# Software Design Description

## Design Overview

* This document describes the technical and user interface design of MIC system. It includes the architectural design, the detailed design of common functions and business functions and the design of database model.
* The architectural design describes the overall architecture of the system and the architecture of each main component and subsystem.
* The detailed design describes static and dynamic structure for each component and functions. It includes class diagrams, class explanations and sequence diagrams for each use cases.
* The database design describes the relationships between entities and details of each entity.
* Document overview:
  + Section 2: gives an overall description of the system architecture design.
  + Section 3: gives component diagrams that describe the connection and integration of the system.
  + Section 4: gives the detail design description, which includes class diagram, class explanation, and sequence diagram to details the application functions.
  + Section 5: describe a fully attributed Entity Relationship Diagram.

## System Architecture Design

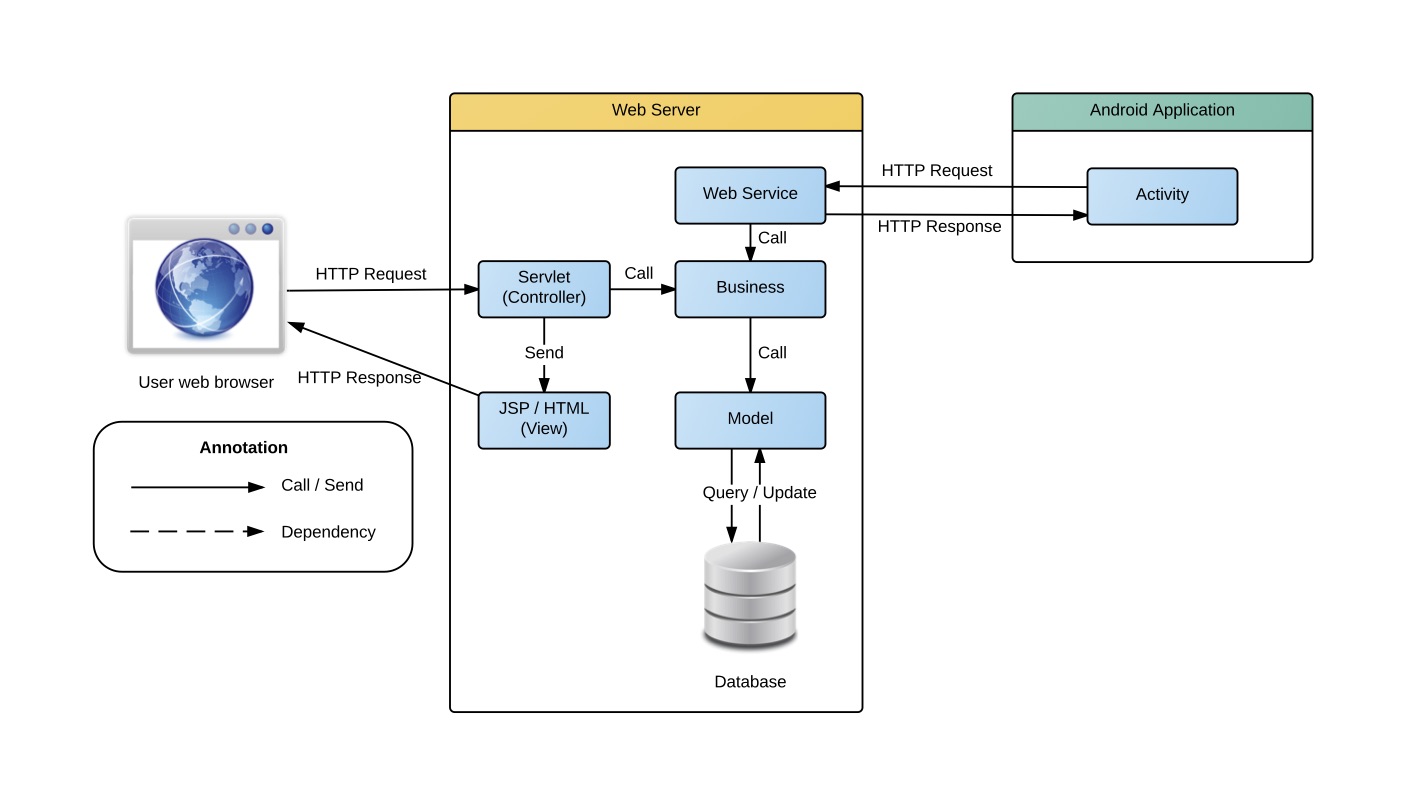


Figure 1 System architecture design

### Web Application architecture description

In this Web Application, the system is developed under J2EE MVC architecture style.

* **Servlet (Controller)** is the parts of the application that acts like event handler to handles user interaction. Typically controller read data from a request and calls appropriate Business’s method then selects view to return to user.
* **JSP/HTML (View)** is the parts of the application that handles the display of the data. The selection of View is under control of Controller.
* **Business** is the parts of the application that do business processing to solve domain problems.
* **Model** is the parts of the application that acts like a data transfer object between the system and database.
* **Web Service** is the parts of the application that acts like event handler for web and mobile communication via REST method.

### Mobile Application architecture description

The application is developed as an Android native application. In general, the application architecture conforms to Android architecture.

* **Activity** is the basic core of an android application that handles user input,create thread to run asynchronous tasks, send request and receive data from server via web services ...

## Component Diagram

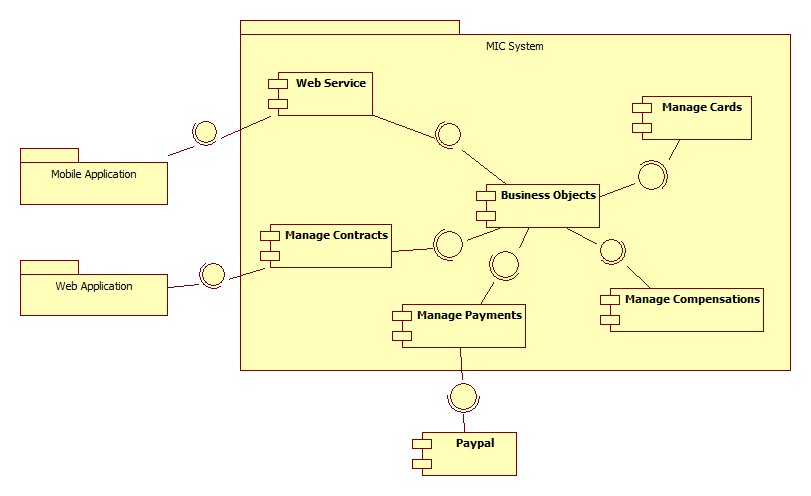


Figure 2 Component Diagram

|  |  |
| --- | --- |
| Component Dictionary: Describes components | |
| Web Application | Web application package: View, Controller |
| Mobile Application | Mobile application package |
| Web Service | Includes all API controller of the system |
| Manage Contracts | Business logic to manage contracts |
| Manage Cards | Business logic to manage cards |
| Manage Compensations | Business logic to manage compensations |
| Manage Payments | Business logic to manage payments |
| PayPal | Handle payment process with PayPal API |

Table 1 Component Dictionary

## Detailed Description

### Class Diagram

### Class Diagram Explanation

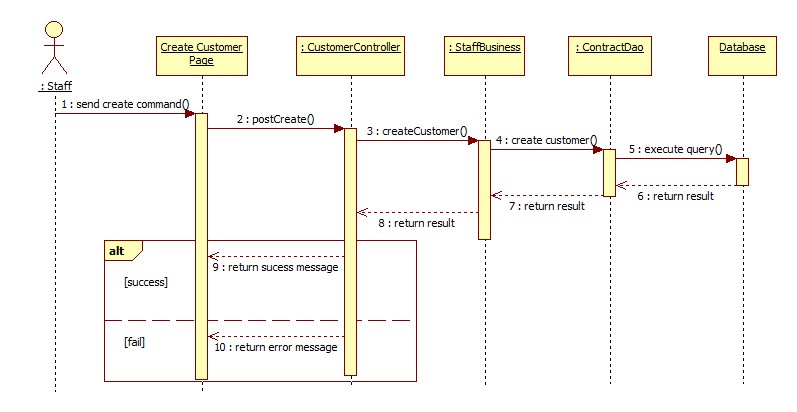
### Interactive Diagram

#### Web Application

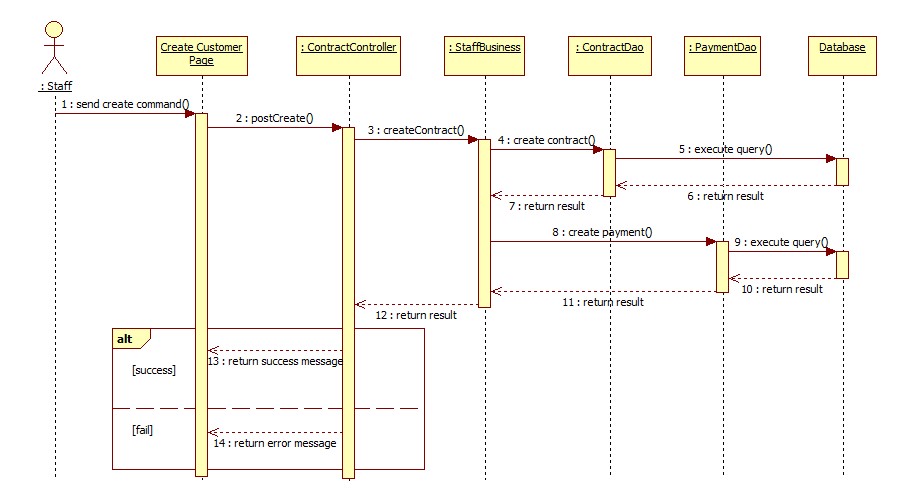
##### Customer

##### Staff

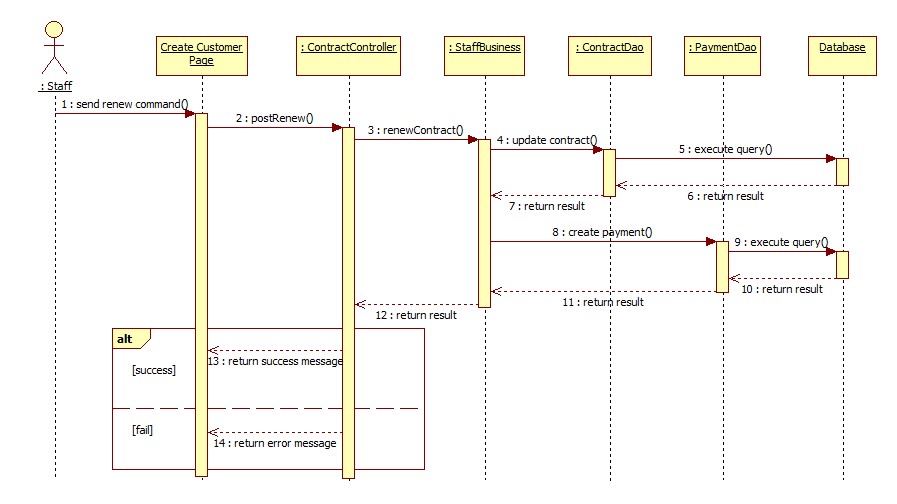
###### Create customer



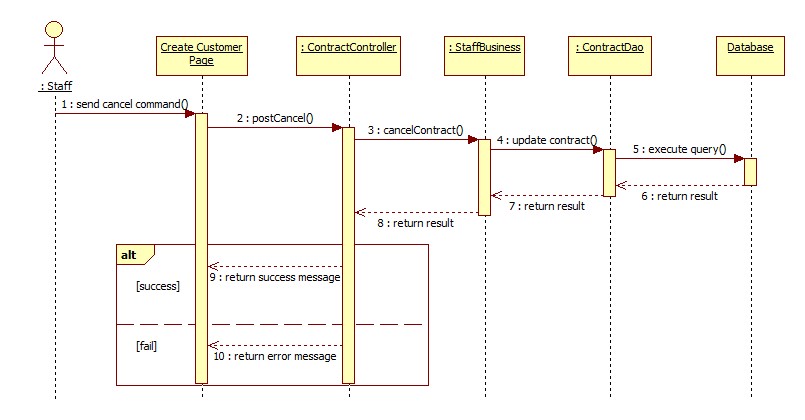
###### Create new contract



###### Renew contract



###### Cancel contract



#### Mobile Application

##### Checker Mobile Application

###### <Police> Verify card validation

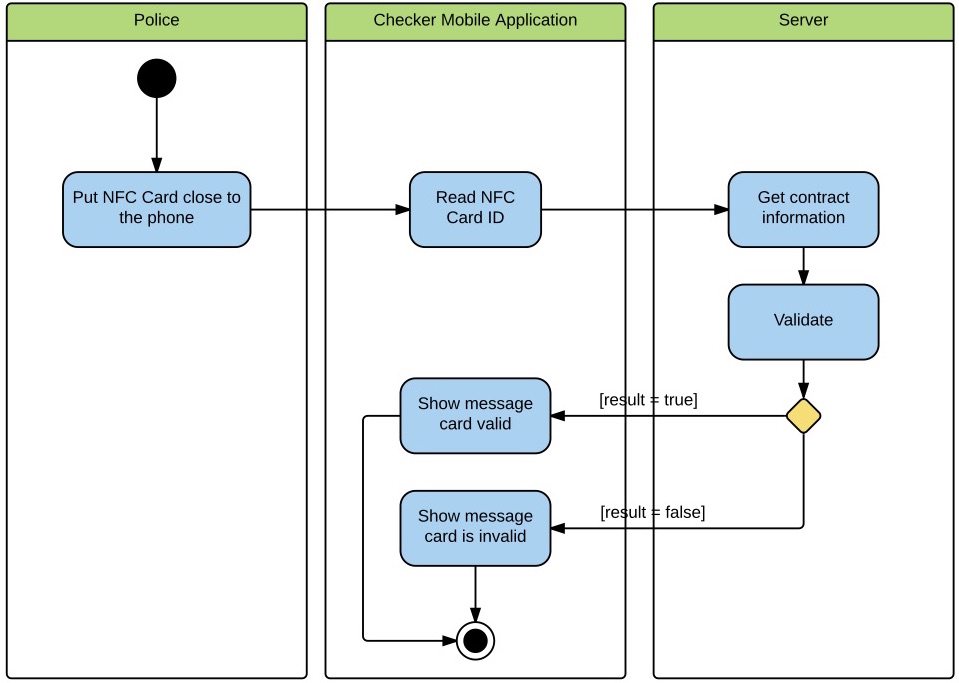


Figure 3 <Police> Verify card validation

###### <Police> Add punishment information

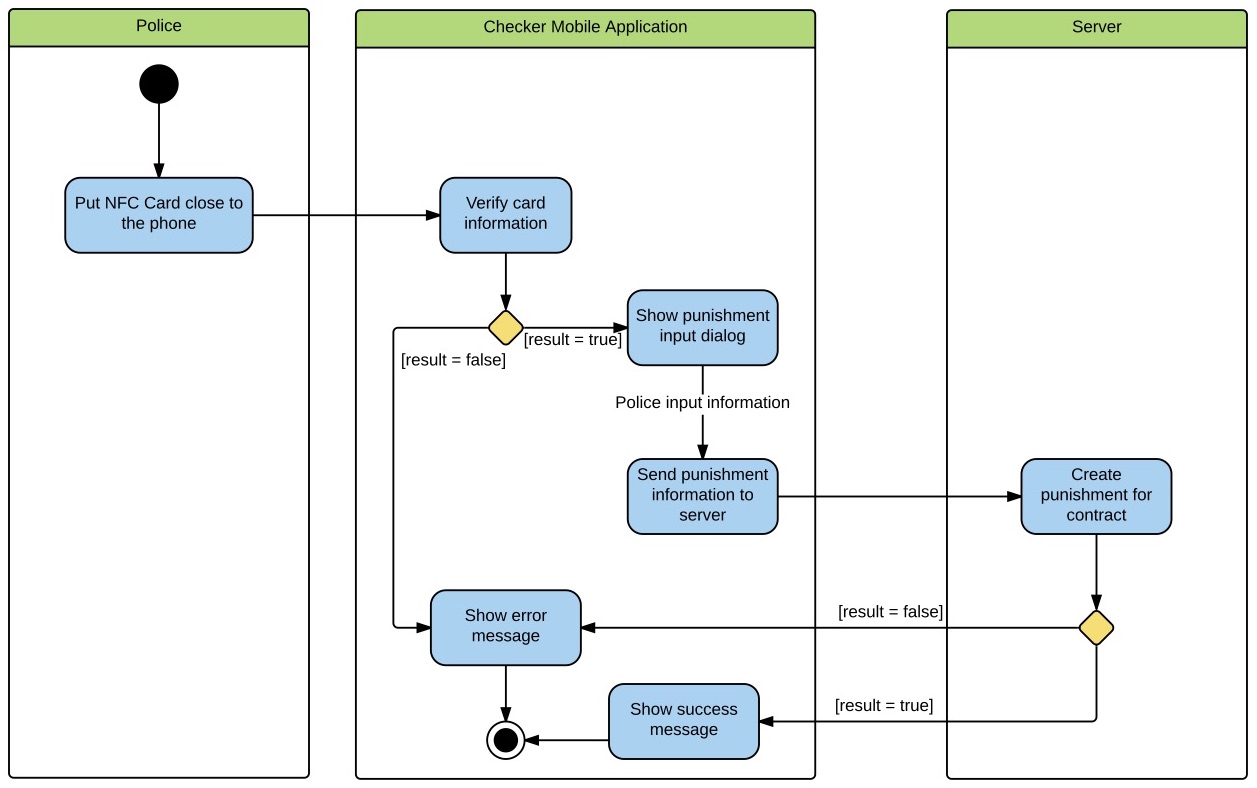


Figure 4 <Police> Add punishment information

##### Printer Mobile Application

###### <Staff> Search contract

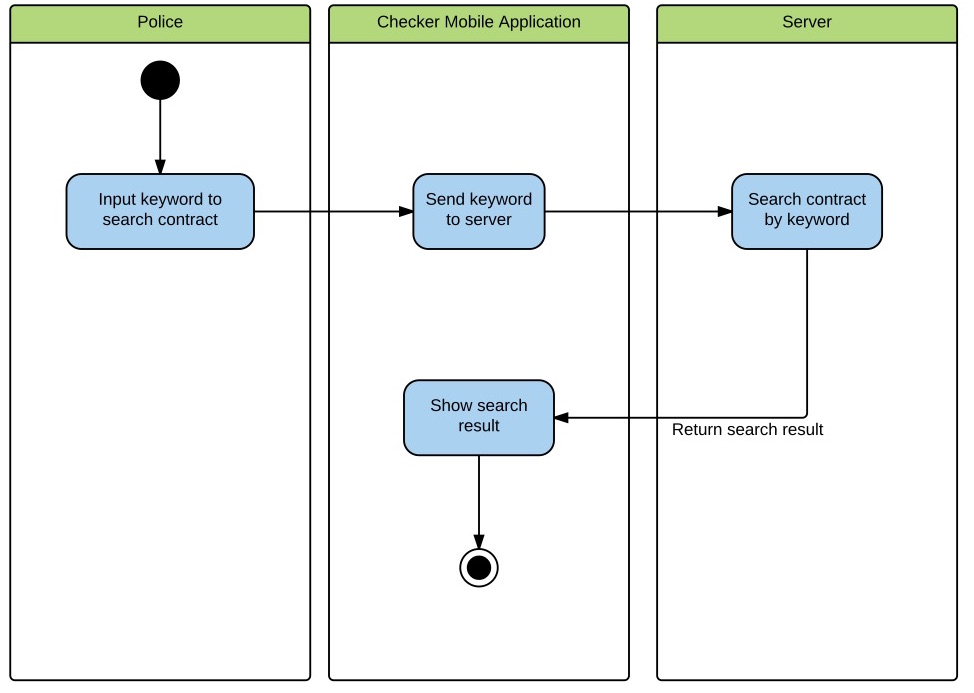


Figure 5 <Staff> Search contract

###### <Staff> View contract information

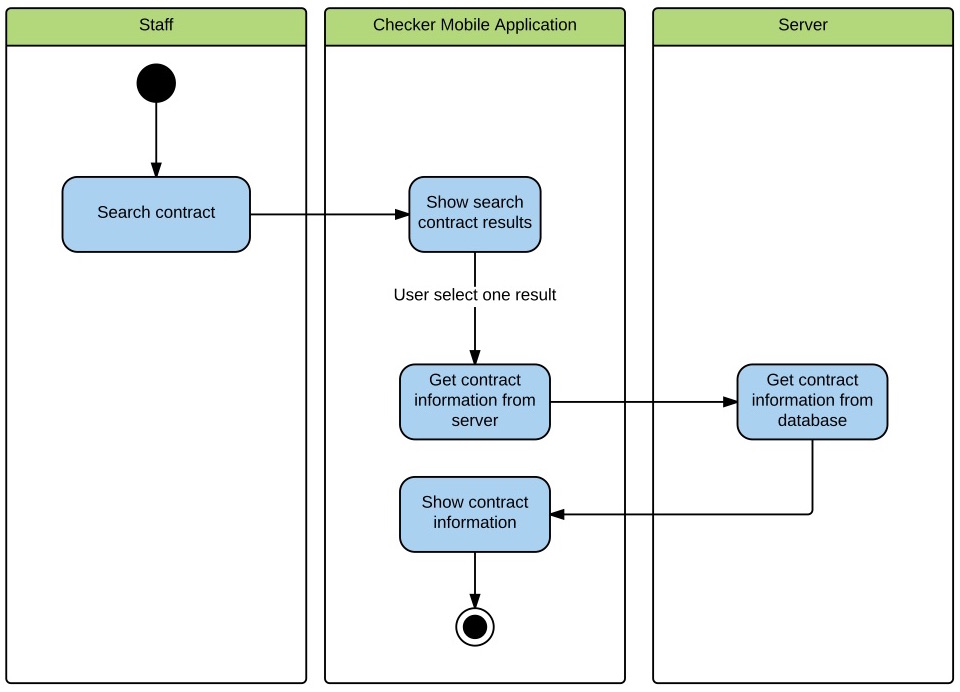


Figure 6 <Staff> View contract information

###### <Staff> Print information to NFC Card

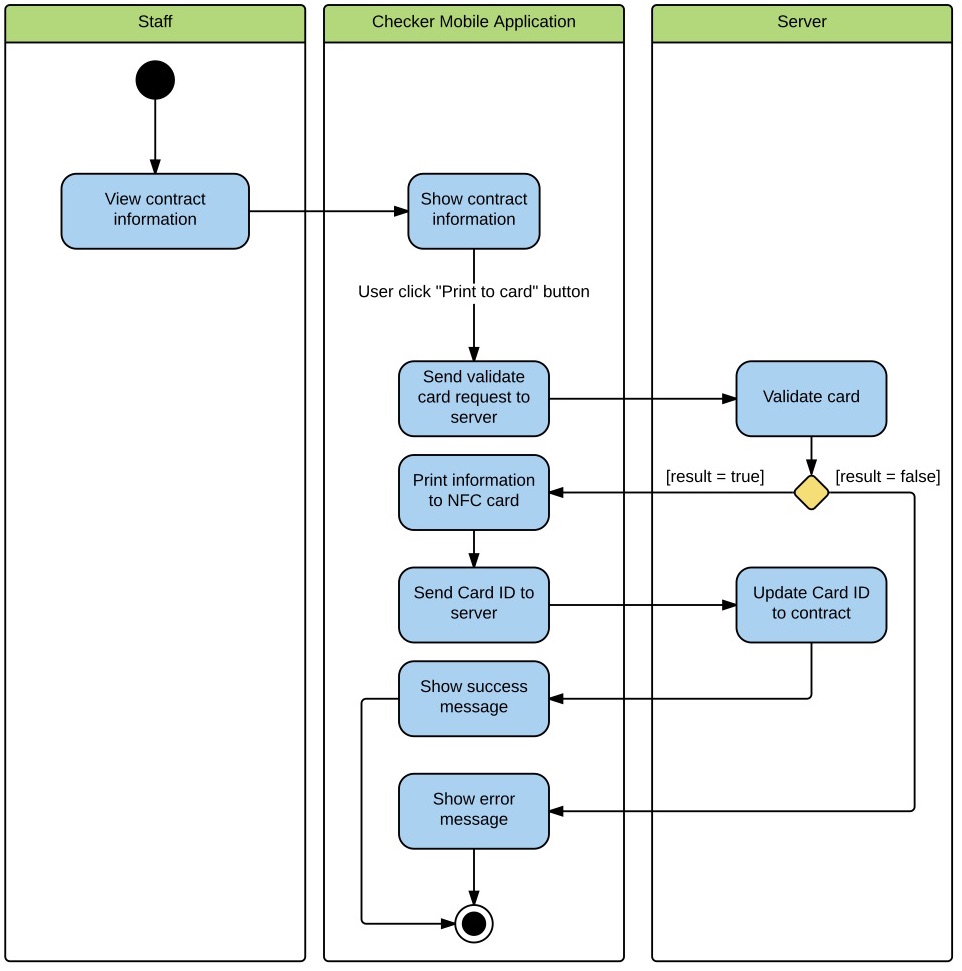


Figure 7 <Staff> Print information to NFC card

## User Interface Design

### Web application Design

#### Customer Interface Design

#### Staff Interface Design

##### Staff home page



**Fields**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| No | Field Name | Description | Read only | Mandatory | Control Type | Data Type | Length |
| 1 | Menu | Navigation bar | Yes | Yes | Menu bar | N/A | N/A |
| 2 | Title | Title of the page | Yes | Yes | Label | N/A | N/A |

**Button/Hyperlinks**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No | Function | Description | Validation | Outcome |
| 3 | View | List all contract | N/A | Transfer to list contract page |
| 4 | View | List all compensation | N/A | Transfer to list compensation page |
| 5 | View | List all new card request | N/A | Transfer to list new card request page |
| 6 | View | List all cancel contract request | N/A | Transfer to list contract page |

##### Manage customer



**Fields**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| No | Field Name | Description | Read only | Mandatory | Control Type | Data Type | Length |
| 1 | Menu | Navigation bar | Yes | Yes | Menu bar | N/A | N/A |
| 2 | Title | Title of the page | Yes | Yes | Label | N/A | N/A |
| 3 | Number | Number of available customer | Yes | No | Label | N/A | N/A |
| 4 | Search | Fill search keyword | No | Yes | Textbox | String | N/A |
| 5 | Table | Table of available customer | Yes | Yes | Table | N/A | N/A |

**Button/Hyperlinks**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No | Function | Description | Validation | Outcome |
| 6 | Create | Create new customer | N/A | Transfer to create new customer page |
| 7 | Search | Search by input keyword | N/A | Transfer to search result page |
| 8 | View | View customer detail | N/A | Transfer to customer detail page |

##### Create customer



**Fields**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| No | Field Name | Description | Read only | Mandatory | Control Type | Data Type | Length |
| 1 | Menu | Navigation bar | Yes | Yes | Menu bar | N/A | N/A |
| 2 | Title | Title of the page | Yes | Yes | Label | N/A | N/A |
| 3 | Name | Fill customer name | No | Yes | Textbox | String | 3 – 80 |
| 4 | Address | Fill address | No | Yes | Textbox | String | 3 – 250 |
| 5 | Email | Fill email | No | Yes | Textbox | String | 3 – 250 |
| 6 | Phone | Fill phone | No | Yes | Textbox | Integer | 8 – 15 |
| 7 | Personal ID | Fill personal ID | No | No | Textbox | Integer | 8 – 15 |

**Button/Hyperlinks**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No | Function | Description | Validation | Outcome |
| 8 | Create | Create new customer | N/A | Transfer to create new customer successful page |

##### Manage contract



**Fields**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| No | Field Name | Description | Read only | Mandatory | Control Type | Data Type | Length |
| 1 | Menu | Navigation bar | Yes | Yes | Menu bar | N/A | N/A |
| 2 | Title | Title of the page | Yes | Yes | Label | N/A | N/A |
| 3 | Number | Number of available contract | Yes | No | Label | N/A | N/A |
| 4 | Search | Fill search keyword | No | Yes | Textbox | String | N/A |
| 5 | Table | Table of available customer | Yes | Yes | Table | N/A | N/A |

**Button/Hyperlinks**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No | Function | Description | Validation | Outcome |
| 6 | Create | Create new contract | N/A | Transfer to create new contract page |
| 7 | Search | Search by input keyword | N/A | Transfer to search result page |
| 8 | View | View contract detail | N/A | Transfer to contract detail page |
| 9 | View | View customer detail | N/A | Transfer to customer detail page |

##### Create contract



**Fields**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| No | Field Name | Description | Read only | Mandatory | Control Type | Data Type | Length |
| 1 | Menu | Navigation bar | Yes | Yes | Menu bar | N/A | N/A |
| 2 | Title | Title of the page | Yes | Yes | Label | N/A | N/A |
| 3 | Customer code | Fill customer code | No | Yes | Textbox | String | 6 |
| 4 | Contract type | Select contract type | No | Yes | Select | N/A | N/A |
| 5 | Start date | Select start date | No | Yes | Date input form | N/A | N/A |
| 6 | Expired date | Select expired date | No | Yes | Date input form | N/A | N/A |
| 7 | Contract fee | Contract fee | Yes | Yes | Label | N/A | N/A |
| 8 | Plate | Fill vehicle plate | No | Yes | Textbox | String | 4 – 15 |
| 9 | Brand | Fill vehicle brand | No | Yes | Textbox | String | 2 – 20 |
| 10 | Engine | Fill vehicle engine | No | Yes | Textbox | String | 2 – 20 |
| 11 | Chassis | Fill vehicle chassis | No | Yes | Textbox | String | 2 – 20 |
| 12 | Capacity | Fill vehicle capacity | No | Yes | Textbox | String | 2 – 20 |
| 13 | Color | Fill vehicle color | No | No | Textbox | String | 2 – 20 |
| 14 | Type | Fill vehicle type | No | No | Textbox | String | 2 – 20 |
| 15 | Model code | Fill vehicle model code | No | No | Textbox | String | 2 – 20 |
| 16 | Year of manufacture | Fill vehicle year of manufacture | No | No | Textbox | String | 4 |
| 17 | Weight | Fill vehicle empty weight | No | No | Textbox | String | 1 – 4 |
| 18 | Seat capacity | Fill vehicle seat capacity | No | No | Textbox | String | 1 – 3 |
| 19 | Paid date | Select paid contract fee date | No | Yes | Date input form | N/A | N/A |

**Button/Hyperlinks**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No | Function | Description | Validation | Outcome |
| 20 | Select | Select customer | N/A | Transfer to select customer modal |
| 21 | Create | Create new contract | N/A | Transfer to create new contract successful page |

##### Renew contract



**Fields**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| No | Field Name | Description | Read only | Mandatory | Control Type | Data Type | Length |
| 1 | Title | Title of the modal | Yes | Yes | Label | N/A | N/A |
| 2 | Start date | Contract’s start date | Yes | Yes | Label | N/A | N/A |
| 3 | Expired date | Select expired date | No | Yes | Date input form | N/A | N/A |
| 4 | Renew contract fee | Renew contract fee | Yes | Yes | Label | N/A | N/A |
| 5 | Paid date | Select paid contract fee date | No | Yes | Date input form | N/A | N/A |

**Button/Hyperlinks**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No | Function | Description | Validation | Outcome |
| 6 | Renew | Renew contract | N/A | Transfer to renew contract successful page |
| 7 | Close | Close modal | N/A | Transfer to contract detail page |

##### Cancel contract



**Fields**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| No | Field Name | Description | Read only | Mandatory | Control Type | Data Type | Length |
| 1 | Title | Title of the modal | Yes | Yes | Label | N/A | N/A |
| 2 | Cancel date | Select cancel contract date | No | Yes | Date input form | N/A | N/A |
| 3 | Cancel reason | Fill cancel contract reason | No | Yes | Textbox | String | 1 – 250 |
| 4 | Cancel note | Fill note about cancel contract | No | No | Text area | String | 1 - 2000 |

**Button/Hyperlinks**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No | Function | Description | Validation | Outcome |
| 5 | Cancel contract | Cancel contract | N/A | Transfer to cancel contract successful page |
| 6 | Close | Close modal | N/A | Transfer to contract detail page |

