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ALARM AND LIGHT EMITTING DIODE FOR ELECTRICITY RESTORATION MONITORING: A TOOL TO PREVENT ENERGY WASTAGE IN NIGERIA

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ABSTRACT: *The power restoration alarm system is a monitoring device that triggers the buzzer and turns ON light emitting diode when the mains supply is restored or available at the cut-out board or unit. This device produces an audible sound and colour lighting which attracts the attention of the electricity user to either switch from direct current supply or connect to the mains. The amount of energy consumed at our homes and offices is measured in wattage. The amount of energy used to actuate the alarm and LEDs is very small when compared to the incandescent lamp/bulb that uses wire/filament. The incandescent bulb uses 5 % of the energy that flows through it to turn ON the bulb and the remaining 95 % is converted to heat energy by the system. This energy that is converted to heat is a huge loss of electricity that is not fully utilized. The monitoring device consumes low wattage and this reduces the energy waste and the wattage billing on the analog and digital prepaid meter. The device will enable the electricity consumer to prevent or reduce energy lost at cut-out unit. Power monitoring and control device for home and commercial networks is becoming important to prevent energy waste for electric appliances. This device is easy to maintain and cost effective when it is properly install*.

KEYWORDS: energy waste, monitoring system, indicator, sound, incandescent bulb and consumption

INTRODUCTION

The development of any nation depends on the availability of the power supply or electricity. There is a drastic increase in the consumption of electricity as the population of a nation increases. As the technology innovation is fast growing, there is a proportionate increase in electricity consumption. The electricity generation in most Nation is very small of about few megawatts compared to the demand of the citizen. During the transmission of electricity, most of the energy is lost as heat across the metallic conductor transmission line. Also, individuals and cooperate body waste electricity during consumption due to carelessness and improper use of

energy consuming equipments/items. Energy saving has been practiced by every consumer in view to prevent waste and effective energy consumption. The prepaid meter is an electronic device use by energy Provider Company to check and account for the amount of energy consumed by the consumers.

The electricity provider uses the billing system of the Kilowatt-hour to measure the energy consumed in our homes and industries. In the past, the analog metering billing system was employed and the incandescent bulbs were used to light our home and as indicator at the cut-out unit. All these have lead to waste of energy during consumption. Also, human error in metering reading and low cost of energy charges have made the consumer not to have any cost effect on the energy consumed. In this digital dispensation, when energy is bill as the amount of energy consumed in kilowatt. Any waste of energy has a proportionate effect on the consumer and can lead to reduction in the economy growth of a Nation. Therefore, there is need to install or use electronic devices as monitoring and lighting system to prevent waste of energy. All electrical and electronic equipment are rated in wattage. Hence, the amount of energy consumed can be estimated by the equipment or lighting system employed in the home and industry.

Electricity Billing System

According to Arimoro, et al., (2019) energy meter is a device designed to quantify or measure the volume of electricity consumed at a given point in time by an electrically powered device, residence, commercial premises or an industrial complex. Typically, electricity meters are calibrated in billing units of kilowatt hour [kWh]. The electricity metersare read periodically to establish billing cycles and energy used during the cycle. The distribution companies use a monthly billing system in which the unit consumed in a previous month is paid in the succeeding month. There are two types of billing system namely the estimated and pre-paid billing system.

Estimated Billing System

The estimated billing is a target system employed by the electricity providers to meet their profit margin at the end of the month. The billing is carried-out after the all the meter houses and industries have been charged for their energy consumption. This billing system is referred to be as company's fraud base unit where consumers are mandated to pay far above what they consumed monthly. Most of the customers under this system are without meters and the residences are never visited to track the energy utilization over the period charged. Provision of meters to individual client may not totally eradicate this menace,

however it is a good step forward to the means. PHCN bills consumers who were on direct connection (otherwise known as without meter) and those on post-paid meters with estimated bills. The main problem with billing by estimate had been the tendency to overcharge electricity users and provoke payment apathy. In the past five years, over 80% of complaints received by NERC from consumers had been centered on issues of estimated metering, excessive tariffs with the metering methodology and poor metering infrastructure (Okafor, 2013). Defaults in payment of electricity bills by consumers arise a protest to perceived exploitation and negligence to complaints made to the PHCN authority. The problem with out-of the meter billing has been that its bill does not tally with the exact amount of energy consumed (Abubakar, 2009). The estimated bills are prone to human error and over estimate of charges by the electricity provider companies.

