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A COMPARATIVE ANALYSIS OF THE TRADITIONAL METERING SYSTEM AND GSM BASED METERING SYSTEM

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ABSTRACT

Although many researchers hitherto have devoted their energies in working and showing copiously that the automatic metering system which has of date incorporated the GSM technology and thus has been modified to GSM based metering system, smart and intelligent GSM based metering system, GSM based automatic meter reading system or automated Billing system among others is the best, most accurate, and most efficient metering system in comparison with the traditional metering system, many electricity consumers, and power supply companies have not wholly embraced it use. This paper, a comparative analysis of the traditional metering system and GSM based metering system aims to demystify the benefits of the new metering technology; namely, GSM based metering system and hence encourage its acceptance over the old system namely, the traditional system.

Keywords: GSM Based Metering, Traditional Metering, SMS, Prepaid Meter.

INTRODUCTION

Till date, many homes in Nigeria still use the old mechanical watt hour metering system which is here referred to as the traditional metering system as their energy metering system even though the traditional metering system has a plethora of shortfalls which are very well known to everybody. These shortfalls which have continually remained a source of worry for both the energy supply company and the customers are, the need for huge man power/cost of operations, huge revenue loss from unsettled bills, extra cost on the customer-a consequence of overbilling, energy pilfering, and absence of data security to mention but a few[1][2][3][4]. The GSM metering system which is a boom in many countries today does not only wipe out the shortfalls of the traditional metering system, it also engenders an atmosphere of check and balancing between the energy supply company and the consumer. The GSM metering system which is implemented in the prepaid meter is designed to automatically shut off customers who have exhausted their units; and also

restore power instantly when the system is recharged. Thus, electricity consumer can control their energy consumption and can be at peace with themselves and the energy supply company because the burden of paying extortionate bills is taken off as customers only have to pay for the energy they actually consumed and not just compelled to pay bills sent from the power supply company like the Benin Electricity distribution company (BEDC) even if there was loss of power supply to the customers' residence during the period for which they have been billed, as is inherent in the traditional metering system. The new system also offers the customer the ability to settle electricity bills by sending a purchased pin representing a particular unit of energy on an authenticated number to the server containing customers' database at the supply company's office via his/her mobile phone to recharge the system. It also gives alerts on power disconnect, unit exhaustion, critically low unit and more via SMS sent to the customer's mobile phone.

Table 1: Comparison between both Metering Systems

S/N	FEATURES	GSM BASED METERINGSYSTEM	TRADITIONAL METERING SYSTEM
1.	Remote monitoring	Possible(Electricity company reads meter without visitation	Not possible
2.	Control of domestic energy meter.	Done from anywhere.	Done only at respective customers' houses
3.	Auto disconnect feature	Present here; customers are also alerted when their unit is exhausted	Not possible
4.	Bill payment as you go.	Bill is settled the moment the system is recharged	Not possible
5.	Power cut information	This system provides power cut information,	Not possible
6.	Data security	This system eliminates meter reading error and manipulation thereby securing data.	Meter reading error and manipulation are inherent; no data security.
7.	Recharge Alert	The system alerts the user of any recharge done on it	Not possible.
8.	Critically Low unit alert.	Present; user is alerted when unit balance becomes critically low to recharge system.	Not possible
9.		No man power required	

Man power	Huge man power required

DESIGN METHODOLOGY/RESULTS

Various data were obtained through sampling of bills sent over three consecutive months by the power supply company, BEDC, to various customers in selected urban, semi-urban, and rural communities of both Delta and Edo states in the south-south geopolitical zone of Nigeria [5]. Actual energy consumed and the operational tariff value of ₦11.20k per Kwh was used to predict the bill using the GSM based metering system in the selected areas. The data obtained from the actual bills sent by BEDC and the predicted bills using the GSM metering system are clearly depicted in the following tables:

