RAMAIAH
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High Way Navigation Using Li-Fi

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Introduction:

With the rapid increase in internet usage and the resulting overuse of radio waves for long-distance data transmission, there's a growing challenge to meet the demand for high-speed connectivity. This shortage of radio wave bandwidth limits data communication speeds. A promising alternative is Visible Light Communication (VLC). One practical application of VLC is improving road navigation using streetlights. Many drivers struggle with navigation at night due to low phone battery or poor network connectivity. This proposed system uses Li-Fi technology, where streetlights transmit area maps to vehicles, aiding navigation without relying on mobile data or Wi-Fi. The received map is displayed on the vehicle's screen, offering a novel solution for nighttime intra-city road navigation.

Motivation:

1.Improve Navigation: Nighttime navigation in unfamiliar areas can be challenging and sometimes dangerous. By utilizing Li-Fi through streetlights, this system aims to provide drivers with an easy and reliable means of navigation, enhancing safety and convenience.

2.Reduce Dependency on Traditional Networks: In many scenarios, people rely on mobile data or Wi-Fi for navigation, which may not always be available or reliable. This project offers an alternative that doesn't depend on these traditional networks, making navigation possible even in areas with poor connectivity.

3.Free and Accessible: Unlike some navigation solutions that require paid subscriptions or data usage, this system is designed to be cost-effective and accessible to a wide range of users. It utilizes existing infrastructure (streetlights) to transmit data for free.

4.Technology Exploration: The project explores the potential of Li-Fi technology in a practical application. It showcases the advantages of using light waves for data transmission, which can be a game-changer in various industries beyond navigation.

Literature Survey:

1. **Navigation System Using Light Fedelity**

   Authors: Niharika Mishra, Monika rai, Riya Mandal, Harjeet Kaur

   This paper introduces a Li-Fi-based navigation system for night-time road navigation using streetlights to transmit map images. It addresses the growing demand for high-speed connectivity by utilizing light waves, overcoming radio wave bandwidth limitations. The system involves LED-based transmitters on streetlights and solar panel receivers in vehicles. Implementation factors such as light intensity and distance affect system

performance. The proposed Li-Fi navigation system offers a promising alternative to conventional navigation methods.

2. **Indoor Navigation Using Li-Fi and IOT Technologies**

   Authors: Bharanidharan N, Darshan Kalyan B S, K Bala Vishnu Vardhan Reddy, Devaki Naga Nithesh , Deepak E, Dharnesh Kumar B.

   The project successfully deployed a Li-Fi-based indoor navigation system, showcasing its energy efficiency and superior accuracy in enclosed spaces compared to GPS. The user-friendly Android app simplifies location and navigation, while cloud-stored navigation data opens monetization possibilities, emphasizing Li-Fi's potential for indoor navigation and data-driven applications.

3. **Li-Fi Based Smart Indoor Navigation System for Visually Impaired People**

   Authors: K. Nikhil, I. Sai Pavan Kalyan, Jetty Sagar, M. Sai Rohit, M. Nesasudha

   They developed a promising indoor navigation system for the visually impaired using Li-Fi technology, harnessing the power of LED lights for precise positional and directional guidance. Li-Fi offers efficiency, security, and environmental benefits, making it a promising solution for the future. With limited available bandwidth causing congestion in airwaves, Li-Fi stands as a viable remedy. Combined with ultrasonic sensors for obstacle detection, our system promises safe and effective navigation for the visually impaired.

4. **Li-Fi Positioning and Optimization in an Indoor Factory Environment**

   Authors: Ziyan Ma, Sepideh Mohammadi Kouhini, Christoph Kottke ,Ronald Freund, Volker Jungnickel ,Marcel Müller ,Daniel Behnke

   This paper introduces a LiFi-based positioning system for real factory use, achieving average accuracies of 7 cm (X), 6 cm (Y), and 3 cm (Z). To boost accuracy, a correction factor addressing angle dependency is applied, resulting in improved precision: 5 cm (X), 4 cm (Y), and 1 cm (Z), with a reduced overall RMSE of 3.3 cm in 3D. The proposed LiFi positioning aligns with existing standards and holds promise for smart factories.

Advantages:

1. Solves Navigation Issues: The system addresses the problem of navigation in intra-city roads at night, providing an alternative solution to traditional GPS-based navigation.

2. No Mobile Data or Wi-Fi Required: It allows for navigation without the need for mobile data or Wi-Fi connectivity, reducing dependency on these resources.

3. Energy Efficiency: Li-Fi technology uses LED lights for data transmission, which are energy-efficient and eco-friendly.

4. Free to Use: do not need to pay for Li-Fi connectivity, making it a cost-effective solution.

5. Enhanced Accuracy: The system can provide accurate navigation information, especially when the receiver is positioned directly under a streetlight.

Disadvantages:

1. Line-of-Sight Requirement: The system relies on a direct line of sight between the transmitter (streetlight) and the receiver (vehicle), limiting its effectiveness in areas with obstacles or when vehicles are not directly under streetlights.

2. Limited Coverage Area: The range of the system is constrained by the distance between streetlights, which is typically around 30 to 50 meters.

3. Interference: Other light sources, such as nearby buildings, may interfere with the Li-Fi signal, potentially affecting data transmission.

4. High-Intensity LED Lights: To ensure proper data transmission, high-intensity LED lights are required, which may lead to higher energy consumption.

5. Delay in Display: The system introduces a delay in displaying the map until the vehicle reaches the next streetlight, which may not be suitable for users needing real-time navigation.

5. **Limited Use Cases:** While the system may work well for intra-city road navigation at night, it may not be suitable for all navigation scenarios or applications.

Components:

1. Arduino Nano (2)
2. LED'S
3. LDR
4. Batteries
5. Voltage Regulator
6. LCD Screen

Gaps Identified:

Highway navigation using Li-Fi is advantageous over traditional methods as it provides faster and more reliable data transfer, reducing the potential for connectivity issues and ensuring real-time, high-speed navigation assistance to drivers.