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Web-based Voucher management system for PHCN prepaid meters

Achonu O. Adejo[1], Caroline O. Alenoghena[2] and Joseph Esemuru [3]

[1, 2] Department of Telecommunications Engineering
Federal University of Technology, Minna – Nigeria
[3]Department of Electrical/Electronics Engineering,
Federal University of Technology, Minna – Nigeria
[1] **Corresponding author details:** achonu@futminna.edu.ng, +2348035900338

Abstract

This paper presents the design of software that provides a convenient means of managing the voucher system for the PHCN prepaid meters which are gradually gaining acceptance in Nigeria. The challenges currently existing when customers try to obtain vouchers to recharge their meters formed the motivation for this research work. There is difficulty experienced in locating vendors to provide the vouchers needed. To solve this problem, web application software was designed using HTML, PHP Javascript and MySQL programming languages. The application was tested on a single PC using the WAMP server. The system creates and manages vendors, taking note of their locations and also provides a means for the vendors to obtain units from the utility company and create vouchers. Customers can access the system and search for vendors close to them so that they can later contact them and make their purchase. The software also has a simulation of the recharging process where a valid PIN from a voucher is loaded into a virtual meter. It is expected that this research forms part of the framework through which an efficient consumer billing system for energy usage in Nigeria can be created.

Keywords: Prepaid meters, Voucher management system, Web application software

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1. Introduction

The importance of electric power in sustaining domestic, office, industrial and economic activities cannot be overemphasized. It is indeed a component that drives human life and processes. In countries with inefficient power

industries, there is a need to improve the quality of the generation, transmission and distribution sectors.

In the distribution sector, an effective billing of electricity usage of consumers is vital for revenue generation. The traditional electromechanical (analogue) meters have been inadequate and inefficient. (Omoleke, 2011) Consequently, Power Holding Company of Nigeria (PHCN), the organization governing the use of electricity in Nigeria has commenced the process of introducing energy prepayment meters as an alternative.

The prepaid meter provides a convenient means of monitoring energy consumption and ensuring that users pay for only what they will consume. (Johnson, Odekoya & Umeh, 2012, Al-Naima & Jalil, 2011). Power is automatically disconnected when the units paid for have been used up. This automated system has resulted in increased efficiency as there is less reliance on human factor for its operation, compared to the analogue meters. Human factors introduce several errors, have high cost implications and are susceptible to fraudulent practices.

Presently, the prepaid meters are recharged by taking the smartcards embedded in the meters to the PHCN offices/agents for reloading of units. Recharge can also be done by obtaining PIN codes (from PHCN offices, banks and other authorized outlets) that can be entered in the meters. The above mentioned methods imply that the consumers go physically to the points of recharge to make their payments, resulting in a level of inconvenience. Advances in Internet technology and other Information and Communication Technologies (ICT) have provided efficient means of making secure payments over the internet. This will bring about less stress, reduced cost and improve the overall efficiency of the system.

This paper presents a web application designed to improve the recharge system of the prepaid meters using Internet technology. Customers are provided an improved access to PHCN-approved vendors who can be accessed easily over the internet. Consumers of power can use

the system to search for vendors close to them. Eventually, when many vendors have been registered, it will be very easy and convenient to get access to the vouchers. The software also has a simulation of the recharging process where a valid PIN from a voucher is loaded into a virtual meter.

The remaining part of this paper is divided into three sections; section two is on literature review, a review of features and benefits of prepaid meters are presented. Section three discusses the design, implementation and results while conclusion and references are presented in section four.

2. Methodology and Literature Review

2.1 Prepaid meter overview and benefits

The typical prepaid meter consists of:

- Monitor unit: which incorporates an LCD display, keypads, a card slot for the smartcard and a communication port.
- Metering unit: which monitors energy consumption and consists of a terminal block for connecting the input from the Power company to the load, an infrared communication port and a relay to trip off power (if the maximum load is exceeded or the credit level is zero).

Figure 1 shown below is a prepaid meter.

Fig. 1: Prepaid meter (inhemeter, 2012)

According to Okafor (2011), the Nigerian Federal Ministry of Power has highlighted the benefits of the energy prepayment meters to both PHCN and the customers. On the side of PHCN:

- Revenue is bound to increase as the overhead incurred due to administrative tasks and house-to-house recovery of revenue will be eliminated. Also due to

anti tamper facilities, tampering of meters will be discouraged.

- The actual energy demand in the country will be determined.
- Bribery and corruption will reduce
- Customer trust will be enhanced since the system ensures fair billing.
- The organization will be able to concentrate on her major task of building new power plants with adjoining transmission and distribution lines.

