BioGecko

Vol 12 Issue 03 2023
ISSN NO: 2230-5807

WIRELESS TECHNOLOGY-BASED SMART STREET LIGHT WITH INTELLIGENT ENERGY

Ramachandran.S[1], Rathinavel.S[1]Mohan Raaj.S[2],Muruga Permual.S[3],Madheswaran.S[4],Dharaneesh Kumar.R[5]

[1] Assistant Professor, Department of Electrical and Electronics Engineering, Paavai Engineering College,Namakkal.

[2]Student, Department of Electrical and Electronics Engineering, Paavai EngineeringCollege,Namakkal.

[3]Student, Department of Electrical and Electronics Engineering, Paavai EngineeringCollege,Namakkal.

[4]Student, Department of Electrical and Electronics Engineering, Paavai Engineering College,Namakkal.

[5]Student, Department of Electrical and Electronics Engineering, Paavai EngineeringCollege,Namakkal.

Abstract

This project's core goal is to increase consumption while decreasing energy loss. The abundant solar energy that is available throughout the day and is stored in solar cells powers street lights continuously throughout the night. Dust detection, lighting on/off, and battery level SMS messages. Also, the system provides a mode of operation that uses less energy by changing the automation method. Due to a dark sensor and a light sensor, street lights have automatic "ON"/"OFF" functionality that allows them to turn on when necessary (i.e., when the surrounding area is dark) and turn off automatically if there is enough light. A vibration sensor, also known as a vibration detector, is used to measure the vibration levels in machinery for screening and analysis.

Keywords: Smart energy, LSPA, Sensors

1.1INTRODUCTION

Global urbanization has led to advancements in digital technology and the creation of smart cities. The use of technology in lighting is one trend in the creation of smart cities. No matter how big or little, every town requires street lighting. Streetlights can lessen the risk of accidents occurrence and enlarge the welfare of both chauffeur and passerby by illuminating streets and public spaces at night. Recently, the use of light-emitting diode, bulbs in streetlights has significantly increased. detector, for inspection and evaluation. LED-based streetlight technology has a variety of benefits over conventional streetlight technologies including high-pressure sodium and low-pressure sodium) lights in terms of energy efficiency and optical luminosity. It is also environmentally friendly because it uses little electrical energy. It has a number of benefits due to its low electrical energy consumption, including uniform illumination levels offered by arrays of multiple LED chips, streetlight visibility provided by correlated color temperature, and increased visual performance provided by a high color rendering index.

1.2 INTELLIGENT STREETLIGHT

Even though we struggle to live in the "connected world" era, automated street lights are necessary. Efficiency and precision are guaranteed via automation. The essay focuses on automatic street lighting despite the fact that the current system has many shortcomings. Here, we're focusing on issues that necessitate manual lab ours. A user might run into troubles with maintenance, timers, connectivity, and displays, to name just a few.

Given that they ensure secure roadways, congenial common spaces, and in augmented ammunition in residences, trafficking, and city centers, streetlights are one of a city's strategic assets. However, they are often highly expensive to operate and, on average, use 40% of a city's electricity. As electricity prices rise and energy waste becomes a growing concern for the public and authorities, municipalities, highway companies, and other owners of streetlights must put control systems in place to dim the lights at the proper light level at the right time, automatically detect lamp and electrical failures, and enable real-time control.

By automatically timing and managing the street light switching, the automated system known as "Street Light Monitoring & Control" seeks to boost a particular industry's efficiency and accuracy. An innovative, cost-effective approach to street light control systems is presented in this research. When an object is present, a sensor-based system for controlling street light illumination turns on the lights at their

brightest setting; otherwise, they remain on at their low setting throughout the night. With the Internet of Things (IOT), real-time street processing updates are presented, and users are notified when changes are made.

Heat emissions, electricity use, maintenance expenses, and carbon dioxide emissions will all decrease as a result.

