Full Length Research

Literature Review on Automatic Streets Lighting Systems in Residential Areas in Nigeria

[1]Eng. OLUSESI, Abayomi & **[2]JOSHUA,** Funmilayo Justina
[1,2]Department of Electrical and Computer Engineering
Bells University of Technology, Ota, Nigeria
[2]Email: justinajoshua34@yahoo.com

[3]ADEGBITE, Ayodeji Gabriel
Department of Computer Engineering,
The Federal Polytechnic, Ilaro, Ogun state
Email: connectayodeji@gmail.com

Abstract: Street lighting has emerged as an essential factor in strategies for crime prevention in residential areas and realization of sustainable growth. The idea is to improve security for street users during the night by guaranteeing a luminance level. This paper introduces a brief investigation of previous researchers on automatic street lighting systems design and implementation. The research adopts an extensive review of literature such as conference papers, journal articles, internet sources, books to research on automated street lighting systems for residential areas in Nigeria. This research concluded that by automating the street lighting system, the lights comes on automatically in the hours of darkness and goes off by itself when it senses the sunlight coming out in the day time. These lightings expose the activities going on within and around our premises at night time when the natural source of lights have become weakened. The study further recommends that future authors should design efficient lighting system in residential areas in other to prevent crimes in the community.

Keywords: Energy Efficient: Lighting Systems: Crime Prevention: Residential Areas: ZigBee: Nigeria.

1.0 Introduction of the Research

Abrol (2013) argued that street lighting has emerged as an essential factor in strategies for crime prevention in residential areas and realization of sustainable growth. The idea of community street lighting is to improve security for street users during the night by guaranteeing a luminance level. This paper introduces a brief investigation of previous researchers on automatic street lighting systems design and implementation. Researchers found that by automating the street lighting system, the lights comes on automatically in the hours of darkness and goes off by itself when it senses the sunlight coming out in the day time. These lightings expose the activities going on within and around our premises at night time when the natural source of lights have become weakened (Yasmin & Sarkar 2014). The study further recommends that future authors should design efficient lighting system in residential areas in other to prevent crimes in the community. Yasmin & Sarkar (2014) reported that some outdoor spaces at the university environment was birthed as a result of the department of electrical and computer engineering's response to the security challenges

arising due to dark spots around the campus that may attract and harbor criminal elements of the society (Abrol, 2013; Abdulazeez, 2015).

Patil et al. (2015) opined that designing a system to be solely controlled by humans will most probably suffer from limitations such as, individual's level of sensitivity, forgetfulness, inaccuracy, inconsistency etc. In other to overcome these challenges, systems such as electric systems incorporate automatic controls to enable electronic components, devices and machines perform human like function in the operations of such systems. Ramil et al. (2015) posited that these types of systems are more efficient, consistent, more accurate than human operated ones, but may also be susceptible to malfunction when faulty. Largely, thermostats, thermocouple, thermistors etc are incorporated in temperature controlled circuits; light sensors are incorporated in ambience monitoring circuits, piezometers, manometers pressure transducers are incorporated in pressure control circuits, sound detectors are also available to detect sound, even there is now an electronic nose that can detect odor. Automatic controlled systems have been found to be far more consistent over manual controlled systems. This article is aimed at researching on previous literatures on automatic streets lighting systems in residential areas in Nigeria.

2.0 Literature Review of the Research

2.1 Energy Efficient of Street Lighting System

Kavita & Tushar (2015) reported that public sector lighting systems are still designed to meet the old standards and often do not benefit from state-of-the-art technological development, the use of new technologies in light sources and the use of the sensor combinations to achieve high street lights efficiency, and efficiency can easily be combined to maximize efficiency at each stage. It is the ideal option as it provides advantages, including conserving electricity and extended life, for Light Emitting Diode (LED) technologies instead of sodium vapor lamp and Compact Fluorescent Light (CFL) (Kavita & Kavita, 2015). Given the long-term advantages and the initial expense, maintaining the time spent for return on investment would never be an issue. The idea may be used in several different applications, such as lighting in industry, campuses and parking areas in big retail centers. This can also be utilized in corporate and industrial monitoring. Sakshée (2013) stressed that smart street light management and monitoring system that combines modern technologies, easily maintained and energy saved. With the usage of the solar panel on the lamp post utilizing LDR, you may save some energy and energy by using the Graphics Application to display the status of lights on streets or highways, monitoring and managing the street lights. Subramanyam1 et al. (2013) opined that design of the energy efficient street light automation wireless framework recommended an intelligent control of the lamps by transmitting Zigbee wireless communication data to a central station. Maintenance from the central station can be simply and effectively scheduled, providing further savings with the proposed method. Nithya et al. (2014) argued that the automatic street light system for ZigBee remote control streetlight management system helps to save energy, identify defective lights and maintain time and enhance system life. Srikanth (2014) found that GSM basic high-efficiency remote control system smart street lighting system uses the Zigbee devices and sensor network.

