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IoT Based Energy Efficient Smart Street Lighting Technique with Air Quality Monitoring for Smart City Application

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ABSTRACT: Today with the advancement of technology, concept of smart cities. The rapid industrialization, fast urbanization, rapid growth in population, drastic increase in traffic on roads and other anthropogenic activities have affected air quality, causing health hazards and other problems. Similarly, street lighting systems are modernizing due to fast-growing urbanization and development of cities. Normally, conventional streetlights like high-pressure sodium (HPS) lamps, once turned ON, tend to remain ON without any intensity change until any power switch turns them OFF. This results in increased power consumption, more manpower and maintenance requirement of system. In addition, people often complain about either the non-functionality of some streetlights or the unnecessary glowing of the streetlights in daytime. So to rectify these problems SSLS with light emitting diodes (LEDs) as streetlights is presented which improves overall system's reliability, reduces maintenance problems and provides real time monitoring of air quality thus enabling authorities to take suitable actions when air quality index exceeds safe limits. Besides the lifetime of the streetlights also gets enhanced because the lights do not have to stay at 100% intensity the whole night

KEYWORDS: piezoelectricity, solar energy, IoT, HPS, Energy efficient

I. INTRODUCTION

Traffic and power generation are the main sources of urban air pollution. The idea that outdoor air pollution can cause exacerbations of pre-existing asthma is supported by an evidence base that has been accumulating for several decades, with several studies suggesting a contribution to new-onset asthma as well. In this Series paper, we discuss the effects of particulate matter (PM), gaseous pollutants (ozone, nitrogen dioxide, and sulphur dioxide), and mixed traffic-related air pollution. We focus on clinical studies, both epidemiological and experimental, published in the previous 5 years. From a mechanistic perspective, air pollutants probably cause oxidative injury to the airways, leading to inflammation, remodeling, and increased risk of sensation. Although several pollutants have been linked to new-onset asthma, the strength of the evidence is variable. We also discuss clinical implications, policy issues, and research gaps relevant to air pollution and asthma.

1.1 PROBLEM STATEMENT

- The major one among this one is wastage of electricity. 19% of energy use in the world is used for lighting
- The energy usage for lighting is wasted by not switching of the lights after usage.

1.2 OBJECTIVE

Our project's primary goal is to automate the ON/OFF switching of street lights according to the amount of light present in the surrounding environment. The IR sensor, which detects movement from moving people or cars, helps with this. The lights will turn on if there are any obstructions detected by the IR sensor. The lights will automatically turn off if the sensor detects no impediments. To differentiate between day and night so that light intensity may be changed in response to outside brightness, LDR circuits are utilized. These intelligent street lights are equipped with sensors that detect and quantify the level of pollution.

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Other uses for the gathered data include route planning and the creation of pollution maps. The three primary factors in today's field technologies are cost-effectiveness, power consumption, and automation. The goal of automation is to use intelligent technology to decrease the need for human labor.

1.3 SCOPE AND STUDY

Scope:

Energy efficiency is the application of Internet of Things (IoT) sensors and controllers to modify lighting levels in response to current circumstances, such as traffic volume, pedestrian activity, and ambient light levels, which results in lower energy usage.
Enabling street light remote monitoring and control would enable authorities to plan maintenance, identify problems, and change illumination parameters all from a single dashboard.
Data analytics: Applying information from Internet of Things sensors to energy usage analysis, predictive maintenance, and scheduling lights based on past trends

Study Focus:

Technical Feasibility: Examining if integrating IoT sensors and controls into the current street lighting infrastructure is technically feasible, taking into account compatibility issues with various lighting technology and communication protocols.
Economic Viability: Calculating the return on investment (ROI) of implementing Internet of Things (IoT)-based energy-efficient street lighting systems by doing a cost-benefit analysis and taking into account initial installation costs, continuing maintenance costs, and long-term energy savings

II. COMPONENTS AND SPECIFICATIONS:

2.1 HARDWARE REQUIREMENTS

- Arduino Uno
- Node MCU
- Gas sensor
- LDR Sensor
- IR Sensor
- Current sensor
- Voltage sensor
- LCD Display
- Exhaust fan
- LED Lights
- GPS
- Solar panel & piezoelectric sensor

