A Review Study of IntelligentStreet Light System

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ABSTRACT: In India, energy usage plays a significant role in everyday life. As a result, if road traffic is light, a large portion of the electrical energy consumed by street lights is lost needlessly. Traditional street lighting systems turn on and off for a predetermined period of time. A lot of energy may be saved if smart street lighting are designed and installed in cities. The use of LED lights instead of conventional street lamps lowers pollution and increases the life of the lamps. LED lights offer a greater luminous efficacy and colour rendering index. The system has been updated so that it will automatically switch off during the day and only function at night. After midnight, the system automatically lowers the intensity of the light, but if a vehicle drives by, the appropriate set of lights will switch on at full intensity.

KEYWORDS: Arduino Board, Energy, LED Lamps, Vehicle Detection Sensor, Light Dependent Resistor (LDR).

INTRODUCTION

Environmental problems have gotten a lot of attention in recent years on a global scale. As a result, conserving energy for illumination in large-scale operations such as street lighting is becoming more important. In cities, street lights are the largest energy consumer, and a smart street light system based on LED bulbs may help. Previously, street lights were manually controlled by placing a control switch in each street light [1]–[3].

In both the global economy and everyday life, automation plays a critical role. Manual systems are favored over automatic ones. When no movement is detected, intelligent street lighting stays low, but when movement is detected, it becomes bright. Because it consumes the most energy in a city, the street lighting system plays an essential role in the global economy. The cost of street lighting may be reduced by 50-70 percent by adopting an intelligent street lighting system. It changes the light output in response to the movement of road users such as pedestrians, cyclists, and automobiles.

The light pole is fitted with a street lighting system that includes an AVR microcontroller, as well as numerous sensors and wireless modules. To monitor the system, data from the street light may be sent through Bluetooth to a remote user. The LDR sensors detect the day and night modes, while the ultrasonic sensor detects the item under the light and counts the cars passing under the street pole. Solar panels are being installed to provide electricity. If the solar panels are unable to transfer current, a backup DC current will keep the situation stable. Another interesting aspect of this study is the use of a current sensor to detect faults. When the Pole is damaged, it sends a notice to the remote user. Smart lighting aids cities in decreasing energy usage, expenses, and maintenance, all while better serving people and lowering CO2 emissions. By combining automation and networked control, you may save even more energy and money on maintenance. Created on a quantifiable basis, networked street lighting can reduce crime by 10% and make roads safer.

The recommended remedy was to replace inefficient incandescent bulbs with energy-efficient LED lights, which may save up to 80% on energy costs. The intelligent street light can detect both sunlight and vehicles and change the intensity of the LED street lights accordingly. HID Lamps are used as light sources for lighting. The amount of CO_2 produced by HID lamps has risen. To decrease the amount of energy used by street lights, the best choice is to control the intensity of light. Day and night detection will be available at first. Light Dependent Resistor worldwide issues are used to find it. As a result, LED array lighting has gotten a lot of attention as an energy-saving light source. When compared to HID lamps, LED lights consume around one-third to one-half the amount of electricity[4]–[7].

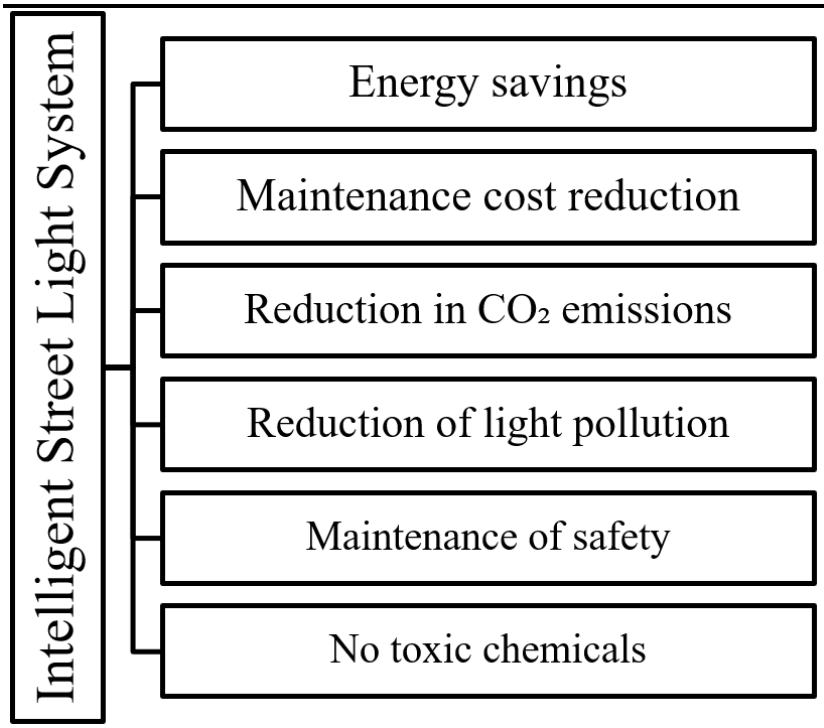

Figure 1: Illustrating the Various advantages Associated with Intelligent Street Light System

Some of the advantages of this system are illustrated in Figure 1.

