Nano World Journal

https://doi.org/10.17756/nwj.2023-s5-029

Research Article

Open Access

An IoT Based Traffic Controller with Li-Fi by Nanotechnology

John De Britto Chinnappan[1*], Senthil Kumar Ramalingam[1] and Anoop Kuttichakku Johny[2]

[1]*Department of Electrical and Electronics Engineering, Saveetha Engineering College, Chennai, Tamil Nadu, India*

[2]*Department of Electrical and Electronics Engineering, VISAT Engineering College, Ernakulam, Kerala, India*

[*]Correspondence to:
John De Britto Chinnappan
Department of Electrical and Electronics Engineering,
Saveetha Engineering College,
Chennai, Tamil Nadu, India.
E-mail: yjohnde@gmail.com

Received: October 11, 2023
Accepted: December 19, 2023
Published: December 22, 2023

Citation: Chinnappan JDB, Ramalingam SK, Johny AK. 2023. An IoT Based Traffic Controller with Li-Fi by Nanotechnology. *NanoWorld J* 9(S5 S149-S153.

Published by United Scientific Group

Abstract

Future IoT (Internet of Things) systems must become more dynamic, multimodal, and expandable as a function of the emerging human-centricity of IoT applications. Recently, rising technologies like the IoT and shade summing have arisen and are now a regular part of our lives. An innovative IT support is creature fashioned added by mutual rune of the darken and IoT to lecture to existing and probable strain. Because of the restricted network bandwidth and high latency disruption caused by the continued growth for and volume in IoT data, data transfer from the network edge to computer servers has become a crucial challenge. Eliminating the inherent limitation was becoming necessary due to the adoption of a recent computing idea in the architecture of cloud computing. By distributing and receiving data over LED headlights and taillights, Li-Fi technology enables deeply effective vehicle to vehicle interaction. In this study, we suggest a traffic management and car safety system that incorporates Li-Fi enabled LED headlights, taillights, and traffic signal lights. This system's inventors wanted to make travelling safer and extra enhanced manage traffic with nano technology.

Keywords

Li-Fi, Elegant car, Accident exposure, Perceptible radiance statement, Bus communication, Nanotechnology

Introduction

It is crucial that people and things collaborate more efficiently given the IoT broad variety of ever-expanding uses. In practically every facet of society, the IoT has the ability to procure people with new services. The ambient-assisted living scenario includes an enabling element that introduces a human-centered idea to support residents' daily life in a distinct manner depending on their unique needs. Analyzing user behavior and demands is crucial for human-centric operations, which leads to the production of gigantic amounts of individual data that demand efficient handing out and immediate function hold.

The global automobile sector has experienced a remarkable expansion. As the population grows, more and more individuals relocate to metropolitan areas, accelerating urbanization. Technology has raised the level of living with the increase in computerization and IoT [1]. About 25% more cars are sold each year, primarily due to decreasing prices and accessibility of personal transportation. It follows that everyone in today's society owns a private vehicle. When it hits to the negative impacts on the environment brought on by the emission of CO_2, CO, etc. [2]. Vehicles have an impact on the environment, but it is also impossible to dispute that there has been an enormous increase in traffic as a result of the increased number of vehicles in cities, which makes it unsafe for citizens to

travel on roads, highways, etc. [3]. However, very little study has been done on the actual application of Li-Fi. Studies includes to demonstrate how Li-Fi preserve be original in the Indian railways, how Li-Fi be capable of be second-hand to intelligently green vehicles [4], the process of detecting the location of a touching singular and fine-tuning his position in his machine by means of Li-Fi [5], how Li-Fi shared with a PIC microcontroller can be second-hand for road executive and road safety [6], and how vehicle to vehicle communication be able to be new to decrease accidents [7]. Light fidelity technology operates on a considerably more straightforward theory. The innovative production of lofty radiance LEDs, which be capable of be turned on top of in totting up to off very quickly, are the core component of Li-Fi technology. Double statistics is transferred while the LED is on or off by transfer 1 for on and 0 for inedible [8].