Analog Metering System

The analog electricity metering system is read periodically to establish billing cycles and energy used during the cycle. The meter uses part of the energy that flows through it to turn the spring attached the motor. The periodic motion of the spring in an hour is use to determine the energy consumed per hour. This movement of the spring enables the distribution companies read the value at the end of the month and calculate their amount of energy consumed by the customer. Most of the energy supplied is use by the meter to turn it ON.

Prepaid Metering System

Prepayment metering is a well established technology being introduced by more and more utility companies. According to Kettless (2004), prepayment metering system is a system where a customer pays for energy before using it which comprises a system master station (a computer that administers the whole system),a vending machine (where customers buy their electricity) and prepayment energy meters (or dispensers, which dispenses the electricity to the customer).This meter has an interface to the customer for managing the transfer of credit and to display the meter and credit status. Prepayment method involves consumers to possess a credit in their electricity account before the usage of the service, when such credit is depleted, supply is remotely disconnected. Electricity prepaid billing system was first used in 1980s with the motives of check-mating energy waste by the consumer which cannot be accounted for by the electricity provider.

Wattage

This is the unit of power that is use to measure the energy consumption by electrical appliance installed at any point/terminal. Most electrical and electronic equipments are rated according to their energy consumption. This rated value is used to determine the load of the electrical appliances installed in a home or industry.

Incandescent Bulb

The incandescent bulb is a lighting system that uses wire/filament. The filament is enclosed in a bulb to protect the filament from radiation. It has a voltage rating from 1.5 - 300 V. The incandescent light bulbs are less efficient than other electric lighting bulbs by converting 5 % of the energy they use into visible light. The remaining energy is lost as heat. Previously, incandescent and fluorescent light fixtures were the light source of choice for hospitals. But as both LED technology and healthcare facilities improve, flickering dull light is being replaced with warmer, more human-centric illumination. The transition to LED lighting not only allows hospitals to provide better service to their patients, but reduces maintenance and energy consumption by the user. The luminous efficacy for 120 V incandescent bulb operates at 60 lm/w compared to 150 lm/w for low energy bulb. Incandescent bulbs are used as heat lamp for incubator and lava lamp. It plays an important role in the industry as paint curring. This bulb has a short lifetime of about 1000 hours as home light bulb.

Light Emitting Diode

A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. The color of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor. White light is obtained by using multiple semiconductors or a layer of light-emitting phosphor on the semiconductor device.

Buzzer

The buzzer is a sound device which produces audible signal or sound when current flows through its terminals. It is widely used in electronic circuit to generate audible sound. It uses little energy to produce it's sound. This buzzer can be used by simply powering it using a DC power supply ranging from 4V to 9V. A simple 9V battery can also be used, but it is recommended to use a regulated +5V or +6V DC supply. The buzzer is normally associated with a switching circuit to turn ON or turn OFF the buzzer at required time and require interval.

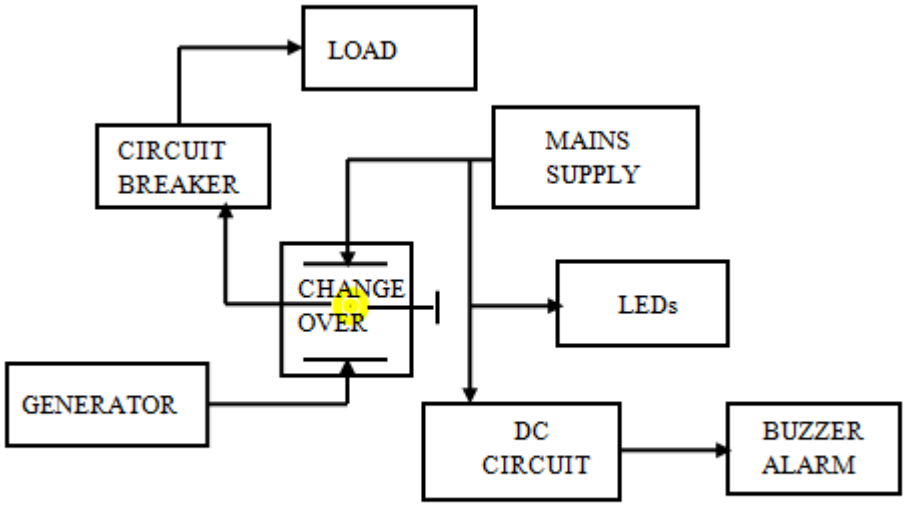

Figure 1: Block diagram of power restoration system

Calculations;

Case study of using 60 Watts incandescent bulb for power restoration at cut-out board

