

# Integration of Attendance Monitoring System Using RFID Technology with Web-based Facility Booking System for University Cleanroom Laboratory Application

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DOI: <https://doi.org/10.30880/eeee.2021.02.02.005>

Received 04 July 2021; Accepted 14 August 2021; Available online 30 October 2021

**Abstract:** This project introduced an integration of the attendance system and facility booking system for university cleanroom application that could vastly reduce human effort as compared to the traditional paper-based booking and attendance systems. The PHP programming languages integrated with the MySQL database were used for developing the booking system while the Radio Frequency Identification (RFID) technology was selected for the attendance system as it is cheaper in price as compared to other technologies. The web-based booking system has been successfully developed as it consisted of dual functions which were for the users and the administrator for booking and managing. This website has been integrated with the RFID technology attendance system. The attendance system was used to control and record the user, which only allows the user who was granted to enter the laboratory according to the booking request, as well as to record the entering and leaving time. This integration of the system can help the laboratory assistant to manage the laboratory efficiently and hence maintain a clean environment in the university cleanroom laboratory.

**Keywords:** Facility Booking, Attendance System, RFID, PHP, MySQL, Cleanroom Laboratory

## 1. Introduction

Information and Communication Technology (ICT) takes part in our daily life, and it is important to integrate the technologies in the educational system, for example, in the university laboratory [1]. A university laboratory is a place provided for students and lecturers for teaching and carries out scientific research and experimental works [2]. The existing booking facility and attendance methods available in the university cleanroom laboratory are manually recorded, and it is inefficient and inconvenient. The users such as the student or the staff are required to face-to-face make a booking with the administrator, and it is a waste of time if the user is unable to find the administrator for the facility

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booking. Moreover, the booking and attendance records are easy to tamper with because it is maintained on paper. Thus, in order to eliminate the problems arising from the traditional booking and attendance record methods and to promote a clean environment in the cleanroom laboratory, a Cleanroom Laboratory Attendance and Booking (CLAB) system was developed in this project.

The CLAB system is an integration of attendance monitoring system using Radio Frequency Identification (RFID) technology with a web-based facility booking system for the university cleanroom laboratory application. The smart attendance management system using IoT technology such as sensors or biometric methods had been widely used to remove the traditional way of registering the attendance and thus reduce the workload of the administrator [3]. Biometric technologies such as fingerprint, face, and iris for attendance systems have been developed by some researchers due to the high-security level of the system. However, the implementation cost is high as it required supporting equipment such as a camera or a fingerprint scanner to detect the attendance of users and some problems will arise such as the user scan with a damp hand, scratches on the fingers, and wearing glasses or contact lens during the scanning process [4] – [8]. RFID technology was used in the system due to its low cost and does not require line-of-sight communication between the reader and carrier as compared to the barcode system [9].

Besides that, there is much research dealing with using ICT in the laboratory booking management system to replace traditional booking in the laboratory. S. Yali and groups [2] produced an Opening Laboratory Reservation System (OLRS) that allowed the students to do the reservations for experiments and scientific research and allowed the administrator to manage the reservations by replying or deleting any conflict reservation. P. Spilakova et al., [1] had developed a Remote Laboratory Management System (RemLabNet) that allowed a student to reserve a facility through a calendar form booking system and delete or modify previous reservation functions. However, the application designed by those researchers only involved either the attendance or the booking function, hence, the CLAB system developed in the project tends to combine both of the functions into one system to improve the existing attendance and facility booking system available in the university cleanroom laboratory.

