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MITIGATION OF POWER WASTAGE IN THE DISTRIBUTION NETWORK

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Abstract - Electricity power supply in Nigeria is grossly inadequate due to shortage in production capacity and consequent shortage in the transmitted and distributed networks of the sector. This has greatly hampered the standard of living of the citizenry. The wastage of the scarce distributed power due to negligence of the electricity consumers by leaving on the lighting systems around the homes in broad day light has been a concern in the research industry. This paper focuses on the way to curb this menace among the electricity consumers. A device to mitigate power wastage among shortage of same was constructed. This device when applied at the distribution network will automatically control the lighting system of the environment when it senses radiation from sunlight indicating daylight or darkness indicating dark hour of the day thereby curbing the incessant power wastage through lighting in broad day light and reserves the available distributed power to meaningful use by the consumers.

Keywords: Power Wastage, Mitigation, energy consumption, semiconductor technology, Distribution network

I. INTRODUCTION

Electricity generation capacity of Nigeria is still grossly inadequate to meet the need of the ever-increasing population of the country. Since energy demand is on the rise every day, and generation of such is not matching up, there is a need to engage effective and efficient power management technique to ensure good electricity consumption with a reduction in power wastage by the consumers [1]. One major source of electricity wastage was identified as lightning points within and around the residential environments. In this work, an electronic device that controls the lightning systems in the residential at the sight of illumination from the ray of sun is developed, thereby conserving the electrical power available for useful application during the night and useful period during the day [1].

The generation of electricity in Nigeria dated back to a century ago, yet slow progress in the infrastructure advancement of the sector has engendered the inadequacy of delivery of constant and reliable power to the citizenry. It has been reported that about 46.09% of the population have no access to electricity, while the estimated demand of 24,380MW electricity by the population, only 7,139MW is the generation capacity of the nation's power plant [2]

The power loss at the point of power generation is estimated to about 50%. Also, 30.5% of total capacity of the Delta State four generation plants was realised while the remaining 69.5% was lost [3]. It is obvious that a great deal of power generated is lost at the point of transmission and distribution due to many factors militating against this sector.

While effective face lift of the transmission and distribution networks are needed, the aspect of mitigating the available power wastage is crucial and should attract immediate and urgent attention. It is then that improvement in power generation can have meaningful impact. The erratic power supply is majorly attributed to wastage of the supplied power at the consumption level occasioned by grievances of the consumers as a result of default or outrageous estimated billing system [3]

The distribution system being an important part of the total electricity supply chain, provides the final link between a utility's bulk transmission system and its ultimate consumers, is faced with undaunting problems of a combination of technical, commercial and collection losses among others. These losses are incurred on regular note as a result of many factors such as theft, vandalization, poor distribution infrastructures, and evasion of electricity charges. These losses totalled to 58.91% has loads demand and weak distribution network as major contributors of technical losses in power network [4,2]

1.1 Power Wastage in the Distribution Network:



Consumers of electricity comprising households, industries, commercial ventures, among others, have risen significantly. Rising population and improvement in industrial and commercial activities are key factors driving the trend. As a result, demand for electricity has continually be on the rise, while the largest consumption of electricity generated is the residential of the global population [6]. The work in [7] estimated that in 2016, residential sector consumed 26% of the global energy generated. Fig 1 shows the electricity consumption comparison across the different economic sectors in 2016

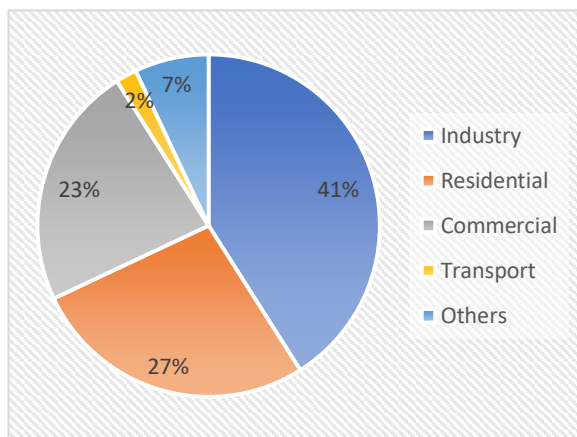


Fig 1: Electricity consumption across the economic sector [7]

It is also obvious that large percent of distributed power is lost due to negligence on the part of the consumers. Electric devices and lighting points are sometimes deliberately left on in a bid to vent the grievances of the consumers over the unfair estimated bills from the power distribution company while others unintentional do same. This act is not only affecting the transmission and distribution networks but also short changing the entire consumers of adequate supply of power when it is most needed [3,1,5]. Hence, in this work, a device that automatically switches off the lightning points when the rays of sun indicate sufficient illumination are sensed is developed. The carefree, laziness and forgetfulness to switch off the lighting points by the consumers while leaving the environment is addressed by this device and salvage electrical power wastage.

