A Practical High Efficiency Video Coding Solution for Visual Sensor Network using Raspberry Pi Platform

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Abstract

Visual sensor network (VSN) has recently emerged as a promising solution for tremendous range of new vision-sensor based applications, from video surveillance, environmental monitoring to remote sensing. However, the practical VSN currently faces to the visual processing and transmitting problems due to the limitation of power at sensor nodes and the restriction of transmission bandwidth. In this context, the selection of a suitable video compression algorithm is utmost important task for achieving a practical VSN. To address this problem, this paper introduces a practical Raspberry Pi based High Efficiency Video Coding (HEVC) solution for visual sensor networks. The selected video coding solution is one of the most up-to-date compression engines but still achieving the low complexity capability. Experimental results show that the proposed video coding architecture has good compression performance with acceptable complexity performance.

Keywords: Visual sensor network, Raspberry Pi, HEVC

1. Introduction

Nowadays, Visual Sensor Networks (VSNs) [1, 2] plays an important role in the era of Internet of Things. A VSN typically consists of a large number of sensor nodes, i.e., cameras. VSNs have been successfully applied in many applications such as video surveillance and security system where a network of nodes can identify and track objects from their visual information, i.e., video. Such networks are made up of multiple cameras capable of capturing visual information from their surrounding environment, performing simple processing on the captured data and transmitting the captured data to remote locations for further content analysis and distribution.

However, in a VSN, sensor nodes usually have limited processing capabilities and power budget. This constrains naturally requires lightweight video signal processing and compression algorithms for individual sensor nodes. At the same time, the restriction of the transmission bandwidth in a VSN also asks for an efficient video compression solution which must be used at each sensor node. These two requirements are critical to achieve a practical VSN system.

Video coding aims to reduce the size of video data by exploiting the spatial, temporal and statistical correlation of video and the human visual system characteristics. The current video coding standards, such as H.264/AVC [3] or High Efficiency Video Coding (HEVC) [4] can drastically reduce the size of transmitted video data while still guaranteeing the acceptable decoded information at the receiver. HEVC is the most recent video coding standard, which provides around 50% of bitrate reduction in comparison with the widely deployed H.264/AVC standard [3] while preserving the same subjective quality. However, the achievement of compression efficiency of HEVC usually associates to a large number of coding modes and selection process, i.e. 35 directional intra predictions, expensive motion estimation process. This may restricts the use of video compression engine in a practical VSN.

In this context, we present a practical, low complexity HEVC solution for visual sensor network using the common Raspberry Pi platform [5]. The low complexity characteristic is achieved by using an appropriate HEVC compression profile as described later. The Raspberry Pi platform is chosen as it is popular, low cost and be able to play the role of sensor nodes in a visual sensor network. HEVC Test Model (HM) reference software [6] is used to provide implementation of HEVC encoder.