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# Smart Locker for Post Office

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**Abstract**: Internet of Things (IoT) is a network of physical, set with intelligence software with sensors which can receive and transmit data intelligently. IoT allows a hardware to be control via applications that is connected to the Iinternet. Nowadays, post office break in cases occurs and the users unable to take immediate action to prevent theft from entering the post office because of lack of protection. The post office does not have a special locker with security protection and the users are just keep the money in normal locker during break time so the users unable to secure the money. Therefore, a Smart Locker System is proposed to solve this problem. Project objective is to develop a locker using mobile application and IoT platform with high security implementations in order to secure the money from intruders perhaps, perform testing the functionality of the system on receiving and display the data given from the hardware to the admin and staff of the post office through mobile. This system limit to alert the users of post office about the unauthorized unlocking of the locker by the intruder besides, it designed to overcome frauds. The methodology used to build this Smart Locker project is Waterfall methodology. The Smart Locker encrypted with GPS modem that is able to track the location of the intruder when they stole the locker and move from predefined location. Furthermore, notifications also sent through GSM modem to the users when the locker is activated. In addition, security camera of the locker able to detect the presence of the intruder and send alert notification to admin. The system able to send OTP password through GSM to access the locker only by registered staff of post office. A mobile application also developed and able to register, login and store specific database of the system. In a nutshell, these implementations are more secured and it is easy to use. It is better to have a strong Wi-Fi and mobile data for the system so the system can perform well.

**Keywords**: Smart Locker, Internet of Things (IoT), Global System for Mobile Communication (GSM), Global Positioning System (GPS), One Time Password (OTP)

## 1. Introduction

Post office is one of the most important place that indicates high security and it has become a significance part for common human being. Presently having a Locker system is extremely imperative

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because of the expanding instances of robbery at post offices. The security and safety are the main concern which is to be deal by the users. Nowadays post office faces a tremendous task of maintaining and accounting thousands of money. Every year news flashes in social media, newspaper that there is at least 2 cases of post office robbery or money get stolen [1]. Therefore, "Smart Locker for Post Office" project is being designed and developed to ensure the security of the post office against frauds by implementing an IoT and mobile-based platform. Internet of Things (IoT) basically known as any electronic devices that can communicate with each other and able to interface with human [2].

One of the basic concept of this project is whenever the user accessing the system for the first time, they need to install the mobile application to their mobile to perform the tasks. To perform the tasks, the locker should be in on state. All of the hardware components and modems connected and fixed inside the locker. This system consists of two users which are admin and also staff. For the admin section, the admin able to login using the fixed username and password. After that, the admin login page redirect to the menu page. Security camera function able to capture the presence of intruder then send alert notification through GSM. Furthermore, the view history database function able to display the database history of the staff whenever the staff accessing to the system. The history includes with staff name, time and date of accessing the locker. GPS function is not included in the mobile application but it able to send predefined location of the intruder with the help of GPS and GSM modem when the intruder tries to trigger the locker in different area. For the staff section, the staff able to register and then login using mobile application with username and password. Then, the staff login page able to redirect to the menu page. Here, OTP function implemented and it able to open the locker if only the staff click on the "REQUEST OTP" button otherwise no one can open the locker. The staff able to receive message through GSM modem once the locker is activated.

The problem is whenever the users of the post office went out for a break without lock the locker in proper way, the third party trigger the locker and stole the money from the locker. This case happens because of lack of security and protection. The objectives are to design MyLocker based on Internet of Things and Android Studio which alerts the users of the post office. Next, to develop a system with Piezo Buzzer which it will alert the users and send notification message. Moreover, to design the system by perform testing the functionality of the system on receiving and display the data given from the hardware to the users through mobile. Project scope is to alert the users about the unauthorized unlocking of the locker besides, it designed to overcome frauds.

Chapter 2 is the literature review consisting of introduction, domain background, technology and method, the study of existing systems and proposed system and chapter summary. Chapter 3, is the methodology which thoroughly explains the methodology approach that used for the project. Chapter 4 will be discussed on analysis and design which is consist of object oriented structure, functional and non-functional requirements. Chapter 5 is the implementation and testing where the designed system is implemented and tested for errors. Chapter 6, the conclusion that explains on the project achievements, project limitations and future works.

## 2. Related Work

To develop the Smart Locker for Post Office system, a literature review was conducted to ensure that the system developed reflects both advantages and disadvantages. Several studies have been done regarding the smart locker system to ensure that the development of the project runs smoothly by considering the pros and cons of the existing systems. The disadvantages have been identified in the existing systems which can be used as a guide in order to eliminate them in the proposed system. The advantages of the existing systems have contributed support and guidance in order to improve the efficiency of the proposed system which is Smart Locker for Post Office. The developer can find some alternative way to introduce new elements which makes Smart Locker for Post Office system different than the existing systems.

The existing systems are consisting of simple integration of security and these systems do not have mobile application to control the locker and to track the safety of locker perhaps, GPS location to trace the intruder. Furthermore, some of the existing systems do not have database to record the data,

registration or login for authentication, OTP password implementation, security camera and backup battery.

