



An Implementation of NFC Based Restaurant Table Service

Aditya. R¹, Anirudh. K. R¹, Karthik. K. S¹, Mahinder. P¹, Deepa. S. R²

U. G Students, Department of Computer Science and Engineering, K.S Institute of Technology, Bengaluru, India¹

Associate Professor, Department of Computer Science and Engineering, K.S Institute of Technology, Bengaluru, India²

ABSTRACT: This paper proposes a Near Field Communication (NFC) based food ordering system in restaurants. Near Field Communication (NFC) is one of the latest technologies in radio communications and being a subset of RFID technology, it is growing at a very brisk rate. NFC technology provides the fastest way to communicate between two devices and it occurs within a fraction of a second. It has various applications in Mobile Communications and transactions. An NFC supported ordering system in restaurants is discussed as one potential use of this technology. Customers, who visit restaurants, usually have to wait for being serviced by a waiter. One of the solutions for this is to enable the customer to order his food directly from his table without the need of a waiter by using near field communications technology.

KEYWORDS: NFC; NFC-enabled Smartphones; NFC Tag; NFC Card; NFC Payment machine;

I. INTRODUCTION

The food ordering process in many full-service restaurants comprise of several steps starting after the guests got seated in the restaurant. A waiter would bring a paper based menu for browsing and waits for the guests to make decision on ordering the items. Such process has at least two limitations, one is ordering must be done in the restaurant and secondly, the waiter must wait for the guests to browse the menu and make a decision. While the restaurant is one of the business sectors in service industry with high competition, elimination or reduction of such limitation will be greatly beneficial to the business owner in terms of a wider channel to attract more customers, promote efficiency and reduce service cost.

In the proposed system, we are planning to use the NFC reader/writer. The smart menu consists of QR Code and NFC Contactless Card. The customer scans the QR and tap on NFC card by his/her NFC-enabled Smartphone using NFC Read Application. If both are validated, the customer gets the food menu into their Smartphone. They can select the food which is displayed on their mobile screen. Now, when they confirm, the order will be displayed in the NFC-enabled device. Once confirmed, the information will go to the Chef (inside the kitchen) and the Cashier. Now the chef prepares the food which is served to the customer.

Finally, when the customer is about to leave, he pays the total amount manually to the cashier. The proposed solution tries to overcome the mentioned limitations by leveraging the versatile nature of Smartphone and the upcoming NFC technology to implement the service automation for the restaurant. The result can reduce cost with restaurant perspective and time in customers' perspective.

II. RELATED WORK

A. Existing Food Order Process:

1. Full Service Restaurant: Traditional food order process used in most full-service restaurants starts with a waiter bringing the guests the paper-based menu, and then waiting for the guests to choose items from the menu and inform the waiter to place the order. The process typically requires the guests to be seated in the restaurant and a waiter to assist in the ordering.
2. Automated Food Ordering System: In order to enhance customer experience and reduce service costs, few restaurants have invested in the service automation system. The automation system captures the food order



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from guests ranged in many forms, but mostly comprises of an electronic device with a screen that presents the menu and accepts user input for placing the order [1].

The proposed solution provides alternative ordering option to customers and is beneficial to existing process in several ways depicted by following figure 1.

Quality	Full Service Process	Automated Ordering Devices	Proposed Solution
Capture Pre-Order	No	No	Yes
Require Waiter Resources	High	None	None
Reduce Service Cycle Period	No	No	Yes
Solution Cost	None	High	Low