Three components make up the majority of the planned smart street lamp

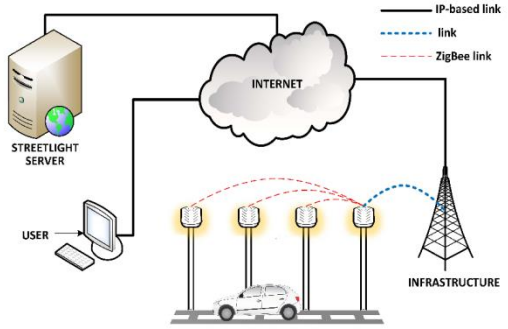
1) A flood lamp with intelligent sensors that permits brightness adjustment and automatically sounds an alarm in the event of unexpected behavior.
2) Real-time communication is possible through the network, which is efficient. Wi-Fi and 4G are utilized to connect servers to enormous street lamps, while NB-IoT is used to connect servers to administrators.
3) The adaptable stewardship manifesto allows for resource scheduling optimization for straightforward and highly automated management.

2. INTELLIGENT SENSING STREET LAMP

To provide smart sensing street lighting, the flood lamp is fitted with a number of sensors, including a position sensor, an infrared sensor, and a luminescence sensor. As a result, flood luminescence's can be adjusted for brightness. These sensors allow the flood lamp to connect to the server over the network. This article regularly reports on the voltage and current levels sent by the street lamp. The drudge can assess the state of the flood lamp using the current and voltage data. If the exact flowing through the street lamp is zero but the voltage is not, the server can infer that the lightbulb might be broken. The server can determine if a flood lamp is on or off thanks to position sensors in the lamp. As a result, the street lamp can still be located even if it vanishes. Also, if a server observes that a street lamp's light bulbs require replacement, the server can inform the serviceman of its precise location so that he can fix it. This increases efficiency.

2.1 EFFICIENT NETWORK

Among those in use right now UMTS/LTE, GSM, 4G, Wi-Fi, Bluetooth, ZigBee, LPWA, and other network technologies. The SSL employs big data analysis to address this lag. The street lighting provides the server with information about the brightness of the surroundings on a regular basis. Finding the correlation between each street lamp's brightness and the season is simple with the help of this knowledge and big data analytics techniques. The link between the brightness of the environment and the positioning, hour of the day, and season of two street lighting is shown in Fig. 4. The SSL may decide the priority for each street lamp based on that relationship. As the surroundings grow darker, the priority will rise. Also, as the command is given out more swiftly, the significance of the street lamp grows.



2.2 SYSTEM REQUIREMENTS

- NodeMCU – ESP8266
- LED Driver Circuit and LED
- LCD display
- Power supply

- PC
- Webcam

2.3SOFTWARE REQUIREMENTS

- Arduino IDE (Embedded C Program)
- Python IDE (Deep Learning – Object Detection)

3. EXISTING LAMP

ZigBee, LPWA, GSM, and a number of other automations have been suggested for intelligent street lighting. There are other connectivity choices, such as Wi-Fi, Bluetooth, and UMTS/LTE. These communication techniques all have something unique about them.

A form of radio-communication for wide-area networks is the Low-Power Wide-Area Network or Low-Power Wide-Area Wireless. The low transmission rate required for long-distance communication, ranging from 0.3 kbps to 50 kbps per channel, is met by the LPWA. The LPWAN, which offers an affordable and dependable solution for communication between embedded devices, has the potential to revolutionize the Internet of Things. One of the most widely used LPWAN technologies is LoRa WAN.

A Lora WAN gateway must be appropriately sized to meet the needs of each use case, with a range of tens of kilometers and the capacity to handle heaps of end ploys. Whether LoRa WAN access based on ALOHA and the strictest duty cycle control are appropriate for each use case depends on the number of end devices, chosen SFs, and channel count. Modern Lora WAN technology does not provide real-time operation or deterministic monitoring.

The third-generation mobile cellular system built on the GSM standard is known as the Universal Mobile Telecommunications System (UMTS) (UMTS). UMTS, a part of the International Telecommunication Union's IMT-2000 standard framework, was created and is maintained by the Third Generation Partnership Project (3GPP). Moreover, the standard sets for networks built on the rival CDMA One technology are UMTS and CDMA2000. In the vast majority of Asia and Europe, the UMTS operates at 2100 MHz (downlink: 2100 MHz, uplink: 1900 MHz).

It is now also accepted throughout North America. While 2G (PCS) services run at a frequency of 1900 MHz, satellite communications operate at 2100 MHz The authorities have made a number of frequency regions around 1700 MHz and 2100 MHz available for 3G's uplink and downlink, respectively. UMTS has both a large coverage area and a fast transmission rate. The high coverage area and average transmission rate of GSM, however, make up for it.

On the other hand, Bluetooth and ZigBee are built on the IEEE 802.15.1 and 802.15.4 standards, respectively. For short-range communication, these two wireless connections protocol standards are used. For instance. While Bluetooth is designed for a cordless mouse, keyboard, and hands-free headset, ZigBee is developed for dependable wirelessly networked monitoring and control systems. The main differences between Bluetooth and ZigBee are their constrained ranges and slow transmission speeds.

Broadly speaking, wireless broadband uses the standard, also referred to as the Wi-Fi (Wireless Fidelity) standard. Wi-Fi is frequently referred to as a wireless industry standard for network communication. A 2.4 GHz operational frequency and a maximum 11 Mbps transmission rate, which as expansion. Thanks to a technology known as Wi-Fi, mobile phones, tablets, computers, and other terminals may interact wirelessly. Wi-Fi promotes interoperability because so many network systems follow the IEEE 802.1 standard. Wi-Primary Fi has quick coverage and transfer times as advantages.

• A single platform was usually chosen over illumination for smart LED streetlight systems based on associated color temperature in earlier research.

• Most of the LED streetlight control systems now in use do not take traffic events into account

by utilizing weather information like fog or pollution.

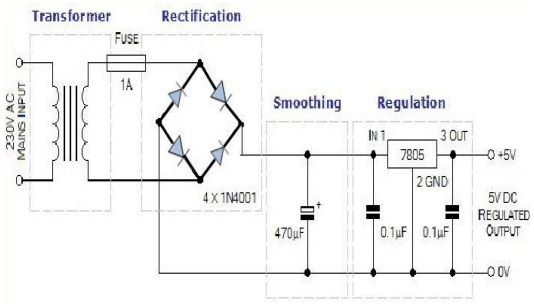
• Digital addressable lighting (DALI) streetlight control systems are largely concerned with using the DALI protocol to control LED streetlights. The DALI protocol is one of the most well-liked ways to control LED lights, as is well recognized.

4. HARDWARE AND SOFTWARE USED

4.1 *Power Supply*

A power supply of the device, which can deliver electrical and other types of energy to a group of loads to an output load, is also referred to as a power supply unit. It is primarily used in conjunction with electrical energy sources and is rarely used in the mechanical and other energy domains.

A straightforward +5V supply, such as the one in this design, is useful for testing digital circuitry. Any big-box retailer or electronics store will have small, affordably priced wall transformers with variable output voltage. These transformers are widely accessible; however, they usually exhibit poor voltage regulation, making them useless for experimenters with digital circuits unless a stronger regulation can be produced in some manner. the circuit's next question is answered.



4.2*Transformer*

A transformer is an electrical device that used inductively coupled wires to move electrical energy from one circuit to another. A shifting magnetic field produced by a fluctuating current in the main circuit induces a fluctuating voltage in the secondary circuit (the secondary). Energy can be moved from one circuit to another by placing a load on the transformer's secondary circuit and pushing current to flow through it. By scaling the primary induced voltage VP by an amount that is ideally equal to the ratio of the number of wires turns in each winding, the secondary induced voltage is created.

$$\frac{Vs}{Vp} = \frac{Ns}{Np} \longrightarrow (1)$$

A transformer can step up or step down an alternating voltage by selecting the appropriate number of turns and making sure that NS is greater than NP.

Transformers are frequently used to lower the current before sending electrical energy over long distances with wires. Most cables have resistance loss, which is a loss of electrical energy proportional to the square of the current they are carrying.

Electrical power can be efficiently delivered over long distances by being transformed from a low-current to a high-voltage form using transformers. As a result, transformers have had an impact on the power supply sector by enabling generating to be located far from demand centers. By the time it gets to the customer, the majority of the electrical power in the world has already been through many transformers.

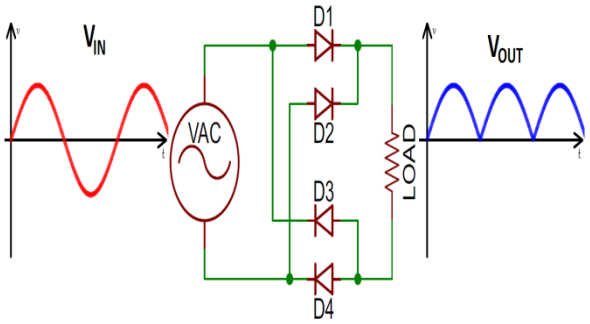
One of the most effective electrical "machines" is a transformer, which can transport 99.75% of the power from its input to its output in certain gigantic quantities. Transformers are available in a wide range of dimensions and configurations, from tiny coupling transformers used to connect individual national power grids to enormous gigavolt-ampere-rated transformers used to connect whole national power grids.

4.3 *Rectifier*

Direct current, which only flows in one direction, is created by converting alternating current, which systematically transpose direction, by the use of an electrical component known as a rectifier. Correction is the name given to the action. Rectifiers are used to detect radio waves and in power supplies. Bridge, full wave, and half wave rectifiers are the three basic types of rectifiers.

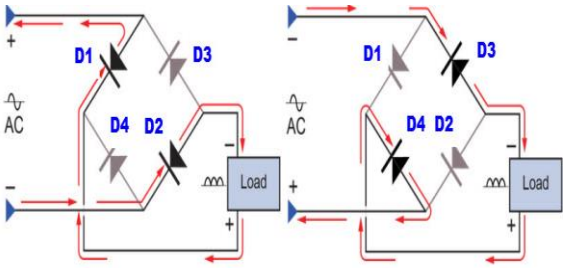
4.4*Reconverter bridge*

A diode bridge is also referred to as a bridge when it is used primarily in classic applications and involves tuning alternating current input into direct current output. A bridge is a circuit configuration made up of four or more semiconductor units that produces the same divergence of output for either divergence of input. compared to a therapy using a cable input from a center-drained piece of equipment. Full-wave rectifier is produced from a two-line AC input using a secondary coil and a bridge rectifier, which results in less cost and weight. The important feature of a graetz-bridge is that the output divergence remained constant despite the input divergence.



4.5*Simple operation*

Coinciding to the traditional theory of new run, when current travels via electrical maestro from the constructive to the pessimistic pole, it is said to be positive current. Free electrons almost usually move from the pessimistic to the constructive pole of a conductor. Yet, in the vast majority of applications, the present flow superintendence is meaningless. The conventional model is used in the discussion that follows because of this.



Positive half cycle Negative half cycle

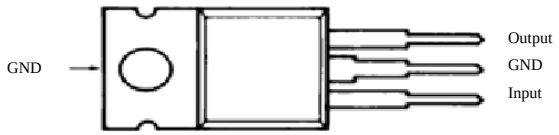
4.6 *IC Voltage Regulators*

The voltage regulator is a commonly used IC type. Regulator IC components incorporate a single circuit that includes the components for a reference source, comparator amplifier, control device, and overload protection integrated circuit. While having a different internal structure, the IC operates in a manner that is relatively comparable to discrete voltage regulator circuits from the outside. IC devices can regulate a set voltage that is either fixed positive, fixed negative, or changeable. In order to rectify the voltage of the alternating current, filter the voltage the alternating current supply line can be connected to a transformer The regulators can be set up to work with load currents ranging from

hundreds of milliamperes to tens of watts and amperes, if necessary, and power ratings ranging from milliwatts to tens of watts and amperes.

By this metallic shaft, the dynamo obtains mechanical energy from the motor. Similar to this is the mechanism used in automobiles to transfer mechanical energy by coupling the transmission shaft of the motor to the dynamo. With the dynamo's mechanism, the mechanical power is converted to electrical power. The dynamo's electrical output is transferred to the battery storage device a dc-dc buck-boost companion and a battery charge controller the Buck-Boost companion is used to provide a constant input voltage to the cell, regardless of whether the dynamo's output is higher or lower than that of the battery.

4.7 *Three-Terminal Voltage Regulators*



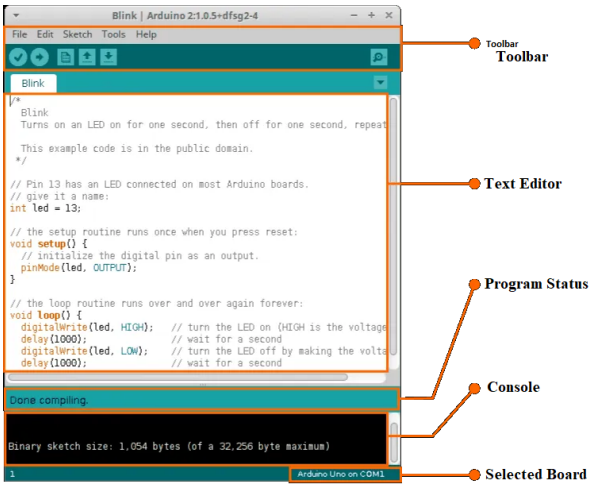
Top view

The established voltage regulator uses a three ratai integrated regulators connection to transfer unbounded dc input voltage to one input incurable, regulated dc output voltage to a second incurable, and ground is secured to a third incurable. According to the IC device requirements for the selected regulator, the input voltage may fluctuate within a defined range in order to manage a organized output voltage throughout a dimension of load currents. And the requirements of specify degree of output voltage sag that may occur as a result of variations in input voltage or load current (line regulation). Between 5 and 24 V are produced by the series 78 regulators as set, controlled voltages. Figure displays a single instance of an integrated. Figure demonstrates the wiring for a 7805 integrated circuit, which generates a +5V dc output and is used to regulate voltage.

5. SOFTWARE DISCRIPTION

5.1 *Arduino Software*

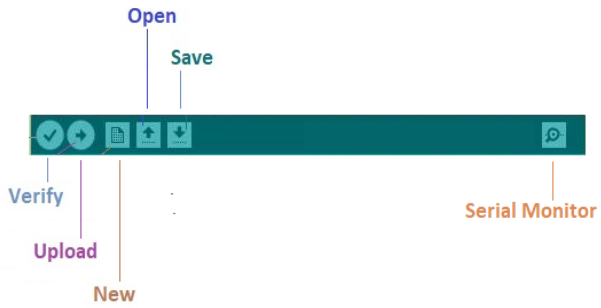
There is also the Eclipse Arduino IDE, which has a text editor, a pillar box, a content console, a sidebar with buttons for sporadic use of effort, and a variety of food. It connects to the Arduino hardware in order to broadcast and distribute applications.



5.2 *Delineation*

At delineation are programmes when using the software is used in the system. The text mate was use at create this graphics, and the files were saved as. in. Together with copying and pasting, the editor provides features for finding and replacing text. The message area reveals issues and offers feedback when saving and exporting. The terminal displays text that was produced by the Arduino Software (IDE),

together with additional data and comprehensive error warnings. The configured board and serial port are visible in the support at corner of this aperture. Use the sidebar buttons to create, open and save delineation, launch the serial monitor, evaluate programmes, and submit them.



- **Authenticate** checks your code for assortment issues.
- **Upload** Uploads your code after it has been compiled to the set-up board. See uploading below for details. To use this icon while using an external programmer with your board, hold down the "shift" key on your computer. The phrase "using a programmer to upload" will be used instead.
- **New** does a fresh delineation.
- **Open** Displays a menu of every drawing in your sketchbook.
- Open in the current aperture after being clicked, displacing its content. **Save** your drawing as a file.
- With **Serial Monitor**, you can start the serial monitor.

More commands are available in the Document case, Adapt, Delineation, Contrivance, and Help menus as the menus are context aware, only items that are applicable to the current task are available.