**Table 1: Comparison of existing systems with proposed system**

| Properties | Networked Digital Post Box Locker System | GSM Based Smart Locker | GSM Based Door Locker System | Proposed System (Smart Locker For Post Office) |
|---|---|---|---|---|
| Mobile Application | No | No | No | Yes |
| Network Technology | Data usage with IoT | Data usage with IoT | Data usage with IoT | Data usage with IoT |
| Database | Yes | No | No | Yes |
| Registration/ Login | Yes | No | No | Yes |
| GPS | No | No | No | Yes |
| Locker Controller | Yes | Yes | Yes | Yes |
| OTP password | Yes | No | No | Yes |
| Security Camera | No | No | Yes | Yes |
| GSM | Yes | Yes | Yes | Yes |
| Backup Battery | No | No | No | Yes |

Based on the research paper, the Smart Locker system was proposed which is convenient with post office security that able to inform the users about the frauds or whenever the locker is triggered by the intruder. After the observation and studies on the three existing systems, some features are so useful and helpful for the system developers in order to improve and apply those features on the development of proposed system. Few properties were used to find the availability of the existing system and proposed system. Table 1 shows the comparison between existing systems with proposed system. The three existing systems are Networked Digital Post Box Locker System, GSM Based Smart Locker and GSM Based Door Locker System. These existing systems own some of the security services. These research was summarized in table form to see the usage properties that used for the existing system so from that it helps to improvise the proposed system in term of usability, security and availability. The properties like mobile application, network technology, database, registration or login, GPS function, locker controller, OTP password, security camera, GSM and backup battery have been discussed in table as follows. Some features are not present in existing systems which is evaluated but the features had implemented in proposed system in order to make the system more reliable and effective.

## 3. Methodology

Methodology will thoroughly discuss about the research methodology in order to build the Smart Locker for Post Office. Research methodology is important in arranging the project's journey to be further organizing and reducing the problem in carrying out the project. Furthermore, the research methodology is a stepping stone in solving problems in more systematic investigation [3]. The development process of the system will also be discussed in more detail. Moreover, phases that involved in the selected process model and proper work flow which is associated in the system will also be explained thoroughly. The selection of this process model is through the operation and methods that are appropriate with the development of Smart Locker for Post Office. The methodology that has been selected for the development of Smart Locker for Post Office system is Waterfall Model. Waterfall Model is one of the software development life cycle (SDLC). Software development life cycle (SDLC) is a framework that determines the tasks that will be performed at each step in the development process of a system [4].

### 3.1 Waterfall Model

The software development life cycle (SDLC) is a structure for identifying which tasks must be accomplished at each phases of the system development [4]. Waterfall Model is a sequential software development approach in which process is considered to flow downstream throughout a sequence of phases that should be fulfilled for software development to succeed [5]. This model is suitable for this project because it is easy to implement for small project with simple system specifications. The Waterfall Model has many consecutive stages where these stages must be completed one by one [6]. Before starting work, it is recommended to do planning for all the processes and each activity because the process principle for Waterfall Model is based on planning [6]. Figure 1 shows the Waterfall Model of the Smart Locker for Post Office system.

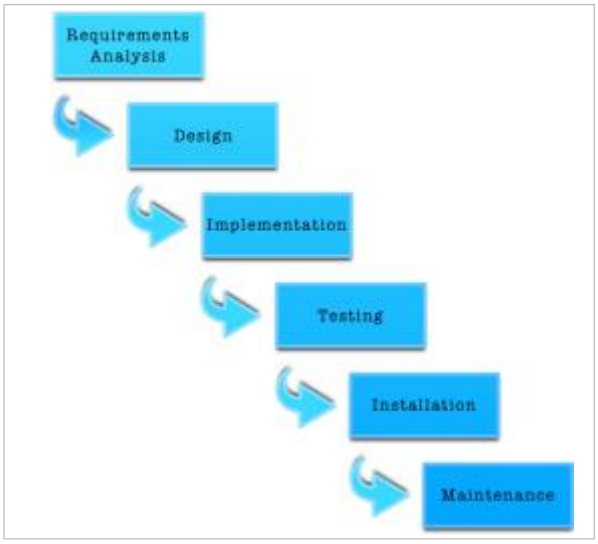


**Figure 1: Waterfall Model [5]**

Figure 1 shows the work flow of waterfall model which used for Smart Locker for Post Office. According to the model, once each and every requirement is successfully fulfilled, the installation process will be executed without any hesitations. Before carrying out the full installation process, the unit testing and integration testing need to be performed. This Waterfall Model is super effective to make sure that each module developed are going to be more organized and may be found out at the designated time.

### 3.2 Planning Phase

The first phase for system development is the planning phase. Planning phase contains identifying the problem that arise, project objectives and also the scope of the system. Some survey was carried out to identifying the problem that faced by the post office users throughout the planning phase. According to the technique, it was discovered that the existing systems does not have some functions GPS function, database and backup battery. So, planning phase help to identify the problems and help to guide the developer through the implementation phase of the project. Furthermore, the objectives and scopes of the project are identified at this phase. Once the developer successfully identifying the problem, objectives and scopes, the methodology for the project also determined at the same stage.

