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**TP. HỒ CHÍ MINH – Tháng 1 năm 2024**

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# **I. Introduction**

In the current era of technological advancement, service and management systems have become more modernized. A notable example is a parking management system utilizing RFID technology and web services. This project aims to implement a vehicle parking management system that incorporates RFID technology for vehicle identification and a web-based service for efficient administration.

## II. Technology Stack

<b>Hardware</b>	STM32F411CEU6 ESP32-CAM Ai-Thinker
<b>Services</b>	Firebase Cloud Firestore Authentication
<b>Framework</b>	Flutter
<b>Programming language</b>	Dart C / C++

*Table 1 - Technology Stack*

### III. Architecture Design

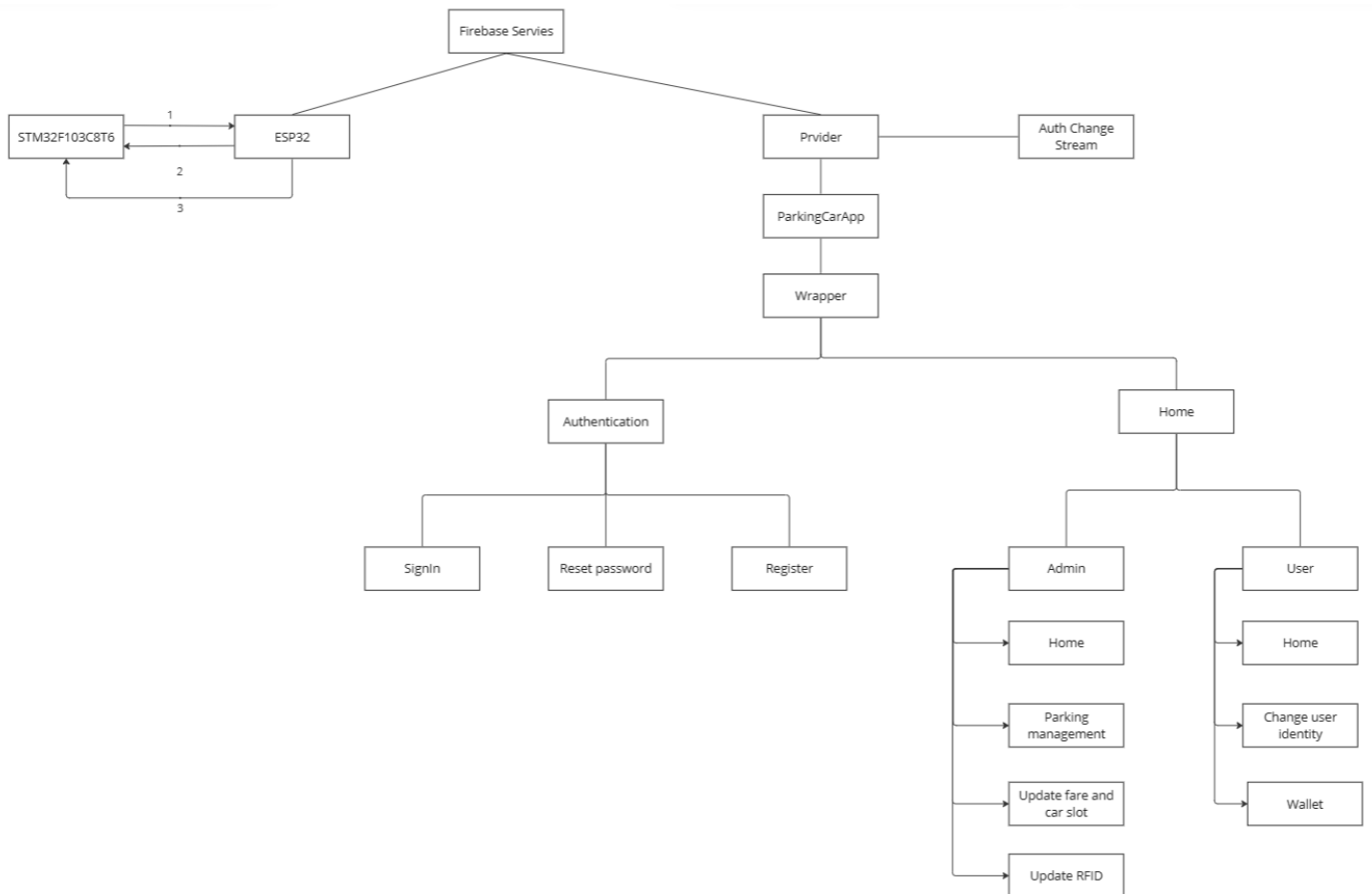


Figure 1 - Architecure Design

**Description:** Diagram representing the connection architecture between hardware, database and software of the parking app

