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A Review on Smart Metering for Energy Management and Real-Time Monitoring in Nigeria

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Abstract: Managing power consumption in Nigeria has become a serious concern to both households and business owners. The increasing rate of electricity charge is seriously alarming. There is therefore need for households as well as business owners to look for ways to effectively manage theirenergy/powerconsumptionrate. This paper therefore, seeks to review smart metering and real time monitoring systems as a tool for effective energy/power management. It also reviewed several works that have been done on smart metering and suggested an automated smart metering for real-time monitoring and energy management using business intelligence solution and deep learning approach as an automated.

Keywords: *Smart Metering, Energy Management, Real-Time Monitoring, Energy Efficiency.*

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I. INTRODUCTION

Energy plays a vital role in the socio-economic development of any nation (Abdallah &Odeleke, 2023). In fact, energy is one of the major factors that determine the development of any society. Zahid (2008) pointed out that economic growth cannot exist without a growth in the energy sector of any nation as most production and consumption activities involve energy as a basic input.

It is worthy to note that the energy sector of any nation has positive impacts on poverty eradication, standard of living and national security (Abdallah &Odeleke, 2023). Energy affects various aspects of human life, such as nutrition, health, education, technology, transportation, and communication (Oyedepo, 2013). With this, it is right to say that the growth of any economy largely depends on energy.

Nigeria, as the most populous country with largest economy in Sub-Sahara Africa, has a great limitation in power which has immensely affected it growth and development rate (Sasu, 2023). With its fast-growing population, the demand for energy increases and is a key to unlocking further economic development. In 2022, the electricity demand in Nigeria amounted to 32.1 terawatt hours (Sasu, 2023). The cost of electricity in Nigeria as of March 2023 has increased to about 23 naira per kilowatt hour for household use, while industrial electrical energy was priced at approximately 36 NGN per kilowatt hour, which has adverse effect in all sector of the economy (Sasu, 2023). In trying to meet up with the cost of production and consumption, households and companies, power management and monitoring has been a major concern for business owners as well as the general public. Even with the increase in price of goods and services, most companies are still finding it hard to manage their consumption rate, hence the need for real time monitoring system.

This paper seeks to investigate smart metering and real time monitoring systems in Nigeria as a tool for energy management.

- *Energy Management in Nigeria*

Energy is crucial to the wellness of humans and to a country's economic development. Unfortunately, Nigeria is challenged with low availability of electricity in rural areas and with frequent power outages, energy theft, unrealistic and conflicting bills and unreliability in the urban centers (Simonyan&Fasina, 2013).

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Energy management is an energy saving measures which involves the application of technological means of less energy utilization for provision of same level energy required for a certain services. Energy Management refers to the systematic approach of planning and controlling energy consumption across an entire system, be it a building, a factory, or even a whole country. It involves practices like monitoring usage, identifying areas for improvement, and implementing strategies to reduce waste (UNIDO, 2015).

Energy Efficiency focuses on getting the most output from the least amount of energy input. This can involve using energy-efficient appliances, optimizing processes, and adopting new technologies that require less energy to perform the same tasks. It is a significant parameter in ascertaining a safe, affordable, reliable and sustainable energy system for the future. This measure is the cheapest and easiest means of addressing energy security as well as environmental and economic challenges ranging from combating climate change, cleaning of the natural air we breathe, enhancement of business competitiveness and drastic reduction of energy cost for consumers. Doing more energy requiring task with a less energy have an outstanding effect on our national economy by saving huge amount of money from reduced costs, spurring innovation, unemployment inter alia.

Energy management is the strategy for energy optimization and adjustment. It encompasses an expansive range of activities and expertise in optimal use of energy. This include but not limited to areas of control and measurement; development of management strategies, plans and programs, essential implementation of techniques, technology and tools to improve the efficiency, productivity and to crown it all a sustainable energy.

Energy efficiency should be the baseline for transition in Nigeria from the present economic retardation to a resource-efficient economic state. For effective businesses to flourish which is the backbone of any economy, it needs to meet a conventional level of standardization. A rational use of energy results in significant benefits in areas of cost savings and promoting efficiency.

II. MATERIALS AND METHOD

Twelve journals from scholarly databases like Google Scholar, ScienceDirect, and IEEE Xplore, ResearchGate on energy management in Nigeria, two reports from the Nigerian Electricity Regulatory Commission (NERC), Distribution Companies (DisCos), and Meter Asset Providers (MAPs) on smart metering implementation plans and pilot projects and one news articles discussing challenges and progress in smart metering rollout in Nigeria (Nairametrics). Out of the fifteen papers (journals, reports and news articles), twelve were excluded as they did not consider the use of smart metering for real time monitoring and energy management in Nigeria. Only three were included and thus reviewed.