6.REAL TIME SURVEY

TIME	ILLUMINATION (Sun Light)	INPUT VOLTAGE	OUTPUT VOLTAGE
10:00AM	63	12.5V	4.3V
12:00PM	91	17.8V	4.7V
01:00PM	94	18.3V	5V
03:00PM	85	17V	5.2V
05:00PM	43	7.3V	5V

7. UNIQUENESS

This project's core goal is to increase consumption while decreasing energy loss. The abundant solar energy that is available throughout the day and is stored in solar cells powers street lights continuously throughout the night. Dust detection, lighting on/off, and battery level SMS messages. Also, the system provides a mode of operation that uses less energy by changing the automation method. Due to a dark sensor and a light sensor, street lights have automatic "ON"/"OFF" functionality that allows them to turn on when necessary (i.e., when the surrounding area is dark) and turn off automatically if there is enough light. A vibration sensor, also known as a vibration detector, is used to measure the vibration levels in machinery for screening and analysis.

The goal of this project is to identify the flaws—such as overload, battery failure, battery not charging, and lamp asymmetrythat may have an impact on the entire system of solar street lights and to notify the user of these occurrences via SMS notifications. Electrical system defect detection is crucial

for the longevity and proper operation of machinery and electronic devices.

It is a more advanced, self-contained smart solar street light that enables us to monitor several operations through email and an app. It is frequently employed in remote locations, such as mountain stations, rural settlements, and metropolitan areas. Using sensors like a vibration sensor, MEMS sensor, and dust sensor, LORA serves as the communication link between our gadgets. Consumers are encouraged to make use of affordable, green systems.

Fig. Smart Street Light

8. CONCLUSION

This recommendation offers an effluvium-running lamp standard. A rapid on the uptake sensor lamp standard street light luminance can be accommodated, and a self-governing alarm advise of an abnormal lamp can trigger an effective web work concurrent connection. IoT is used to connect workers to massive street lamps, and internet-connected devices like Wi-Fi and 4G are used to communicate between workers and nodes. A flexible regulation platform, management platform, and asset organization can improve resources and organize for smooth and highly automated street lamp system supervision. SSL was tested using a prototype module, and the outcomes demonstrated exceptional effectiveness. the time between a malfunctioning lamp and the regular maintenance window the server verified when state appeared. Also, by minimizing useless routine inspections, the suggested SSL can save human resources.

REFERENCES

[1] C. Atıcı, T. Özçelebi, JJ. Lukkien, “Exploring User-Centered Intelligent Road Lighting Design: A Road Map and Future Research Directions,” IEEE Transactions on Consumer Electronics, vo. 57, pp. 788-793, 2011.

[2] MS, Pan, LW, Yeh, YA Chen, YH Lin, YC Tseng, “A WSN-based intelligent light control system considering user activities and profiles,’ IEEE Sensor Journal, vol. 8, pp. 1710–1721, 2008.

[3] S. Li, A. Pandharipande, “Networked Illumination Control with Distributed Light-Harvesting Wireless Sensors,’ IEEE Sensor Journal, vol. 15, no. 3, pp. 1662-1669, 2015.

[4] Z. Kaleem, I. Ahmad and C. Lee, "Smart and Energy Efficient LED Street Light Control System Using ZigBee Network," 2014 12thInternational Conference on Frontiers of Information Technology, Islamabad, 2014, pp. 361-365.

[5] F. Leccese, M. Cagnetti, and D. Trinca, “A Smart City Application: A Fully Controlled Street Lighting Isle Based on Raspberry-Pi Card, a ZigBee Sensor Network and WiMAX,” Sensors,vol. 14, pp. 24408-24424, 2014.

[6] P. Mlynek, J. Misurec, J. Kolka, Z. Slacik, and R. Fujdiak, “Narrowband Power Line Communication for Smart Metering and Street Lighting Control,” IFAC-PapersOnLine, 2015, vol. 48, pp. 215–219.

[7] A. Ozadovics and J. Grela, “Energy saving in the street lighting control system—a new approach based on the EN-15232 standard,” EnergyEfficiency, DOI: 10.1007/s12053-016-9476-1, 2016.