2.2 Temperature LED Street Light.

Devi & Anila (2014) investigated about saving power in street lighting using six components in controller PIC16ff877A, LCD display, current transformer and GSM module (DTMF). Microcontroller PIC16ff877A; used to link all other elements together, GSM module; used to show load value for SMS transmittal to the control station, LCD for Dim, Brighten LED for DTMF and DTMF, DTMF specifies times to move the LED. The main goal was to manage the lighting of the street (dim at morning and also to radiate at night). The street light was regulated by engineers based on the Electricity Board. During transmission of the information to the power system through GSM, a disconnection occurred in the case of an overload. Data was forwarded to the power board using an RFID reader to be placed in a street light pole in which the tag was issued to every consumer in the case of consumer complaints. Rubananth et al. (2012) suggested that a novel approach for decreasing the energy usage was presented. The recovery duration was decreased after electricity failure. The GSM module suggested streetlight maintenance, load maintenance and other electricity concerns. The writers stated that this approach would be embraced by the electricity divisions in order to remember that the final objective is to preserve power and time.

2.3 Light Sensor

Sumathi et al. (2013) posited that some sensors were used to improve and operate the system efficiently. A movement felt by the IR sensor. When a human was spotted in detection, street lights were turned ON. The system has employed a GSM module for effective administration and control of street lamps. The road light condition was verified and a problem notice was sent to the control centre. The GSM module method helped to save considerable electricity and increases the system's performance and maintenance. Vinitha et al. (2012) investigated on the creation of an integrated street light energy saving system. This study provided an excellent alternative for wasting electricity. Manual lighting system operation in this research was completely destroyed, the authors used two sensors used for indicating day and night dependent resistance and IR sensors used for detection of street motion. The street light control was using PIC16F877A microcontroller. The language utilized in this programming was C. On a prototype version the system was implemented. The two sensors utilized to operate the circuit were the LDR sensor and the IR sensor. The automation of each lighting column was controlled by each sensor. A microcontroller was applied effectively to the street light (Chaitanya et al., 2013).

Rajasree (2016) suggested the use of a system in real-time sensing because the module may also alter the intensity of the LEDs. The circuit was inconvenient; there was high maintenance staub on the sensor easily collected and cleaned-up infrequent periods. The author claimed that the automatic failure detection based on the central system might be integrated with wireless communication. They authors developed another 24 technique for changes in the light intensity of a timer circuit, by means of which a thyristor modified the luminosity of the LED based on atmospheric conditions and the environment day by night (Prabu et al., 2016; Sachin et al., 2015; Ramli et al., 2015). A system that monitors road light and detects errors using an RF technology was created. The disadvantage of this method was that it was costly, but the high cost of the lamp post was offset by less affordable wiring and power network availability when taking its benefits into consideration (Ananh et al., 2015).

Akash et al. (2015) created a lighting system to save energy and to operate independently, with quick response to defects. The system may account for the use of street light for a certain region. Errors from manual operation have also been removed. The system may also be driven from a PC or automated from the control station. The concept was based on light sensors installed in the poles circuits. Present sensors have reported the central system status via the GSM module and the fault status makes it easy to detect the defective street light thus the time needed to find faulty lamps has been decreased. At the conclusion of every day, data were gathered and saved in the database (Prabu et al., 2016; Sachin et al., 2015; Ramli et al., 2015). Details of the power consumption, burning hours number, interruptions and failure detection details; the position of defective street light, failure time and repair were all gathered and kept in the database. Sachin et al. (2015) found that the system performed the feat that it took days or months to discover problems in order to remedy failures in comparison with the manual system.

2.4 **Development of Photovoltaic LED Street Lighting System.**
Sachin et al. (2015) studied the solar photovoltaic panel-based street-lighting systems to enhanced street-lighting efficiencies and saved energy utilization. For automation, LDR has been utilized in the study. The LED intensity was regulated by the pulse width modulation and IR sensor. When light hit it, the resistance of the LDR reduced (Suganya et al., 2014). The authors in empirical research developed a method that listed the relevance of street light management in reducing energy usage. In this research study, the clock timer, photodiodes, LED and transistors were employed. The IR sensors gave glowing LED signals. For intensity control based on observed movement, pulse width modulation was also employed. Prabu et al. (2016) posited that dynamically the intensity varied because the design saved a great deal of energy. The automatic street lighting control system based on a UA741, which is set up as Schmitt Trigger and as a light-dependent resistor, has been designed and implemented (Isah et al., 2015). In the middle of the day the LDR has adequate lighting and the light is off. In addition, the resistance of the LDR increases dramatically when there is darkness, causing the light go "on."In addition, a 12V relay transistor is used to provide a switching mechanism for the parallel activation of street lights. The requirement to operate the security lights manually is totally removed and a great deal of energy saved would otherwise have been lost should the user forget to power the light "OFF" at any moment.

