Design &Verification of Reconfigurable Transducer Nodes for Smart Home Environments Using Framework (March2016)

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***Abstract*—This paper present *a new intelligent home control system based on a framework of reconfigurable tranducer node. And develop a new routing protocol LQIR to improve the performance of our active sensor networks. This paper introduces the proposed home control system's design that provides intelligent services for users and* a transducer network framework that supports the multiple transducers into single wireless nodes. The aimed at decreasing energy consumption by reducing the number of wireless transitor & receiver in networks. An XML based protocol is devised to allow nodes to communicate a description of their layout, measured data and control information. To verify the proposed framework, multiple reconfigurable wireless nodes are used to monitor the dynamic condition.**

Keywords: Smart environments, context-aware computing, machine learning, prediction, user modeling, transducer network, wireless sensor.

1. Introduction

In a smart home environment, two kinds of transducer networks can be involved, wired and wireless. Each kind has its merits and disadvantages. Wireless transducer networks typically have distinct energy consumption patterns that correspond to their phase of operation: sensing, processing, and communicating. The energy consumption in the first and second phases is negligible compared to that of the communicating phase. Various mechanisms are proposed by researchers in order to minimize or optimize the energy consumption for wirelessly communicating sensors. These mechanisms can be divided into three ways: *software*, *hardware* and *communication*:

For *software solutions*, researchers have implemented algorithms in order to minimize the power consumption of wireless nodes. In terms of *hardware solutions*, researchers have combined transducers together in one wireless node to reduce the number of nodes in the network and consequently decrease the energy consumption of the whole network .Since the *communication* phase of the wireless node consumes most of the energy as mentioned earlier, researchers such as Zhang *et al.*, and Surie *et al.* [8, 9] proposed the use of the energy-efficient ZigBee (IEEE 802.15.4) communication protocol as opposed to Wi-Fi or Bluetooth in wireless
transducer networks used for home monitoring purpose.

II.FREMEWORK ARCHITEECHIRE

For example, the Georgia Tech Aware Home [1], the Adaptive House at the University of Colorado at Boulder [26], and the MavHome smart home at the University of Texas at Arlington [10] use sensors to learn models of the inhabitants and automate activities accordingly. Other types of smart environments, including smart offices, classrooms, kindergartens, tables, and cars have been designed by MIT [4], Stanford University [14], the University of California at Los Angeles [31], INRIA in France [23], and Ambiente, Nissan, and Intel. Connected

homes with device communications capability have become the focus of companies such as Philips, Cisco [6], GTE, Sun, Ericsson, and Microsoft [5].

A.OVERVIEW

The data produced by the collection of sensors on each node is hierarchically organized into an extensible Markup Language (XML) message that is wirelessly communicated to other nodes. Two XML messages are involved: one directed from a wireless node to other nodes or a central server which includes the node's overall information, layout description, and periodic sensory measurements .The other message, a control message, is received by a transducer node to activate its vibro-tactile actuators.

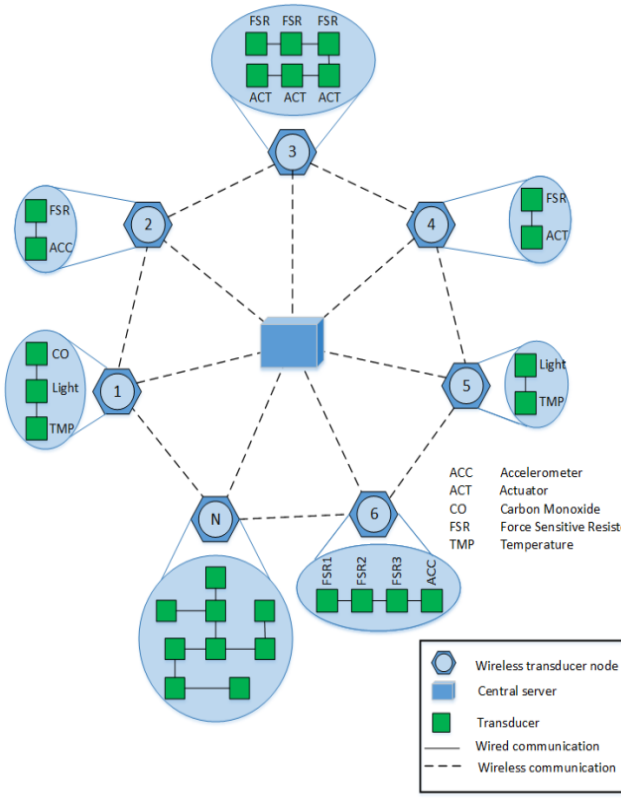

Figure 1. Wireless nodes with reconfigurable transducers.

