

DESIGNING AND IMPLEMENTATION OF A SECURITY SYSTEM VIA UML: SMART DOORS

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Abstract

Companies or estate have problems stealing employees of items or records by using common keys because the usual key is less reliable. This paper seeks to control intelligent doors by means of a RFID card. In addition, a security system was created for employee entrances and exits with a system-specific server and may allow staff to open a particular door and specify a time for RFID card operation. The design and implementation of a robust and intelligent system were thus designed to control an employee's or a person's entry and exit through the use of an intelligent key and smart doors. This paper proposes the safety improvement plan based on the Smart Door Lock System for the security problem caused by the physical key in unmanned automation machines, like ATMs, KIOSKS and sales machines. The use of hardware and software inventions to construct this program was an effective factor.

Keywords: - Smart Locks, UML, Data Modeling, Information Security, Java, Networks.

1. INTRODUCTION

The Internet of Things (IoT) is the application of physical devices and everyday objects of Internet connectivity. Using circuitry, internet connectivity and other equipment (sensors, for example), these devices can communicate and engage with others over the Wireless and can also be monitored and controlled remotely; where they are built into the Internet. The most commonly employed technology, Internet technology, brings information, expertise and wisdom revolution in society, and is identified as the third-largest wave after the industrial and agricultural revolution. [1][13][19].

According to the integration of various technologies, real-time computing, machine learning, product sensors, and embedded systems, the Internet of Things has evolved. [2][14]. Including home and building automation, new areas of embedded systems, wireless controls, control systems and all other fields related to the internet [1][16]. One of the IoT implementations is the smart door A smart door is an electromechanical lock designed to lock and unlock operations on the door when it is directed by an approved computer to perform the permit process by using a wireless protocol and a cryptographic key. It also tracks exposure and provides updates to the various events these controls and other important activities related to the device's status. Smart doors can be taken into account as part of the smart house. The system needs functional and non-functional requirements; the Use-Case Model is used for this paper. [1][20][21][22].

Recently it is increasingly valuable and important to develop robust methods of analyzing and exhibiting such data and of extracting motivating knowledge that could support decision making with the huge amount of data stored in databases, repositories, and files. [23].

Most smart locks (simple locks, like deadbolts) are mounted on automatic locks and the ordinary locks are physically modified. Smart locking controllers have recently been introduced on the market as well. Unlike conventional locks, intelligent locks need to operate in two main parts: the lock and the key. The key is not a normal key, but a mobile or special key fob that is specially designed for that function to authenticate the wireless system in order to open the door automatically when the automatic locks are activated. ISO security concept is; confidentially and integrally protect information for quick access to information, it is also credible, sensitive and secure. information security [1] [2][24].

Smart locks enable users to access a third party via a virtual key. a person can use regular messaging protocols like e-mail or SMS to transfer the key to the device of the destination. Once this key has been issued, the receiver can open the smart lock during the time the sender has already specified. Doors can be accessed remotely via a mobile app or are denied access. Some smart locks are fitted with built-in Wi-Fi access, which provides the access request person with monitoring features such as notifications of access or cameras [2]. Most smart doors function with a smart portal to inform the user who is at a door and when.

1.1 Problems statement

Technological advances have displaced manual processes effectively in this fast-moving digital world. Controlled access to office space can be a major concern for many well-known companies. Digital login codes will allow companies to keep track of the entry/exit of employees. Login keys to a website provide a secure way to identify a certain location via radio frequencies (RFID) cardholder. Some of the system's common features include running convenience, improved security and remote control at a particular site. Employees can link a particular physical site by using an RFID card.

1.2 Objectives

The researcher's goal is to create a safe system for easy installation and low-cost door smart doors with fingerprint access feature, and RFID card remote control.

In order to guarantee safe and comfortable home security by handling and controlling all proposed devices via the server-based system, we aim to increase security and improve convenience.

2. LITERATURES REVIEWS

A smart lock is an electromechanical lock that enables locking and unlocking of doors from an approved computer with a wireless protocol and a coding key to operate the authorization process. We need these things in order to build a security system for smart doors: [1][2][18] [19]

- **PHP** is the open-source, server-side and script language used to build web applications that PHP reflects the Hypertext Preprocessor. The researcher says a script-based program (code lines) written to automate tasks by the scripting language [8]. PHP can be developed into HTML and it is well designed for developing web applications, eCommerce apps and database applications as well as building dynamic web pages. It is a common language with the ability to connect easily to MySQL, Oracle and other databases [9].

In this case, the PHP script can be executed without a server system or application by using only a PHP parser, used for simple text processing jobs and mission managers this is usually the PHP script [7].

- **Raspberry**, the low-cost, device in credit card size which connects to a computer monitor or a TV with a regular mouse and keyboard is shown as shown in Figure (1). It's a versatile little device that allows visitors of all ages to discover information technology and learn how to program in Scratch and Python languages. It can do everything you would expect from the Internet, high-definition video playback, smartphones, text processing, and online software on your phone [6].

However, Raspberry Pi can communicate with the outside world and is used in various remote maker ventures, from music machines and parent detectors to meteorological stations and in fraternized birdhouses. We want to see kids from all over the world use the Raspberry Pi to learn how computers work and how to program [17].

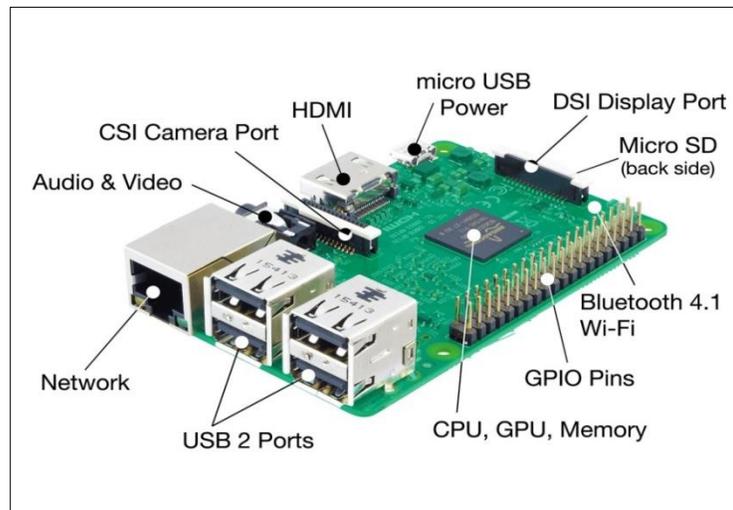


Fig. (1) Raspberry Pi3

- **The Arduino**, is a software and hardware-based open-source electronics platform, as shown in figure (2). Inputs-the sensor signals, finger on a button or the Twitter message are read by Arduino boards and turned into a power output by turning a motor on, flipping on a Lamp, posting something online. When submitting a set of instructions, the developer will advise the board on what to do [10].



