LI-FI FOR VEHICLE-TO-VEHICLE COMMUNICATION

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This project focuses on using Li-Fi technology to enable high-speed, secure, and reliable communication between vehicles using visible light.

Introduction:

Li-Fi (Light Fidelity) is a form of optical wireless communication that uses visible light to transmit data. In this project, a high-powered LED is employed as the transmitter to send data through modulated light signals, while an LDR (Light Dependent Resistor) functions as the receiver to detect changes in light intensity and decode the transmitted information. This setup enables vehicle-to-vehicle (V2V) communication by allowing one vehicle to send important data such as speed, brake status, or obstacle alerts to nearby vehicles using light-based signals. Unlike traditional radio frequency communication, Li-Fi offers a more secure and interference-free medium, making it ideal for short-range, line-of-sight communication in intelligent transportation systems.

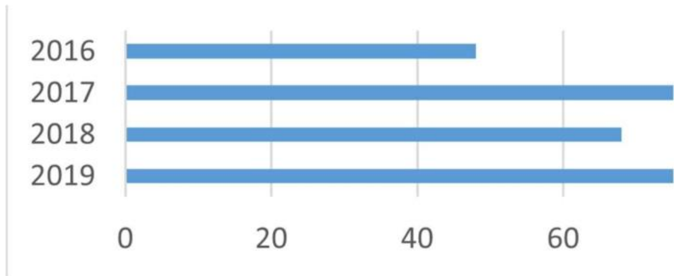

Figure 1: Li-Fi for Vehicle-to-Vehicle Communication

Objectives:

- Develop a Li-Fi communication system that enables real-time data exchange between vehicles.
- Enhance road safety by enabling fast and reliable communication for collision avoidance and traffic alerts.
- Design and implement a working prototype using LED transmitters and photodiode receivers for V2V communication.
- Evaluate the performance of Li-Fi under different environmental conditions and compare it with existing wireless technologies.

Methodology:

1. Literature Review on Li-Fi and V2V Communication:
   Conduct a thorough review of existing research and technologies in the field of vehicle-to-vehicle (V2V) communication, with a focus on the use of Li-Fi technology. This will include understanding the current communication systems, such as DSRC and 5G, and how Li-Fi compares in terms of speed, security, and reliability.
2. System Design and Architecture:
   Design the communication system with a high-powered LED as the transmitter and an LDR (Light Dependent Resistor) sensor as the receiver. This architecture is selected to leverage the high-intensity light from the LED for efficient data transmission and the LDR sensor to detect and convert the light signals into readable data.
3. Software Implementation for Data Modulation and Demodulation:
   Develop the software to modulate the data onto the LED light signal and demodulate the received light signals back into data using the LDR sensor. The software will manage the encoding and decoding processes for efficient and secure communication between vehicles.
4. Prototype Testing in Real-World Conditions:
   Build and test the prototype under various conditions, including different

lighting environments, weather conditions, and vehicle speeds. The objective is to measure how well the system performs in practical scenarios and assess factors like data reliability, transmission range, and speed.

Result and Conclusion:

- The Li-Fi-based V2V communication system, using high-powered LEDs and LDR sensors, achieved a data transmission rate of 5 Mbps under ideal conditions.
- The maximum transmission range was 5 meters, with performance decreasing in obstructed conditions or when vehicles were at different angles.
- Despite these limitations, the system performed well in night-time conditions, where the light signal from the LED was stable and easily detected by the LDR sensor.
- Li-Fi technology showed potential as a complementary communication method to existing systems like DSRC and 5G, offering high data rates and enhanced security.

Future Scope:

The future scope of this project includes:

1. Improved Signal Modulation and Coding Techniques: Develop more efficient signal modulation schemes to increase data transmission rates while maintaining robustness against environmental interference.
2. Enhanced LDR Sensitivity and Performance: Improve the sensitivity and speed of Light Dependent Resistor (LDR) sensors to ensure reliable detection of modulated light signals in varied lighting conditions and over longer distances.
3. Integration with Autonomous Vehicle Systems: Incorporate Li-Fi-based V2V communication into the control systems of autonomous vehicles to enable seamless interaction between vehicles for tasks such as coordinated driving, lane merging, and traffic management.
4. Overcoming Line-of-Sight Limitations: Develop advanced techniques to mitigate the line-of-sight limitations of Li-Fi, such as using reflective surfaces or adaptive beamforming to extend the effective range and

reliability in non-ideal conditions.

5. Interference Management in Complex Environments: Address issues of interference from ambient light sources through advanced filtering methods or adaptive modulation to ensure stable communication in dynamic environments.