### 3.3 Analysis Phase

Analysis phase is a study of the main functions of the system based on user requirements. An analysis of problem statements has been constructed to determine the needs of the user, through the data information that have been provided from the planning phase. Three existing systems such as

Networked Digital Post Box Locker System, GSM based Smart Locker and GSM based Door Locker System have been chosen and studied. After that, system requirements changed and represented in sequence diagram, use-case diagram, activity diagram and class diagram. Improvements identified to decide the needs for the system to be evolved. Hardware and software requirements of the project recorded and evaluated in this section. Moreover, the troubleshooting steps can be diagnosed and identified efficiently. As an outcome, the study documents and system specifications have been created in analysis phase.

### 3.4 Design Phase

In design phase, the object oriented diagrams such as sequence diagram, class diagram, activity diagram and use-case diagram have been designed according to the system specifications which had carried out in analysis phase. The database also designed in order for entering data through the mobile application. Input and output design also designed in order to connect the IoT hardware and mobile application. Then, the user interface for mobile application has been designed using WPS Office 2016 based on user's requirements and suitability perhaps the data structure for the proposed system also has been designed. The user interface of each process of the system is determined to ensure the flow of the system is reliable and systematic. The interface shows how the user will move from one page to another in the system using navigation methods provided such as buttons.

### 3.5 Implementation

Implementation phase is to get the review from the user by watching and listening the reviewers carefully. This phase is described about run a project in real environment. Implement all the components or the function that were created to confirm that the project work as the planned. In this phase, the user interface has been develop using appropriate software like Android Studio. Furthermore, schematic diagram has been developed using Proteus software where it helps the developer to view the overall functions of the IoT part. The IoT hardware for the system such as Arduino UNO microcontroller, GSM modem, GPS modem, security camera, backup battery, LCD screen, keypad have been connected through jumper wires then the source code for the IoT hardware has developed using Arduino IDE software. As a result, the source code has been developed for both IoT hardware and mobile application with appropriate software.

### 3.6 Testing Phase

The system's functions and interfaces are checked to ensure that the system is working properly and there are no problems with system functionality. System testing is also performed on users to determine if the system meets the needs of the user and the purpose for which the system is being developed. At the end of this stage, the system function and interface test documents and user test documents are generated. For this system, there are two testing criteria which are unit testing and integration testing. It is important to do system testing to ensure the system work properly and efficiently.

### 3.7 Maintenance Phase

To ensure the systems operational performance, the maintenance phase involves in making modifications to hardware or software [7]. During this phase, the system is modified and improved based on user feedback and the results from the testing phase. Changes and improvements are made to make the needs of users. This includes making changes to improve the system efficiency, fix bugs and enhance security.

## 4. Results and Discussion

### 4.1 Analysis and Design

System analysis describes what a system should do to meet the information needs of users. Analysis is also a comprehensive study of a range of operations that have been performed by system and their interaction between internal and external structure of the system. System design specifies how the system will accomplish this objective. Interface and database are the two types of design that helps for a better development and it helps admin and staff to understand the proper progress of the system. Analysis and Design, mainly deals with the software and also hardware development activities. It is a step-by-step process for developing high-quality systems. Use Case Diagram, Sequence Diagram, Activity Diagram and Class Diagram were used to develop in this chapter based on the system. Furthermore, there are two important elements in the system requirements which are the functional and non-functional requirements. These requirements ensure that the functionality of the proposed system can meet the project objectives. These requirements are crucial in determining how well the system meets the user's needs.

## 4.2 Requirement Analysis

Requirement analysis is to identify the user requirements of the admin and staff for the proposed system. Requirement analysis divided into two which are admin requirement and staff requirement.

### 4.2.1 Admin Requirement Analysis

The target user for this system is the admin and staffs. In this section, some features and functionalities for admin side were identified based on proposed system. Table 2 shows the admin requirements for the system.

**Table 2: Admin requirements for the proposed system**

| No | Admin Requirement |
|---|---|
| 1 | Admin able to login in to the mobile application. |
| 2 | Admin able to view staff locker access history. |
| 3 | Admin able to view SMS notification. |
| 4 | Admin able to view GPS location. |
| 5 | Security camera alert. |

### 4.2.2 Staff Requirement Analysis

In this section, some features and functionalities for staff side were identified based on proposed system. Table 3 shows the staff requirements for the system.

**Table 3: Staff requirements for the proposed system**

| No | Staff Requirement |
|---|---|
| 1 | Staff able sign up to use the mobile application for verification purpose. |
| 2 | Staff able to login in to the mobile application. |
| 3 | Staff able to view OTP password. |
| 4 | Staff able to view SMS notification. |

## 4.3 System Requirements Analysis

Functional requirements and non-functional requirements are two important elements in system requirements. These requirements ensure that the functionality of the proposed system can meet the project objectives.

### 4.3.1 Functional Requirement

Functional requirements can be defined as the functions and capabilities that exist in the system or its components. The functional requirements also describe the list of functions that the system must complete. Table 4 shows the functional requirements for the proposed system.

**Table 4: Functional requirements for proposed system**

| No | Module | Functionality |
|---|---|---|
| 1 | Register/ Verification | The mobile application should allow the staffs to register as a new user of the system for verification purpose. |
| 2 | Login | The mobile application should allow the admin and staff to input the valid username and password so that can access to the locker system. |
| 3 | History | Admin able to view history of staff whenever the staff access to the system. |
| 4 | OTP password | The locker able to send OTP password when the locker is at correct location. The OTP password can manage by staffs. |
| 5 | GSM | The both users able to get alert message when anyone try to trigger the locker. |
| 6 | GPS | The admin able to receive location when the third party stole and access the locker at different location. |
| 7 | Security camera | The security camera able to alert the presence of the third party. The buzzer will make alarm sound when camera starts to act. |

4.3.2 Non-Functional Requirements

For non-functional requirements, it is basically describing the general attributes and quality of the final system. This requirement usually specifies a standard that can be described as a constraint on the behavior of the system. Table 5 shows the non - functional requirements of the proposed system.