A shiny establishment or LED tuber give out as the headset on solo closing stages and a luminosity antenna or photo detector give out as the headset. A photo detector is trigger by the activities of an LED after it flash, temporary as a prompt. The LED flashes repeatedly to create a message or data is collected using an array of LEDs in a few distinct colours [9, 10].

Smart devices are widely disseminated all through the IoT network in order to assemble and transport enormous amounts of information in real time during a mixed location. Yet, these strategies have limited energy, computing, and cargo space possessions. It is difficult to transmit data from the network's edge to the technical institute in cloud computing, however, because of the volume of data that must be transmitted, which requires a lot of bandwidth. Due to the limitations of data, computing, and oil reserves in the wireless sphere in the foreseeable, a system of this intricacy is just not possible. Aside from some of these issues, volatile delays can harm the customer incident in time-sensitive applications like proper analysis, rescue services, and human-machine interactions. It is essential to defeat the natural drawbacks of shade computing associated to spot responsiveness, scalability, liveliness bandwidth restrictions, portability, and efficiency, and latency impediment [11-13] in order to implement a novel hypothesis of computing in the cloud computing planning. Meanwhile, the IoT network's radio spectrum is no longer enough to convene the mounting claim in wireless facts connection. The concept of Li-Fi was explicitly Professor Harald Haas of the University of Edinburgh first projected it in 2011, in Scotland. We can communicate data using the Li-Fi approach using visible light communication. Because of its efficiency, speed, security, and availability properties, which can help with resolving many of the problems faced by various businesses, it has recently become ever more fascinating [14-16]. The most recent financial research divination situation that by 2020, the market for Li-Fi technology will now be worth $8500 million [17]. Column standard for transmission, a light source, and a light detector are all characteristics of Li-Fi. The majority of applications use LEDs as your preferred light source due to feature including energy efficiency, cost benefits, and weak regulations. By 2018, new energy-efficient led illumination must be primarily LED, with incandescent bulbs being displaced as the principal illumination source in most public and residential settings. For agreed the again and again increasing trend and faster speeds, laser diodes appear to be a preferable choice [18, 19]. This system's main goal is to show how intelligent traffic systems may be utilized to make a traffic signal based on population density and then use that information to guarantee a smooth flow of vehicles [20]. In order to identify unusual events such lane changes frequently and lane violations, this research provides unique machine learning-based approaches [21]. To safeguard data from unauthorized users, trustworthy data security is required [22]. The purpose of this research is to suggest a paradigm for the identification and detection of traffic signals [23]. This system's implementation aims to show how intelligent traffic systems can be used to produce a traffic signal depending on density [24].

In totalling from the higher than literature we have get a severe result from, the detecting choice of the ultrasonic series sensor can be prolonged. To be acquainted with plane energy collisions, lane-change help, or blind-spot gratitude, the optional arrangement can be extended. Potential smart cars could very well fit in the not compulsory process with the accurate help on or behind the applicable establishment.

Experimentation

Proposed circuit model and description

When the speed is at its highest, the rotational angle must be at its lowest, and vice versa. As an illustration, the angle of rotation is 25° for the 90 km/h speed and 0 km/h for a speed of 0 km/h. Figure 1 presents block diagram of an IoT based traffic controller with LIFI and ultrasonic sensor unit. Figure 2 presents detailed hardware unit for the implementation of traffic controller with LIFI-LCD-nano-controller. Figure 3 presents the proposed traffic light LIFI model.

In figure 4 and figure 5, it is shown how the suggested and developed prototype avoids collisions in two different ways (warning and safe zone). From figure 6, it can be deduced that the LCD on the When the automobiles are in the danger zone, that is, when the space between them is less than the threshold coldness, the spreader side resolve exhibit "caveat," and the LCD and speedboast on the phone side resolve explain a modify in speed. (the least amount aloofness to keep amid the cars to stay away from accident (100 cm or 1 m) in extent. Particularly, if car C2 is touching at 90 km/h and the coldness among the vehicles is subordinate to a smaller amount than the doorstep remoteness, car C2's velocity will by design raise.