### Checker Mobile Application Design

#### Scan NFC card screen

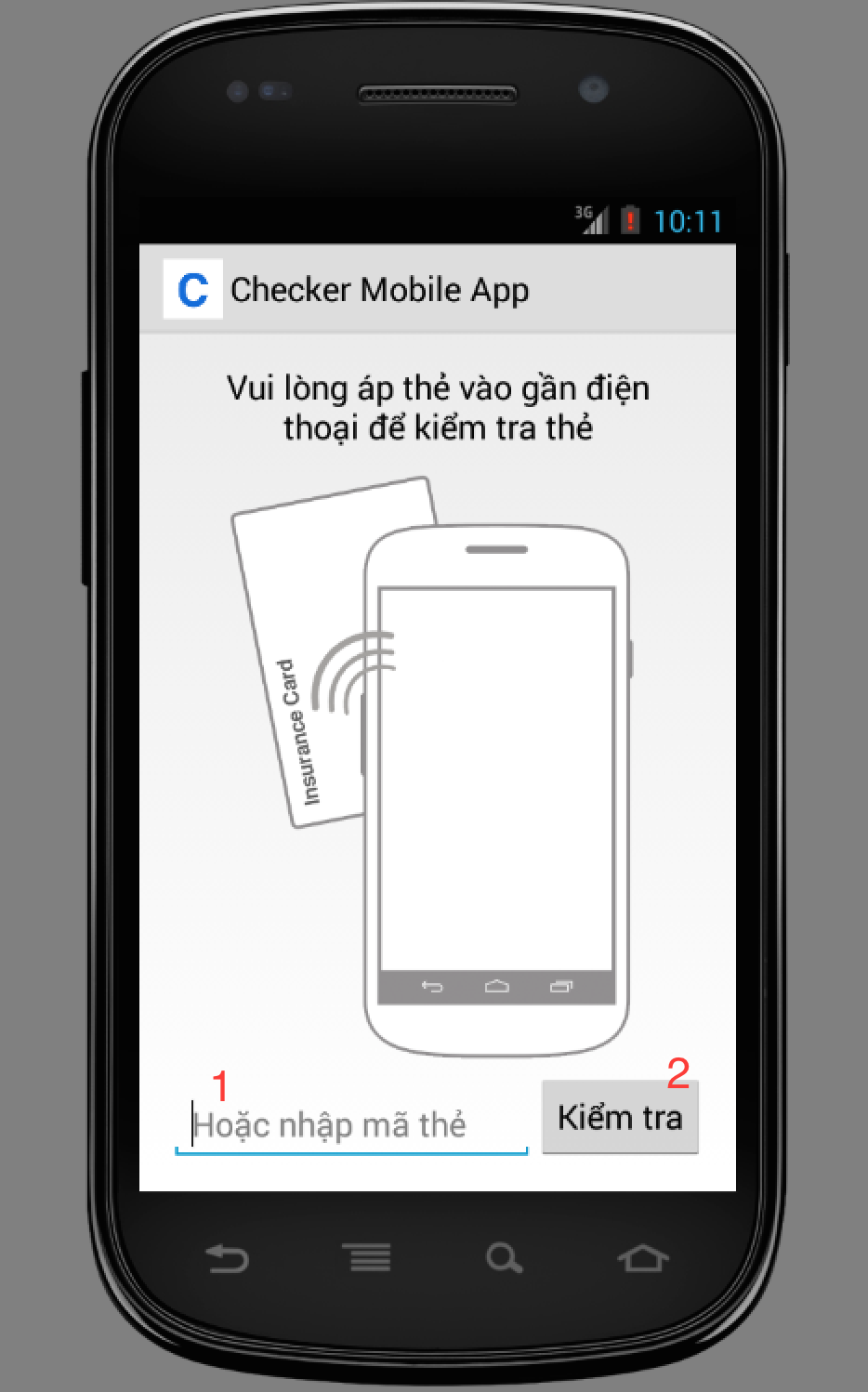


Figure 8 Scan NFC card screen

**Fields**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| No | Field Name | Description | Read only | Mandatory | Control Type | Data Type | Length |
| 1 | CardIDnpen print card screen supporto view detail information of that contractCard | ID of the card | No | No | Textbox | String | 20 |

Table 2 Scan NFC card screen - Fields

**Buttons**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No | Function | Description | Validation | Outcome |
| 2 | Cnpen print card screen supporto view detail information of that contractheck Card | Verify card validation | N/A | Go to view card information screen |

Table 3 Scan NFC card screen - Buttons

#### View card information screen

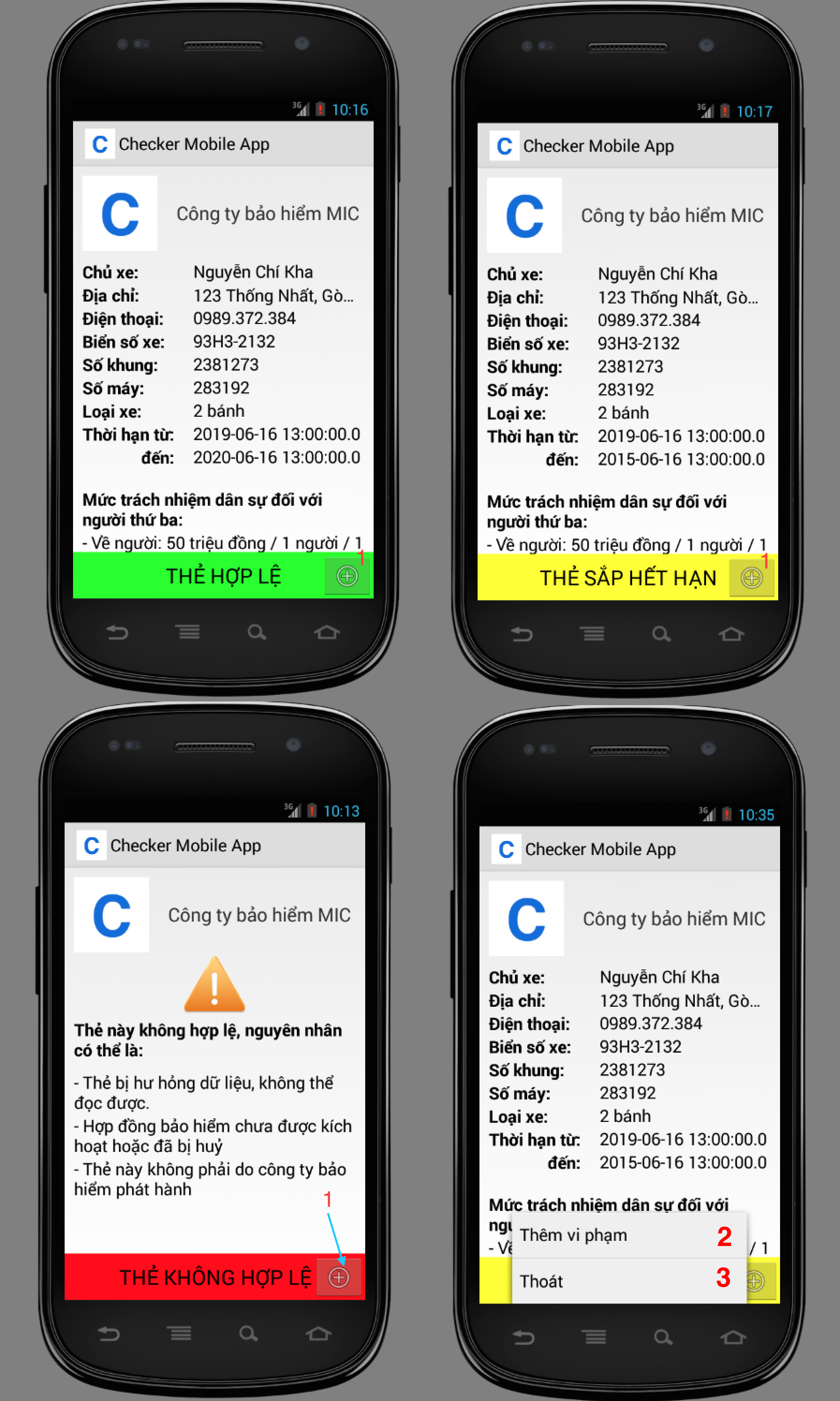


Figure 9 View card information screen

**Buttons**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No | Function | Description | Validation | Outcome |
| 1 | Show menu | Show menu which contains “Add punishment” button and “Exit” button | N/A | Open menu |
| 2 | Add punishment | Add punishment information | N/A | Open add punishment dialog |
| 3 | Exit | Exit the current page | N/A | Return to Scan screen |