2.2 SOFTWARE REQUIREMENTS

- Arduino IDE
- Embedded c Programming language

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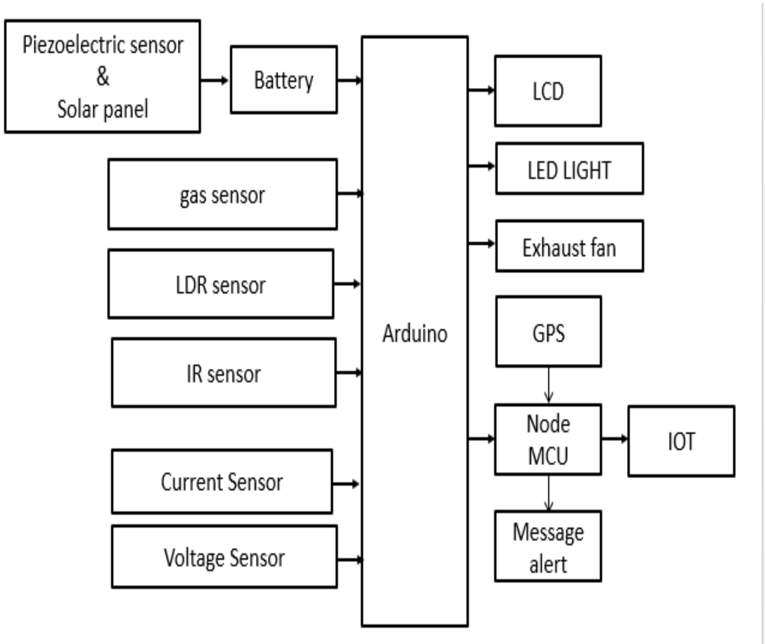
2.3 BLOCK DIAGRAM



2.4 WORKING

In modern urban environments, the integration of IoT sensors into street lighting systems represents a significant advancement in efficiency, sustainability, and overall functionality. Sensor integration is a pivotal component of smart street lighting solutions, enabling enhanced monitoring, control, and optimization of lighting infrastructure. One of the key aspects of sensor integration is the deployment of various types of IoT sensors, including motion sensors, ambient light sensors, and weather sensors, onto streetlights. These sensors serve multiple purposes, such as detecting movement, measuring ambient light levels, and monitoring environmental conditions such as temperature, humidity, and air quality. By capturing real-time data on these parameters, street lighting systems can adapt dynamically to changing conditions, improving both energy efficiency and user experience.

Remote monitoring and control capabilities are another critical feature facilitated by sensor integration. Streetlights equipped with IoT sensors are connected to a central control system via wireless or wired networks, enabling remote access to individual lights or groups of lights. This centralized control allows authorities to monitor the operational status of streetlights in real-time, adjust lighting levels as needed, and even schedule automated lighting sequences based on predetermined criteria.

The abundance of data gathered by Internet of Things sensors may be transformed into useful insights with the help of data analytics. City authorities can discover defects or inefficiencies within the street lighting network, manage lighting schedules, and identify consumption trends by doing real-time or retrospective data analysis. Data analytics algorithms, for instance, may evaluate patterns of traffic from vehicles or pedestrians and modify lighting settings appropriately, saving energy and guaranteeing sufficient illumination for security and safety.

Energy optimization is a key objective of sensor-integrated street lighting systems. By leveraging data from IoT sensors to dynamically adjust lighting levels based on factors such as pedestrian or vehicle traffic, weather conditions, and time of day, energy consumption can be optimized to minimize waste without compromising safety or visibility. For instance, streetlights can dim during periods of low activity or brighten in response to increased foot traffic, resulting in significant energy savings over time.

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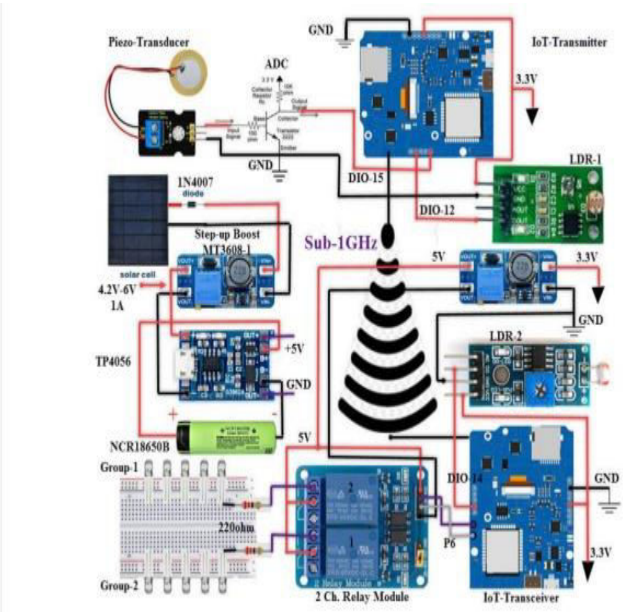
Predictive maintenance is an additional benefit enabled by IoT-enabled street lighting systems. By continuously monitoring the performance of individual lights and analyzing sensor data for anomalies, predictive maintenance algorithms can anticipate maintenance needs before they escalate into critical failures. This proactive approach to maintenance helps to reduce downtime, extend the lifespan of street lighting infrastructure, and optimize maintenance resources effectively.

