AUTOMATION OF USSD-BASED PAYMENT MODEL FOR E-COMMERCE SYSTEMS USING AGILE TECHNIQUE

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Abstract:
The way we conduct business has been altered by technology. It has completely changed how financial transactions are conducted, but in the long run, requires certain things like smart gadgets and internet connection. As a result, businesses have lost a sizable number of potential clients. To close the gap and give businesses the ability to collect money from various clients, Unstructured Supplementary Service Data (USSD)-based payment processing was developed. Additionally, a web-based tool was developed to help merchants/retailers keep track of their clientele. To create an appropriate USSD application for this system, agile technique was used. Results gained from testing a prototype system utilizing Sandbox App demonstrated that customers can use USSD and SMS technologies to pay for items instead of solely depending on online payment technologies.

Keywords: USSD, Online payment, E-commerce system, E-payment, Financial technology.

Introduction

Without using checks or cash, electronic payments (also known as "E-Payments") are means to conduct transactions or make payments for goods and services using an electronic medium (Wróbel-Konior, 2019). A growing number of people are using this method of payment as a result of technological advancements and laws that are friendly to electronic money transactions. Online or offline electronic payments are both possible. The majority of financial technology companies are concentrating more on online payment processing than offline payment processing, thus there have been greater developments in this area. Payment gateways like Remita, Paystack, and Flutterwave were made possible thanks to these innovations. Compared to internet payments, the expansion of offline electronic payment processing has been slower. One of the causes is because it is not always possible to conduct offline payment transactions using specialized hardware like POS terminals and ATMs (Ayo & Babajide, 2016).

One of the industries that heavily relies on e-payments services, particularly online e-payments, is e-commerce. Up until recently, shops exclusively accepted cash from customers to pay for their purchases. With the advent of the cashless economy, consumers started asking for cashless payment options. POS (Point of Sale) hardware, which was embraced by retailers, was made possible by the advent of credit and debit cards. Even though credit and debit cards handled transactions effectively, not every store could afford to have one. According to Ayo and Babajide (2016), some establishments were not even qualified to receive a device because they are only distributed by recognized financial organizations (such as banks), who only offer their clients who have a particular number of transactions on their accounts. With the exception of online payment gateways, which offer services that can only be incorporated on a website, there are still no common (or generally acceptable) methods of payment by e-commerce establishments (Khan, 2016). This suggests that payment gateways enable payments for online shops with websites, which means that in order to complete transactions, one requires a smart phone or another high-end gadget.

On the other hand, POS terminals only offer features that allow for payments for tangible goods (Ayo & Babajide, 2016). This suggests that POS terminals can only be used to process payments at physical stores. However, it has its own drawbacks that prevent both businesses from adopting it, inter-bank transfers using USSD technology have been able to serve as a bridge between the two stores. This research determines that it is appropriate to find an offline solution that is comparable to online e-payment solutions utilizing the USSD technology that can be implemented by both online (E-Commerce) and physical stores in order to give the convenience of financial transactions.

Review of Related Literatures

With the goal of easing payment for security concerns, several academics have focused on cashless transactions. An offline electronic payment system was proposed by Abdullah et al. (2017) in their research, and it complies with the key security requirements of e-payments, including anonymity, unlink-ability, unforge-ability, double spending control, conditional traceability, theft prevention, offline payments, and date attach-ability. The research led to the use of an untraceable blind signature based on Rivest-Shamir-Adleman (RSA) and the creation of a "e-coin". Despite being an offline payment system, the effort is mainly concerned with transaction security. Because the bank is not required to be involved in the interactions between a merchant and a consumer, it is considered a "offline" transaction. It is important to note that it describes in great detail how business transactions between customers and vendors take place, with the bank serving as the controlling party. However, there are certain drawbacks, including transaction time lag and the requirement to first convert flat cash to an electronic coin (e-coin).

A cashless transaction system that uses what Hari and Punitha (2020) referred to as a "cryptographic card" for offline transactions has been developed. The cryptographic card has an ATM card appearance and functionality. However, the card includes a chip attached that has a memory for keeping track of transaction balances as well as the information required for transaction authentication. Charles & Wilfred (2010) carried out another study that led to the creation of an ATM-like card for offline transactions. These works, however, are more security-focused, necessitating the

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235

installation of specialized hardware for reading the card. Additionally, it makes it user-unfriendly because a customer must memorize a very long string of characters that is used as a "pass-phrase" for each transaction.

