An Integrated Chassis Manager Card Platform Featuring Multiple Sensor Modules*

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Abstract. The gradually growing demand for experimentation of protocols designed for wireless networks in real environments has resulted in the development of experimental network facilities (testbeds). Most currently deployed testbeds have been designed so as to offer services to experimenters that lie within the testbed's premises, thus limiting the accessibility to external users. The requirement for multi-user access of network resources has led several large-scale testbeds to provide remote access services to certified experimenters. However, management and maintenance of large-scale remotely accessible testbeds is a rather challenging task that requires proper hardware, as well as software custom-built tools. In order to provide for remote switching of testbed nodes, NITOS has developed a new chassis manager (CM) card and also a custom framework that allows for monitoring and controlling of the nodes' operational mode. In addition, NITOS CM card provides for gathering of various types of sensor measurements, through the attached temperature, humidity and light intensity sensor modules. Another innovative characteristic of the proposed card is that it provides the experimenters with the ability to monitor the energy consumption of each testbed node, which is rather important for experimentation with power optimization schemes. In this demo, we will present the various functionalities of the NITOS CM card and the developed control framework that accompanies it.

Keywords: Chassis Manager, Testbed administration, Wireless Sensor Networks, Power Consumption Measurements.

1 Introduction

Remote administration of testbed resources requires proper custom-built solutions that are composed of both hardware and software parts. Toward, this

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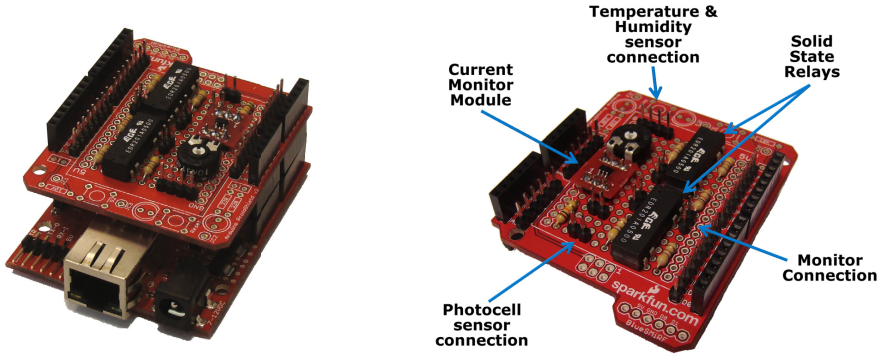


(a) Microcontroller board (b) Custom extension module

Fig. 1. NITOS CM Card

direction, NITOS testbed has developed a custom framework that provides for remote controlling of the testbed nodes' operational mode. The hardware part consists of the newly introduced NITOS CM card, while the software part is composed of custom scripts that enable monitoring and controlling of the nodes' operational mode, through a graphical user interface.

2 NITOS Chassis Manager Framework

In this demo, we will present a framework that enables remote chassis management of testbed nodes, as well as gathering and analysis of various types of sensor measurements. The tool was developed for NITOS testbed [1], which is a large scale, remotely accessible testbed that currently consists of 50 operational WiFi nodes. NITOS is deployed at the Computer & Communication Dept. University of Thessaly building. Currently all testbed nodes are equipped with NITOS CM cards.

2.1 NITOS CM Card

The NITOS CM card is based on a micro-controller board, which is compatible with the Arduino programmable, open-source platform. The card features an Ethernet network interface, which provides connectivity through the transmission and reception of Ethernet frames. Moreover, the card features a custom-built extension module that consists of:

- two solid state relays used to short the power ON/OFF and reset jumper circuits of each node's motherboard,
- one monitor connection that gathers voltage values, which are used to determine the current operational mode (ON/OFF) of the node.

In Fig. 1(a) and Fig. 1(b), we present the developed CM card and the custom extension module accordingly.

As previously mentioned, NITOS CM card supports also gathering of various types of sensor measurements, such as temperature, humidity and light intensity. In order to gather humidity and temperature measurements, we use digital Sensirion SHT1x [2] series sensors, while for light intensity measurements, we use a properly calibrated analog photo-conductive cell. More specifically in Fig. 2(a) and Fig. 2(b), we present the two different types of sensors that are attached to the card.

(a) Temperature/ humidity (b) Photoconductor (c) INA 139 custom module.

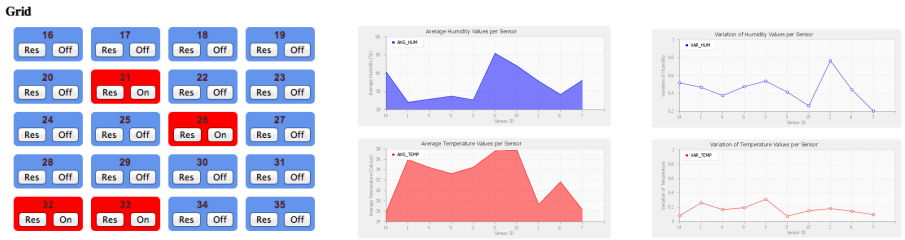
Fig. 2. Types of sensors attached to NITOS CM card

Another innovative characteristic that the NITOS CM card provides is the ability to estimate the energy consumption of each individual testbed node. More specifically, we use the INA 139 [3] integrated circuit to monitor the level of current across the motherboard's power supply pins. In order to estimate the power consumption a specified time interval, we also require the motherboard's constant voltage supply, which is acquired through the monitor connection of the CM card. In Fig. 2(c) we can see the custom module part that features the INA139 integrated circuit.

2.2 NITOS CM Framework

The NITOS CM framework consists of custom scripts that enable monitoring and controlling of the nodes' operational mode, as well as gathering of sensor measurements. In essence, the scripts that experimenters use to control the CM card, send corresponding http requests, which are destined to the static IP address that is assigned to each specific CM card. Then, the web server running at each CM card, executes the selected operation (power ON/OFF, reset, gathering of sensor measurement) and sends back an http response with details about the operational mode of the node, or the actual sensor measurement. Moreover, the CM framework is accompanied by a web graphical user interface that reports the operational mode of each node, which is presented in Fig. 3(a).

The user is also able to get a graphical representation of the various sensor measurements (temperature, humidity, light, power consumption) that have been stored in NITOS database. Various statistical measures can be extracted from the corresponding records, such as average and deviation values per each sensor. Fig. 3(b) and Fig. 3(c) show snapshots of the supported statistical measures.



(a) Chassis Management Interface

(b) Average values representation

(c) Variation representation.

Fig. 3. NITOS CM Framework web GUI

3 Conclusions and Future Work

In this demo paper we presented a framework for remote chassis management of testbed nodes that also enables gathering and analysis of measurements gathered from various types of sensors. The developed framework is based on the newly designed NITOS CM card and features also a web GUI that further simplifies the experimentation process. Currently, we are in the process of extending the framework features by providing mechanisms able to estimate the actual power consumption of the wireless cards that are attached to each node. In Fig. 4 we present a prototype PCMCIA adapter that is able to connect directly to the CM current monitor input and calculate the energy consumed during the operation of the wireless card.

Fig. 4. NITOS PCMCIA prototype adapter for energy comsunption measurements

References

1. NITOS Wireless Testbed, `http://nitlab.inf.uth.gr/NITlab/index.php/testbed`
2. Sensirion SHT1x – Humidity and Temperature Sensors, `http://www.sensirion.com/`
3. TI INA 139 - Current Shunt Monitor, `http://www.ti.com/product/ina139`