Unit price of electricity **per kilowatts** = ₦34

Conversion of 60 watts to kilowatts $= \frac{60}{1000}$

$= 0.06\,\text{Kw}$

Period of power restoration/supply = 12 Hours

Energy consumed = 0.06×12

$= 0.72 Kwh$

Cost of energy per day = energy consumed daily x Unit price of energy

$$= 0.72 \times 34$$

$$= 24.48$$

Number of day in a month = 30 days

Cost of energy consumed in a month $= 30 \times 24.48$

$$= ₦734.4$$

Annual Cost of electricity = Monthly cost x 12

$$= 734.4 \times 12$$

$$= ₦8812.8$$

Equivalent 10 W LED for restoration lighting system

Conversion of 10 watts to kilowatts $= \frac{10}{1000}$

$$= 0.01\text{Kw}$$

Period of power restoration = 12 Hours

Energy consumed $= 0.01 \times 12$

$$= 0.12Kwh$$

Cost of energy per day = energy consumed daily x Unit price

$$= 0.12 \times 34$$

$$= ₦4.08$$

Number of day in a month = 30 days

Cost of energy consumed in a month $= 30 \times 4.08$

$= ₦122.4$

Annual Cost of electricity = Monthly cost x 12

$= ₦122.4 \times 12$

$= ₦1468.8$

Table 1: Comparison of incandescent and LED bulbs for power restoration

Comparison of LEDs and Incandescent Equivalent Wattage on Electricity Consumption										
Lumen (Brightness)	**Unit Cost Per Kwh (₦)**	**Power (Watts)**		**Electricity Restored on Average of 12 Hours Per Day (KWh)**		**Monthly Electricity Cost (₦)**		**Annual Electricity Cost (₦)**		**Cost Per Wattage Savings/Wastage (₦)**
	(a)	**LEDs**	**Incandescent**	**LEDs** (b)	**Incandescent** (c)	**LEDs** d=(axb)	**Incandescent** e=(axc)	**LEDs** f=(dx12)	**Incandescent** h=(ex12)	g=(h-f)
450	34.83	5	40	0.06	0.48	2.09	16.72	25.08	200.62	175.54
800	34.83	10	60	0.12	0.72	4.18	25.08	50.16	300.93	250.78
1100	34.83	18	75	0.216	0.9	7.52	31.35	90.28	376.16	285.88
1600	34.83	25	100	0.3	1.2	10.45	41.80	125.39	501.55	376.16
2600	34.83	37	150	0.444	1.8	15.46	62.69	185.57	752.33	566.75
3700	34.83	40	200	0.48	28.8	16.72	1,003.10	200.62	12,037.25	11,836.63

CONCLUSION

The light emitting diode and incandescent bulb are glowing devices that illuminant it's environ for proper vision. The alarm system turns off immediately after some seconds. This makes the device consume less energy compared to the incandescent bulb. The electricity generated is inadequate for consumption by the consumer and need to be conserved. The table 1 shows that a

consumer that uses LEDs as power restoration conserved electricity and save cost compared to any incandescent bulb of any wattage. Hence, the use of LEDs at lighting points will increase economic growth and reduce poverty among citizen. The lighting system evaluation and electrical appliance wattage can be use by electricity provider to determine the monthly billing of energy consumed by consumers rather than the estimated billing system. This will encourage the consumers to easily pay their bills.

REFERENCES

[1] Elamvazulhi, I., Ahamed, K., Syfiq, B., Rajendran, S. and Amudha, M. (2012), Electrical Power Consumption Monitoring using Real-Time System. IEEE conference, Kuala Lumpur, Malaysia.

[2] ChiaHung, L , Hsien-Chung, C , Ying-Wen, B , and Ming-Bo, L. (2008), Power Monitoring and Control for Electric Home Appliances Based on Power Line Communication. International Instrumentation and Measurement Technology Conference Victoria, Vancouver Island, Canada. May 12–15

[3] Chinwuko E. C , Mgbemena, C. O, Aguh, P. S and Ebhota, W. S (2011), Electricity Generation and Distribution in Nigeria: Technical Issues and Solutions. International Journal of Engineering Science and Technology,Vol. 3. (7934-7941)

[4] Arimoro, T.A , Oyetunji, A.R and Odugboye, O.E. (2019), Analysis of Electricity Billing System in Corporate Buildings in Lagos, Nigeria Journal of Management and Economic Studies, 1(6): (10-20)

[5] Energy Commission of Nigeria, Energy Resources Review, Vol 4, No.3, 2003 pp 7-10.

[6] Deshpande,M.V.(1993).Elements of Electrical Power Station Design.Wheeler Publishing. Allahad India: