IoT-based New Normal Face-to-Face Class Health and Safety Monitoring System via Image Processing

A Design Project
Presented to the
Computer Engineering Faculty
College of Computing Studies
Don Honorio Ventura State University
Bacolor, Pampanga

In Partial Fulfilment
of the Requirement for the Degree
Bachelor of Science in Computer Engineering

By:
Ronel T. De Jesus
Rommel S. Alberio
Aaron Jhey C. Hermoso
Arcris Millen C. Tipun

JUNE 2022

APPROVAL SHEET

This thesis entitled "**IoT-based New Normal Face-to-Face Class Health and Safety Monitoring System via Image Processing**", prepared and submitted by **Ronel T. De Jesus, Rommel S. Alberio, Aaron Jhey C. Hermoso, Arcris Millen C. Tipun** in partial fulfillment of the requirements for the **Degree Bachelor of Science in Computer Engineering**, has been examined and found in order and hereby recommended for acceptance and approval for the **ORAL EXAMINATION**.

ENGR. JUVY N. CRUZ
Adviser

THESIS COMMITTEE

JOEL D. CANLAS, MIT, MBA
Chair

JULIETA M. UMALI, MSIT, MAIE
Co-Chair

ASIL KASTLE S. DELA CRUZ, PCpE, MIT
Member

MARIA IVY M. GUESE, MIT
Member

EDEN D. GARCIA, MIT
Member

PANEL OF EXAMINERS

Approved by the committee on Oral Examination with a remark of **PASSED** on July 06, 2022

ENGR. RANIE B. CANLAS
Chair

ENGR. GROSBY A. DELA CRUZ
Member

ENGR. ARVEE L. DOMINGO
Member

ENGR. RUBY ROSA N. PUNO
Member

Accepted and approved in partial fulfillment of the requirements for the Degree of Bachelor of Science in Computer Engineering.

JOEL D. CANLAS, MIT, MBA
College Dean

Republic of the Philippines
DON HONORIO VENTURA TECHNOLOGICAL STATE UNIVERSITY
COLLEGE OF COMPUTING STUDIES
COMPUTER ENGINEERING DEPARTMENT
Bacolor, Pampanga

July 7, 2022

GRAMMARIAN'S CERTIFICATE

This is to certify that the undersigned has reviewed and went through all the pages of the design project entitled "**IoT-based New Normal Face-to-Face Class Health and Safety Monitoring System via Image Processing**" as against the set of structural rules that govern the composition of *sentences*, *phrases*, and *words* in the English language.

Signed:

Claudia Jumelle E. Quinto, RPM
Grammarian

ACKNOWLEDGEMENT

We, Ronel T. De Jesus, Rommel S. Alberio, Aaron Jhey C. Hermoso, and Arcris Millen C. Tipun, a Bachelor of Science in Computer Engineering section 4A at Don Honorio Ventura State University, would like to acknowledge and give the warmest appreciation to our adviser, Engr. Juny N. Cruz, for his guidance and advices that made possible for us to accomplished and completed this study.

We would also want to express our gratitude to Engr. Asil Kastl S. Dela Cruz, our CpE Practice and Design Professor, for her patience and for helping us out with this journey. We are also grateful for her considerations.

In addition, we are also thankful to our college professors who educated and taught us the things that we needed to developed and improved this study. Besides, without this knowledge and skills, we won't be qualified in doing this challenging study and maybe won't able to finish it.

On top of that, we are also very thankful and grateful to our family, friends and other people who helped, cheered and supported us physically, financially, and emotionally that made us strong and determined to finished the research.

Most significantly, to the Almighty, for His everlasting love and grace, for giving us the inner spiritual strength to stay focused on the path of righteousness. Lastly, we are thankful for Him, for giving us the wisdom and intelligence to accomplished everything in this study.

TABLE OF CONTENTS

Title Page	.....	i
Approval Sheet	.....	ii
Grammarian's Certificate	.....	iii
Acknowledgement	.....	iv
Table of Contents	.....	v
List of Figures	.....	vi
List of Tables	.....	viii
List of Appendices	.....	ix
Abstract	.....	1
Introduction	.....	2
Methods	.....	9
Result & Discussion	.....	33
Conclusion	.....	52
Recommendation	.....	52
References	.....	53
Appendices	.....	55

LIST OF FIGURES

Figure 1: Conceptual Framework 8
Figure 2: Iterative Waterfall Method 9
Figure 3: Block Diagram 12
Figure 4: Schematic Diagram 14
Figure 5: Automatic Hand Sanitizer 18
Figure 6: Automatic Temperature Sensor..... 19
Figure 7: RFID Student Attendance 20
Figure 8: Website Registration 21
Figure 9: Website Login 22
Figure 10: Website Add New Student..... 23
Figure 11: Website Show Attendance..... 24
Figure 12: Website Show Notification 25
Figure 13: Automatic Social Distancing Monitoring 26
Figure 14: Design Project Architecture..... 33
Figure 15: Sanitizing 34
Figure 16: Attendance 34
Figure 17: Temperature 34
Figure 18: Miniature's Model 35
Figure 19: Sanitizing 35
Figure 20: Sanitizing Storage Status 35
Figure 21: Checking Temperature 36
Figure 22: Temperature Notification 36
Figure 23: Student Attendance 36
Figure 24: Student Attendance 37
Figure 25: Student Counter 38
Figure 26: Automatic Sanitizing 39
Figure 27: Sanitizing Storage Status 40
Figure 28: Automatic Temperature Checker..... 41

Figure 29: Web Notification of Automatic Temperature Checker …….. 42
Figure 30: RFID Attendance System ……... 43
Figure 31: Social Distancing Detector System …….. 44
Figure 32: System Functionality Average Percentage of Respondents……..… 45
Figure 33: System Usability Average Percentage of Respondents ……. 46
Figure 34: System Portability Average Percentage of Respondents ……. 47
Figure 35: System Efficiency Average Percentage of Respondents…..…….. 48

LIST OF TABLES

Table 1 Face to Face Interview on UOSHO…….. 10
Table 2 Interview to a Student …….. 10
Table 3 System Requirements …….. 11
Table 4 System Specification …….. 12
Table 5 Website Application …….. 16
Table 6 ISO 9126 Characteristic and Sub-characteristics…….. 28
Table 7 System Evaluation Form …….. 29
Table 8 System Evaluation for Expert…….. 31
Table 9 Respondents Status and Weight…….. 31
Table 10 Rating Scale and Descriptive Rating…….. 32
Table 11 Weighted Mean and Descriptive Rating…….. 32
Table 12 Student Counter Test …….. 38
Table 13 Automatic Sanitizing Test …….. 39
Table 14 Sanitizing Storage Status Test…….. 40
Table 15 Automatic Temperature Checker Test…….. 41
Table 16 Web Notification of Automatic Temperature Checker Test…….. 42
Table 17 RFID Attendance System Test…….. 43
Table 18 Social Distancing Detector Test…….. 44
Table 19 System Functionality Total Percentage of Respondents…….. 45
Table 20 System Usability Total Percentage of Respondents…….. 46
Table 21 System Portability Total Percentage of Respondents…….. 47
Table 22 System Efficiency Total Percentage of Respondents…… 48
Table 23 System Evaluation Result …….. 49
Table 24 System Evaluation Result for Expert…….. 51

LIST OF APPENDICES

Appendix A: Gantt Chart …….. 55
Appendix B: Preliminary Survey Questionnaire and Result…….. 57
Appendix C: Evaluation Questionnaire and Results…….. 59
Appendix D: Defenition and Terms …….. 65
Appendix E: List of Components …….. 67

ABSTRACT

The COVID-19 pandemic is first and foremost a health crisis. Implementing new normal limited face-to-face class has guidelines that strictly need to be followed. Research has shown that the lack of technological advancements for the monitoring and managing of new normal face-to-face class needs to be addressed and filled based on the current circumstances like social distancing and constant disinfection. This study aims to prevent the spread of the virus to students who are attending limited face-to-face class. To provide innovative solution on the problem, Applied Research Design was used with the type of Research and Developmental. A face-to-face interview was conducted with two separate questionnaires intended for UOSHO official (Vice President) and students who experienced limited face-to-face class. Analysis of the responses demonstrated that a technological advancement on conducting limited face-to-face class will benefit the students and the school. The results indicate that there is a great need for technological advancement in monitoring and managing limited face-to-face classes to avoid possible problems like determining the student count, lack of sanitizing stations, lack of temperature checkers, technology-based attendance system, and the monitoring of social distancing on the students in a room. It is recommended that there be an increase in the accuracy of the temperature checker, have a spare part for the hardware, and use a better microprocessor in order to decrease the delay time of image processing. Further research is needed to identify other factors that could strengthen the effectiveness of the system.

Keywords: *technological advancement, new normal limited face-to-face class, COVID-19*

INTRODUCTION

The COVID-19 pandemic is first and foremost a health crisis. Many countries have rightly decided to close schools, colleges, and universities. The crisis crystallizes the dilemma policymakers are facing between closing schools----reducing contact and saving lives (Burgess, Sievertsen, 2020). To respond to the needs of learners, especially of the 3.5 million tertiary-level students enrolled in approximately 2,400 HEIs, certain HEIs in the country have implemented proactive policies for the continuance of education despite their closure (Joaquin, Biana, Dacela, 2020). In line with the new normal, the Department of Education established the Basic Education – Learning Continuity Plan (BE-LCP) as a response to protect the health and safety of the students, educators, and personnel from the ongoing pandemic. This aims to provide quality distance learning with the use of self-learning modules in digital form, radio, television, and the internet. (CHP, 2021).

Online classes, which are courses held on the internet, are one form of flexible learning that is widely used in the Philippines. Because of the pandemic, mobile learning is the way to go to continue learning. The student can either attend online class or opt for a modular style. Online learning may be in the form of synchronous which include real-time lectures and time-based outcomes assessments, or asynchronous which involves delayed-time activities, like pre-recorded video lectures and time-independent assessments (Oztok, 2013).

After 2 years, the government's pandemic task force approved on Tuesday, November 16, the phased rollout of face-to-face classes for colleges and universities. The Commission on Higher Education (CHED) has allowed schools in conducting limited in-person classes for all degree programs. Examples of conditions included in allowing academic institutions are limited indoor venue capacity, no opposition from the respective local government unit, and the exclusive participation of fully vaccinated students, teachers, and non-teaching personnel.

The government's pandemic task force has allowed face-to-face classes in all college degree programs at 50% capacity in areas under Alert Level 2, according to CHED Chairperson Prospero de Vera. In September, CHED confirmed the expansion of limited in-person activities for the second batch which included engineering and technology programs, hospitality/hotel and restaurant management, tourism/ travel management, marine engineering, and marine transportation.

Regional and local governments worldwide are working tirelessly to implement effective ways of addressing the COVID-19 crisis. During this time, the government ensured that they will provide full usage of technological means to confront the pandemic and discourse a wide range of COVID-19-related problems. Further, it highlights how government and health organizations have introduced new policies intending to curb the spread of the coronavirus. These new policies, such as lockdowns and social distancing measures, have resulted in technological advancement and new means of interaction with government, businesses, and citizens. Such changes include increased online shopping, as well as robotic delivery systems, the introduction of digital as well as contactless

payment systems, remote working, the role of technology in distance learning, Telehealth, 3D Printing, and online entertainment (Renu, 2021).

Most patients infected with COVID-19 will have a fever. Therefore, the monitoring of body temperature has become one of the most important bases for pandemic prevention and testing. Among them, the measurement of body temperature through the Forehead Thermometer is utilized, but the measurement speed is relatively slow. The cost of fact-checking body temperature measurement equipment, such as infrared body temperature detection and face recognition temperature machine, is too high, and it is difficult to build Disease Surveillance System (DSS). ITMS is used to detect body temperature (Lin, Hsieh, J. Chen, T. Chen, Lee, W. Chen, 2021). To solve the above-mentioned problems, the Intelligent pandemic prevention Temperature Measurement System (ITMS) and Pandemic Prevention situation Analysis System (PPAS) are proposed in this study.

In current circumstances, social distancing and constant disinfection of public places became a necessity. Nowadays, it is essential to sanitize hands and touching the same bottle surface already used by someone may increase the risk of contamination. Thus, a suitable assessment of the efficiency of the antiseptics disinfectants is a crucial matter. This study aims to design and develop a smart contactless hand sanitizer-dispensing system using IoT-based robotics technology (Mohammed, Daood, Bahrain, AlZubaidi, Al-Sanjary, A.K., 2020).

Research on monitoring social distancing has been conducted by Dongfang Yang, Ekim Yurtsever, Vishnu Renganathan, Keith A. Redmill, and Umit Orguner. This work presents A Vision-Based Social Distancing and Critical Density Detection System for COVID-19 that proposed an active surveillance system to slow the spread of COVID-19 by warning individuals in a region of interest. They introduce a vision-based real-time system that can detect SD violations and send non-intrusive audio-visual cues, they define a novel critical social density value and show the chance of SD violation. (Yang, Yurtsever, Renganathan, Redmill, Orguner, 2021).

The existing conventional attendance system requires students to manually sign the attendance sheet every time they attend a class. As common as it seems, such a system lacks automation, where several problems may arise. This includes the time unnecessarily consumed by the students to find and sign their names on the attendance sheet, some students may mistakenly or purposely sign another student's name and the attendance sheet may get lost. Having a system that can automatically capture students' attendance by flashing their student card at the RFID reader can save all the mentioned challenges. Looking at a bigger picture, deploying the system throughout the academic faculty will benefit the academic management as students' attendance in classes is one of the key factors in improving the quality of teaching and monitoring their students' performance (Kassim, Mazlan, Zaini, Salleh, 2012).

In this proposed system, the four health parameters implemented are the LM35 temperature sensor, heartbeat sensor, accelerometer sensor, and eye blink sensor. Using these four parameters simultaneously, the patient’s condition has been monitored. Hence ruling out the use of the thermometer and other devices to check the condition of the patient. Consequently, there is no need for a lot of clinical staff or accompanying persons

to be physically present to check the condition of the patient because there is a GSM module to send an SMS message to the mobile phone of the person in charge (nurse/doctor) in case there are any abnormalities in health parameters (Fati, Muneer, Mungur, Badawi, 2018).

Another research about monitoring social distancing has been conducted by Adina Rahim, Ayesha Maqbool, Tauseef Rana wherein they made a project to provide an effective social distance monitoring solution in low light environments in a pandemic situation and to take effective measures to monitor the safety distance criteria to avoid more positive cases and to control the death toll. The proposed framework utilizes the You Only Look Once v4 (YOLO v4) model for real-time object detection and the social distance measuring approach is introduced with a single motionless time of flight (ToF) camera.