Rajput et al. (2013) argued that a system based on GSM was developed where the lighting system has been developed to reduce power consumption and self-contained operation. This was achieved when the chips were installed on the LED circuit. The chip consisted of a microprocessor, sensors and GSM module used for message transfer on the PC. The program has been created to guarantee that energy usage is minimized. The CO_2 sensor employed was also used to measure atmospheric pollutants. Achana et al. (2015) developed a system that detects vehicle movement and switches LES to an ON state. After a few seconds, the LED shuts off. There were 5 highlights in this system. He checked the street light instinctively. i.e switched off during daytime and activated by LDR during night. It controls the intensity of street light by diming and lighting the item. Using PIR sensors objects were identified. For safety considerations, the system featured a camera (Harshitha et al., 2017). Authorities will automatically be given fault signals utilizing the GSM module technology when the LEDs fail. Also added was the feature of manually switching using a GSM handset. They have also devised a system that automatically illuminated street LEDs at night and disabled them at dawn. In order to demonstrate LED condition for proper maintenance, light dependent resistors were also employed. This system was developed for automated node operation.

2.5 ZigBee Applications

ZigBee technology is based on ieee802.15.4 industry standard. It incorporates the standard, adding the logical network, security and software to it, It supports up to 3 network topologies namely star, mesh and cluster tree. Developers need only have to focus on application while the mcu/microprocessor/rf transceiver makers and zigbee alliance take care of the RF transmitter, RF receiver, RF channel and its protocol.

3.0 Methodology of the Research

This paper introduces a brief investigation of previous researchers on automatic street lighting systems design and implementation in residential areas in Nigeria. The research adopts an extensive review of literature such as conference papers, journal articles, internet sources, books to research on automated street lighting systems for residential areas in Nigeria.

4.0 Conclusions of the Research

The aim of this study was to carry out an extensive literature review of secondary sources to examine research on automatic street lighting systems design and implementation in residential areas in Nigeria. The research adopted review of literature such as conference papers, journal articles, internet sources, books to research on automated street lighting systems for residential areas in Nigeria. The authors in this study found that an automatic controlled system is far more efficient than a manually controlled one. It makes the system operation seamless and stress free. The provision of the manual over-ride option makes the system even better in case of testing, troubleshooting and fault in the control circuit. The researchers in this study further added that manual mode serves as a redundancy option in case of fault in the automatic control mode and allows for the continuous operation of the system till the control fault is rectified. Authors reported that the automatic control of the street lighting system will save cost and reduce energy wastage that may result from human limitations such as forgetting to switch off the system soon enough in the morning when daylight is available. In addition, different cross sectional area of poles were encountered during the installation of lamps on the pole, giving rise to construction of different sizes of mounting bracket. This study recommended that for subsequent empirical investigation of this nature the lamps mounting holes should be carefully matched with the mounting arm of the installation bracket. Consideration for different cross sectional area sizes of poles should be made when cutting the threaded rods for the mounting bracket.

6.0 References of the Study

Agono, C. I. & Haruna, N. O. (2022). Application of Matrices and Linear Programming in Economics. American Journal of IT and Applied Sciences Research, 1(1): 1-15.

Anand, S. & Jain, N. (2015). Intelligent Street lighting system using RF transmission. *"International Journal of Advanced Research in Computer Science and Software Engineering,* **5**(5): 76-87.

Akash, R. B., Holabasappa, K., Kumar, K., Mardi, K. & Nandini, B. M. (2015). Street Light Monitoring and Control System. I*nternational Journal on Modern Trends Engineering and Research, 4(7): 24-37.*

Achana, G., Aishwarya, N., Anitha, J. & Kumar, V. (2015). Intelligent Street Lighting System. *International Journal of Recent Advances in Engineering & Technology,* **3**(4): 149-138.

Amin, C., Ashutosh, N., Holani, P. & Kaul, R. (2013). GSM Based Autonomous Street Illumination System for Efficient Power Management. *International Journal of Engineering Trends and Technology,* **4**(1): 77-89.

Abdulazeez, I. W. (2015). Design and Implementation of an Automatic Street Light Control System. *International Journal of Engineering Technology and Advanced Engineering,* **5**(3): 99-110.

Abrol, V. P. (2013). Design of Traffic Flow-Based Street Light Control System. *International Journal of Computer Applications,* **72**(18): 99-110.

