

The Food Pre-Order System for Restaurant using NFC Based Smartphone

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Abstract—Typical food order process in a restaurant involves several steps for the guests starting from browsing the paper based menu and inform a waiter of the ordering items. The process usually requires the guests to be seated before starting. The solution “Food Pre-Order System using NFC Based Smartphone” introduces an alternative method for the guests to be able to create the order before they approach the restaurant. Using NFC based Smartphone; the pre-ordered items can be captured by touching the phone at the NFC attached menu poster placed in eye-catching crowded area. When the guests approach the restaurant, the saved order can be confirmed by touching the Smartphone at the Order Dispatching Station located in the service area inside the restaurant. The list of captured pre-ordered items shall be shown on the station’s screen, and when confirmed, order slip shall be printed for further order processing. The solution provides easy and convenient way to capture pre-order transaction from customers, entitled restaurant the ability to perform marketing promotion and offer services off its perimeters, and can leads to cost reduction incurred by utilization of restaurant facilities and waiter staffs.

Keywords—Service Automation, Food Pre-Order System, Restaurant Service, NFC, Smartphone, Smart Poster

I. INTRODUCTION

The food ordering process in most full service restaurants comprise of several steps starting after the guests got seated in the restaurant. A waiter would bring to the guests the paper based menu for browsing and waiting for the guests to make decision on the ordering items. Such process has at least two limitation, one is ordering must be done in the restaurant and another is the waiter must wait for the guests to browse menu and make decision. While the restaurant is one of a business sector in service industry with highly competition [4], eliminate or reduce of such limitation will greatly beneficial the business owner in terms of a wider channel to attract more customers, promote efficiency and reduce service cost.

With the emergence of computerized mobile device, for more specifically the Smartphone and Tablet, consumers tend to adopt it in many ways including communication, entertainment, social networking, and accessing or purchasing products and services. While the Smartphone has proved its usefulness for most users in many scenarios, the Near Field Communication (NFC) is the technology that is on its way to further enhance its ubiquitousness by adding the short-range communication capability. Expected use cases for the NFC

have demonstrated in many scenarios including mobile payment, shopping, communication, social-networking and entertainment. Furthermore, most major Smartphone manufacturers have committed to adopt the NFC into their newer release of the devices [5].

The proposed solution usage scenario started by having the customer touch their NFC enabled Smartphone to the NFC attached poster in order to capture their preferred food menu item. The captured list can then be later confirmed by touching the Smartphone to an NFC device located in the service area inside the restaurant. The poster rendered with beautiful food menu and maybe together with some promotion can be place in crowd area to attract customers beyond the restaurant physical perimeter and can capture the pre-order transactions while the ordinary poster cannot. Also the major part of ordering process is done outside the restaurant and without the need for waiter assistant.

The proposed solution tries to overcome the mentioned limitations by leveraging the versatility of Smartphone and the upcoming NFC technology to implement the service automation for the restaurant. The result can be effectively reduce service cost and, and more importantly, provide better service experience to the customers.

II. RELATED RESEARCH

A. Existing Food Order Process

1) *Full Service Restaurant*: Tradition food order process used in most full-service restaurants starting when a waiter brought the guests the paper-based menu, and then waiting for the guests to choose items from the menu and inform the waiter the order items. The process typically required the guests to be seated in the restaurant and a waiter to assist the ordering [3].

2) *Self Service Restaurant*: This process required the guests to place order at the service counter in the restaurant. The guests shall have decision in advance, before presented at the counter, of which menu items to order. Menu catalog is mostly presented as posters placing behind the order counter [3].

3) *Automated Food Ordering System*: In order to reduce service cost and enhance customer experiences, few restaurants have invested in the service automation system. The automation system used to capture the food order from guests ranged in many forms but mostly comprise of an electronic

device with a screen presenting the menu and accept user’s input for order placing [2, 6, 10].

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

TABLE I. ORDER METHOD COMPARISONS

Quality	Full Service Process	Self Service Process	Automated Ordering Devices	Proposed Solution
Capture Pre-order	No	No	No	Yes
Require Waiter Resources	High	Low	None	None
Reduce Service Cycle Period	No	No	No	Yes
Service Location	Table	Counter	Table	Anywhere
Solution Cost	None	None	High	Low

B. Related Technology

1) *Android Smartphone*: The solution prototype is developed on an Android Smartphone. Although in commercial grade solution, it will required to support NFC based Smartphone from manufacturers such as Apple, Microsoft, Nokia, and Blackberry. Despite the fact that Android Smartphone has installation based almost 50% of Smartphone market [8], it is for the convenience of the researcher to have first prototype on Android device to test the usability of the solution.

Android Smartphone usually refers to mobile phone running Android operating system developed by Google. The Android is a free, open source platform for anyone to use. Application development on Android device requires the Java based SDKs, provided with no charges on Google web site [1]. The SDKs packed with libraries, manuals, examples, and other stuffs required for easy, rapid and powerful application creation.

2) *Near Field Communication (NFC)*: The Near Field Communication (NFC) is the short-range communication technology that supports data transmission between electronic device developed by Sony and NXP. Major Smartphone manufacturers have adopted the NFC into their Smartphone devices including Nokia, Samsung, Google, HTC, and Motorola; as for example [5].

Application of NFC can be categorized into 3 modes [5]:

a) *Card Emulation*: Enables NFC devices to act like contactless cards. Use case including NFC-enabled mobile phones used for payment and transit.

b) *Reader/Writer*: Enables NFC devices to act as Reader/Writer and interact with NFC tags. Use case including NFC-enabled mobile phones used to read “Smart Posters”.

c) *Peer-to-Peer*: Enables NFC devices to communicate with one another. Use case including connecting NFC-enabled laptops and printers or sharing photos between a camera and TV.

The NFC technology employs the radio communication on the frequency 13.56 MHz, according to the ISO18092 standard. The technology also conformed to the RFID technology on the same frequency according to ISO-14443 A&B and ISO-15693 standard [7]. Such interoperability will help accelerate the NFC adoption by leveraging existing infrastructure and applications.

The Smart Poster is the term mostly describes the paper based poster with NFC or RFID tag attached on it. The tag normally contains the identity and brief information regarding the poster content. As the attached NFC or RFID tag is capable of wireless short-range communication, when a user places the NFC capable device closely to the tag (usually less than 4cm), the device can detect the presence of the tag, read information from it, and then the device can perform any required actions accordingly.

While the tag can contains any data, the NFC Forum has suggest a standard named NFC Data Exchange Format (NDEF), to be used as a standard format of data contained within the tag.

The proposed solution uses Smart Poster with NDEF encoded NFC tag attached to it. The posters can be place in crowded area to easily get the customers attention. To capture the pre-order, customer can touch the poster with their NFC-enabled Smartphone. Thanks to the NDEF standard, the Smartphone can be configured to automatically activate the specific installed application to handle the data read. If the application is not installed, the Smartphone can then be configured to redirect to restaurant web site to provide further suggestion.

III. THE SOLUTION

A. Service Scenario

The proposed system comprises of 3 components, NFC-capable Smartphone, NFC-attached Poster or Smart Poster, and Order Dispatch Station. The service scenario is described using figure 1



Figure 1. Service Scenario

1)Step 1: When using the service, a guest would first place the NFC Smartphone at the desired food item on the Poster.

2)Step 2: The Smartphone shall read information from the NFC tag, of the chosen food item located on the Poster, and activate the pre-installed application developed specifically for the service. In case if the application is not installed, the Smartphone shall provide direction for the user to download and install the application on-the-fly.

3)Step 3: On the Smartphone application, user reviews the pre-ordered item details, then confirm to keep the item for later confirmation at the restaurant. User may repeat the steps to order more items as desired.

4)Step 4: When the user approaches the restaurant, user will be directed to touch the Smartphone to the Order Dispatch Station, LCD screen on the station will shows the captured pre-ordered items. Users may choose to discard some items, and then perform the order confirmation.

5)Step 5: When order is confirmed, the slip-printer attached to the Order Dispatch Station will print out the confirmed order items. The restaurant will use the printed details for further order processing.

B. Technical Architecture



Figure 2. Solution Architecture

The service architecture of the solution is the cloud based service. The service center is a server hosted within the Internet domain. It provides service functional to Smartphone and Order Dispatch Station via the Internet communication. The service center maintains the restaurant service catalog and presented to users on their Smartphone or on Order Dispatch Station upon requested by the running application on each devices. The center also keeps users and restaurants profiles, preferences and other service configuration. When a pre-ordered transaction is captured on the Smartphone, the transaction shall be forwarded to the server and stay there for later use on Order Dispatch Station.

C. The Service Center

The Service Center is a Linux based server running Apache Tomcat web server, MySQL database, and the created web service application.

The Service Center provides 2 types of services, one is API functional for Smartphone application and Order Dispatch station, and another is web pages for ordinary web browser.

The Web Pages provide information to the Smartphone in case if the NFC tag is read by the Smartphone but the specific mobile application is not installed. Note that the URL for the Web Pages is as of encoded into the NFC tag on Smart Poster.

The application is developed using Java language. The software design is done in modular fashion and split functional into 4 main modules as API Interfacing module, Web Pages, Business Logic Functional module, and Data Access module. Functional architecture of the server application is described using figure 3.

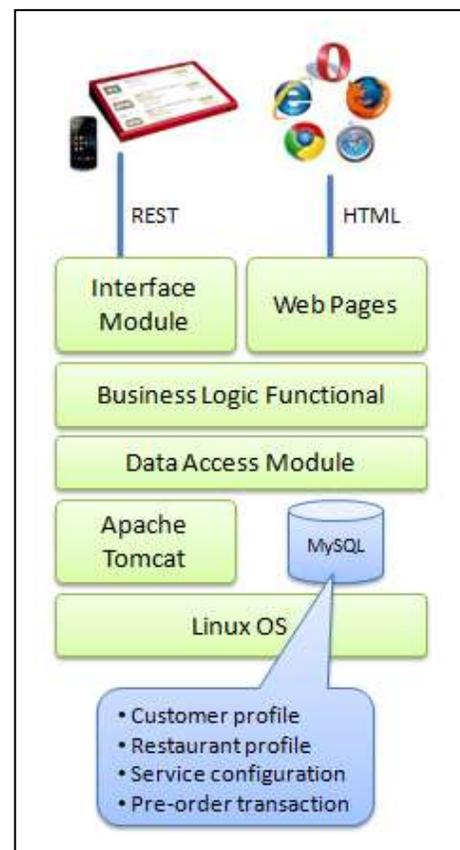


Figure 3. Service Center Software Architecture

The server provides its service to client devices; that is the application running on Smartphone and Order Dispatch Station, via the REST protocol. REST is employed in order to achieve the scalability, to simplifying implementation, and to increasing reuse ability of the service components [9].

Implementation of REST is done on top of Servlet Java library, which provides the foundation for software interface through HTTP protocol.

D. The Smartphone Application

The development of the application on Android Smartphone is done using Java language together with libraries provided by the Android SDK [1].

The application leverages Android platform functional to capture the NFC data. It is required that the phone must be configured to enable the NFC tag reading. When the phone approaches near an NFC tag, usually less than 4 cm., it will sense the tag presence and start reading data from it. In case if the tag is encoded with NDEF, the Android will parse the data and try to activate proper application accordingly. Thus the developed application also needed to define its identity and register it to the Android while installing the application.

The functional architecture of the application software designated to run on Android Smartphone devices is described using figure 4.