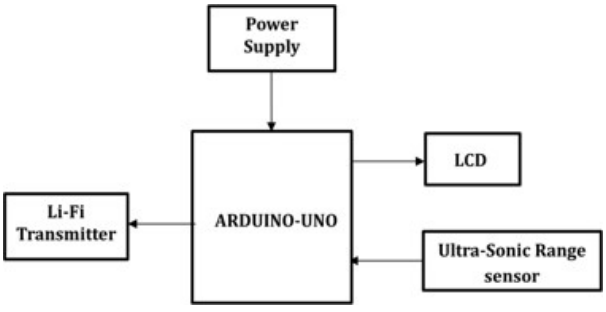

Figure 1: Block diagram of an IoT based traffic controller with Li-Fi and ultrasonic sensor unit.

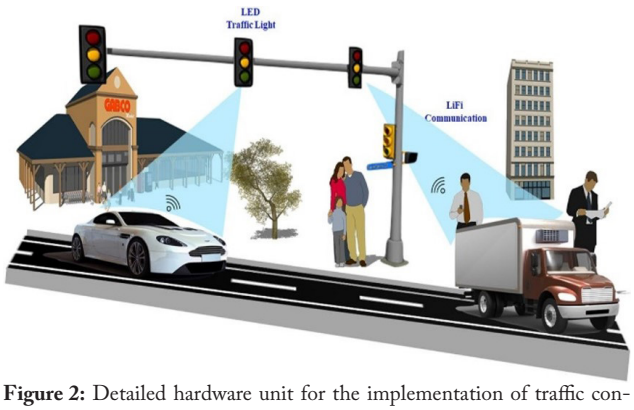

Figure 2: Detailed hardware unit for the implementation of traffic controller with Li-Fi-LCD-nano-controller.

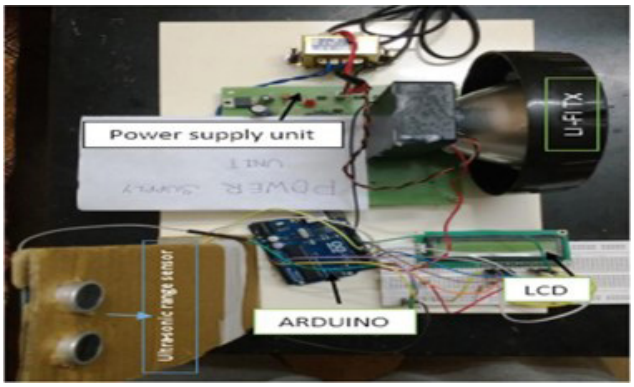

Figure 3: The proposed traffic light Li-Fi model.

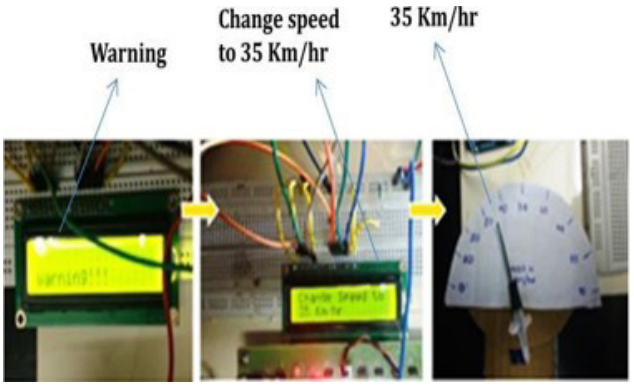

Figure 4: Plot of angle of rotation vs speed.

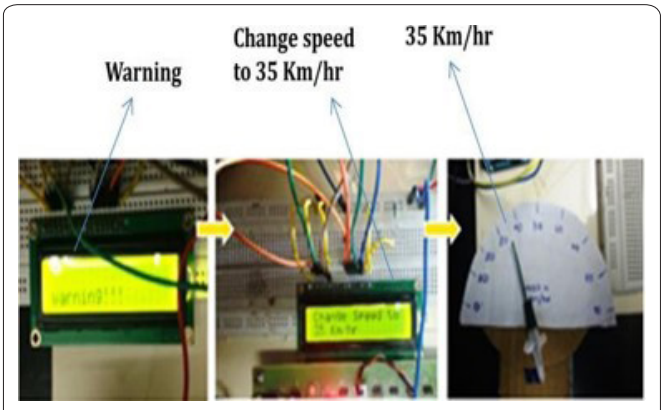

Figure 5: When the cars are in danger zone (<100 cm).

