Demo: The Eyes of Things Project

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ABSTRACT

The Eyes of Things project envisages a computer vision platform that can be used both standalone and embedded into more complex artifacts, particularly for wearable applications, robotics, home products, surveillance etc. The core hardware will be based on a Software on Chip (SoC) that has been designed for maximum performance of the always-demanding vision applications while keeping the lowest energy consumption. This will allow "always on" and truly mobile vision processing. This demo presents the first prototype applications developed within the EoT project. First, example vision processing applications will be shown. Additionally, an RTSP server implemented in the device will be demonstrated. This server can capture and stream images. Finally, connectivity will be shown using a minimal MQTT broker ("Pulga") specifically implemented for the device.

CCS Concepts

•**Computing methodologies** → **Computer vision;** •**Computer systems organization** → **Embedded systems;** •**Hardware** → *Emerging technologies;*

Keywords

embedded vision; computer vision; Eyes of Things

1. INTRODUCTION

Vision, our richest sensor, allows inferring big data from reality. Arguably, to be "smart everywhere" it is necessary to have "eyes everywhere". Coupled with advances in artificial vision, the possibilities are endless in terms of wearable applications, augmented reality, surveillance, ambient-assisted living, etc. Currently, computer vision is rapidly moving beyond academic research and factory automation. However, no flexible and optimized platform for embedded vision is currently available.

The main objective of Eyes of Things project (EoT) [1] is to build an optimized core vision platform that can work independently and also embedded into all types of artefacts (Figure 1). The envisioned open hardware must be combined with carefully designed APIs that maximize inferred information per milliwatt and adapt the quality of inferred results to each particular application. This will not only mean more hours of continuous operation, it will allow to create novel applications and services that go beyond what current vision systems can do, which are either personal/mobile or "always-on" but not both at the same time.

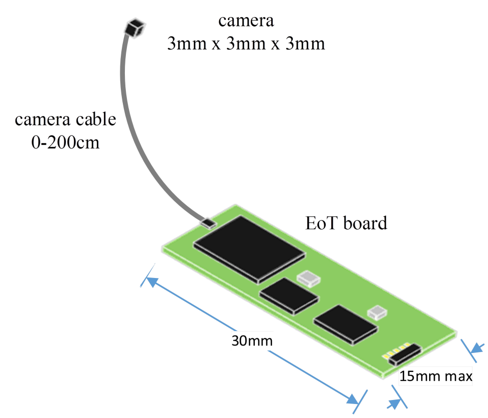

Figure 1: EoT device

Software is being developed in parallel to the design of the SoC, at both the low and middleware levels, and also for a number of demonstrators. The demonstrators span applications in four scenarios: security, augmented reality, cloud processing and perceptual computing. Each scenario will involve the creation of a specific vision app for the device

ICDSC 2015 September 8–11, 2015, Seville, Spain

DOI: 10.475/123_4

that will be deployed using the middleware API.

The EoT platform must be flexible and easy-to-use. In this respect, the core platform also includes a low-power state-of-the-art WiFi chip. This provides mechanisms that allow both image streaming and metadata communication. This demo will also show these aspects.

2. DEMO STRUCTURE

This demo will have 3 main parts: basic computer vision examples with HDMI ouput, MQTT messaging management and RTSP streaming through WiFi connection.

2.1 Basic examples

In this part of the demo the current prototype of EoT device and some examples of its vision libraries will be shown. Concretely, the demo will focus on showing some simple computer vision operations and the output on an HDMI screen (Figure 2).

