Demo: Video Transmission Using Low-Cost Visible Light Communication

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ABSTRACT

In this paper we document the demo of the latest version of OpenVLC, a low-cost platform for communicating using Visible Light, and we prove we can transmit video with it. This paper shows the setup used, the behavior of each of its components, and the results expected. This is the first time video transmission has been possible with OpenVLC and to the best of our knowledge, the first time it has been done with low-cost components.

CCS CONCEPTS

• **Computer systems organization** → **Embedded systems**; • **Networks** → *Wireless local area networks*; • **Software and its engineering**;

1 INTRODUCTION

Visible Light Communication (VLC) has been pointed in the last years as a new technology to connect to the Internet [1][15]. In the last few years there has been several applications which use VLC: communication with toys [9], human sensing [6], indoor localization [5][14], mobile interaction [13], and passive VLC [11][12].

Nevertheless, the access to VLC technology is not trivial as communications using light in the free space have physical properties immensely different to other Radio Frequency (RF). This makes difficult to start the research in VLC systems. This is why we introduced OpenVLC at the VLCS'14 workshop [10]. OpenVLC is a Open Source VLC platform that we have improved since then [3][2].

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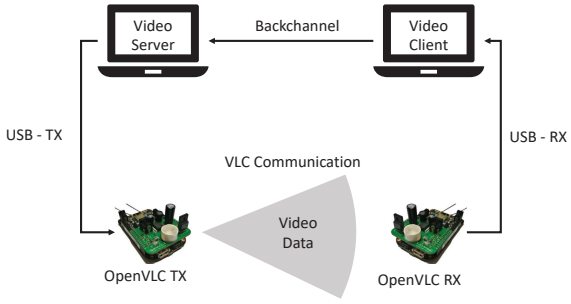

Figure 1: System scheme. Each black line represents a a different communication link.

Although there has been other projects [8][4] that have transmitted video using light, this is, to the best of our knowledge, the first work that tries to minimize the cost of the system, while trying to have a throughput sufficiently high for video transmission.

In this demo, we show the capabilities of the latest OpenVLC version. Due to the increase in throughput compared to previous versions, we are able, for the first time, to transmit video through VLC using the OpenVLC platform.

2 SYSTEM VIEW

The system that has been designed and implemented has several components that are described here separately. Due to space constraints, no picture of the setup is shown but a video URL is provided in Sec. 3.

2.1 VLC link

The VLC link is the main component whose performance is shown in this demo. The VLC link is created using two BeagleBone Blacks (BBB) with two OpenVLC capes on top. One of the BBBs is used as VLC transmitter (TX) and the other as VLC receiver (RX). In the current version, maximum UDP throughput of this link 415 kb/s.

2.2 Video transmission and playback

In order to transmit and reproduce the video we use a HTTP stream. One computer behaves as a HTTP video server and

the second as a HTTP client. Both computers are running Ubuntu 18.0.4. For the server, we use an Apache 2.4.29. The video is stored as a Transport Stream file (.ts) as it is the best format for our case scenario. It is compressed in MPEG format using FFmpeg and ready to be transmitted, minimizing workload on the computers.

2.3 Network connections

The VLC interface that this demo uses is OpenVLC1.3. OpenVLC has increased the throughput to more than 400 kb/s. This allows users of OpenVLC to have a data-rate high enough to, for the first time, be able to transmit video in real-time.

The transmission between the computers and the BBBs where OpenVLC software is running is done through USB using TCP/IP. The OpenVLC software and firmware then handles the hardware control and packet TX and RX.

OpenVLC1.3 creates a VLC simplex connection. This follows the current trend where VLC hybrid system are usually deployed with VLC as downlink and RF as uplink [7]. Nevertheless, as in any communication system, there are sometimes transmission errors. Without a backchannel, the video shows errors and the performance of the system may drop dramatically. For this reason, the nodes of the system have been prepared to transmit the control messages necessary for the retransmission of lost video packets. Messages in the backchannel are sent using Ethernet. A scheme of the system can be seen in Fig. 1.

3 RESULTS

Once the system has been correctly configured and all the devices set up, the video client (which is responsible for playing the video) makes an HTTP request to the server through the backchannel and then the server replies through VLC.

The video player has a buffer that is used to store the video. In case of an error, the buffer should be large enough to allow the video player to request the missing packets without disrupting the transmission. Nevertheless, if we voluntarily interrupt the connection, for example putting our hand on top of the LED, it can be seen how the video stops as soon as the buffer is depleted.

Multiple video qualities have been tested, from 480p to 720p. When no VLC link blockage is present, the system is able to transmit the videos without perceivable errors. Nevertheless, having a fixed buffer size, what we see is that although the amount of video in bits is the same, the buffered time is higher when the quality is lower.

All the code for running this demo can be found in the Github repository of OpenVLC. https://github.com/openvlc/OpenVLC. The video showing the demo of our system running a can be found at https://youtu.be/DeEhffECR5k.

The organization should provide a long table of 2 meters and a power connection. The BBBs, capes and computers will be provided by IMDEA Networks Institute.

4 CONCLUSION

In this demo we show the capabilities of the latest OpenVLC, which is now able to transmit real-time video using low-end embedded system. This can be done due to the improved communication throughput that OpenVLC allows. We hope that the new capabilities and easy access of OpenVLC will attract new researchers and developers.

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