On the part of the energy consumers,

- They will experience fair billing as estimated billing is eliminated,
- They will be able to control their energy consumption,
- Cases of theft of meters will be reduced due to security features on the meters
- Power supply will become reliable

Invariably, the benefits extend to every facet of the nation and the national economy. (Okafor , 2011 and Osunkwo, 2009)

2.2 Software Design technique:

The technique used in this design is the waterfall software design model. It is easy to implement, requires minimal resources, is widely used and has the following phases:

- Analysis (Requirements specification)
- Software design (Architectural and detailed design),
- Implementation and Integration (including coding),
- Testing (or validation),
- Deployment (or Installation) and
- Maintenance.

(Munassar & Govardhan, 2010, Murugaiyan & Balaji, 2012)

3. Design, Results and Discussion

3.1 Requirements Specification: The system is expected to provide the following features:

- The Administrator section should effectively manage vendors of PHCN prepaid vouchers. Individuals, organizations and financial institutions etc should be able to register as vendors easily

- Visitors (Consumers) should have easy access to vendors and obtain vouchers upon payment online.
- The prototype meter should simulate the recharging process that would take place in a real meter by validating PINs generated.

Figure 2 below shows the different sections, their functions and how they relate with each other:

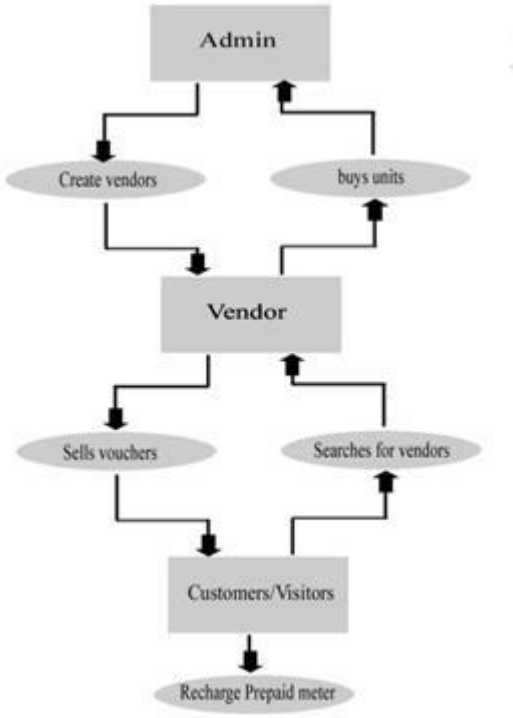

Fig. 2: Different units in the design

3.2 Tools & Programming Languages

The tools used for the design are: Macromedia Dreamwaver 8.0, WampServer, HyperText Markup Language (HTML), Cascading Style Sheet (CSS), PHP, MySQL and Javascript

3.3 Software design: The general program flowchart showing details of the different sections and the relationships between the key entities and their functions in the overall design is as shown in Figure 3 below.

The administrator (which should be a PHCN staff) controls the vendors section (adds, edits, deletes vendors unit and vendors). "Instruction-A" describes the validation process of the administrator's login details verified at the homepage of the system administrator's section called the control panel.

Visitors can login and search for vendors within their locality. Vendors can login and after validation, generate vouchers based on their available units, view the voucher history and edit their profiles. "Instruction-B" describes the validation process of a registered vendor's