**Table 5: Non-Functional requirements for proposed system**

| No | Data | Functionality |
|---|---|---|
| 1 | Operational Requirement | This mobile application will operate using android studio in smart phone. The system only available when there is Iinternet connection. |
| 2 | Usability Requirement | The IoT system provides features such as user-friendly and easy to understand Provides various types of modules for both of the users. |
| 3 | Security Requirement | Both users need to input credential details like username and password to access to the locker system. |

**Table 5: Non-Functional requirements for proposed system (Continued)**

| No | Data | Functionality |
|---|---|---|
| 4 | Portability Requirement | The application is portability due to the system supports real-time guarantees which a certain action is performed within a given time frame. |

### 4.4 Unified Modelling language (UML)

The Unified Modelling Language known as UML which defines a modelling language that is standardized which provide means for determining, illustrating, constructing and documenting the information for the software system.

### 4.5 Use Case Diagram

The use case diagram is a representation of a user's interaction with the system that shows the relationship between the user and system. There are two actors in the use case diagram which are admin and staff. When the intruder stole the locker and went to different location the buzzer makes beep sound and then followed up by the security camera and it will send alert notification. At the same time, the admin and staff will receive alert notification to mobile application which ask them to see the SMS when intruder is detected by the system. Figure 2 demonstrates the use-case diagram for both admin and staffs with their responsibilities.

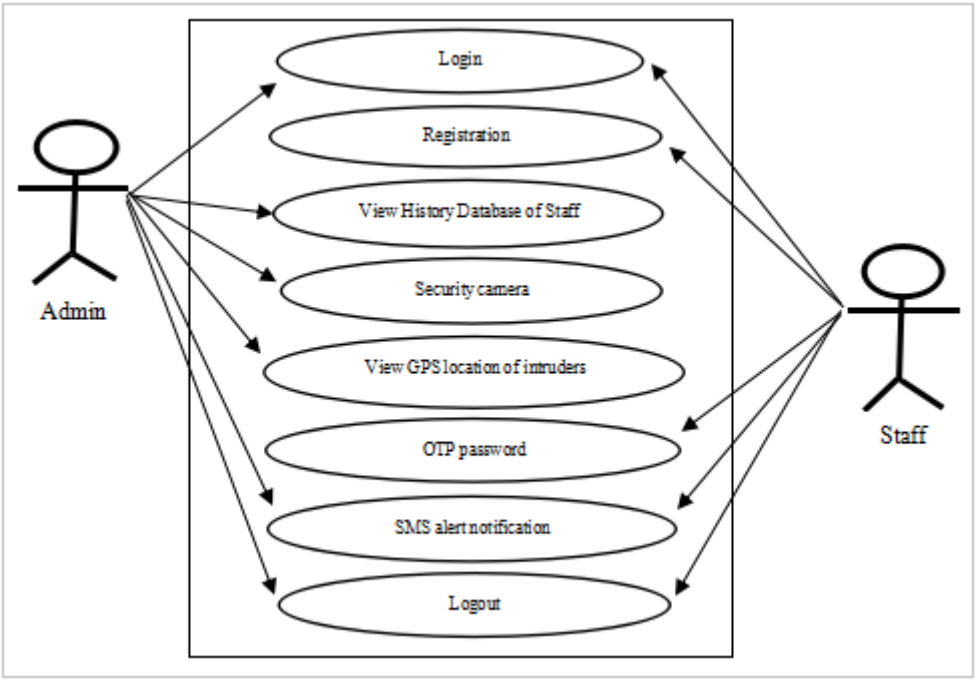


**Figure 2: Use-Case diagram**

Figure 2 shows the functions and responsibilities for both admin and staff where it is implemented in the proposed system as well. For admin, there are six use cases such as login, view history database of staff, security camera alert, view GPS location of intruders, SMS alert notification and logout. For staff, there are five use cases like registration, OTP password, SMS notification and logout.

### 4.6 Sequence Diagram

Sequence used to display in more detail the interactions involved in this system. The sequence of the system starts up when user read the alert notification sent from the Arduino. Next, the admin and staff may view and read the notification through mobile apps which ask them to see the real message that sends through locker to normal GSM(SMS). Figure 3 shows the sequence diagram for admin and Figure 4 shows the sequence diagram for staff.