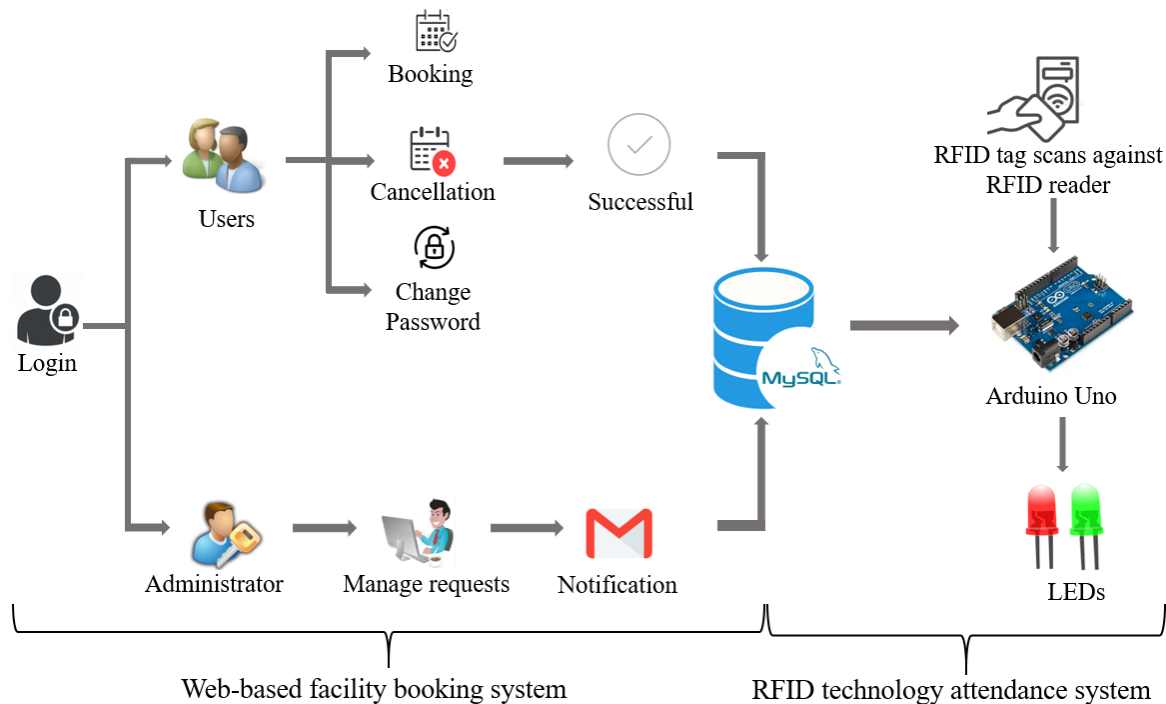
In the CLAB system, the attendance of users was detected by the RFID technology. The entering and leaving time of the users will be updated into the MySQL database once the users scan their RFID card against the reader. A website was developed to facilitate the users and the administrator to make a reservation and cancellation of the cleanroom laboratory facility instantly, as well as to help the administrator manage the booking request from the users effectively. For example, users can make a facility reservation through the website and the booking information will be updated into the database. After the administrator approved the booking request from the users, the users will get permission to enter the cleanroom laboratory by scanning the RFID card near the RFID reader. This website was created using the PHP programming language and integrated with the MySQL database due to its compatibility usage as compared to other languages such as Python, Perl, C and C++. The advantage of using the MySQL database is there are no limitations for storing, accessing and creating the set of data elements such as tables in MySQL [10].

## **2. Methodology**

The CLAB system was divided into two parts which were the web-based facility booking system and the attendance system. The web-based facility booking system was developed by using the PHP programming languages since it is inexpensive open-source software that can work efficiently with the database used in this system, which was MySQL database [11], [12]. On the other hand, the attendance system was developed by using RFID technology and Arduino Uno in which the Arduino Uno acts as the main controller in the system. The RFID used in the CLAB system consisted of a reader and passive tags. Each of the RFID tags was embedded with a specific serial number which is known as Unique Identification Number (UID). The RFID reader will read the UID from the RFID tags and then grant the user access to the cleanroom laboratory. Both of the booking and attendance systems were integrated with the MySQL database to retrieve or write data in the database.

The CLAB system starts with a login activity for the users and administrator as shown in Figure 1. The users and the administrator will be accessed into a different web page for executing dissimilar

operations following the successful login. The user can make a booking or cancel requests as well as change the password for login purposes on the user web page. Subsequently, that successful booking or cancel request data will be updated into the MySQL database. The administrator can manage the user's request either to approve or decline on the administrator web page by retrieving the data from the MySQL database. Once the request was approved, the users will receive an email to notify them that they are allowed to access the cleanroom laboratory by scanning the RFID card at the RFID reader. The red and green LEDs were used in the system to display the accessibility of the user to the cleanroom. The red LED indicates that the user access is denied and the green LED indicates that access is granted. The details on the process flow of the CLAB system will be discussed in the next section.