B. WIRELESS NODE ARCHITECTURE

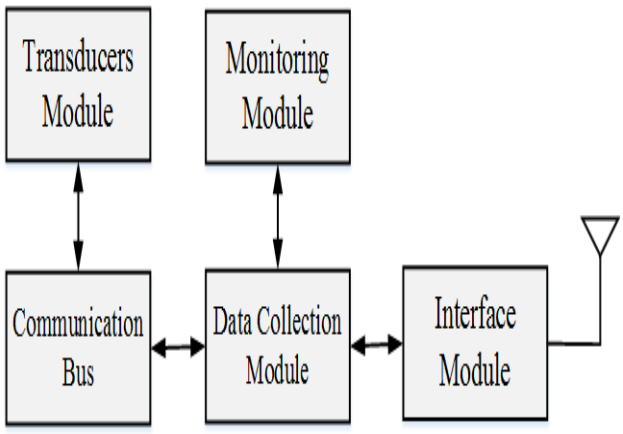

Figure 2. Wireless node architecture

Fig. Shows the architecture of the wireless node. It is composed of the following five main modules:

1)TRANSDUCERS MODULE

Each unit is composed of a microcontroller, an analog to digital converter (ADC) or a digital to analog converter (DAC). A unique ID is assigned to each transducer in order to identify it.

2)COMMUNICATION BUS

The onboard communication bus is based on I^2C.

3)DATA COLLECTION MODULE

This module provides the necessary space to collect all the measured data that comes from the transducers module, and pass them to the interface module.

4)MONITORING MODULE

The monitoring module records the change regarding the added or removed transducer and sends this information to the data collection module in order to update the corresponding transducer status.

5)INTERFACE MODULE

Five possible media of communication can be used with the proposed transducer node including: USB (RS232), Bluetooth technology, Ethernet, Wi-Fi, and ZigBee. However, the ZigBee communication technology is considered more preferable in designing sensor networks due to its low power consumption.

III.IMPLEMENTATION AND EVALUATION

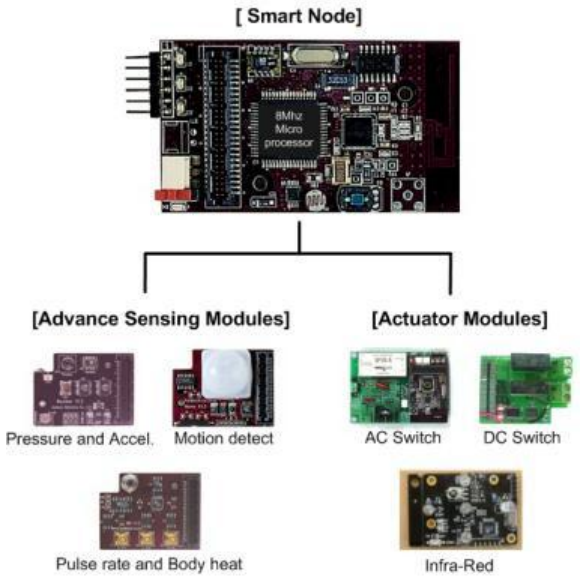

Figure3.*Sensor/Actuator Node Implementation*

For example-The benefits of automation can influence every environment we interact with in daily lives. As an example, consider operations in a smart home and illustrate with the help of the following scenario. To minimize energy consumption, the home keeps the temperature cool throughout the night. At 6:45am, the home turns up the heat because it has learned that it needs 15 minutes to warm to the inhabitant's favorite waking temperature. The alarm sounds at 7:00, which signals the bedroom light to go on as well as the coffee maker in the kitchen. The inhabitant, Bob, steps into the bathroom and turns on the light. The home records this manual interaction, displays the morning news on the bathroom video screen, and turns on the shower. While Bob is shaving, the home senses that Bob is four pounds over his ideal weight and adjusts his suggested daily menu and displays in the kitchen. When Bob finishes grooming, the bathroom light turns off while the kitchen light and display turn on. During breakfast, Bob requests the janitor robot to clean the house. When Bob leaves for work, the home secures all doors behind him and starts the lawn sprinklers despite knowing the 30% predicted chance of rain. To reduce energy costs, the house turns down the heat until 15 minutes before Bob is due home. Because the refrigerator is low on milk and cheese, the home places a grocery order. When Bob arrives home, his grocery order has arrived, the house is back at Bob's desired temperature, and the hot tub is waiting for him. This scenario highlights a number of desired features in a smart environment such as a home.

