the system, the developers would make sure that it was fully operational, and all the requirements had met, and the technicians currently used the software. Moreover, the software was maintained or monitored to make sure the problems that might arise in the software would be determined. Afterwards, the developers fix the problem by the source code or design and will be re-tested to guarantee that the issue has been fixed.

The Waterfall Model is shown in Figure 1.

3.1.2 Conceptual Paradigm

A conceptual paradigm was a model that will organize and guide an understanding of complex circumstances regarding the study. The framework presented below showed the important factors and the correspondences of the system as well as how it would function. It aimed to provide a brief overview of the main components of the system and how it would benefit the technicians in CSOL. The system "CSOL Connect" included a GUI that showed the statuses of the computers in the laboratories. In addition, the software gave the administrators the capability to monitor the peripherals of the computers.

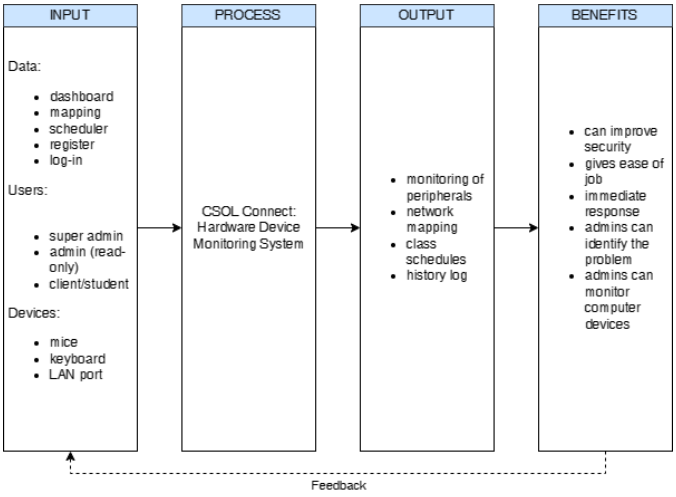

Figure 2. Conceptual Paradigm

3.1.3 Flow of Existing System

The currently existing system of the Cavite School of Life used normal client/server monitoring of the computer. The school was using an open-source software which is called *Netmonitoring*. The admin could check the status of the computers in each laboratory and be able to navigate the monitor of each pc that was being used and also be able to remotely shut down the computer. This section presented the diagrams which presented the flow on how the system works and its relationship to the user along with its function and use.

3.1.3.1 Flowchart of the Existing System

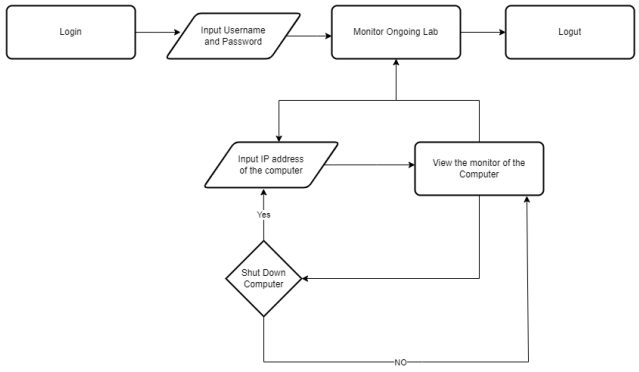

Figure 3. Flowchart of the Existing System (Netmonitoring)

3.1.3.2 Data Flow Diagram of the Existing System

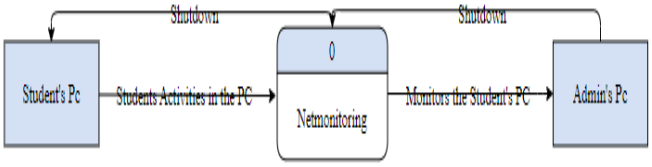

Figure 4. Context Diagram of the Existing System

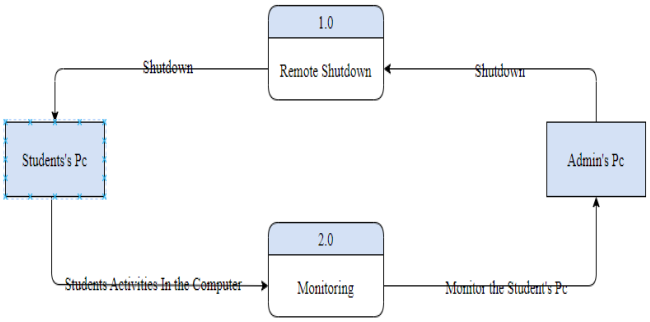

Figure 5. Data Flow Diagram of the Existing System (Level 0)

3.1.4 Flow of Proposed System

This was the representation of the system's flow which indicated its relationship to its user. It showcased the functions that the system would bring to the Cavite School of Life laboratory and bring changes or improvements to the current system that was being used in the school. This showed the step-by-step process of creating a flowchart which could assist in determining its key steps and provide the process overall picture at the same time. The tasks are arranged chronologically and classified by category. And, by using the Data Flow Diagram it could find the possible issues, boost productivity, and create better procedures, one needs to better understand how a process or system operates. They could be straightforward overviews or intricate, detailed displays of a system or process.

3.1.4.1 Flowchart of the Proposed System

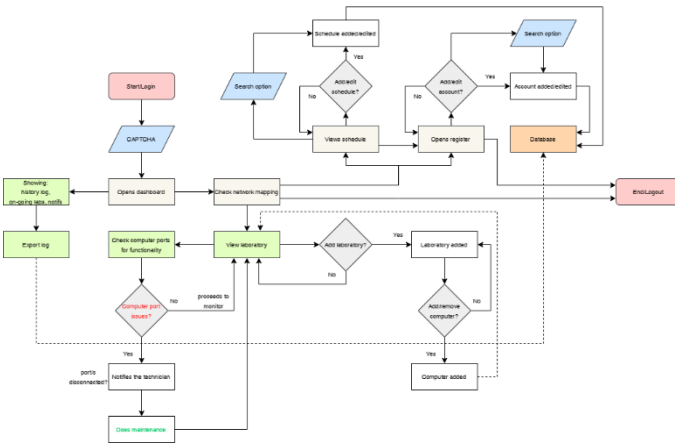

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Figure 6. Flowchart of the Proposed System (Csol Connect)

3.1.4.2 Data Flow Diagram of the Proposed System

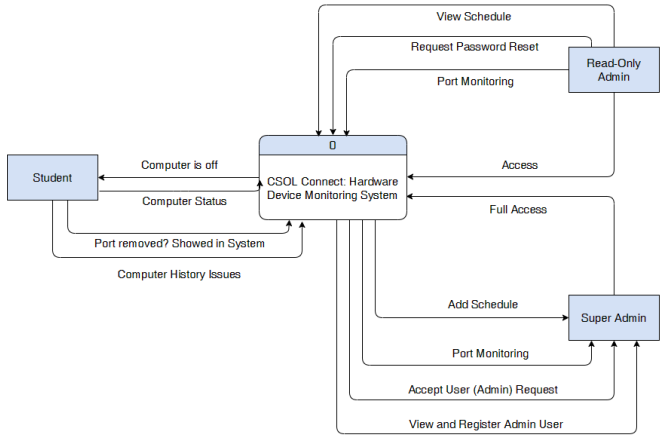


Figure 7. Context Diagram of the Proposed System

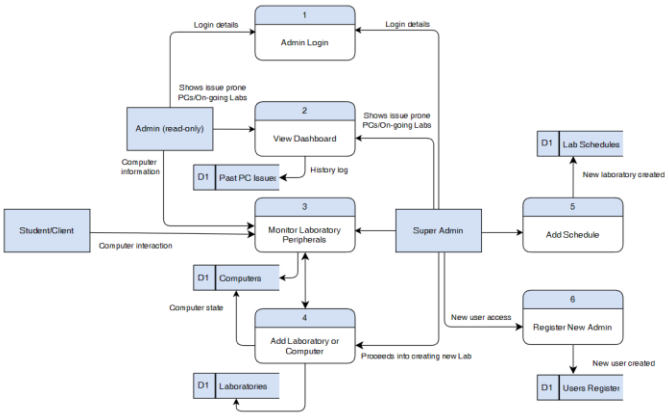


Figure 8. Data Flow Diagram of the Proposed System (Level 0)

3.1.5 Network Diagram of Existing System

A network diagram is a visual depiction of a project that uses linked arrows and boxes to show how many project tasks are related to one another. The activity description is represented by boxes or nodes, and the relationships between the activities are depicted by arrows. Each action must have a beginning and an end, and all other activities must fit within these constraints.

In this section, it displayed the physical and logical view of the network of the system that the Cavite School of Life was currently using. It showed the laboratory and the server room that were being used. The system had to be downloaded onto each of the computers in the laboratories of Cavite School of Life. The current system utilized a LAN network with DHCP/IP addresses in order to identify the computer the admin wants to view. This utilized the whole management of the monitors of the computers in the laboratories that were being used.

3.1.5.1 Logical Network Diagram of the Existing System

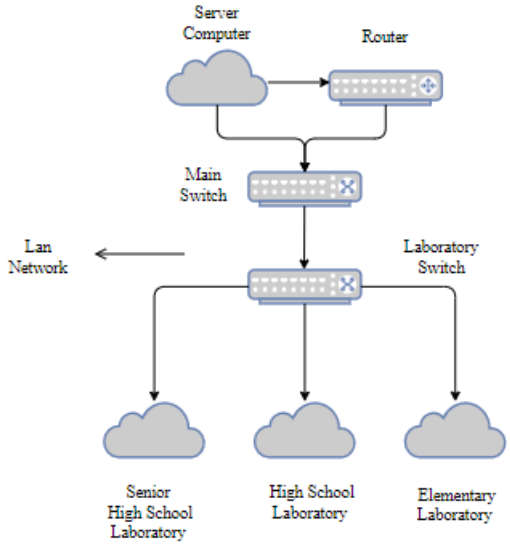


Figure 9. Logical Network Diagram of the Existing System

3.1.5.2 Physical Network Diagram of the Existing System

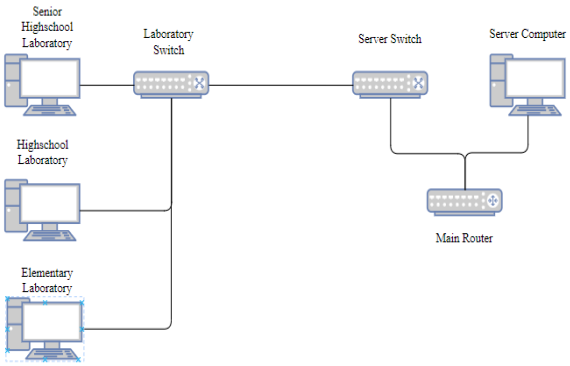


Figure 10. Physical Network Diagram of the Existing System

Figure 11. Logical Network Diagram of the Proposed System

3.1.6.2 Physical Network Diagram of the Proposed System

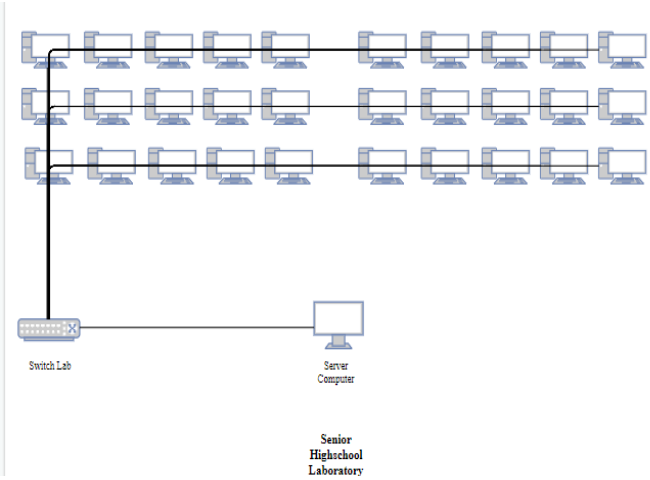
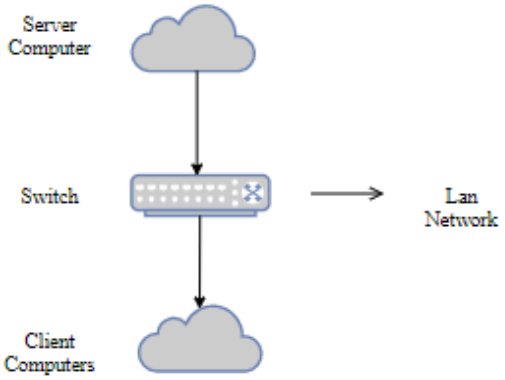


Figure 12. Physical Network Diagram of the Proposed System

3.1.6 Network Diagram of Proposed System

In this section, it displayed the physical and the logical network diagram of the system which was composed of a single laboratory which was the senior high school laboratory of Cavite School of Life. The beneficiary had given the group a permission to use the senior high school laboratory for the implementation of the system and use the devices that were within that laboratory. The devices were composed of one switch, 30 client computers, and one server computer.