In accordance with the pertinent provisions of Republic Act (RA) No. 7722, otherwise known as the Higher Education Act of 1994B, CHED and the Department of Health (DOH) released a Joint Memorandum Circular (JMC) No. 2021-001 on the guidelines for the gradual reopening of campuses of Higher Education Institutions (HEIs) for limited face-to-face classes during the COVID-19 Pandemic together with the Inter-agency Task Force (IATF) for the Management of Emerging Infectious.

Diseases Guidelines on the Nationwide Implementation of Alert Levels System for COVID-19 Response is allowing the conduct of limited face-to-face classes for higher education in areas under Alert Level System 1, 2 and 3. On the other hand, IATF Resolution No. 148-G is approving the phased implementation of limited face-to-face classes for all programs under the Alert Levels System for COVID-19 Response of CHED. CHED and DOH hereby adopt and promulgate the following guidelines on the implementation of limited face-to-face classes for all programs HEIs in areas under alert levels system for COVID-19 Response.

The General Guidelines consist of Limited Face-to-Face Classes is Not Mandatory, Implementation of Flexible Learning, DOH Minimum Public Health Standards, . Minimum Physical Distance in HEIs: 1.5 meters, Physical Education (PE) Classes, Off-Campus Activities, Co-curricular and Extracurricular Activities, and Medical Insurance.

With those gathered information, it shows that the problem will be the lack of technological advancements set by the Don Honorio Ventura State University for the monitoring and managing of new normal face-to-face class with the guidelines set by the Joint Memorandum Circular No. 2021-001 issued by the Commission on Higher Education (CHED) and the Department of Health (DOH). The researchers propose to create another technological advancement for a new normal face-to-face class entitled: “IOT-based New Normal Face-to-Face Class Health and Safety Monitoring System via Image Processing” by implementing a management system to further enhance the methods of a new normal face-to-face class. This ensures that monitoring and managing new normal face-to-face classes will be easier because of the features of this system. The system consists of 7 modules which are the Web App/Data Base, Web Notification, Student Counter, Sanitizer, Attendance Recorder, Temperature Checker, and Social Distancing Checker.

The web application will save the attendance of the students by using RFID tags for the instructor to access the data of the students. The Web notification will send an alert message to the clinic staff and UOSHO staff for them to be notified that there was a

student detected with a high temperature. The student counter will be tasked to do the counting of arriving and exiting students in the room. The attendance recorder using the RFID scanner is connected to the Atmega328p. The module will send data to the web application and the information will be saved in the database of the web app. The temperature checker will be tasked to check the student's temperature to determine whether a student may be allowed to enter the room or not. Lastly, the social distancing checker will be tasked with monitoring the social distancing of the students inside the room. By the use of a camera that captures real-time footage of the room, it will be processed on the RPI and it will check whether it detects a violation.

The system limitations are--- real-time monitoring on social distancing has a delay of 5-10 seconds in displaying to the monitor, power supply of the system has no UPS or back up power in case of power interruption.

For the conceptual framework, the knowledge requirements of the system are Programming, Linux-Deviant, Circuits, and Electronics. The requirements of the design project are Raspberry pi 4, Ultra Sonic Sensor, LCD i2c, Temperature Sensor, RFID-reader, Water Pump, Piezo Buzzer, Led, Micro Controller Unit, AC Power Supply, Camera, Relay Module, and. The software requirements of the system are Python, Arduino Uno IDE, MYSQL, HTML, CSS, and PHP. By processing the requirements of the system through planning, Hardware Development, Software Development, Testing, and Evaluation. The design project entitled, "IOT-based New Normal Face to Face Class Health and Safety Monitoring System via Image Processing" will be fully functional.

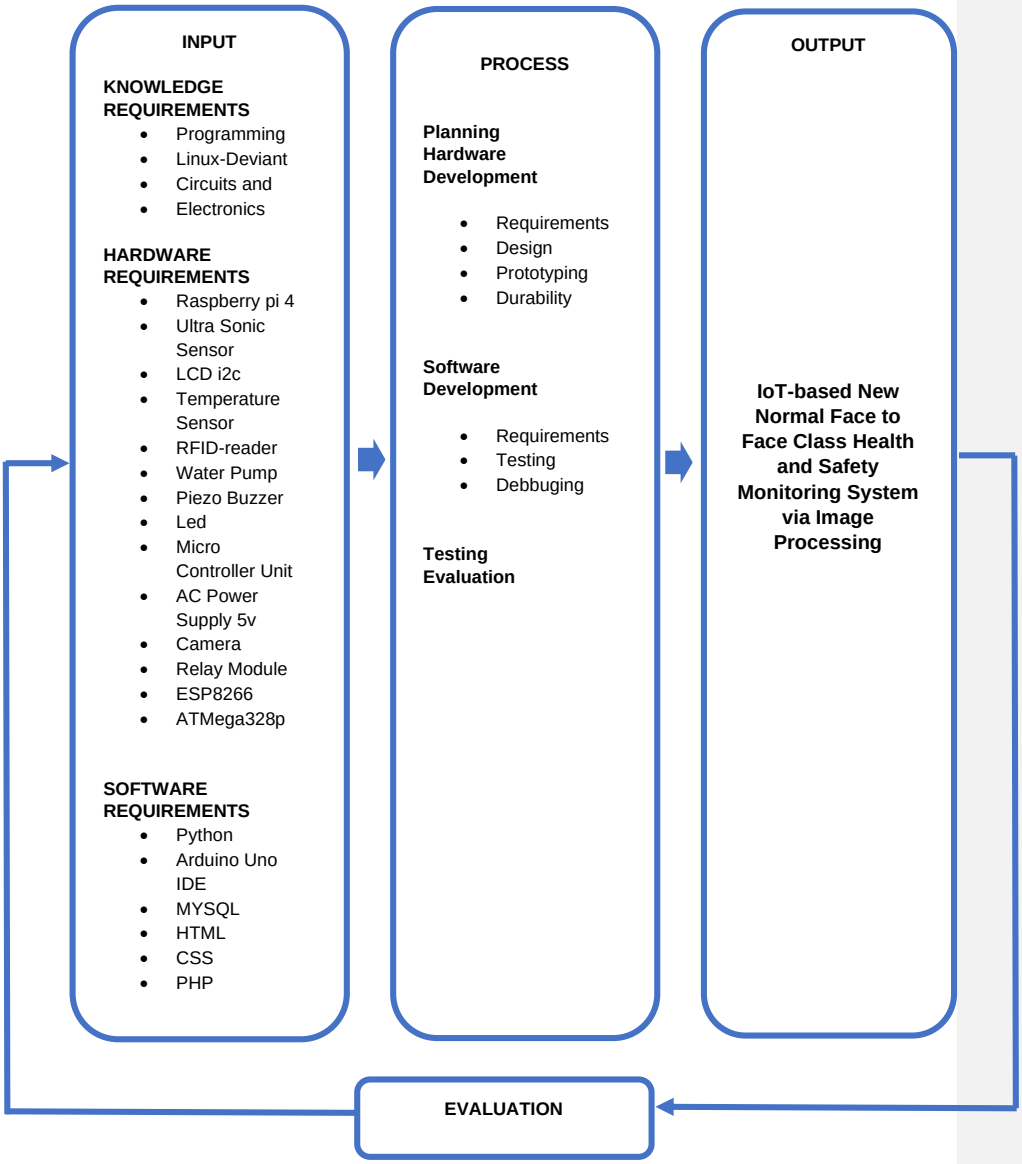

Figure 1: Conceptual Framework

METHODS

The research design that the researchers will use is Applied Research and Descriptive Research. According to Benedictine University, applied research is a type of research design that seeks to solve a specific problem or provide innovative solutions to issues affecting an individual, group, or society. It is often referred as a scientific method of inquiry or contractual research because it involves the practical application of scientific methods to everyday problems. Applied research is sometimes considered to be a non-systematic inquiry because of its direct approach to seeking a solution to a problem. It is typically a follow-up research design that further investigates the findings of pure or basic research to validate these findings and apply them to create innovative solutions. According to Voxco Website, the descriptive research design is a type of research design that aims to obtain information to systematically describe a phenomenon, situation, or population. More specifically, it helps answer the what, when, where, and how questions regarding the research problem, rather than the why. The researchers used descriptive research because it aims to see the current situation in conducting new normal face-to-face classes to determine the possible problems and solutions.

The type of applied research the researchers used is Research and Development. According to Benedictine University, research and development are a type of applied research that is focused on developing new products and services based on the needs of target markets. It focuses on gathering information about marketing needs and finding ways to improve on an existing product or create new products that satisfy the identified needs.

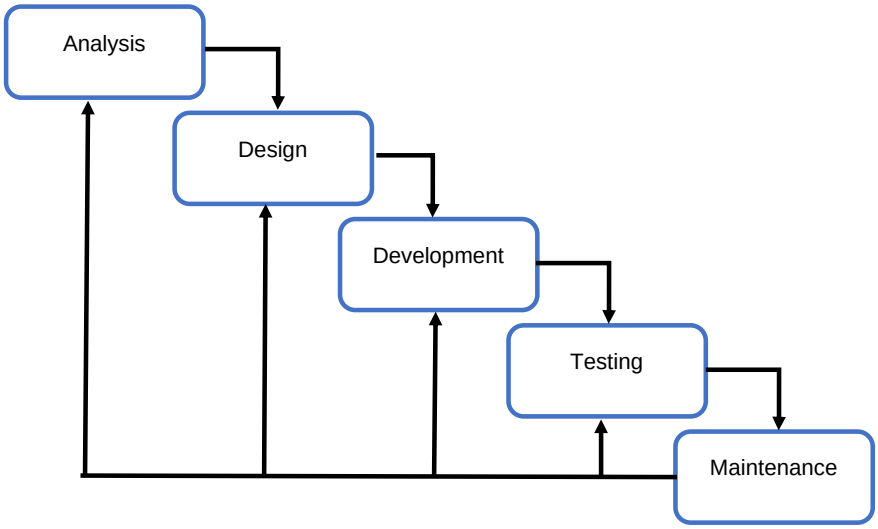

Figure 2: Iterative Waterfall Method

In developing the system, the researchers used iterative waterfall in which the development process flows through separate phases: Analysis, Design, Development, Testing, and Maintenance.

In the analysis phase, the researchers conducted a face-to-face interview at the University Occupational Safety and Health Office (UOSHO) in Don Honorio Ventura State University with Rohel S. Serrano, RCE, MAIE, the lead consultant and an executive vice president of University Occupational Safety and Health Office (UOSHO). This is to gain in-depth knowledge and relevant information regarding Safety and Health protocol which is relevant to the design project. The researchers also interviewed one of the students of Holy Angel University who has an experience in a limited face-to-face class.

Table 1

Face to Face Interview on UOSHO

1. What is the university's action plan against COVID-19?
2. What are the requirements of the student to avoid transmission of COVID-19?
3. What is the required temperature to enter the school?
4. If there is a student who has a high temperature what UOSHO will do?
5. What is the distance required in social distancing protocol?
6. Is there a possibility for Face to Face class at DHVSU?
7. When is the possible Face to Face class?
8. If Face to Face class is implemented, how many students can a room handle?

Table 2

Interview to a Student

What are your experiences and observations of attending limited face-to-face classes?

Commented [CJQ1]: You amy want to consider not putting it in a table since it is understandable that they are answers to your interview questions. Also, kindly take note of the proper APA citation for Tables. They should be placed before the table. Example:

Table 1
Face to Face Interview

With the data gathered from the interview, the researchers initially identified 7 modules: Web App/Database, Web notification, Student Counter, Sanitizer, Attendance Recorder, Temperature Checker, and Distance Checker.

The following are the System Requirements and System Specifications of the design project:

Table 3

System Requirements

Commented [CJQ2]: Please follow this format for all your table labels

System Requirements	Characteristic Properties
Operating System Used	Raspberry Pi OS (32-bit)
Programming Language(s)	C++, Python 3.7, HTML, CSS, PHP
Database Language(s)	MariaDB
Input Data/Device(s)	Webcam, RFID Scanner, Ultrasonic Sensor, Contactless Temperature Sensor, Keyboard, Mouse
Output Data/Device(s)	16x2 LCD I2C, Buzzer, LED, Monitor, Water Pump
Sensor(s)	Contactless Temperature Sensor, Ultrasonic Sensor
Single-Board Computer(s)	Raspberry Pi 4 Model B
Microcontroller Unit	ATmega328P, ESP8266
Power Source	5V Power Supply

Table 3 shows the system requirements and characteristics properties. The operating system used is Raspberry Pi OS (32-bit) and for the programming languages, the researchers used C++, Python 3.7, HTML, CSS, PHP, and the database language used is MariaDB. The input devices used are Webcam for the social distancing monitoring, RFID scanner for the attendance of the students, Ultrasonic sensor id used for counting station, automatic sanitizing station, and checking temperature station. The output devices used are: 16x2 LCD I2C for the display of student counting station and checking temperature station; LED is used for student counting station, sanitizing station and student attendance station; the monitor is used for the real-time monitoring of social distancing; the water pump is for the automatic sanitizing station; and Web Notification is used for the alert notification in temperature checking station.

Table 4

System Specification

System Specification	Characteristic Properties
Operating Voltage	5V
Operating Current	20A
Internal Memory	4GB
External Memory	32GB
Station Dimension	20cm x 20cm x 20cm
Miniature Dimension	60cm x 60cm x 40cm
Alcohol Capacity	7.5L

Table 4 shows the system specification and the characteristic properties. The Operating voltage used is 5V, the operating current is 20A, the internal memory is 4GB, the external memory is 32GB, the stations dimension is 20cm x 20cm x 20cm, and the alcohol capacity is 3.79L. In order to simulate the scenario in a new normal face-to-face class, the researchers used a miniature classroom with a dimension of 60cm x 60cm x 40cm.