## Keynote

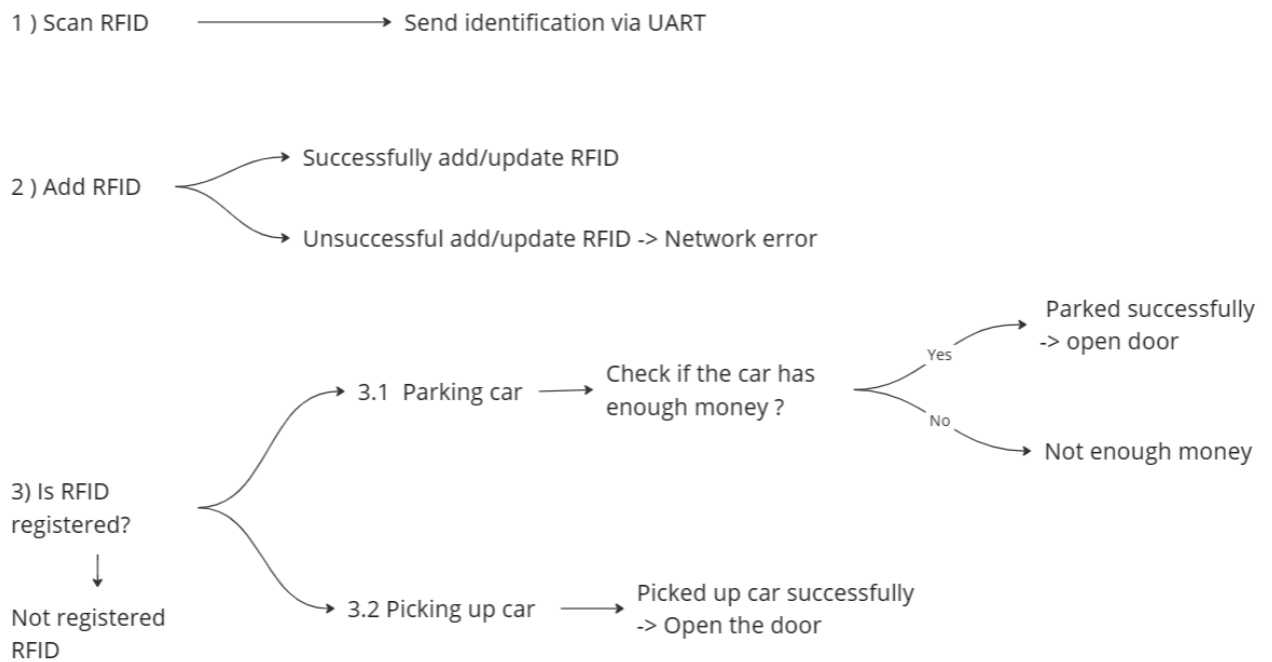


Figure 2 - Keynote

**Description:** This image is used to explain states 1,2,3 