3.1.6.1 Logical Network Diagram of the Proposed System



3.1.7 Network Security of the Proposed System

The system integrated a security protocol which could bring an improvement from the previously used system that the Cavite School of Life used. With the help of a network security system, the admin could have an assurance with the security that comes with knowing that their most valuable assets, their computer systems, networks, and data are safe, secure, and guarded against intrusions and unauthorized users from both within and outside of their business. The system used a multi-factor authentication for the security of the system.

2-factor Authentication (2FA)

Two-Factor Authentication (2FA) is a method used to enhance the security of user accounts. It adds an extra layer of verification beyond the standard username and password combination. Two-factor authentication, or 2FA, adds an additional degree of verification to passwords, making it a vital security feature for systems. By forcing users to submit a second form of identification, such as a temporary code delivered to their mobile device or the use of a CAPTCHA, it reduces the risks associated with password-based authentication. This considerably improves system security overall by lowering the possibility of data breaches, identity theft, and illegal access. In the system, it uses a username and password for the login along with the use of CAPTCHA for the security measures

The CAPTCHA could be used as a method to distinguish between human users and artificial users like bots. CAPTCHAs provide problems that are challenging for machines to solve but relatively simple for people. Detecting stretched characters or numerals, for instance, or clicking on a certain spot.

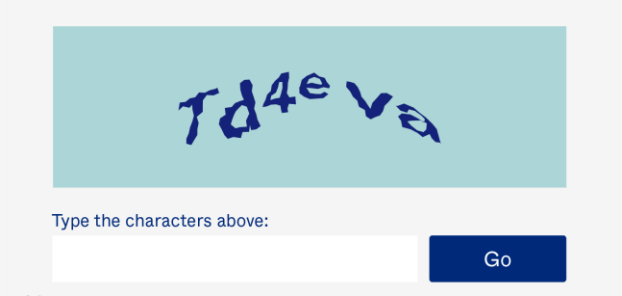


Figure 13. Multi-factor Authentication Process (CAPTCHA)

3.2 Requirements Documentation

3.2.1 Methods of Research

The research method that the researchers used was Quantitative research. In quantitative research, numerical data are gathered and examined. It was perfect for seeing patterns and averages, formulating hypotheses, vetting connections, and extrapolating findings for huge populations. In fields including biology, chemistry, psychology, economics, sociology, marketing, and others, as well as the scientific and social sciences, this approach was frequently employed. Using the quantitative research for the study was appropriate for gathering the data of the effect of the system to the target user, brings the benefit to the user, and be able to use it thoroughly.

The research design that was used was descriptive development research. It relates to the period of data collection. These featured longitudinal, sequential, and cross-sectional designs. It had the methodical study of creating, producing, and assessing educational processes, products, and programs that must adhere to internal consistency and effectiveness standards. By using this research method, the researchers were able to observe the process in the development of the system as it would be done.

3.2.2 Research Instruments

The research instrument used in an interview was also used in gathering the data after the system's implementation. Along with the use of observation, which was the system's use and how the user comprehended how effective it was in the target user's work. And to evaluate the system's efficiency, researchers had conducted a survey to evaluate the system.

Interview

The interview was used to ask the target user feedback on how the user perceived the system and if it benefits from its work.

Observation

It had been used to check the efficiency of the user in using the system. The researchers will be observing the user while the user is using the system. That’s how the researchers perceived the efficiency of the system.

Survey

The survey was composed of open-ended and closed-ended questionnaires that had been used to evaluate the efficiency of the system that was being used.

3.3 Technical Background

3.3.1 Product Description

The system is used by the Cavite School of Life technician. It has been used in monitoring the hardware or the ports of the computers in the laboratory and be able to navigate the disconnections that were happening within the laboratories. It helped the network admins/technicians of CSOL in monitoring their network through the various features that the system offers. The real time LANs' Port monitoring was a feature that was effective in monitoring the physical ports of the computers in the computer laboratory.

3.3.2 Economic Use of the Product

This kind of system had not been used by schools even though there were these kinds of software in the industry, it was only used by big companies as it required a lot of money to acquire this kind of system. The use of this system could be beneficial for schools as students tend to do things and play with the peripherals around the computer laboratory.

3.3.3 User Requirements

The users of the system would be the technicians of the Cavite School of Life. They were categorized into two categories which were the Admin and the Superadmin. These two differed from the rights and accessibility they had to the system. The technician would administer the system and were the only people with access to it.

Admin

- Technician of CSOL

Superadmin

- Technician of CSOL
- Head technician

3.3.4 System Requirements

The system integrated a LAN network which was already being used in the laboratory of the Cavite School of Life. Also, peripherals like keyboard, mouse, and ethernet were used in the system, which would serve as the main component in its implementation. The requirement for the server and the client computer are the following:

Server	Client
Minimum Requirement: • OS: Windows 10 64-bit or higher • Processor: AMD or Intel quad-core processor • Memory: 8 GB RAM • Graphics: Integrated graphics or dedicated graphics card with basic 2D rendering support • Storage: 1.3 GB of free space • Display: 1280 x 720 resolution Dependencies: • .NET Framework 4.7 or later • SQL Server Management Studio 2019 Maximum Requirements: • OS: Windows 10 64-bit or higher • Processor: AMD or Intel six-core processor • Memory: 16 GB • RAM Graphics:	System Requirements: • OS: Windows 10 64-bit or higher • Processor: AMD or Intel quad-core processor • Memory: 4 GB RAM • Graphics: Integrated graphics or dedicated graphics card with basic 2D rendering support • Storage: 1.2 GB of free space Dependencies: • .NET Framework 4.7 or later • SQL Server Management Studio 2019
Integrated graphics or dedicated graphics card with basic 2D rendering support • Storage: 1.3 GB of free space • Display: 1280 x 720 resolution Dependencies: • .NET Framework 4.7 or later • SQL Server Management Studio 2019	

3.4 Development and Testing

In the system's development process at the end of the month in April and based on the SDLC, the design was built. And 50 percent of the system was working and had already been developed. This was the targeted set of dates to finish the development of the system and in August the system would be developed and be able to function as a whole system.

The testing of the prototype was done on Oct 12, 2023. The testing of the system or the prototype has been conducted on one of the laboratories of the CSOL which has been supervised by the head technician of the school who handles the network of the school, it displays the functionality and the process on how the system will work and the implementation process that will be done. The beneficiary approves of the functionality of the system and has a positive response in the benefit that the system gives.

3.5 Description of the Prototype

This section discussed the prototype of the system. The prototype will be shown as an explorative version of the system that provides an actual representation of the system's outline and functionality. The screenshots will present the overall sequence of the system and how it will operate.

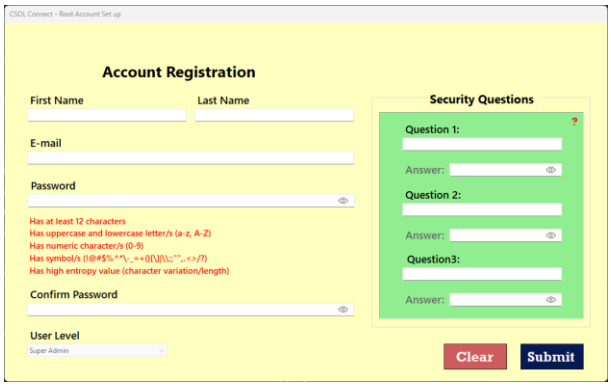


Figure 14. Root Account Setup

As the client opens the system, the client will first create an account for the users of the system which can be the superadmin

and the admin. It will require the name, email and password for the account, the user level, and the security questions in case of the client forgot its password.

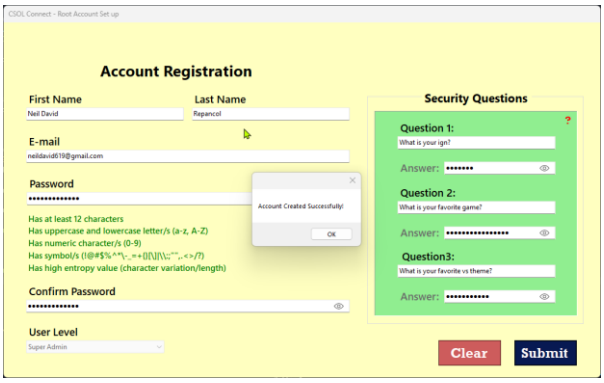


Figure 15. Root Account Setup (Successful)

After putting in the required information needed, the client will click the submit button and it will show a message box that the account has been created successfully.

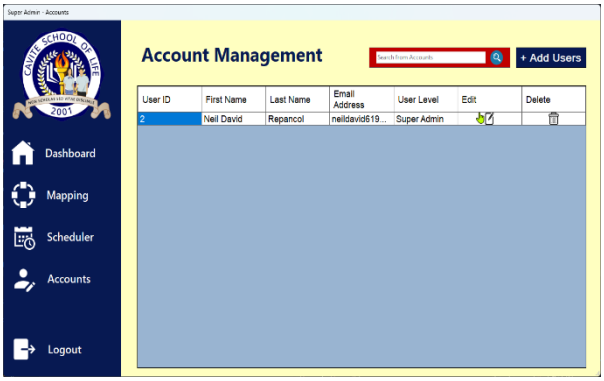


Figure 16. Account Created

This is the created account after the setup and has the detailed information like the user id, first name, last name, email address, and its user level. The accounts that have been created can also be edited and deleted only by the superadmin account.

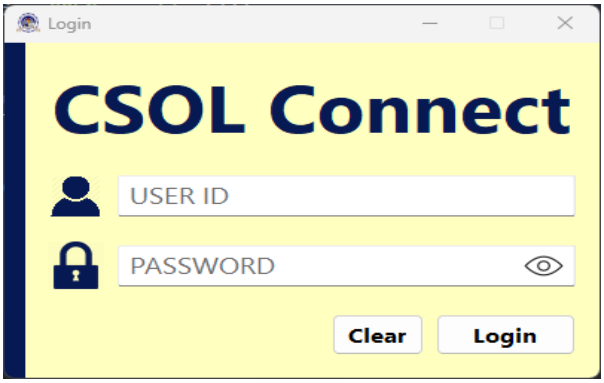


Figure 17. Login of account

After creating the account, the client will need to login to the account that has been created.