- Electricity savings: This kind of equipment preserves energy by dimming the lights at night when there is less activity.

- Lower maintenance expenses: Servicing rates are cheaper since the lights last longer before needing to be changed.

- CO_2 emissions decrease: The reduction in energy consumption results in a reduction in CO_2 emissions.

- Minimized light pollution: Light pollution is decreased since the intensity of street lamps changes with traffic movement.

- Safety is preserved: The safety is preserved since the lights are reduced, rather than fully shut out. When a vehicle approaches from afar, it is visible from afar, which intensifies the lights.

- The light bulb does not contain any hazardous substances (e.g., mercury).

LED lighting has recently begun to take the place of previously used light sources such as HID lights. As a consequence of such a system, energy-efficient technology is developed, resulting in lower energy usage and carbon footprints. This technique may be utilised in any location where timely management is required, such as highways, stations, schools, and the energy industry. Furthermore, the system includes a temperature and humidity sensor that will monitor not just the streetlight but also climatic change and display it on an LCD.

The goal of efficient energy use, or simply energy efficiency, is to reduce the amount of energy required to provide products and services. Energy efficiency and renewable energy are the two cornerstones of a sustainable energy strategy, and they have gotten a lot of investment in recent years. In many countries, energy efficiency is regarded as a national security benefit since it may be used to reduce the quantity of energy imported from other countries while also delaying the depletion of domestic energy resources. The US Department of Energy funds research and development to develop energy-efficient and renewable-energy technologies, best practises, and products for commercial and residential buildings [8].

Street lights are necessary for our survival since they illuminate our path in the dark. They make the world a better and safer place. It's past time to switch to more energy-efficient renewable energy sources now that fossil fuels are running short. Using non-conventional energy sources for street lighting is also a practical solution to the global energy crisis. In today's energy-scarce climate, the need for street light automation is

inevitable. Due to human error, street lights are not switched off throughout the day. Street lights, according to research, account for 18-38 percent of total energy costs; therefore, if we are concerned about energy conservation, street lights are one of the most important areas to investigate. LED lighting may save up to 60% on electricity when HID lights are replaced. We must automate our street lights and power them with solar panels in order to maximise our energy-saving performance. Furthermore, most accidents are seen via the lens of a street light. According to the World Health Organization's Global Status Report on Road Safety, about 130,000 people die in India each year as a result of traffic accidents. Failure to help the injured person accounts for more than 40% of their deaths. As a consequence, street lights may be used to identify an accident's exact site. As a consequence, people may get timely medical attention, which may help reduce the number of people died in road accidents as a result of negligence [8], [9].

LITERATURE REVIEW

Smart Streetlights are capable of working independently while being overseen from afar. These two capabilities may significantly enhance the overall efficiency of lighting systems, both in terms of energy use and maintenance costs. Climate factors may influence its behaviour. Only the smallest number of streetlamps would be equipped with sensors and long-range specialist devices in this framework. The rest of the device was supposed to set up a lattice network connecting streetlamps in the same topographical or electrical region. Sundown limit light force, passerby stream, daylight, and climatic conditions are the five information limits suggested in the framework. The combination of cutting-edge distant correspondences, detection, and metering limitations in a one-of-a-kind infrastructure will contribute to the future of savvy urban planning [10].

The most efficient strategy to reduce the amount of energy used by street lights is to regulate the intensity of the light. Detection will be accessible both during the day and at night initially. It's detected via a Light Dependent Resistor (LDR), which detects darkness when sunshine intensity drops, raising the LDR's resistance until it hits a threshold level, at which time Arduino recognises night mode. Because traffic density is highest during peak hours (6 p.m. to 12 p.m.), LED lights will be switched on at full power (100 percent). Intensity Control in advance street lighting is a function that allows you to control how bright your lights are. There will be a waste of energy if the lights are kept on beyond midnight since traffic density will have decreased. We're progressively reducing the intensity to solve this issue. Pulse Width Modulation (PWM) is used for this, allowing us to adjust the duty cycle intensity of the light. In fact, when the duty cycle drops, so does the light intensity. A certain percentage of the duty cycle will be decreased. When the LDR detects Daylight after the dawn threshold has been reached, the lights will automatically turn off. When a vehicle passes through the system's motion detection sensor at night, the particular set of lights will glow brightly, and when it passes through the next sensor, the previous lamps will return to normal functioning. This process will be repeated until the vehicle has crossed the street [11], [12].

