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Development of Water Billing System:
A Case Study of Akwa Ibom State Water Company Limited, Eket Branch

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Abstract:
Computers are now taking over virtually every field of human endeavours and most functions. Computers affect our daily lives more and more and hopefully, can be used to improve the quality of our lives by releasing us from dull, repetitive tasks and allowing us to expand our minds. Thispaper explains how the old Water Billing System can be improved in AkwaIbom State Water Company Limited (AKSWCL), Eket. The research work aims at designing and developing a Water Billing System for AKSWCL. The formation of the system was approached using a requirement, analysis and capturing methodology that consist of four main phases, namely domain understanding, requirements capturing, classification, and validation. A tool called the Visual Basic was used for validating the syntax of the system while a prototype with test scripts was used for validating the system as a whole.

Keywords: Bills, billing system, water billing system, etc.

1. Introduction
The present technological age has eaten deep into the very fabric of our own existence and has brought about development through the active participation of many experts who involve in the digital world through research and innovations. Over the years, the billing system has been operated manually irrespective of the internet and has aided intrinsic short falls. In the light of this, payment turns out to be a hard nut to crack for the consumers. This is caused by some inherent problems such as missing data and information sent to the wrong place. Furthermore, the company could not effectively and efficiently handle the massive volume of data of consumers.
Thus, this study solves the problem of:-
1. Accuracy
2. Data loss
3. Delay in preparing and dispatching of bills and
4. Fraud and inefficiencies in handling monthly billing operations of the water consumers due to unavailability a software package to handle the operations.

Nowadays, computer has become such an important part of modern living that it is difficult to make a statement about the impact of these machines in our lives without sounding trite. Due to recent arising issues and concerns face by both consumers and AkwaIbom Water Corporation, it is inherent that such disputes are caused by inability to understand what consumers' and users' needs are, resulting in adequate system implementation. Realizing this fact, a computerized water billing system could assist in minimizing these issues, thus providing an effective payment and verification mechanism.
The general need for computerization of the water billing system was to reap the benefits of information technology to improve operational performance besides providing error free and faster services to the consumers.
Automation plays an increasingly important role in the global economy and in daily experience. There has been a great change since the emergence of technology. Many minds have been awakened and can now help by inventing things that one would not have imagined to be in existence many years ago. The availability of the internet is one of those that have been a good contributing factor to the changes that we admire these days (Hatem Mostafa, 2005).
To keep pace with the modernization, there should be room for improvement in the field of information technology. Nowadays, companies haveshifted from manual operations to computerized operations primarily because of the advantages brought by the use of computers. Under the old manual billing systems, it takes too much time to process. (Ghoshal K. 1997).
A billing system is a combination of software and hardware that receives call details and service usage information, groups this information for specific accounts or consumers, produces invoices, creates reports for management, and records (posts) payments made to consumers' accounts (Althos Billing Dictionary, 2009).

1.1. Objectives of the Study
The following are the objectives of the study:
1. To highlight the problems encountered in the bills.
2. Suggest the extent to which the problem of accuracy, fraud, data loss and delay in preparing and dispatching of bills could be solved.
3. Develop a system that will achieve speed efficiency and accuracy of the bills produced by AkwaIbom State Water Corporation.