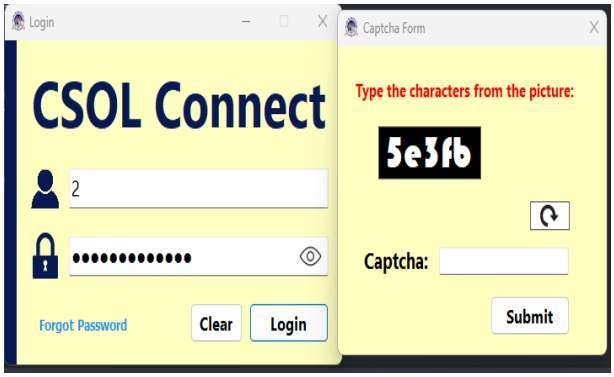


Figure 18. Captcha (Login)

After putting the user id and the password, it will trigger a captcha for another security authentication.

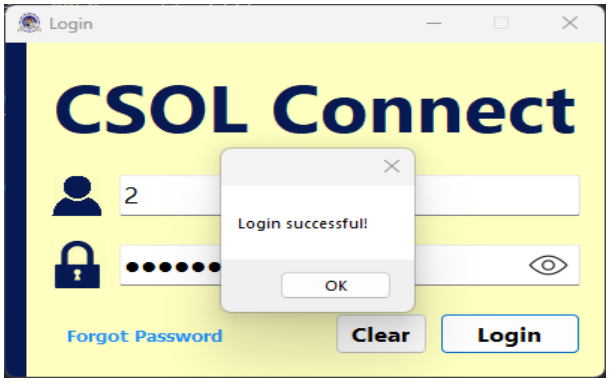


Figure 19. Login Successful

After putting the user id, password, and successfully typing the captcha. It will show a message box that will login the user to the system.

Figure 20. Forgot Password (security questions)

In case the client forgets its password, to reset its password the client will be redirected to the security questions that have been created in the account creation.

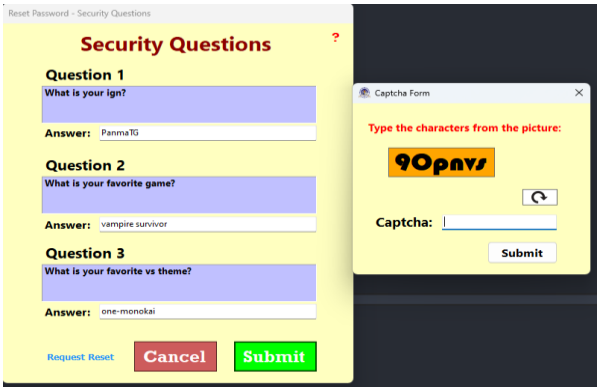


Figure 21. Forgot Password (captcha)

After answering the questions, it will also trigger a captcha before the client can request a reset of the password

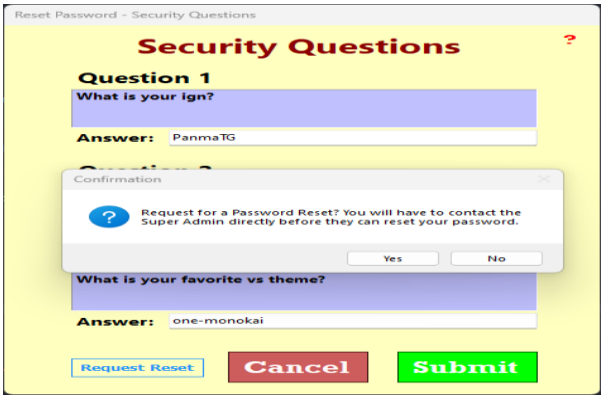


Figure 22. Request for reset of password

The request for password will be redirected to the superadmin in order to reset the password.

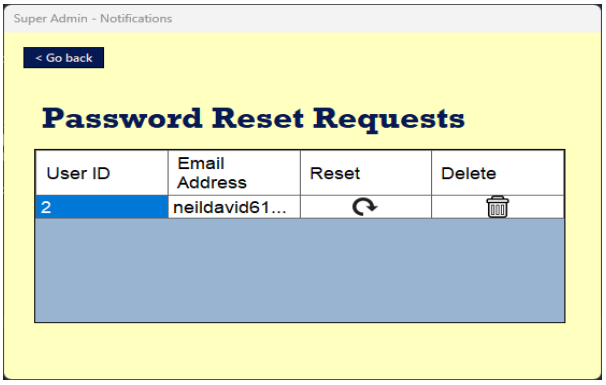


Figure 23. Reset of Password

The superadmin now can reset the request of the reset of password.

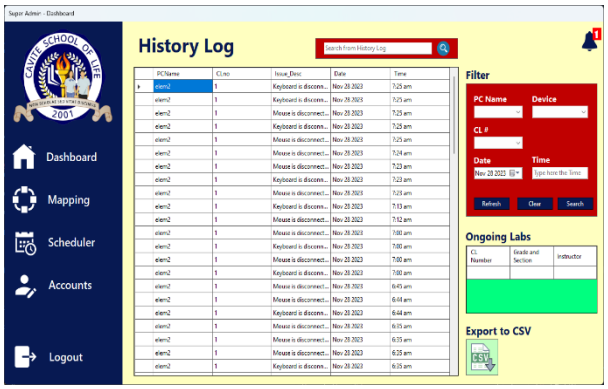


Figure 24. Dashboard (Superadmin)

In the dashboard for the superadmin, it has the history log which has the data of the issues that has happened in the laboratory. It has the detailed information from the Pc name, computer laboratory, the issue or the instance that happened, date, and time. It can also be specified by its categories, and it will only show the designated data that has been specified. It also shows the ongoing laboratory that is currently happening in real time. The history log can be exported into a csv or excel file in case it is needed for a copy.

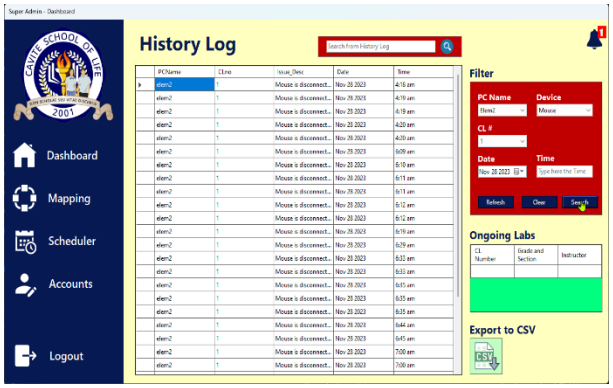


Figure 25. Dashboard (Search filter)

This is the specified filter on the history log, which indicates a certain date, pc name, and device.

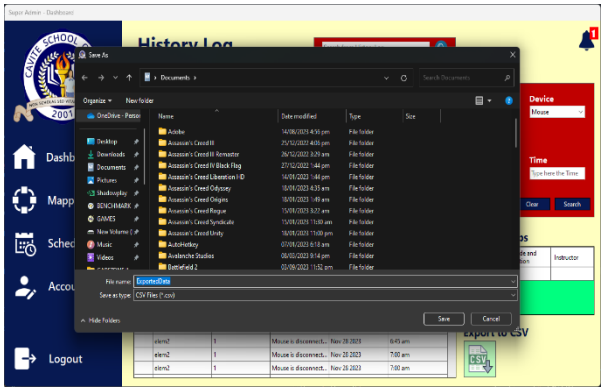


Figure 26. Dashboard (Exporting file)

This is the process of exporting the data into a csv, it will prompt a download and will be saved on the documents.

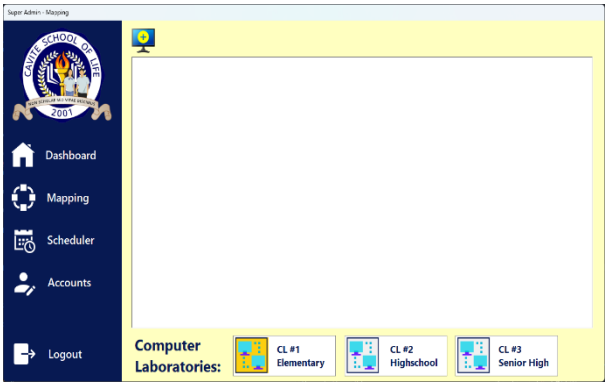


Figure 27. Mapping

This is where the monitoring of the computer can be seen from computer laboratories.

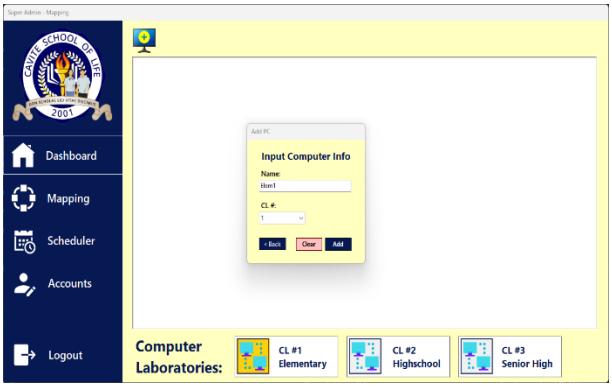


Figure 28. Mapping (Adding a computer)

One of the features in the mapping is the adding of a computer in a laboratory.

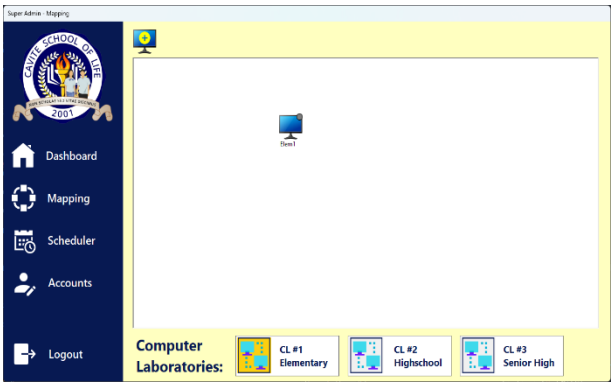


Figure 29. Mapping (Computer added)

This is the created computer that has been created from adding a computer.

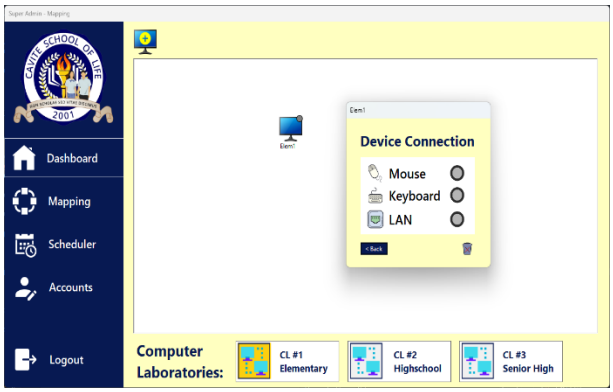


Figure 30. Mapping (Device Connection)

When clicking the computer, it will show the devices that will be monitored like the mouse, keyboard, and Lan.

Figure 31. Mapping (Device Connected)

The indication if the devices are all connected will be a green light.

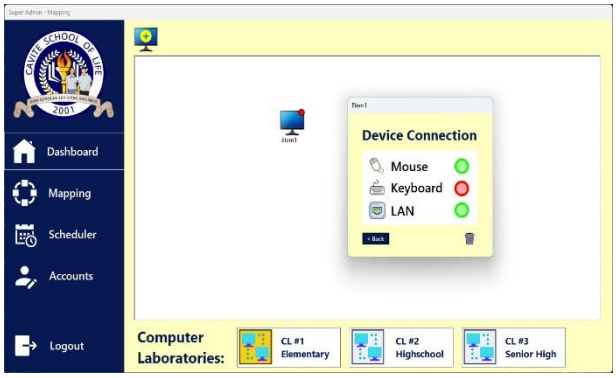


Figure 32. Mapping (Device Not Connected)

The indication if the devices are not connected will be a red light.