Table 2: Energy Consumed and Bill sent by BEDC to selected consumers in some urban Areas of Delta and Edo States/ Data Obtained from selected Consumers in such Areas

LOCATION		CONSUMED ENERGY	BEDC BILL WITHOUT METERS OR WITH METERS NOT WELL READ	THIS STUDY'S PREDICTED BILL
(A) Benin	Sample A	301.32kwh	₦ 6,815.19k	₦ 3,374.78k
	Sample B	255.16kwh	₦ 4,500.18k	₦ 2,857.79k
	Sample C	310.55kwh	₦ 5,100.17k	₦ 3,478.16k
	Sample D	213.00kmh	₦ 5,000.18k	₦ 2,385.50k
	Sample E	198.70kwh	₦ 4,400.17k	₦ 2,225.44k
(B) Warri	Sample A	415.80kwh	₦ 8,000.80k	₦ 4,656.96k
	Sample B	400.06kwh	₦ 9,180.90k	₦ 4,487.39k
	Sample C	315.17kwh	₦ 7,335.80k	₦ 3,529.90k
	Sample D	290.23kwh	₦ 5,260.50k	₦ 3,250.58k
	Sample E	300.23kwh	₦ 6,117.10k	₦ 3,360.00k
(C) Asaba	Sample A	388.18kwh	₦ 9,860.15k	₦ 4,347.62k
	Sample B	401.13kwh	₦ 10,120.13k	₦ 4,492.66k
	Sample C	190.77kwh	₦ 4,600.12k	₦ 2,136.62k
	Sample D	245.30kwh	₦ 2,500.16k	₦ 2,747.36k
	Sample E	213.45kwh	₦ 2,500.00k	₦ 2,390.64k

Table 3: Energy Consumed and BEDC Bill sent to selected consumers in some semi-urban Areas of Delta and Edo states/ Data Obtained from selected Consumers in such Areas.

LOCATION		ENERGY CONSUMED	BEDC BILL	THIS STUDY'S BILL
(A) Auchi	Sample A	202.33kwh	₦ 4,200.19k	₦ 2,266.10k
	Sample B	204.08kwh	₦ 3,600.20k	₦ 2,285.70k
	Sample C	195.00kwh	₦ 4,800.00k	₦ 2,194.86k
	Sample D	175.00kwh	₦ 3,500.10k	₦ 1,960.00k
	Sample E	180.13kwh	₦ 4,100.10k	₦ 2,017.46k
(B) Agbor	Sample A	244.05kwh	₦ 3,600.10k	₦ 2,733.36k

	Sample B	288.10kwh	₦ 4,900.05k	₦ 3,226.72k
	Sample C	300.08kwh	₦ 5,000.00k	₦ 3,360.90k
	Sample D	249.10kwh	₦ 3,050.15k	₦ 2,789.92k
	Sample E	190.16kwh	₦ 4,100.70k	₦ 2,129.79k
(C) Obiaruku	Sample A	105.55kwh	₦ 2,500.30k	₦ 1,182.16k
	Sample B	110.20kwh	₦ 2,000.00k	₦ 1234.24k
	Sample C	98.17kwh	₦ 2,300.00k	₦ 1,099.50k
	Sample D	50.16kwh	₦ 1,500.00k	₦ 561.79k
	Sample E	88.09kwh	₦ 1,600.20k	₦ 986.608k

Table 4: Energy Consumed and BEDC Bill sent to selected consumers in some Rural Areas of Delta and Edo states/ Data Obtained from selected Consumers in such Areas.