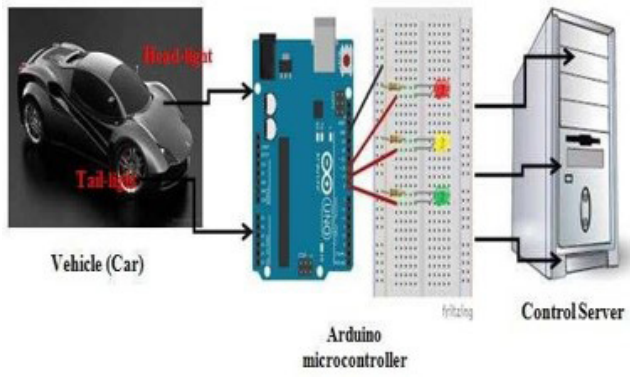

Figure 6: Experimental setup on traffic controller with vehicle.

Figure 7 presents a further example of a "safe zone" for rear-ender avoidance. According to the figure 7, if there is more space between two cars than the threshold distance, there is a very low possibility of an accident, and the vehicles will be in a protected area. "Safe zone" resolves also emerge on the LCD on the bringer side, while "Change Speed to 90" will emerge on the LCD and speedometer on the receiving face. In this case, car C2's speed can be raised if the gap between the vehicles is closer than its threshold value. Figure 8 sample value, which represents the amplified speed of automobile C2 at 90 km/h, is one example. Table 1 presents the measurement of actual and measured signals with accuracy of Li-Fi detectivity.

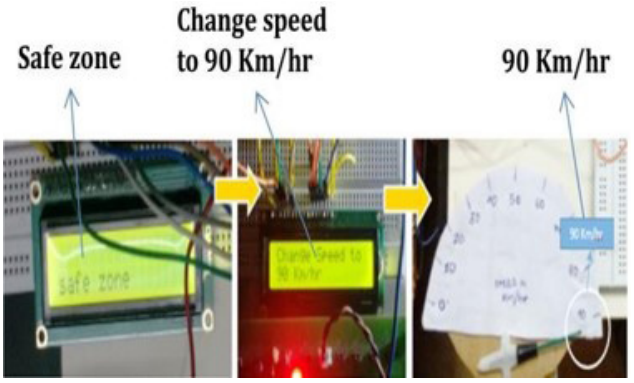

Figure 7: When the cars are in safe zone by nanotechnology (>100 cm).

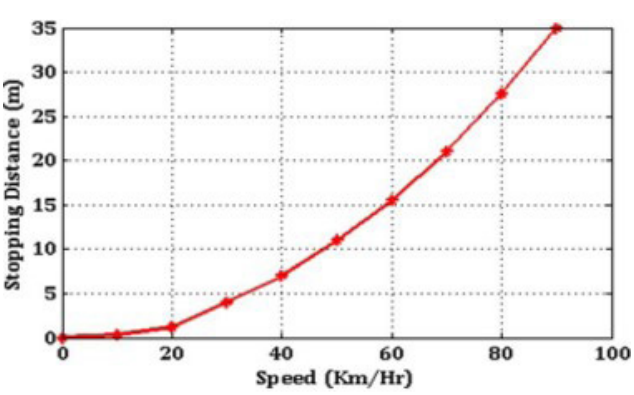

Figure 8: Plan of closing distance vs speed based on nanotechnology.

Table 1: Performance of TG-1-BFA-based 4-bit RCA.