in the above architecture diagram

# State Diagram

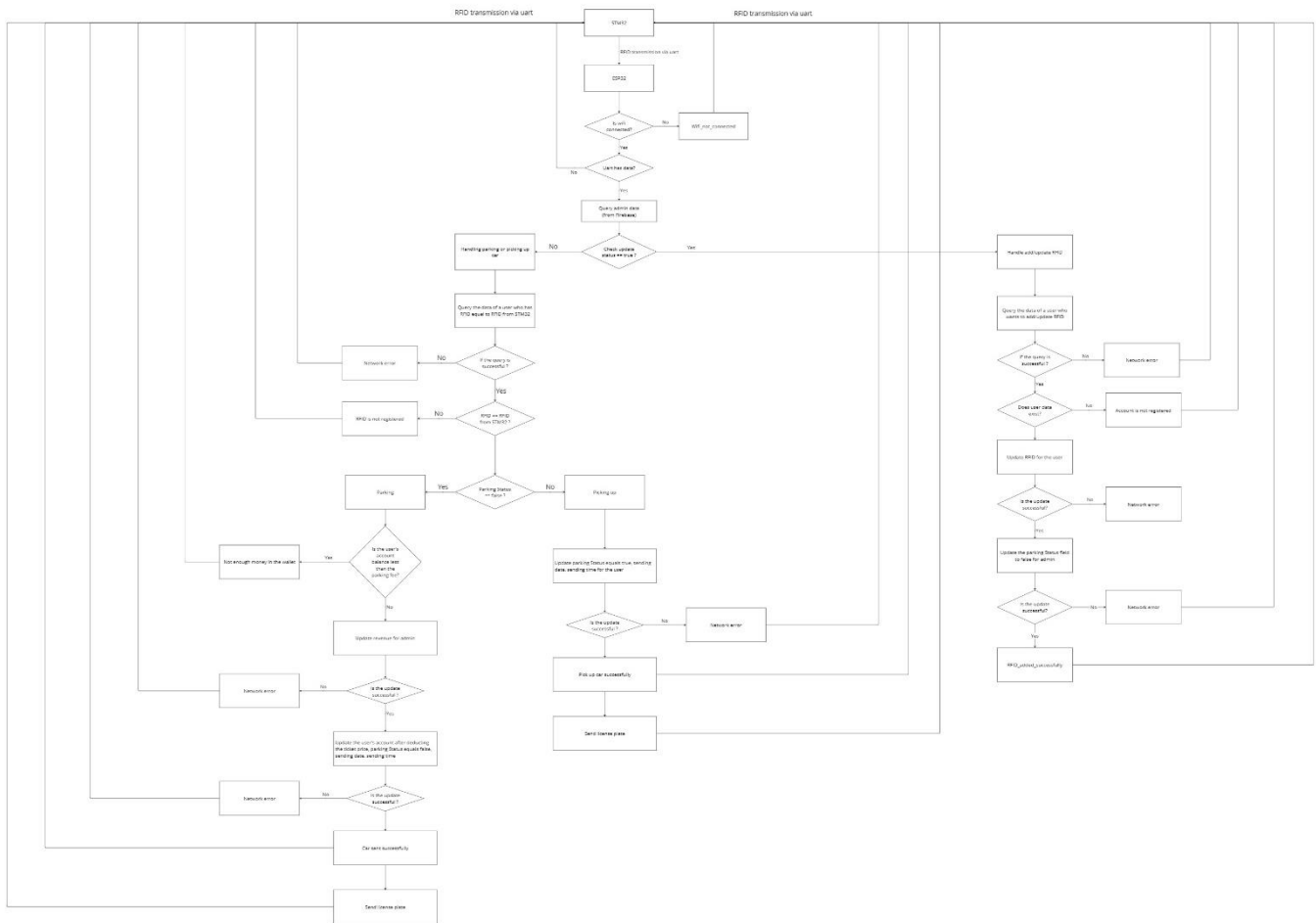
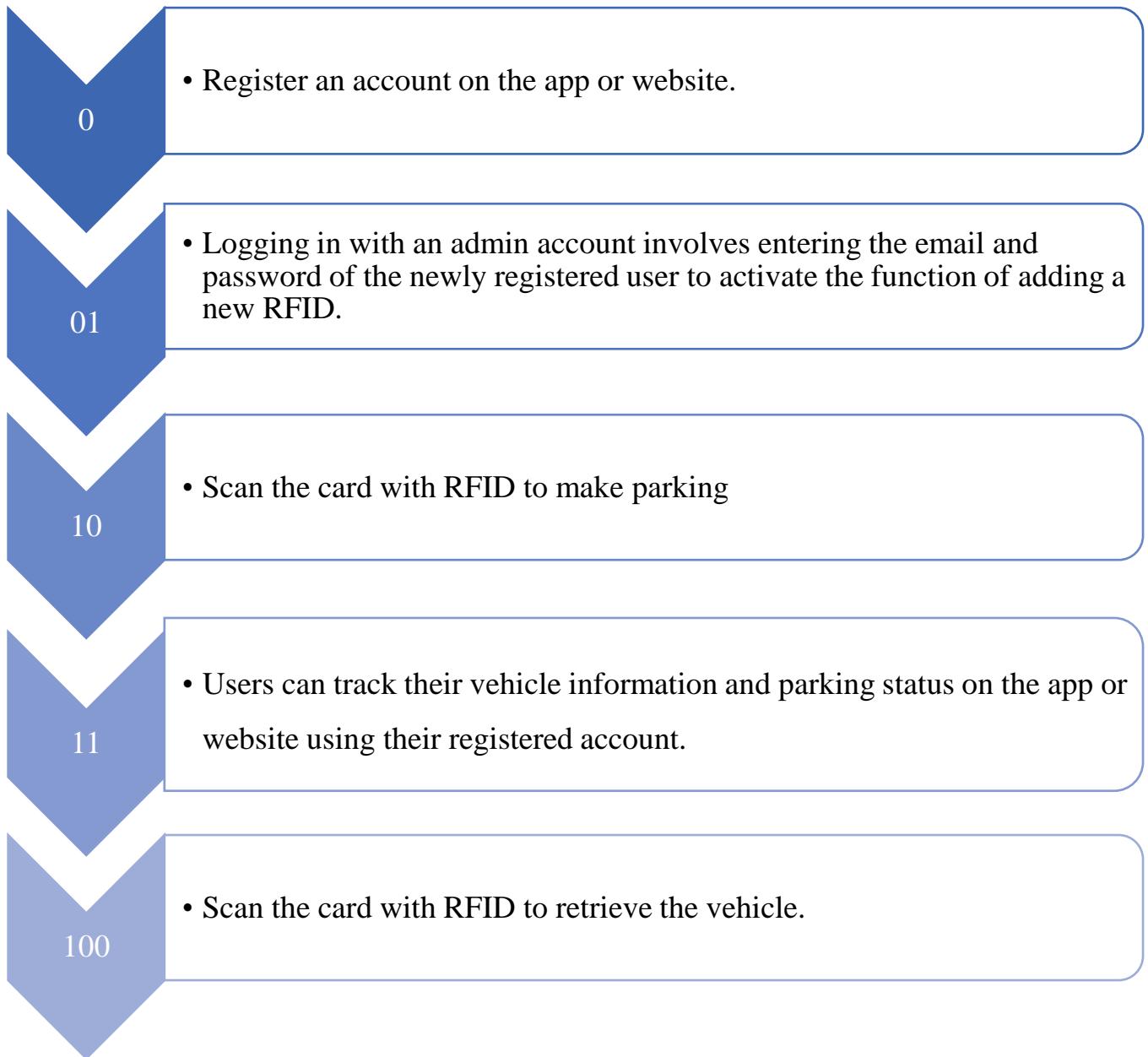