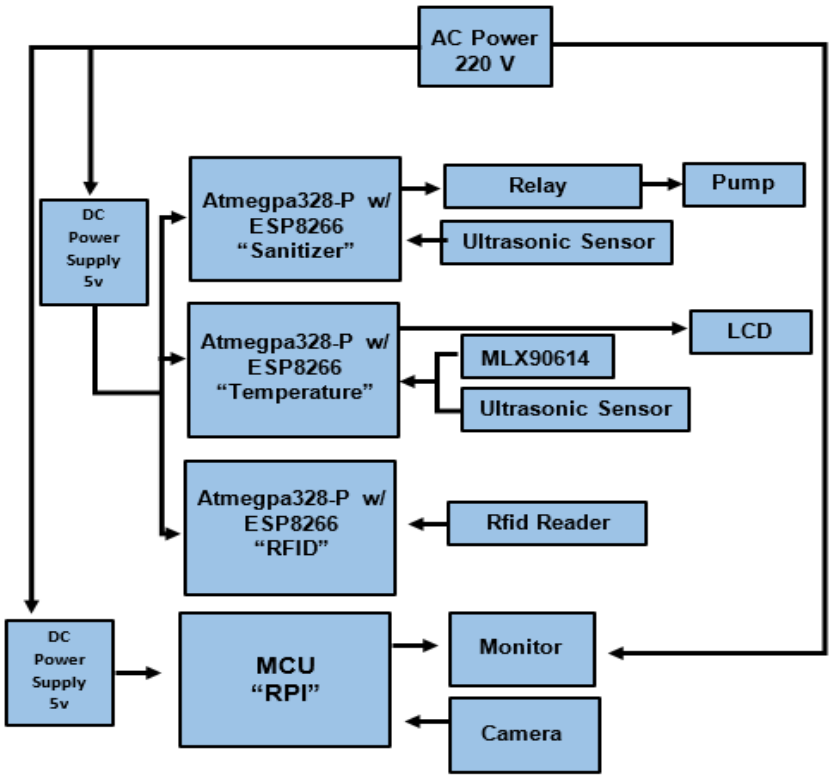

Figure 3: Block Diagram

Figure 3 shows how the power source powered the components and how the components will be connected. The monitor and two DC Power supplies are powered by AC Power to run the MCUs to start the system. In the system, there are four features and there is one feature for every station. The first station is the Automatic Sanitizer which can do automatic sanitize before the student enters inside the room to prevent and avoid spreading or adapting viruses or other diseases. The second station is a temperature sensor to check the temperature of individual students or people before entering the classroom. The third station is the RFID attendance to monitor the student's attendance by determining who enters the classroom every day. The fourth or last station is monitoring social distance and counting students by using Raspberry Pi to monitor the social distancing and count the number of students inside the classroom to follow the social distancing protocol and maximum capacity inside the room.

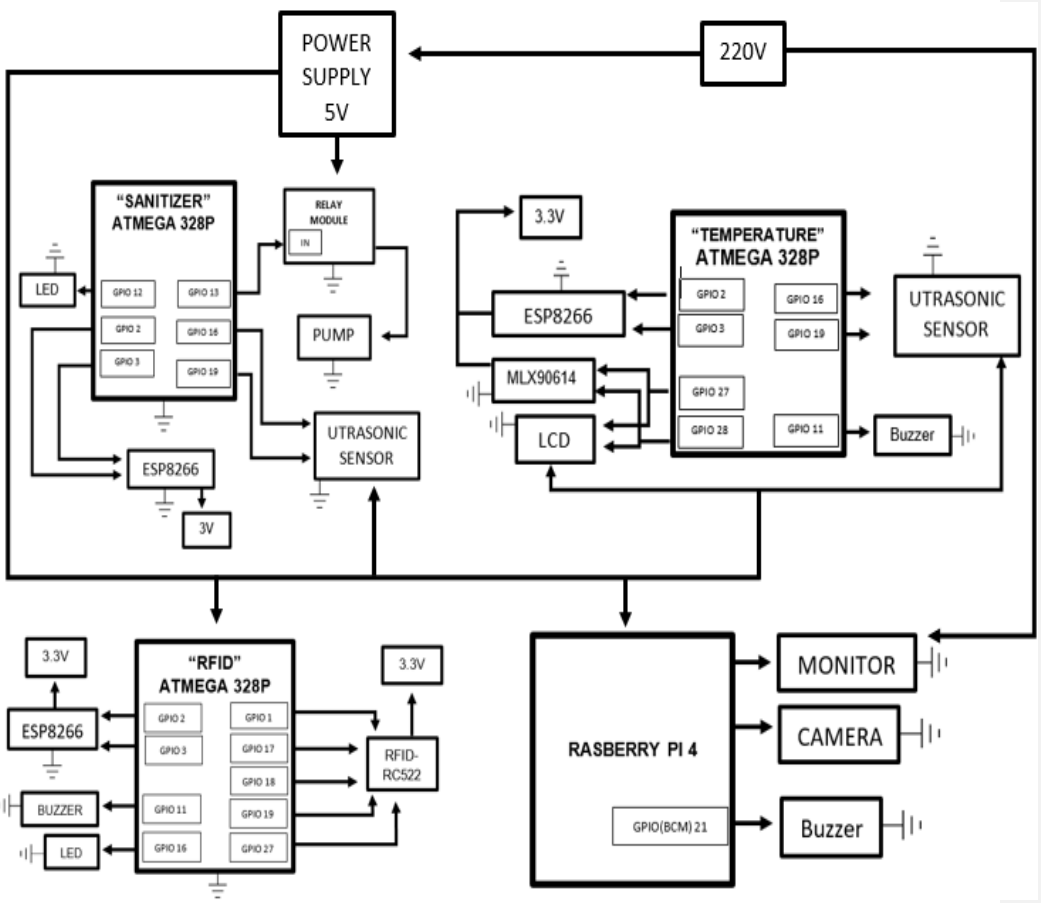

Figure 4: Schematic Diagram

Figure 4 shows how the components and MCUs have been connected. In Sanitizing, it uses General Purpose input/output (GPIO) 2, 3, 12, 13, 16, and 19 are connected to MCU atmega328p for Sanitizer. GPIO 2 and 3 are connected to ESP8266 to transmit and receive the connection for sending data to the website. GPIO 16 and 19 are connected to an Ultrasonic sensor used to send a signal and receive a signal from the ultrasonic sensor to detect the hands of a student. The GPIO 12 is connected to a LED to turn the light on when detecting the hands of the student. GPIO 13 is connected to IN of Relay to turn on the pump and to produce a sanitizer for the student.

In temperature, it uses a General Purpose Input/output (GPIO) 2, 3, 11, 16, 19, 27, and 28 are connected to MCU atmega328p for temperature. GPIO 2 and 3 are connected to ESP8266 to transmit and receive the connection for sending data to the website. GPIO 27 and 28 are connected to MLX90614 which is used to transmit and receive signals to sense the temperature of a student. GPIO 27 and 28 are connected to the LCD which is used to transmit and receive signals to the output of LCD from the temperature sensor and ultrasonic sensor. GPIO 16 and 19 are connected to ultrasonic sensors used to send a signal and receive from the ultrasonic sensor to detect the distance to show the output of temperature in LCD with GPIO 11 which will buzz once detected.

In attendance RFID, it uses General Purpose Input/output (GPIO) 1, 2, 3, 11, 16, 17, 18, 19, and 27 are connected to MCU atmega328p for attendance system. GPIO 1, 17, 18, 19, and 27 are connected to RFID Reader to run it for scanning the RFID tags or cards. GPIO 2 and 3 are connected to ESP8266 to transmit and receive the connection for sending data to the website. GPIO 11 and 16 are connected to the LED and buzzer. if RFID Reader detected a tag or card, the LED and buzzer will turn ON to show that RFID reader have scanned.

In monitoring social distancing, it uses monitor and camera that are connected to raspberry pi 4 (RPI) and GPIO(BCM) 21 connected to buzzer for notiffication.

Table 5

Website Application

Website Application	
Login Window	**Specification**
Login (Button)	Proceeding to the main window
Register (Button)	Proceeding to the register window
Username (Input)	Username input of the user
Password (Input)	Password input of the user
Register Window	**Specification**
Full name (Input)	Full name input of the user for registration
Username (Input)	Username input of the user for registration
Password (Input)	Password input of the user for registration
Confirm Password (Input)	Confirm password input of the user for registration
Register (Button)	Register the user
Login (Button)	Proceeding to the login window
Main Window	**Specification**
Logout (Button)	Proceeding to login window
Time to arrive (Label)	Shows the time of arrival
Time to leave (Label)	Shows the time of leave
Export to excel (Button)	Export the student attendance to excel
Add New Student (Button)	Proceeding to the Add new student window
Select the date Log (Date Selector)	Selecting the date that the user wants to view
View Attendance (Button)	Showing the selected attendance date
Student Attendance (Table)	Showing the attendance of the students
Notification (Button)	Proceeding to the notification window
Add New Student Window	**Specification**
Attendance Log (Button)	Proceeding to the main window
Name (Input)	Input of student's name
Number (Input)	Input of the student's student number
Gender (Radio Button)	Selecting the student's gender
Add (Button)	Adding the students' information
Update (Button)	Updating the student's information
Options (Input)	Input of student's card ID
Cross (Button)	Deleting students' information
Pin (Button)	Selecting the student's information
Students Information (Table)	Showing students information
Notification Window	**Specification**
Navigation Bar	Notification of detected students with high temperature
Sanitizer Level	Shows the status of the sanitizer storage

The camera monitor between students shows if the distance is safe for social distancing or not. If the student follows the social distancing like one meter along each other, it will show a green box around the student in the monitor and if they are not following the right distance from each other, it will display red box around the student.

There are different problems in system design and how researchers solve them. While designing the first station for the counter, the first sensor was used by researchers for counting. There are two passive infrared (PIR) sensors--- this sensor detects the motion of an object, but when researchers use it for the design for counting students it is difficult. There is sensitive detection and inaccurate detection of a student thus the researchers looked for another sensor that could be used to detect the count of the students before entering the classroom. The researchers have used an ultrasonic sensor which is more accurate and not sensitive than the one that was first used because this sensor did not detect the motion like detecting the distance of an object, etc.

The researchers have a problem with regards to how to fit the many pins needed for four stations on one Arduino UNO therefore, the researchers built four (MCU). There is one MCU for every station. In the system, they have one MCU for every station to fit the separated pins for its station. The first problem is the sketch of the printed circuit board (PCB) for designing an (MCU). The problem is that the researchers try to print in a normal printer of the sketch so it doesn't stick to the (PCB). The researchers printed in laser print so it successfully sticks on the (PCB) therefore, the researchers continued to design an (MCU). While fixing the parts of Arduino Uno on (PCB), the researchers bought the wrong part for the one they will use in the design thus the diode in the MCU is not working. In this problem, it is important to buy the right parts for designing an (MCU).

The researchers experienced using the wrong power source for other components and parts to power it. Another is when other components of their (LCD) output is showing unknown characters or words that are not understandable. The researchers will organize their power source to maintain it in a good condition for supplying their electric power by each component.

Another technical problem that the researchers had was designing in the third station---temperature sensor. On the temperature sensor, it needs a stable distance for detecting a temperature of a student to become accurate in detecting temperature because when students place their hands at different distances, they cannot detect the exact temperature. Thus, the researchers equipped it with a distance sensor for more accurate temperature detection.

Software design in the fifth station (monitoring social distancing) is difficult to use (RPI). It is hard to time, to find and download the required RPI libraries for the system. Therefore, the researchers coded first on a laptop, and when it was done, they transferred it to RPI. The researchers find the compatible libraries and after that run it. Another problem with this system is the solving of distance.

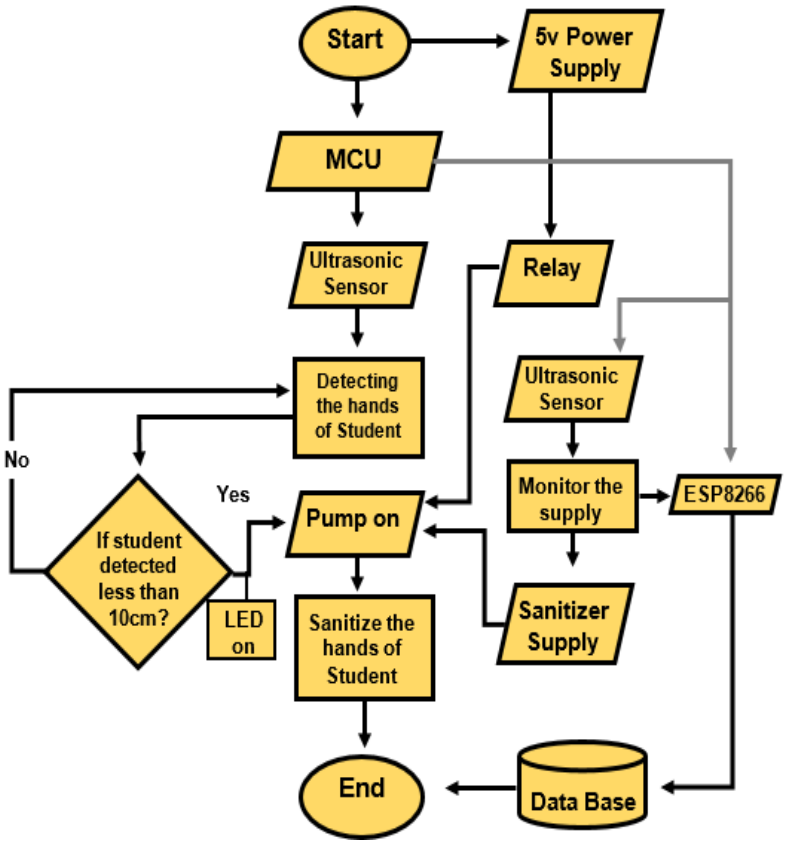

Figure 5: Automatic Hand Sanitizer

Figure 5 shows the process of sanitizing the student. It starts with a Microcontroller Unit (MCU) then it needs a 5v power supply that is connected to the relay to help the power of the pump. It has two ultrasonic sensors and one esp8266 that is connected to (MCU). One is for detecting the hands of student, it will detect the hand that is less than 10cm than the pump, it will turn on and it starts to sanitize. The second is for monitoring the supply of sanitizer to see if it still has supply and sending data to database.

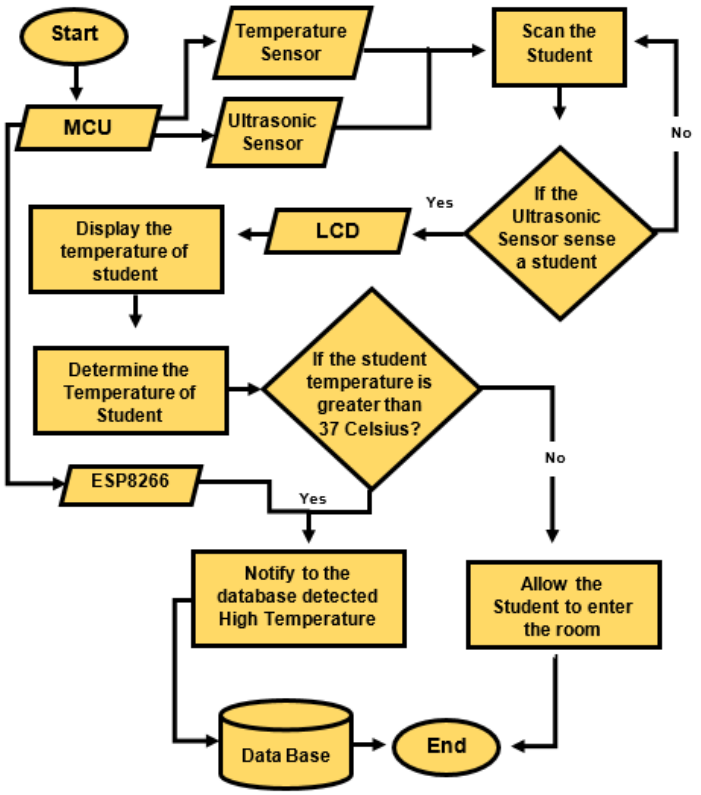

Figure 6: Automatic Temperature Sensor

Figure 6 shows the process that can automatically detect the temperature of the student. It starts with a Microcontroller Unit (MCU) connected to esp8266, Ultrasonic Sensor, Temperature Sensor and the LCD. The mlx90614 or temperature sensor detects the temperature of a student while detecting temperature, the ultrasonic sensor senses the student to display the temperature of a student on the LCD. Then, it determines if the student's temperature is greater than 37 Celsius. If the student detected has a low temperature, it is safe to enter the room. But, if the student detected has a high temperature, it notifies to the database that there is a student with high temperature.