**Figure 1: Overview of system architecture of CLAB system**

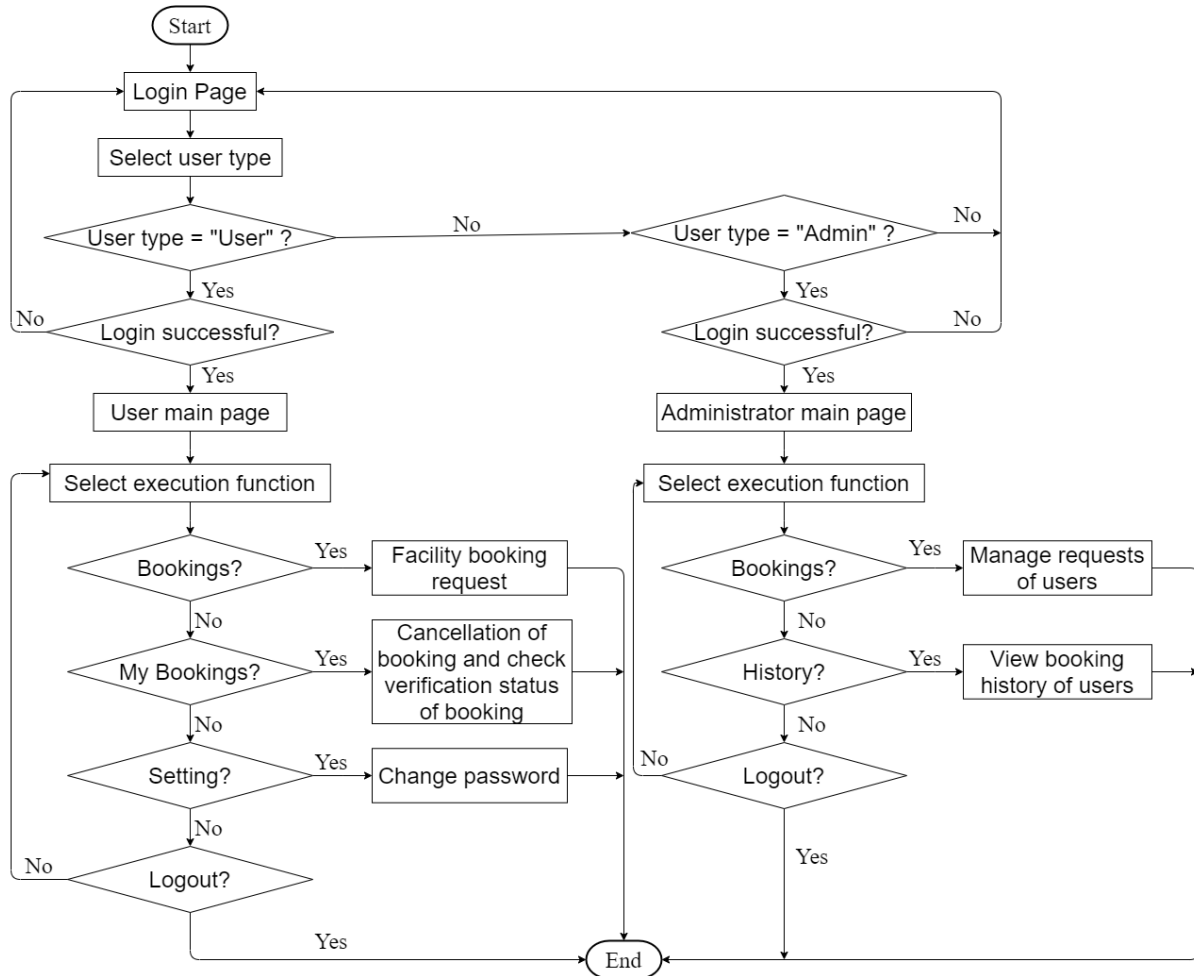
## 2.1 Facility Booking System

The facility booking system starts with the login page by selecting the user type as shown in the flowchart in Figure 2. If the selected user type was “User” and the login activity was successful, the user will be accessed to the user main page while if the selected user type was “Admin” and the login activity was successful, the administrator will be accessed to the administrator main page. The web pages for the user and the administrator contained different functionalities and operations. The overall process flow of the booking system is shown in Figure 2.