1.2. Background of the Study
Water Corporations need effective and accurate billing systems to be able to assure their revenue.The view of several filtered sources with respect to the marketing of AkwaIbom State Water Corporation (AKSWCL) and its mechanization shall be briefly analysed against the backdrop of the general public water supply status of the state via review publication and literature.
With the advent of the industrial revolution and ever increasing amount of data to be processed in the shortest possible time, businesses felt the need for faster, cheaper and more efficient method of processing data. To make for this need, various types of automated devices were developed and produced on the business scenes. The most recently impact was the introduction of the computer, the faster and a more sophisticated business tool so far advised by man. (Zainla et al, 2004).
Seshema et al, (2006) defines computer as not being a simple machine but an inter-connection of related sub-systems that work harmoniously together in accepting inputs, processing them and relinquishing to outputs as solution to man's problem at a fantastic speed.
According to the Ministry of Urban Development (2006), the various categories of consumers are:-
  i. Domestic
  ii. Commercial (Business entities, Hotels, Industries, etc.)
  iii. Government Authorities,
  iv. Partly commercial,
  v. Bulk consumers.
According to the Ministry, among the five categories, the domestic consumers are the privileged class of people in terms of supply of water and collection of taxes mainly because they use water for their healthy existence. The other categories of consumers largely use water while carrying out commercial/business activities. Therefore, the distribution of cost incurred on the maintenance of such system to each class of consumers should be logically and appropriately determined with reference to the level of service rendered.

1.3. Methods of Water Charges
The methods of levying water charges according to the Ministry of Urban Development (2006) can be any one or more of the following:
  A. Metered System
    ➢ Actual Consumption of Water
    ➢ Minimum fixed charge
  B. Non-Metered System
    ➢ Fixed charge per house per month
    ➢ Fixed charge per family per month
    ➢ Fixed charge per tap per month
    ➢ Percentage of ratable value of the property.

1.4. Water Billing Process
Basically, three (3) main steps accompany billing operations. Hags (2002) outlines these steps as follows: -
1. Input
2. Processing
3. Output

According to Akinyionne (2003), even with these steps, the AkwaIbom State Water Company Limited (AKSWCL) utilizes the manual method which has exposed them to certain difficulties. Billings sometimes require a systematic procedure and operation before it could be completed successfully.

The Ministry of Urban Development (2006) expatiates the various stages in the cycle of water billing as: -
  • Data gathering (meter reading in case of metered billing)
  • Generation of bill based on this data
  • Distribution of bill to consumer
  • Payment of the bill by the consumer
  • Sending the receipt details to billing section
  • Related accounting.

According to the Ministry, irrespective of the basis of the billing system-metered/unmetered, the billing system needs three (3) major databases:

❖ Master Data: this is the data, which needs to be entered only once when the consumer/connection is added into the database. Various data items, which need to be stored, (depending on the type of water charges) are:

Consumer number, name of consumer, address, type of use, type of consumer, tap size, data of connection, details of feeder line, locality, house number, water connection number, number of taps, meter number, first reading, ownership of meter, deposit amount, etc. This data is relatively static in nature and does not change periodically.

❖ Data for each billing cycle: this data will be entered for every consumer for every cycle and will be used for calculating the demand of that billing cycle. Various data items needed are:-

Consumer number, data of meter reading/period for which it is billed, status of the connection and any changes in master data etc.

❖ Receipt Data: this data will be the data related to the payments made by the consumer against the bill issued. This data will be entered on daily basis irrespective of the billing frequency.

1.5. Computerized Water Billing System

Computers are now widely used in day to day activities. For a water billing system, which is complex, repetitive and has voluminous data, computerization is recommended. According to Zainal et al (2004), computerization overcomes many of the defects in the manual system; is fast and gives a control on the system. Computerization helps in making decision.

Ola (2004), argues that it is imperative to understand that question of efficacious billing should not be attributedto automation alone. Other factors such as tariffs, VAT, multipliers etc., should be set by appropriate body to ascertain reasonable bill sums.

Computer billing is one of major needed to establish a good effective telecommunication network (Ayatalumo, 1997). Therefore, the combination of computer software and hardware distributed system is one major tool needed for efficiency and effectiveness in water distribution and accounting (Millman, 1979).

The Ministry of Urban Development (2006) says that water billing system is complex, repetitive and voluminous, hence computerization is recommended. According to the Ministry, computerization of water billing overcomes many of the defects in the manual system, and is fast and gives a control on the system. This is so because the frequency of billing governs the cash flow of billing system and thus more frequency means regular cash flow.