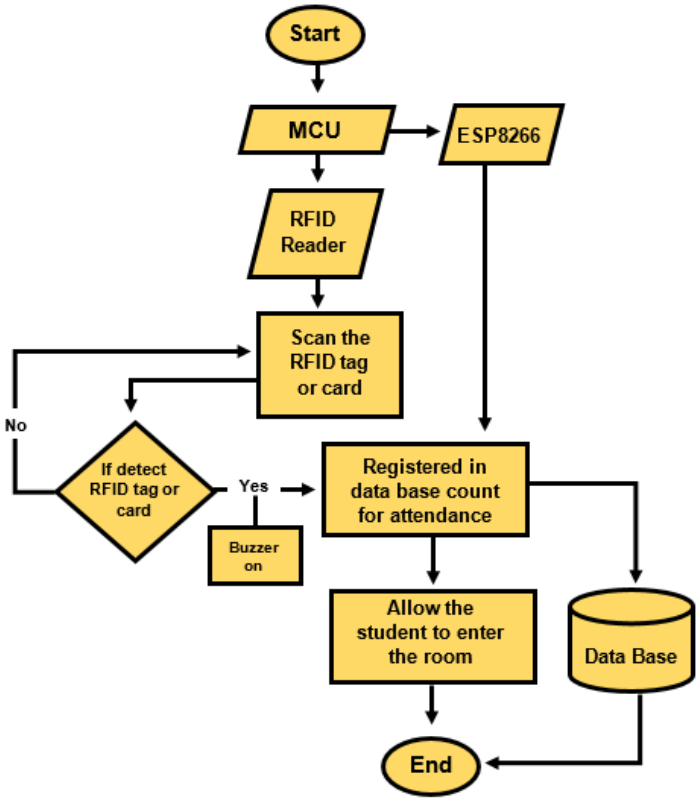

Figure 7: RFID Student Attendance

Figure 7 shows the process of attendance of the students before entering the room. The microcontroller unit (MCU) is connected to an RFID scanner and ESP8266. Students need to scan an RFID tag or card. If an RFID scanner detected an RFID tag or card, the buzzer will turn on indicating that the scanner has detected an RFID tag. Afterwards, it will process the RFID tag whether it was registered or not. When the tag is registered, it will count as the attendance of the student, and it sends the data to the database.

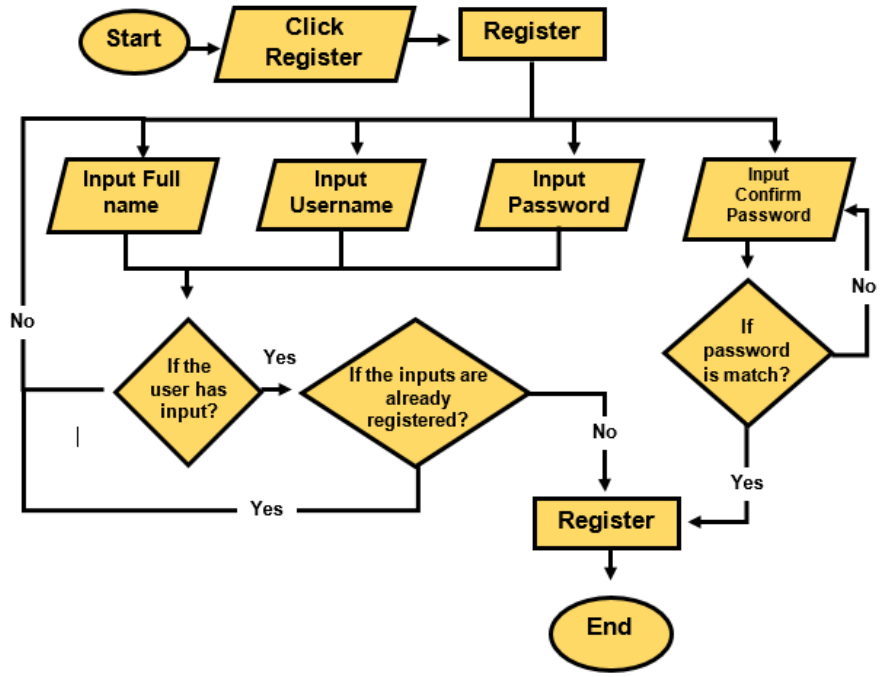

Figure 8: Website Registration

Figure 8 shows the process of how the registration works. First, one needs to click register and fill out the following---- Full Name, Username, Password, and Confirm password. If the password matches, it will register. If the password does not match, it will loop until it becomes a match. If the user has filled out the requirements, it will ask if the input is already registered, it will loop in the fill-up form. It will ask again if the input is already registered, if not, it will register first.

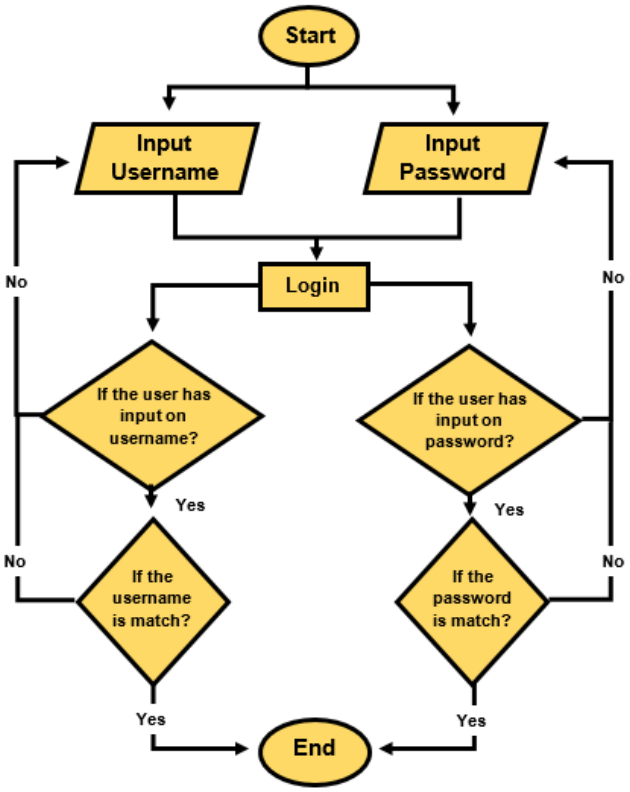

Figure 9: Website Login

Figure 9 shows the process on how to log in. It starts with Input User and Password then if the user already has one, input username and password. If not, it will loop to the input username and password. If yes, it will ask if the username and password match. If no, it will loop until it matches. If yes, the user will log in and it will end.

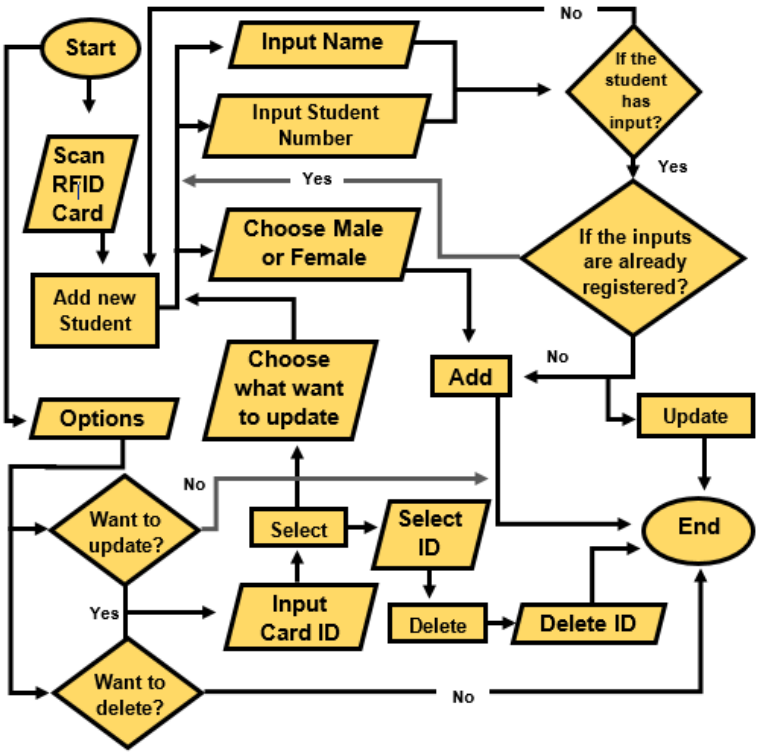

Figure 10: Website Add New Student

Figure 10 shows the process of adding a student to the attendance. It starts with scanning the RFID Card then adding a new Student, fill up the Name and Student Number. After that, if the student already has, input for name and student number. If not, they need to input details to proceed, but if yes, it asks again if the input is already registered. If yes, they need to input other details that was not previously taken then if not proceed to choose what gender, then add, and then end. After that, they have the option if they want to update or delete their data information. If they want to update the input card ID, choose select then select what they want to update in their information then click the update then end. However, if they want to delete the selected card ID, choose select then select card ID that they want to delete then click delete then end.

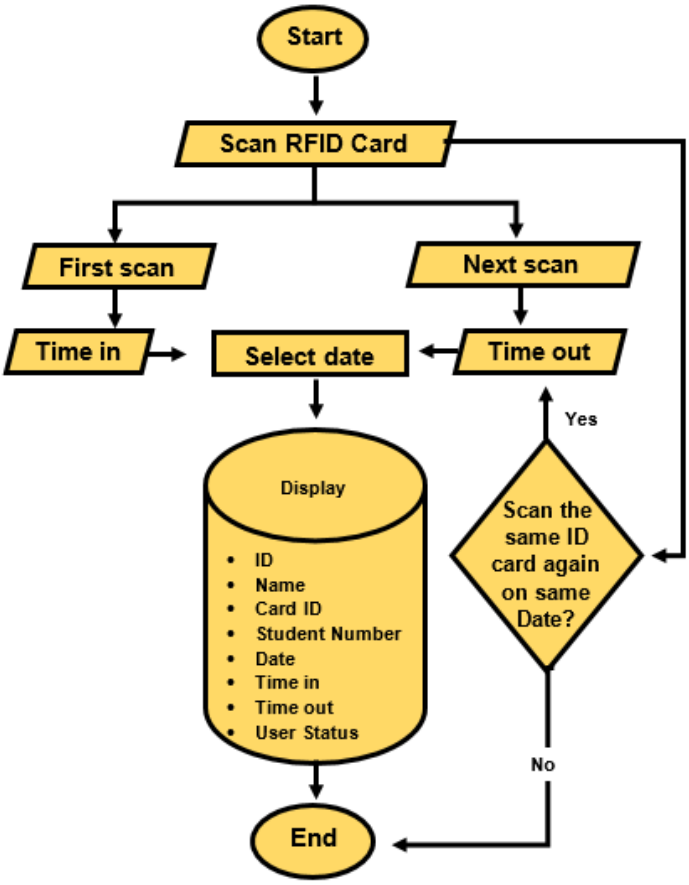

Figure 11: Website Show Attendance

Figure 11 shows the process of attendance and displays. It starts with scan RFID card. First scan will show the time, the second scan will show the time out and then if you select the date, it will display the ID, Name, Card ID, Student Number, Date, Time in, Time out, User Status. If the same RFID card is scanned again on the same date, it will only record the Time out and it will end.

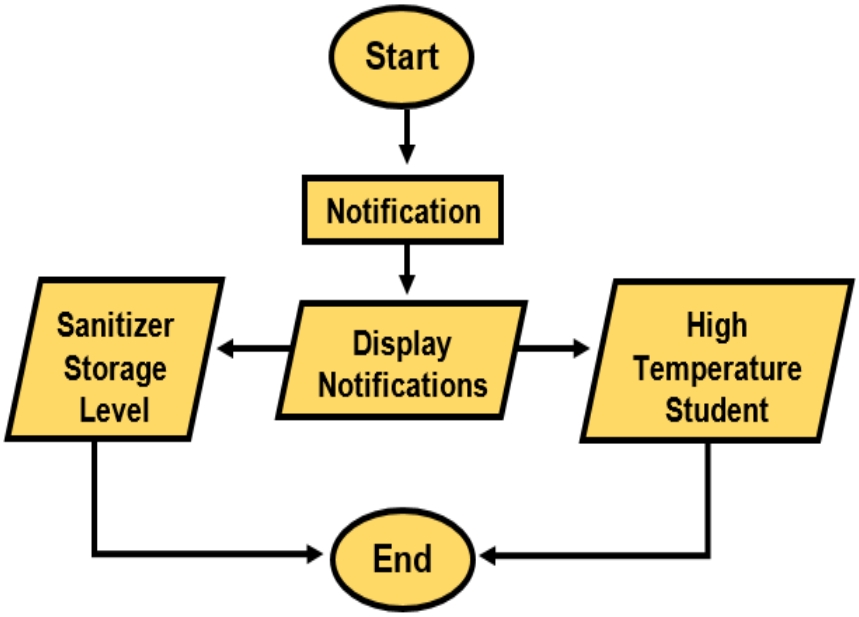

Figure 12: Website Show Notification

Figure 12 displays how to know and see the notification of sanitizer storage level and high-temperature students. It starts by clicking the notification button on the website then it will display on the website. The sanitizer storage level shows the level of alcohol. For students with high temperature, it shows the detected high temperature only.