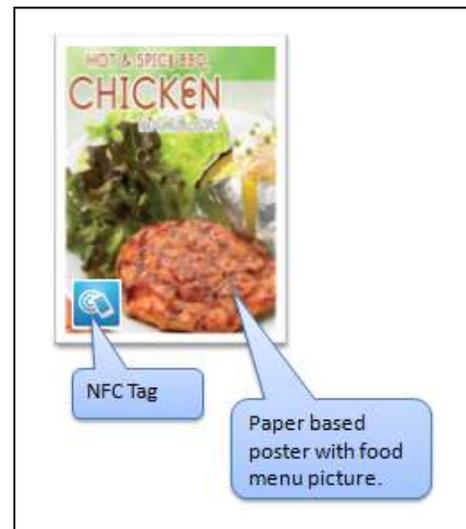


Figure 5. Smart Poster

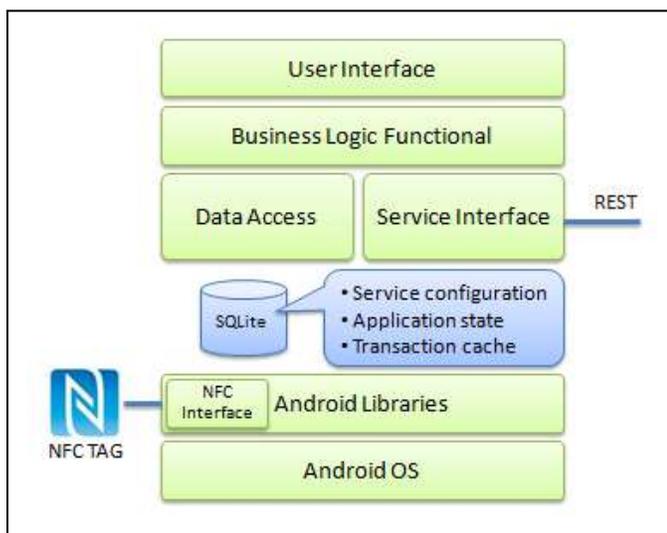


Figure 4. Smartphone Application Software Architecture

E. The Smart Poster

The Smart Poster is the typical paper based poster rendered with food menu served by the restaurant. The poster has an NFC tag attached to it. The tag is encoded with NDEF format to provide identity of the food menu it presented. The URL of the service web site is also encoded into the tag for the Smartphone that doesn't have the designated service application installed - to be able to retrieve service details and further guidance information.

The restaurant may put some promotion to the menu item to attract more customers and place the poster in the location where the people can easily get attention on it. Price for each NFC tag can be as low as \$1 USD; many posters can be place without too much cost.

Example of Smart Poster is shown as figure 5.

F. The Order Dispatch Station

The Order Dispatch Station is the device located in the restaurant used when a guest would like to place order when captured by the Smartphone. The device comprises of an Android tablet connected to the NFC Card Reader via USB interface. When the guest places the Smartphone on the card reader, the reader will read the NFC tag built in the Smartphone in order to identify the guest identity. The identity will then be used by the application running on the tablet to retrieve pre-order transactions and present to the guest on its screen. Using the touch screen on the tablet, the guest shall be able to remove some items and proceed with order confirmation. The confirmed order shall be printed on wireless slip printer connected through Wi-Fi to the tablet. The functional architecture of Order Dispatch Station is shown as figure 6.

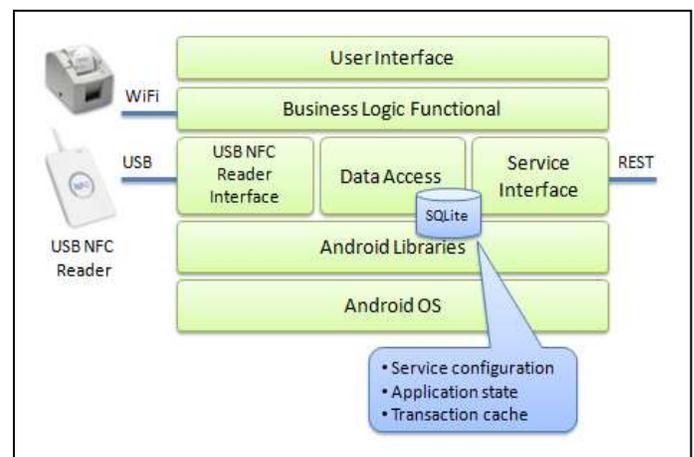


Figure 6. Order Dispatch Station Software Architecture

The solution for the station can be more simplified if the tablet in used is NFC capable. Thus require no external interface to NFC card reader. As of today, there're very few of such devices, for example, Sharp RW-T107 launched in Japan and TazPad launched in France [5].

IV. RESULTS AND DISCUSSIONS

- 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, a guest just pick a phone from his or her pocket, place the phone at the food poster, click confirm, go to restaurant, place the phone at Order Dispatch station, click confirm on the station.
- While the solution cost is expected to be very low, it entitled the restaurant the ability to capture order beyond its perimeter, and to attract customer using different service channel.
- The proposed solution has a great potential for the restaurant to perform additional marketing promotion or provides additional service options to customers. The example including provide discount coupons, allow customer to send the captured menu to their friend through social-network, allow customer to perform reservation as well as the payment from their mobile device.
- The same solution model can be extended to capture pre-order transaction or to place actual order for other retail products and services.
- 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 proposed “Order Dispatch” station proposed by the solution can be extended to accept just-in-time orders from customer from within the restaurant perimeters and can also be installed on customer’s table to maximize service convenience. In this case, its role is extended to be the “Automated Interactive Service Station”, which then can provides automated, self-service, and interactive service channel to the customers.

V. CONCLUSIONS

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 from customers. The most part of order process can be done without the limitation of “only inside the restaurant”, and primarily not require waiter staff assistant. The process is intuitive, customer just attach the Smartphone to the food poster, only another touch is required to confirm the order inside the restaurant.

As the process for the solution is of type self service and off-restaurant perimeter, implementation can results to 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. Also with the highly customizable nature of the Smartphone, it entitled the restaurant with flexibility to offer promotions and enhance service experiences through the solution infrastructure.

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