Demo Abstract: The Signpost Network

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ABSTRACT

The era of city-scale sensing is dawning. Supported by new sensing capabilities, the capability to detect and measure phenomena throughout a large area will allow deeper insight and understanding into how cities work. The challenge of city-scale sensing is not limited to developing new sensing applications, however. A sensor must be installed in a location. It must be provided power, storage, and communications. All these tasks stand aside from the desired sensing effort, but are necessary nevertheless.

In this demo, we introduce an initial prototype for a modular, city-scale sensing platform—the signpost network. The platform, designed to be physically attached to sign posts throughout a city, reduces the burden for sensor and application developers by providing the necessary resources to modules attached to it. Power is provided by harvesting from solar panels with battery storage, with each module allocated a certain subset of the system energy. The signpost platform also provides data storage, long-range communication, data processing, module isolation, and an installation point for connected modules. The signpost acts as a modular base station for researchers, citizen scientists, and other interested parties to deploy custom sensors for applications such as pedestrian counting, air quality monitoring, and RF spectrum sensing at a city-wide scale.

Categories and Subject Descriptors

B.4.2 [HARDWARE]: Input/Output and Data Communications—Input/Output Devices; C.3 [COMPUTER-COMMUNICATION NETWORKS]: Special-Purpose and Application-Based Systems

Keywords

City-scale sensing, Modular architecture, Energy harvesting

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Figure 1: Signpost in an urban setting. Sign posts are natural and unobtrusive sights in even modestly urban settings. The form factor is conducive to reasonably large solar panels and provides area for mounting a diverse array of sensor modules, all while blending into the background environment of a city.

1. INTRODUCTION

It is well-known in the sensor networking community that in many cases, “sensing” is the easy part. The most challenging aspects of many deployments are providing energy to the sensor, facilitating a reliable communication channel, handling long-term storage of sensor data, and in many cases physically deploying the sensor itself.

In this demo, we begin to explore a possible new approach to solving these challenges in urban environments. In contrast to previous city-scale deployments, which rely on cooperation from local industries such as taxi and bus companies [1] or the local municipality [2], we aim to provide a standalone infrastructure by deploying a network of energy-harvesting signposts, such as that seen in Figure 1.

Our proposed signpost platform includes a large, sign-sized solar panel for energy harvesting, a battery for time-shifting energy availability, a power module for metering, rationing, and distributing energy, a communications module for cloud and signpost-to-signpost connectivity, a storage module for long-term data collection, a computation module for local processing, and a controller module to manage all of these components. The signpost uses these modules to provide the essential services – energy, storage, computation, and communication – to sensor modules that plug in to the signpost.

The goal of the signpost network is to act as an easily deployable, infrastructure-independent platform for city-scale sensing. Persons
At the same time, our proposed signpost network requires minimal installation, isolation, power, storage, communication, and computation allocation and modify their behavior. Modules wishing to be agnostic can do so, but will be shut down by the controller once their current energy conditions can query the controller for their remaining energy allotment.

Signpost provides both capabilities through LoRa, a low-power wide area network operating in the 915 MHz band.

Finally, data collection necessitates storage and processing capabilities. While each module can maintain its own storage, they may also take advantage of a centralized data store. This can be used by applications which synthesize data from several modules in order to gain deeper insight. Since processing collected data in embedded code can be a difficult task, signpost introduces the capability of Linux-as-a-coprocessor. Each module can request to activate the Linux, running applications of their choosing and paying out of their own allotted energy store.

3. DEMO

For the demo, we will bring a signpost platform with several installed sensing modules, demonstrating the signpost architecture as well as several possible applications. The platform will be capable of energy-harvesting, power allocation, module isolation, data storage, data processing, and long-range communication. Modules and applications include an RF-spectrum sensing module, shown in Figure 2, an environmental sensor, and a pedestrian tracker.

Along with demonstrating the applications themselves, we will show how the signpost architecture enables and affects the sensing modules. This includes automatically adapting module duty-cycle as stored energy fluctuates and enabling local synthesis and processing of data from multiple applications.

As we expect the demonstration space to be indoors, we plan to simulate the signpost adapting to dynamic energy availability (i.e. how much energy the solar panel is collecting), however, if a space near a window, sunlight, and/or the outdoors is available, that would be ideal.

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5. REFERENCES