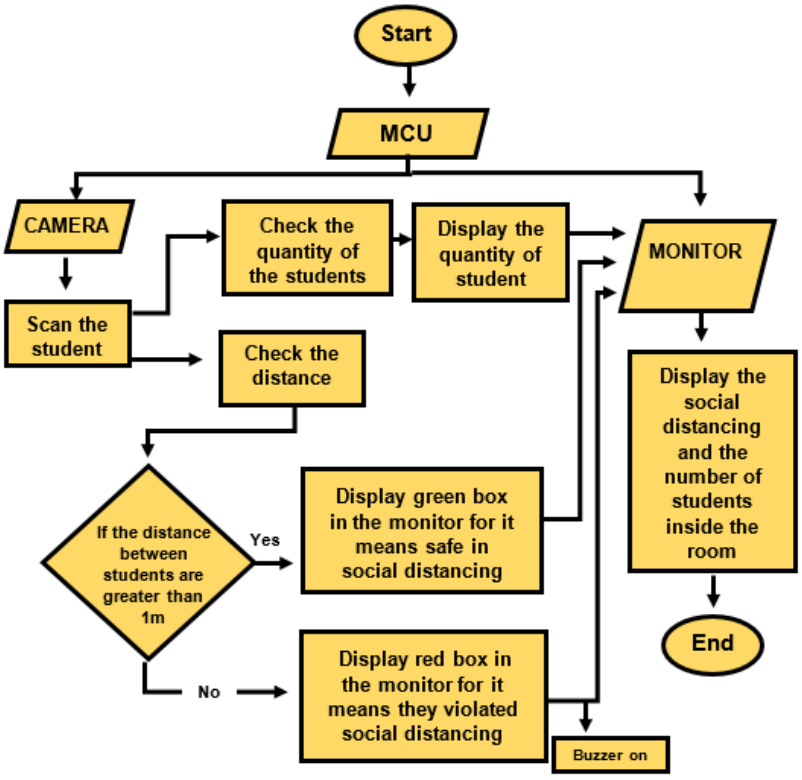

Figure 13: Automatic Social Distancing Monitoring

Figure 13, shows the process that can monitor the number of students and social distancing inside the classroom. It starts with Raspberry Pi 4 (RPI) connected to the camera and monitor. First, the Camera scan will detect the students and check the distances. If the distance between students is greater than 1meter, it will display a green box around the student on the monitor meaning they are safe in social distancing. But if it displayed the color red box around the student in the monitor, the buzzer would turn on. It means they violated the social distancing and it can monitor the number of students inside the room by scanning on camera to show on the monitor.

In the testing phase, the researchers used two types of testing: functional testing and non-functional testing.

Functional testing is a type of software testing that validates the system against the functional requirements/specifications. The purpose of functional tests is to test each function of the system by providing appropriate input, and verifying the output against the functional requirements (Guru99, 2022).

Under functional testing, the researchers performed four types of testing which are: Unit Testing to determine whether or not individual pieces of code function in the specific method that they were intended; Integration Testing to ensure that different modules of an system work well with each other; System Testing to test the entirety of the system in an environment much like production; and User Acceptance Testing to ensure that the entirety of application functions within a real-world environment.

Non-functional testing tests areas of the system that are independent of the individual features or components of the system, such as performance testing (Guru99, 2022). For the non-functional testing, system was evaluated using ISO 9126 characteristics which are Functionality, Reliability, Usability, Efficiency, Maintainability, and Portability.

In user acceptance testing, the researchers conducted an online evaluation on 30 students---5 faculty staff, 4 UOSHO staff, 5 clinic staff, and 6 experts (two computer engineering, two electrical engineering, and two electronics and communications engineering) with a total of 50 respondents. The evaluation form used in the survey consists of a video showing the system running fully functional.

Statistics was used to analyze the data gathered from respondents. The criteria used are based on the ISO 9126, by getting the weighted mean of the System Functionality, System Portability, System Usability, and System Efficiency.

where:

$\sum$ = summation

W = the weights

X = the value

$$\bar{X} = \frac{\sum(w \cdot x)}{\sum w}$$

Table 6

ISO 9126 Characteristic and Sub-characteristics

Characteristics	Sub Characteristics	Explanation
Functionality	Suitability Accurateness Interoperability Compliance Security	Can system perform the tasks required? Is the result as expected? Can the system interact with another system? Is the system compliant with standards? Does the system prevent unauthorized access?
Reliability	Maturity Fault tolerance Recoverability	Have most of the faults in the system been eliminated over time? Is the system capable of handling errors? Can the system resume working & restore lost data after failure?
Usability	Understandability Learnability Operability Attractiveness	Does the user comprehend how to use the system easily? Can the user learn to use the system easily? Can the user use the system without much effort? Does the interface look good?
Efficiency	Time Behavior Resource utilization	How quickly does the system respond? Does the system utilize resources efficiently?
Maintainability	Analyzability Changeability Stability Testability	Can faults be easily diagnosed? Can the system be easily modified? Can the system continue functioning if changes are made? Can the system be tested easily?
Portability	Adaptability Install ability Conformance Replaceability	Can the system be moved to other environments? Can the system be installed easily? Does the system comply with portability standards? Can the system be easily replaced?

Table 7

System Evaluation Form

NAME:					
STATUS (Student, Faculty, UOSHO, Clinic, Expert):					
CONTACT NUMBER:					
STATEMENTS					
SYSTEM FUNCTIONALITY	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Adding students is accurate in counter					
Subtracting students is accurate in counter					
Automatic sanitizer gives sanitizer required					
Temperature Sensor showing accurate temperature					
Web notification works only when a high temperature is detected					
RFID scans accurate ID for the attendance					
Import to Excel data is accurate to the website data					
The data of the students shows in the website accurately					
Social Distancing is measured accurately					
SYSTEM USABILITY					
Does the design of the system is good?					
Users learn to use the system easily					
Users learn to use the website easily					
Users can use the system without much effort					
The design of the website is user friendly					

SYSTEM PORTABILITY					
The system can be moved to the other places					
The system can be installed easily					
The parts can easily find and replace (skip if there is no idea)					
The system size can fit any places					
SYSTEM EFFICIENCY					
Students counter-respond quickly					
Automatic sanitizer responds quickly					
Temperature sensors respond quickly					
Web notifications respond quickly					
RFID scanner responds quickly					
Data on the website shows quickly					
Social distancing is detected quickly					
Buzzer responds quickly when it detected a social distancing violation					

Table 8

Commented [CJQ3]: No table title yet

System Evaluation for Expert

NAME:					
STATUS (Expert):					
CONTACT NUMBER:					
STATEMENTS					
Questions	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
The web app design is good?					
Components used in the system are correct?					
The design of the stations is good, and correct?					
The hardware is durable?					
Sensor's accuracy is good?					
Image processing delay is good?					

Table 9

Respondents Status and Weight

Status	**Weight**
Student	30
Faculty	5
UOSHO	4
Clinic	5
Expert	6
TOTAL	**50**

The following rating scales with corresponding values were used:

Table 10

Rating Scale and Descriptive Rating

Rating Scale	Descriptive Rating
5	Strongly Agree
4	Agree
3	Neutral
2	Disagree
1	Strongly Disagree

Table 11

Weighted Mean and Descriptive Rating

Weighted Mean	Descriptive Rating				
	Functionality	**Usability**	**Portability**	**Efficiency**	
4.21-5.00	Very Functional (VF)	Very Usable (VU)	Very Portable (VP)	Very Efficient (VE)	
3.41-4.20	Functional (F)	Usable (U)	Portable (P)	Efficient (E)	
2.61-3.40	Fair	Fair	Fair	Fair	
1.81-2.60	Less Functional (LF)	Less Usable (LU)	Less Portable (LP)	Less Efficient (LE)	
1-1.80	Not Functional (NF)	Not Usable (NU)	Not Portable (NP)	Not Efficient (NE)	

Legend:

WM = Weighted Mean

DR = Descriptive Rating

RESULTS AND DISCUSSIONS

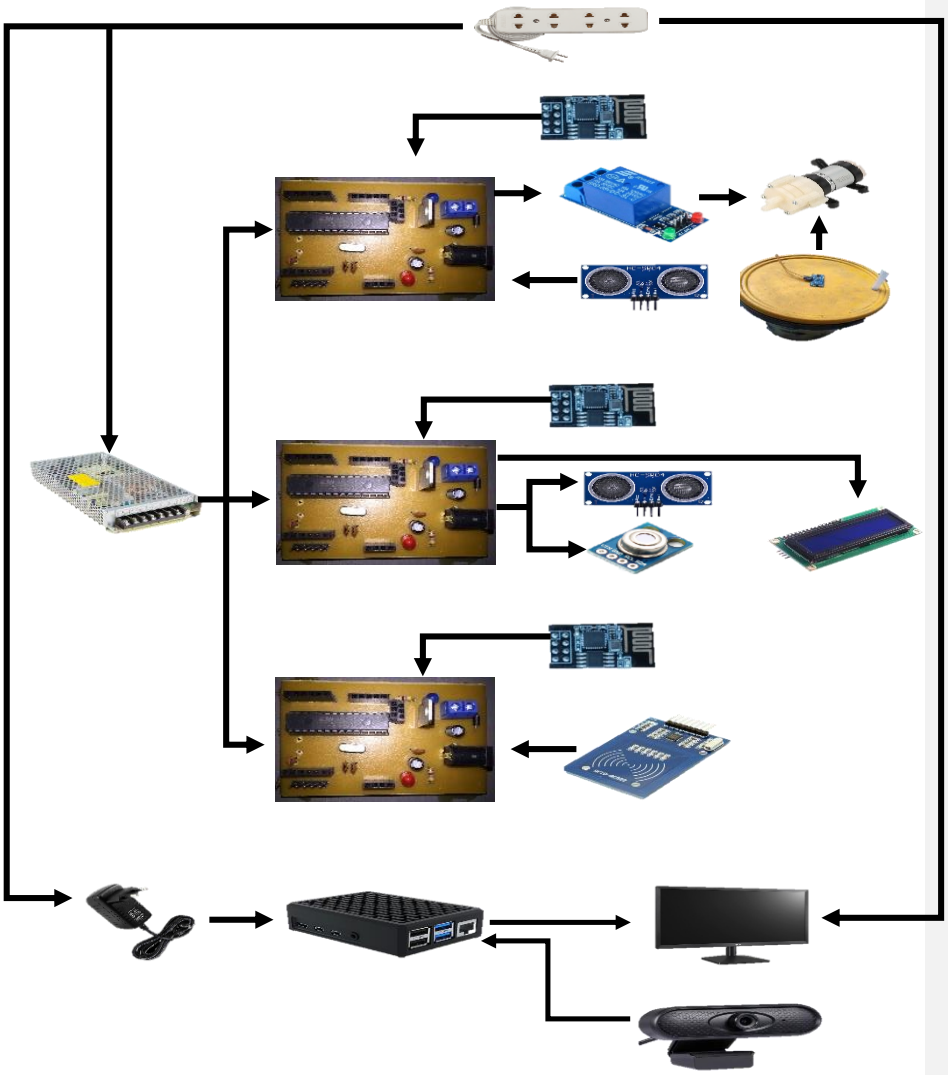

Figure 14: Design Project Architecture

Figure 14 shows how the components are connected. The monitor and two DC Power Supply is powered by AC Power to run the MCUs to start the system. In the system, the researchers have four features that have one feature with an individual MCU in every station. Once the MCU activates, all sensors are ready to detect individual features of the station to ensure that it follows the safety health protocol to avoid disease or viruses. The first station is connected to one MCU for the Automatic Sanitizer that can do automatic sanitize before the student enters the room to prevent and avoid spreading or adapting of viruses or other diseases. The second station is a temperature sensor connected to one MCU to check the temperature of individual students or people before entering the classroom. The third station is the RFID connected to one MCU for attendance to monitor the student's attendance who enter the classroom every day. The fourth and last station is the miniature of a classroom and student miniature to monitor the social distance and number of students inside the room by using Raspberry Pi with the camera and monitor This is to ensure that the social distancing protocol is followed and to limit the capacity of room. The camera used by the researchers is of a higher specification which has a resolution of 1080p/25fps. The researcher carefully chose this camera for the system in the fourth station to ensure the quality of video for use in real-time monitoring of social distancing.

Figure 15: Sanitizing

Figure 16: Attendance

Figure 17: Temperature

Figure 18: Miniature's Model

Figures 15, 16, 17, and 18 are the results of the station's model and miniatures built by the researchers. With the information collected, the researchers built one model and one miniature. The station's model with a dimension of 20cm by 20cm by 130cm are the hardwares for three stations which are the Automatic Hand Sanitizer, Automatic Temperature Sensor, and RFID Student Attendance. Inside of the design model, it would operate through the use of four microcontrollers. The miniature with the dimension of 60cm by 60cm by 40cm for the fifth station is monitoring social distance and the number of student inside the room by using Raspberry Pi, the miniature represention for a classroom that has six students miniature inside the design.

Figure 19: Sanitizing

Figure 20: Sanitizing Storage Status

Figure 19 is the first station which is the automatic sanitation. This station gives the students alcohol to sanitize their hands and to help the student avoid the spreading of the virus to every student in the room. Figure 20 shows on the website the level of sanitizer storage supply to know if is empty or not.

Figure 21: Checking Temperature

Figure 22: Temperature Notification

Figure 21 shows the second station for checking the temperature of the student. Figure 22 If it is high, low, or normal if the temperature checker determines that the student is at a high temperature it will send a notification to a website that there is a high-temperature student detected.

Figure 23: Student Attendance

Figure 23 shows the third station in the student should tap their card to record their attendance first tap the site will record in the time in, after the class the student should tap again their card to record on time out then the teacher will log in to the site for checking if all the student is done attending the class and then they can print the class record attendance after they proceeding to the fourth station.

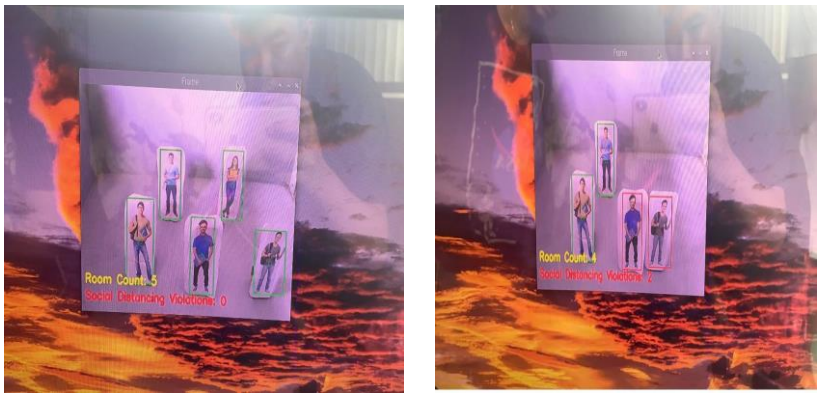

Figure 24: Social Distancing and Student Counting

Figure 24 shows the fourth station which is the checking of social distancing and number of students inside the classroom. If the student is following the social distancing protocol inside the classroom, it will display in the monitor color green box around the students. If the student violates the social distancing protocol, it will buzz. It will display in the monitor a color red box around the students, then display how many students violate the protocol and display how many students are inside the classroom.

