

Project: IEEE P802.15.7a OCC TG

Submission Title : Bi-level Pulse Position Modulation (BPPM) for Single Camera-based Optical Vehicular Communication

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Source : Md. Osman Ali and Yeong Min Jang

Company : [Kookmin University]

Address : [Seoul, Korea]

Voice : [+82-2-910-5068], E-Mail: [yjang@kookmin.ac.kr]

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Abstract : This document focuses on a new modulation techniques for optical vehicular communication.

Purpose : To convert the current two camera-based optical vehicular communication system into one.

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Introduction

- ❑ Optical camera communication (OCC) uses an LED array as a transmitter and cameras as a receiver.
 - ❑ Nowadays, most of the modern cars are equipped with one or multiple cameras for driver assistance.
 - ❑ Additionally, OCC uses license free visible light spectrum that is almost interference free.
 - ❑ Hence, vehicular OCC system is considered as one of the potential candidate for vehicular communication.
 - ❑ The concept of connected vehicles is expected to play a key role to ensure road safety by providing safety and non-safety information to the drivers.
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OCC operating principle

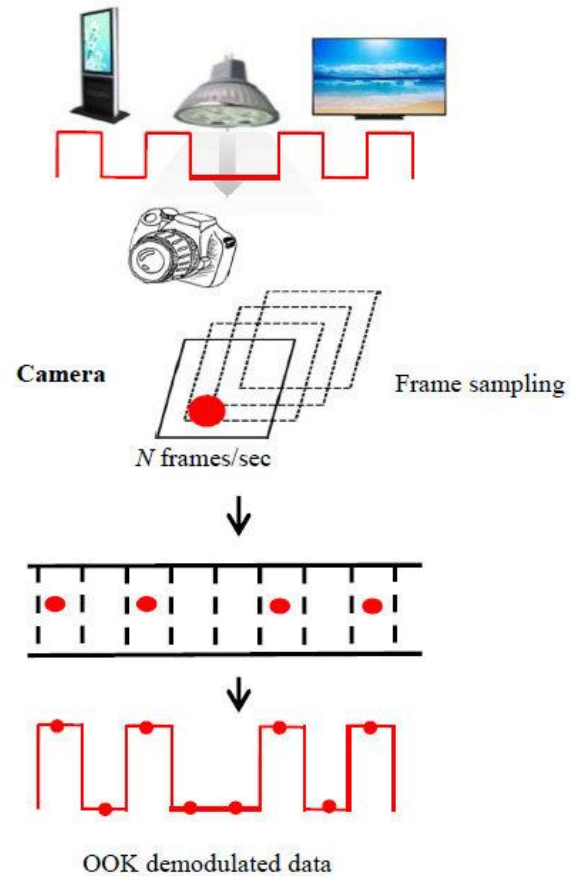


Figure 1. Basic operating principle of OCC.

Distinguishing between different transmitters



Figure 2. A congested traffic scenario at night time

- ❑ There are a large number of vehicles along with numerous interfering light sources on the streets.
 - ❑ Thus, every vehicle needs unique vehicular ID to be distinguished from other vehicles.
 - ❑ Therefore, vehicular IDs need to be transmitted to establish a successful communication link prior to communication data.
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Current two camera-based modulation techniques

- ❑ At present, there are only two modulation techniques for VOCC system, such as Twinkle-AM and HS-PSK.
 - ❑ In both case, a low-rate stream is transmitted as vehicular ID along with the high-rate stream used for transmitting necessary information to the drivers.
 - ❑ In Twinwle-AM, the low-rate stream is generated by varying the pulse width of the variable pulse position (VPPM) waveform.
 - ❑ On the other hand, in HS-PSK, the low rate spatial 2-phase shift keying (S2-PSK) is generated by varying the dimming level of DS8-PSK waveform.
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Proposed BPPM technique

