EE 344 Project Report 1 : Visible Light Communication using LED
Group No. B-05
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1 Work Promised

- Understanding the literature
- Finishing the transmitter ciruit
- Getting started with the receiver circuit

2 Work Accomplished

2.1 Block Diagram and Demonstration

We will demonstrate transmission of letter from the pc to pc. For demonstration (debugging) purposes we have used USB to UART converter and to show that our transmitter and receiver circuits are working correctly.

2.2 Reading Literature

During the first week, each of us went through a number of papers in the field of visible light communication and brainstorming simulataneously. The papers included a wide variety of theoretical aspects regarding the basic concept, however did not extensively cover about the implementation issues.

2.3 Software Implementation

- Familiarized with TivaC capabilities and Code Composer Studio IDE.
- Coded serial transmission and reception in PySerial, for testing the transmitter and receiver circuit using UART.
- Code for OOK (On-Off Keying) on the transmitter side is implemented, but rigorous testing is still left.

2.4 Hardware Implementation

- Transmitter circuit: The current circuit comprises an inverter which drives the LED according to the input signal. The waveform input to the LED follows the bit stream upto 1Mhz. The LED is biased using a pull up resistor to make the ensure a certain level of brightness of the LED while transmitting.

- Receiver Circuit: It consists of a photodetector (BPW34), followed by an amplifier and a high pass filter to remove the 50hc noise due to ambient light. We have currently tested number of designs for the filter by simulating them on LT spice. We are still working on the exact specifications of the filter taking into consideration a number of factors.

3 Testing

We tested each of the components in a sequential manner in order to ensure the integrity of each component.

- The voltage waveform at the output of the LED driving circuit. It was ensured it followed the input.
- The voltage waveform at the output of the amplifier was tested using a DSO and was resembling the input waveforms reasonably well upto 75 khz.
- The distance between the LED and the photodetector was gradually increased upto 50 cm and we could receive the transmitted waveform accurately upto 40 khz.
- Finally, we gave the input(a single character) from our laptop through the USB to UART converter and received it through another USB to UART converter on another laptop. We successfully the reception for a range of angles and a distances upto 10 cm and for frequencies upto 40khz.
- We have tested the receiver circuit separately and it had a good response upto 200kHz before distorting. We are thus looking for better designs.

4 Problems Faced

- The Code Composer Studio has many intricacies and getting it to work with TivaC was quite troublesome, since some rule files had to be changed. Also it is quite difficult to debug without a DSO.
- We initally had tried to drive the LED using MOSFET IRF840 but there seemed to an issue which we couldn't quite figure out the reason for and hence tried the inverter which gave good results.
- Another issue was with the choice of OPAmp. We had begun with using ua741 which had a very poor slew rate and hence distorted the waveforms. We switched to TL082 which has a slew rate sufficient for our application.
- Another issue is about the design of the filter. We tried we a simple first order high pass filter which gave poor results even at frequencies as low as 20kHz due to capacitive effects. We resorted to a higher order filter which gave better results. Currenty, the issue is about to understand the real bottleneck among the Opamp, the filter design and or capacitive effects of the breadboard at these frequencies.

5 Goals for the next evaluation

- Transmit files asynchronously upto data rates of 100kbps successfully
- Integrate the circuits and add a PLL for synchronous reception and ensure reception of a basic toggling waveform
- Code the modulation the demodulation schemes in the microcontroller