Actual distance (cm)	Measured distance (cm)	Accuracy (%)
10	11.23	89.04
20	21.04	95.05
30	30.96	96.89
40	40.77	98.11
50	50.65	98.71
60	60.51	99.15
70	70.36	99.48
80	80.19	99.76
90	90.14	99.84
100	100.11	99.89

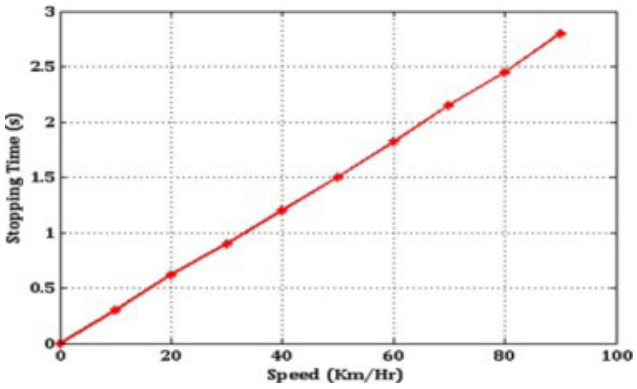

Figure 9: Plan of closing time vs speed.

Results and Discussion

Analysis of the theorem

For every collision detection system, knock avoidance is essential. Knowing how long it takes a car to stop after spotting an obstruction and how far it drives in that time are essential knowledge for successfully avoiding collision. When these two factors are combined, it makes it easier to create a structure that is both proficient of predicting and avoiding collisions.

The maximum deceleration of a car, pretentious the vehicle has an ABS structure fitted, has been observed to be 9 m/s^2 according to experimental evidence [19]. Speed and deceleration have the following mathematical relationship:

$$v2 - u2 = 2 \times a \times sd \quad (1)$$

Using the aforementioned connection, figure 9 displays a speed vs stopping distance graph for a car. The mathematical equation for the link between time and speed is:

$$v = u + at \quad (2)$$

Figure 9 depicts a speed vs stopping time graph for a car using the relationship mentioned above. According to the findings shown in figure 8 and figure 9, the regular stopping detachment of a car travelling at a range of speeds ranges from 1 to 35 m, and the normal stopping time is between 0 and 3 s. Due to the confines of the ultrasonic series sensor, the safety margin of 1 m is instead suggested in the study. The safety margin must adhere to the following mathematical relationship in order to prevent collision.

Conclusion

In order to lessen car collisions and minor the probability of fatal traffic accidents, this revise introduces a unused and pioneering smash uncovering knowledge. Li-Fi aerial and handset system are shot in the approach that is projected in this manuscript. In order to enlarge more successful strategies to augment the transmitting series of the Li-Fi classification and recommend inspired solutions to skirt the complications caused by file of sight affirmation and white light intrusion, which is related with the Li-Fi, this document will persuade and motivate others to further investigate the idea of big cage and the use of Li-Fi technology. The fusion of IoT with cloud computing heralds a new theory in information machinery for next-generation cloud computing surrounded by a supple IoT intricate. Since of this association, establishment and academic study will have admission to clean, motivating solutions. In charge to carry an IoT complex that is human-centric, this study residential an encrusted hybrid cloud computing building.

Acknowledgements

None.

Conflict of Interest

None.

References

1. Zhu C, Leung VC, Shu L, Ngai EC. 2015. Green internet of things for smart world. *IEEE Access* 3: 2151-2162. https://doi.org/10.1109/ACCESS.2015.2497312
2. Harish M. 2012. A study on air pollution by automobiles in Bangalore city. *Manage Res Pract* 4(3): 36.
3. Shruthi P, Venkatesh VT, Viswakanth B, Ramesh C, Sujatha PL, et al. 2013. Analysis of fatal road traffic accidents in a metropolitan city of South India. *J Indian Acad Forensic Med* 35(4): 317-320.
4. Kim N, Jing C, Zhou B, Kim Y. 2014. Smart parking information system exploiting visible light communication. *Int J Smart Home* 8(1): 251-260. https://doi.org/10.14257/IJSH.2014.8.1.26
5. Bal S. 2014. Light fidelity for position detection. *Int Res J Eng Technol* 3(12): 1-4.
6. Kapre KS. 2015. Road traffic management and safety using Li Fi technology. *Int J Adv Res Sci Eng Technol* 2(12): 1101-1104.
7. Yeasmin N, Zaman R, Mouri IJ. 2016. Traffic control management and road safety using vehicle to vehicle data transmission based on Li-Fi technology. *Int J Comput Sci Inf Technol Res* 6(3/4): 1-7. https://doi.org/10.5121/ijcseit.2016.6401
8. Adwani A, Nagtode S. 2016. Li-Fi: information transferring through LED's. In International Conference on Electrical, Electronics, and Optimization Techniques, Chennai, Tamil Nadu, India.
9. Patel B. 2018. Li-Fi technology: transmission of data through light. *Int J All Res Writ* 1(6): 1-4.
10. Gupta S, Gupta S, Pandey S, Ranjan S, Goel S, et al. 2016. Study & analysis of role of Li-Fi in future. *Int J Smart Home* 10(2): 213-218. http://dx.doi.org/10.14257/ijsh.2016.10.2.20
11. Hao Z, Novak E, Yi S, Li Q. 2017. Challenges and software architecture for fog computing. *IEEE Internet Comput* 21(2): 44-53. https://doi.org/10.1109/MIC.2017.26