Fig. (2) Arduino

- **MySQL** is today's leading and most respected open-source software platform. Because of its ubiquity across heterogeneous systems and program piles and its well-known performance, reliability, and usability numerous of the best-known and most popular websites in the world are based on MySQL. One of the activities of the Institute for Research and Community Service is research, publications and community services. There is no distinction between the management of these tasks today and the Internet, and therefore, we need a framework that can handle each activity. A framework supported by the database system is also ideal for ensuring proper management. This article discusses how to configure the database system to ensure that the performance of the storage systems does not alter when the data is accessed [25].
In the construction of the database system, operation optimization is carried out. When deciding on system performance, database architecture plays an important role. This study uses one of the functions given when MySQL to automate the process by using the view [15][17][25].
- **Wi-Fi module ESP8266** is an autonomous SOC with an optimized TCP / IP protocol connection that provides access to a Wi-Fi network for any micro-controller. The ESP8266 can either host an application or access all Wi-Fi networking features of a different application processor, as shown in figure (3). You can easily connect it to your Arduino computer and get as much Wi-Fi as a standard Wi-Fi shield provides (and that's just out of the box). Every ESP8266 module comes pre-programmed with an (AT) command-set firmware. The ESP8266 is an incredibly economical board with a large group that is constantly growing [11][12][26].



Fig. (3) ESP8266 Wi-Fi Module

- **JavaScript**, is a lightweight, interpreted and first-class object-oriented language, best known for Web Pages scripting, but it is also used in many Non-browser settings. It is a multi-paradigm scripting language built on a framework that is versatile and supports object-oriented, critical and functions [4][5]. JavaScript is running on your customer's side of the web to design/program how the web pages perform in the event. JavaScript is a powerful language that is commonly employed to govern website actions and also easy to learn [5].

3. METHODOLOGY

The overall project framework, including the planning, design, and implementation of a security system for smart doors on the Website, is discussed in this section.

3.1 Smart system security doors Requirements

The basic idea is that the user employs an RFID reader to open the smart door and then, via his website, the manager will access login information and server name as shown in figure (4).

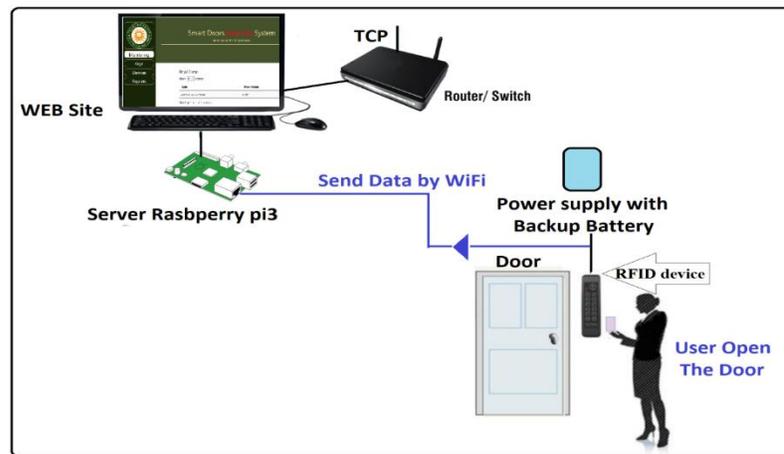


Fig. (4) Send data opening the door to the manager through the server

First, after signing on the system, the user will sign within. A system of four main sections can be seen by the manager In the first section all user data are monitoring including the date and time of entrance and exit. The second section is the keys in which managers track the RFID for applications, the validity of doors, the time and validity according to the user form, and the third section is the unit from which the doors within the network are registered and the fourth and last section is the notifications through this section.

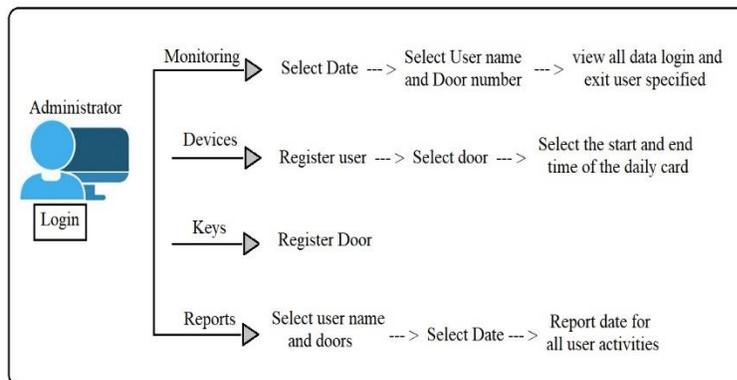


Fig. (5) Use Case Model Smart System

The user will record the RFID in the network, where only cards can be registered by the manager. The boss then allows him to open the door based on the purpose of the customer. Use the status table, as shown in figure (6).

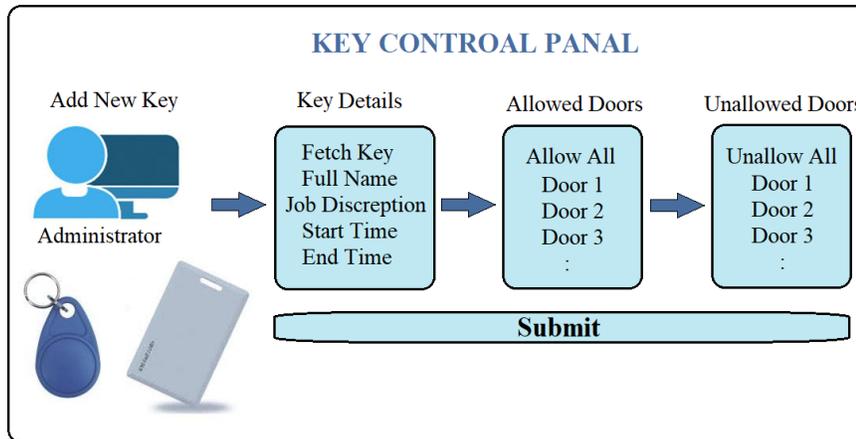


Fig. (6) Use case Model

When the card is switched on, the user may use the card for opening the smart door and send data to the system or the server automatically when the door is opened. The information (user name, user function, door opening validity or not and could open the door or not with time and date to open the smart door) As illustrated in figure (7), using the status chart.