The researchers conducted the test to gauge the response time of the student counter using the researchers. The researchers made 5 tests while continuously modifying the program to improve the response of the student counter. The result is seen in Figure 12 and are as follows:

Table 12

Student Counter Test

Test	Time
Test 1	8.23 seconds
Test 2	5.89 seconds
Test 3	4.26 seconds
Test 4	7.73 seconds
Test 5	3.28 seconds
Average	**5.89 seconds**

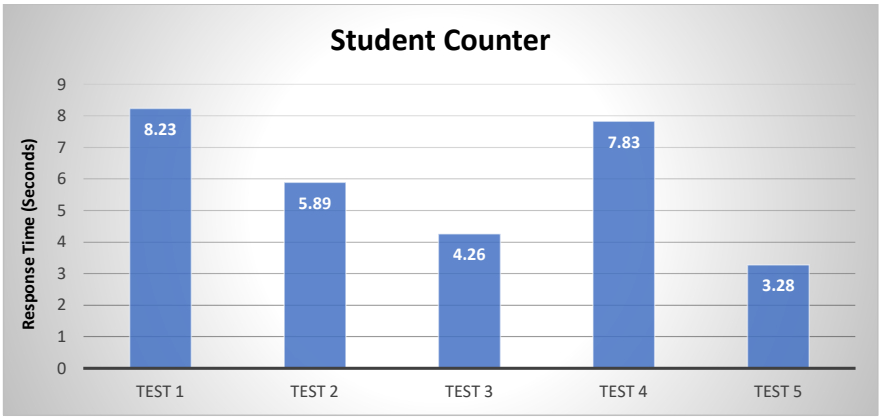

Figure 25: Student Counter

According to the gathered data results, it shows that the average response time of the student counter is 5.89 seconds. This computed average response time is within the "acceptable" range base on the ISO 9126 Characteristic and Sub-characteristics.

The automatic sanitizing also underwent five tests to identify the performance of its response time. The researcher intentionally triggered the condition of detection of automatic sanitizing and the result are the following:

Table 13

Automatic Sanitizing Test

Test	Time
Test 1	2.24 seconds
Test 2	0.54 milliseconds
Test 3	0.57 milliseconds
Test 4	0.60 milliseconds
Test 5	0.53 milliseconds
Average	**0.90 milliseconds**

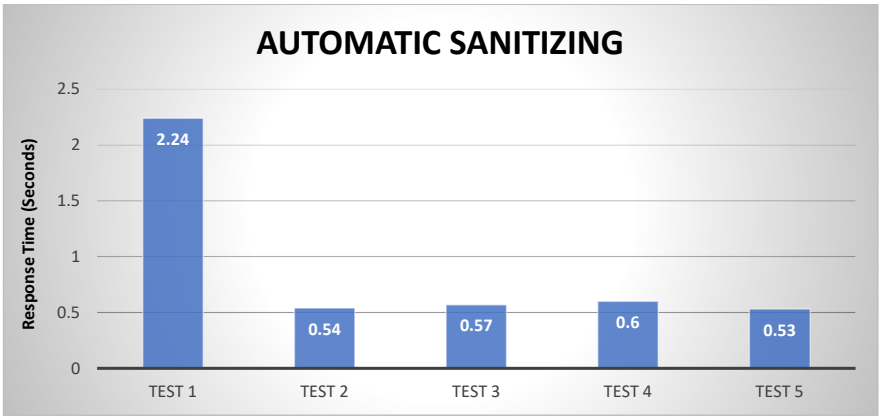

Figure 26: Automatic Sanitizing

Figure 26 shows that according to the gathered data the average response time of the automatic sanitizing, from the point the hand is detected up to the sensor the retrieval, is 0.896 seconds. Hence, the researcher concluded that this average response time is within the “Acceptable” range base on the ISO 9126 Characteristic and Sub-characteristics.

To test the response time of the Sanitizing Storage Status, the researchers conducted five tests to identify the response time of the Sanitizing Storage Status. The researcher used a Sanitizer storage and water to identify the response time of the data retrieval using the timer and the result are the following:

Table 14

Sanitizing Storage Status Test

Test	Time
Test 1	1.26 seconds
Test 2	1.84 milliseconds
Test 3	0.89 milliseconds
Test 4	3.20 milliseconds
Test 5	1.68 milliseconds
Average	**1.77 milliseconds**

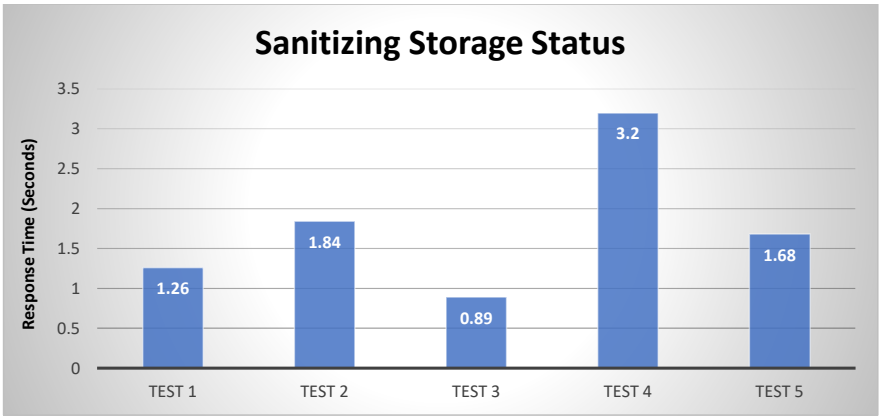

Figure 27: Sanitizing Storage Status

Figure 27 shows the result of the average response time of the Sanitizing Storage Status of the Automatic Sanitizing. From the Storage sensor up to the Sanitizing Storage Status retrieval, it is 1.77 seconds. This computed average response time is within the "Acceptable" range base on the ISO 9126 Characteristic and Sub-characteristics.

To test the accuracy of the automatic temperature checker, the researchers conducted five tests to identify the accuracy of performance. The researchers intentionally triggered the condition of the temperature checker and the results are:

Table 15

Automatic Temperature Checker Test

Test	Temperature
Test 1	34 Degree Celsius
Test 2	35 Degree Celsius
Test 3	36 Degree Celsius
Test 4	36 Degree Celsius
Test 5	35 Degree Celsius
Average	**35.2** Degree Celsius

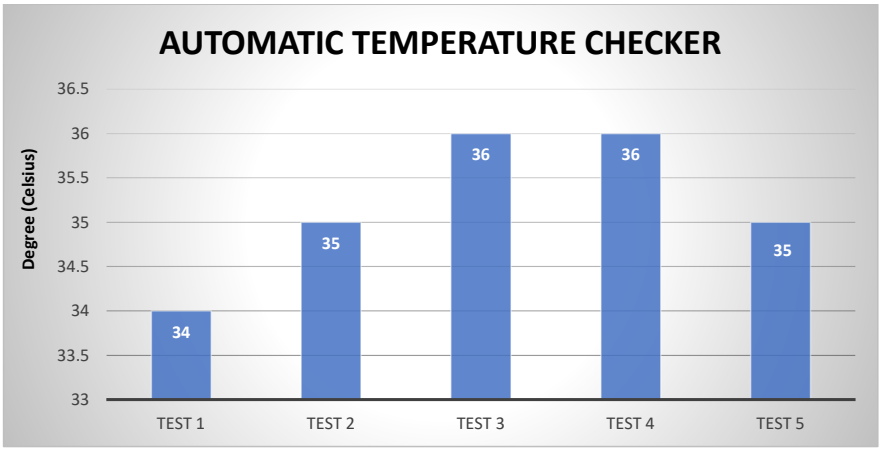

Figure 28: Automatic Temperature Checker

Figure 28 shows the result accuracy of the Automatic temperature checker with an average retrieval of 35.5 Degree Celsius. This average accuracy is “Acceptable” based on the ISO 9126 Characteristic and Sub-characteristics.

.

To test the response time of the Web Notification of the Automatic temperature checker, the researchers conducted five tests to identify the response time of the notification. The researcher used a Soldering Iron to trigger the automatic temperature checker and then notify and the result is the following:

Table 16

Web Notification of Automatic Temperature Checker Test

Test	Time
Test 1	2.20 seconds
Test 2	3.68 seconds
Test 3	1.78 second
Test 4	2.12 seconds
Test 5	1.03 seconds
Average	**2.16 seconds**

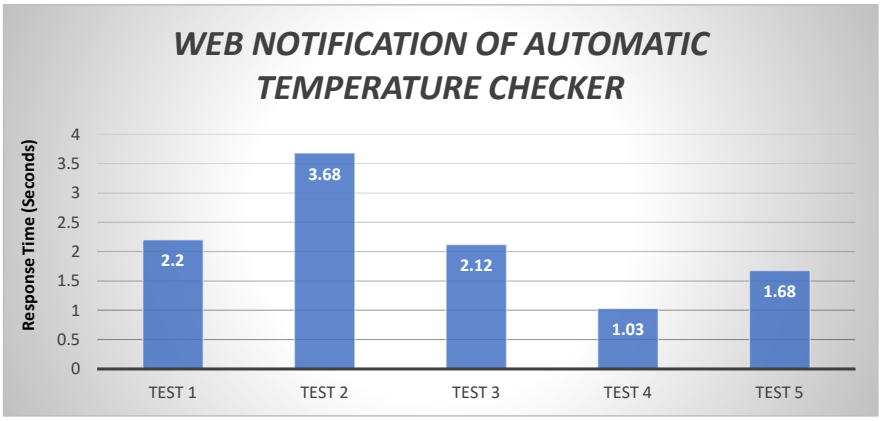

Figure 29: Web Notification of Automatic Temperature Checker

Figure 29 shows the result of the average response time of the Web Notification of the Automatic Temperature Checker. From the temperature detector up to the Web notification retrieval, it is 2.168 seconds. This computed average response time is within the “Acceptable” range based on the ISO 9126 Characteristic and Sub-characteristics.

To test the response time of the RFID Attendance System, the researchers conducted five tests to identify the response time of the RFID Attendance System. The researchers intentionally triggered the condition of the detection of the RFID to identify the response time of the data retrieval using the timer and the result are the following:

Table 17

RFID Attendance System Test

Test	Time
Test 1	2.23 seconds
Test 2	1.89 seconds
Test 3	2.03 seconds
Test 4	2.03 seconds
Test 5	2.36 seconds
Average	**2.11 seconds**

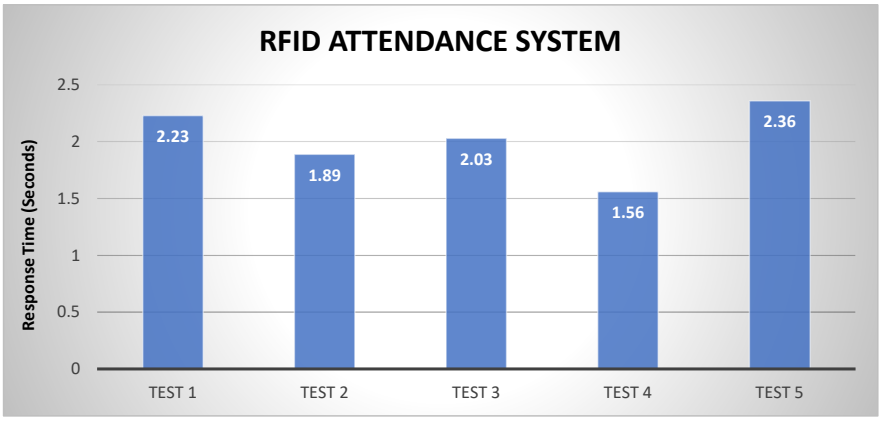

Figure 30: RFID Attendance System

Figure 30 shows the result of the average response time of the RFID Attendance System. From the FRID Card up to the in-app Attendance System retrieval, it is 2.014 seconds. The computed average response time is within the “Acceptable” range based on the ISO 9126 Characteristic and Sub-characteristics.

.

To test the response time of the Social Distancing Detector, the researcher conducted five tests to identify the response time of the Social Distancing Detector. The researcher used a miniature student to identify the response time of the data retrieval using the timer and the result are the following:

Table 18

Social Distancing Detector Test

Test	Time
Test 1	8.23 seconds
Test 2	5.89 seconds
Test 3	4.26 seconds
Test 4	7.73 seconds
Test 5	3.28 seconds
Average	**5.89 seconds**

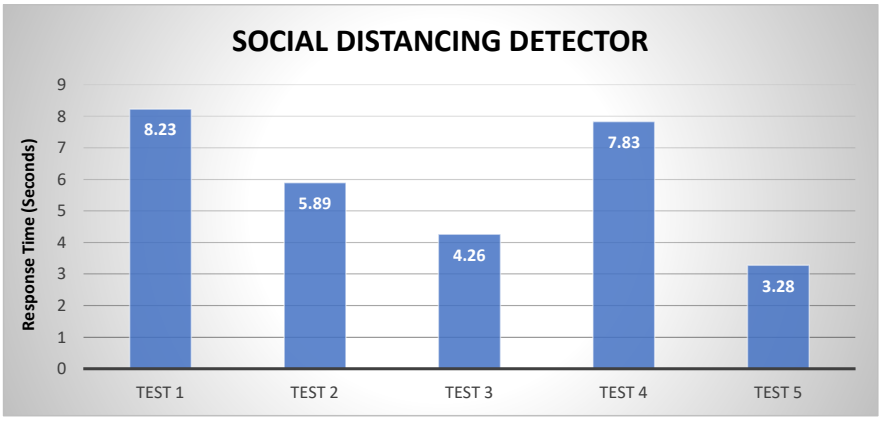

Figure 31: Social Distancing Detector System

Figure 31 shows the result of the average response time of the Social Distancing Detector. From the miniature student up to in-app notification retrieval, it is 5.898 seconds. The computed average response time is within the “Acceptable” range based on the ISO 9126 Characteristic and Sub-characteristics.