12. Baccarelli E, Naranjo PG, Scarpiniti M, Shojafar M, Abawajy JH. 2017. Fog of everything: energy-efficient networked computing architectures, research challenges, and a case study. *IEEE Access* 5: 9882-9910. https://doi.org/10.1109/ACCESS.2017.2702013
13. Keegan N, Ji SY, Chaudhary A, Concolato C, Yu B, et al. 2016. A survey of cloud-based network intrusion detection analysis. *Hum Cent Comput Inf Sci* 6: 19. https://doi.org/10.1186/s13673-016-0076-z
14. Fath T, Haas H. 2012. Performance comparison of MIMO techniques for optical wireless communications in indoor environments. *IEEE Trans Commun* 61(2): 733-742. https://doi.org/10.1109/TCOMM.2012.120512.110578
15. Tsiatmas A, Willems FM, Linnartz JP, Baggen S, Bergmans JW. 2015. Joint illumination and visible-light communication systems: data rates and extra power consumption. In IEEE International Conference on Communication Workshop, London, UK.
16. Gilliard R. 2010. The Li-Fi lamp high efficiency high brightness light emitting plasma with long life and excellent color quality. In IEEE International Conference on Plasma Science, Norfolk, VA, USA.
17. Sharma PK, Ryu JH, Park KY, Park JH, Park JH. 2018. Li-Fi based on security cloud framework for future IT environment. *Hum Cent Comput Inf Sci* 8: 23. https://doi.org/10.1186/s13673-018-0146-5
18. Grobe L, Paraskevopoulos A, Hilt J, Schulz D, Lassak F, et al. 2013. High-speed visible light communication systems. *IEEE Commun Mag* 51(12): 60-66. https://doi.org/10.1109/MCOM.2013.6685758
19. Haas H, Yin L, Wang Y, Chen C. 2015. What is Li-Fi? *J Light Technol* 34(6): 1533-1544. https://doi.org/10.1109/JLT.2015.2510021
20. Sangeetha V, Nath SS, Helenprabha K. 2015. Congestion control using alternative path selection for heterogeneous traffic oriented wireless sensor networks. *Int J Appl Eng Res* 10(44): 30911-30916.
21. Athanesious JJ, Vasuhi S, Vaidehi V, Christobel JS, Julus LJ. 2020. Adaptive density based data mining technique for detection of abnormalities in traffic video surveillance. *J Intell Fuzzy Syst* 39(3): 3737-3747. https://doi.org/10.3233/JIFS-192062
22. Nagappan G, Chellappan C. 2012. Intelligent model for traffic safety applications. *J Comput Sci* 8(3): 358.
23. Pandurangan R, Jayaseelan SM, Rajalingam S, Angelo KM. 2023. A novel hybrid machine learning approach for traffic sign detection using CNN-GRNN. *J Intell Fuzzy Syst* 44(1): 1283-1303. https://doi.org/10.3233/JIFS-221720
24. Raj AA, Bhargavi R, Anjali SM, Teja A. 2022. Smart traffic management system for priority vehicle clearance using IoT. In International Conference on Automation, Computing and Renewable Systems, Pudukkottai, Tamil Nadu, India.