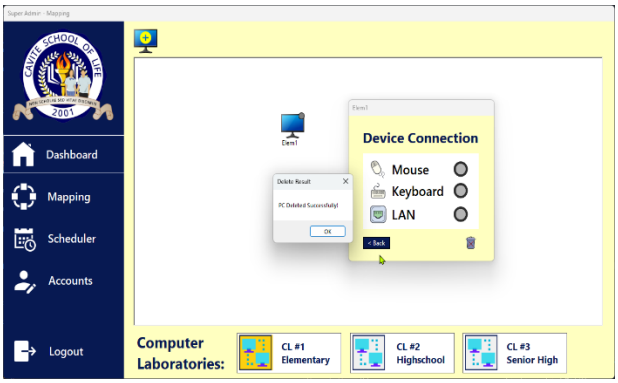


Figure 33. Mapping (Computer deletion)

The computer can be deleted by clicking the trash bin icon on the device connection.

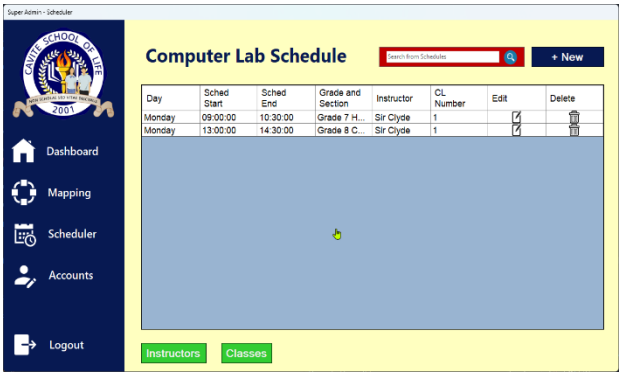


Figure 34. Scheduler

This the feature for scheduling of the laboratories based on the day, time it started and ended, the grade and section, instructor, compuer laboratory number, and the instructor. It will indicate who will be using the laboratory. The created schedules can also be edited and deleted only by the superadmin.

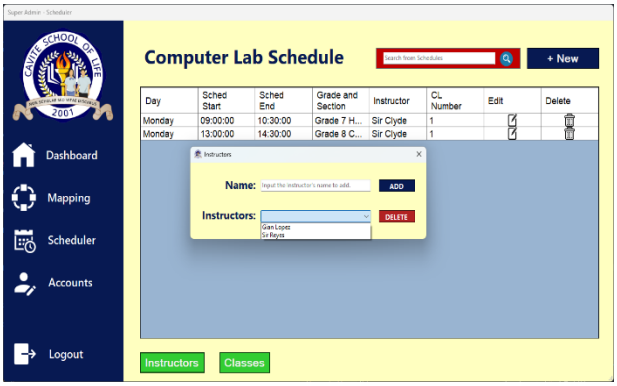


Figure 35. Scheduler (Adding Instructor)

This is the adding of the instructors who will be using the laboratories.

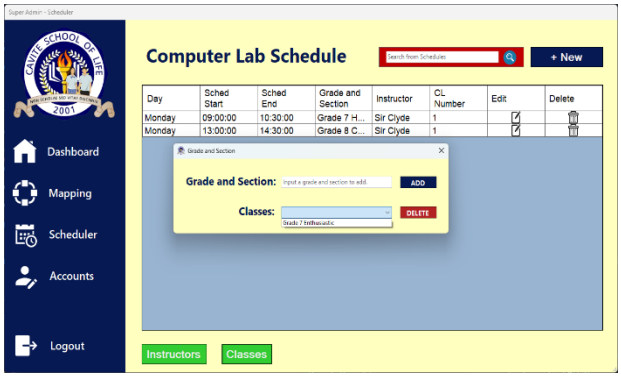


Figure 36. Scheduler (Adding Grade and Section)

This is the adding of the grade and section who will be using the laboratories.

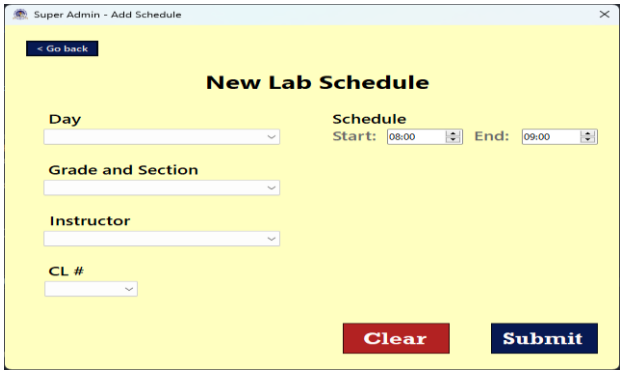


Figure 37. Scheduler (Adding a schedule)

This part is where the superadmin can create or edit a schedule on using the laboratory for the instructors and grade section.

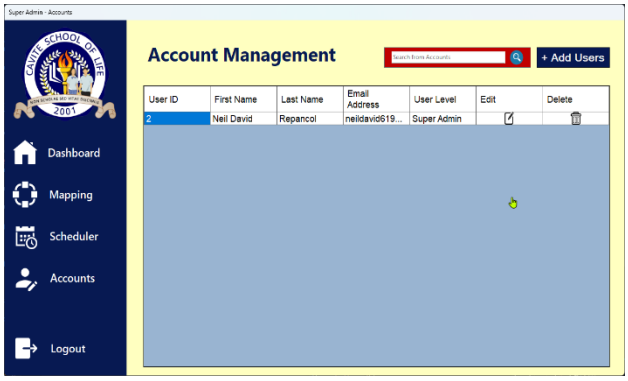


Figure 38. Account Mangement

This part is where the superadmin can create another account or edit the account.

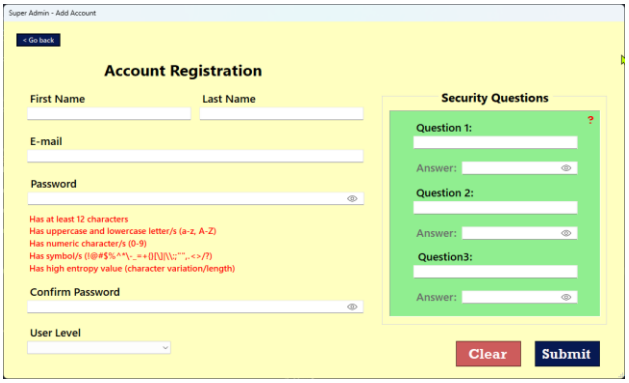


Figure 39. Account Mangement (Add or edit an account)

This is how the superadmin can create an account or edit the account that has been created.

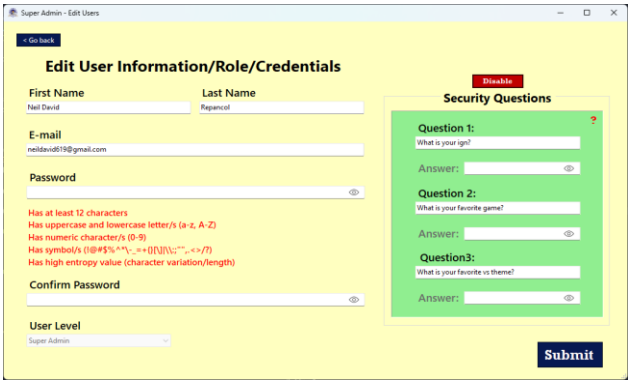


Figure 40. Account Mangement (Creating security Questions)

The superadmin can create the specified security questions for the account that is being created or edited.

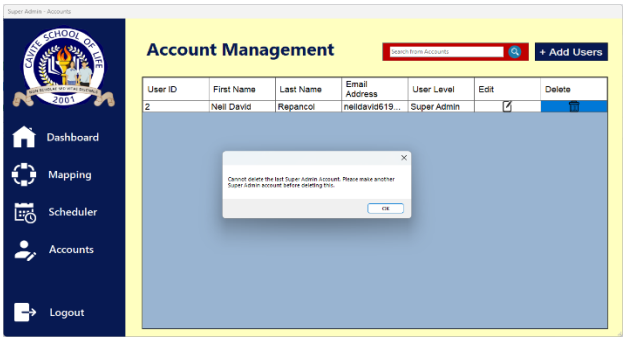


Figure 41. Account Mangement (Prompt of deleting superadmin)

The superadmin account cannot be deleted unless there is another superadmin account that has been created.

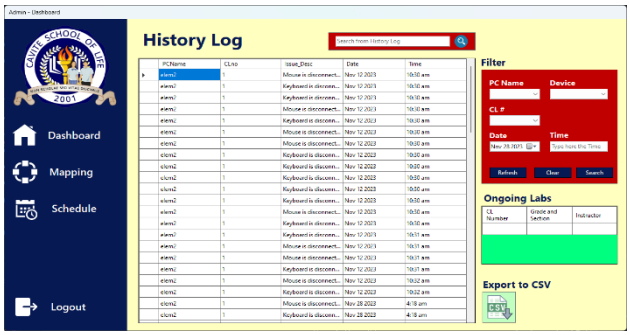


Figure 42. Dashboard (Admin)

The admin account dashboard has the same features as the superadmin .

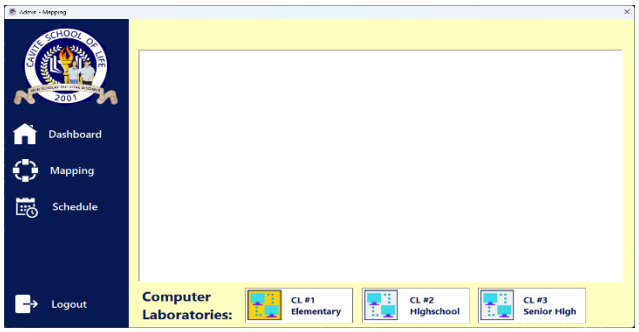


Figure 43. Mapping (Admin)

The mapping of the admin account can also monitor the device connections and create a computer but can't delete a computer.

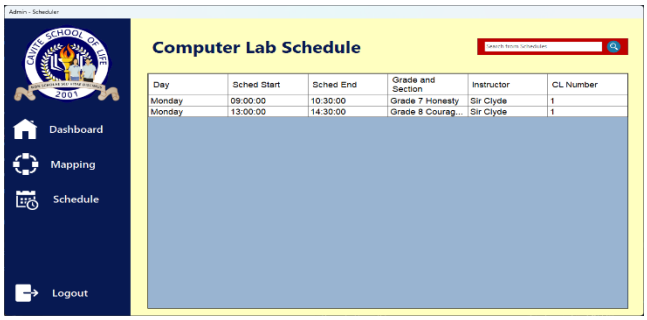


Figure 44. Scheduler (Admin)

The admin account can only view the schedules that are created by the superadmin.

3.6 Implementation Plan

The implementation is a crucial factor to the system's success. Regarding data migration, the system was installed in the administrator room first. The software could not be installed to every available computer instead, supporting software was deployed that would let the system function. For the target users, it is divided into two user levels which are the superadmin and the admin. As the system is present in the admin room, both user levels had the capability to use the software, but it was differentiated in terms of the features. Concerning the technical support, the administrators of the CSOL had reached out to the developers if a certain problem occurred in the system.