- *Review of Related Work*

Aniedu *et al.*, (2016) looked at Smart prepaid energy metering system to detect energy theft with facility for real time monitoring in Nigeria. They x-rayed the benefits of the application of smart meters and Advanced Metering Infrastructure (AMI) towards solving electric energy billing and monitoring problems in Nigeria. In their design, Atmel microcontroller was used as the main controller for evaluating consumed electric power and Power Factor (PF), an ADE7756 metering IC for voltage and current transforming, a GSM module used for communicating to Management and Monitoring Module, and an LCD for displaying the root mean square (rms) values of voltage and current, consumed electric power, and PF. Result shows an easy and convenient way of acquiring meter readings (Automatic meter readings) hence ensuring accuracy, lower operational cost and removal of possible corruption and fraud related to meter reading and revenue collection.

Oluwafemi and Chika (2021) developed a mobile web application with Internet of Things (IoT) and short message service (SMS) for consistent, transparent recording, monitoring of energy consumed, amount billed, infrastructure theft and meter control. Arduino, sensors and relay modules were some of the hardware components used with communication application programming interface (API) accessed through the Wi-Fi module. The communication between the hardware and the server were the response based on different commands, which includes turning on and off, setting threshold, and requesting consumption and even paid for consumed power. The app enabled the consumer monitor their current energy consumption through the web and android interface and remotely turn the meter on and off. It also enables stored data to be retrieved at any time.

Somefun *et al* (2019) carried out a research on Smart prepaid energy metering system to detect energy theft with facility for real time monitoring in Nigeria. The research provides an approach for handling energy meter by-passing and tampering. The system design is based on the monitoring of the readings of two current sensors by a programmed microcontroller. While one of the current sensors monitors the current drawn by the user's load, the latter installed before the meter monitors current drawn by all loads. A momentary switch is also installed in the meter to trigger the meter once it is tampered with. Furthermore, the user is provided with a remote access to the energy meter for recharging energy units and for monitoring energy consumption. Results shows that any discrepancy between the values read, indicates theft and system accurately measured load consumption and detect any attempt to by-pass or tamper with the energy meter. Also, unscrupulous attempts were reported using GSM technology.

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III. RESULTS AND DISCUSSIONS

❖ *Results*

Table I shows the classification of the related works reviewed itemizing the research purpose, tools used, and results

Table 1: Classification of Related Works Reviewed itemizing the Research Purpose, Tools used, and Results

Authors/Dates	Research Purpose	Tools used	Results	
			Mode of communication	**Automated Process**
Oluwafemi and Chika (2021)	Real time energy monitoring, billing, infrastructure theft and meter control	Web application using IoT to make the meter smart	Short Message Service (SMS)	NO
Somefun *et al* (2019)	Theft detection and real time energy monitoring	Sensors and programmed micro-controllers	GSM (Mobile)	NO
Aniedu *et al* (2016)	Theft detection and real time energy monitoring	Atmel microcontroller as the main controller, an ADE7756 metering IC for voltage and current transforming, LCD for data visualization	GSM (Mobile) and LCD for data visualization	Meter readings is automated

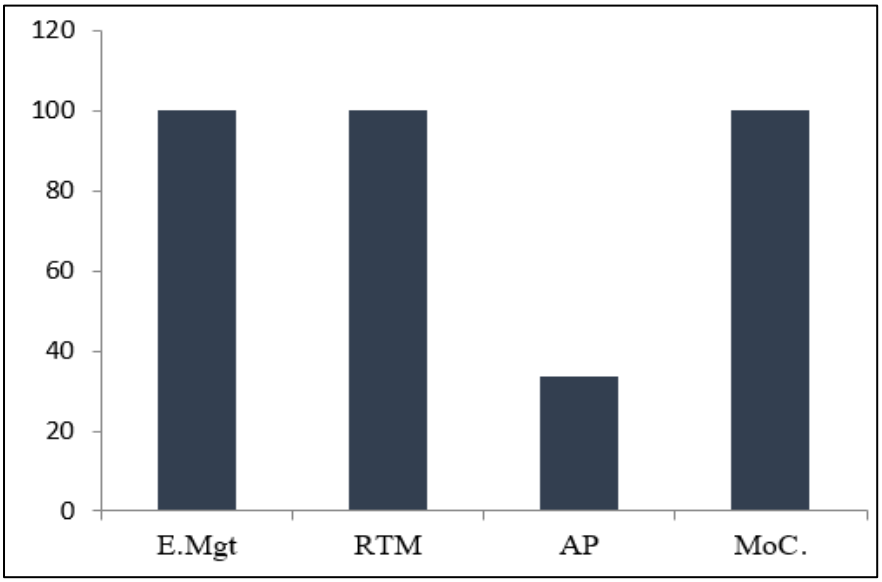

Fig 1: Chart Showing the Percentage of Key Features in the Reviewed Work

(**E.Mgt = Energy Management, RTM = Real time Monitoring, AP = Automated Process, MoC = Mode of Communication/ Interaction*)