Fig.1. Order Method Comparison

B. Related Technology:

1. **Android Smartphone:** The solution prototype is developed on an Android Smartphone. On the other hand, in a commercial grade solution, it will be required to support NFC based Smartphone from manufacturers such as Apple, Microsoft, Nokia, and Blackberry. In spite of the fact that Android Smartphone has installation based in almost 50% of Smartphone market, it is for the convenience of the researcher to have the first prototype on an Android device to test the usability of the solution. Android Smartphone are mobile phones that run-on Android operating system developed by Google. The Android is open source platform that is free for anyone to use. Application development on Android device requires the Java based SDKs, provided with free of charges on Google website. The SDKs packed with libraries, manuals, examples, and other stuffs required for easy, rapid and powerful application creation.
2. **NFC:** The Near Field Communication (NFC) is the short-range communication technology which enables data transmission between electronic devices developed by Sony and NXP. Major Smartphone manufacturers are adopting the NFC technology into their Smartphone and Tablets including Nokia, Samsung, Google, HTC, and Motorola; as for example. The 3 Modes of Application of NFC are categorized as follows:
 - **Card Emulation:** Enables NFC devices to act like contact less cards. It includes NFC-enabled mobile phones used for payment and transit.
 - **Reader/Writer:** Enables NFC devices to act as Reader/Writer and interact with NFC tags. It includes NFC-enabled mobile phones used to read "Smart Posters".
 - **Peer-to-Peer:** Enables NFC devices to interact with one another. It includes connecting NFC-enabled laptops and printers or sharing photos between a camera and TV.

The NFC technology uses the radio communication on the frequency 13.56 MHz, according to the ISO18092 standard. NFC's are also bounded to the RFID technology on the same frequency according to ISO-14443 A&B and ISO-15693 standard. This reconcilability will help accelerate the NFC adoption by leveraging existing framework and applications. The Smart Poster is the term mostly describes the paper based poster with NFC tag attached on it. The tag normally contains brief information regarding the poster content. As the attached NFC tag is capable of short-range wireless communication, when a user places the NFC capable device near the tag (usually less than 4cm), the device is able detect the presence of the tag, read information from it, and then the device will carry out required actions accordingly. While the tag can contain any data, the NFC Forum has suggested a standard named NFC Data Exchange Format (NDEF), to be used as a standard format of data contained within the tag. The proposed solution will use Smart Poster with NDEF encoded NFC tag attached to it. The posters can be place in crowded area to attract the customer's attention easily. In

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restaurants, to obtain the pre-order, customer can touch the poster with their NFC-enabled Smartphone. By the virtue of NDEF standard, the Smartphone can be configured to automatically validate the PIN in the specific application installed to handle the data read. If the user has not installed the particular application, the restaurant can provide this application to the user or place a NFC tag which redirect to website of the restaurant to download the application.

III. NEAR FIELD COMMUNICATION

NFC [2] [3], or near-field communication, is an easy and intuitive technology that allows users to use their mobile phone for special purposes. NFC tag/contactless reader [4] can share and link to information such as web pages, social media and all other sorts of information generally. NFC can work in 3 modes. They are NFC reader/writer, NFC peer-to-peer and NFC card emulation. These are the areas where NFC is starting to evolve into are making payment, exchange money for a ticket simultaneously, scanning the NFC tags in the public places to get the Travel information and many more. All of these actions have something in common, that is they invoke an action based on user placing their phone (or any other NFC device) near the object the user wants to read or interact with. NFC is bridging this gap between both the physical and virtual world. By bringing two devices near each other, there is a virtual reaction. NFC uses electromagnetic induction between 2 devices operating within globally available unlicensed radio frequency ISM band of 13.56 Mhz on ISO/IEC 18000-3 air interfaces at rates ranging from 106 to 424Kbps. The act of communicating is called 'Tap-in' and the electrical communication is called 'Inductive Coupling'. In general, the user has to scan/tap the NFC Tag/Reader so that the information embedded within the tag is obtained via a Smartphone. Bluetooth and Wi-Fi do not have this ease in set up. So, the key feature of NFC is automatically getting the data on to user phone's screen without user accessing it. In more technological terms, NFC defines the way two products communicate with each other. NFC is a short-range wireless RFID technology [5] (1-4cm. realistically, 10cm. theoretically), which uses low speeds (106-414 kbps) and a low friction setup (no discovery and no pairing), which permits two devices to automatically start communicating when they are close to one another. NFC uses passive targets with/without batteries and random devices that may/may not be powered, so-called tags or stickers, sometimes NFC contact less reader. NFC Tags/Readers are essentially "targets" that "want" to be touched by NFC devices like mobile. These can contain information, applications or services. NFC is coming to many phones and handset manufacturers like HTC, Nexus, Samsung, Sony and Blackberry have been pushing the deployment of the technology [6]. The various applications of NFC are shown below and in the figure 2.