The user web page contained four functions for the user to execute which were “Bookings”, “My Bookings”, “Setting” and “Logout”. The “Bookings” function allowed the user to make a facility booking by selecting the facility available in the cleanroom laboratory through a dropdown list selection, select the date available in a calendar form booking page, select the time slot and fill in the booking details forms. The user can check the verification status of the booking request and make a cancellation of the booking under the “My Bookings” function. Under the “Setting” function, the user can change the password for login activity purposes. The “Logout” function allowed the user to log out of the system after the user finished the operations.

On the other hand, the administrator web page was to manage the booking or cancel request from a user and check the booking history of the user. Three functions provided for the administrator to execute were “Bookings”, “History” and “Logout”. The administrator can manage the booking and cancel request of a user under the “Bookings” function to either approve or decline the booking request of a user. An email notification will be sent to the user to alert the user regarding the administrator’s

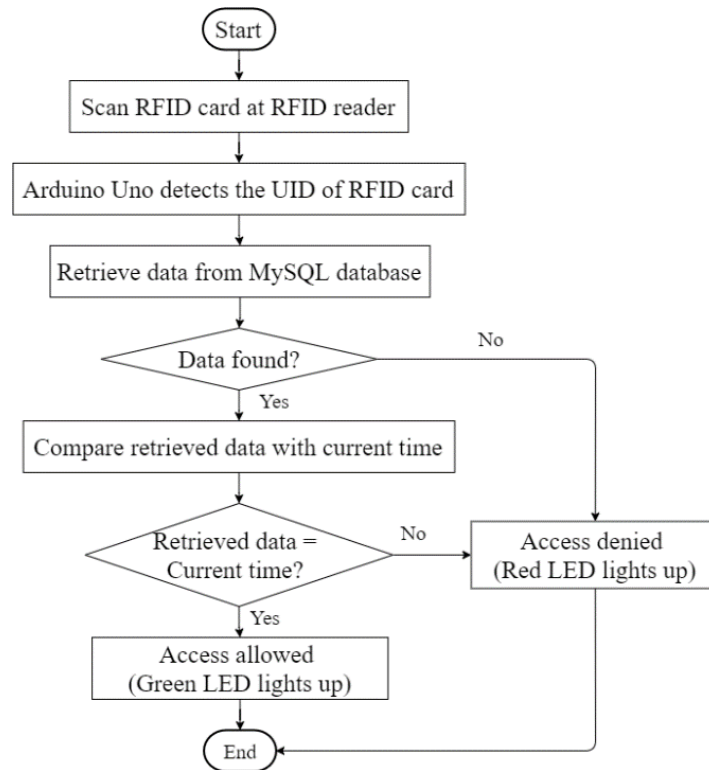
decision. Furthermore, under the “History” function, the administrator can view and check the booking history of the user to trace the last user for using the equipment. The “Logout” function was also provided on the administrator web page that allows the administrator to log out of the system.



**Figure 2: Overall process flow of facility booking system**

## 2.2 RFID Technology Attendance System

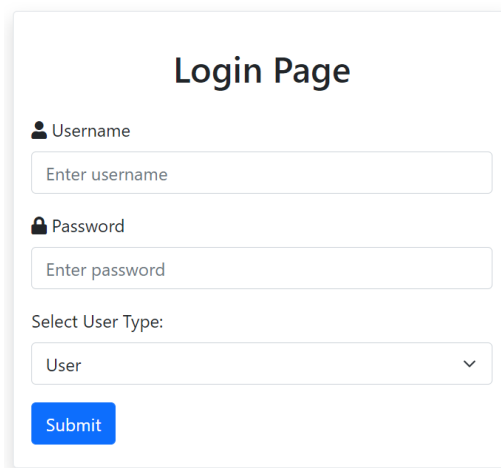
The attendance system was integrated with the facility booking system to give permission for the user to access the cleanroom laboratory. The user was allowed to access the cleanroom laboratory after the booking request has been approved by the administrator. Once the user scans the RFID card against the RFID reader, the Arduino Uno detects the unique identification number of the RFID card and searches the booking time for the detected card in the MySQL database. If the booking time was found in the database, a green LED will light up to indicate the user was allowed to access the cleanroom laboratory, otherwise, a red LED will light up to indicate the user was not allowed to access the cleanroom laboratory. The overall process flow of the RFID technology attendance system is shown in Figure 3.



