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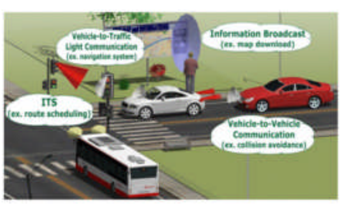
Visible Light Communication Applications: geolocation, navigation, guidance and vehicular communication

With the rapid increase in wireless mobile devices, the continuous increase of wireless data traffic has brought challenges to the continuous reduction of radio frequency (RF) spectrum, which has also driven the demand for alternative technologies. In order to solve the contradiction between the explosive growth of data and the consumption of spectrum resources, Visible Light Communication (VLC) has become the development direction of the next generation communication network with its huge spectrum resources, high security, low cost, and so on. The increasing shortage of radio frequency spectrum and the development of Light-Emitting Diodes (LEDs), VLC has attracted extensive attention. Compared to conventional wireless communications, VLC has higher rates, lower power consumption, and less electromagnetic interferences. VLC is a data transmission technology that can easily be employed in indoor environments since it can use the existing LED lighting infrastructure with simple modifications.

The main goal is a Visible Light Communication (VLC) based guidance system to be used by mobile users inside large buildings. This system is composed of several transmitters (ceiling luminaries), which transmit map information and path guidance messages. Mobile devices, with VLC support, decode the information. A mesh cellular hybrid structure is proposed. The luminaires, via VLC, deliver their geographic position and specific information to the users, making them available for whatever use they request. The communication protocol, coding/decoding techniques, and error control are examined. Bidirectional communication is implemented and the best route to navigate through venue calculated. We propose several guidance services and multi-person cooperative localization. By analyzing the results, it became clear that the system not only provides self-location, but also the capability to determine the direction of travel and to interact with information received in order to optimize the route towards a static or dynamic destination.



The main objective of the Intelligent Transport System (ITS) technology is to optimize traffic safety and efficiency on public roads by increasing situation awareness and mitigating traffic accidents through vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications. By knowing, in real time, the location, speed and direction of nearby vehicles, a considerable improvement in traffic management is expected. The goal is to increase the safety and throughput of traffic intersections using cooperative driving. The traffic data collected by the current traffic control system using induction loop detector and other existing sensors is limited. With the advancement of the wireless communication technologies and the development of the V2V and V2I systems, called Connected Vehicle, there is an opportunity to optimize the operation of urban traffic network by cooperation between traffic signal control and driving behaviors. Besides, it will also provide a technical support for the development of Vehicle-to-X systems and autonomous driving industries. In this area, Visible Light Communication (VLC) has a great potential for applications due to their relatively simple design for basic functioning, efficiency, and large geographical distribution. Monitoring the network traffic status of urban roads in real-time can provide rich and high-quality basic data and allow the assessment of traffic control effects. Our work focuses on the use of Visible Light Communication (VLC) as a support for transmission of information providing guidance to drivers, as well as specific information to them. Connected vehicles communicate with one another and with the infrastructure using street lights, street lamps, and traffic signals. As a result of joint transmission, optical mobile receivers collect data, calculate their location for positioning, and, correspondingly, read transmitted data from each transmitter. The results indicate that the V-VLC system increases safety by directly monitoring critical points such as queue formation and dissipation, relative speed thresholds, as well as inter-vehicle spacing.