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Title : MOBILITY ENHANCEMENT FOR VLC RECEIVER USING AVALANCHE PHOTODIODE ARRAY

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The visible light communication (VLC) is a promising wireless communication technology and solution for the growing global demand for mobile bandwidth. The VLC is an optical wireless communication (OWC) technology that uses the transmission of information carried over the optical radiation through a free-space channel. The distinct feature of the VLC is it uses the visible light as a transmission medium allowing it to concurrently provide both the indoor lighting and the wireless data communication. The restricted mobility always associated with any OWC solution is the main hindrance for the VLC from becoming a popular indoor wireless solution like the wireless fidelity (Wi-fi), the Bluetooth and the cellular 4G solutions that have provided the wireless communication convenience for the modern living. This thesis presents an investigation into the design and the development of a free mobility operation for the indoor VLC system. The first novel contribution of this thesis is the development of an experimental VLC system with a free mobility operation based on a few reference designs from other works. The system has a data rate of above 2 Mbit/s that is widely accepted for a personal area network (PAN) coverage. Likewise, the commercial VLC systems with similar data rate from PureLifi and Oledcomm are purely stationary systems. Many of the research works and the commercial VLC systems have been focusing on the improvements of the data rate and to optimize the optical property and quality of the VLC. The experimental VLC system presented in the thesis has a smaller receiver fixture that provides the free mobility operation that is comparable with the radio wireless solutions. The thesis also proposes a significant physical change to the VLC receiver by using the avalanche photodiode (APD) array device as the photodetector which is uncommonly used in the VLC systems. The array APD devices that are suitable for the VLC are difficult to obtain from the open market. Most commercial APDs are expensive and are usually restricted for use in the high-end optical and military applications. They are also mainly used for the remote optical sensing and long range fiber optics applications. The optical application market for the APD devices is also relatively small. Many of the current optical applications are configured for stationary. It only requires a low-cost integration of the silicon-based photodiodes and the optical lens that magnifies the optical signal. In fact, the simple integration has almost an equal performance with the APD. On the contrary, a VLC system with an array APD device can achieve a full and free mobility operation as opposed to the stationary VLC use. This thesis presents the second contribution through the development of a novel low-cost silicon-based array APD device using a low complexity reach-through common cathode structural array APD. The low complexity structure allows the array APD device is fabricated using the conventional complementary metal-oxide-silicon (CMOS) technology. In short, the thesis investigates the VLC system to understand the strengths and weaknesses to present a novel design, approach, and method to develop a VLC receiver with enhanced indoor mobility with an acceptable data rate performance associated with a PAN application. The solution is achieved through the integration of an optical concentrator-less receiver with the experimental array APD device. The work and the results of the thesis offer much potential future enhancement works for the VLC as a popular wireless solution.