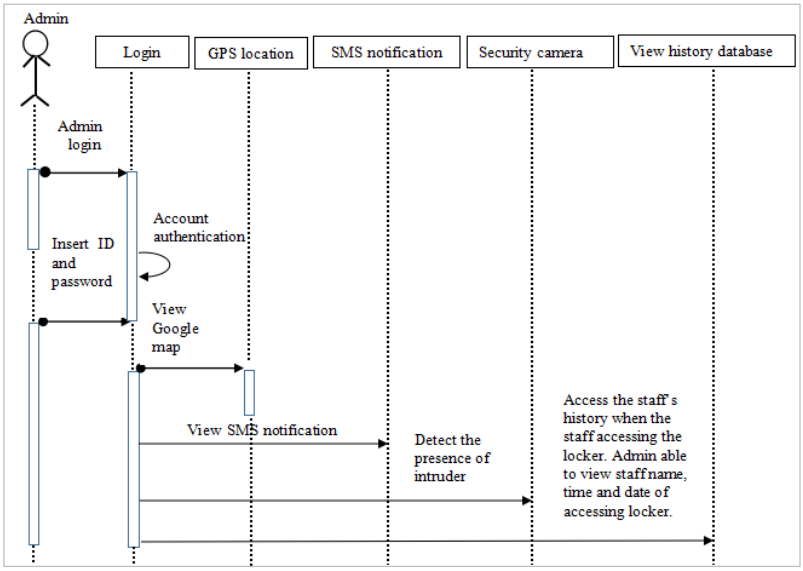


**Figure 3: Sequence diagram of admin**

Figure 3 shows the sequence diagram for admin side which implies that it gives a general idea of the admin's performance as well as the correct order in which each event should occur. It also demonstrates how different objects interact with one another. Admin consist of login, GPS location, SMS notification, security camera with view history database functions.

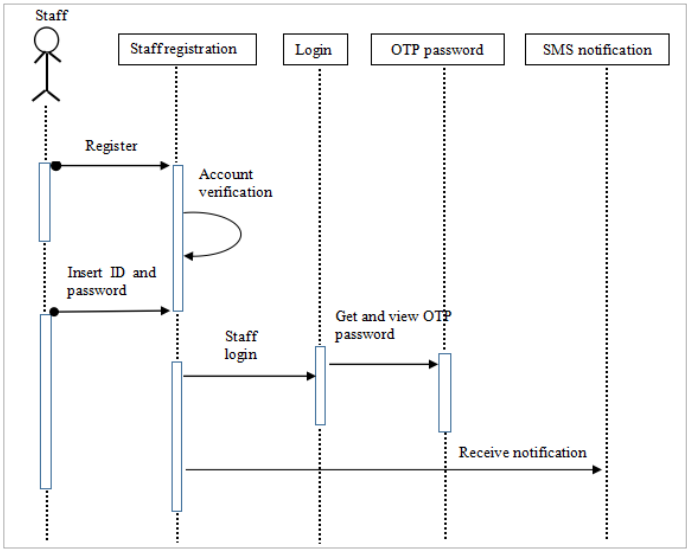


**Figure 4: Sequence Diagram of staff**

Figure 4 shows the sequence diagram for staff side where it demonstrates the correct order sequence following by different flow of the process. Staff sequence diagram consist of registration, login, OTP password and SMS notification functions.

## 4.7 Class Design

Each class has its own internal structure and its own relationships with other classes. During the design phase, class diagrams are used to show the general roles and responsibilities of the entities that provide the behavior of the system. This diagram used for general conceptual modelling of structure of this IoT. Figure 5 shows the class diagram of the proposed system.

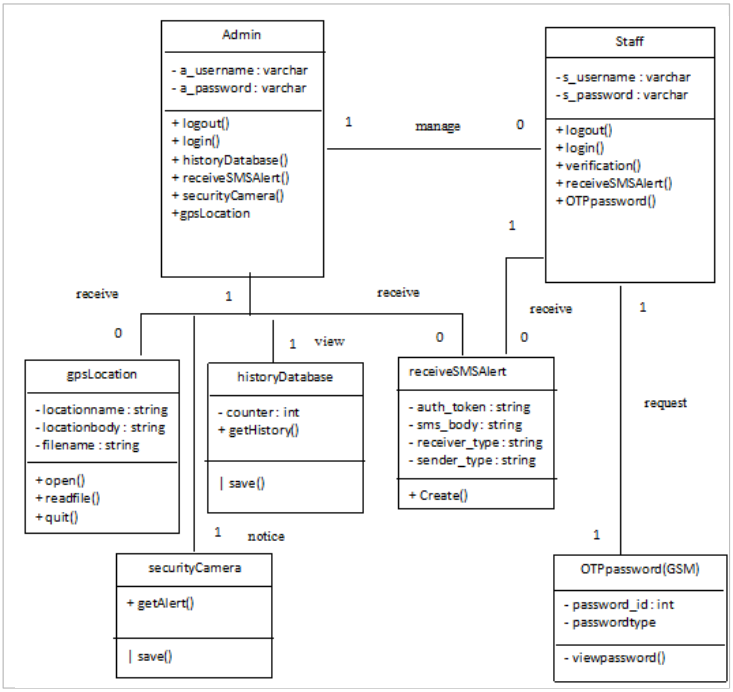


**Figure 5: Class diagram of the system**

Figure 5 shows the class diagram of the Smart Locker system. The diagram explains the process that have been carried out by the admin and the staff. Every functions have its own process. Inside every function, there is a collection of names, attributes on data elements which is being used in the system development.

## 4.8 Activity Diagram

Activity diagrams are also graphical representations of activity workflows to support gradual selection, iteration, and concurrency control. The activity diagram is one of the UML specification. Activity diagrams illustrate the flow of activities that focus on detailed use cases or design methods. The activity diagram includes several symbols used in the flow diagram such as input, output, process, and data flow. Figure 6 shows the activity diagram with the process of mobile application with Smart Locker for admin and staff.