LOCATION		ENERGY CONSUMED	BEDC BILL	THIS STUDY'S BILL
(A) Urhonigbe	Sample A	22.10kwh	₦ 1,200.00k	₦ 2,285.70k
	Sample B	20.10kwh	₦ 1,000.00k	₦ 2,285.70k
	Sample C	15.16kwh	₦ 800.05k	₦ 169.79k
	Sample D	18.12kwh	₦ 3,500.10k	₦ 202.94k
	Sample E	14.13kwh	₦ 1,200.15k	₦ 158.26k
(B) Eku	Sample A	12.15kwh	₦ 1,650.11k	₦ 136.06k
	Sample B	18.27kwh	₦ 900.05k	₦ 204.62k
	Sample C	16.28kwh	₦ 1,100.10k	₦ 182.34k
	Sample D	12.13kwh	₦ 900.10k	₦ 135.34k
	Sample E	11.10kwh	₦ 1,050.20k	₦ 124.32k
(C) Ozoro	Sample A	12.33kwh	₦ 1,250.20k	₦ 138.10k
	Sample B	10.18kwh	₦ 890.13k	₦ 114.02k
	Sample C	11.26kwh	₦ 600.12k	₦ 126.11k
	Sample D	12.13kwh	₦ 500.00k	₦ 135.86k
	Sample E	13.17kwh	₦ 1,350.00k	₦ 147.50k

Table 5: Energy Consumed and BEDC Bill sent to selected consumers in Urban, Semi-Urban and Rural Communities of Delta and Edo States.

LOCATION	AVE. ENERGY CONSUMED	AVE. BEDC BILL SENT
Benin	255.75kwh	₦ 5,163.17k
Warri	344.37kwh	₦ 7,178.78k
Asaba	210.13kwh	₦ 5,916.11k
Auchi	191.50kwh	₦ 4,040.08k
Agbor	254.30kwh	₦ 4,130.20k
Obiaruku	90.43kwh	₦ 1,980.10k
Urhonigbe	13.50kwh	₦ 780.06k
Eku	11.56kwh	₦ 1,120.09k
Ozoro	11.81kwh	₦ 918.15k

Table 6: Energy Consumed and This Study's Bills Estimate

LOCATION	AVE. ENERGY CONSUMED	AVE. OF THIS STUDY'S BILL ESTIMATE
Benin city	255.75 kwh	₦ 2,864.4k
Warri	344.37 kwh	₦ 3,856.94k
Asaba	210.13 kwh	₦ 2,353.46k
Auchi	191.50 kwh	₦ 2,144.80k
Agbor	254.30 kwh	₦ 2,848.16k
Obiaruku	90.43 kwh	₦ 1,012.82k
Urhonigbe	13.50 kwh	₦ 151.20k
Eku	11.56 kwh	₦ 129.47k
Ozoro	11.81 kwh	₦ 132.27k

Table 7: Validation (Comparison of the Average Bill sent by BEDC and This Study's Average Bill Estimate with the Average Energy Consumed)

Location	Ave. Energy Consumed	Ave. BEDC Bill Sent	This Study's Bill Estimate
Benin	255.75kwh	₦ 5,163.17k	₦ 2,864.4k
Warri	344.37kwh	₦ 7,178.78k	₦ 3,856.96k
Asaba	210.13kwh	₦ 5,916.11k	₦ 2,353.46k
Auchi	191.50kwh	₦ 4,040.08k	₦ 2,144.80k
Agbor	254.30kwh	₦ 4,130.20k	₦ 2,848.16k
Obiaruku	90.43kwh	₦ 1,980.10k	₦ 1,012.82k
Urhonigbe	13.50kwh	₦ 780.06k	₦ 151.20k
Eku	11.56kwh	₦ 1,120.09k	₦ 129.47k
Ozoro	11.81kwh	₦ 918.15k	₦ 132.27k