Figure 3 - State diagram

**Description:** Diagram showing the status of signal processing when receiving RFID data from STM32 and data from Firebase.



## IV. Implementation process



## V. User Interface

### 1. Sign-in

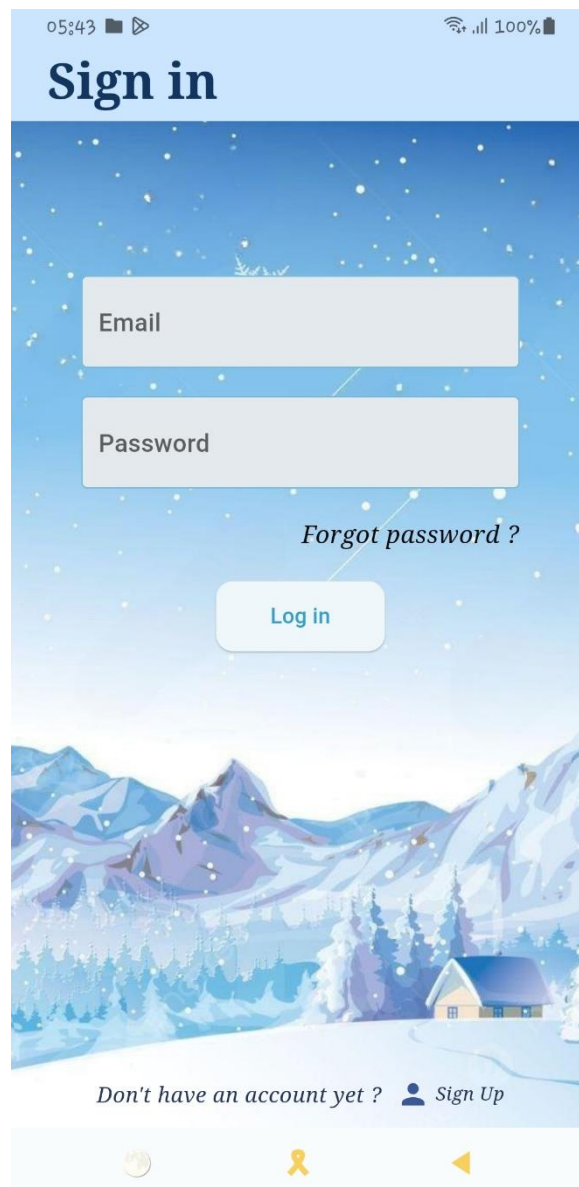
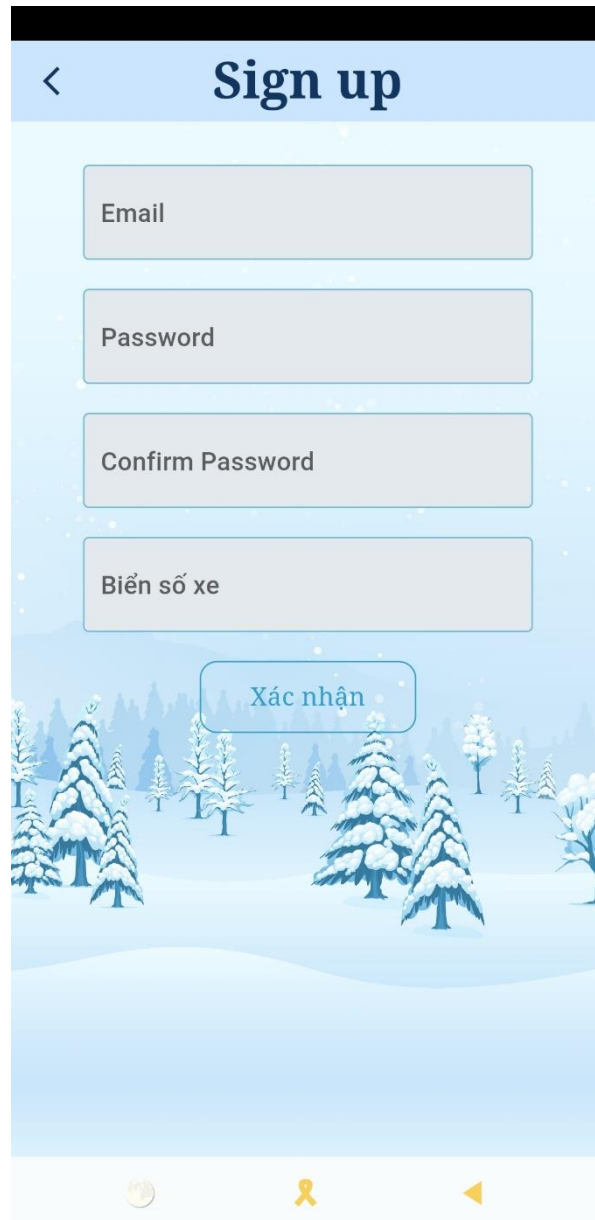