2.5 CIRCUIT DIAGRAM



III. RESULT AND DISCUSSIONS

To enhance air quality, a method for monitoring ambient air quality utilizing an Arduino microcontroller and Internet of Things technology is suggested. The process of monitoring different environmental factors, like the air quality monitoring issue raised in this study, is improved by the usage of IOT technology. Here, the Arduino is the brains behind the project, while the MQ135 and MQ6 gas sensors provide the sense of several types of hazardous gas. which oversee the entire procedure. The procedure is connected to the internet for the visual output using a Wi-Fi module. The Arduino system, which is used for Internet of Things-based pollution monitoring and control, has sensors for radiation, temperature, and smoke. Should any pollution be found, that industry's power supply will be turned off.

IV. CONCLUSION

The charge controller contains a Wi-Fi module for data storage on the Thingspeak cloud, as well as a battery management system. Thingspeak Cloud is an open-source program used to analyze uploaded data graphicalmatically. The sensors are used to detect day and night, turn on and off or dim streetlights, and keep an eye on the surrounding temperature and humidity levels.

Because the sensors utilized are affordable, low input voltage, and provide precise readings, this increases the system's reliability.
The charge controller integrates a Wi-Fi module for seamless data storage on the Thingspeak cloud and includes a battery management system. The Thingspeak Cloud platform enables graphical analysis of uploaded data. Affordable, low-input voltage sensors detect day and night, control streetlights, and monitor temperature and humidity levels. Their precision enhances system reliability.

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REFERENCES

[1] G. Shahzad, H. Yang, A. W. Ahmad, and C. Lee, "Energy-efficient intelligent street lighting system using traffic-adaptive control," IEEE Sensors Journal, vol. 16, no. 13, pp. 5397-5405, 2016.

[2] P. T. Daely, H. T. Reda, G. B. Satrya, J. W. Kim, and S. Y. Shin, "Design of smart LED streetlight system for smart city with web-based management system," IEEE Sensors Journal, vol. 17, no. 18, pp. 6100- 6110, 2017.

[3] G. Jia, G. Han, A. Li, and J. Du, "SSL:Smart street lamp based on fog computing for smarter cities," IEEE Transactions on Industrial Informatics, vol. 14, no. 11, pp. 4995-5004, 2018. S

[4] L. P. Maguluri, Y. S. V. Sorapalli, L. K. Nakkala, and V. Tallari, "Smart street lights using IoT," in 2017 3rd International Conference on Applied and Theoretical Computing and Communication Technology (iCATccT), 2017: IEEE, pp. 126-131.

[5] S. Bartha, "Design and Simulation of the Solar Street Lighting Photovoltaic System with LED Energy Lamp," Electrotehnica, Electronica, Automatica, vol. 60, no. 2, p. 79, 2012.