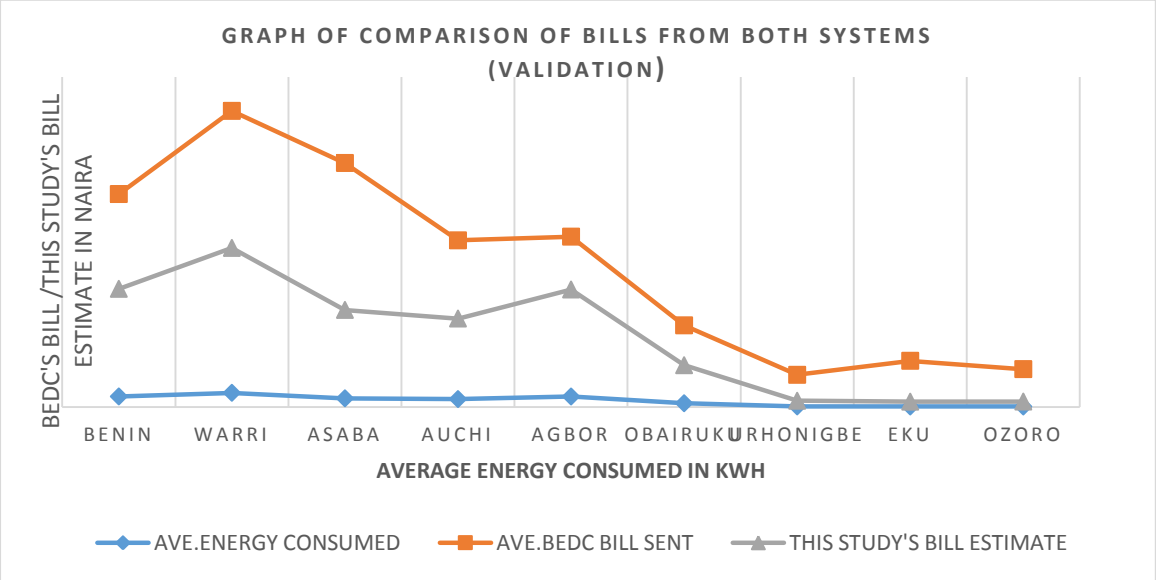

Figure 1: Graph of comparison of bills from both metering systems (validation)

DISCUSSION OF RESULT

In this study, existing methods of electricity measurement and Billing by the Benin Electricity distribution Company (BEDC) such as estimated billing system, wrong meter reading by (BEDC) staff etc., were closely examined. Similarly, prediction of electricity consumed in selected houses in both Urban, Semi-Urban and Rural Communities were carried out using the technique of the GSM metering System. The values obtained were plotted and the results were compared. First and foremost, the values obtained from the present energy billing system sent by BEDC to consumers in all the areas investigated were generally higher than the predicted values of this proposed system. This shows that BEDC present method of billing is inaccurate. A closer look at the figure 1 shows that the variations of the traditional method of energy billing plotted against energy consumption (in Kwh) is exponential as a higher rise and fall are noticed along the length of the curve in all cases. This is not the same in the case of the proposed technique where the rise and fall along the curve is proportional to the energy consumed because billing was purely based on actual energy consumed.

CONCLUSION

The results obtained in this research are so significant because they have revealed the evil in the concept of sending bills to consumers of electricity by power supply companies without proper metering, and have also provided an accurate method that could engender a level playing field for both suppliers and consumer of electricity. The present method of electricity billing in Nigeria has negative effects on the customers as well as on the staffs of the electricity supply companies. On the customers, the tendency not to pay the bill is there especially when the supply is irregular and the bill sent is high. How could one pay a bill that is more than twice the amount he/she would pay if the supply were regular and meter accurately read? This anomaly has led to accumulated bills that are in many cases never paid by the consumers; as a consequence, a colossal sum from unpaid bills are owed the power supply companies culminating in a huge revenue loss to the nation. This present method of energy metering has also increased the level of corruption among staffs of the power supply companies. Since most consumers would not want to pay their bills which are quite exorbitant, they bribe the marketers with a token so that a large chunk of the bill can be "written off". In most cases, the marketers initiate the process. These observations will in the nearest future belong to the past if the metering system proposed in this paper is adopted. It saves time, energy, cost as well makes billing / assessment of multiple customer in the network easier, faster and more efficient.

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