Table 4 View card information screen - Buttons

#### Add punishment screen

### Printer Mobile Application Design

#### Search contract screen

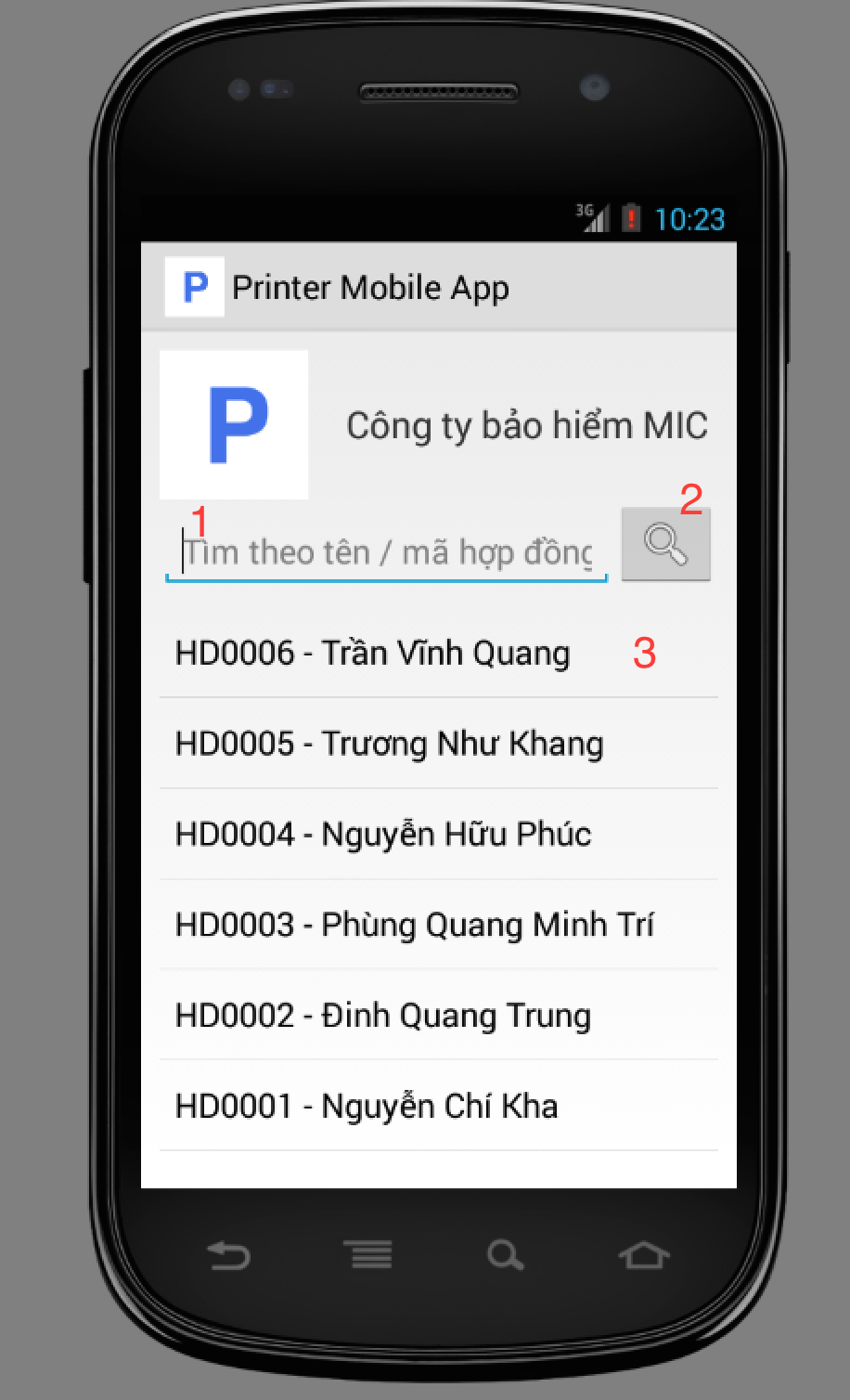


Figure 10 Search contract screen

**Fields**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| No | Field Name | Description | Read only | Mandatory | Control Type | Data Type | Length |
| 1 | SearchBox | Search box where user input search keyword | No | No | Textbox | String | 0 - 200 |

Table 5 Search contract screen - Fields

**Buttons**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No | Function | Description | Validation | Outcome |
| 2 | Search | Search contract with keyword | N/A | The list will be updated with search results |
| 3 | View contract detail | Click to a row from the list to view detail information of that contract | N/A | Show view contract screen |

Table 6 Search contract screen - Buttons

#### View contract screen



Figure 11 View contract screen

**Buttons**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No | Function | Description | Validation | Outcome |
| 1 | Print to card | Click to print information to NFC card | Phone have to have NFC support | Open print card screen |

Table 7 View npen print card screen supporto view detail information of that contractcontract screen - Buttons

#### Print card screen



Figure 12 Print card screen

## Database Design

### Logical Diagram

### Data Dictionary

## Algorithms

### System Scheduler Process

#### Definition

System scheduler is a component of the Web application, this component is responsible for checking the changes from web application and updates information day by day.

#### Define problem

In Web application, the we need a system scheduler that runs every day at 00:00 to check the status of contracts, send notification via web, emails, changes the contract status if the due dates is exceed… etc.

#### Solution

We create a Cronjob in Unix operating system that run on the same server of the Web application, Cronjob will automatically run at specific time that system administrator define when deploy the system. The Cronjob will access to database to check the status and update information to database.

The checking process is described as follow:

1. Get all the contract from the system.
2. With each contract, check following information:
   1. Contract status
   2. Contract expired date
   3. Contract renew due date
   4. Contract payment due date
   5. Compensation requests
   6. New card requests
   7. Cancel request
3. Update the contract state follow the business rules.

#### Complexity

With ***N*** is the number of contract in system, the complexity of the system scheduler process is ***N***.

#### Flow chart

The following flow chart diagram describes all the process of the System scheduler.