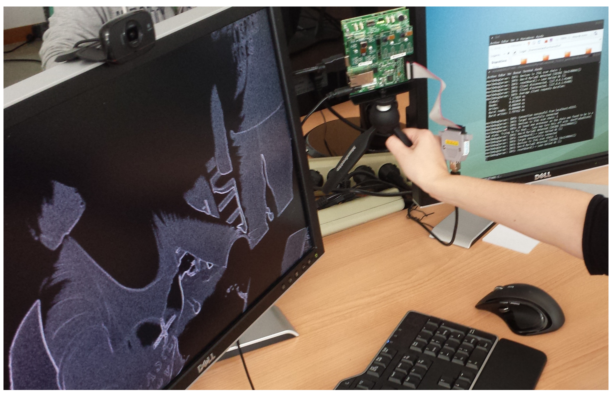

Figure 2: Basic embedded vision examples

2.2 MQTT messaging in EoT device

Since EoT is intended for mobile battery-operated devices, an efficient communication layer protocol is necessary. That protocol will be used for sending the results of computer vision processing, including text, images or other types of data. For this purpose, the approach proposed is to use the MQTT protocol. MQTT is a lightweight publish/subscribe protocol designed for use over TCP/IP networks which provides an efficient 1-to-n communication mechanism. While other common protocols such as HTTP are text-oriented, MQTT has been designed for low bandwidth and unreliable or intermittent connections. MQTT-enabled devices can open a connection, keep it open using very little power and receive events.

Most IoT devices include an embedded client which connects to an MQTT server (broker) in the cloud. However, we propose an architecture in which each EoT device can act as a broker. This way no external server will be needed, and data will not be initially sent through the internet. In fact, the configuration device and the EoT node do not need to be in a Wi-Fi network infrastructure, since an ad hoc connection can be established. This allows setting up applications in which only the EoT and another device (say, a tablet) are involved. That is in fact the default mode upon boot, with the possibility of connecting to an existing WiFi network as an option.

In this part of the demo a minimalist MQTT broker for IoT devices and some examples of its usage will be presented (Figure 3). This broker (called Pulga) will be made open-source.

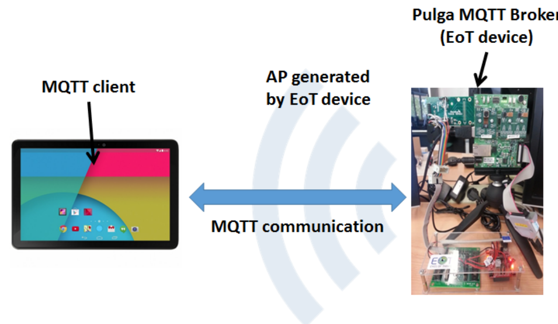

Figure 3: MQTT broker demo

2.3 RTSP streaming

EoT devices should provide means to stream video in known ways. Otherwise we would risk integration with existing services such as video surveillance clients and cloud-based video analytics. Streaming may be also useful to configure or monitor the vision application from an external device like a tablet or PC. For all these reasons EoT will also implement the RTSP/RTP application layer protocol typically used for video streaming in IP cameras.

Streaming with RTSP/RTP will be controlled by the application running in the EoT device and/or externally via MQTT commands sent to it. This allows using the energy-consuming streaming only for specific applications and only when it is needed.

In this part of the demo the RTSP server for the EoT device and its usage with mobile clients (tablets) will be presented (Figure 4).

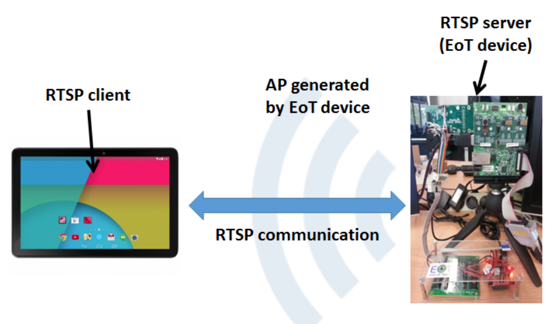

Figure 4: RTSP server demo

3. ACKNOWLEDGMENTS

This work is supported by the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No. 643924 (EoT Project).

4. REFERENCES

[1] http://eyesofthings.eu. Last accessed: 26th of June 2015.