It is unfortunate that most consumers do not know the great damage their unattended attitude to the power consumption and wastages by leaving the lightning points on day and night is causing to the energy distribution network [1]. It is hoped that information provided in this work and consequent

developed device will awakened the consciousness of the consumers on the importance of preserving the electricity supply for profitable use instead of wastage of this scarce and essential commodity. This electronic device controls power management in homes, offices to mitigate power wastages. The operation of the device is to switch off all the lightning points when the day breaks and there is sufficient illumination and help to restore electricity when the dawn sets in.

II. RELATED WORK

Power management and control system in lecture theatres in a University environment with the intention to curb wastage as well as reduce consumption tariff in favour of the consumers was conducted in the work of [1]. A microcontroller unit set at a reference voltage sends a signal to relay for activation of the lightning system of the environment was used in the work. However, this work is limited to a specific location and not covering the residential area which is the focus of our work. It was reported in [2] that the usage of energy saving bulbs in a three-bedroom apartment will annually save about 551.88kWh of energy and this is translated to huge amount of money saved in favour of the energy consumers per annum hence making the generated capacity saving the citizen longer for profitable use. [6] carried out extensive reviews of the state-of -the-Earth in standby energy management. It was revealed in the work that there is high level of energy wastage even though the generated and supply capacity is grossly inadequate for the citizens. They conclude by proposing an intelligent system with little or no man influence for efficient electricity wastage mitigation. This shares a similarity with our work but implementation of a typical intelligent system that automatically controls the switching on and off of the lighting system with the help LDR when it senses rays of light from the sun thereby saving energy for proper usage.

A feasibility study of the residential areas to establish the fact that a large chunk of the supplied electricity is wasted by the residence during the day due to their negligence and carefree attitude was carried out and reported in this work. The perpetual scenarios on our streets and residential environments are as depicted in Fig 2, where the scarce electricity supplies are left unattended to during broad day light. You don't need anybody to alert you of electricity outage and when it is restored, the environment does that at any time of the day. This is injurious to the system as a whole and needs

attention of the stakeholders hence the drive behind this device to adequately checkmate this waste [8,9].



Fig 2: Power wastage through lighting during daylight

It is advantageous to both the power sector as well as the consumers to preserve electricity by powering off unused appliances and lighting points during the day, but this is not adhering to by majority of the consumers as show in Fig 2. An electronic device as means to curb this wasteful attitude is the focus of this paper. This device will have a wide range of applications in indoor and outdoor environments.

III. MATERIALS AND METHOD

The design control circuit includes transistors used as the main switching component. The Light

Dependent Resistor (LDR) has high resistance, hence low conductivity when it senses ray of light during the day and then sends signal to the transistor to switch off automatically. The converse takes place in the night or when the sun has withdrawn its rays. The developed mechanism is found to exhibit efficient automatic switching control using the Semiconductor Technology to control the overall system. This reduces the design and control complexity of the system. Other active and passive elements used in the construction of the device are diode, relay switch, transformer, capacitor, resistors and cable for connections.

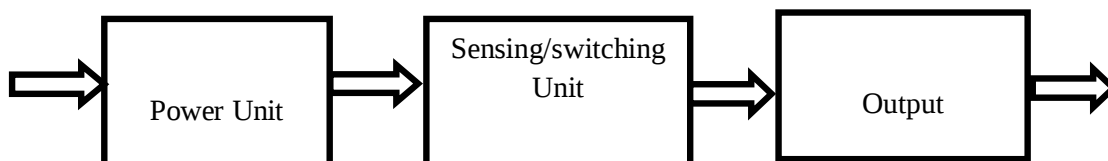


Fig: 3 Block Diagram of the Hardware Module of the Automatic Lighting Control Device