A work on SMS and USSD models for location-based mobile advertising in microenterprises was proposed by Thiga and Siror (2014). SMS and USSD are two offline technologies that the author used. The system's design allowed businesses to advertise offline. Through SMS and USSD, it gives customers in a specific location a list of nearby businesses and services. USSD technology, which will be used in this endeavor, was utilised in the research. However, there was a significant vacuum in the author's business logic for the system. It allows companies to interact with customers without having a way for them to make money through the system. Value Added Tax (VAT) and other commissions are taken out of each purchase thanks to this research.

Akinlade (2015) created the online payment gateway paystack.com, which enables retailers to accept payments for their products and services. Numerous alternatives for processing payments are offered by the payment gateway. The first is the USSD payment choice. To allow one to make a payment, it creates a random and unique USSD code that is peculiar to some banks (Akinlade, 2015). Despite the simplicity of the transaction, one needs an internet connection to generate the USSD code and it only works with certain banks. The research's suggested solution will need the customer to be completely offline in order to complete the transaction, and it will use NIBSS Instant Payment to make transactions feasible independent of the user's bank.

A study paper titled "Offline payments for central bank digital currency" was issued by the Bank of Japan (BOJ, 2020). They described how they were able to create a 12-button handheld gadget for doing business between retailers and customers in it. The gadget serves as a wallet and operates independently of the internet. The device can communicate with other users, verify transactions, save money, and submit payment instructions. It is clear from their work that installing this payment method will be expensive because it requires that both the merchant and the customer have a device. However, this study suggests a straightforward payment method that makes advantage of the customers' already-present mobile devices. Consequently, there is no need to purchase a specific mobile device.

A summary of works reviewed, their implementation strategies and the drawbacks are highlighted in Table 1.

Table 1: Summary of work

Author/Year	Title	Implementation	Limitation
Charles and Wilfred (2010)	Design of a secure unified e-payment system in Nigeria: A case study	For all banking transactions, a unified (single), smart card-based ATM card with a biometric cash dispenser was used.	Transactions can only be made by the account owner. No transactions can be made via a proxy
Thiga and Siror (2014)	An SMS and USSD model for location-based mobile advertising in microenterprises	Two-way SMS technology and USSD software	Manual entry is used for locations. Not automatically downloaded
Akinlade (2015)	USSD option on Paystack.com	a single platform for handling transactions based on USSD	Restricted to specific banks
Abdullah, et al. (2017)	An offline electronic payment system based on an untraceable blind signature Scheme	Constructing a cryptographic framework for bank transactions	Security received increased attention. Transactions take a long time, and both the seller and the buyer must be tech adept.
Hari and Punith (2020)	Offline Rig - Offline and Cashless Payment	Cryptographic card (physical card)	For a transaction to be completed, a POS device must be available.
BOJ (2020)	Bank of Japan research: offline payments for central bank digital currency.	Transaction mobile device	Cost to install.

Analysis of the developed model

Numerous problems with the previous system led to the construction of the current one. Accessibility is a noteworthy problem because those without smartphones are largely excluded from using the previous system. Users are unable to use the previous system if they have no/inadequate internet access. Another motivation for creating the current system was to employ universally available and common technology (USSD) to lessen the problem of unsuccessful transactions.

A distinctive USSD code is used by the new payment processing system to collect payments for retailers. Customers can execute a purchase without using the internet or a smart device. The new approach can be used by companies that run both physically and online to collect payments from clients. As opposed to early systems that tended to generalize their services to other sectors away from business ventures, it focused exclusively on the purchase of products and services. It provides a platform for online management of stores and products for retailers. Additionally, retailers have access to the list of payments made for each particular item and may seek the withdrawal of payments made as necessary.

The agile methodology was chosen for this study. In order to create a condensed version of the system and offer it to the users for evaluation and feedback, the

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236

processes of analysis, design, and deployment were quickly completed. Due to the difficulties in articulating system needs, this technique proved quite helpful. High level model of the new model is shown in Figure 1.
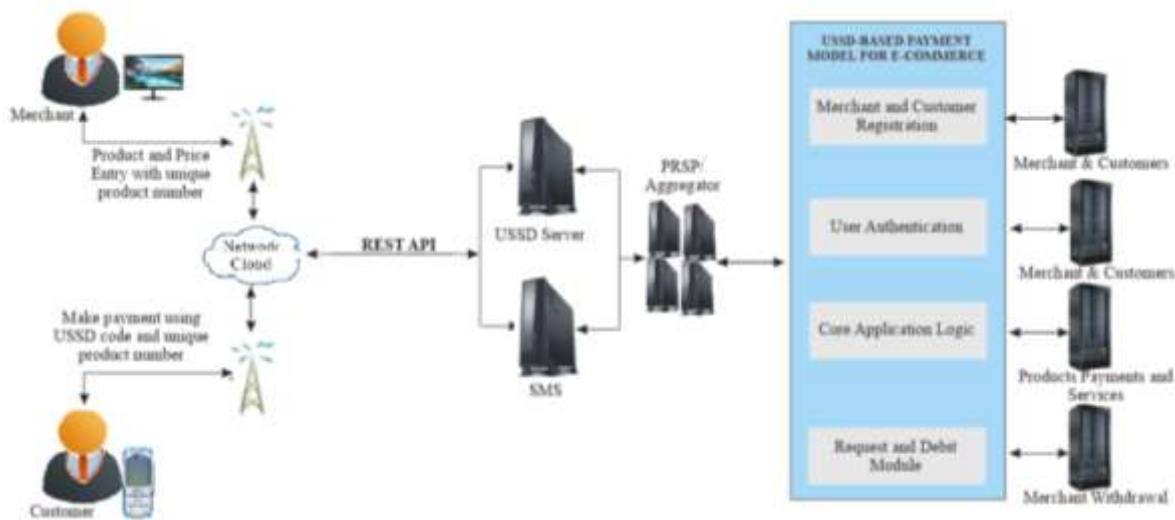

Figure 1: High level model of the new system

Results and Discussion
A web-based tool for managing businesses and a USSD interface for customers were built in this system.
The primary menu options for web-based apps are:
Merchant registration page: The interface that the merchant will use to set up an account is provided on this page. The following input fields are present on it:
i.   The name of the firm
ii.   Its email address
iii.   Its phone number
iv.   The nature of the business
v.   The business's physical address and a succinct explanation of what it does.
vi.   Account information for the merchant

The merchant login page: This page offers a sign-in interface for the merchant to access their account. It has fields for the username and password.
The merchant dashboard: The merchant has control over their business through the dashboard. There are options for managing their profile, payments, and items. This dashboard is used by the retailer to enter the prices of the products. As shown in Figure 2, the vendor provides a special product number for each item as well as the quantity on hand. The concept is that consumers who want to pay via USSD code can enter the specific product number during the transaction process, and the system will display the pricing and quantity options for the client to choose from.
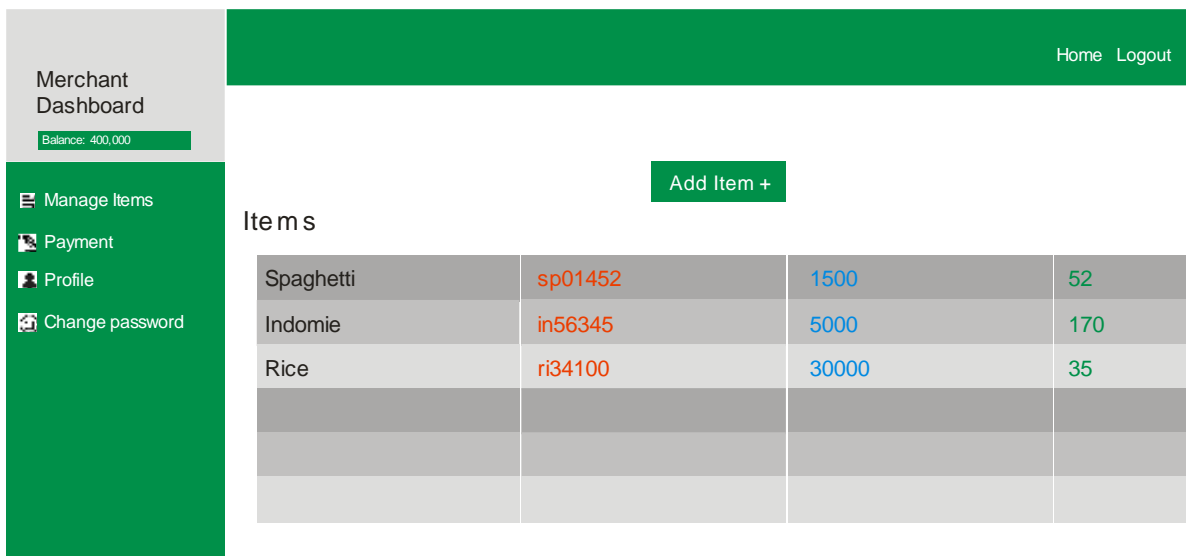

