Title

Investigation of Architectures for Wireless Visual Sensor Nodes

Abstract

Wireless visual sensor network is an emerging field which has found its uses in many applications, including industrial control and monitoring, surveillance, environmental monitoring, personal care and virtual world. Traditional imaging systems used a wired link, centralized network, high processing capabilities, unlimited storage and power source. In many applications, the wired solution results in high installation and maintenance cost. However, wireless solution is preferred choice as it offers less maintenance, infrastructure cost and greater scalability.

The technological developments in image sensors, sensor networking, distributed processing, low power processing and embedded systems have paved the way for smart camera networks usually referred as wireless visual sensor networks (WVSNs). The smart cameras can perform complex vision tasks using limited resources such as batteries or alternate energy sources, embedded platforms, a wireless link and a limited storage facility.

Current research in WVSNs is focused on reducing the energy consumption of the node so as to maximize the life of the sensor node. To meet this challenge, different software and hardware solutions are presented in the literature for the implementation of vision sensor nodes.

The focus in this thesis is on the exploration of energy efficient reconfigurable architectures for vision sensor nodes by partitioning vision tasks on software, hardware platforms and locality. For any application, some of the vision tasks can be performed on the sensor node and then data is sent over the wireless link to the server where remaining of the vision tasks are performed. Similarly, at the sensor side, vision tasks can be partitioned on software and hardware platform.

In this thesis, all possible processing strategies are explored for our application, by partitioning vision tasks on the sensor node and on the server. The energy consumption of the sensor node is evaluated for different strategies. It is observed that performing some of the vision tasks on the sensor node and sending compressed images to the server where remaining of the operations are performed, will have less energy consumption.

In order to have better performance and low power consumption, Field Programmable Gate Arrays (FPGAs) are introduced for the implementation of sensor node which further improves the results. The suitable strategies with reasonable design time and hardware costs are implemented on hardware-software platforms. Based on the implementation of the vision sensor node on FPGA together with micro-controller, the life time of the vision sensor node is predicted using the measured energy values of the platforms for different processing strategies. The implementation results prove our analysis that a vision sensor node with such characteristics will result in a longer life time.