**Figure 3: Process flow of RFID technology attendance system**

### 3. Results and Discussion

The user interface of the CLAB system has been developed for the user and administrator. To access the web page, a user authentication page was provided in order to prevent intruders from accessing the web-based system. Figure 4 shows the interface of the Login Page. The login page was integrated with the MySQL database to verify the username and password that matched the data in the database. When the login was successful, the user and the administrator will be redirected to the user and administrator web page respectively.



**Figure 4: Interface of Login Page**

Upon successful login to the user’s main page, the user will be redirected to the main page which was also the “Bookings” page that included a responsive navigation menu on top of the page with four functions which were “Bookings”, “My Bookings”, “Setting” and “Logout” as shown in Figure 5. The “Bookings” page included a dropdown list facility selection that allows the user to select the facility available in the cleanroom laboratory, a calendar form date selection that displayed the available date

for booking and the time slot selection. The booking will be created successfully on the “Bookings” page when the user fills in the booking information such as name, matric number, email address and phone number in the fields provided. The user can check the verification status of the booking and make a cancellation of a booking on the “My Bookings” page. The additional function included in the user web page was the password changing function for login activity purposes on the “Setting” page. Figures 5 until 7 show the user web page in the CLAB system.

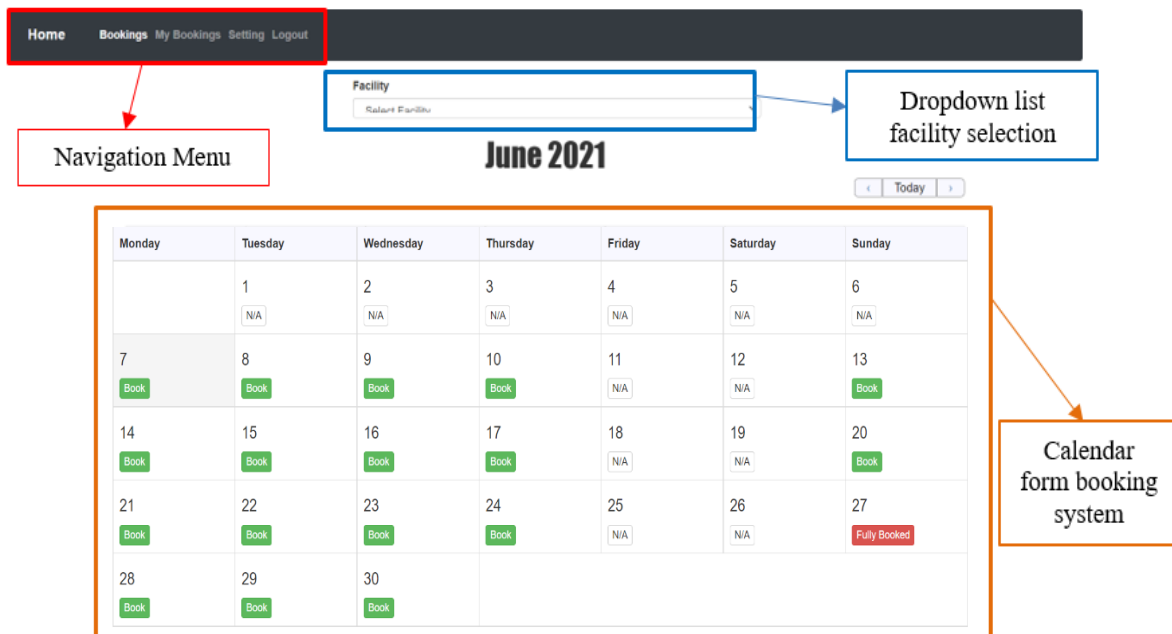


Figure 5: Interface of user “Bookings” page

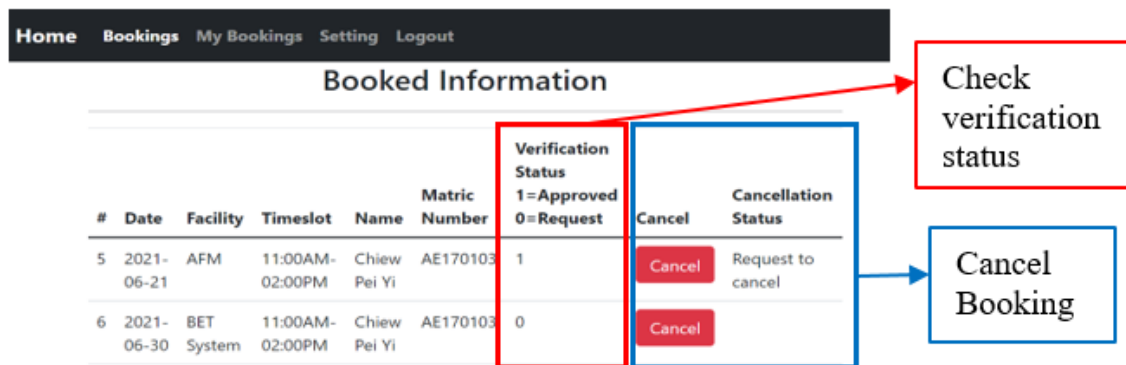
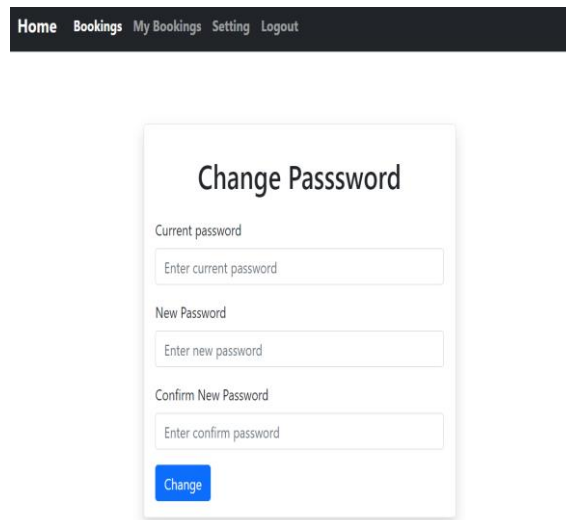


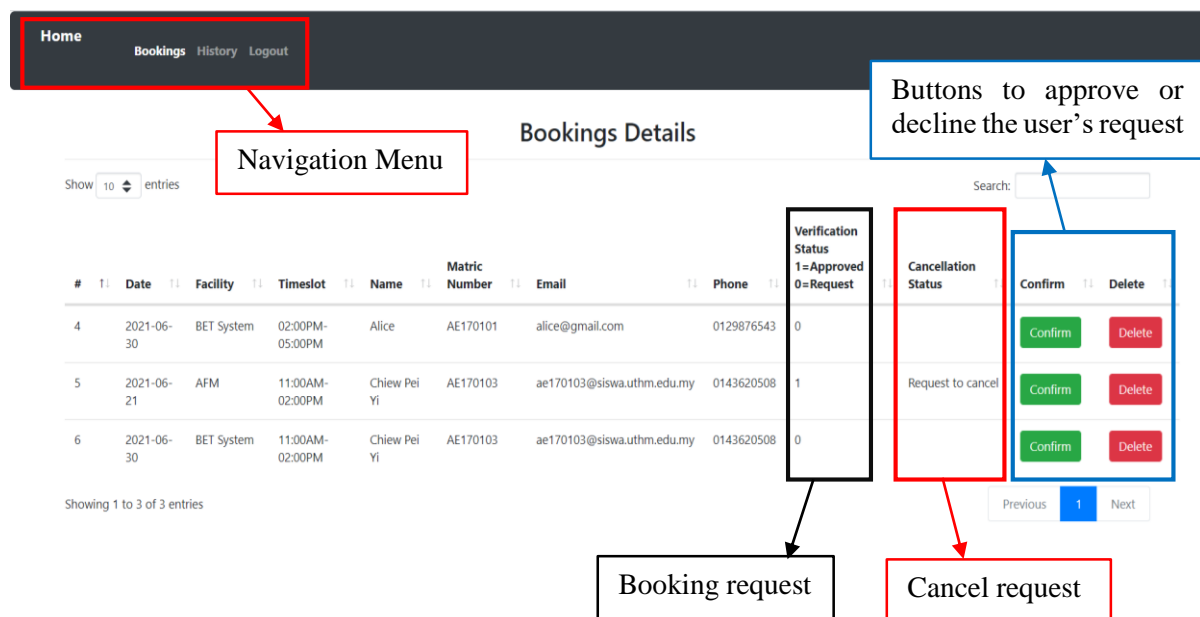
Figure 6: Interface of user “My Bookings” page