AAC - ASTM - B All Aluminium Conductor, available at https://www.elandcables.com /media/38190/aac-astm-b-all-aluminium-conductor.pdf

Bolotinha, M. (2018). Public Street & Road Lighting & Illumination Design, available at https://www.electricaltechnology.org/2018/06/street-road-lighting-illumination-design.html

Harshitha, K. M., Taranum, L., Mamatha, G. & Divya, K. V. (2017). Automatic Street Light, Fault Detection, and Traffic Density Control. *International Journal of Innovative Research in Computer and Communication Engineering,* **5**(5): 130-148.

Illuminance: Recommended Light Level, available at https://www.engineeringtoolbox.com/light-level-rooms-d_708.html

Kumarrath, D. (2016). Arduino Based Smart Light Control System. *"International Journal of Engineering Research and General Science,* **4**(2): 44-58.

Lavric, A., Popa, V., Finis, I. & Simion, D. (2018). The Design and Implementation of an Energy Efficient Street Lighting Monitoring and Control System. The Stefan Cel Mare University of Suceava. Przegląd Elektrotechniczny (Electrical Review), R. 88 NR 11a/2012.

Meihua, X. U., Zhang, Y. & Wang, G. (2012). Design of Intelligent Street Light Monitoring System Based on STM 32. *IEEE Symposium on Electrical and Electronics Engineering, 7(12): 87-104.*

Natu, O. & Chavan, S. A. (2013). GSM Based Smart Light Monitoring and Control System. *International Journal of Computational Sciences and Engineering, 4(7): 99-120.*

Otaru, O. & Haruna, H. O. (2022). Advances in the Usage of Search Engine Technology by University Students in Nigeria. *American Journal of IT and Applied Sciences Research,* 1(1): 1-12

Patil, G. S., Rudresh, S. M., Kallendrachari, K. M. & Kumar, K. (2015). Design and Implementation of Automatic Street Light Control using Sensors and Solar Panel. *International Journal of Engineering Research and Applications,* **5**(6): 34-45.

Prabu, P. & Rajendra, D. (2016). Internet of Things Based Intelligent Street lighting system for Smart City. *International Journal of Innovative Research in Science, Engineering, and Technology,* **5**(5): 56-67.

Rajput, K. Y. (2013). Intelligent Street Lighting System using GSM. *International Journal of Engineering Science Invention,* **2**(3): 150-168.

Rubananth, R. & Kavitha, T. (2012). GSM Based RFID Approach to Automated Street Lighting System. *Journal of Theoretical and Applied Information Technology,* **38**(2): 39-49.

Ruchitha, K. S., Agarwal, N., Anand, S., Das, A. & Rajasree P. M. (2016). Design and Development of Automatic Adjustment of Street Light Intensity. *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering,* **5**(4): 21-34.

Recommended Lighting Levels in Buildings, available at https://www.archtoolbox.com/materials-systems/electrical/recommended-lighting-levels-in-buildings.html

Ramli, N. L., Yamin, M. N., Ghani, S. A. B., Saad, N. M. & Sharif, S. A. (2015). Implementation of Passive Infrared Sensor in Street Lighting Automation System. *Asian Research Publishing Network (ARPN) Journal of Engineering and Applied Sciences,* **10**(22): 12-23.

Street L. D: Layout & Calculations, available at https://www.electrical4u.com/road-lighting-design/

Samir, A. & Mohamed, E. (2013). Smart Street Lighting Control and Monitoring System for Electrical Power Saving by VANET. *International Journal Communications, Networks and System sciences, 2(8): 55-66.*

Sumathi, V., Sandeep, K. A. & Kumar, T. B. (2013). Arm Based Street Lighting System with Fault Detection. *International Journal of Engineering and Technology,* 5(5): 100-121.

Saad, M., Farij, A., Salah, A. & Abdaljalil, A. (2020). Automatic Street Light Control System using Microcontroller. *"Journal of Mathematical Methods and optimization Techniques in Engineering, 1(4): 76-89.*

Salem, A. L., Sagar, R. R., Datta, N. S, Sachin, H. S. & Usha, M. S. (2015). Street Lighting Monitoring and Control System. *International Journal of Engineering and Techniques, 8(7): 120-134.*

Suganya, S., Sinduja, R., Sowmiya, T. & Senthil, K. S. (2014). Street Light Glow on Detecting Vehicle Movement using Sensor. *"International Journal for Advance Research in Engineering and Technology, 2(8): 160-170.*

Working-principle-of-solar-led-street-light-system.htm Ada Wang https://www.hepetech.com/new

Yasmin, F. & Sarkar, A. (2014). Automatic Light Control System using Microcontroller Based LDR. Daffodil International University Dhaka, Bangladesh.