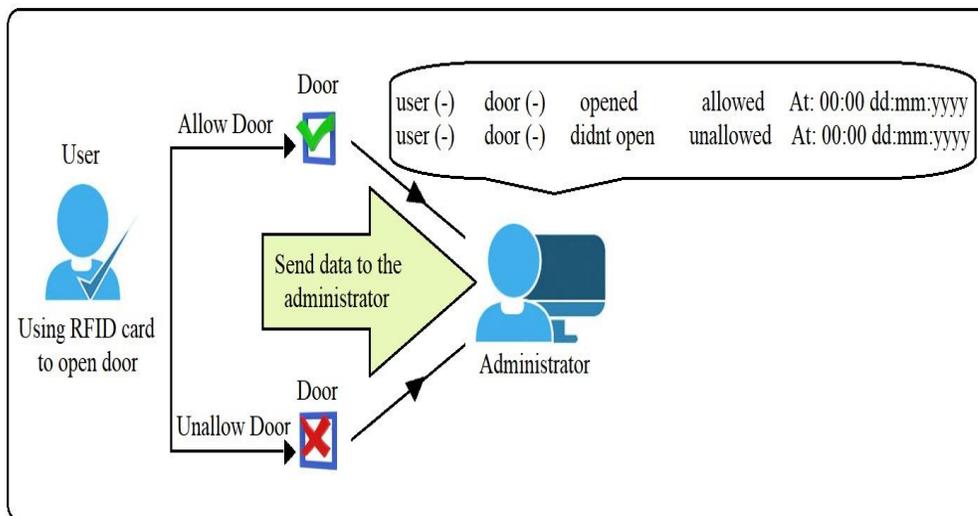


Fig. (7) Use case Model

3.2 Smart System Server Side

The server contains:

- 1- JSON as serialization and transmission via a network connection of structured data.
- 2- MySQL as a database and PHP scripts.

3.2.1 PHP:

1. Used to connect the server to the database.
2. Used to process the data.

3.2.2 MySQL:

1. Used to create databases and tables.
2. Store information and data.

The researcher builds "Smart Doors Security System" tables with MySQL, according to the figure (8).

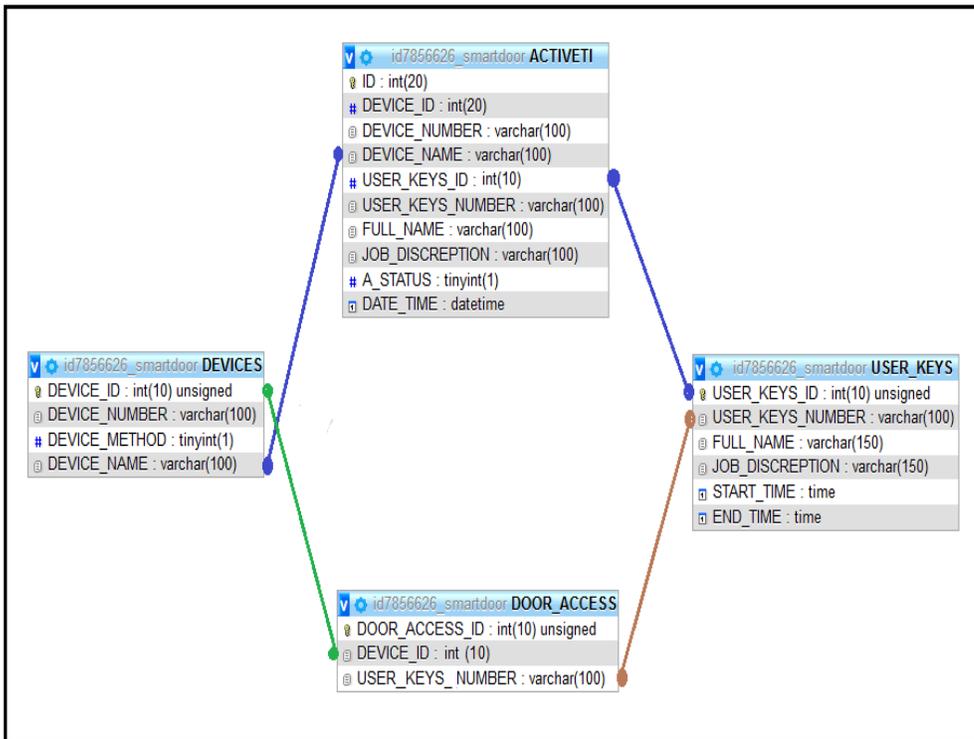


Fig. (8) Database ER-diagram

3.3 Smart System Client Side

Bootstrap includes HTML, CSS and JavaScript on the Client-side as a design website.

- **Bootstrap:**

1. Used to design a website.
2. Used to support for JavaScript plugins.

Using Bootstrap, the researcher designed a site shown in figure (9) for the "smart door security system".

Fig. (9) Website Design

3.4
Smart



System client-side has two types which are administrator and user:

3.4.1 Administrator:

By using the website of the security system and its authorities the system fully monitors the smart doors:

1. Add a new key or new user.
2. Add a new door.
3. Monitor all user activities at any time as all activities are recorded in the system.
4. Edit user name or delete a user.
5. Edit door name or delete door.
6. Searching for data.

3.4.2 Add new key or new user

This process requires testing whether or not the ID card is included in the system. the manager is able to determine the time allocated to the operation of the ID card as shown in figure (10) in order to add and give the user the authority according to their task.

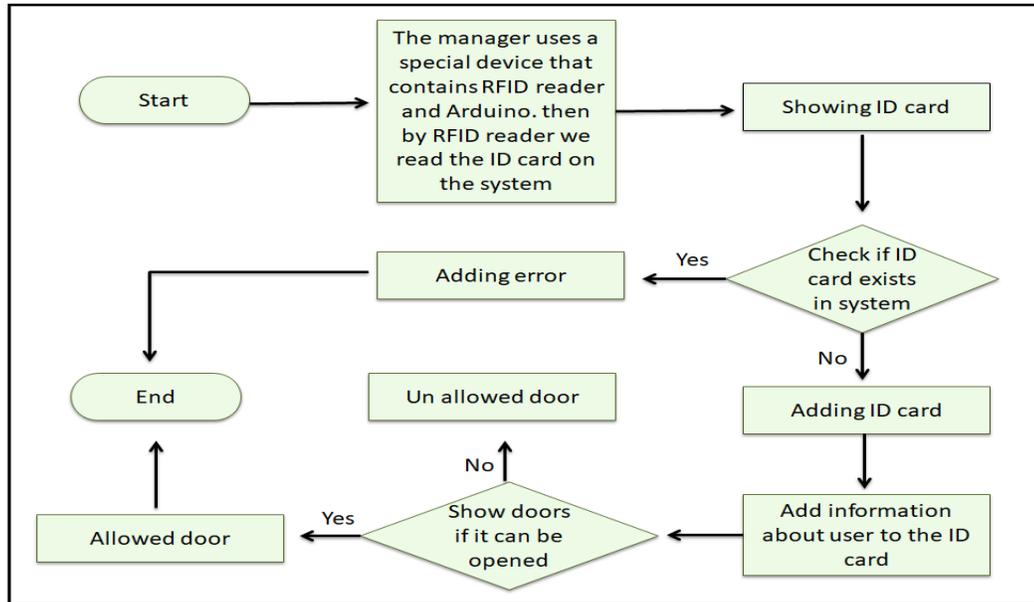


Fig. (10) Adding user

3.4.3 Add a new door

This activity includes verifying or not the system's RFID software access. Then give the name of a door and the Door Number to add a new device into the network and any user who opens the door, as shown in figure (11) can be selected.

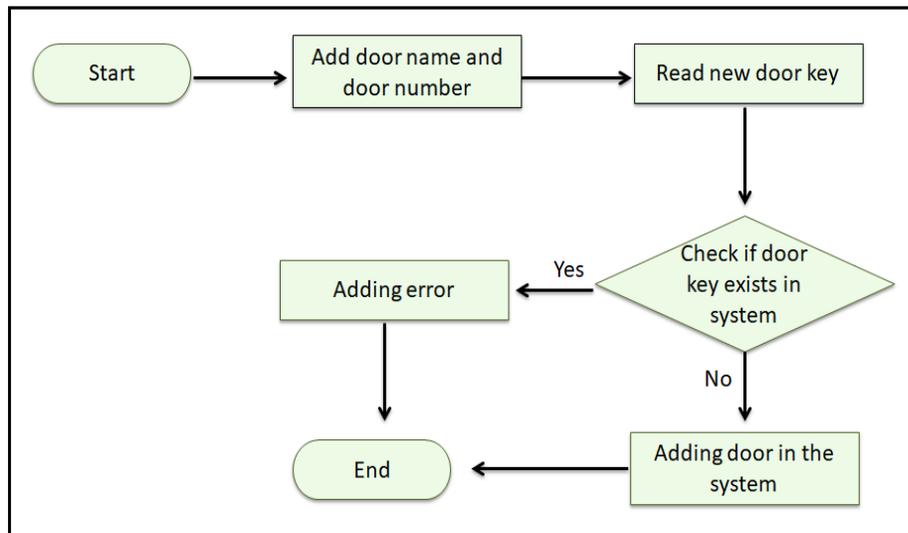


Fig. (11) Adding device

3.4.4 Monitor all user activities at any time because the system records all activities:

Using an ID card, the display shows the user's full information, as shown in figure (12): the date and time of opening the door and whether or not the door is opened.

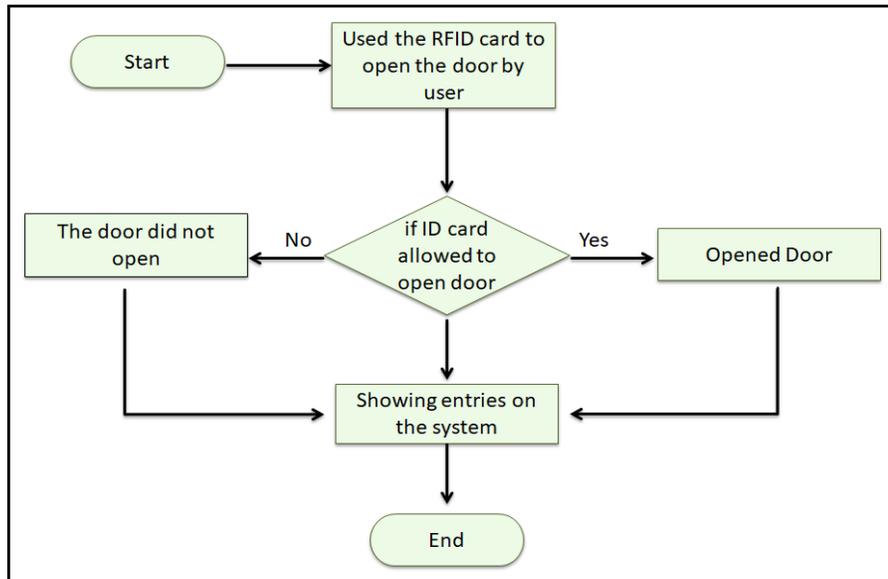


Fig. (12) monitoring user activity

3.4.5 Change user name or delete user

Update or delete a user's name: In order to change or remove a user, the user name must be specified, as shown in figure (13).

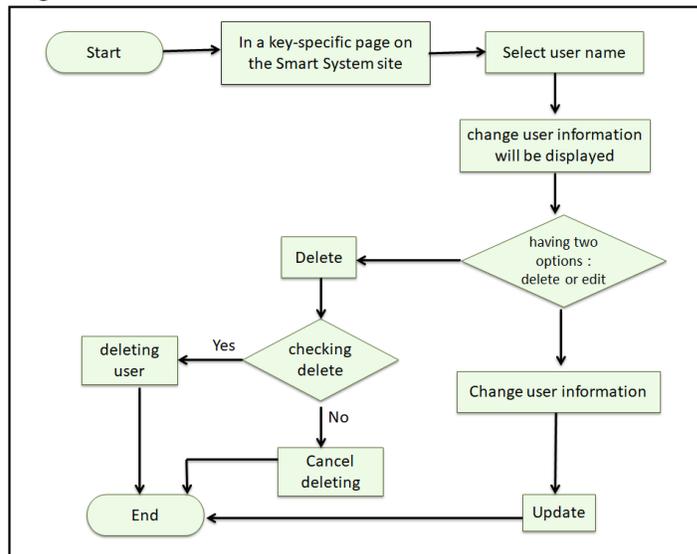


Fig. (13) change the user name and deleting

3.4.5 Change door name or delete door:

Changing the door name and deleting the door, which is shown in figure (14), implies that the door name is specified in order to change or remove the door.