Figure 4 – Sign-in screen

**Description:** Log in to the app using the registered user's email and password.

## 2. Sign-up

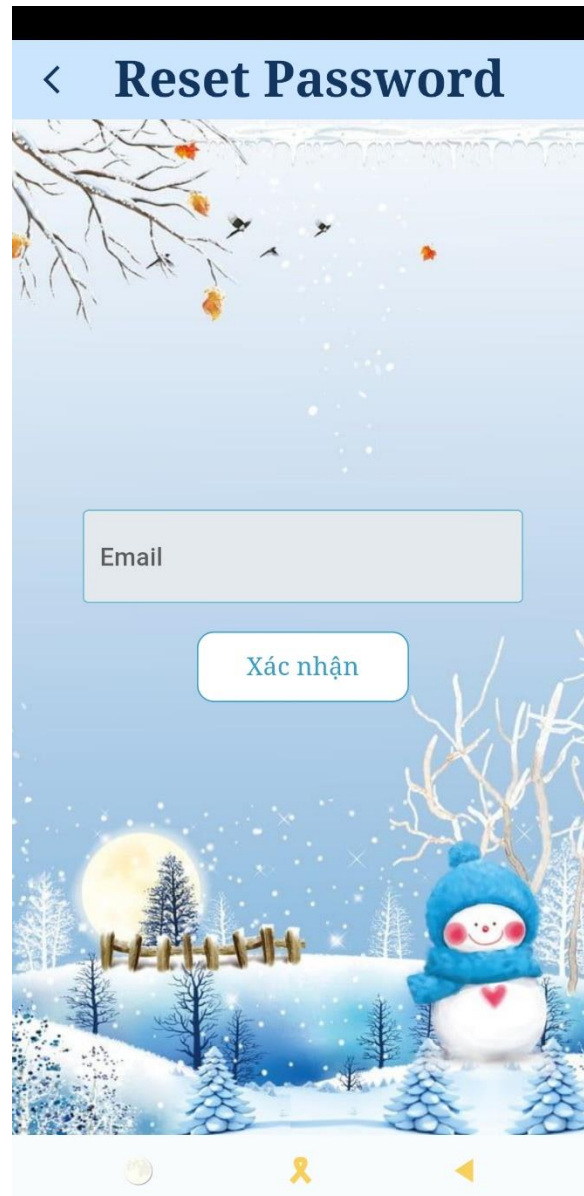


The image shows a mobile application sign-up screen. At the top, there is a blue header bar with a back arrow icon on the left and the text "Sign up" in the center. Below the header, the background is a light blue gradient with a subtle pattern of small white dots. The main content area features four light gray rectangular input fields stacked vertically, each with a label inside: "Email", "Password", "Confirm Password", and "Biển số xe". Below these fields is a rounded rectangular button with the text "Xác nhận" in blue. The bottom of the screen is decorated with a winter-themed illustration of snow-covered evergreen trees and rolling hills. At the very bottom, there is a white navigation bar containing three icons: a gold coin, a yellow ribbon, and a yellow left-pointing triangle.