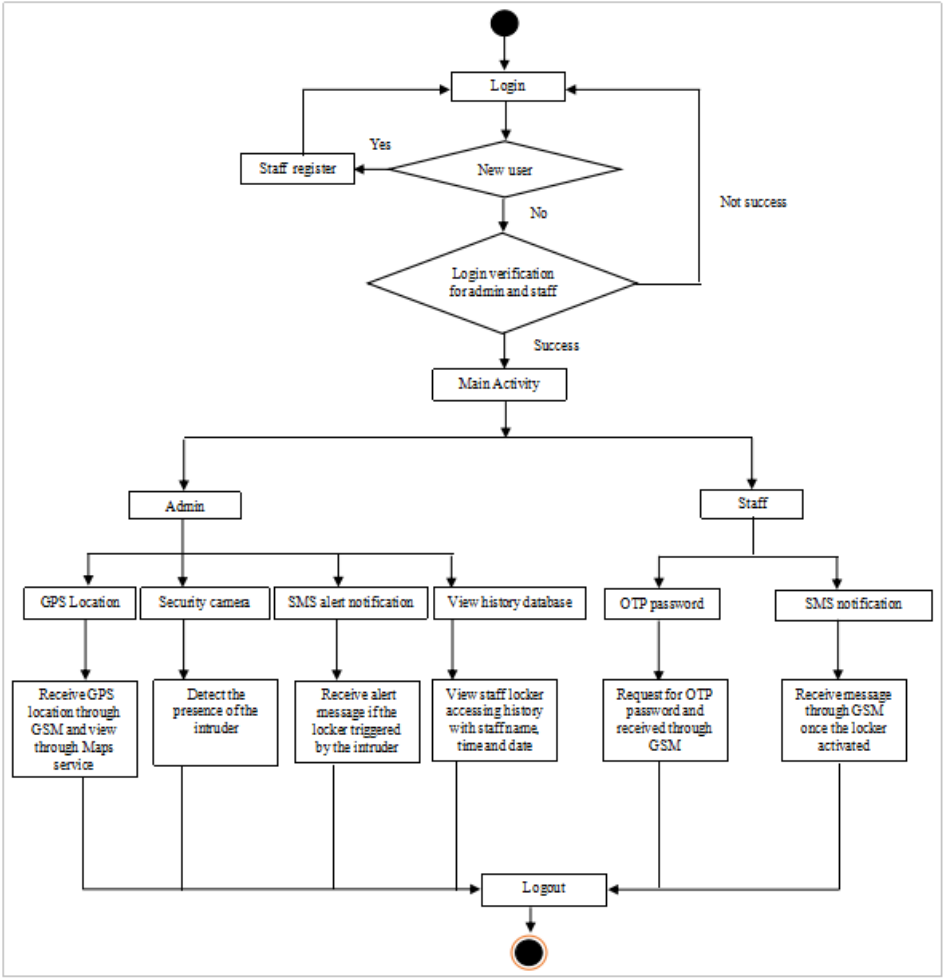


**Figure 6: Activity diagram of the system**

Figure 6 shows the activity diagram of Smart Locker system. The system's process identified from beginning to the end with the functions. There are two users which are admin and staff who are being operating the system. The diagram thoroughly explained the work flow of the proposed system. Under every functions some description was written for understanding the system.

## 4.9 IoT Hardware

The IoT hardware is crucial to develop this Smart Locker for Post Office. Figure 7 shows the connected IoT hardware of the Smart Locker System. The hardware component consists of Arduino UNO microcontroller, Piezo Buzzer, backup battery, GSM modem, GPS modem, security camera, LCD screen and keypad which is connected through the jumper wires so that the locker functions worked in proper flow. The locker is then developed using aluminium case, hinges and screws.

**Figure 7: Hardware Circuit of the system**

## 4.10 Application Interfaces

This section will show the interfaces of the smart locker system.

### 4.10.1 Register module interface

Figure 8 shows the register module for the staff to register to the system to access the locker. The staff need to insert their username and password and retype the password for confirmation. The staff will then have to click on the "SIGN UP" button to successfully register. Once the user key in the details correctly, one success message will pop out like "Sign up process completed". The details will then be sent to Blynk cloud database and the data will be store there. If the staff has already registered and would like to login, the staff can click on "LOGIN" button to proceed.


**Figure 8: Register page of the IoT based locker system for staff**

### 4.10.2 Login Interface

Figure 9 shows the login interface for admin. Admin can login as normal using fixed username and password. After the verification is successful, the admin will be redirects to the admin menu page of the system.


**Figure 9: Login Page for Admin**

Figure 10 shows the login interface for staff. If the staff is new to the system, they need to register to the system before they perform login process. The staff need to login using the registered username and password. After the verification is successful, the staff will be redirects to the staff menu page of the system.


**Figure 10: Login Page for Staff**

4.10.3 Menu Interface for Admin

Figure 11 shows the menu interface for admin with the security camera and view history database function. The menu interface also has locker status and logout. If the locker gets activated, the locker status turned into online otherwise it is in offline state.