3.7 Implementation Results

The functionality of the system is expected to operate. This enhanced the effectiveness of the processes to support the beneficiary. It is made to improve the current system in the CSOL that could allow the administrators to monitor the laboratories in real-time. The system is also expected to provide better data about the client PC and how the students interacted with the computer. In that way, it boosted productivity and enabled the production of accurate reports in CSOL. Overall, the beneficiary and its users had gained a lot from the system as it was used in their facility.

4. SUMMARY, CONCLUSION AND RECOMMENDATIONS

4.1 Summary

This chapter discusses the overall result of the proposed system on its purpose and be able to discuss the process in attaining the result. With this, the objectives, the foundation of the system through past studies and literatures, and methodology has been proposed.

The lack of a monitoring system for the computers inside the computer laboratories in CSOL, contributes to the problem where some students tend to play with the computers and disconnect it from the Internet or disconnect the hardware devices from the computer. The researchers have created a system that will answer the problems that CSOL is experiencing. This system assists CSOL's network administrators and technicians in keeping an eye on their network, the hardware devices that are connected in the computer lab are being monitored thanks to a feature of real-time LANs called mapping. Every time a network cable or device is unplugged, the administrator is notified. There are two user levels in the system, which are the superadmin and the admin. For the superadmin, they were given a module that allowed them to see, add, edit, and delete laboratories or individual PCs within a laboratory in real time. They also have the scheduler, where they can create and edit a schedule for the teacher and the grade and section that will be using the laboratory. The superadmin can also create and edit a schedule for the accounts of the system. For the admin, they can only view the schedules and the accounts that have been created by the superadmin. They can monitor the computer and devices that are connected from the computer in the mapping section. As for the security of the system, it utilizes a two-factor authentication using both login and captcha to enter the system. It also utilizes security questions for situations where the user may forget the password on their account.

The results on how the system helps in CSOL have received a great response. Using the ISO 25010 as a method to gather the results of the systems to the users and be able to assess its functionality and effectiveness the researchers have surveyed the technician of the CSOL, IT professionals that have knowledge in this field, and students for the respondents of that will assess the systems functionality. The breakdown of the profile of respondents can be seen in Table 1 in the appendix. The questionnaires have been categorized into 8 categories which are Functionality, Performance Efficiency, Compatibility, Usability, Reliability, Security, Maintainability, and Portability. These categories are used to evaluate its overall structure and effectiveness, it can be rated from 1 to 5 where 5 being highest and 1 being the lowest. 1 is equivalent to Poor, 2 is equivalent to Fair, 3 is equivalent to Good, 4 is equivalent to Very Good, and 5 is equivalent to Excellent. Based on the result of the survey, Functionality has a mean of 4.81, Performance Efficiency has a mean of 4.8, Compatibility has a mean of 4.85, Usability has a mean of 4.7, Reliability has a mean of 4.72, Security has a mean of 4.85, Maintainability has a mean of 4.72, and Portability has a mean of 4.83. The overall mean has 4.79 as its rating and when it has been rounded off it will equivalent to Excellent as its result. The breakdown of the survey results can be seen in Table 2 in the appendix.

4.2 Conclusion

In conclusion, the system has proven to be helpful in the problem that CSOL has and is able to perform its functions to the fullest and be able to do the purpose and its objectives. The purpose of the system is that the system helps the network admins/technicians of CSOL in monitoring their network through the various features that the system offers. The Real-time LANs' Port monitoring is the feature that has be used in monitoring the physical ports of the computers in the computer laboratory of CSOL. The general objective was to develop a system, which was a hardware device monitoring system for the computer laboratories of CSOL, has been achieved through the implementation of the system in the computer laboratories of CSOL. The specific objectives which are planned and developed a network monitoring system for the school computer laboratories, provide a login and log out module for the system, integrated a Completely Automated Public Turing test to tell Computers and Humans Apart (CAPTCHA) in the system for its security, made 2 user levels which are Superadmin and admin, a dashboard that showed important information about the network being monitored, made an interface wherein the admins could create a network map for the computer laboratories, made a module that lets the admin make a scheduler to keep in track of the time and classes who would use the labs, and developed a registration module that allows the Superadmin to create admin with read-only rights. All the specific objectives have been met throughout the creation of the system and have been functioning effectively. This can be proven with the results of the testing which test the system's effectiveness. Based on each category for Functionality it has a mean of 4.81, Performance Efficiency has a mean of 4.8, Compatibility has a mean of 4.85, Usability has a mean of 4.7, Reliability has a mean of 4.72, Security has a mean of 4.85, Maintainability has a mean of 4.72, and Portability has a mean of 4.83. The overall mean has 4.79, which means that the system has proven to be effective and be able to answer the purpose of creating the system.

4.3 Recommendations

Throughout the span of developing the system, the researchers have fulfilled the aim of monitoring the computers in laboratories of CSOL as it was implemented. The system aids the technicians to identify the problems of a single computer according to its physical connections.

To make the system more enhanced in the future, conducting further user testing is necessary to address potential problems and usability issues. Furthermore, adding more features that could improve the system's monitoring capabilities and detection of other peripherals of a computer would increase the functionality of the system and interactivity.

5. ACKNOWLEDGMENTS

Completing this Capstone Research Project indicates the combined efforts and support of numerous individuals. In extending our appreciation, we express our sincere gratitude to those who have significantly contributed to our academic goals:

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APPENDIX

A. PRESENTATION OF FINDINGS

A.1 Profile of the Respondents

Table 1. Frequency and Percentage of Respondents Profile

Respondents	Frequency	Percentage
CSOL Technician	1	3.33%
I.T Experts	4	13.33%
Students	25	83.33%

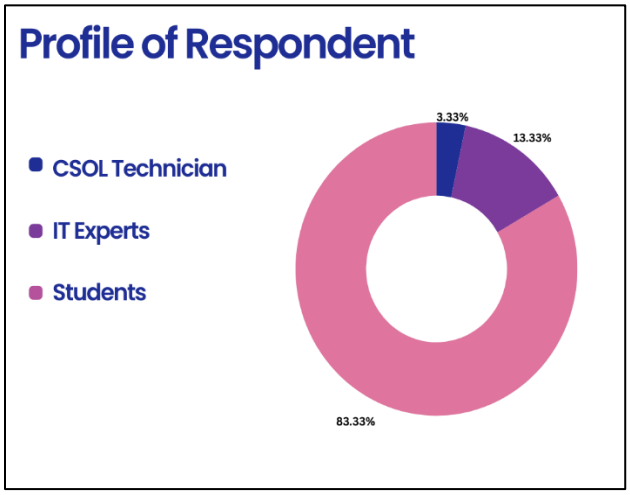


Figure 45. Pie Graph of the Profile Respondents

A.2 Survey Results

Table 2. Frequency and Percentage of Respondents

	5		4		3		2		1				
	f	Percentage	f	Percentage	f	Percentage	f	Percentage	f	Percentage			
A. Functionality											Mean of each question	Mean of Functionality	Interpretation
Completeness	21	70%	9	30%	0	0%	0	0%	0	0%	4.7	4.81	Excellent
Correctness	24	80%	6	20%	0	0%	0	0%	0	0%	4.8		
Appropriateness	28	93%	2	7%	0	0%	0	0%	0	0%	4.93		
B. Performance Efficiency												Mean of Performance Efficiency	
Time Behaviour	23	77%	7	23%	0	0%	0	0%	0	0%	4.76	4.8	Excellent
Resource Utilization	25	83%	5	17%	0	0%	0	0%	0	0%	4.83		
Capacity	24	80%	6	20%	0	0%	0	0%	0	0%	4.8		
C. Compatibility												Mean of Compatibility	
Co-existence	26	87%	3	10%	1	3%	0	0%	0	0%	4.83	4.85	Excellent
Interoperability	26	87%	4	13%	0	0%	0	0%	0	0%	4.86		
D. Usability												Mean of Usability	
Appropriateness recognizability	26	87%	4	13%	0	0%	0	0%	0	0%	4.86	4.7	Excellent
Learnability	24	80%	5	17%	1	3%	0	0%	0	0%	4.76		
Operability	23	77%	7	23%	0	0%	0	0%	0	0%	4.76		
User Error Protection	23	77%	7	23%	0	0%	0	0%	0	0%	4.76		
User Interface Aesthetics	14	47%	12	40%	4	13%	0	0%	0	0%	4.33		
Accessibility	21	70%	9	30%	0	0%	0	0%	0	0%	4.7		
E. Reliability												Mean of Reliability	
Maturity	25	83%	5	17%	0	0%	0	0%	0	0%	4.83	4.72	Excellent
Availability	25	83%	5	17%	0	0%	0	0%	0	0%	4.83		
Fault tolerance	23	77%	6	20%	1	0%	0	0%	0	0%	4.73		
Recoverability	17	57%	11	37%	2	0%	0	0%	0	0%	4.5		
F. Security												Mean of Security	
Confidentiality	28	93%	2	7%	0	0%	0	0%	0	0%	4.93	4.85	Excellent
Integrity	28	93%	2	7%	0	0%	0	0%	0	0%	4.93		
Non-repudiation	23	77%	7	23%	0	0%	0	0%	0	0%	4.76		
Accountability	25	83%	5	17%	0	0%	0	0%	0	0%	4.83		
Authenticity	24	80%	6	20%	0	0%	0	0%	0	0%	4.8		
G. Maintainability												Mean of Maintainability	
Modularity	22	73%	8	27%	0	0%	0	0%	0	0%	4.73	4.74	Excellent
Modifiability	22	73%	8	27%	0	0%	0	0%	0	0%	4.73		
Testability	23	77%	7	23%	0	0%	0	0%	0	0%	4.76		
H. Portability												Mean of Portability	
Adaptivity	25	83%	4	13%	1	3%	0	0%	0	0%	4.8	4.83	Excellent
Installability	26	87%	4	13%	0	0%	0	0%	0	0%	4.86		
												Overall Mean: 4.79	Excellent