Fig.2. Various Applications of NFC Technology



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IV. THE PROPOSED SYSTEM

A. Service Scenario:

The proposed system comprises of 2 components, NFC-enabled Smartphone and NFC Smart Menu which consists of QR code and NFC card. The service scenario is described below:

Step 1: The customer need to have or download NFC Read Application.

Step 2: The customer need to register himself by providing their information such as Name, Phone no., E-Mail ID, etc.

Step 3: The customer need to tap on the QR code PIN in the application and enter his name so that he can scan the QR which is present on the table to obtain his/her PIN.

Step 4: The customer need to tap on the Tap NFC in the application and tap his/her NFC-enabled smartphone on the NFC card which is present on the table.

Step 5: The PIN which is obtained by scanning QR and the table number is encrypted and embedding within the NFC card by the restaurant people before the customers enters the restaurant.

Step 6: If both PIN in QR code and PIN in NFC card are validated, then the customer can see the Menu in their smartphone from which they can select the food and confirm the order.

Step 7: The Restaurant people can see the customer order in their respective system and process the order. The customer also obtains Bill to their E-Mail ID after the order is processed.

B. Smart Menu:

This consists of the QR code and the NFC tag. The user needs to first scan the QR code to get the initial pin which is in plain text format. The NFC card is used to check the validity of this PIN and allows the customer to access the menu content and order food items.

C. NFC Write Application:

The NFC writer application is used by the restaurant employees to write into the NFC tag. The details entered by the hotel employees are the table number and the user pin. The snapshot of write application is shown in figure 3.

D. NFC Read Application:

The NFC reader application is the one which is used by the customer after they enter restaurant. The snapshot of read application shown in figure 4. The NFC reader application is used by the customers to register their details (name, phone no., e-mail id and place) by pressing on the 'REGISTER' button. After registering, the customer scans the QR code to generate pin by providing username using 'QR CODE PIN' button. Then he/she taps the NFC card by tapping the 'TAP NFC' button. The card also contains a pin, and the application validates whether the pins are same. If the pins are the same, then the user can gain further access to the app to place orders. To place an order, he/she can browse through category of items and choose whichever item he/she wishes. They can also specify the quantity of the items. The app also gives information about the complete order and gives the total cost of all the items to order so that the user can pay the final amount. The Customer also gets an e-mail as soon as the order is completed.

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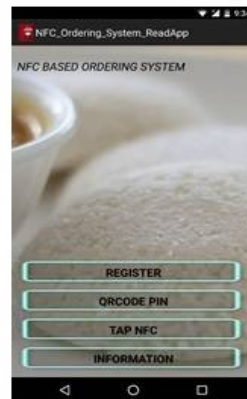


Fig.3. NFC Write Application Fig.4. NFC Read Application

E. Web Application:

The Web Application has the facility for Admin and Support user login as shown in figure 5. Admin is a single person controlling entire restaurant and Support users are Chef, Cashier, etc. The Admin can add, remove and edit support user's details. Admin can also add, remove and edit food categories and food items. He/She can also view the order details placed by customer and obtain details about daily transaction summary. The support users can also view order details in order to process the customer's order. For example, a chef can see the order details as soon as customer place, in his/her screen which is placed in the kitchen so that chef can process the order i.e., in this case, prepare food. Support users can also clear the order placed by the customer as soon as the order is completed. In general, the web application is front-end for restaurant people.