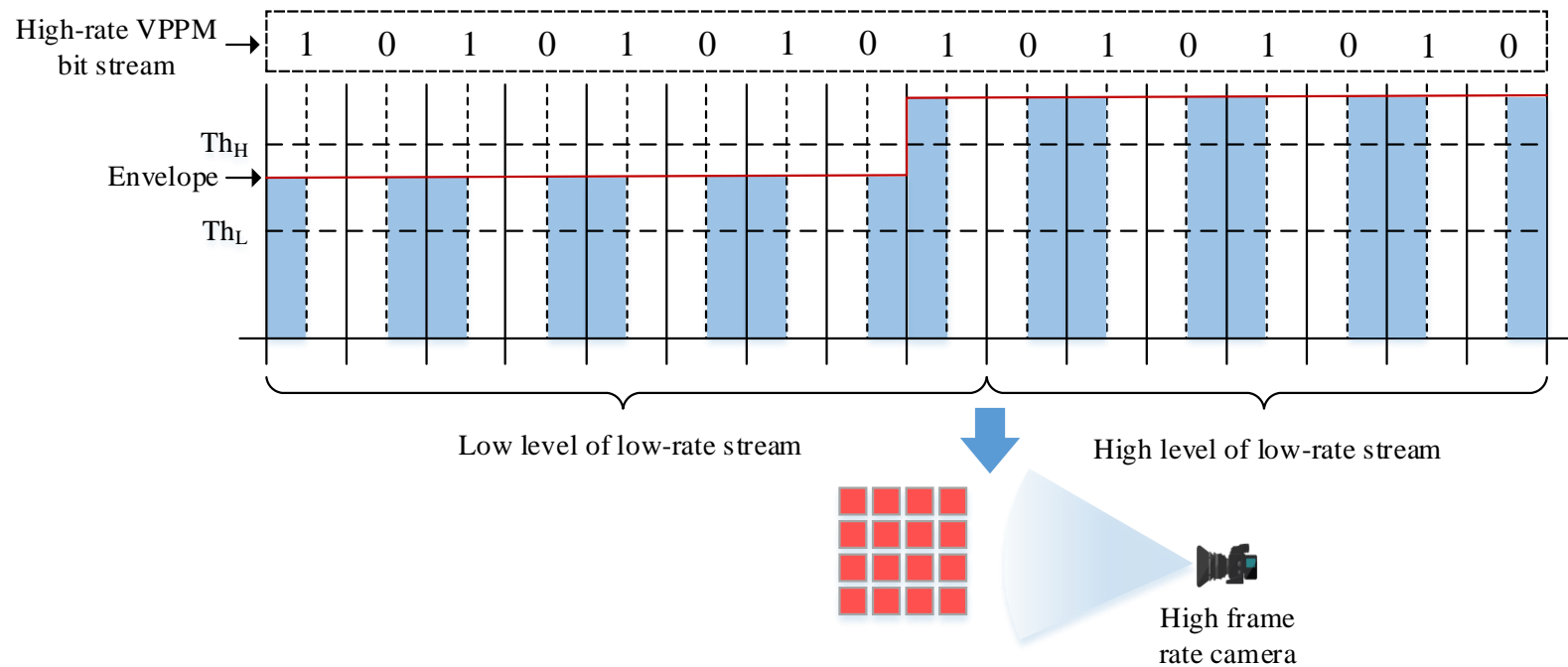


Figure 3. Proposed bi-level pulse position modulation technique for vehicular OCC system.

General architecture of VOCC system

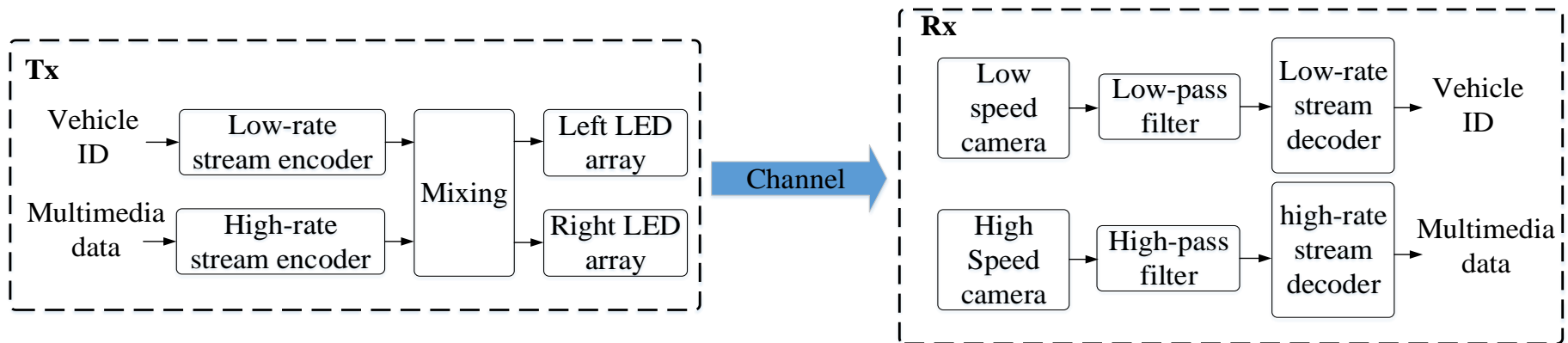


Figure 4. General block diagram for VOCC system

Proposed architecture for VOCC system

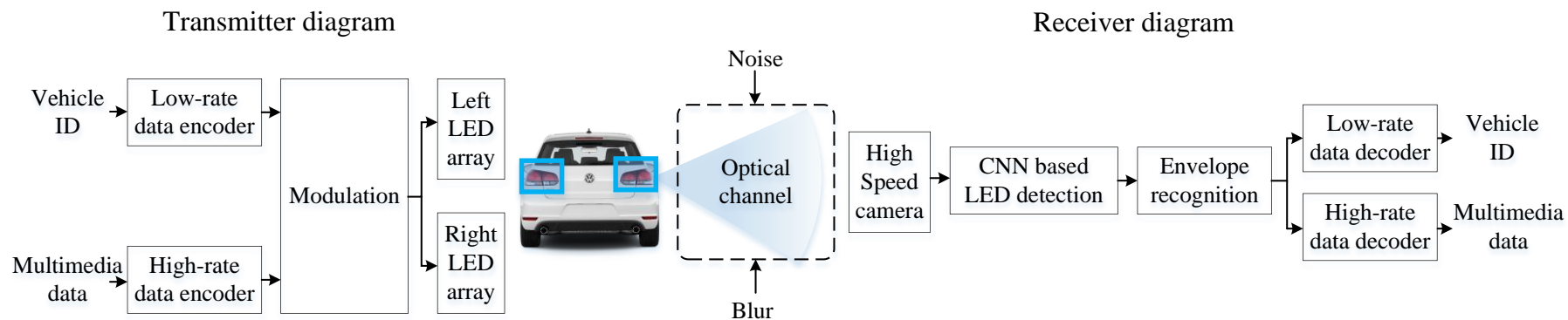


Figure 5. Proposed single camera-based VOCC system.

Conclusions

- ❑ The proposed modulation technique has converted the two camera-based vehicular OCC system into one.
 - ❑ This system uses adaptive thresholding technique by considering the high and low level of the BPPM signal.
 - ❑ It supports the high mobility of the vehicles.
 - ❑ It is an economical system as it eliminates the necessity of low speed camera.
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