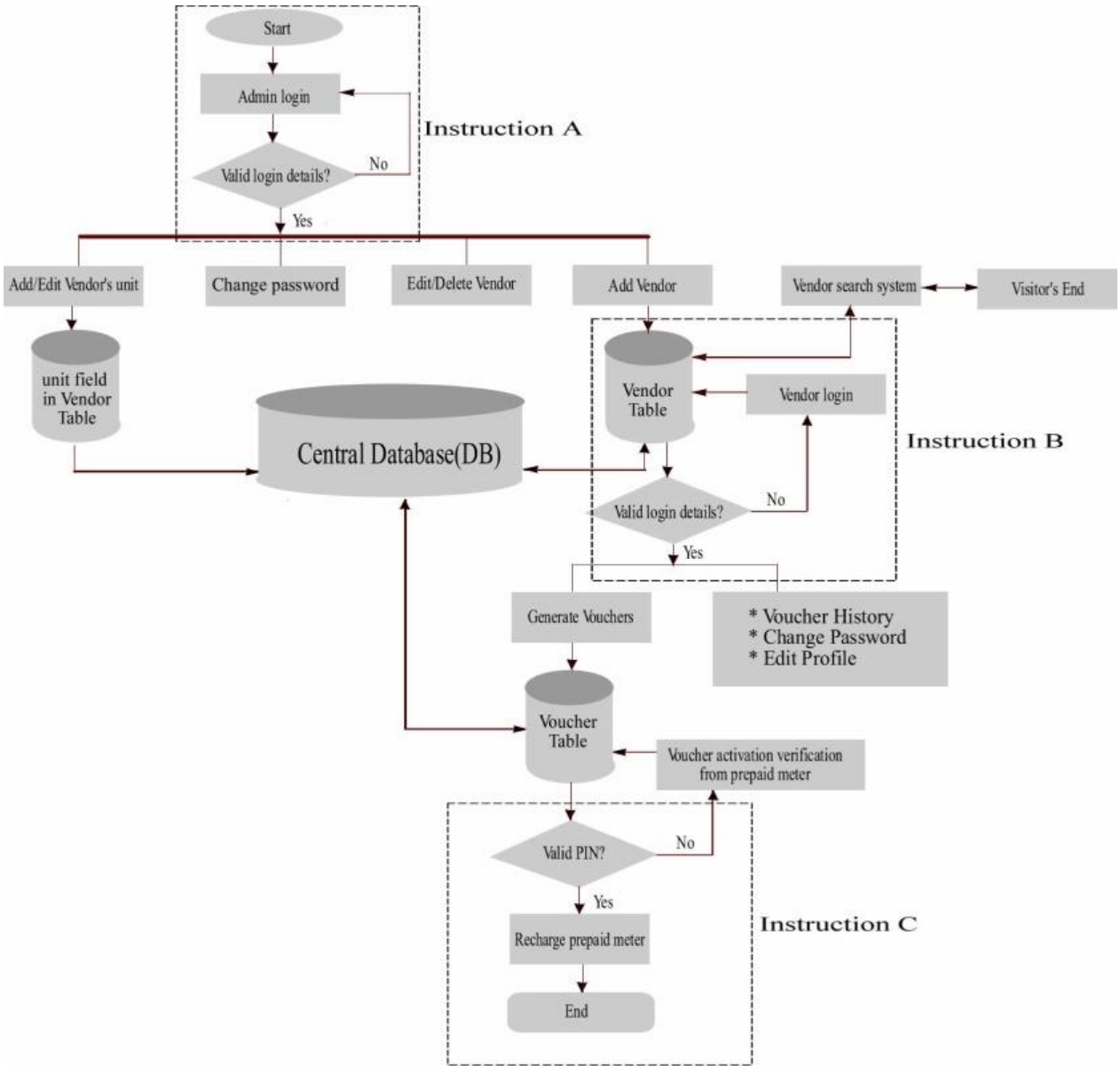

Fig. 3: Design Flowchart

login details verified at the homepage of the system vendor's section.

At the prototype meter section, the recharging process is simulated as vouchers generated can be entered into the meter and validated. "Instruction-C" describes the validation process of a PIN from the voucher purchased. It demonstrates the connection between the system and the physical prepaid meter.

3.3.1 Database (back-end) design: The back-end (database) was designed in WAMP Server PhpMyAdmin. The database is named as

phcn_vendor with five tables named as admin, location, vendors, vouchergen and vouchers

The diagram is shown in Figure 4:

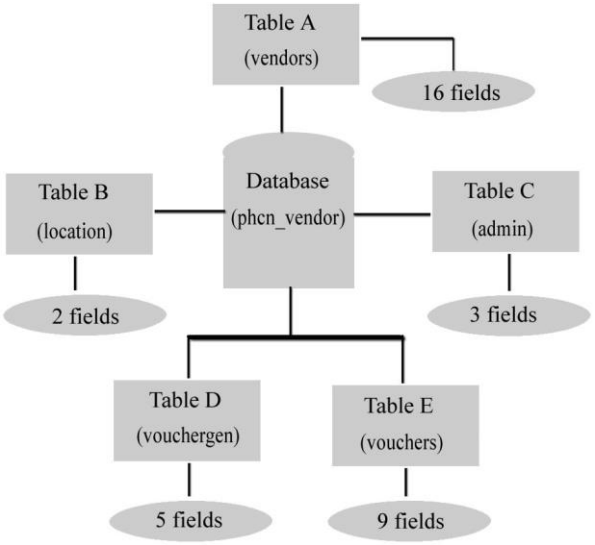

Fig. 4 Database tables

3.3.2 Interface (Front-end design): This was designed using the Graphic User Interface tool for web design and development known as Dreamwaver. PHP served as the main programming language used to carry out major programming task with the support of Javascript. The front end comprises of four major sections these includes;

Administrator's section: consists of:

(a) Admin's Log-in Page (ALIP):

(b) Admin's Homepage (AHP): AHP comprises of three sub-sections which includes Vendors' Desk (VED), Admin's Desk (AD) and Vouchers' Desk (VOD)

Vendor's section: consists of

(a) Vendor's Log-in Page (VLIP)

(b) Vendor's Homepage (VHP): VHP comprises of three sub-sections which includes; Vouchers History (VOH), Vouchers Panel (VOP) and Profile Manager (PMG)

Visitor's Section: This is the first Graphic User Interface (GUI) encountered by visitors to the website or online system. It is the main or index page of the system. Visitors search for available vendors close to their neighbourhoods through this section, obtaining instant search results.