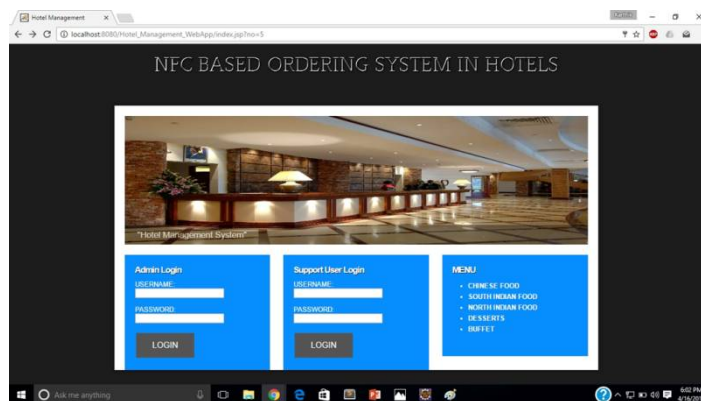


Fig.5. Snapshot of Web Application Homepage

F. Server:

The Smartphone application NFC Read App communicates with the server using wireless application protocol (WAP). The server used here is the Apache Tomcat 6.0. The web app is as the front-end for restaurant people and server app is used to communicate with the Smartphone application.

G. Database:

The database is used to store almost everything. MySQL Server 5.0 is used as the SQL Server and SQLyog is the interface for the database. Here, the admin details, support user details, food category, food items, order placed by customer, order summary which included date & total amount and table details are stored in the database. The content of the database is just shown in the NFC read application and web application.

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V. TECHNICAL ARCHITECTURE

A. System Architecture:

The main system architecture consists of the user, android application, NFC card, server, database, admin and the support users. The user taps on the NFC card using his NFC-enabled Smartphone. The Smartphone application communicates with the server using wireless application protocol (WAP). The database stores the user data and the food items ordered by each customer. It also stores the details of the admin and the support users. The customer can interact with the system through the mobile application. As soon as the tap in is done, the customer's Smartphone is connected to the server. The order details are sent from the Smartphone to the database which is also displayed in admin and support user's system for order processing. The system architecture of the system is shown in figure 6.

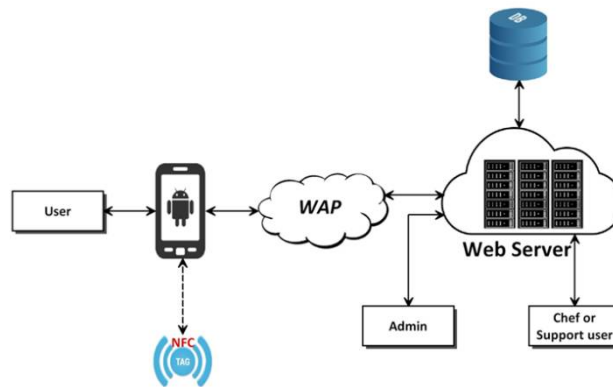


Fig.6. System Architecture

B. Context Analysis:

The admin enters the details of the support users, the food items and other relevant information into the J2EE web application. The admin then gets the confirmation from the application regarding the successful input of the data into the application. The support users can request any information regarding the order placed by the user through the web application. The web application will then make available the information through table wise details for every user. On the customer side, they tap the NFC tag to gain access to the menu in the mobile application from which they can place their orders. The orders are then transmitted through to the support users and the admin through the web application. The user then gets the confirmation regarding the successful ordering of items. The context analysis diagram of the system is as shown in figure 7.

C. Data Flow:

The flow of the NFC Food Ordering System is pretty simple. The customers first scan the QR and obtain a pin. Then, they tap on NFC card. If both the PIN are matched, then only menu is displayed to the customers. Now, they can select from the various items from several categories. Once confirmed by the customer, the food order details are sent to the web application which is constantly being seen by the restaurant people. The order is seen by the support users and admin because the customer order is stored in the database as soon as the select it. The customers can also view the order details in the NFC read app as soon as they select. If the PIN do not match then, the customers are taken back to home screen of NFC read app by saying PIN is not validated. The data flow diagram is shown in figure 8.