Table 19

System Functionality Total Percentage of Respondents

SYSTEM FUNCTIONALITY	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Adding students is accurate in counter	72%	20%	6%	2%	0
Subtracting students is accurate in counter	66%	24%	8%	2%	0
Automatic sanitizer gives sanitizer required	74%	18%	8%	0	0
Temperature Sensor showing accurate temperature	50%	26%	18%	6%	0
Web notification works only when a high temperature is detected	74%	16%	8%	2%	0
RFID scans accurate ID for the attendance	78%	18%	4%	0	0
Import to Excel data is accurate to the website data	72%	20%	8%	0	0
The data of the students shown in the website accurately	72%	18%	10%	0	0
Social Distancing is measured accurately	68%	24%	8%	0	0
TOTAL PERCENTAGE	72%	19%	8%	1%	0%

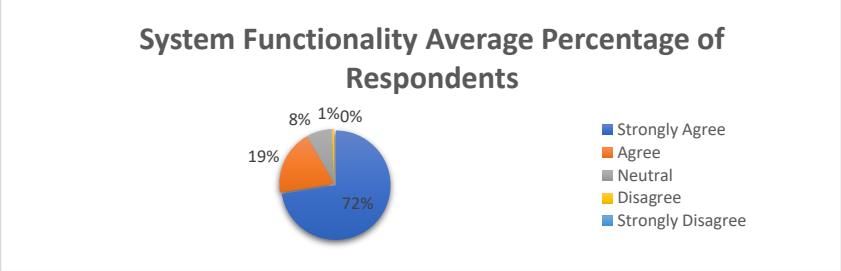

Figure 32: System Functionality Average Percentage of Respondents

Figure 32 illustrates the System Functionality Average Percentage of Respondents. Out of 50 respondents, 72% of them said that the system functionality is excellent, 19% said very good, 8% said good and 1% said it was bad. With the weighted mean of 4.64, it means that the system is very functional in terms of adding students is accurate in counter, subtracting students is accurate in counter, automatic sanitizer gives sanitizer required, temperature sensor showing accurate temperature, Web notification works only when a high temperature is detected, RFID scans accurate ID for the attendance, import to excel data is accurate to the website data, the data of the students shown in the website accurately, and social distancing is measured accurately.

Table 20

System Usability Total Percentage of Respondents

SYSTEM USABILITY	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The design of the system is good	70%	24%	6%	0	0
Users learn to use the system easily	66%	28%	6%	0	0
Users learn to use the website easily	64%	22%	14%	0	0
Users can use the system without much effort	60%	30%	8%	2%	0
The design of the website is user friendly	70%	22%	8%	0	0
TOTAL PERCENTAGE	**66%**	**25%**	**9%**	**0%**	**0%**

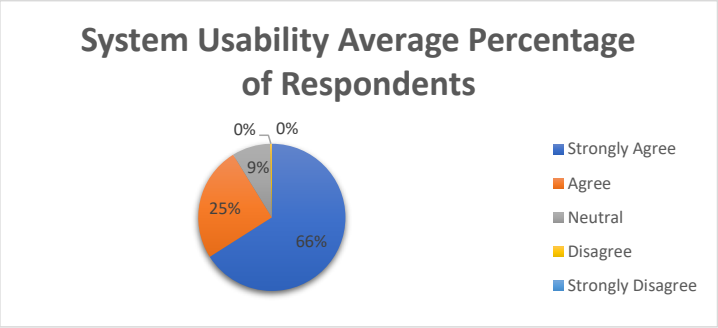

Figure 33: System Usability Average Percentage of Respondents

Figure 33 illustrates the System Usability Average Percentage of Respondents. Out of 50 respondents, 66% of them said that the system functionality is excellent, 22% said very good, and 9% said well. With the weighted mean of 4.57, it means that the system is very usable in terms of the design of the system which is good. Users learn to use the system easily, users learn to use the website easily, users can use the system without much effort, and the design of the website is user friendly.

Table 21

System Portability Total Percentage of Respondents

SYSTEM PORTABILITY	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The system can be moved to the other places	56%	32%	10%	2%	0
The system can be installed easily	48%	32%	20%	0	0
The parts can easily find and replace (skip if there is no idea)	34%	24%	8%	0	0
The system size can fit any places	48%	36%	14%	2%	0
TOTAL PERCENTAGE	**51%**	**34%**	**14%**	**1%**	**0%**

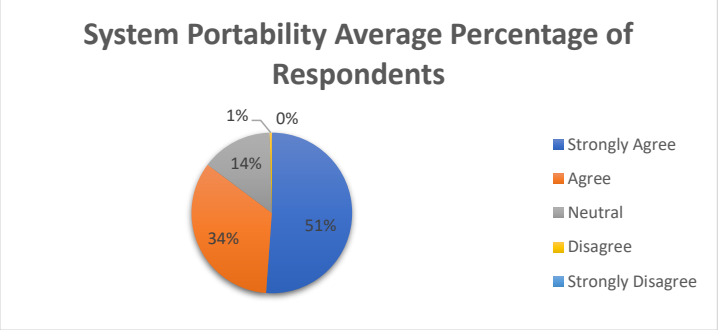

Figure 34: System Portability Average Percentage of Respondents

Figure 34 illustrates the System Portability Average Percentage of Respondents. Out of 50 respondents, 34% of them said that the system functionality is excellent, 14% said very good, and 1% said well. With the weighted mean of 3.98, it means that the system portability is portable in terms of the system being moved to other places, the system can be installed easily, the parts can easily find and replaced, and the system size can fit any places.

Table 22

System Efficiency Total Percentage of Respondents

SYSTEM EFFICIENCY	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Students counter-respond quickly	74%	20%	6%	0	0
Automatic sanitizer responds quickly	78%	14%	8%	0	0
Temperature sensors respond quickly	74%	18%	8%	0	0
Web notifications respond quickly	76%	18%	4%	2%	0
RFID scanner responds quickly	80%	16%	4%	0	0
Data on the website shows quickly	72%	16%	12%	0	0
Social distancing is detected quickly	72%	18%	10%	0	0
Buzzer responds quickly when it detected a social distancing violation	74%	22%	4%	0	0
OVERALL WEIGHTED MEAN RATING	**70%**	**17%**	**13%**	**0%**	**0%**

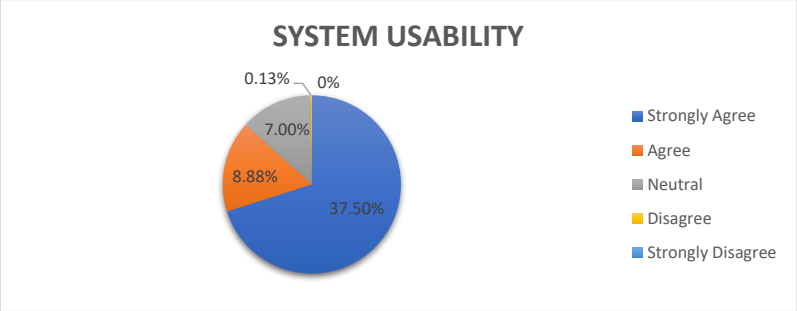

Figure 35: System Efficiency Average Percentage of Respondents

Figure 35 illustrates the System Efficiency Average Percentage of Respondents. Out of 50 respondents, 70% of them said that the system functionality is excellent, 17% said very good, and 13% said well. With the weighted mean of 4.66, it means that the system efficiency is very efficient in terms of student's counter-respond quickly, automatic sanitizer responding quickly, temperature sensors responding quickly, Web notification responding quickly, RFID scanner responding quickly, data on the website showing quickly, social distancing is detected quickly, and buzzer responds quickly when it detected a social distancing violation.

Table 23

System Evaluation Result

SYSTEM USABILITY						**MW**	**DR**
Does the design of the system is good?	35	12	3	0	0	4.64	VU
Users learn to use the system easily	33	14	3	0	0	4.6	VU
Users learn to use the website easily	32	11	7	0	0	4.5	VU
Users can use the system without much effort	30	15	4	1	0	4.48	VU
The design of the website is user friendly	35	11	4	0	0	4.62	VU
OVERALL WEIGHTED MEAN RATING						**4.57**	**VU**

SYSTEM PORTABILITY						***WM***	***DR***
The system can be moved to the other places	28	16	5	1	0	4.42	VP
The system can be installed easily?	24	16	10	0	0	4.28	VP
The parts can easily find and replace (skip if there is no idea)	17	12	4	0	0	2.9	Fair
the system size can fit any places	24	18	7	1	0	4.3	VP
OVERALL WEIGHTED MEAN RATING						**3.98**	**P**

SYSTEM EFFICIENCY						WM	DR
Students counter-respond quickly	25	13	7	5	0	4.16	E
Automatic sanitizer responds quickly	39	7	4	0	0	4.7	VE
Temperature sensors respond quickly	37	9	4	0	0	4.66	VE
Web notifications respond quickly	38	9	2	1	0	4.68	VE
RFID scanner responds quickly	40	8	2	0	0	4.76	VE
Data on the website shows quickly	36	8	6	0	0	4.6	VE
Social distancing is detected quickly	25	11	8	6	0	4.1	E
Buzzer responds quickly when it detected a social distancing violation	37	11	2	0	0	4.7	VE
OVERALL WEIGHTED MEAN RATING						**4.55**	**VE**

Table 23 shows the system evaluation result for the System Functionality, System Usability, System Portability, and System Efficiency. In system functionality, it consists of nine questions. The first question has a weighted mean of 4.62 which is equivalent to VF (Very Functional), the second question has a weighted mean of 4.54 which is equivalent to VF (Very Functional), the third question has a weighted mean of 4.66 which is equivalent to VF (Very Functional), the fourth question have a weighted mean of 4.2 which equivalent to F (Functional), the fifth question have a weighted mean of 4.62 which equivalent to VF (Very Functional), the sixth question have a weighted mean of 4.74 which equivalent to VF (Very Functional), the seventh question have a weighted mean of 4.64 which equivalent to VF (Very Functional), the eighth question have a weighted mean of 4.62 which equivalent to VF (Very Functional), the ninth question have a weighted mean of 4.6 which equivalent to VF (Very Functional). The overall weighted mean rating of the nine questions is 4.59 which is equivalent to VF (Very Functional).

System usability consists of five questions. The first question has a weighted mean of 4.64 which is equivalent to VU (Very Usable), the second question has a weighted mean of 4.6 which is equivalent to VU (Very Usable), the third question has a weighted mean of 4.5 which is equivalent to VU (Very Usable), the fourth question have a weighted mean of 4.48 which equivalent to VU (Very Usable), the fifth question have a weighted mean of 4.62 which equivalent to VU (Very Usable). The overall weighted mean rating of the five questions is 4.57 which is equivalent to VU (Very Usable).

System portability consists of four questions. The first question has a weighted mean of 4.42 which is equivalent to VP (Very Portable), the second question has a weighted mean of 4.28 which is equivalent to VP (Very Portable), the third question has a weighted mean of 2.9 which is equivalent to Fair, the fourth question has a weighted mean of 4.3 which equivalent to VP (Very Portable). The overall weighted mean rating of the four questions is 3.98 which is equivalent to P (Portable).

In system efficiency, it consists of eight questions. The first question has a weighted mean of 4.16 which is equivalent to E (Efficient), the second question has a weighted mean of 4.7 which is equivalent to VE (Very Efficient), the third question has a weighted mean of 4.66 which is equivalent to VE (Very Efficient), the fourth question have a weighted mean of 4.68 which equivalent to VE (Very Efficient), the fifth question have a weighted mean of 4.76 which equivalent to VE (Very Efficient), the sixth question have a weighted mean of 4.6 which equivalent to VE (Very Efficient), the seventh question have a weighted mean of 4.1 which equivalent to E (Efficient), the eighth question has a weighted mean of 4.7 which equivalent to VE (Very Efficient). The average weighted mean of the eight questions is 4.55 which is equivalent to VF (Very Efficient).

Table 24

System Evaluation Result for Expert

STATEMENTS						OVERALL	
Questions	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**	**WM**	**DR**
The web app design is good?	2	3	1	0	0	4.16	
Components used in the system are correct?	2	2	2	0	0	4	
The design of the stations is good, and correct?	4	2	0	0	0	4.67	
The hardware is durable?	3	1	2	0	0	4.17	
Sensor's accuracy is good?	5	1	0	0	0	4.83	
Image processing delay is good?	0	2	4	0	0	3.33	
OVERALL WEIGHTED MEAN RATING						**4.19**	**Agree**

The question for the expert consists of six questions. The first question has a weighted mean of 4.16 which is equivalent to Agree, the second question has a weighted mean of 4 which is equivalent to Agree, the third question has a weighted mean of 4.66 which is equivalent to Agree, the fourth question have a weighted mean of 4.17 which equivalent to Agree, the fifth question have a weighted mean of 4.83 which equivalent to Agree, the sixth question have a weighted mean of 3.33 which equivalent to Neutral And the overall weighted mean is 4.19 which is equivalent to Agree.

CONCLUSION AND RECOMMENDATIONS

Analysis of the testing and evaluation obtained in this study shows that the system IoT-based New Normal Face-to-Face Class Health and Safety Monitoring System via Image Processing presented here can be used in limited face-to-face classes at Don Honorio Ventura State University for limiting the risk of spreading viruses to every student. There is a great need for technological advancement in monitoring and managing limited face-to-face classes to avoid possible problems like determining the student count, lack of sanitizing station, lack of temperature checker, technology-based attendance system, and the monitoring of social distancing on the students in a room.