**Figure 11: Menu interface for admin**

4.10.4 Security Camera Function

Figure 12 shows how the security camera functioning. The security camera has been connected through local network where it has its own username and password. The local network connected using lockers Wi-Fi. Unknown F5D known as security camera with the IP address. The IP address will automatically connect with the mobile application and whenever the security camera detects the presence of the intruder, the security camera will give alert to admin through GSM service. It is important to have a strong Iinternet connection so that the security camera can detect the presence of the intruder.


**Figure 12: Security camera functioning with IP address**

4.10.5 View History Database Interface

Figure 13 shows the interface of view history database with the result. Whenever the staff accessing to the locker system, the data of the staff will store in the Blynk cloud. The admin able to view the history of the staff. The data such as staff name, date and time will be saved in the history page.


**Figure 13: View database history of staff**

4.10.6 GPS Implementation

Figure 14 shows the GPS implementation for Smart Locker system. The GPS function is not included in mobile application, but the locker has been connected with GPS modem and it send alert message with the location of the intruder when the intruder triggers the locker from different area through GSM modem. Once the admin receives the alert message with location, the admin can use Maps service to view the current location of the intruder.

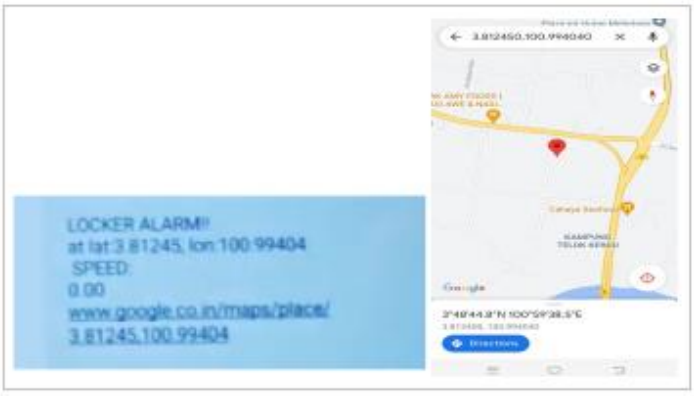


**Figure 14: The implementation of GPS function**

4.10.7 Menu Interface for Staff

Figure 15 shows the menu interface for the staff. The staff menu interface consists of OTP password function. The username will appear when the staff accessing to the locker system. If did not perform task, the staff can click on logout button.


**Figure 15: Menu interface for staff**

4.10.8 OTP Password Interface

Figure 16 shows the OTP password function. If the staff want to access the locker to perform service at post office, the staff need to activate the locker using turn on button at the locker. Once turn on, the staff will receive SMS notification through GSM modem like “Locker is now ready”. When the locker is activated, the locker status will have turned into online. Then, the staff can request for OTP password to open the locker. The staff only can request for OTP password whenever the locker is in online state otherwise could not perform. After the request, the staff will receive OTP through SMS as in Figure 16 shown.


**Figure 16: Process of Receiving OTP password**

### 4.11 Testing

Functional testing and user acceptance testing will be used to test the proposed system during this phase. Testing should be carried out to ensure that the system is free of errors and it meets the project specifications. The results are partially matched with the predicted results at this stage. It claims that the project was successful and completed in accordance with the requirements.

#### 4.11.1 Functional Testing

The purpose of functional testing is to ensure that the system meets the functional requirements that were previously planned. It also ensures that the system requirements are met properly and work correctly in effective way or not. All of this testing was done to ensure that the systems' functionality, database and interface is free from errors. For the testing of each feature, several test plans had established to view the accuracy of the system.

#### 4.11.2 Test Plan

Test plan is usually carried out after the completion of the project. It can be used to determine whether the system meets the project requirements or not. Table 6 to 11 shows the test plan for all of the elements of the Smart Locker for Post Office system.

**Table 6: Test plan for Login**

| No | Test Case | Expected Result | Actual Result |
|---|---|---|---|
| 1 | Enter valid password | Once the user key in valid password, the login page redirect to menu page. | As expected |
| 2 | Enter invalid password | If the login attempt fails, a dialog box displays with the message "Invalid user or pass". | As expected |

Table 6 shows the test plan for the user login interface. This module can test with the user's username and password as input.

**Table 7: Test plan for Registration**

| No | Test Case | Expected Result | Actual Result |
|---|---|---|---|
| 1 | Register using valid username and password | If the registration successful, a dialog box displays with a message "Sign up process completed". | As expected |
| 2 | Enter invalid username and password | Error message will be displayed "Registration failed" | As expected |

The test plan for the staff register interface is shown in Table 7. The user's username and password will be verified, and they will be able to proceed to the system's next interface. The registration is only for the staff.

**Table 8: Test plan for GPS Location**

| No | Test Case | Expected Result | Actual Result |
|---|---|---|---|
| 1 | View current location | Display integrated Google Maps view with intruders current location. | As expected |

**Table 8: Test plan for GPS Location (Continued)**

| No | Test Case | Expected Result | Actual Result |
|---|---|---|---|
| 2 | Send alert message with current location of the intruder | Alert message and current location of the intruder send through GSM modem that fixed in the locker when the intruder trigger and access the locker at different area. | As expected |

The test plan for GPS location is shown in Table 8. In this activity the admin should be able to receive alert notification and able to view current location of the intruder. The location can view by the admin.