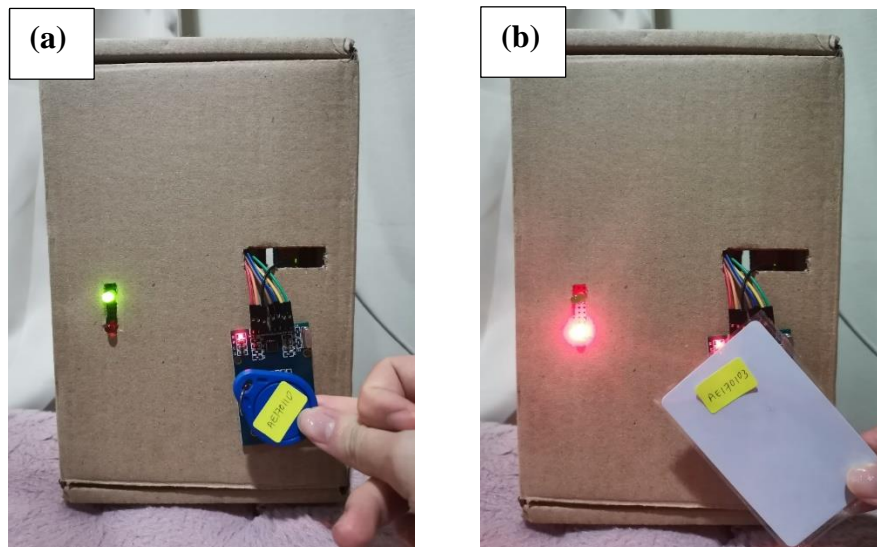
**Figure 7: Interface of user “Setting” page**

The administrator web page was the second important section in the CLAB system. Upon successful login to the administrator’s main page, the administrator will be redirected to the main page which was also the “Bookings” page that included a responsive navigation menu on top of the page with three functions which were “Bookings”, “History” and “Logout”. The “Bookings” page as shown in Figure 8 allowed the administrator to approve or decline the booking and cancel requests of the user. The administrator can also track and trace the booking history of a user on the “History” page. The CLAB system also granted a logout function for the user and administrator to exit from the user or administrator web page and return to the login page.

The last important section in the CLAB system was the RFID technology attendance system that allowed the user to access the cleanroom laboratory after the booking request had been approved by the administrator. The user can swipe the RFID card against the RFID reader and the LED will light up to represent the accessibility of the user into the cleanroom laboratory. The green LED will light up if the access was granted while the red LED will light up if the access was denied as shown in Figure 9.



**Figure 8: Interface of admin “Bookings” page**



**Figure 9: The accessibility of user into the cleanroom laboratory was (a) granted (b) denied**

#### **4. Conclusion**

The CLAB system has been successfully developed and worked in this project in which the CLAB system was an integration of attendance monitoring system using RFID technology with web-based facility booking system for the university cleanroom laboratory application. The booking system was designed for both the users such as students or staffs and for the administrator functions. The functions provided for the users were to make a booking or cancel request on the user web page while the functions provided for the administrator were to manage the requests from the user to either approve or decline the requests. By implementing the CLAB system, the problems that arise from the traditional and booking system available in the cleanroom laboratory can be eliminated and hence promote a clean environment in the cleanroom laboratory.

#### **Acknowledgement**

The authors would like to thank the Faculty of Electrical and Electronic Engineering, Universiti Tun Hussein Onn Malaysia for its support.

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