2. System Design

The system that will be designed is a user friendly type for the billing of AKSWCL water consumption.
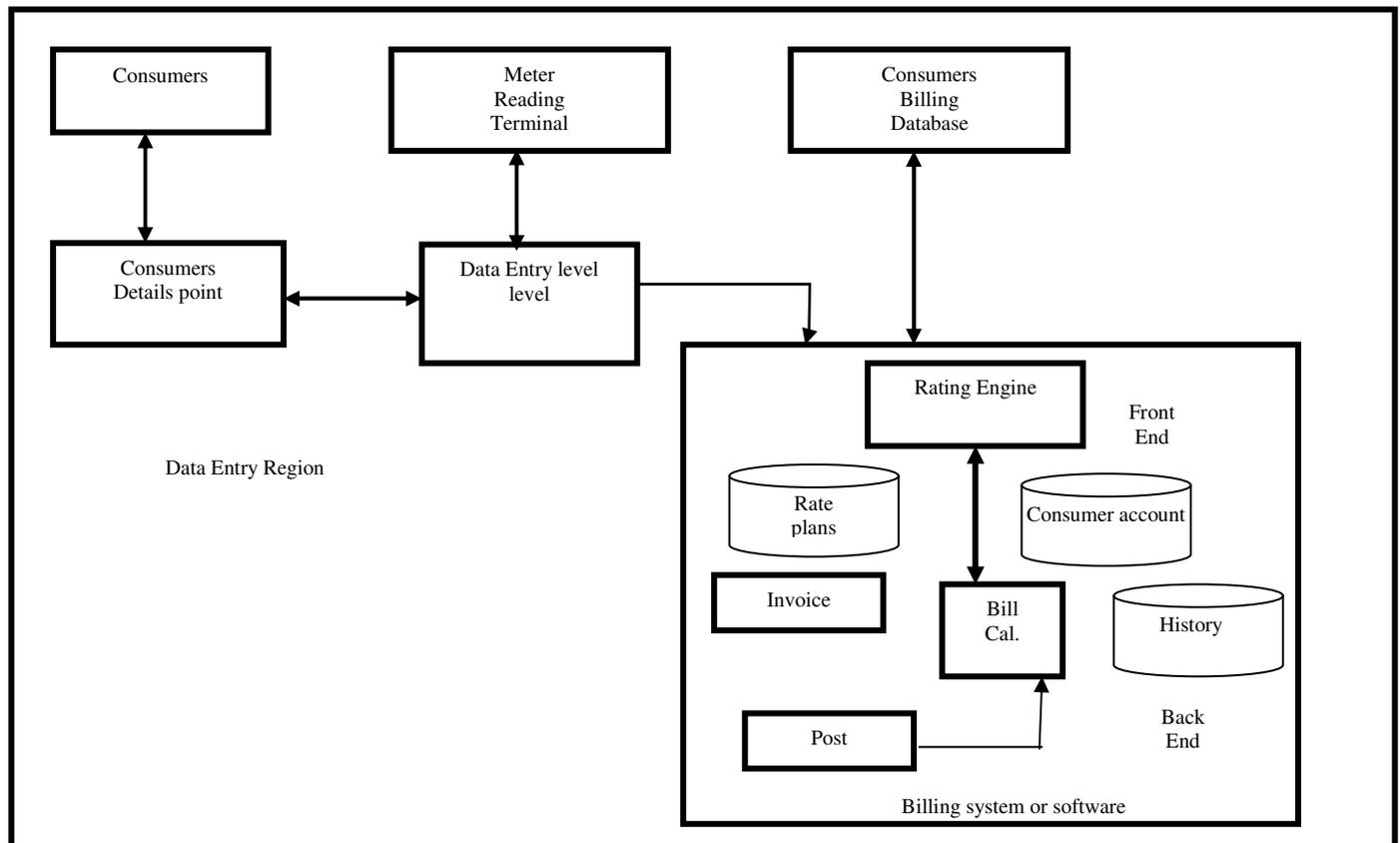Figure 1 below shows the model of the prototype system

Figure 1: A model of a prototype system of water billing system for AKSWCL

The diagram shows that billing system is divided into two (2) parts
(1) Water billing software region
(2) Data entry region.