Figure 5 - Sign-up screen

**Description:** Register an account for new users

### *3. Reset password*



*Figure 6 - Reset password screen*

**Description:** Users who forget their password will have to enter their registered email to reset their password.

## 4. Admin

### 4.1 Home



Figure 7 - Admin home screen

**Description:** Administrators can monitor users' vehicle parking status and daily revenue.

## 4.2 Account Management



The screenshot shows a mobile application interface. At the top, there is a status bar with the time 06:16, signal strength, and battery level at 65%. Below the status bar is a navigation bar with a hamburger menu icon, the text 'Account ...', and a gear icon labeled 'Setting'. The main content area is titled 'User Account Table' and contains a table with 5 columns: Name, Email, Reg plate, RFID, and Money. The table lists 8 test accounts. At the bottom of the screen, there is a light blue bar with three icons: a coin, a ribbon, and a triangle.

Name ↑	Email	Reg plate	RFID	Money
test1	test1@gmail.com	47.HK-T386B	19517617552232	61000
test2	test2@gmail.com	12.90-AB213	1792003252111	0
test3	test3@gmail.com	29.XY-Z4567	21067188463	2000
test4	test4@gmail.com	89.SB-J123	5110716852196	83000
test5	test5@gmail.com	78SG-967.50	6712815353111	32000
test6	test6@gmail.com	12A7-892.84	4421813024108	175000
test7	test7@gmail.com	56.HB-F856		150000
test8	test8@gmail.com	76.JK-G494		500000

Figure 8 - User account table

**Description:** Manage registered user accounts.

### 4.3 Parking Management



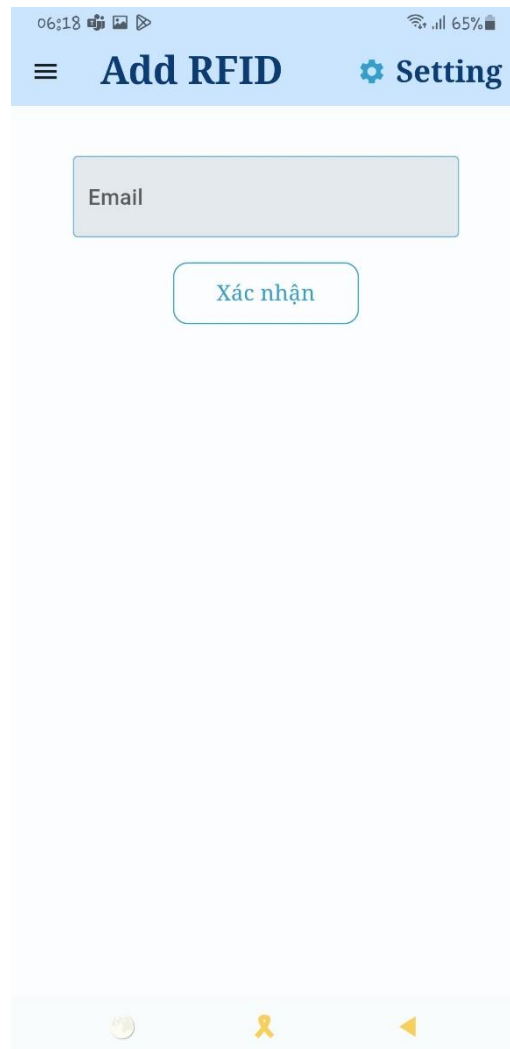
The image shows a mobile application interface for parking management. At the top, there is a status bar with the time 06:16, signal strength, and battery level at 65%. Below the status bar is a navigation bar with a hamburger menu icon, the text "Parking ...", and a "Setting" button with a gear icon. The main title "Car Parking Board" is centered below the navigation bar. A table with four columns: "Name", "Status", "Time", and "Date" is displayed. The table contains six rows of test data. At the bottom of the screen, there is a navigation bar with three icons: a coin, a ribbon, and a left-pointing arrow.

Name↓	Status	Time	Date
test4	parking	17:14:08	05-January-2024
test1	parking	17:13:55	05-January-2024
test3	parking	13:46:27	05-January-2024
test2	parking	17:15:25	05-January-2024
test5	parking	17:14:17	05-January-2024
test6	parking	17:20:26	05-January-2024