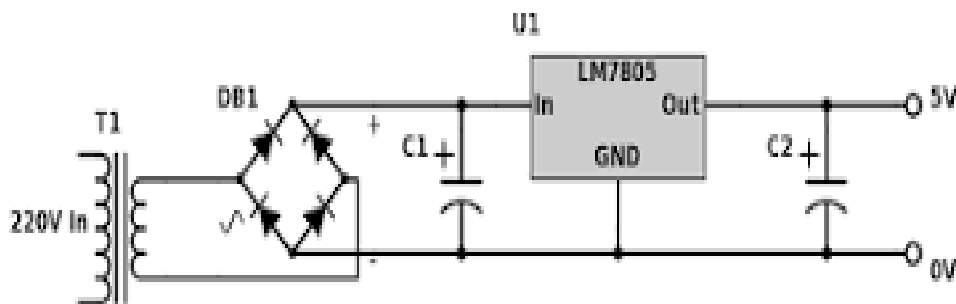


Fig: 4 Power Supply Unit of the Power wastage Mitigation Device

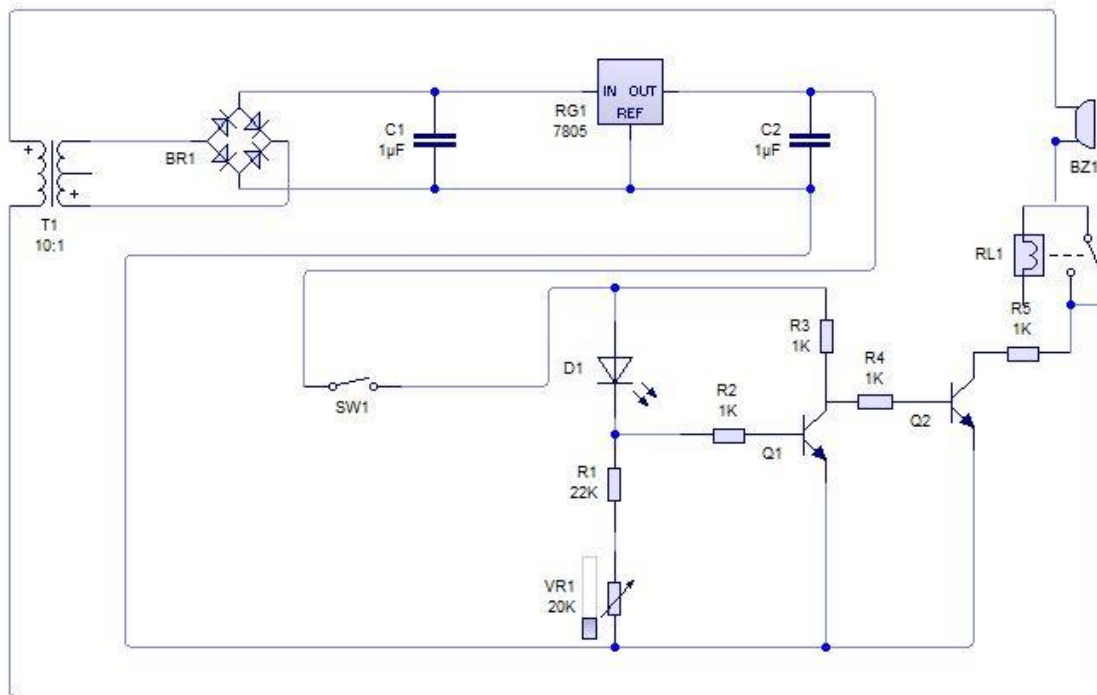


Fig: 5 Circuit Diagram of the Power Wastage Mitigation Device

The LDR and other resistors as shown in the circuit diagram form a simple potential divider where the centre point of the potential divider is fed to the base of the transistor Q1. This signal triggered the transistors Q1 and Q2. The transistors are engaged as switches activated by the signal from the LDR when the signal voltage supplied through the LDR is about 0.7V. The signal from the Transistor is fed into the relay which can be relatively turns on with small current which will power the load. This section energizes the sensory unit, control unit and relays. The sensory and control units require 5V and the relays require 6V dc input supplies while the photocell works on the principle of photoconductivity [8,13].

IV. RESULTS AND DISCUSSION

This work employed Semiconductor Technology approach where a light dependent resistor, which response to the rays of sun light is used for the activation of the switching system. The design

which is meant to be used at the Distribution Fuse Board (DFB) in homes will help to checkmate the power wastage through lightning points in homes, industries, walkways and on the streets. This device will effectively replace the conventional method of switching on and off of the lightings systems that has proved ineffective over the years and have accounted for a great loss of energy due to negligence of the consumers.

When the LDR senses the ray of light from the sun, its conductivity reduces, the supplied current to trigger the device is inadequate hence the device will be in off state indicating day light and this will automatically put off the lighting system connection through the DFB system. In the same way, when the device senses no signal from the sun light indicating darkness, conductivity of the LDR is activated allowing large current to flow through the system, hence the entire circuit is triggered to alert the system to turn on the lighting systems through the DFB

Fig 5 shows the connection procedures of the device while Fig 6 is the assembled device in operation.

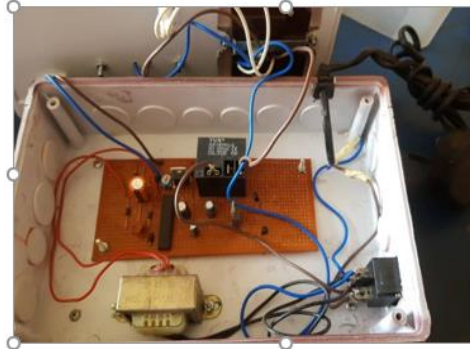


Fig 5: Power Wastage Mitigation Device under Construction



Fig 6 a: Power Wastage Mitigation Device
in Off State



Fig 6 b: Power Wastage Mitigation Device
in On State

V. CONCLUSION

The shortage in power generation and power losses in the transmission, distribution channels of power network system are enormous. While the campaign for face lifts of these sectors are on the high side, the proper use of the available power through the distributive channels must be looked into. The power wastage at the distribution network of the power supply requires urgent attention. This paper proffers an electronic solution for mitigation of wastage of the supplied power to consumers. The negligence of the power consumers to prevent waste by putting off appliances when not in use and the intentional mission of vengeance on the outrageous billing system of the power company will be circumvented by this electronic device which requires little or no human intervention to mitigate the power wastage. This will afford profitable use of the limited power available for consumption.

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