3. The Billing Software

The billing software uses electrical power supply to measure on accurately residential or commercial use of water which is more economical compared to the manual billing method. This will help the AkwaIbom State water company, Eket to directly monitor and control water supply billing of its spatially distributed consumers without engaging the services of meter readers. The water billing software is a PC based billing system that is programmed to display the consumed water rate per minute, the sale rate of water consumption per minute and other parameters necessary. The billing software is designed using Visual Basic 6 (VB6) program to manipulate the incoming data from the data entry region and calculate the bills of water consumption using a set of formulas.

Assuming the water rate is in "i" naira per litre,and the total consumption for the month in "n" litre,
i.e., water rate = i naira per litre and,
total consumption for a month = n litres
The Water Bill (W_{BILL}) will be given as:

$$W_{BILL} = \sum_{i=1}^{n} i \times n \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. (1)$$

If a VAT of α is considered at a point, suppose the VAT is considered as β% of the water consumption rate, hence the VAT could be given as:
VAT (α) = W_{BILL} x β%
$$VAT(\alpha) = \frac{\beta W_{BILL}}{100} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$
This will give the monthly bill (W_{MBILL}) as:
W_{MBILL}= W_{BILL} + VAT (α) …………………………………………………. (3)
That is,

$$W_{MBILL} = \sum_{i=1}^{n} i \times n \ + \ \frac{\beta W_{BILL}}{100}$$

OR

W_{MBILL} =W_{BILL}+ $\frac{\beta W_{BILL}}{100}$ ……………………………………………………… (4)
Assuming the previous bills P_{BILL} was not paid, then, the system will give the total water Bill, W_{TBILL} as:
W_{TBILL}= W_{MBILL}+ P_{BILL}……………………………….................. (5)
Substituting for W_{MBILL}, Equation 5 becomes;

$$W_{TBILL} = \sum_{i=1}^{n} i \times n \ + \frac{\beta W_{BILL}}{100} + P_{BILL} \ldots\ldots\ldots\ldots\ldots\ldots. (6)$$

The software will thus use this formula to calculate the total water bill for a consumer.

4. The Customer Billing Database

The customer billing database keeps track of all the bills about a given customer as well as the record about the financial response of such customer. The database is designed using Microsoft Access 2003 application. Table 1 shows the database structure of the customer details database.

Field Name	Field Type	Field Size	Index
Customer's Name	Text	30	-
Service Address	Text	30	-
Account No	Number	16	-
Meter Number	Number	16	Index
Customer type	Text	20	-
GSM	Number	12	-
Passport	OLE	-	-
City	Text	15	-
State	Text	30	-
Previous charge	Number	Double	-
Current charge	Number	Double	-
Month	Text	15	-
Year	Number	5	-

Table 1: Data structure of customer details database file   (custdata.mdb)

5. The Meter Reading Database

The reading database keeps track of the meter readings, which is the water consumption rate of each customer for every litre of water. At the end of every month, the total reading for the customer is displayed for entry into the system. Table 2 below shows the data structure for the meter reading database.

Field Name	Field Type	Field Size	Index
Customer's Name	Text	30	-
Service Address	Text	30	-
Meter Number	Number	16	Index
Meter type	Text	15	-
City	Text	15	-
Daily consumption	Number	5	-
Monthly consumption	Number	5	-
Total Monthly Consumption	Number	5	-

Table 2: Data structure meter Readings Database (meterdata.mdb)

6. Data Entry Region

Data is fed into the system as input at this level. This region represents the user interface because it is the interface that the user communicates with the system on a user friendly in environment.
The data entry region is made up of three components.
1) Meter reading terminals
2) Customer details point
3) Data entry level

6.1. Meter Reading Terminals

Meter reading is an important part of billing system for residential and commercial household; this often does not reflect the exact or true electricity consumption of such household, resulting in an inefficient bill mainly due to human errors. The meter displays the sale rate of water and the consumed litre of water per minute respectively. The total reading at the end of the month will be computed and feed in as one of the major input for the billing processing operation.

6.2. Customer Details Point

This is where the customer details that correspond to the specific meter are collected. The details will also be fed into the system in other to align with the current charge and then produce the bills for such consumer at the end of the month.

6.3. Data Entry Level

The user communicates with the software at this level. The details collected from the customer details point and the meter reading terminals are coordinated by the data entry level and forwarded from this level to the power billing software for processing.

7. Input Design

The input design of the system is the platform for communication between the system and the user.The system after processing the input provided by the user,produce the billing document as the major output of the system. Figure 2 shows the input design for this system.

Figure 2

8. System Flow Diagram

The system flow diagram gives a brief description of how the system works. Figure 3 below shows a system flow diagram for this system.
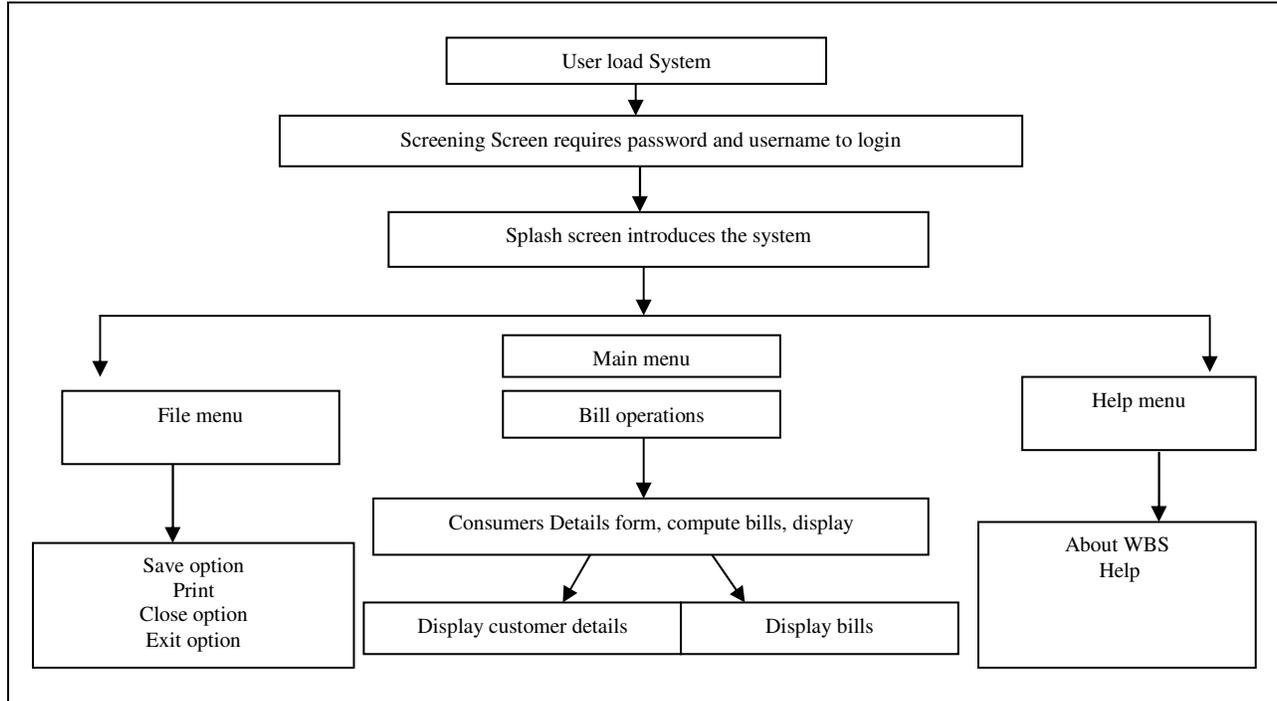

Figure 3: System Flow Diagram of the system

9. System Implementation

Water companies need effective and accurate billing systems to be able to compute their revenues. This system process involves receiving billing records from the data entry region, determining the billing rates associated with the billing records and calculating the cost of each billing aggregating these records periodically to generate invoices, sending the invoices to the customer and collecting payments received from the customer.

The system was developed using Visual Basic 6.0 Enterprise edition as the frontend layout which help in programming the system for appropriate manipulation of the billing records. Math Lab Pro is used as the backend language to simulate the billing rules that helps in the actual computation of the model that calculate the bills and Microsoft Access 2003 database application is used in designing the billing database that holds information about each customer and their corresponding water consumption rate.

When the user loads the system at the initial state, the screening screen appears in form of a log in dialogue box requiring a password and username. The system will now bring up the splash screen introducing the system for a short while and then logging to the main menu. The main menu comprises the File menu, Bill operations and Help menu. The system also has an interface for the user i.e. a monthly Water billing interface which links the database (custdata. mdb and meterdata. mdb) to the system. Figure 4 to 8 shows the screening screen with the log in dialogue box, the splash screen, the main menu, the monthly water billing interface and the print screen.
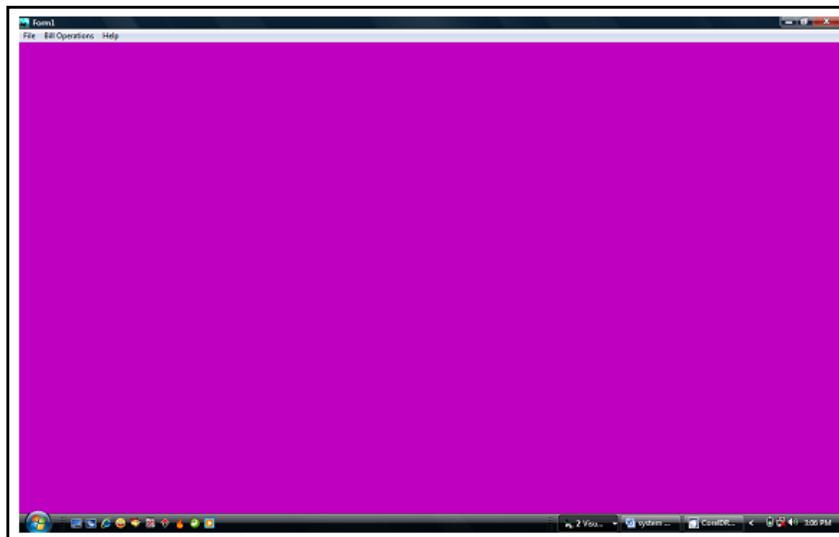

Figure 4: Login Dialogue Box or Screening Screen

Figure 5: Main Menu

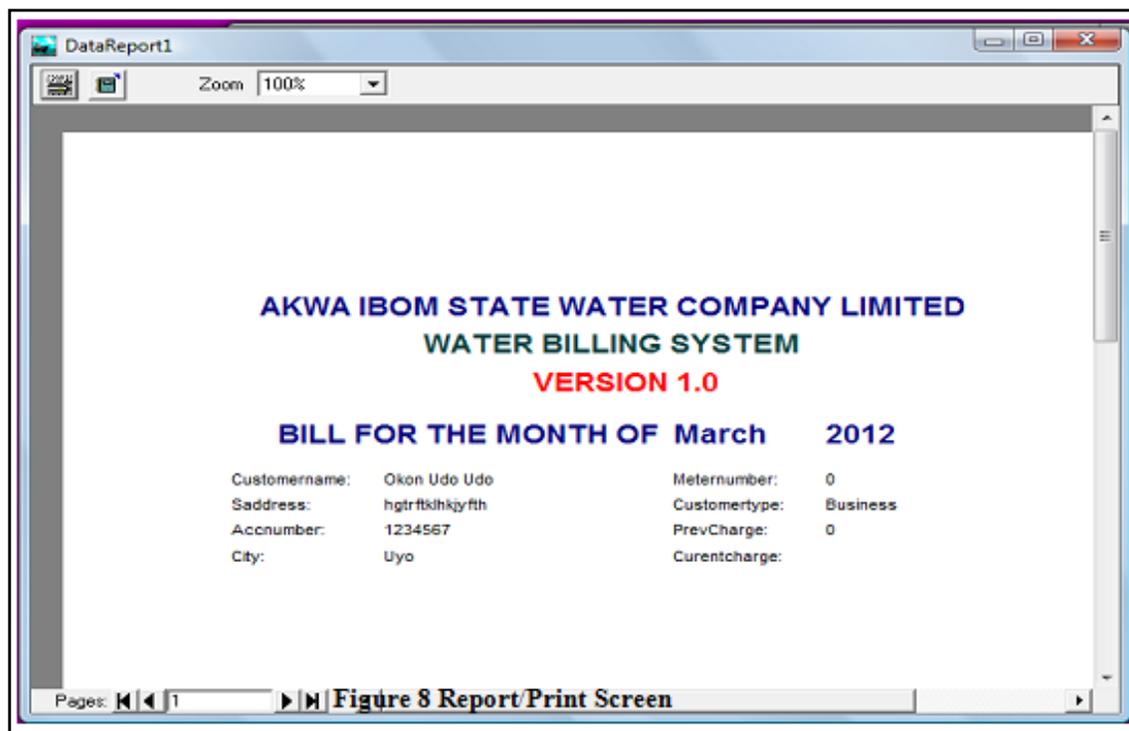*Figure 6: Monthly Water Billing Interface*

Figure 7: Report/Print Screen

10. Summary

The present practice of water billing is manual method only. With this, the total billing is a time consuming process and it requires more manpower. The collection of billing is late procedure and so many consumers may not pay in time. This project reviews how technology can be used to overcome the difficulties encountered in the current billing system of AKSWCL, Eket headquarter office as a case study. The difficulties encountered were:

- Data redundancy
- Insecurity of life
- Time delay in distribution

Based on this investigation, a computerized billing system has been proven to be the only way out. This led to the design and development of a user friendly system that is efficient, effective, reliable and accurate to aid the billing system of AkwaIbom State Water Company Limited.

11. Conclusion

Consequently, upon the investigation we have conducted so far in the bid to unveil the impact of the automation of billing unit of AkwaIbom State Water Company Limited, we have the following conclusion to make:-

- The billing system of the AkwaIbom State Water Company limited can only be required through a fully computerization of this process.
- This system will eliminate the tedious work involved in the calculation and production of water bills.
- Introduction of experts as well as adequate number of system will see to the enhancement of the computerized system geared towards improvement of customer's services.

To this end, the fact that process automation is not the end not withstanding it remains the resort of generating revenue for the government who must in turn show her appreciation for the quest for computerization.

12. Recommendation

Having examined the usefulness of computer in eliminating most of the billing problems at AkwaIbom State Water Company Limited (AKSWCL), the following recommendations are offered:

- All AKSWCL offices should be computerized and this will improve the time of information produced and also reduce delay in dispatching bills.
- The government should support the quest for research as well as seeing to its application and enough computer systems should be provided.
- More trained and qualified system analysts, engineers and computer operators/programmers should be employed.
- Adequate security measures must be embarked upon to secure the system from unauthorized access.
- There should be provision of proper infrastructure for the company.

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