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Fig.7. Context Analysis Diagram

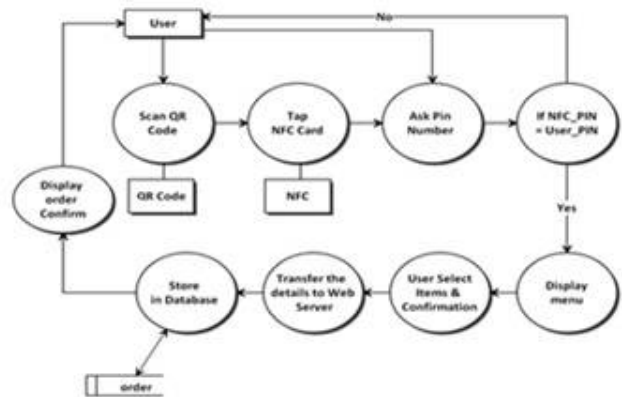


Fig.8. Data Flow Diagram

VI. RESULT

The usefulness of the proposed solution comes from the reason that it provides easy and convenient way for the guests and restaurant to capture pre-order transaction. To be summarized, guests just pick a phone from his or her pocket, place the phone at the food poster, clicks confirm, and the order is then processed. The solution cost is expected to be very low when compared to other alternatives. The adoption of NFC based Smartphone is currently very limited to only few devices. The solution can commercially work only when NFC based Smartphone has widely used. The prototype is shown in figure 9.



Fig.9. QR Code and NFC on the table for validation

VII. FUTURE ENHANCEMENT

The solution model can be not only used in restaurants but also can extended to capture pre-order transaction or to place actual order for other retail products and services.

NFC Payment is one of the latest technology which is setting its trend over the world. Apple Pay, Android Pay and Samsung Pay are examples of NFC Payment Application. It completely eliminates the use of cash and credit/debit card for payment. The users just have to save their credit/debit card details once in the application. So, in order to pay, user just need to tap on the NFC Payment machine. The transaction will be completed within a fraction of second.



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The solution can be extended such that, once the user gets the bill, he/she can tap on the NFC payment machine and transaction is done automatically. Thus, eliminating cash and credit/debit card.

VIII. CONCLUSION

The emergence of smart mobile devices including the Smartphone and Tablet provides new opportunities for services sector business to leverage its capability in many ways; to have more reaches to its customers, to gain more efficiency using service automation, and to get more attractiveness via service experience offering. Yet the upcoming NFC will reinforce its possibility and usefulness.

The proposed solution provides easy, convenient and cost-effective way to capture pre-order transaction form customers. The most part of order process can be primarily done without the requirement of waiter staff assistance. The process is intuitive, customer just scans the Smartphone on the smart menu, and only another touch is required to confirm the order inside the restaurant.

The implementation can result in cost reduction incurred by utilization of restaurant facilities and waiter staffs. Despite the shortcoming of the solution that requires NFC based Smartphone adoption. The solution employs technology that is available to the mass market; choices for implementation can be unlimited and cost effective.

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BIOGRAPHY

Mr. Aditya. R. is a Under Graduate Student in Computer Science and Engineering Department at K. S Institute of Technology-Bangalore, affiliated to VTU.

Mr. Anirudh. K. R. is a Under Graduate Student in Computer Science and Engineering Department at K. S Institute of Technology-Bangalore, affiliated to VTU.

Mr. Karthik. K. S. is a Under Graduate Student in Computer Science and Engineering Department at K. S Institute of Technology-Bangalore, affiliated to VTU.

Mr. Mahinder. P. is a Under Graduate Student in Computer Science and Engineering Department at K. S Institute of Technology-Bangalore, affiliated to VTU.

Mrs. Deepa. S. R. is a Associate Professor, Department of Computer Science and Engineering at K. S Institute of Technology-Bangalore, affiliated to VTU.