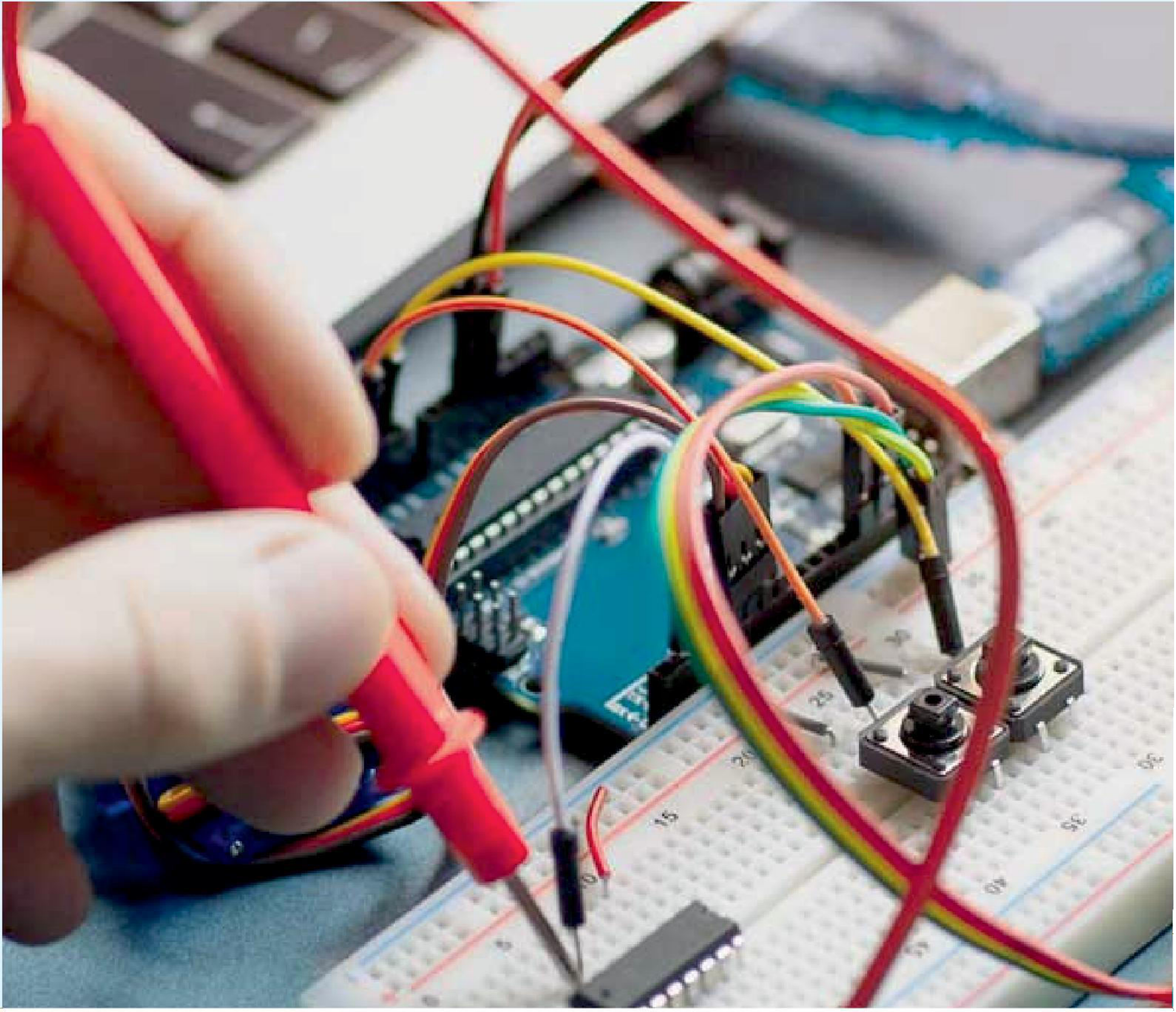
[6] M. M. B. Arnab, S. M. R. Ullah, M. A. Alam, R. K. Nondy, A. F. Alam, and A. P. Mishu, "Generation of electrical energy using piezoelectric material from train wheels: Bangladesh perspective," in 2014 9th International Forum on Strategic Technology (IFOST), 2014: IEEE, pp. 300-303.

[7] R. Kodali and S. Yerroju, "Energy efficient smart street light," in 2017 3rd International Conference on Applied and Theoretical Computing and Communication Technology (iCATccT), 2017: IEEE, pp. 190-193.

[8] B. Abinaya, S. Gurupriya, and M. Pooja, "Iot based smart and adaptive lighting in street lights," in 2017 2nd International Conference on Computing and Communications Technologies (ICCCT), 2017: IEEE, pp. 195-198.

[9] R. Abinaya, V. Varsha, and K. Hariharan, "An intelligent street light system based on piezoelectric sensor networks," in 2017 4th International Conference on Electronics and Communication Systems (ICECS), 2017: IEEE, pp. 138-142.

[10] P. F. Dheena, G. S. Raj, G. Dutt, and S. V. Jinny, "IOT based smart street light management system," in 2017 IEEE International Conference on Circuits and Systems (ICCS), 2017: IEEE, pp. 368-371.



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