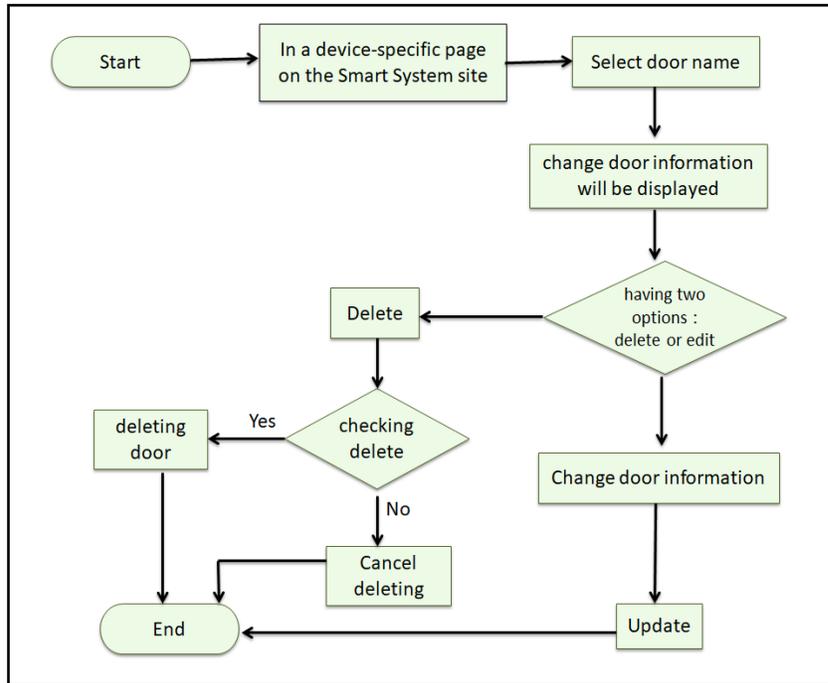


Fig. (14) change device (door) name and deleting

3.4.5 Searching data:

The user is sending the data to the computer and save them because he uses an RFID reader. This operation involves the username, name of the door and date, and we can then see with the door as shown in figure (15), all of the user's activities.

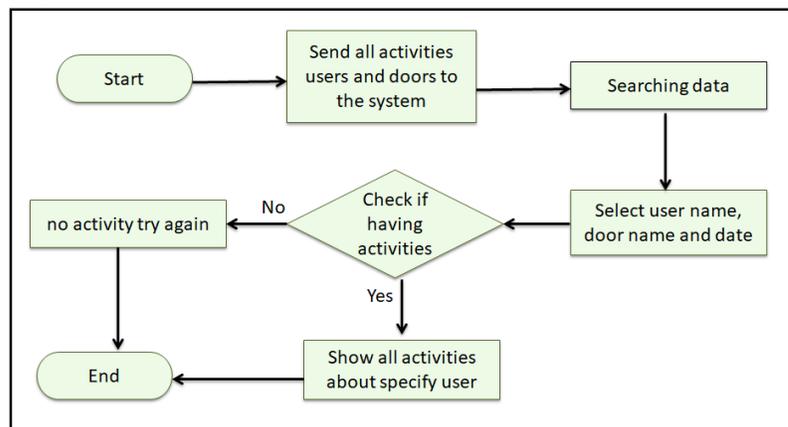


Fig. (15) Searching data

3.5 User:

Control the smart doors with the RFID card, as shown in the figure (16), to open and close the door.

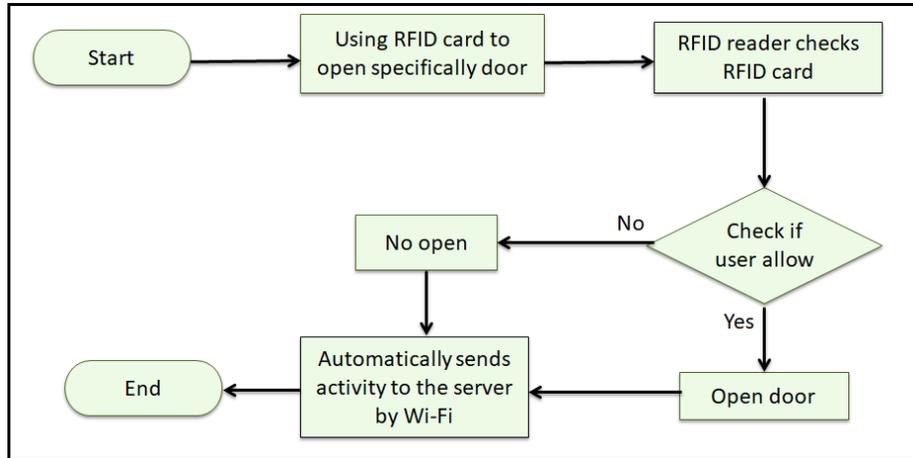


Fig. (16) user activities

3.6 Java script:

These processes are done using JavaScript, which is shown in the following (add user, edit user, delete user, add device update client, remove a device, control, and search):

3.6.1 Add user function:

In order to add new users, the manager first calls databases and table and insert all columns into the table and then select a door for the user, the operation is valid if all columns of data inserted and otherwise, every column is empty.

```
if ($_SERVER["REQUEST_METHOD"] == "POST") {
    // Get the form fields and remove whitespace.
    $key_number = mysqli_real_escape_string($conn, $_POST['key_number']);
    $full_name = mysqli_real_escape_string($conn, ucwords(strtolower($_POST['full_name'])));
    $job_dis = mysqli_real_escape_string($conn, ucwords(strtolower($_POST['job_dis'])));
    $StartTime = mysqli_real_escape_string($conn, $_POST['StartTime']);
    $EndTime = mysqli_real_escape_string($conn, $_POST['EndTime']);
    $Doors = array();
    foreach($_POST['Doors'] as $Door){
        $Door = mysqli_real_escape_string($conn, $Door);
        array_push($Doors,$Door);
    }
    if ( empty($key_number) || empty($full_name) || empty($job_dis) || empty($StartTime)
    || empty($EndTime) || sizeof($Doors) == 0){
        http_response_code(400);
        echo "Oops! There was a problem with your submission. Please complete the form and try again.";
        exit;
    }
}
```

Fig. (17)
add user
function

3.6.2 Edit user

function:

For Edit the User, we first call the database and table and enter the data for all columns in the table to modifying the User Data. This procedure is valid if all the columns entered the data and any column is empty and we receive a message stating that "There was a problem" in figure (18).

```

if ($ SERVER["REQUEST_METHOD"] == "POST") {
    // Get the form fields and remove whitespace.
    $ID = mysqli_real_escape_string($conn, $_POST['edit-id']);
    $full_name = mysqli_real_escape_string($conn, ucwords(strtolower($_POST['edit-full_name'])));
    $job_dis = mysqli_real_escape_string($conn, ucwords(strtolower($_POST['edit-job_dis'])));
    $StartTime = mysqli_real_escape_string($conn, $_POST['edit-StartTime']);
    $EndTime = mysqli_real_escape_string($conn, $_POST['edit-EndTime']);
    $Doors = array();
    foreach($_POST['edit-Doors'] as $Door){
        $Door = mysqli_real_escape_string($conn, $Door);
        array_push($Doors,$Door);
    }
    if ( empty($ID) || empty($full_name) || empty($job_dis) || empty($StartTime)
    || empty($EndTime) || sizeof($Doors) == 0){
        http_response_code(400);
        echo "Oops! There was a problem with your submission. Please complete the form and try again.";
        exit;
    }
}

```

Fig. (18) edit user function

3.6.3 Delete user function:

To delete the user, first of all, call the user database and, if the user ID is selected, we can delete the user's data and then execute the operation in a door table, otherwise we get the message stating "Was a problem," if it's empty, as shown in the figure (19). The operation is executed if it is not performed.

```

if ($ SERVER["REQUEST_METHOD"] == "GET") {
    // Get the form fields and remove whitespace.
    $user_id = mysqli_real_escape_string($conn, $_GET['id']);
    if ( empty($user_id)){
        http_response_code(400);
        exit;
    }
    $sql = "DELETE FROM USER_KEYS WHERE USER_KEYS.USER_KEYS_ID = $user_id ";
    $sql .= "DELETE FROM DOOR_ACCESS WHERE DOOR_ACCESS.USER_KEY_ID = $user_id ";
    if (mysqli_multi_query($conn,$sql)){
        http_response_code(200);
        mysqli_close($conn);
        exit;
    }
}

```

Fig. (19) delete user function

3.6.4 Add device function:

When a manager add a new device, contact the database and the server, then he will insert the data in the table on all columns and there are two choices to define the system function, respectively (Enter new key and door key), if you choose (Enter new key), then if the device you want to add a new user then the door key will add the new button, as shown in figure (20).

```
$sql = "INSERT INTO DEVICES(DEVICES.DEVICE_NUMBER, DEVICES.DEVICE_METHOD,
DEVICES.DEVICE_NAME) VALUES('$device_number', '$device_method', '$device_name')";
$result = mysqli_query($conn,$sql);
if($result){
    $sql = "SELECT DEVICES.DEVICE_ID, DEVICES.DEVICE_METHOD,
DEVICES.DEVICE_NAME FROM DEVICES WHERE DEVICES.DEVICE_NUMBER = '$device_number' ";
    $result = mysqli_query($conn,$sql);
    if(mysqli_num_rows($result) != 0){
        $row = mysqli_fetch_assoc($result);
        if($row["DEVICE_METHOD"]){
            $device_method = "Entering new key";
        }else{
            $device_method = "Door key";
        }
    }
    $array = array(
        "deviceId" => $row['DEVICE_ID'],
        "deviceNumber" => $device_number,
        "deviceName" => $row['DEVICE_NAME'],
        "deviceMethod" => $device_method
    );
};
```

Fig. (20) add device function

3.6.5 Edit device function:

In order to edit the device, first access the database/table, then all columns in the Table can be used, and then the manager can change the device data and the device function if we choose (enter new key), otherwise, the device is to add new users if we choose to add new door (door key), as shown in figure (21).

```
if($result){
    $sql = "SELECT DEVICES.DEVICE_NUMBER, DEVICES.DEVICE_METHOD,
DEVICES.DEVICE_NAME FROM DEVICES WHERE DEVICES.DEVICE_ID = $ID;";
    $result = mysqli_query($conn,$sql);
    $row = mysqli_fetch_assoc($result);
    if($row['DEVICE_METHOD']){$method = "Entering new key";}else{$method = "Door key";}
    $array = array(
        "deviceId" => $ID,
        "deviceNumber" => $row['DEVICE_NUMBER'],
        "deviceName" => $row['DEVICE_NAME'],
        "deviceMethod" => $method
    );
};
```

Fig. (21) edit device function

3.6.6 Delete device function:

Originally, to remove the device name the database and the system that a manager can delete if he choose to have the user ID and delete the data from this device in the device table, otherwise, procedure will be performed in the door row, then the process will be exited if the device I d is empty, as shown in figure (22).

```
$device_id = mysqli_real_escape_string($conn, $_GET['id']);
if ( empty($device_id)){
    http_response_code(400);
    exit;
}
$sql = "DELETE FROM DEVICES WHERE DEVICES.DEVICE_ID = $device_id ";
$sql .= "DELETE FROM DOOR_ACCESS WHERE DOOR_ACCESS.DEVICE_ID = $device_id ";
if (mysqli_multi_query($conn,$sql)){
    http_response_code(200);
    mysqli_close($conn);
    exit;
};
```

Fig. (22) delete device function

3.6.7 Monitoring function:

To monitor users when the key is used to attempt to open a door then to call row status, inform whether or not the key is enabled and display all the key data, as shown in figure (23).

```

if(mysql_num_rows($result) == 0){
    $stack = array();
}else{
    $stack = array();
    while($row = mysqli_fetch_assoc($result)){
        if($row["A_STATUS"]){
            $state = "YES";
        }else{
            $state = "NO";
        }
        $innr_array = array(
            "ID" => $row["ID"],
            "Date" => $row["DATE_TIME"],
            "DoorName" => $row["DEVICE_NAME"],
            "UserName" => $row["FULL_NAME"],
            "Status" -> $state
        );
        array_push($stack, $innr_array);
    }
}

```

Fig. (23) monitoring function

3.6.8 Searching data function:

To check data first we receive a message "Is there a problem," as shown in figure (24), contact the database and the table then select (key and door), and insert the information into (start and end time) if one of them is null.

```

if ($_SERVER["REQUEST_METHOD"] == "POST") {
    // Get the form fields and remove whitespace.
    $StartTime = mysqli_real_escape_string($conn, $_POST['StartTime']);
    $EndTime = mysqli_real_escape_string($conn, $_POST['EndTime']);
    $Doors = array();
    foreach($_POST['Doors'] as $Door){
        $Door = mysqli_real_escape_string($conn, $Door);
        array_push($Doors,$Door);
    }
    $Keys = array();
    foreach($_POST['Keys'] as $Key){
        $Key = mysqli_real_escape_string($conn, $Key);
        array_push($Keys,$Key);
    }
    if ( empty($StartTime) || empty($EndTime) || sizeof($Doors) == 0 || sizeof($Keys) == 0){
        http_response_code(400);
        echo "Oops! There was a problem with your submission. Please complete the form and try again.";
        exit;
    }
}

```

Fig. (24) searching data function

3.7 Arduino

The manager needs Wi-Fi to access the data on your server and this mechanism is enabled on Arduino to allow Wi-Fi. If the Wi-Fi connection is awaiting the turning on of a led yellow, otherwise the led green is enabled if the Wi-Fi connection has been completed, as shown in figure (25).

```
Serial.begin(9600);
WiFi.begin(networkName, networkPassword);
while (WiFi.status() != WL_CONNECTED) {
  delay(200);
  digitalWrite(LED_WIFI, HIGH);
  delay(200);
  digitalWrite(LED_WIFI, LOW);
  Serial.println("Waiting for connection");
}
Serial.println("Connecting successfully");
digitalWrite(LED_WIFI, HIGH);
```

Fig. (25) Wi-Fi connection function

If the door's key is activated or not, the green led turns on as shown in the figure (26) unlike the red led unlocks.

```
Serial.println(kv.value.as<char*>());
if(String (kv.value.as<char*>()) == "true"){
  digitalWrite(LED_ACCEPT, HIGH);
  delay(3000);
  digitalWrite(LED_ACCEPT, LOW);
}else{
  digitalWrite(LED_REJECT, HIGH);
  delay(1000);
  digitalWrite(LED_REJECT, LOW);
}
```

Fig. (26) user activity function

3.8 Implementation and Testing

3.8.1 Security system implementation and testing

The Smart Doors security system acts as a controller and user in two different types of operations. Operating operation is as shown in figure (27), for instance (open a door).



Fig. (27) smart doors security system user operation

Additionally, administrator's activity is a GUI that contains a number of sections, such as adding a new key, removing the user from the device, changing the user name or deleting the device, changing the name of the door or deleting the device, changing the user's time activity and reports, as illustrated in figure (28).

Smart Doors Security System
More secure life for everybody
By Computer science dept./ Cihan University

Monitoring
Keys
Devices
Reports

Real Time
Show 10 entries Search:

Date	Door Name	User Name	Status
2019-03-22 07:46:05	Door3	Mustafa	YES

Showing 1 to 1 of 1 entries Previous 1 Next

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Fig. (28) smart doors security system administrator interface

Here, after entry to a security database, an administrator can use the functionality for smart doors. For instance, in Figure (29) add a new key to the door device After the key has been chosen, the username has been applied to the user and the entry and exit time specified, a new key is attached to the submit button.

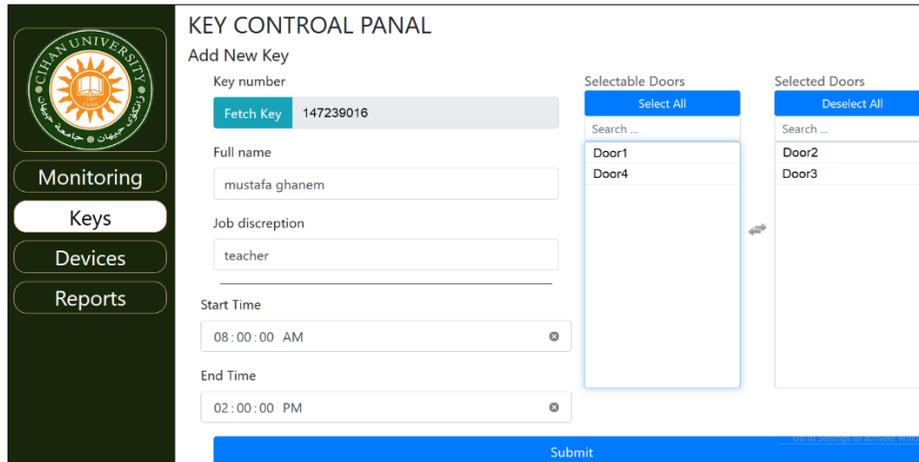


Fig. (29) add new key interface

Once a key has been inserted, the administrator may alter the username or change the time of entry, or delete the door or key, if the key name is changed by the update button, or if a key is removed by pressing the delete button, as shown in the figure (30).

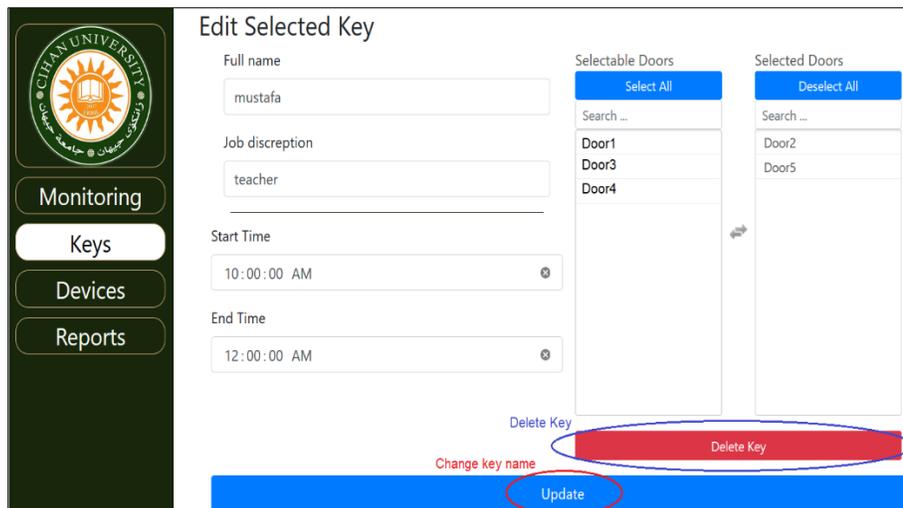


Fig. (30) edit the key name or delete interface

After the system added a new device as shown in figure (31), when a new device (door) is opened, the device name and the interface process are added.

