

# Innovative Payment System for Hospitality Sector using Near Field Communication Smart Bracelet and Arduino

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**Abstract** - Hospitality is among well-established industries that plays an important role in driving better customer experience. Adopting emergent technology is not widely noticed in this industry since the hosts still adopt the same payment models, namely credit cards or cash in their transactions in hotels. Our aim in this paper is to introduce a cost-effective, secure and convenient payment system that fits the hospitality context, which will completely enhance customer experience by providing more enjoyable hassle-free stay at hotels or resorts. Smart silicon bracelet equipped with RFID tag is used as a payment mode at different hotels and resorts facilities (spa, restaurant, Jacuzzi, and shops). Arduino card coupled with RFID/NFC reader is used as payment machine that can be easily plugged in the USB port without any prior configuration. Consequently, convenience, cost-effectiveness and new customer experience are provided through this new payment system by preventing hosts from carrying wallet within the resort facilities. Detailed use –case scenarios are presented and discussed.

**Keywords** – Smart payment, Arduino, NFC, Hospitality, Emergent Technology.

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## 1. Introduction

Arduino is one of the emergent open sources considering electronics platforms, which is created to ease the use of several technologies (Bluetooth, RFID, Sensors, GPS, NFC, etc.) with a full control and less complexity. The availability of Arduino software makes it very helpful, since it can be executed on various operating systems, such as Mac OS, Linux and Microsoft. The usage of Arduino varies depending on the desired need of the project. For example, it can be used by users as a microcontroller board for home automation, controlling robots or for motion sensing lights.

On the other hand, RFID technology is increasingly used by companies for several purposes. Muamar et al [1] identified four main modes of using the RFID namely 1) tracking 2) identification 3) inventory management and 4) payment. Tracking in the context of RFID is performed by tagging cars, so the smart gate can track the then and open gates for the main purpose of parking management [2]. Tracking any other item is also possible using RFID, such as military equipment within bags [3]. Identification is mainly achieved by using access card for attendance system or access control systems [4]. Inventory management is managed efficiently applying RFID technology by tagging all items in warehouses, and then maintaining the inventory data according to the in/out movements of these items [5] in the warehouse. The process of payment using RFID technology is achieved by using RFID cards as a credit card in order to pay for a product whereby the RFID antenna is used as a payment reader [6].

We chose to implement our solution to ease and faster the payment process of several services in hotels. The advantages of using Arduino along with RFID are cost-effectiveness and ease of use the system and finally user-convenience. Implementing this system may help the hotel to collect information about customers' preferences in the hotel (gym, spa, etc), accordingly to the manner by which the hotel makes analysis to invest in better facilities.

Additionally, many hotels realize the need of adopting new technologies facilitating payment methods which will attract more customers, enhance hotel reviews and reputation, as well as a competitive advantage compared with other hotels.

## 2. Literature review

Our literature review reveals that researchers who are focusing on smart payment in hospitality sector direct their effort in the four main aspects of this domain, namely 1) customer acceptance towards this method of payment, 2) used technologies to perform payment transaction, 3) use of technology in hospitality industry and 4) the security level of the implementation of such systems. For the main purpose of user acceptance, Ozturk in [7] presented acceptance model examining consumers' acceptance of RFID cashless payment systems. It is found that self-efficacy was significantly related to perceived ease of use and perceived risk significantly influenced negatively the perceived usefulness and perceived ease of use were significantly associated with intention to use. Cobanoglu in [8] confirmed this finding and recommended hospitality marketers and technology specialist to understand their target segments' values, and then promote mobile payment (MP) technology in a way that suits to their values, needs, and lifestyles by focusing on increasing the level of security.

Fewer researches evaluate the IT security threat that is used in smart payment within hospitality sector. [9] After examining the use of Chip and PIN at the point-of-sale (POS) in restaurants [10] they offered different ways of management, which are introduced in order to follow reduction of the hotel's chances contributing to credit-card fraud. One way to minimize fraud is using electronic data capture machines, that enter information directly into the computer, and another way is reviewing security procedures and devise operational systems to discover and prevent white-collar crime. [11] Emphasizing the importance of adopting the application of biometrics technologies (iris, fingerprint) in the hotel sector and tourism, this technology has the potential to enhance security and increase operational efficiency.