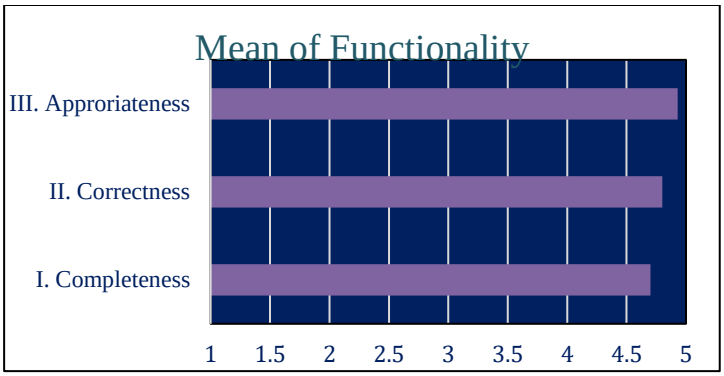


Figure 46. Line Graph of the Results in Functionality

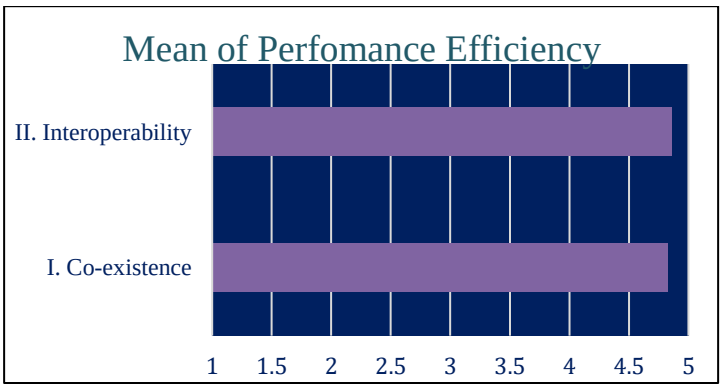


Figure 47. Line Graph of the Results in Performance Efficiency

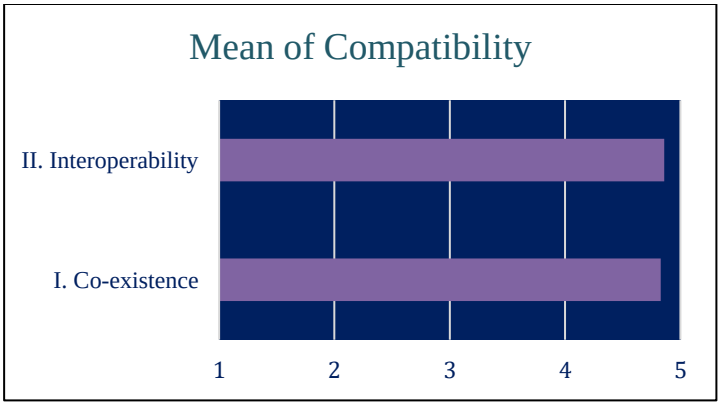


Figure 48. Line Graph of the Results in Compatibility

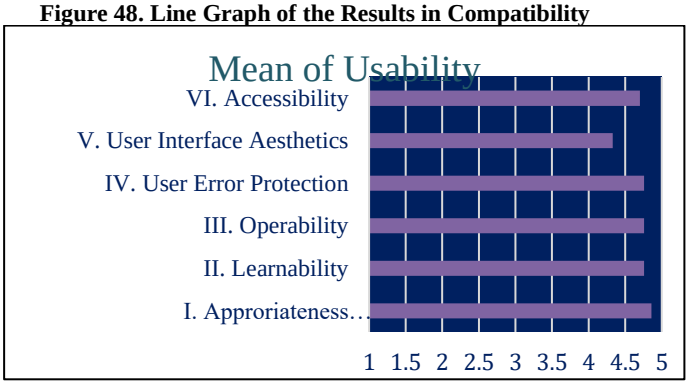


Figure 49. Line Graph of the Results in Usability

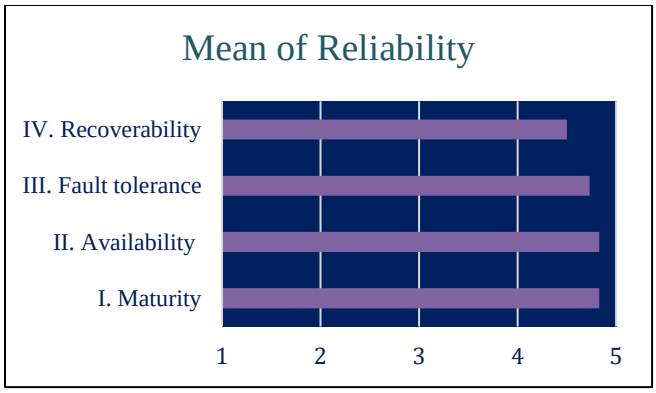


Figure 50. Line Graph of the Results in Reliability

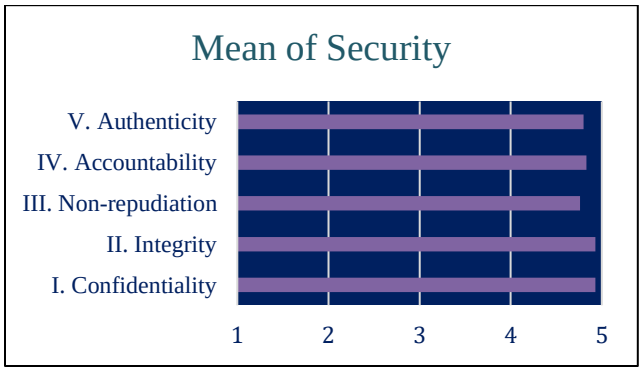


Figure 51. Line Graph of the Results in Security

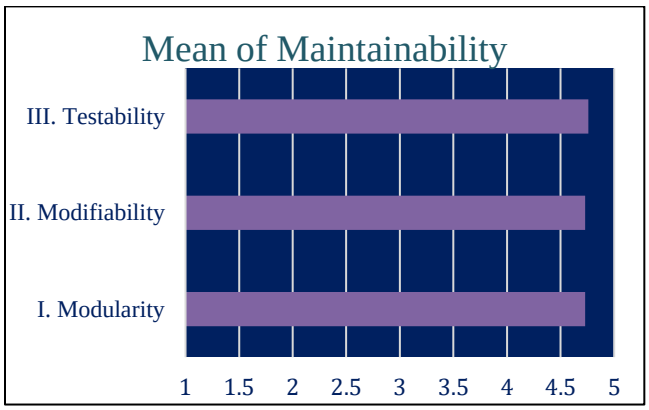


Figure 52. Line Graph of the Results in Maintainability

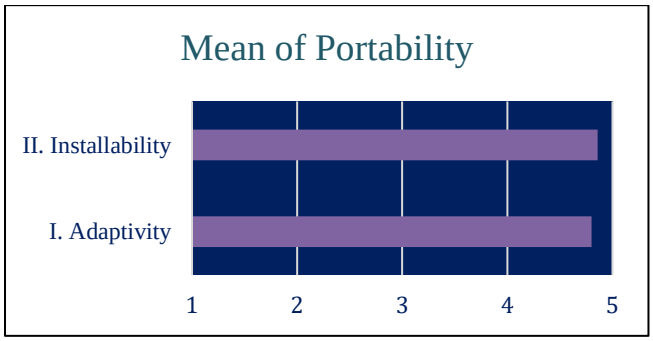


Figure 53. Line Graph of the Results in Maintainability

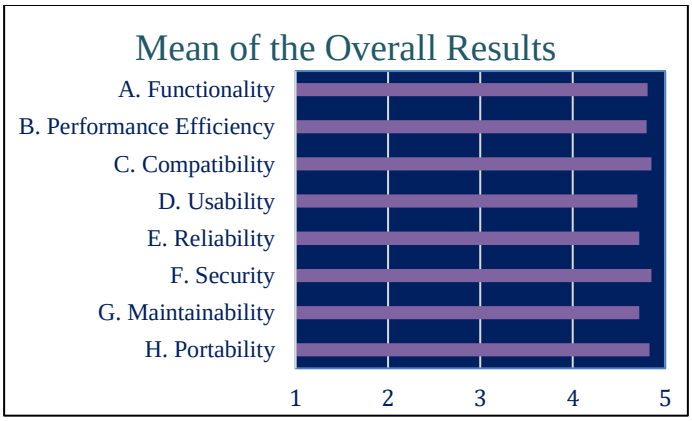


Figure 54. Line Graph of the Overall Results

A.3 GANTT CHART OF DEVELOPMENT SCHEDULE

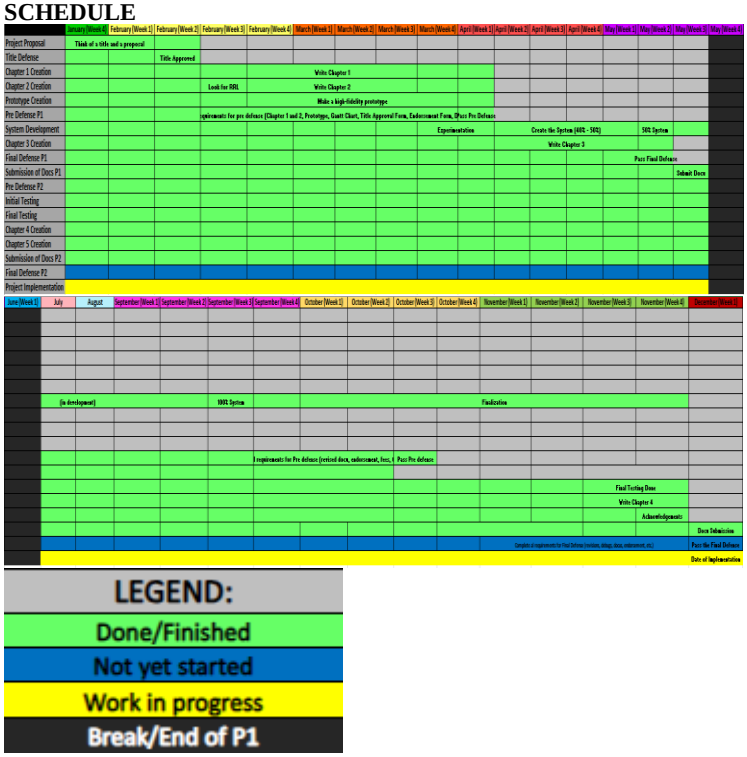
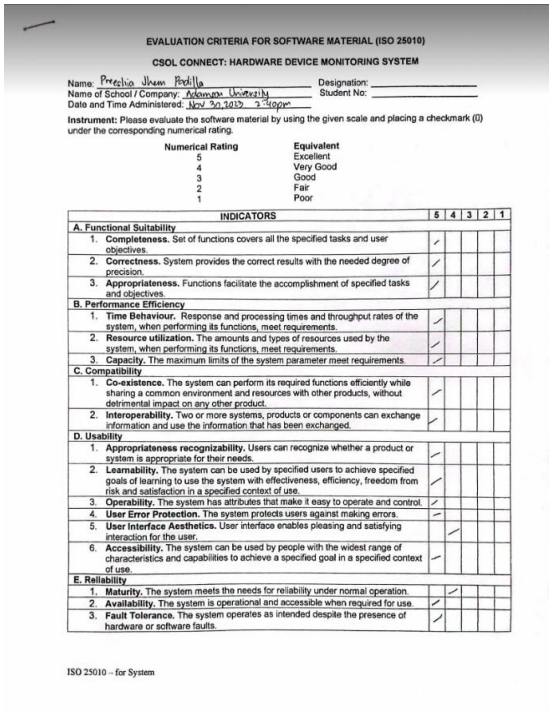


Figure 55. Gantt Chart

B. LETTER OF REQUEST FOR APPROVAL

C. SAMPLE SURVEY QUESTIONNAIRE (WITH RESPONSE) (Initial and Final)



EVALUATION CRITERIA FOR SOFTWARE MATERIAL (ISO 25010)

CSOL CONNECT: HARDWARE DEVICE MONITORING SYSTEM

Name: Preshia Ihem Padilla Designation: _____
Name of School / Company: Adamson University Student No: _____
Date and Time Administered: Nov 30 2023 2:40pm

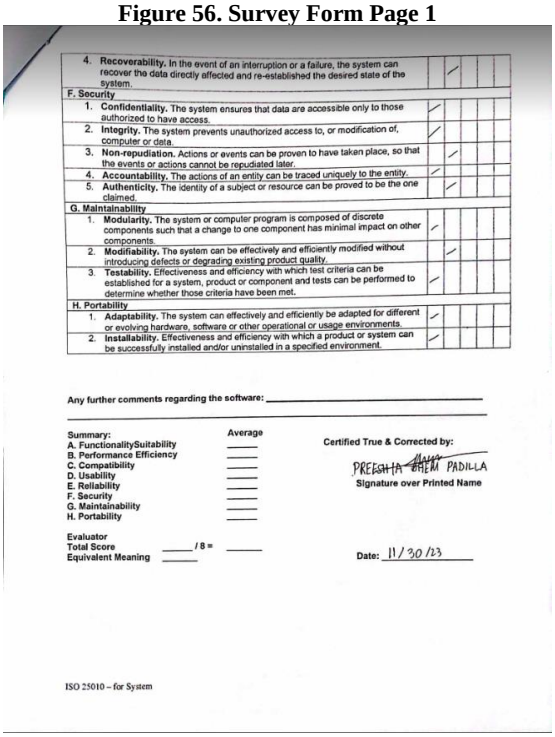
Instrument: Please evaluate the software material by using the given scale and placing a checkmark (/) under the corresponding numerical rating.

