EE 344 Project Proposal - Visible Light Communication using LED

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1 Abstract

LiFi (Light Fidelity) is the new buzzword in new era of communication. It is often used to describe high speed Visible Light Communication (VLC). VLC dedicates itself to solving the problem of illumination and communication together. The way it is implemented is that the light source is switched on and off at a very high speed, such that it is not discernible to the human eye, but a sensitive photodiode can detect it. This solves the problem of illumination and at the same we can encode information in the switching pattern and hence enabling us to transmit data, and recover it using the photodiode receiver.

In our project, we aim to develop a prototype of Visible Light Based Communication link. The project will consist of a transmitter, a LED in this case, which will transmit the message signal which will be received by the receiver. The Transmitter will transmit a file preloaded on a USB/SD card and this will be captured by receiver.

2 Project Description

2.1 Background and Motivation

Visible Light Communication is the most advanced communication technology using "Visible Light"; the visible light everywhere around our daily life. We are heavily relying on our eyes to gather almost all information for our day-to-day activities. "Visibility" is one of the most important things for human being, and many devices are developed to assist our "Visibility".

For instance, there are many devices including the lightings in our offices, home, the lightings on roads, traffic signals, commercial displays, small lamps on electronic home appliances including TVs, etc.

Recently, LED (Light Emitting Diode) has been used for those devices. LED has a special characteristic to light on and off very fast. The data can be transmitted by lighting LED on and off at ultra high speed. And, the digital camera and the camera on cell phones, which are popular now, are very excellent system to receive the visible light.

By using the visible light for the data transmission, many problems related to radio and infrared communications are solved. The visible light communication has characteristics to be ubiquitous, transmitted at ultra high speed and harmless for human body and electronic devices, compared to those by radio and infrared communications.

We wish to explore the possibilities laid down by VLC. In particular we want to evaluate the capacity of LEDs to transmit data at relatively high speed and over a short range.

2.2 Project Goal

Our project aims to achieve the the following objectives in order to make a satisfactory prototype (as given in the project statement)

- Should transmit a file stored in a USB/SD card
- Transmission speed should be 1 Mb/s
- Blinking should not be detected by the naked eye
- Link should work over a distance of 1 m.

2.3 Project Specifications

- Customer Specifications:
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- Technical Specifications:
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3 Technical Design Description

3.1 Possible Solutions and Design Alternatives

3.2 System-level overview

3.3 Performance Validation

4 Project Plan

Tasks to be done:

- Reading Literature →We will read a few papers regarding the implementation done by various researchers and institute. After reading them, we hope to achieve a deep understanding of the logistics behind the working of visible light communication. (2 weeks)
- Designing the Transmitter →As mentioned above, we will be using an LED to transmit the message. The circuit will be designed with proper biasing for efficient transmission (1 week)
- Designing the Receiver→This is relatively the tough part of the circuit. Along with proper biasing, effects of surrounding light need to be taken care of and finally clock synchronization and frequency offset problem will be tackled (3 weeks)
- DSP Board Coding →Code for the acquisition of signal, processing of signal and writing on the computer will be written on the DSP board. (1 week)
- Integration and Testing→After satisfactory implementation of individual components of the main circuit, they will be integrated and tested starting from lower speeds (10 kbps), problems will be identified and subsequently rectified. Finally, we aim to achieve the desired speed of 1 Mbps. (3 weeks)
- Buffer→1 week will be kept buffer to improve the efficiency of the system and tackle last minute debugging issues.

4.1 Work distribution

4.2 Gantt chart

5 Project Implementation

6 Deliverables

- By first week of February, we hope to get done with
  - Understanding Literature
  - Procurement of Components
  - Finishing the Transmitter Circuit
  - Getting Started with the Receiver
- By second week of March, we hope to accomplish

  - Finish Tackling the Problem of Clock Synchronization and Frequency offset
  - Start integrating the components.
- By first week of April, we hope to accomplish
  - After second evaluation, we get started with testing of the circuit. We will start off with 10 kbps, correct the errors which come in the way and in the end hope to get the desired speed of 1Mbps.