Low-Cost Synchronization for Multispectral Cameras

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Abstract - In this paper, we introduce a low-cost multicamera synchronization approach. Our system is low-cost to make, easy to handle and convenient to use. Proposed system can be employed in single- and multi- spectral various cameras, and also used in any devices which support the external trigger. As a result, our system shows a good performance comparing with hand-eye synchronization, and we also shows that synchronized images are enough to use in ADAS systems.

Keywords - Multicamera system, Synchronization

1. Introduction

In multicamera system, the synchronization problem is very important in term of how to capture, and how to save. Generally, the external triggering and real-time operating system are widely used to capture and save multiple images simultaneously. Data acquisition (DAQ) devices are employed when we generate trigger signals. Especially, NI-DAQ devices are supported by Labview for controlling and measuring signals. Due to this convenience, many researcher prefer this kinds of devices. Linux is favorite real-time operating system, because we can easily determine when each thread is run. However, in this paper, we introduce a multicamera synchronization system without special devices and real-time operating system.

2. Our system

Our system consists of two visible cameras and one thermal camera (Fig.1). Built in cameras support the ethernet interface, so these cameras can be controlled from eBus protocol.

2 × PointGrey Flea3 color camera (FL3-GE-13S2C-C), 1280×960, 400∼750nm.

1 × FLIR A35 thermal camera, 320×256, 7.5 ∼ 13um.

Fig.2 shows our configuration. Our thermal camera has a trigger generator in itself, and this function can be used to synchronize with other devices. For this master-slave synchronization technique, *SyncMode* in a thermal camera should be set to *SelfSyncMaster*, and visible cameras need to set by *Trigger Mode 14* (Overlapped Exposure/Readout Mode)[1], also PIN3 to trigger input.

This setup is enough to capture high-resolution and high-framerate images from muticameras. We will show more details in experiment.

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[1]FLIR does not recommend using the external sync interface with a slow-configured camera because there is ambiguity as to which received pulse triggers the frame timing.
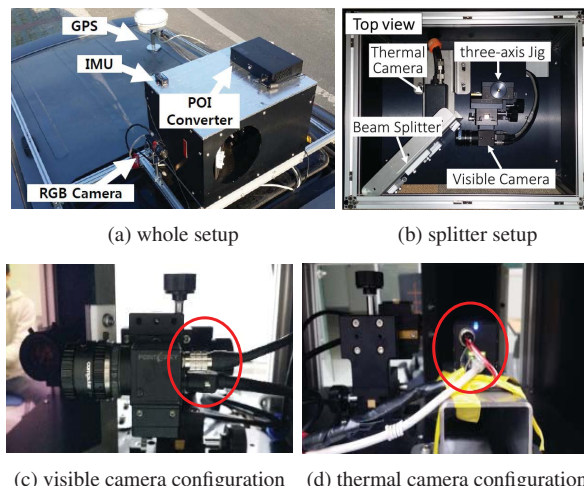
(a) whole setup   (b) splitter setup

(c) visible camera configuration   (d) thermal camera configuration

Fig. 1 (top) our system on top of vehicle, (bottom) GPIO configurarion for external trigger.

Thermal Cam : Signal Generator (Master)

1	RET_GB
2	PWR_GB
3	SYNC_OUT
4	SYNC_OUT_GND
5	SYNC_IN
6	SYNC_IN_GND
7	GPO+
8	GPO-
9	GPIO_PWR
10	GPIO_GND
11	GPI+
12	GPI-

Visible Cam #1 (Slave #1)
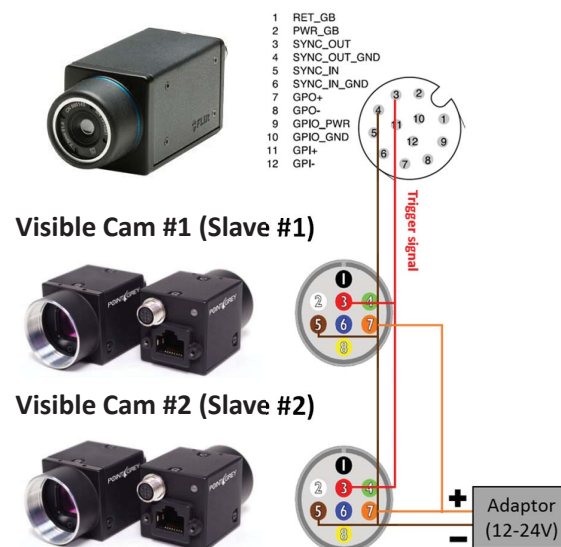
Visible Cam #2 (Slave #2)

Adaptor (12-24V)

Fig. 2 Multicamera setups with visible and thermal cameras.

3. Experiment

Our dataset in Fig.3. is captured in KAIST-Campus, and these figures are collected in different time and similar time-stamp. Forth column of Fig.3 shows fused visible and thermal images. From this, we can see how accurate our system can be captured. This system is also evaluated by visual place recognition and pedestrian detection in day and night. In those applications, we show that our system works well enough.

Thermal	Visible-Splitter	Visible-Stereo	Beam Splitter Alignment

Fig. 3 These figure are dataset examples captured from the same location during a day.

4. Conclusion

This paper introduce a multicamera synchronization technique using a signal generator in a thermal device without expensive special device. As a result, our technique gives enough timing to capture and save images for the exact alignment, and captured dataset works well in two applications such as visual place recognition and pedestrian detection in day and night.

References

[1] S. Hwang et al., Multispectral Pedestrian Detection: Benchmark Dataset and Baseline, CVPR, 2015.
[2] Y. Choi et al., All-Day Visual Place Recognition: Benchmark Dataset and Baseline, CVPRW-VPRICE, 2015.