Figure 9 - Parking management table

**Description:** Table to manage the number of users sending vehicles.

#### 4.4 Add / Update RFID



06:18 06:18 65%

≡ Add RFID ⚙ Setting

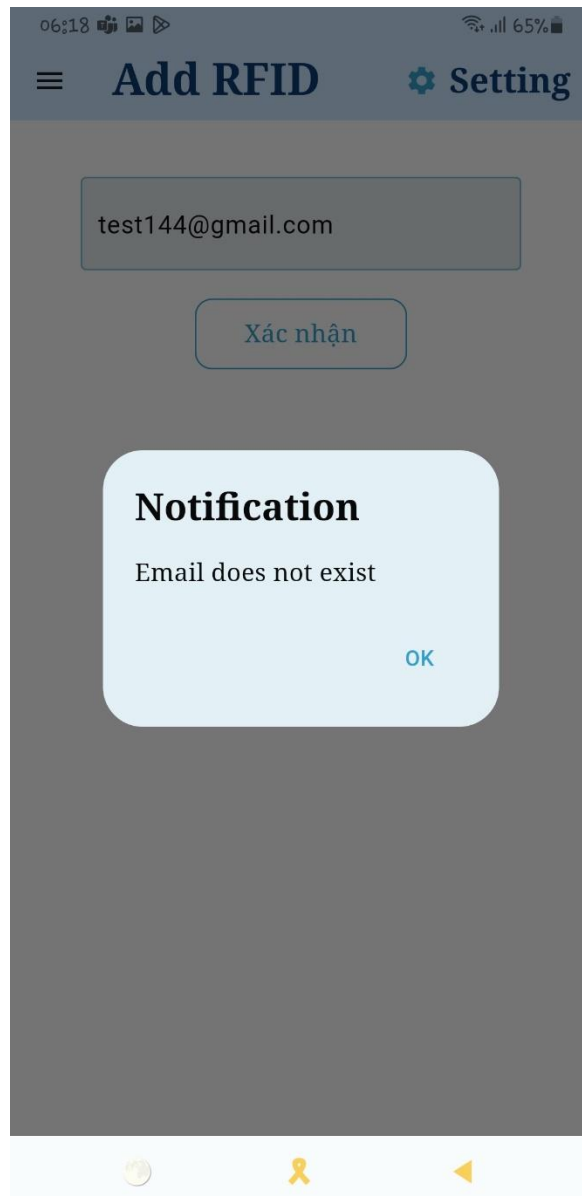
Email

Xác nhận

Figure 10 - Adding / Updating RFID screen

**Description:** Allows administrators to add or update a user's RFID code.





*Figure 11 - Account notification does not exist Screen*

**Description:** Users who enter an unregistered email will display a message that the email does not exist

**Waiting for RFID card  
scanning**



Cancel



**Description:** User waits to scan card to register RFID code.

## 4.5 Update

The screenshot shows a mobile application interface for updating parking information. At the top, there is a status bar with the time 11:57, various icons, and a battery level of 31%. Below the status bar is a blue header with a hamburger menu icon, the word 'Update', and a 'Setting' link with a gear icon. The main content area has a light blue background. It starts with the title 'Information' in bold. Below it, it displays 'Current parking fees : 5000' and 'Current parking space : 50'. The next section is titled 'Update' in bold. It contains two input fields: 'Parking Fee' and 'Car slot'. Below these fields is a button labeled 'Xác nhận' (Confirm). At the bottom of the screen, there is a navigation bar with three icons: a home icon, a ribbon icon, and a back arrow icon.

Figure 12 - Updating fare or car slot screen

**Description:** Allow administrators to update the parking ticket prices or the number of parking spaces in the parking lot.

## 5. Users

### 5.1 Home



Figure 13 - User home screen

**Description:** Users can view their parking information, including user name, email, password, remaining account balance, license plate number, RFID, date and time of the last parking session, and the current status of their parked vehicle.