Due to the progression of technology innovation, solutions in hospitality sector starts gradually to replace traditional system through the implementation of automated ones. Website, self-check –in/out terminals, embedded mobile applications within smartphones are becoming more in use, in order to facilitate booking, reservation, and payment transactions. [12] Proposed application for Android smartphone called NFC Smart Tourist Card (NFC SMTC) with a range of services, initially facilitate the tourists stay, while visiting Italian

cities using NFC technology. The application is a platform for services including information supply, mobile payment, mobile ticketing, device pairing, location-based services, access control, management of loyalty, and bonus, as well as membership cards. NFC SMTC will be managed using smart wallet as an instrument that manages other smart cards and applications for users.

Other research reported several applications in the hospitality sector by highlighting the crucial role of the emergent technologies (such as RFID, NFC and smartphones), and its ability in adding more services to customers in the future. [13] Evaluating the use of technologies in hospitality, and predicting that mobile devices with indoor e.g. RFID and outdoor positioning systems are able to adapt service options based on the customer's location. For example, the check-in icon could light up on the mobile screen when a customer enters the hotel lobby, or in case that a customer requests step by step directions to the casino through a navigationally-enabled phone. [14] Development of a business model framework for NFC is based on mobile payment solutions which consists of four components, namely value service, value network, value architecture, and value finance.

Finally, we consider that payment process in hospitality industry could be simpler and more convenient with wearable devices rather than using cash, smart cards or even mobile phones. Consequently, the aim of our research is to provide a flexible, cost-effective as well easy to use solution to assist payment in the hospitality industry. Wearing a bracelet with payment ability will increase tremendously customer satisfaction, solving hence issues of carrying cash or credit cards.

## 3. Summary of the system

We present several scenarios in this section considering the use of our smart payment system. With this on mind, seven cases are to come to think of it, as the following:

### 1. Create account:

- *Bracelet Activation*: associating a bracelet to a host by linking bracelet Id with customer ID for tracking purpose.

- *Cash deposit*: filling the account balance with a cash so the host can use it in all hotel's facilities

**2. Balance Inquiry**: the host may want to know his bracelet balance before any spending.

**3. Top Up**: host can, at any time, refill his bracelet balance with cash, so he can spend it in hotel's facilities.

**4. Revoke**: user might want to stop using his bracelet, or he simply lost it, so he wants to deactivate his bracelet.

**5. Refund:** while leaving the hotel at the time of checkout, the host can refund whatever amount that is still in his bracelet and have it in cash.

**6. Search account:** by placing the bracelet on the reader, our system will display all related information to the customer, holding the bracelet such as (room number, name, mobile phone, etc). Search can also be done using different criteria (name, room number, etc)

**7. Make payment:** this case will happen any time when a customer uses any facility of the hotel, as well while purchasing anything within the hotel shops or restaurants.

#### 4. System in action

The use cases developed for the system describes the functions that users perform as well as the activities that the system carries out. Each use case includes a workflow of activities to complete a business process. For a better understanding of the business processes and how the new system is supporting them, each use case is documented with a fully developed description.

##### *Use Case (1): Create account*

The first step in adapting this cashless payment system is to create a new bracelet for the guest upon his arrival to the hotel. Once the guest is signed up and checked-in, the guest's details and room number are linked to his bracelet for the future use. Thus, guests have to provide an ID for authentication.

##### *1- Activation of a New Bracelet*

To create a new user, one has to swipe the bracelet first, in order to associate the guest's information with this specific bracelet. The bracelet ID will be provided by the program, then the guest data can be manually entered (guest name, room number, phone number). After that, the database will be automatically updated, and the new user will be added to the system.

##### *2- Cash deposit*

The hotel guest will be able to add an amount of money to his balance, in order to start using his bracelet in hotel's facilities, either by cash deposit or using his credit card. The balance update will be done using the "Top up" frame that will be explained in another use case "Top Up".

##### *Use Case (2): Balance inquiry*

At the hotels' front desks, or through the application, the guest can ask to check his available balance, and decide whether he wants to add more money on his available balance or take other actions.

In the balance inquiry option, the user can swipe his bracelet and the system will read the bracelet ID, displaying the information associated with it (guest name, room number, ID, available balance). Then, if

the user wishes to add more money to his balance or refund it, he can either go to the Top Up screen or the Refund option. Otherwise, only the information associated with the balance will be displayed.

##### *Use Case (3): Top Up*

This feature enables a guest to add or top up his available balance. In this option, the user can swipe his bracelet and the system will read the bracelet ID and display the information associated with it (guest name, room number, ID, available balance). Then, if the user wishes to add more money to his balance, he can simply click on the Top Up button which will redirect him to the Top Up window, in which he will be able to enter the amount he desires. The system will automatically update the balance (upon clicking OK) and display the confirmation message to the user.

