Event-Based Imaging with Active Illumination in Sensor Networks

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***Abstract*—We discuss a distributed imaging architecture with active illumination for sensor network applications. An event-based CMOS imager is employed at the sensor level, to convert light intensity at each pixel into pulse density modulated stream of address events. The wireless nodes are commercial off-the-shelf Motes. Energy-aware communication is implemented at the sensor level by employing an eventbased readout. Additional computation for data reduction is accomplished at the sensor/mote interface level by modulating the event-rate produced by the sensor array to match the bandwidth and latency constraints in the communication network. Information transmitted in the limited bandwidth links of the network yields effective means for detection and partial recognition of the object even at very low bit rates and frame latency as low as** 1*s*.

I. INTRODUCTION

Sensor network nodes must operate under strict power budgets, as dictated by the need to prolong battery life [1]. This requirement calls for a power-conscious design from high-level algorithms down to the circuit implementation. While today a majority of sensor network applications are aimed at sensing and communication of scalar values of data such as temperature, pressure and humidity [2], [3] future networks need to address the challenging problem of sensing and communicating vector data such as images [4], [5]. It should be pointed out that more often than not, the goal of the information processing in such systems is not the precise restitution of the vector data (such as in the scalar sensing case), but rather the extraction of relevant information in a timely manner. It is about finding answers just-in-time locally and co-operatively to questions such as:

• Is there something interesting in the environment? (detection) In a specific class of objects (identification)

• Where is it? (location)

• What is it? (recognition)

In this paper, we report on an architecture for ”eyes” in sensor networks. The system employs event-based image sensor (*ALOHA* imager) [6] and COTS motes forming a sensor network [7] using standard *TinyOS* software interfaces. By actively illuminating the scene through the sensor network infrastructure, the delivery and capture of photons is done in context and in a situated environment, thus spending resources only when necessary.

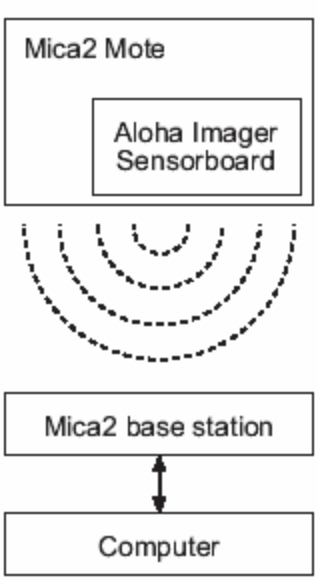

Figure 1. A schematic of the prototype system.


Figure 2. Mica2 mote with interface board and event-based CMOS imager.

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