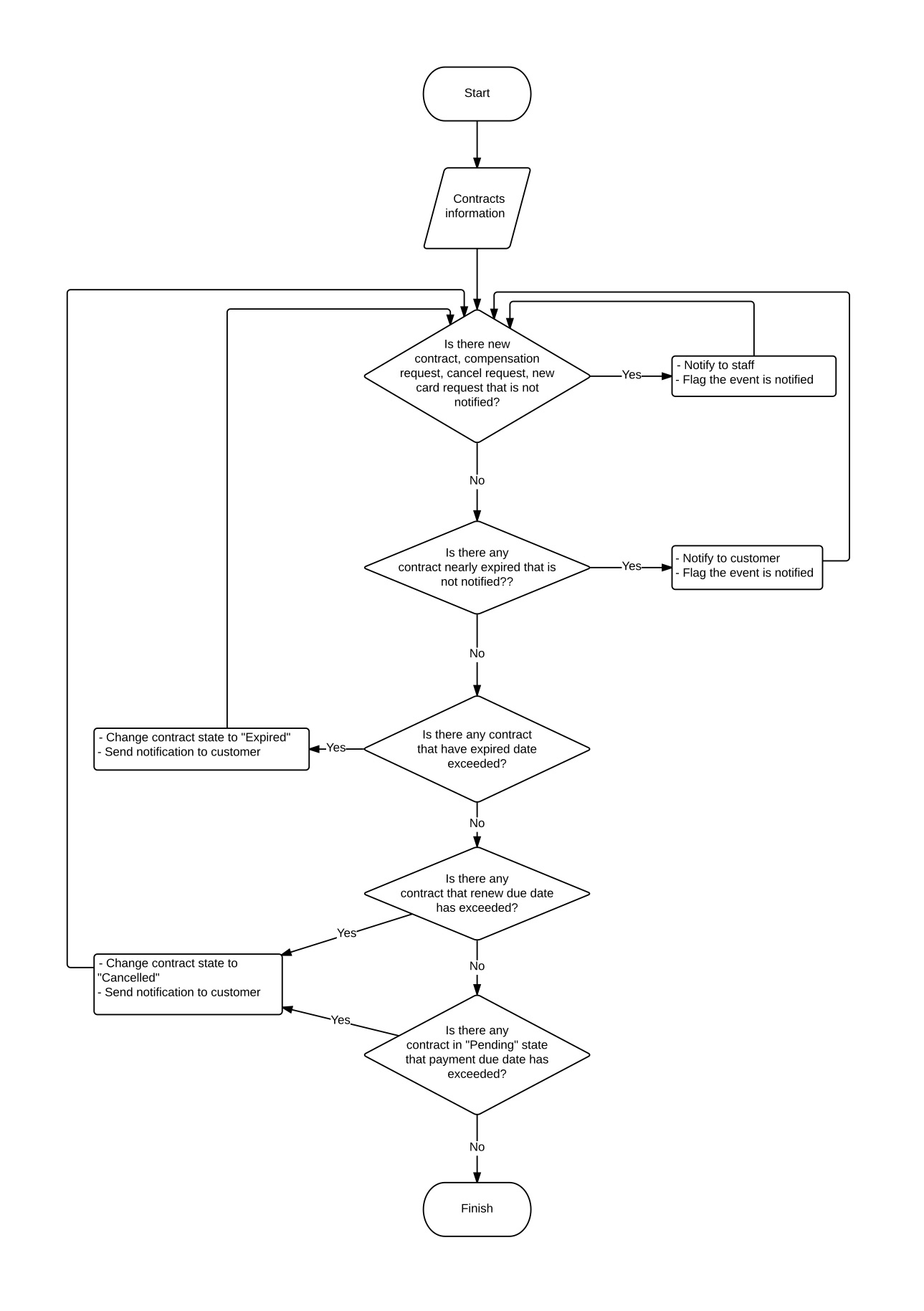


Figure 13 System Scheduler Process

### NFC Card Data Format

#### Definition

According to [Android Developer Forum](https://developer.android.com/guide/topics/connectivity/nfc/index.html) definition, Near Field Communication (NFC) is a set of short-range wireless technologies, typically requiring a distance of 4cm or less to initiate a connection. NFC allows you to share small payloads of data between an NFC tag and an Android-powered device, or between two Android-powered devices. NFC Card Data format is a type of format to store data in the card’s storage.

#### Define problem

The data stored in the tag can be written in a variety of formats, in Printer application and Checker application we use a NFC Forum standard called NDEF (NFC Data Exchange Format) which is highly recommended from Android developer community.

To prevent malicious users to override data on the NFC card or using fake card, we need to find a solution to protect data written on the card.

#### Solution

For security reason, we decided to not to write any contract information data to the tag but use only the card low level ID to verify the card.

To make sure the card can only be read by our Checker application, we write a special record named Android Application Record (AAR).

**Bellow is the flow to write an NFC tag for customer:**

1. Printer application get contract information
2. Staff confirm the contract information is correct
3. Printer read card ID
4. If the card is not exists in system, update the card ID to the contract
5. Write AAR record to the tag and finish.

**Bellow is the flow to read an NFC tag for police officer:**

1. Checker application read card ID from the card
2. Checker application send card ID to system to verify the card
3. Show result to police officer

#### Complexity

#### Flow chart

### Contract State

The contracts in MIC system is complex and can be managed differently during the operation. The state chart bellow describes all the state of a contract.

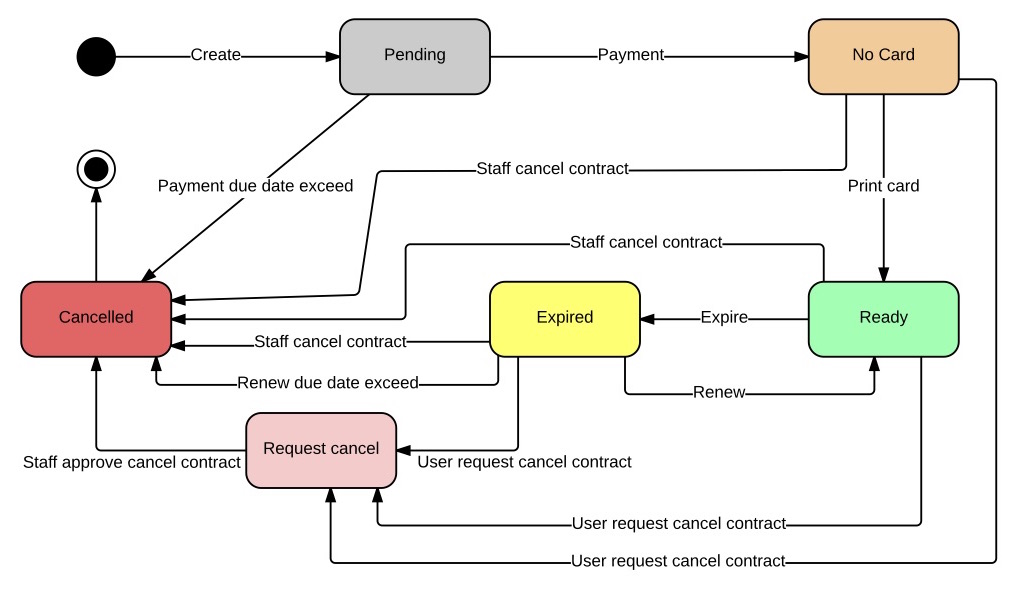


Figure 14 Contract State Chart

|  |  |
| --- | --- |
| State Dictionary: Describes States | |
| Pending | The contract is created and do not have payment |
| No card | The contract had have payment but have not assigned to a card |
| Ready | The contract is assigned with a card and ready to use |
| Expired | The contract due date is exceed and no longer valuable |
| Request cancel | The contract is requested to cancel by customer |
| Cancelled | The contract is cancelled and no longer valuable |

Table 8 Contract State Dictionary

* First customer create new contract, contract is in “Pending” state.
* Next, customer pay for the contract via PayPal or direct payment, contract state change from “Pending” to “No card”.
* Next, staff print the card for customer, the card ID is saved to the system, contract state change from “No card” to “Ready”.
* Next, when the contract due date is exceed, system will change the contract status from “Ready” to “Expired”
* Next, when customer renew the contract, the contract state change from “Expired” to “Ready”. Customer can renew the contract when the contract is in “Ready” or “Expired” state.
* If customer does not renew the contract, after 1 month the contract state will change from “Expired” to “Cancelled”.
* When the contract is in “No card” or “Ready” or “Expired”, staff can cancel the contract to change the state to “Cancelled”.
* When the contract is in “No card” or “Ready” or “Expired”, customer can send contract cancel request, contract state change to “Request cancel”
* When the contract is in “Request cancel”, staff can approve the request to change contract state from “Request cancel” to “Cancelled”.