Numerical Rating	Equivalent
5	Excellent
4	Very Good
3	Good
2	Fair
1	Poor

INDICATORS	5	4	3	2	1
A. Functional Suitability					
1. **Completeness.** Set of functions covers all the specified tasks and user objectives.	✓				
2. **Correctness.** System provides the correct results with the needed degree of precision.	✓				
3. **Appropriateness.** Functions facilitate the accomplishment of specified tasks and objectives.	✓				
B. Performance Efficiency					
1. **Time Behaviour.** Response and processing times and throughput rates of the system, when performing its functions, meet requirements.	✓				
2. **Resource utilization.** The amounts and types of resources used by the system, when performing its functions, meet requirements.	✓				
3. **Capacity.** The maximum limits of the system parameter meet requirements.	✓				
C. Compatibility					
1. **Co-existence.** The system can perform its required functions efficiently while sharing a common environment and resources with other products, without detrimental impact on any other product.	✓				
2. **Interoperability.** Two or more systems, products or components can exchange information and use the information that has been exchanged.	✓				
D. Usability					
1. **Appropriateness recognizability.** Users can recognize whether a product or system is appropriate for their needs.	✓				
2. **Learnability.** The system can be used by specified users to achieve specified goals of learning to use the system with effectiveness, efficiency, freedom from risk and satisfaction in a specified context of use.	✓				
3. **Operability.** The system has attributes that make it easy to operate and control.	✓				
4. **User Error Protection.** The system protects users against making errors.	✓				
5. **User Interface Aesthetics.** User interface enables pleasing and satisfying interaction for the user.		✓			
6. **Accessibility.** The system can be used by people with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of use.	✓				
E. Reliability					
1. **Maturity.** The system meets the needs for reliability under normal operation.		✓			
2. **Availability.** The system is operational and accessible when required for use.	✓				
3. **Fault Tolerance.** The system operates as intended despite the presence of hardware or software faults.	✓				

ISO 25010 – for System

Figure 56. Survey Form Page 1



4. **Recoverability.** In the event of an interruption or a failure, the system can recover the data directly affected and re-established the desired state of the system.		✓			
F. Security					
1. **Confidentiality.** The system ensures that data are accessible only to those authorized to have access.	✓				
2. **Integrity.** The system prevents unauthorized access to, or modification of, computer or data.	✓				
3. **Non-repudiation.** Actions or events can be proven to have taken place, so that the events or actions cannot be repudiated later.		✓			
4. **Accountability.** The actions of an entity can be traced uniquely to the entity.	✓				
5. **Authenticity.** The identity of a subject or resource can be proved to be the one claimed.		✓			
G. Maintainability					
1. **Modularity.** The system or computer program is composed of discrete components such that a change to one component has minimal impact on other components.	✓				
2. **Modifiability.** The system can be effectively and efficiently modified without introducing defects or degrading existing product quality.		✓			
3. **Testability.** Effectiveness and efficiency with which test criteria can be established for a system, product or component and tests can be performed to determine whether those criteria have been met.	✓				
H. Portability					
1. **Adaptability.** The system can effectively and efficiently be adapted for different or evolving hardware, software or other operational or usage environments.	✓				
2. **Installability.** Effectiveness and efficiency with which a product or system can be successfully installed and/or uninstalled in a specified environment.	✓				

Any further comments regarding the software: _____

Summary:	Average
A. FunctionalitySuitability	_____
B. Performance Efficiency	_____
C. Compatibility	_____
D. Usability	_____
E. Reliability	_____
F. Security	_____
G. Maintainability	_____
H. Portability	_____

Certified True & Corrected by:

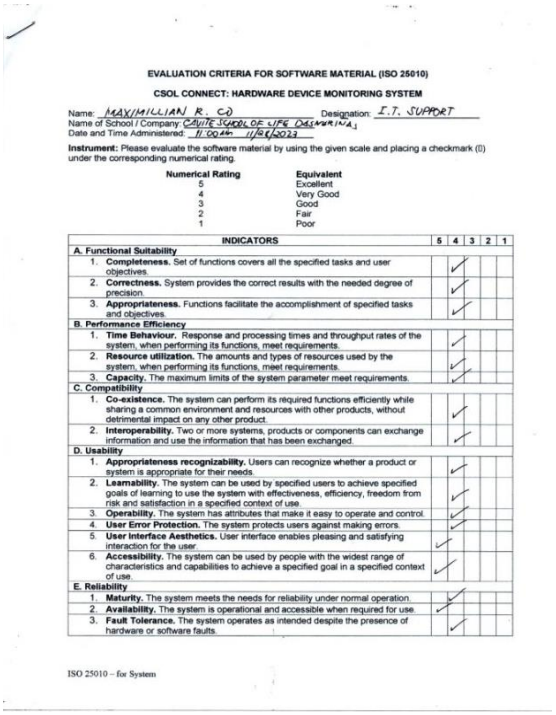
PRESHIA ~~Maya~~ IHEM PADILLA
Signature over Printed Name

Evaluator
Total Score _____ / 8 = _____
Equivalent Meaning _____

Date: 11/30/23

ISO 25010 – for System

Figure 57. Survey Form Page 2



EVALUATION CRITERIA FOR SOFTWARE MATERIAL (ISO 25010)

CSOL CONNECT: HARDWARE DEVICE MONITORING SYSTEM

Name: MAXIMILLIAN R. CO Designation: I.T. SUPPORT
Name of School / Company: CAVITE SCHOOL OF LIFE OPPORTUNITY
Date and Time Administered: 11:00AM 11/28/2023

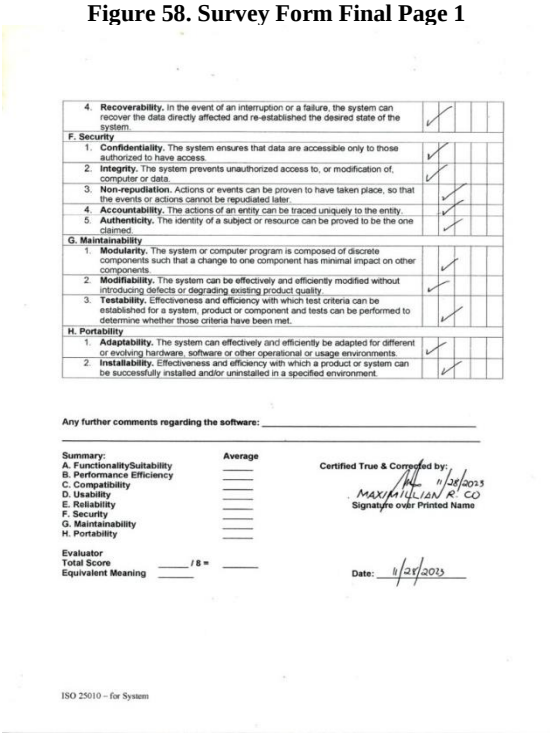
Instrument: Please evaluate the software material by using the given scale and placing a checkmark (/) under the corresponding numerical rating.

Numerical Rating	Equivalent
5	Excellent
4	Very Good
3	Good
2	Fair
1	Poor

INDICATORS	5	4	3	2	1
A. Functional Suitability					
1. **Completeness.** Set of functions covers all the specified tasks and user objectives.		✓			
2. **Correctness.** System provides the correct results with the needed degree of precision.		✓			
3. **Appropriateness.** Functions facilitate the accomplishment of specified tasks and objectives.		✓			
B. Performance Efficiency					
1. **Time Behaviour.** Response and processing times and throughput rates of the system, when performing its functions, meet requirements.		✓			
2. **Resource utilization.** The amounts and types of resources used by the system, when performing its functions, meet requirements.		✓			
3. **Capacity.** The maximum limits of the system parameter meet requirements.		✓			
C. Compatibility					
1. **Co-existence.** The system can perform its required functions efficiently while sharing a common environment and resources with other products, without detrimental impact on any other product.		✓			
2. **Interoperability.** Two or more systems, products or components can exchange information and use the information that has been exchanged.		✓			
D. Usability					
1. **Appropriateness recognizability.** Users can recognize whether a product or system is appropriate for their needs.		✓			
2. **Learnability.** The system can be used by specified users to achieve specified goals of learning to use the system with effectiveness, efficiency, freedom from risk and satisfaction in a specified context of use.		✓			
3. **Operability.** The system has attributes that make it easy to operate and control.		✓			
4. **User Error Protection.** The system protects users against making errors.		✓			
5. **User Interface Aesthetics.** User interface enables pleasing and satisfying interaction for the user.	✓				
6. **Accessibility.** The system can be used by people with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of use.		✓			
E. Reliability					
1. **Maturity.** The system meets the needs for reliability under normal operation.		✓			
2. **Availability.** The system is operational and accessible when required for use.	✓				
3. **Fault Tolerance.** The system operates as intended despite the presence of hardware or software faults.		✓			

ISO 25010 – for System

Figure 58. Survey Form Final Page 1



4. **Recoverability.** In the event of an interruption or a failure, the system can recover the data directly affected and re-established the desired state of the system.	✓				
F. Security					
1. **Confidentiality.** The system ensures that data are accessible only to those authorized to have access.	✓				
2. **Integrity.** The system prevents unauthorized access to, or modification of, computer or data.	✓				
3. **Non-repudiation.** Actions or events can be proven to have taken place, so that the events or actions cannot be repudiated later.		✓			
4. **Accountability.** The actions of an entity can be traced uniquely to the entity.		✓			
5. **Authenticity.** The identity of a subject or resource can be proved to be the one claimed.		✓			
G. Maintainability					
1. **Modularity.** The system or computer program is composed of discrete components such that a change to one component has minimal impact on other components.		✓			
2. **Modifiability.** The system can be effectively and efficiently modified without introducing defects or degrading existing product quality.		✓			
3. **Testability.** Effectiveness and efficiency with which test criteria can be established for a system, product or component and tests can be performed to determine whether those criteria have been met.		✓			
H. Portability					
1. **Adaptability.** The system can effectively and efficiently be adapted for different or evolving hardware, software or other operational or usage environments.	✓				
2. **Installability.** Effectiveness and efficiency with which a product or system can be successfully installed and/or uninstalled in a specified environment.		✓			

Any further comments regarding the software: _____

Summary:	Average
A. FunctionalitySuitability	_____
B. Performance Efficiency	_____
C. Compatibility	_____
D. Usability	_____
E. Reliability	_____
F. Security	_____
G. Maintainability	_____
H. Portability	_____

Certified True & Corrected by:

11/28/2023
MAXIMILLIAN R. CO
Signature over Printed Name

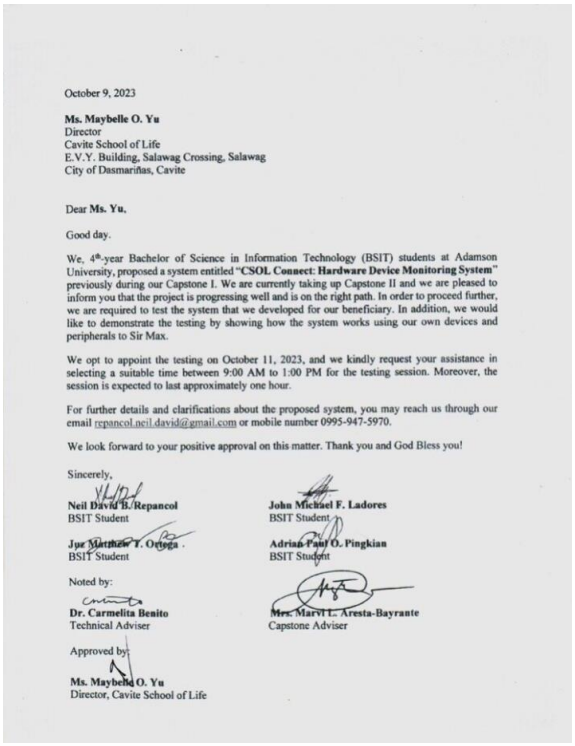
Evaluator
Total Score _____ / 8 = _____
Equivalent Meaning _____

Date: 11/28/2023

ISO 25010 – for System

Figure 59. Survey Form Final Page 2

D. APPROVAL FOR TESTING (Initial and Final)



October 9, 2023

Ms. Maybelle O. Yu
Director
Cavite School of Life
E.V.Y. Building, Salawag Crossing, Salawag
City of Dasmariñas, Cavite

Dear **Ms. Yu,**

Good day.