3.4 Prototype Prepaid Meter:

This software based meter demonstrates how the system would interface with the prepaid meter. It is made up of a keypad and an output screen which displays the input and feedback messages. This prototype is expected to be

operated by the customer who recharges his meter with electric energy via inputting the voucher's PIN into the meter

3.5 Results and Testing

3.5.1 Output results: The diagrams below show the graphical display of selected portions of the implemented software:

Fig 5: Administrator's Log-in Page

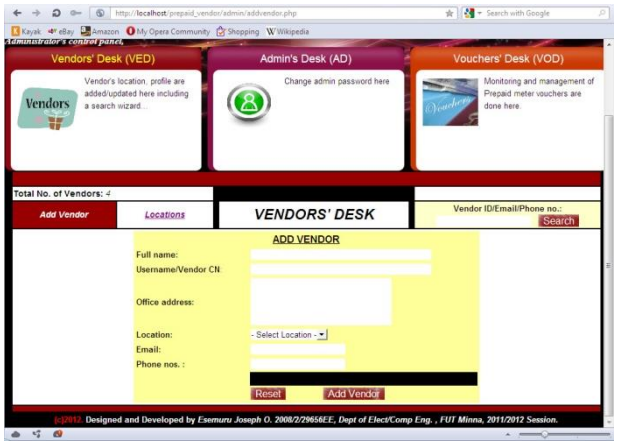

Fig 6: Vendors' Desk showing a form to add/register vendors

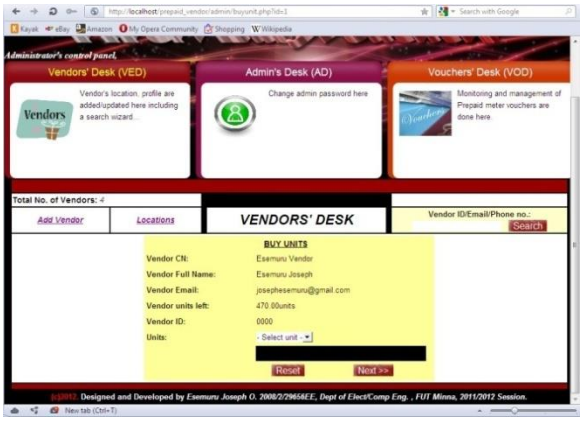

Fig 7: Vendors' Desk showing the first step in purchasing units

Fig 8: Vouchers' Panel 1 showing the voucher generator's page (step 1)

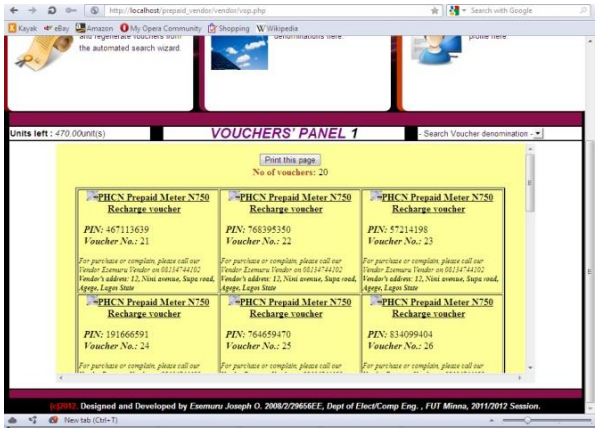

Fig 9: Voucher generator's output

Fig 10: Search results of some locations

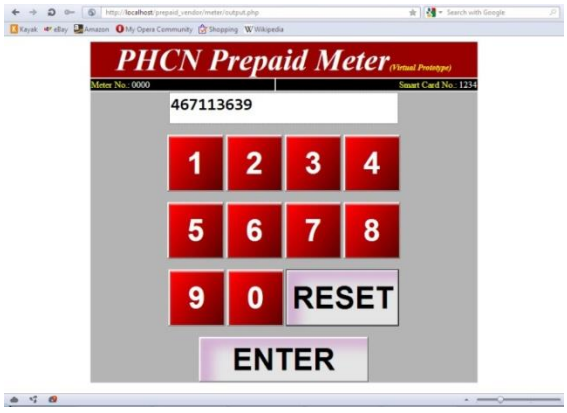

Fig 11: Virtual Prototype Prepaid meter

4. Conclusion

In this paper, we have presented a web application software that efficiently generates vendors and vouchers for recharging PHCN prepaid meters and connects consumers to easily obtain them. The recharging process is demonstrated via a prototype meter created in the software. For further research, it is recommended that the infrared port of the meter be utilized by PHCN for remote monitoring and that recharging via other channels like mobile phones be exploited.

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