Bachelor Thesis Project Proposal
Visible Light Communication with Smartglasses

February 9, 2016

Description

The existing Visible Light Communication (VLC) library implemented at Disney Research en-
ables communication of heterogeneous microcontroller-based VLC devices such as smart objects,
toys, and light bulbs. The library includes a Physical (PHY) layer and a Medium Access Control
(MAC) layer [1, 2] for several microcontroller architectures [3, 4, 5] providing a basic API for
visible light LED-to-LED communication systems.

One application of VLC is LED to low-cost camera systems. In particular, recent work
focused on smartphones and tablets. The camera can be used to receive data with modulated
light from a VLC-enabled system and the phone flashlight can transmit data with specific flash
patterns to another VLC system [6]. Although external passive components, such as an audio
plug, can provide relative high data rates [7], using external hardware might be inconvenient and
bulky in some circumstances.

In this thesis, we explore the LED to smart glasses VLC communication channel. Smart
glasses use low-cost vision systems to sense the environment and augment the reality through
head mounted displays. In this work the camera will be able to read hidden VLC-enabled LEDs
to receive optical beacons such as location markers or additional pieces of information.

Expected Results

The goal of this thesis is to exploit the smart glass camera components and processors to receive
and decode VLC messages. The VLC library will run on the glass operating system or on a
connected smartphone.

The system can be built on top of already existing software implementations [6, 7, 8]. The
software running on the glass or on a smartphone should recognize incoming messages by an-
alyzing readings from the camera(s). It should also be investigated if it possible to receive from
multiple light sources at the same time. The implementation’s performance should be evaluated
using a testbed consisting of multiple different VLC devices. How light intensity influences the
vision of the person that carries the glasses should be investigated as well. Further should be
investigated how to change the VLC protocol to make the communication more efficient, e.g.
decrease packet error rate or increase the communication range.

The following deliverables are expected:
• Implementation of the VLC communication system on Android smartglasses
• Testbed based on the implemented system and other VLC devices
• Evaluation and performance analysis for the implemented systems
• Written report and oral presentation

Required Skills

• Good programming skills in C/C++/Objective C/Java
• Experience with iOS and Android development
• Experience in software engineering for embedded systems
• Basic knowledge in working with microcontrollers
• Basic knowledge of electrical circuits for LEDs

Grading

Grading will be based on the following criteria:

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Weight (± 0.5)</th>
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<tbody>
<tr>
<td>Implementation (functionality, extensibility, documentation)</td>
<td>3</td>
</tr>
<tr>
<td>Report (content, illustration, writing)</td>
<td>2</td>
</tr>
<tr>
<td>Presentation (content, illustration, quality of talk)</td>
<td>1</td>
</tr>
<tr>
<td>Approach (organization, approaching problems, independence, involvement)</td>
<td>1</td>
</tr>
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<td>Contribution to the state of the art research</td>
<td>1</td>
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<tr>
<td>Completion of all tasks</td>
<td>3</td>
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Each criterion will be graded in accordance with the “Merkblatt zur Bachelor-Arbeit in Informatik nach Studienreglement 08”.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Requirements</th>
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<tbody>
<tr>
<td>6.0</td>
<td>Extraordinary quality, the results are much higher than expected.</td>
</tr>
<tr>
<td>5.5</td>
<td>Thesis results are very good; student expanded on the original theme.</td>
</tr>
<tr>
<td>5.0</td>
<td>Thesis meets expectations.</td>
</tr>
<tr>
<td>4.5</td>
<td>Thesis partially meets expectations and has minor deficits.</td>
</tr>
<tr>
<td>4.0</td>
<td>Thesis meets minimum quality requirements; but has deficits and is below expectations.</td>
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</tbody>
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Thesis Supervision

Advisors:
Gábor Sőrös, ETH Zurich, gabor.soros@inf.ethz.ch
Stefan Schmid, Disney Research & ETH Zurich, stefan.schmid@disneyresearch.com
Supervisors:
Dr. Giorgio Corbellini, Disney Research, giorgio@disneyresearch.com
Prof. Thomas Gross, ETH Zurich, thomas.gross@inf.ethz.ch
Prof. Friedemann Mattern, ETH Zurich, mattern@inf.ethz.ch

References