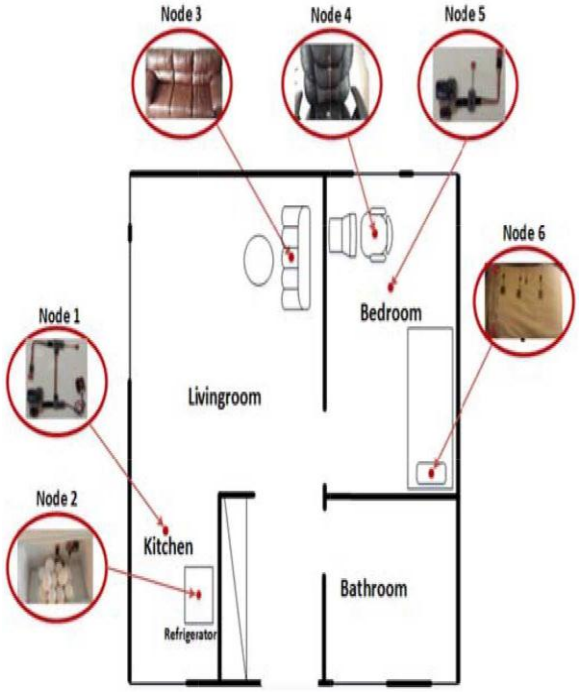

Figure 4.wireless nodes with different reconfigurable transducers.

In the current implementation, the transducers cluster includes pressure (FSR, force sensitive resistor), ambient light (TEMT6000), carbon monoxide gas (MQ-7),triple axes accelerometer (ADXL 345), temperature (TMP 102), and flex sensors and vibro-tactile actuators. Some of these plug and play transducers are implemented on top of Android pro-mini microcontrollers. Each transducer has its assigned ID number for a unique identification and is able to communicate with each node's microcontroller through the I^2C serial communication protocol.

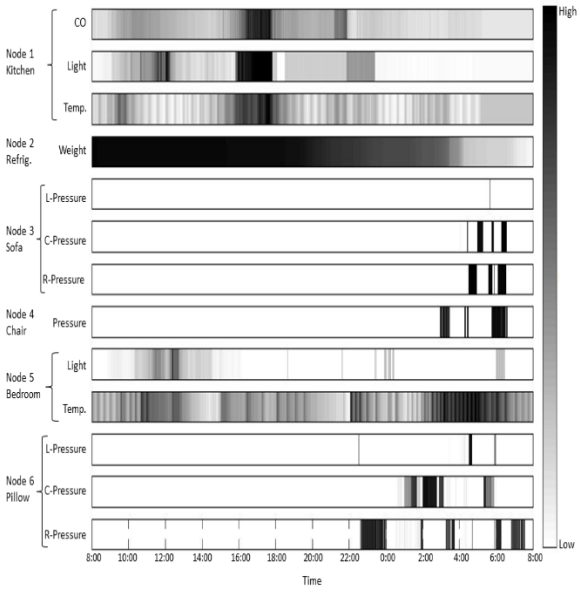

Figure 5.Nodes sensors measurement.

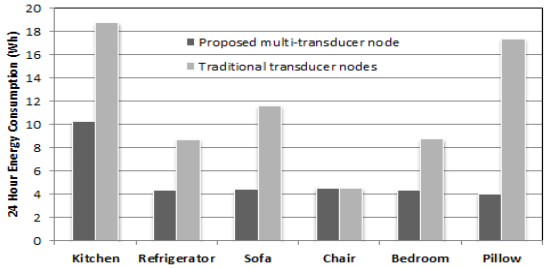

Figure 6. Energy consumption of each proposed node compared with traditional transducer nodes

IV. CONCLUSION

This paper shows that the use on WSN in our daily life can help us in several aspects. Firstly, we have presented development of WSN to monitor some fact in nature. on this one hand , We have seen a system to control and verify the existence of fire in the rural area . This system reduce the time between a fire is originated and the arrival of firefighter at the fire. We have also presented a system to detect diseases in vineyard and a WSN based on IEEE802.15.4 standard to avoid the attacks and thefts. For our home setups, our proposed method consume 46% energy compared to traditional approaches.

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