Visible Light Communication for medical technology application

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Thesis advisors: Prof. Dr. Bertrand Dutoit, Aymeric David Niederhauser
Experts: BSc Leoni Etter (Ypsomed Holding AG), PhD Stefan Mangold (Ypsomed Holding AG)
Industrial partner: Ypsomed Holding AG, Burgdorf

Visible Light Communication (VLC), is a communication technology that uses light as the main carrier to transmit data from one device to another. Ypsomed is using VLC for transmitting data to and from one of their products, the YpsoMate On. The purpose of this thesis is to test the effectiveness of the concept when applied to multiple devices simultaneously, and create a prototype to demonstrate it.

Introduction

The VLC is applied in secure communication and high-speed or wide-area data transmission, it currently finds also particular application in the field of Internet Of Things. Ypsomed is developing a new model of smart auto-injector called YpsoMate On, including a system capable of connecting to the user's smartphone via Bluetooth, to record data concerning the injections. Ypsomed is testing VLC to transmit data to and from the electronics on the back cap of this device, via a LED normally used to notify the user that the injection has ended. The goal of this project, is therefore to use the VLC to develop a concept for reading data from multiple devices simultaneously.

Approach

The main challenge is to be able to receive the transmitted data from each device at the same time, a thing that would save time once applied to multiple devices. Two basic approaches were compared, one by using a matrix of light sensors and one based on the use of a video camera to record the transmitted data. After an initial evaluation of the pros and cons of each system, and the formulation of a more detailed concept for each, the camera-based system was chosen as being more versatile.

The concept was turned into a prototype by developing the necessary electrical circuits and mechanical components. Then a program was developed to enable processing of the recorded images and the analysis of the collected data. Finally, a simple Graphical User Interface was developed to allow the end user to interact with the system and visualize the received data.

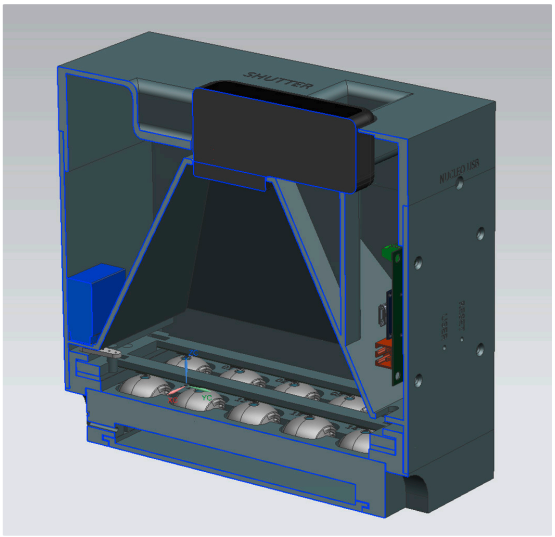
To test the system, a simulation of the real working conditions in which it could be implemented was developed, which helped to identify possible challenges.

Results

The complete prototype was tested on 20 devices placed in a 4x5 holder. Those devices were transmitting a binary signal at a baud rate of 100 bps. The result was the uncorrupted reception of about half of the sent data. While this result highlights that the software involved in detecting the sent signal needs improvement, this also proves the fact that the VLC system for this application can be used on multiple devices at the same time as well.

Outlook

On hardware side, some details can still be improved, such as sliders to help move the mobile parts more smoothly, but the concept has proven to be reliable. The software is the part that can still be enhanced the most, making the whole process faster by identifying which operations take the longest time and optimizing them, or making it more reliable with an automatic recognition of the device positions. The data collected could also in the future be analyzed to enable the program to evaluate their integrity.



Section of the CAD model of the produced prototype

Federico Gianfranco Giorgio Dalessi
fede.dalessi@bluewin.ch