We, 4th-year Bachelor of Science in Information Technology (BSIT) students at Adamson University, proposed a system entitled "**CSOL Connect: Hardware Device Monitoring System**" previously during our Capstone I. We are currently taking up Capstone II and we are pleased to inform you that the project is progressing well and is on the right path. In order to proceed further, we are required to test the system that we developed for our beneficiary. In addition, we would like to demonstrate the testing by showing how the system works using our own devices and peripherals to Sir Max.

We opt to appoint the testing on October 11, 2023, and we kindly request your assistance in selecting a suitable time between 9:00 AM to 1:00 PM for the testing session. Moreover, the session is expected to last approximately one hour.

For further details and clarifications about the proposed system, you may reach us through our email repancol.neil.david@gmail.com or mobile number 0995-947-5970.

We look forward to your positive approval on this matter. Thank you and God Bless you!

Sincerely,

Neil David B. Repancol
BSIT Student

John Michael F. Ladores
BSIT Student

Juz Matthew T. Ortega
BSIT Student

Adrian Paul O. Pingkian
BSIT Student

Noted by:

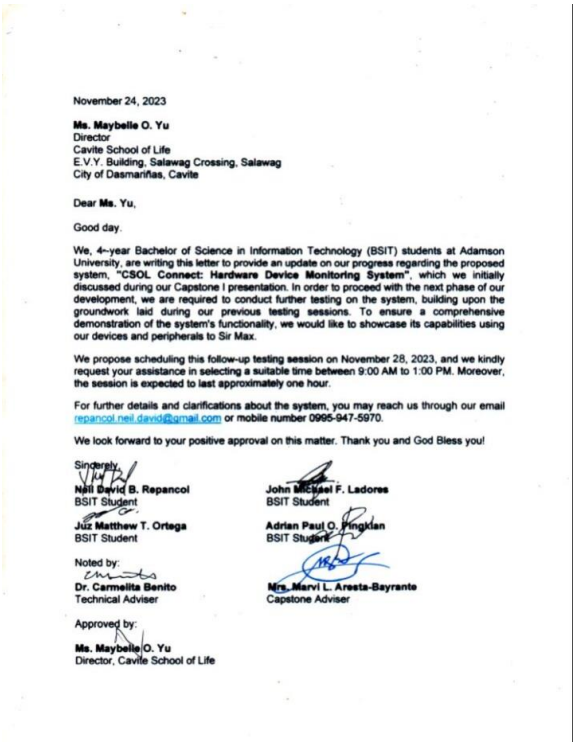
Dr. Carmelita Benito
Technical Adviser

Mrs. Marvi L. Aresta-Bayrante
Capstone Adviser

Approved by:

Ms. Maybelle O. Yu
Director, Cavite School of Life

Figure 60. Letter of Approval (Initial)



November 24, 2023

Ms. Maybelle O. Yu
Director
Cavite School of Life
E.V.Y. Building, Salawag Crossing, Salawag
City of Dasmariñas, Cavite

Dear **Ms. Yu,**

Good day.

We, 4th-year Bachelor of Science in Information Technology (BSIT) students at Adamson University, are writing this letter to provide an update on our progress regarding the proposed system, "**CSOL Connect: Hardware Device Monitoring System**", which we initially discussed during our Capstone I presentation. In order to proceed with the next phase of our development, we are required to conduct further testing on the system, building upon the groundwork laid during our previous testing sessions. To ensure a comprehensive demonstration of the system's functionality, we would like to showcase its capabilities using our devices and peripherals to Sir Max.

We propose scheduling this follow-up testing session on November 28, 2023, and we kindly request your assistance in selecting a suitable time between 9:00 AM to 1:00 PM. Moreover, the session is expected to last approximately one hour.

For further details and clarifications about the system, you may reach us through our email repancol.neil.david@gmail.com or mobile number 0995-947-5970.

We look forward to your positive approval on this matter. Thank you and God Bless you!

Sincerely,

Neil David B. Repancol
BSIT Student

John Michael F. Ladores
BSIT Student

Juz Matthew T. Ortega
BSIT Student

Adrian Paul O. Pingkian
BSIT Student

Noted by:

Dr. Carmelita Benito
Technical Adviser

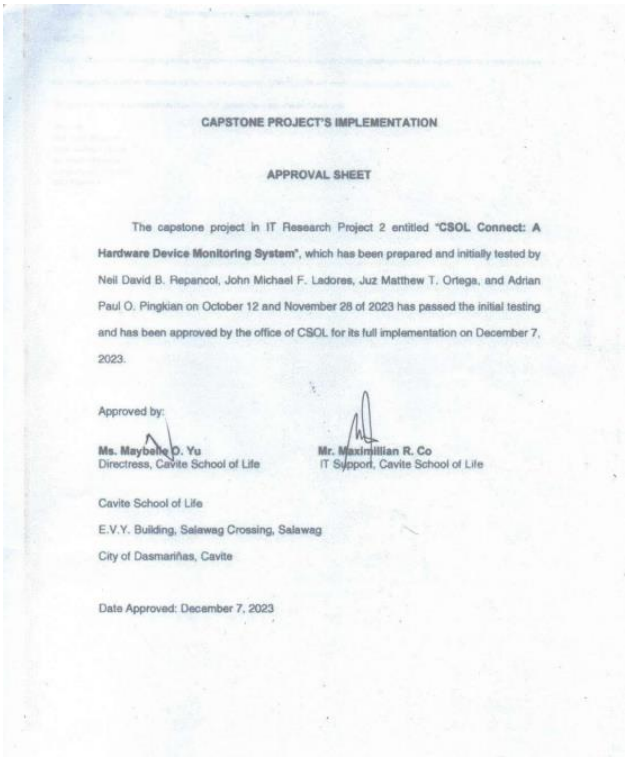
Mrs. Marvi L. Aresta-Bayrante
Capstone Adviser

Approved by:

Ms. Maybelle O. Yu
Director, Cavite School of Life

Figure 61. Letter of Approval (Final)

E. CERTIFICATE OF IMPLEMENTATION



CAPSTONE PROJECT'S IMPLEMENTATION

APPROVAL SHEET

The capstone project in IT Research Project 2 entitled "**CSOL Connect: A Hardware Device Monitoring System**", which has been prepared and initially tested by Neil David B. Repancol, John Michael F. Ladores, Juz Matthew T. Ortega, and Adrian Paul O. Pingkian on October 12 and November 28 of 2023 has passed the initial testing and has been approved by the office of CSOL for its full implementation on December 7, 2023.

Approved by:

Ms. Maybelle O. Yu
Directress, Cavite School of Life

Mr. Maximillian R. Co
IT Support, Cavite School of Life

Cavite School of Life
E.V.Y. Building, Salawag Crossing, Salawag
City of Dasmariñas, Cavite

Date Approved: December 7, 2023

F. USER'S MANUAL

Introduction

Purpose
The purpose of this user manual is to teach users how to operate CSOL Connect.

Overview
CSOL Connect is a Hardware Device Monitoring System for Computer Laboratories. This product is used to monitor computer labs by detecting the keyboard, mouse, and LAN connections of the computers.

Intended Audiences
This product is intended for the IT technician/s of CSOL Dasmariñas Campus.

Getting Started

Installation/Setup
1. Install the Client App on the computers in the computer labs to be monitored.
2. Install the Server App on the Server/Admin computer.

Note: The user should know the IP Address of the server computer as it would be needed in the client app to establish a connection with the server app, hence the next steps

3. In the Server/Admin computer, go to CMD.
4. Type the command ipconfig and take note of the IP Address.

5. Input the Server/Admin computer's IP address in the Client app installed on the computers in the lab.

First-time Use
1. For the Server app, the user will be prompted to set up root account.
2. Fill in the required fields correctly.
3. Click Submit.

Using the Product

Log in
1. Enter User ID and Password correctly
2. Press Login
3. Press Clear to reset the fields

CAPTCHA
1. Type the characters in the screen correctly to proceed.
2. If there's a difficulty in reading it, press the retry icon at the bottom right area of the CAPTCHA text.
3. Press Submit.

Forgot Password
1. In the Login, input your User ID correctly.
2. A "Forgot Password" text will appear at the bottom part of the page.
3. Click Forgot Password.
4. Answer all the Security questions correctly.
5. Click Submit.
6. If the user cannot answer their security questions, click "Request Reset" at the bottom left of the page to directly inform the superadmin.

Dashboard
1. The History Log shows all the activity in the monitored labs.
2. The latest activity is at the top of the table.
3. New logs will produce a sound to notify the technician in charge.
4. Users may use the search feature and filter feature to shorten the list and be specific.
5. Click the import to CSV icon to save it in Excel.
6. Ongoing laboratory classes are also viewable in this page

Request Reset Notification
1. In the Dashboard, look at the bell icon in the uppermost right corner of the page.
2. There will be an indicator on how many "request password reset" has been made.
3. Click the bell icon to see the requests.'
4. The user may approve the request by clicking the reset button.
5. The user may delete the request by clicking the delete button.
6. Default Password is "CSOL-connect2023!".

Mapping
1. User may add computer by clicking the computer button with plus icon at the top of the panel
2. Enter the required fields to proceed.
3. The computers can be arranged according to their actual position in the physical laboratory for organization purposes, through drag and dropping the computer icons.
4. User may switch to the different laboratories by clicking the desired laboratory at the bottom of the panel.
5. The computer icons have light indicators to show connection status, green for connected; red for disconnected; and grey if there is no set up yet.
6. User may take a closer look at each computer by clicking their icon.
7. User may also delete the computer by clicking the delete icon.

Scheduler
1. The table shows the schedules made for the computer laboratories.
2. Users may edit schedules by clicking the edit button.
3. Users may also delete schedules by clicking the delete button.
4. Users may use the search feature to be specific with what they are looking for.
5. Users may add new schedule by clicking "+New" button at the top right part of the page.
6. Add new schedule by inputting all the required field
7. Click submit to proceed.
8. Click cancel to discontinue.

Instructors
1. In the Scheduler, users may add or delete instructors by clicking the instructors button.
2. Input the name of the instructor and click the add button.
3. To delete instructor, choose their name in the dropdown and click delete.

Classes
1. In the Scheduler, users may add or delete classes by clicking the classes button.
2. Input the grade and section of the class and click the add button.
3. To delete class, choose their class in the dropdown and click delete.

Accounts
1. The table shows the accounts made in the system.
2. Users may edit accounts by clicking the edit button.
3. Users may also delete accounts by clicking the delete button.
4. Users may use the search feature to be specific with what they are looking for.
5. Users may add new accounts by clicking "+Add Users" button at the top right part of the page.

Logout
1. To close the app, click the logout button at the bottom of the side panel of the page.