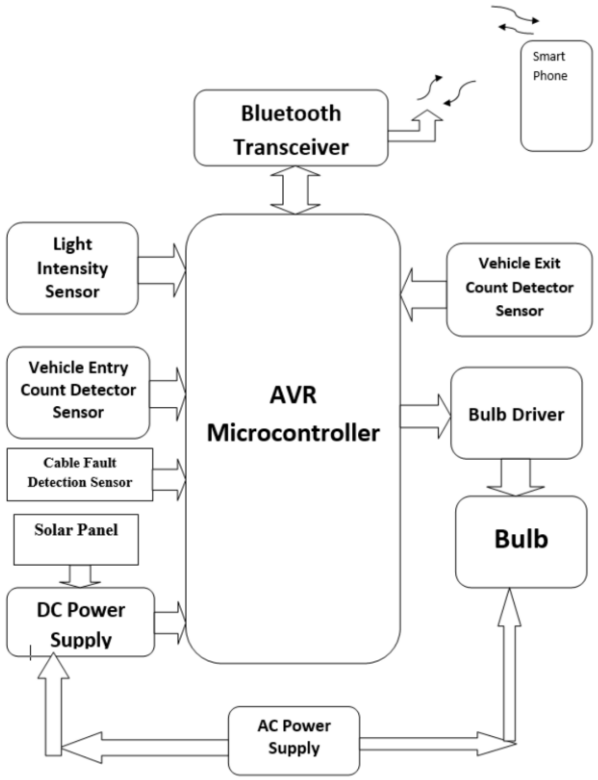

Figure 2: Illustrating the Proposed system of Intelligent Street Light System

The authors suggested a system for the Intelligent Street Light System as shown in Figure 2.

The AVR (Audio or Video Receiver) microcontroller is an 8-bit device that belongs to the Reduced Instruction Set Computer (RISC) family (RISC). In RISC, the computer's instruction set is processed in a way that is not only limited in quantity, but also simpler and quicker when compared to other microcontrollers.

LDR (Light Intensity Sensor): LDRs (light dependent resistors, also known as photo resistors) are electrical components that detect sunlight and alter the functioning of a system circuit based on the light levels. This LDR, also known as a photo resistor, is widely used in electrical components that need light sensing.

Ultrasonic Transducers: An ultrasonic transducer is a device that converts energy into ultrasonic energy. There are three types of ultrasonic transducers. Transceivers, receivers, and transmitters are all types of radio equipment. These three types of ultrasounds are used to convert electrical signals into ultrasounds, ultrasounds into electrical signals, and both receive and send ultrasounds.

Bluetooth: Bluetooth is a wireless device technology that is used to transmit data over short distances between smart phones and to create personal area networks (PAN s).

Relay or Bulb Driver: A relay is an electromagnetic switch that operates at l2 volts and draws a minimum of I amps of current. In this article, we utilized an SPDT relay switch with a voltage of 2 volts and a current of 5 amps to regulate the bulb (on/off based on light intensity and vehicle movement).

Cable Problem Detection: This system operates on the concept of open and closed logic to identify any fault in a street lighting pole.

Solar Panels: Solar panels are often referred to as photovoltaic (PV) modules since they utilize sunlight as a source of energy and produce DC electricity. Solar energy may be used to power electrical devices.

DISCUSSION

The use of a street light automation controller may assist with energy conservation and management. It has a lower maintenance cost. Because the lights fade at night when there is less activity, the amount of energy consumed and the cost of street lighting has decreased. Because street lights do not beam at maximum

brightness and have greater precision, light pollution is minimised. Because the lights are muted rather than shut out entirely, safety is preserved. Installation and expansion are simple: By defining the parameters, each device may be joined to the network one at a time.

The system is distributed and self-contained. The use of a host computer is not required. Because just mass-produced components are used in this sophisticated street light system, it is less expensive. It's been Update the firmware with ease: The firmware of each device may be easily updated. Control algorithms should be developed for situations such as a calm residential neighbourhood, a shopping street, a part, a main route, and a mountain road. In the instance of self-diagnosis in a street light, the worst-case situation is that the light does not come on when a person approaches. Each unit keeps note of failures when motion is sensed in front of it without the other units being notified. The smart street lighting system not only saves energy and money, but it also helps the government cut down on losses from major accidents that occur in flame storms. When there is no car in the area, the street lights automatically switch off during the day and dim at night. An automatic fault detection sensor is included into the advanced street light, which detects broken street lights and sends them to authorities through a GSM/GPRS module.

CONCLUSION

In cities, street lights are the largest energy user, accounting for up to 50% of total energy consumption. As a result, if intelligent street lighting is planned and implemented in cities, a significant amount of energy may be saved. According to the study, the intelligent street light can identify cars and adjust the intensity of the street light based on traffic flow by utilizing LED lights. It can also assist in the monitoring and management of street lighting systems as well as the identification of lamp faults using wireless technology. The system is adaptable, expandable, and completely customizable to the requirements of the user.

Because the system solution is naturally scalable, it may be quickly extended to accommodate any particular expansions that may be developed in response to the requirements and needs set out by public authorities. In addition, by properly adjusting the intensity of light, we may save a considerable amount of energy. Because LED lights do not pollute the environment and have a long lifetime, they are easy to use. Overall, this system is extremely beneficial. Because it consumes less power than a conventional system, this kind of system will provide a long-term return.

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