## 5.2 Wallet

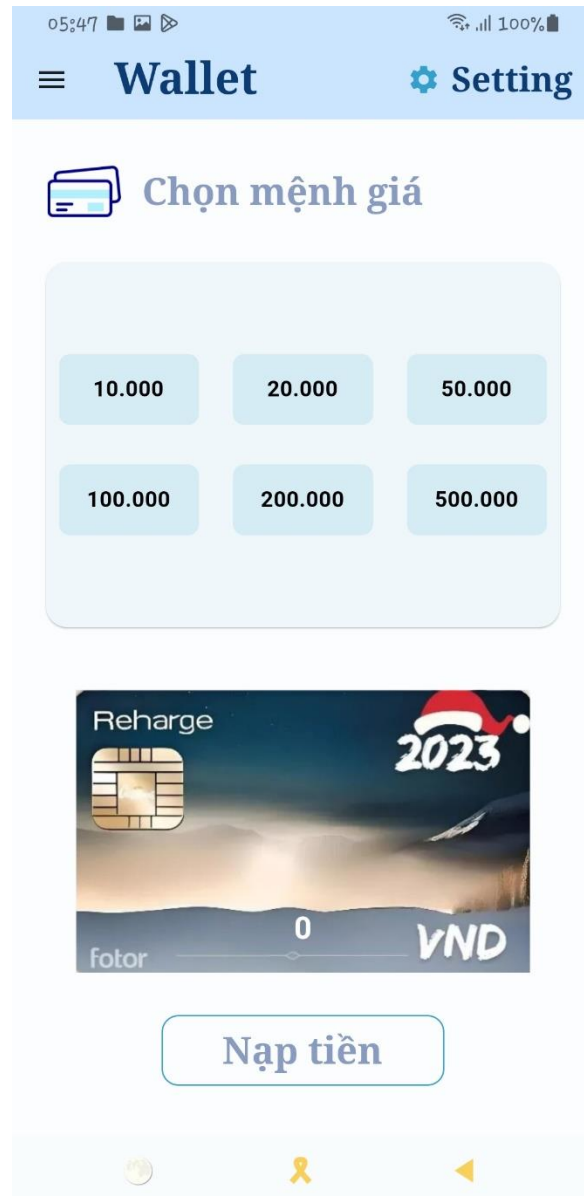
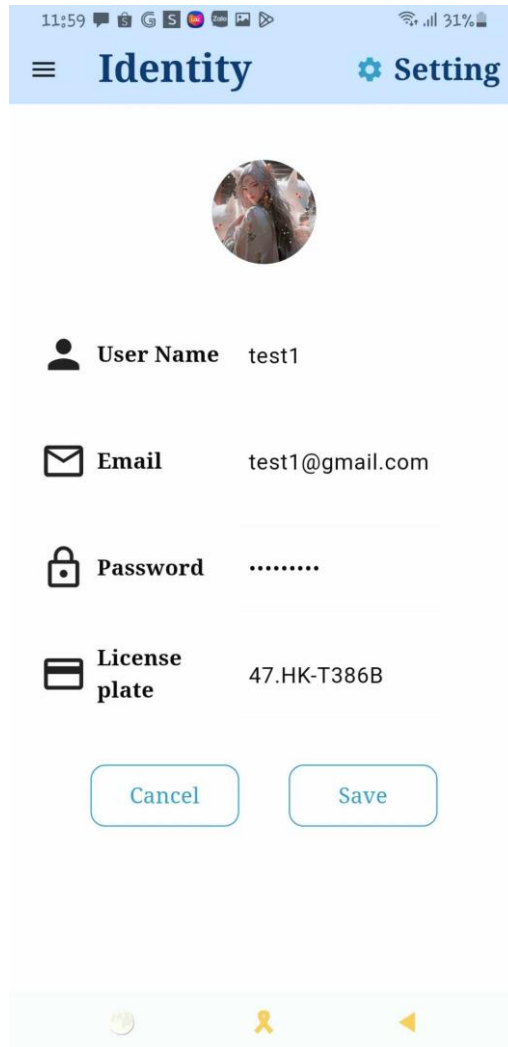


Figure 14 - Deposit money into your account screen


**Description:** Users can select the desired denomination to recharge their account.


### 5.3 Change user identity





11:59 31%


≡ Identity ⚙️ Setting



 **User Name** test1

 **Email** test1@gmail.com

 **Password** .....

 **License plate** 47.HK-T386B

Cancel Save

Figure 15 - Change user identity screen

**Description:** Users can change their user name, email and license plate number. If the user is parking your vehicle, you will not be allowed to change the license plate.

## VI. ESP32

*The ESP processor used in this project is ESP32-CAM Ai-Thinker.*

*Uart pins U0TXD, U0RXD are changed to pins GPIO13(RX) and GPIO12(TX).*

```
3 #include "Admin.cpp"
4 #include "User.cpp"
5 #include "Network.h"
6 #include "time.h"
7 // #include <HardwareSerial.h>
8
9
10 // Change uart pin
11 #define RX_PIN 13
12 #define TX_PIN 12
13
14 DynamicJsonDocument docJson (2048);
15
16 Network *network;
17 User *user;
18 Admin *admin;
19
20 // User
21 #define urlGetUserDocuments "https://firestore.googleapis.com/v1/projects/parkingcarapp-ef7de/databases/(default)/documents/Users"
22 #define urlPatchUserDocument "https://firestore.googleapis.com/v1/projects/parkingcarapp-ef7de/databases/(default)/documents/Users"
23 #define urlUserDocumentsWithQuery "https://firestore.googleapis.com/v1/projects/parkingcarapp-ef7de/databases/(default)/documents:runQuery"
24
25 // Admin
26 #define urlAdminCollection "https://firestore.googleapis.com/v1/projects/parkingcarapp-ef7de/databases/(default)/documents/Admin/"
27 #define AdminId "UubQpLMKwDsdTiNhuYPowLh6cnk2"
28
```

*Users set up wifi password and password in the Network.cpp file*

```
ParkingCarApp.ino Admin.cpp Network.cpp Network.h User.cpp
1 #include "Network.h"
2
3
4 #define WIFI_SSID "****"
5 #define WIFI_PASSWORD "****"
6
7 #define API_KEY "AIzaSyDrX5ni-Lonj3pFc0CGdVmeYBVeAToliYw"
8 #define FIREBASE_PROJECT_ID "parkingcarapp-ef7de"
9
10
11 static Network *instance = NULL;
12
13 Network::Network(){
14     instance = this;
15 }
16
```

--- End ---