❖ *Discussion of Findings*

A. Smart Metering in Nigeria

Results from Table 1show that no much work has been done on smart metering in Nigeria. Though smart metering has gained attention as a solution to energy distribution challenges, electricity theft and customer dissatisfaction due to inaccurate billing and has been encouraged by governmental policies with the aim of modernizing the country's energy infrastructure and improve grid reliability, its implementation has been epileptic (Ayotunde, 2023) With smart metering, utility companies can identify unauthorized connections, maximize energy efficiency and reduce losses.

B. Energy Management and Real-time Monitoring

Results from Table 1 and Figure 1 show that smart metering allows for effective energy management and real time monitoring. All reviewed papers (100%) show that smart meters provides both distribution companies and consumers an effective way to manage, monitor and control the rate of energy consumption. It also helps billing and understanding which appliance consumes more power on real time (Aniedu *et al*, 2016).

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C. Automated Process

An automated process in effective energy management is very important due to the fact that people especially in urban areas are very busy and might not have the time to keep track. Result from Figure I shows that only 1 out of every three smart meters in Nigeria is automated. Even at that, it only allows for automated meter reading and billing for each appliances.

D. Mode of Interaction

The reviewed works showed that the mobile phone (GSM) served as a good means of interaction. Communication is a major challenge in electricity distribution and billing in Nigeria, owing to the fact that the only way to know that unit is finished in the meter is when the light goes off which has caused so many problems for consumers. More so, bad network might lead to a delay and failed real-time notification.

IV. CONCLUSİON AND RECOMMENDATİON

Smart metering and real time monitoring systems is an effective tool for effective energy/power management. Though smart metering has gained attention as a solution to energy distribution challenges, electricity theft and customer dissatisfaction due to inaccurate billing and has been encouraged by governmental policies with the aim of modernizing the country's energy infrastructure and improves grid reliability, its implementation has been epileptic. The mobile phone (GSM) served as an excellent means of communication between the smart meters and the customers. Communication is a major challenge in electricity distribution and billing in Nigeria, owing to the fact that the only way to know that unit is finished in the meter is when the light goes off which has caused so many problems for consumers. More so, bad network might lead to a delay and failed real-time notification.

We therefore recommend smart metering system for real-time enrgy management and monitoring using business intelligence approach for effective data visualization and deep learging for intelligent and automated process.

REFERENCES

[1]. Abdallah, A.A &Odeleke, O.B. (2023). Energy Security in Nigeria: Challenges and Prospects, Journal of Arid Zone Economy, 1(1): 101 – 111

[2]. Aniedu, A.N., Inyiama, H.C. &Azubogu, A.C.O (2016). Smart meters and advanced metering infrastructure: panacea to Nigeria's energy billing and monitoring problem, *Journal of Engineering and Applied Science*, V11, ISSN: 1119 -8109

[3]. Ayotunde F. (2023). Energy policy as a tool for sustainable energy development -A Nigerian Perspective. DOI:10.13140/RG.2.2.30721.22883

[4]. Oluwafemi, I.&Chika, O. Y. (2021). A Novel Mobile and IOT Enabled Application for Smart Energy Meter, *FUOYE Journal of Engineering and Technology*, 6(4),DOI: https://doi.org/10.46792/fuoyejet.v6i4.680

[5]. Oyedepo, S. O. (2013). Energy and sustainable development in Nigeria: the way forward. *Energy Policy*, 52, 28-35.

[6]. Sasu D.D (2023). Energy sector in Nigeria - statistics & facts. Retrieved on 29/04/2024 from https://www.statista.com/topics/11022/energy-sector-in-nigeria/

[7]. Simonyan K. J, &Fasina, O. (2013). Biomass resources and bioenergy potentials in Nigeria, African Journal of Agricultural Research (AJAR),Vol. 8(40), pp. 4975-4989

[8]. Somefun, T.E., Awosope, C.O.A, &Chiagoro A. (2019). Smart prepaid energy metering system to detect energy theft with facility for real time monitoring, *International Journal of Electrical and Computer Engineering (IJECE)*,9(5): 4184 –4191

[9]. UNIDO (2015). *What is an energy management system?*Retrieved on 29/04/2024 from https://www.unido.org/sites/default/files/2015-12/11._IEE_EnMS_Brochure_0.pdf

[10]. Zahid A. (2008). Energy–Gdp Relationship: A causal analysis for the five countries of South Asia, *Applied Econometrics and International Development*, *Euro-American Association of Economic Development*, vol. 8(1), pp 167-180.