ABSTRACT

Visible Light Communications qualifies as a good alternative for the communication of data. This is because light-emitting diode bulbs have become brighter and more affordable, thus are being used more widely than before. This enables the integration of visible light communications into existing lighting infrastructure. On the other hand, Fast Fourier Transform has become a very widely used algorithm in the field of telecommunications, especially in multicarrier transmission.

In this final project, a visible light communication system has been implemented, using Inverse/Fast Fourier Transform to implement frequency multiplexing. Before being multiplexed, data is first mapped using 4-QAM. After the multiplexing process, an analog signal is produced that represent the data. This analog signal is transmitted with light using a Cree XML-2 LED bulb, and received using a BPV10 PIN photodiode. The received signal is converted again into its digital form. Then a demultiplexing process using FFT and a demapping process using 4-QAM are peformed, resulting in the original data being recovered. The digital part of the system was implemented on an Altera De-0 Nano board, at the heart of which lies the Altera Cyclone 4E FPGA. The analog part of the system was implemented using discrete components soldered on perfboards.

The overall implementation achieves a bitrate of 302 kbps. Both the analog and digital parts of the system has the necessary specifications necessary to support that bitrate, with the VLC transmitter supplying around 0.10125 W to the LED bulb.The system was then tested with in various distances ranging from 25 cm to 60 cm. At 25 and 30 cm, the system shows no character error. At 35 cm, an error of 0.042 % shows up. As the distance increases, the error increases until it reaches 7.42 % at 60 cm. This is expected due to the fact that at 25cm and 30 cm, the received signal is still big enough and the SNR is still good. Beyond that, the signal becomes smaller and the SNR gets worse.

Keywords: *Visible Light Communications, FFT, frequency multiplexing, digital design, FPGA*