##### *Use Case (4): Revoking*

In case the guest wishes to cancel his bracelet, that may happen for several reasons, one of which may be due to the loss of the bracelet, or simply because the guest does not want to use it anymore. The guest can simply ask the front desk to revoke his bracelet. Obviously, authentication is required in order to perform this action, verifying that the person revoking the bracelet is its actual owner.

The user has to swipe his bracelet for reading the ID and other information associated with it (guest name, room number, ID, available balance). In this case, canceling the bracelet can simply be done by clicking on the Cancel button. The system will automatically update the database (upon clicking OK) and display the confirmation message to the user.

##### *Use Case (5): Refund*

Before leaving the hotel, the guest may wish to redeem the rest of the money that he has in his bracelet account, or even during his stay. This is a very simple procedure; the guest can choose either to redeem his balance in cash, or to be sent to his credit card. The credit card transfer may take a few days, unlike the cash refund which is instant.

In the refund option, the user can swipe his bracelet and the system will read the bracelet ID and display the information associated with it (guest name, room number, ID, available balance). Then, if the user wishes to refund money from his account, he can simply click on the Refund button which will redirect him to the Refund window, in which he will be able to enter the amount he desires to refund. The system will automatically update the balance (upon clicking OK) and display the confirmation message to the user.

**Use Case (6): Search account**

In the search account option, the user must enter the guest name and a room number, and then choose appropriate method he would like to use (either search by phone number or bracelet ID). Furthermore, if there is a match all of the information, the balance of the account (along with all the information) will be displayed.

**5. System interfaces**

**A) Home Screenshot**

In the home screen (see Figure 1) the user will find eight options namely Top up, Balance Inquiry, Refund, Create Account, Delete Account, Search Account, Payment and Log Out. This is the first screen that the user will see once the application is opened.

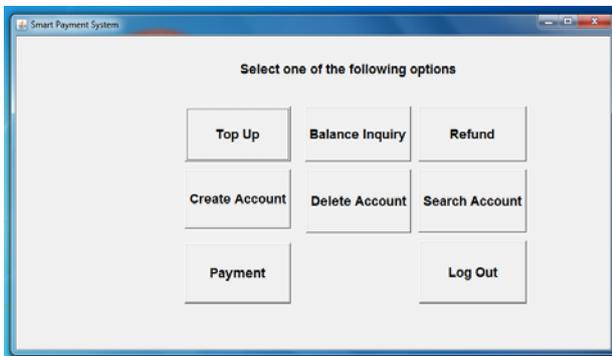


Figure 1. Home page Screenshot

**B) Make Payment Screenshot**

The employee using the application might be in different locations in the hotel (spa, jacuzzi, restaurant, etc). He has to provide the amount of the transaction. The application will deduct this amount from the balance, and update the database (see Figure 2).

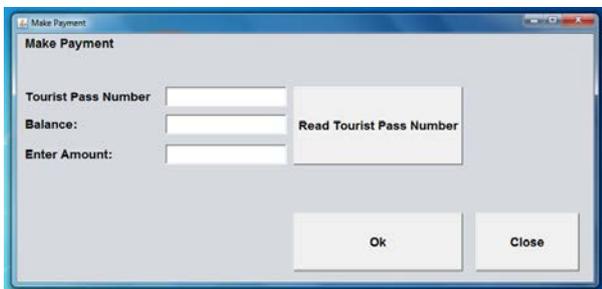


Figure 2. Make payment Screenshot

**C) Top Up Screenshot**

The Top Up feature (see Figure 3) is used if the customer requests to add money to his bracelet. The user will first scan the bracelet and click on “Read ID”. The Bracelet ID will show up on the screen, as

well as the current balance consecutively the user will enter the amount that the customer wishes to add and click ok. Once done, user has to close the window using close button.