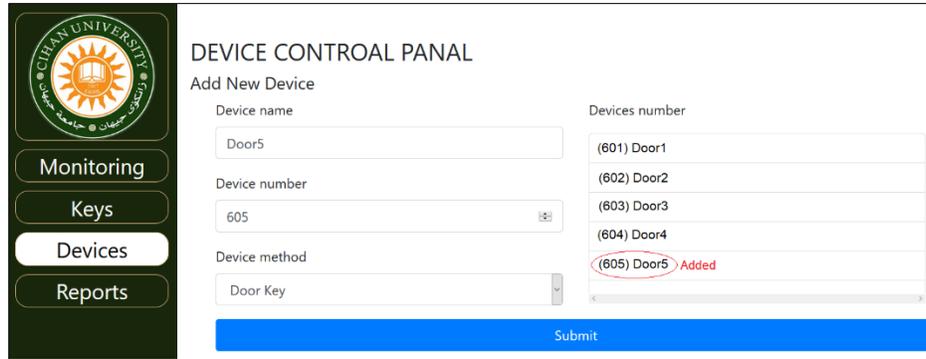


Fig. (31) add new device interface

After you have installed the device, the administrator will change the approved device name or door when you push an updating button to modify a key name, or a device can be disabled as shown in figure 32, by clicking the Remove Device button.

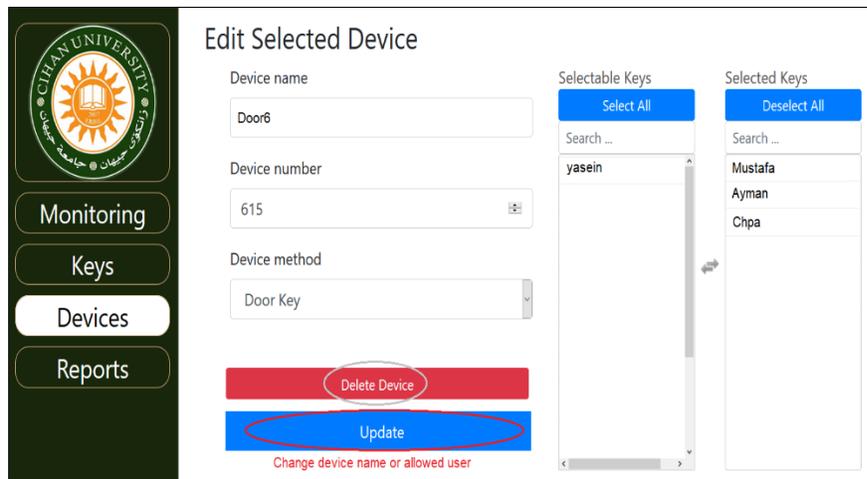


Fig. (32) Edit a device or delete interface

The Manager will monitor full data of the user and the information as shown in figure (33): date and time when to open the door and whether the user's door is allowed or not.

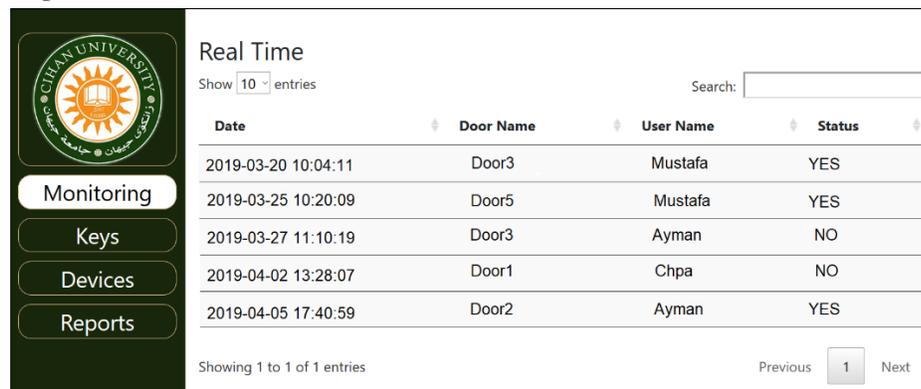


Fig. (33) monitoring interface

If the user employs or does not use a door tool that we determine after pressing the search button, it may report any key. If the door is opened or not, results will appear, showing the time and date as shown in figure (34).

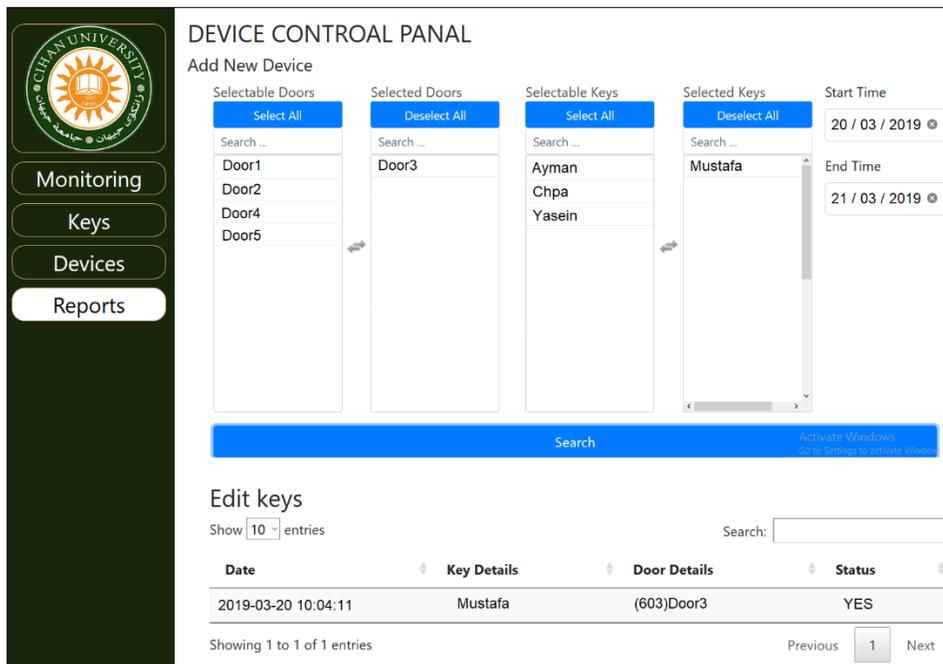


Fig. (34) Reports interface

4. CONCLUSIONS

Findings indicate that the security system of smart doors is conveniently and safely managed by its administrator using the website in conjunction with a raspberry server even when the server is away from the entrance via the Wi-Fi network.

This was done by solving a simple and general problem facing an administrator who cannot control user interactions in his daily routines. The security system of smart doors has many of the issues that have been answered by this research: not knowing the location of the mobile phone, this work has fixed by having the last recorded mobile phone location and sending it to users

- ❖ Unknown to the user, this research solved this by using a website connected to the raspberry server which sends all action to the administrator and tracking the user's behavior.
- ❖ When a user utilizes the standard door opening key, the time to open and close the door cannot be determined and this is solved by using the RFID card and the device can be used to determine the time for the door open and close.
- ❖ By comparison to the standard key, this search gives the user the right to open the door and to do so by creating its own system of security.

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