Figure 2: Merchant dashboard for price and product entry with unit product id

Merchant can edit or add product to the existing products in the shelve. This is necessary due to unstable market price that may result into a change in price of product. Figure 3a and 3b is a description of how to add and edit an item in the system.

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237

Figure 3a: Add Item to existing products   Figure 3b: Edit an item in the shelve

The main menus for the USSD interface are "My Wallet" and "Pay for a Service". The customer utilizes the USSD service by dialing *384*70072# from their device.
Wallet: Customers have access to their wallet information through this option. It enables brand-new users to build a wallet, as seen in Figure 4.

Figure 4: Wallet creation in the new system

Pay for a Product: The USSD interface accepts an item ID, processes the payment, and credits the merchant after deducting the appropriate amount from the customer's wallet. This is showing in Figure 5a, 5b and 5c.

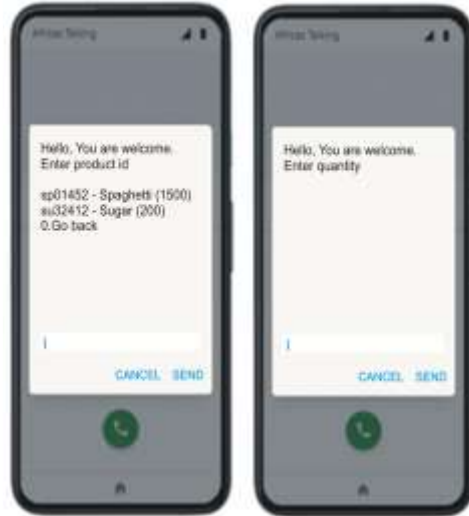Figure 5a: Showing the first two steps in purchasing a product

Figure 5b: Showing the third and fourth steps in purchasing a product
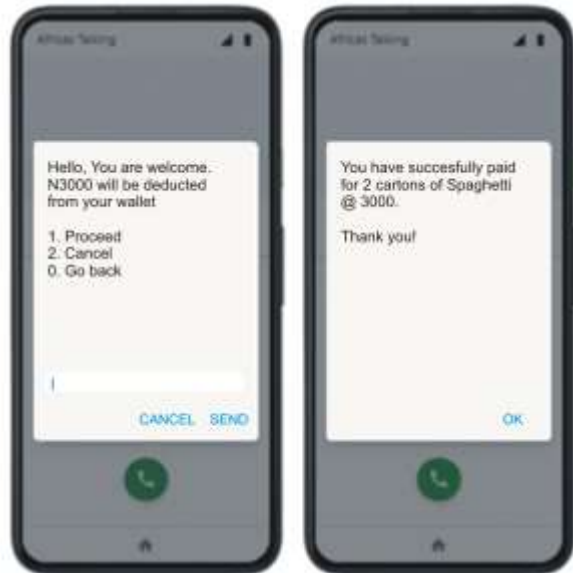

Figure 5c: Showing the last two steps in purchasing a product

A merchant can claim his/her money by submitting a request to his/her account as shown in Figure 6.

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238

Figure 6: Merchant request to withdraw money from destination account

Conclusion

The difficulty of using the internet and mobile devices to complete transactions was resolved by e-payment for retailers using USSD. At the conclusion of the research, two applications—a web application and a USSD application—were constructed. Customers can interact with businesses via the USSD application, whereas merchants utilize the online application to administer their operations. Both systems have a user-friendly interface and are simple to operate.

The software developed as a result of this research enables customers to make purchases of goods and services using any kind of device—as long as it has the ability to use the USSD interface—without the need for an internet connection. Given that no previous research of this kind has been conducted, this represents a significant advancement in the field of financial technologies.

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239