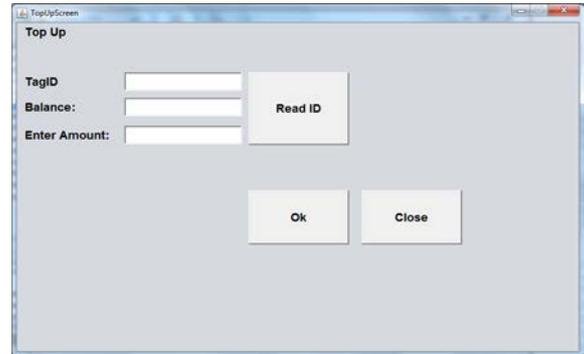


Figure 3. Top-up Screenshot

**D) Refund Screenshot**

In the refund screen (see Figure 4), if a customer wishes to refund a certain amount or all of the amount available on his bracelet, the user will simply scan the bracelet and click on “Read ID” the available balance and Bracelet ID number will show up on the screen. The user is supposed to enter the amount that will be refunded back to the customer in the “Enter Amount” field and click ok.

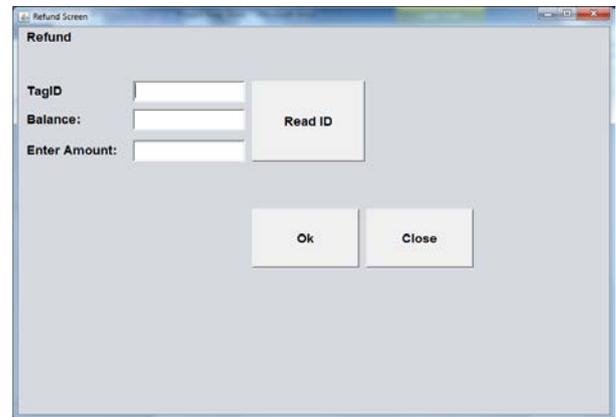


Figure 4. Refund Screenshot

**E) Create Account Screenshot**

In the Create Account screen (see Figure 5), if a new customer checks in the hotel/resort and wishes to use this system he or she will enter the customer name in the field “Customer Name” and then add the customers mobile number in the “Mobile Number” field. Finally the addition of the room number is needed in the “Room Number” field. Additionally, the user will scan one of the bracelets which was not assigned to any customer, and click on “Read ID.” Moreover, the user will ask the customer the amount they wish to have on the ID and enter that amount. Once done, user has to click on Create.



Figure 5. Create account screenshot

#### F) Search Customer Account Screenshot

The Search Customer Account Screen depicts (see Figure 6), the case in which a customer may lost or misplaced his bracelet. Subsequently, he has to inform the information desk employee, who will search according to the mobile number and confirm the customer his name, as well as his room number. Additionally, in case a host brings the lost bracelet to the reception they can identify its owner using the search feature.

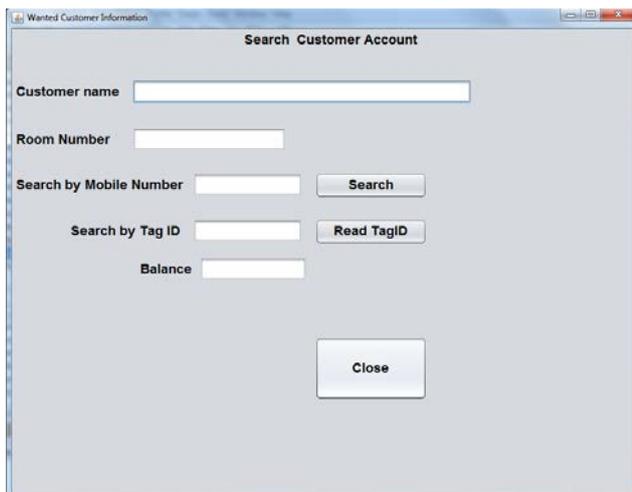


Figure 6. Multi Search criteria Interface

## 6. Conclusion and Future Work

We presented in this paper a smart payment system using emergent technologies (Arduino, RFID/NFC) and aiming at providing a new user experience in hospitality sector. Hotels' hosts will be able to pay conveniently for all the services they are getting in all hotel facilities without carrying wallets or credit cards. They can use their smart bracelet instead. RFID antenna coupled with Arduino device is used as a bracelet reader, which makes the solution very cost effective. In addition, the proposed system is easy to use as it does not require any prior configuration. As far as seven cases of use were presented and explained namely: Create account,

Delete account, Search account, Balance Inquiry, Top Up, Refund and Make payment. Convenience, cost effectiveness and ease of use are our main value propositions of the proposed system. Future research will focus on improving the security level of our system by including a personal photo (that can be taken at registration time), assuring that the bracelet's holder is the same as the bracelet's owner. Finally, to avoid a situation where a guest might not have enough balance in his bracelet, a notification via email or SMS about the balance of the account will be implemented, which will help anticipating such an embracing scenario.

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