The researchers identified the following recommendations for this system based on the study's findings:

- Increase the accurate reading in the temperature checker station.
- Always have spare parts in case there is a problem in the system that needs the to be replaced
- To decrease the time delay of the monitoring of social distancing and student counting, use a microprocessor with better specs than the Raspberry Pi 4
- It is better to use high quality materials for better durability of the system
- Connect the student count in the image processing to the web application

REFERENCE

Commented [CJQ4]: You may want to format your references. Alphabetical order according to APA

2013, Oztok et al, “Exploring asynchronous and synchronous tool use in online courses” https://www.sciencedirect.com/science/article/abs/pii/S0360131512001935

2020, VINCE MCLEOD, CIH” COVID-19: A History of Coronavirus” coronavirus- 22021 https://www.labmanager.com/lab-health-and-safety/covid-19-a-history-of

2020, Eddy Yusufa, M. N. Mohammed, Ismail I Daood, Siti Humairah Kamarul Bahrain, S. AlZubaidi, Omar Ismael Al-Sanjary, Sairah A.K., “2019 Novel Coronavirus Disease (Covid-19): Smart Contactless Hand Sanitizer-Dispensing System Using IoT Based Robotics Technology” https://www.proquest.com/openview/2f36a0a76fbe93b820264b2f5b346195/1?p-origsite=gscholar&cbl=4380457

April 2020**,** Simon Burgess, Hans Henrik Sievertsen “Schools, skills, and learning: The impact of COVID-19 on education” https://voxeu.org/article/impact-covid-19-education

April 2021, Dongfang Yang, Ekim Yurtsever, Vishnu Renganathan, Keith A. Redmill and Umit Orguner, “A Vision-Based Social Distancing and Critical Density Detection System for COVID-19” https://www.mdpi.com/1424-8220/21/13/4608/htm

April 2021, Grace Karimi, “Introduction to YOLO Algorithm for Object Detection” https://www.section.io/engineering-education/introduction-to-yolo-algorithm-for-object- detection/

April 2021, Subhashish Das Mohapatra, Suvendu Chandan Nayak, Sasmita Parida, Chhabi Rani Panigrahi, Bibudhendu Pati, “COVTrac: Covid-19 Tracker and Social Distancing App” https://link.springer.com/chapter/10.1007/978-981-33-4299-6_50

August 19, 2021, Child Hope Philippines, “Online Classes in the PH Push Through Amid the Pandemic” https://childhope.org.ph/online-classes-in-the-philippines/

February 2021, Adina Rahim, Ayesha Maqbool, Tauseef Rana, “Monitoring social distancing under various low light conditions with deep learning and a single motionless time of flight camera” https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0247440

January 2020, JSTOR," Photoelectric sensor" https://en.wikipedia.org/wiki/Photoelectric_sensor

January 2022, Commission on Higher Education, Department of Health, "Joint Memorandum Circular No. 2021-001",https://ched.gov.ph/wp content/uploads/CHED-DOH-JMC-No.-2021-004.pdf

July 2012, Murizah Kassim, Hasbullah Mazlan, Norliza Zaini, Muhammad Khidhir Salleh, "Web-based student attendance system using RFID technology" https://ieeexplore.ieee.org/abstract/document/6287164

July 2018, Suliman Mohamed Fati, Amgad Muneer, Dheeraj Mungur, Ahmad Badawi, "Integrated Health Monitoring System using GSM and IoT" https://ieeexplore.ieee.org/abstract/document/8538366

June 2020, Adrian Rosebrock, "OpenCV Social Distancing Detector" https://www.pyimagesearch.com/2020/06/01/opencv-social-distancing-detector/

March 2021, Nishant Renu, "Technological advancement in the era of COVID-19" https://journals.sagepub.com/doi/full/10.1177/20503121211000912

May 2021, Wei-Ling Lin, Chun-Hung Hsieh, Tung-Shou Chen, Jeanne Chen, Jian-Le Lee, Wei-Chung Chen, "Apply IOT technology to practice a pandemic prevention body temperature measurement system: A case study of response measures for COVID-19" https://journals.sagepub.com/doi/full/10.1177/15501477211018126

October 2020, Jeremiah Joven B. Joaquin, Hazel T. Biana, Mark Anthony Dacela, "The Philippine Higher Education Sector in the Time of COVID-19" https://www.frontiersin.org/articles/10.3389/feduc.2020.576371/full

Appendix A

(Gantt Chart)

Group BSCpE 4A-6 Gantt Chart

"Internet of Things Based New Normal Face to Face Class Health and Safety Monitoring System via Image Processing"

Task	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10
	Mar 7-12	Mar 14-19	Mar 21-26	Mar 28-Apr 2	Apr 4-9,	Apr 11-16	Apr 18-23	Apr 25-30	May 2-7	May 9-14
Gathering Components										
Website Development										
Attendance Database										
Prototype Building										
Hardware Programming										
Building Miniature Classroom										
Project Design Testing										
Debugging										
Improving Project Design										
Data Collection										
Manuscript Development										
Documentation										

Noted by:

JUVY N. CRUZ, PCpE, MIT
Adviser

Appendix B

(Preliminary Survey Questionnaire and Result)

1. What is the university action plan against covid19?
Answer- The university action plan against covid19 present the strategy and general guidelines to contains, prevent and eliminate the threat of pandemic and mitigate its social, environmental, and security impacts on the university
2. What are the requirements of the student to avoid transmission of covid19?
Answer- The university Prevention and Control strategies student should wear a facemask and face shield, disinfect foot wear with the foot bath provider, check body temperature, Hand sanitizes, accomplish the health declaration checklist and social distancing is being observed.
3. What is the requirement temperature to enter the school?
Answer-If the student temperature is 37.5C rest in isolated holding area for 5 minutes, then recheck temperature. If the temperature is still 37.5C the student will be assessed by University Doctor. If the student temperature higher than 37.5C the student cannot enter in the university. If the student temperature lower than 37.5C the student can enter the university.
4. If there is a student that have a high temperature what UOSHO will do?
Answer- UOSHO has established an isolation room shall be installed for symptomatic individuals, and once identified as a suspect COVID-19 case shall be reported to the Rural Health Unit Bacolor, for further referral and interventions.
5.What is the distance required in social distancing protocol?
Answer- 1 meter minimum
6. There is a possible Face to Face class in DHVSU?
Answer- Yes there is possible
7. When is the possible Face to Face class?
Answer-Face to Face class will be august 2022
8. If Face to Face class is implemented, how many students a room can handle?
Answer-Can handle 50% capacity of student inside a classroom.

What are your experience and observation on attending limited face-to-face class?
Answer- Lack of sanitizing station on every room
Answer- Difficulty on determining how many students are inside the room
Answer- Social distancing is not monitored well
Answer- Lack of technological advancement on temperature checker, for example is alert notification when a student is not feeling well or detected with high temperature
Answer- Lack of technological advancement for attendance
Answer- Minimal communication and interaction to co-students because of social distancing

Appendix C

(Evaluation Questionnaire and Results)

NAME:					
STATUS (Student, Faculty, UOSHO, Clinic, Expert):					
CONTACT NUMBER:					
STATEMENTS					
SYSTEM FUNCTIONALITY	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Adding students is accurate in counter					
Subtracting students is accurate in counter					
Automatic sanitizer gives sanitizer required					
Temperature Sensor showing accurate temperature					
Web notification works only when a high temperature is detected					
RFID scans accurate ID for the attendance					
Import to Excel data is accurate to the website data					
The data of the students shows in the website accurately					
Social Distancing is measured accurately					
SYSTEM USABILITY					
Does the design of the system is good?					
Users learn to use the system easily					
Users learn to use the website easily					
Users can use the system without much effort					
The design of the website is user friendly					

SYSTEM PORTABILITY					
The system can be moved to the other places					
The system can be installed easily					
The parts can easily find and replace (skip if there is no idea)					
The system size can fit any places					
SYSTEM EFFICIENCY					
Students counter-respond quickly					
Automatic sanitizer responds quickly					
Temperature sensors respond quickly					
Web notifications respond quickly					
RFID scanner responds quickly					
Data on the website shows quickly					
Social distancing is detected quickly					
Buzzer responds quickly when it detected a social distancing violation					

NAME:					
STATUS (Expert):					
CONTACT NUMBER:					
STATEMENTS					
Questions	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
The web app design is good?					
Components used in the system are correct?					
The design of the stations is good, and correct?					
The hardware is durable?					
Sensor's accuracy is good?					
Image processing delay is good?					

STATEMENTS						OVERALL	
SYSTEM FUNCTIONALITY	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**	**WM**	**DR**
Adding students is accurate in counting	36	10	3	1	0	4.62	VF
Subtracting students is accurate in counting	33	12	4	1	0	4.54	VF
Automatic sanitizer gives sanitizer required	37	9	4	0	0	4.66	VF
Temperature Sensor showing accurate temperature	25	13	9	3	0	4.2	F
Web notification works only when a high temperature is detected	37	8	4	1	0	4.62	VF
RFID scans accurate ID for the attendance	39	9	2	0	0	4.74	VF
Import to Excel data is accurate to the website data	36	10	4	0	0	4.64	VF
The data of the students shown on the website accurately	36	9	5	0	0	4.62	VF
Social Distancing is measured accurately	34	12	4	0	0	4.6	VF
OVERALL WEIGHTED MEAN RATING						**4.59**	**VF**

SYSTEM USABILITY						MW	DR
Does the design of the system is good?	35	12	3	0	0	4.64	VU
Users learn to use the system easily	33	14	3	0	0	4.6	VU
Users learn to use the website easily	32	11	7	0	0	4.5	VU
Users can use the system without much effort	30	15	4	1	0	4.48	VU
The design of the website is user friendly	35	11	4	0	0	4.62	VU
OVERALL WEIGHTED MEAN RATING						**4.57**	**VU**

SYSTEM PORTABILITY						*WM*	*DR*
The system can be moved to the other places	28	16	5	1	0	4.42	VP
The system can be installed easily?	24	16	10	0	0	4.28	VP
The parts can easily find and replace (skip if there is no idea)	17	12	4	0	0	2.9	Fair
the system size can fit any places	24	18	7	1	0	4.3	VP
OVERALL WEIGHTED MEAN RATING						**3.98**	**P**

SYSTEM EFFICIENCY						WM	DR
Students counter-respond quickly	25	13	7	5	0	4.16	E
Automatic sanitizer responds quickly	39	7	4	0	0	4.7	VE
Temperature sensors respond quickly	37	9	4	0	0	4.66	VE

Web notifications respond quickly	38	9	2	1	0	4.68	VE
RFID scanner responds quickly	40	8	2	0	0	4.76	VE
Data on the website shows quickly	36	8	6	0	0	4.6	VE
Social distancing is detected quickly	25	11	8	6	0	4.1	E
Buzzer responds quickly when it detected a social distancing violation	37	11	2	0	0	4.7	VE
OVERALL WEIGHTED MEAN RATING						**4.55**	**VE**

STATEMENTS						**OVERALL**	
Questions	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**	**WM**	**DR**
The web app design is good?	2	3	1	0	0	4.16	
Components used in the system are correct?	2	2	2	0	0	4	
The design of the stations is good, and correct?	4	2	0	0	0	4.67	
The hardware is durable?	3	1	2	0	0	4.17	
Sensor's accuracy is good?	5	1	0	0	0	4.83	
Image processing delay is good?	0	2	4	0	0	3.33	
OVERALL WEIGHTED MEAN RATING						**4.19**	**Agree**

Appendix D

(Defenition and Terms)

IoT - The Internet of Things (IoT) describes the network of physical objects “things” that are embedded with sensors, software, and other technologies to connect and exchange data with other devices and systems over the internet.

Image Processing - the analysis and manipulation of a digitized image, especially to improve its quality.

Raspberry Pi - is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. It’s capable of doing everything you’d expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games.

GPIO - Stands for "General Purpose Input/Output." GPIO is a type of pin found on an integrated circuit that does not have a specific function. While most pins have a dedicated purpose, such as sending a signal to a certain component, the function of a GPIO pin is customizable and can be controlled by software.

MCU - A microcontroller (MCU for *microcontroller unit*) is a small computer on a single metal-oxide-semiconductor (MOS) VLSI integrated circuit (IC) chip. A microcontroller contains one or more CPUs (processor cores) along with memory and programmable input/output peripherals.

YOLO - (You Only Look Once) is a method/way to do object detection. It is the algorithm /strategy behind how the code is going to detect objects in the image.

UOSHO - University Occupational Safety and Health Office

PCB - A printed circuit board (PCB) or printed wiring board (PWB) is a laminated sandwich structure of conductive and insulating layers. PCBs have two complementary functions. The first is to affix electronic components in designated locations on the outer layers using soldering. The second is to provide reliable electrical connections (and also reliable open circuits) between the component's terminals in a controlled manner often referred to as PCB design.

Appendix E

(List of Components)

Components	Quantity
Student Counter	
Ultrasonic Sensor	2 pcs
Atmega 328PU	1 pc
28 Pin IC Socket	1 pc
Pcb Copper Clad Board Single	1 pc
Capacitor 100uF	2 pcs
Capacitor 22pF	2 pcs
Capacitor 100pF	2 pcs
Red LED 5mm	1 pc
Blue LED 5mm	4 pcs
White LED 5mm	1 pc
1N4007 Diode	1 pc
DC Female Barrel Jack Switch	1 pc
1x6p Female Pin Header Socket 2.54mm	1 pc
1x5p Female Pin Header Socket	1 pc
1x4p Female Pin Header Socket	1 pc

Components	Quantity
Automatic Hand Santizer	
Atmega 328PU	1 pc
28 Pin IC Socket	1 pc
Pcb Copper Clad Board Single	1 pc
Capacitor 100uF	2 pcs
Capacitor 22pF	2 pcs
Capacitor 100pF	2 pcs
Red LED 5mm	1 pc
Blue LED 5mm	2 pcs
1N4007 Diode	1 pc
DC Female Barrel Jack Switch	1 pc
1x6p Female Pin Header Socket 2.54mm	1 pc
1x5p Female Pin Header Socket	1 pc
1x4p Female Pin Header Socket	1 pc
1x5p Male Pin Header Socket	1 pc
2x3p Male Pin Header Socket	1 pc

1x5p Male Pin Header Socket	1 pc		Terminal Block 1x2 5.0mm	1 pc
2x3p Male Pin Header Socket	1 pc		Resistor 470 ohm	2 pcs
Terminal Block 1x2 5.0mm	1 pc		L7805CV Voltage Regulator	1 pc
Resistor 470 ohm	2 pcs		16MHz Crystal Oscillator	1 pc
L7805CV Voltage Regulator	1 pc		Ultrasonic Sensor	1 pc
16MHz Crystal Oscillator	1 pc		Electric R385 12V DC Pump	1 pc
16x2 I2C LCD	1 pc		18AWG Wires	
Mini Piezo Buzzer	1 pc		Aquarium Hose 9/12	
18AWG Wires				

Components	Quantity	Components	Quantity
Figure 6 Automatic Temperature Sensor		**RFID Student Attendance**	
Atmega 328PU	1 pc	Esp8266	3 pcs
28 Pin IC Socket	1 pc	Mini Piezo Buzzer	1 pc
Pcb Copper Clad Board Single	1 pc	White LED 5mm	1 pc
Capacitor 100uF	2 pcs	16x2 I2C LCD	1 pc
Capacitor 22pF	2 pcs	RFID Card	10 pcs
Capacitor 100pF	2 pcs	Rc522 RFID Card Reader	1 pc
Red LED 5mm	1 pc		
Blue LED 5mm	2 pcs	**Automatic Social Distancing Monitoring**	
1N4007 Diode	1 pc	Rasberry pi4	1 pc
DC Female Barrel Jack Switch	1 pc	Monitor	1 pc
1x6p Female Pin Header Socket 2.54mm	1 pc	Piezo Buzzer	1 pc
1x5p Female Pin Header Socket	1 pc	Full HD 1080P Webcam	1pc
1x4p Female Pin Header Socket	1 pc	Mouse	1pc
1x5p Male Pin Header Socket	1 pc	Cellphone Charger	1pc

2x3p Male Pin Header Socket	1 pc
Terminal Block 1x2 5.0mm	1 pc
Resistor 470 ohm	2 pcs
L7805CV Voltage Regulator	1 pc
16MHz Crystal Oscillator	1 pc
mlx90614 Temperature Sensor	1 pc
Ultrasonic Sensor	1 pc
16x2 I2C LCD	1 pc
TM Sim Card	1pc
18AWG Wires	

Other Components	
5v Power supply	1pc
DC Male Connector	7pcs
Flywood	
Wood Nails	
Glue Stick	
Paint	
Door Hinges	2pc
Gypsun screw	
Leather	
Extension	