**Table 9: Test plan for Security Camera**

| No | Test Case | Expected Result | Actual Result |
|---|---|---|---|
| 1 | Detect the presence of the intruder | Security camera able to detect presence of intruder through sensor device that fixed in the locker. | As expected |
| 2 | Buzzer give alarm sound | The locker will give alarm sound through Piezo Buzzer once the camera detect frauds. | As expected |
| 3 | Send notification message to user | The user will receive alert message if the camera and buzzer detect intruders | As expected |

The test plan for security camera function is shown in Table 9. In this page user should be able to receive alert message if the camera and buzzer detect the intruder's activity. The admin will receive the alert notification through GSM modem which is integrated in the locker itself.

**Table 10: Test plan for View History Database**

| No | Test Case | Expected Result | Actual Result |
|---|---|---|---|
| 1 | Save data in Blynk cloud | The staff's data able to save in Blynk cloud whenever they accessing the locker system. | As expected |
| 2 | View staff data | The admin able to view staff's history such as staff name, time and date if the staff accessing the system. | As expected |
| 3 | Save the database in mobile | The admin able to save the history in mobile as well. | As expected |

The test plan for view history database is shown in Table 10. In this section, admin able to view the database history of the staff when the staff accessing to the locker system. The details like staff name, date and time of accessing the system will be saved and the admin can go through it anytime when needed.

**Table 11: Test plan for OTP password**

| No | Test Case | Expected Result | Actual Result |
|---|---|---|---|
| 1 | Request OTP | The user able to request for OTP password using mobile application. | As expected |
| 2 | Receive OTP | The user receive OTP password through GSM. | As expected |
| 3 | OTP expired | The OTP password will expire in one minute if the user did not key in on time. "OTP Expired" will display on LCD screen if the user unable to enter it on time. | As expected |
| 4 | Valid OTP | If the OTP is valid, the LCD screen will display "Door unlocked" | As expected |
| 5 | Invalid OTP | If the entered OTP password is invalid, the LCD screen will display "Wrong OTP" | As expected |

The test plan for OTP password function is shown in Table 11. The staff able to request and receive the OTP password in order to unlock the door otherwise unable to open the locker. The staff need to key in the given OTP password within one minute, if not the OTP password will expire. If the staff simply key in the OTP password without verification, the LCD screen will display "Wrong OTP" The staff will perform this task.

## 5. Conclusion

Smart Locker for Post Office with the IoT and android application technology throughout the whole process of developing perhaps using several software and hardware have been carried out to meet the target of achieving satisfactory of the users at post office. In addition, this system is also expected to be enhanced by improving its quality in the near future. The improvement can be done by optimizing performance and usability of the system. This system has achieved the objectives while fulfilling the project's scope. First objective which is that the design MyLocker based on Internet of Things and Arduino which alerts the admin and staff of the post office was successfully implemented. Other than that, system with Piezo Buzzer which is giving alarm sound whenever the third party try to trigger the locker and it will send notification through mobile to the admin and staff was achieved with the GSM technology. Moreover, the system has successfully received and display the data given from the hardware to the admin and staff of the post office through mobile. The GPS function was successfully developed and tested. If there is any unauthorized activity happens to the locker, the GPS module sends the location at the same time alert message. Almost all functions will act fast at the same time, perhaps the security camera will alert the presence of third party and the buzzer will make sound then send alert message. The locker is just for temporary use but it has high security functions such as GSM module, GPS module, OTP password, security camera for the Smart Locker for Post Office system. All of these functions were worked smoothly as expected. The project also has some limitations such as the users unable to get any security notifications if the mobile device is not running. Furthermore, the locker is only used as temporary to secure money. In addition, Internet connection for the GPS module is required in order to view the location of the third party. Moreover, the system only applicable for android user but not for IOS users. Some improvements can be done in future works like adding fingerprint reader to provide high security that help to prevent from frauds which need to be implement through IoT hardware and the data sends to mobile application. Other than that, enhancing the interface with UI design. Improving the looks and feel of the Smart Locker System for mobile application part with more

attractive design for users. Furthermore, implement face recognition algorithms which is able to verify user faces to access the locker.

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**References**

[1] Allison Lai (2012, Dec 4). Mini post office robbed. Retrieved from https://www.thestar.com.my/news/community/2012/12/04/mini-post-office-robbed

[2] Mehta, Rishika, Sahni, J., & Khanna, K. (2018). Internet of things: Vision, applications and challenges. *Procedia computer science*, 132, pp.1263-1269.

[3] Kumar, Naresh, Raduan Che Rose & Jeffrey Lawrence D'Silva (2008). Predictors of Technology Deployment Among Malaysian Teachers. Graduate School of Management, Universiti Putra , Malaysia, 5(9), pp.1127–1134.

[4] Ruparelia,(2010). ACM SIGSOFT Software Engineering Notes, 35, pp.8-13. https://doi.org/10.1145/1764810.1764814

[5] Youssef Bassil and Sharma, (2012). A Simulation Model for the Waterfall Software Development Life Cycle, Vol. 2, No. 5.

[6] Bassil (2012). A simulation model for the waterfall software development life cycle. Retrieved from https://arxiv.org/pdf/1205.6904

[7] Eian, Isaac Chin, Lim Ka Yong, M. Y. X & Hasmaddi N. A. B. N. (2020). Integration of Security Modules in Software Development Lifecycle Phases. *arXiv preprint arXiv:2012.05540*.