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Evaluation of Sensor Networks in Smart Home

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***Abstract* – Smart homes are no longer design concepts of the future. They are being built now, and they are having a direct impact on the lifestyles of people living in them. The aim of smart home systems is to create an environment that is aware of the activities taking place within it. Beside the healthy people, disabled people also need such systems to make their life easier. Because they encounter with a lot of difficulties in their everyday life especially when they are at home. Accordingly the home which is smart must contain an internal network, an intelligent control and a home automation. The internal network is the priory basis; it can be wire, cable and wireless. It enables communication of sensors and actuators with each other providing services to humans. We described you how we had applied and used the existing sensors. Then we designed total architecture which used ubiquitous sensor networks to generate context information and to provide services to users by controlling wireless networked devices (actuators) in smart home.**

***Keywords* – Sensor networks, Smart Home, WSN, Protocol Introduction.**

I. INTRODUCTION

Wireless technologies have been developing rapidly in these years. The obvious advantage of wireless transmission is a significant reduction and simplification in wiring and harness [1]. Wireless sensor network (WSN) can be described as a collection of these low power sensor nodes which are connected wirelessly. It is a network system that enables to communicate sensor nodes between each other. Each sensor node is capable of only a limited amount of processing and power. But when they are coordinated with other nodes in the network, they have the ability to communicate measure and actuate in great detail. With the help of combination of these nodes, ad-hoc networks can be created. For example, the nodes can be distributed to an environment and wireless ad-hoc networks can 2 be formed these distributed and formed nodes constitute a sensor network system. WSN provides the capability of revolutionary detection over a wide range of different applications. Because the sensor networks have features such as: Reliability, Accuracy, Flexibility, Cost efficiency, Ease of Installation [3].

"Smart Home" is the term commonly used to define home or building, equipped with special system that does some intelligent actuations according to situation. Integration of the home systems allows them to communicate with one another through the home controller in pre-programmed scenarios or operating modes. We call these kinds of systems as "Context Aware Systems" that are aware of where the person is and make decisions about what actuation should be done. All of these smart home systems are used to make easier of people's daily life, especially disabled people. Wireless sensor networks (WSNs). In previous work, much research has been done using wireless sensor technologies. Literature search indicates that applications using wireless sensor technologies have already existed in the following four fields [3]:

Home automation and remote monitoring of houses [4].
Environmental monitoring, including humidity, temperature and radiation [5].
Fault tracking and fault management [6].
Health monitoring. For instance, [7, 8].

II. IMPLEMENTED SENSOR NETWORK

Sensor network consists of three types of elements: sink node, sensor and actuator node. Every tiny node is connected to other (one or more) by managing of a sink node to form a sensor network. We developed a low data-rate wireless personal network (LoWPAN) with IEEE 802.15.4 which is called ZigBee standard. We implemented some sensor nodes, sink node and the nodes formed a network topology dynamically. It is connected to server computer with USB port. While it is communicating with other nodes in the network, it is capable of communicating with the computer. It provides the data flow between computer and network. The data transmitted to computer with the help of sink node can be recorded to database or used to trigger another process. The sink node consisted of RS232C, to relay sensing data to home server, RJ45 interfaces and also CC2420, to communicate to other sensor nodes. Moreover it adapted mobile telecommunication modem called CDMA modem to alarm emergency message into voice or SMS for user mobile.

Fig.1. Sink Node

Depending on the type of packets (see Figure 2.), the monitoring packets are transferred from sensor nodes to a

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sink node like (a). The controlling packet can be transferred as (b).

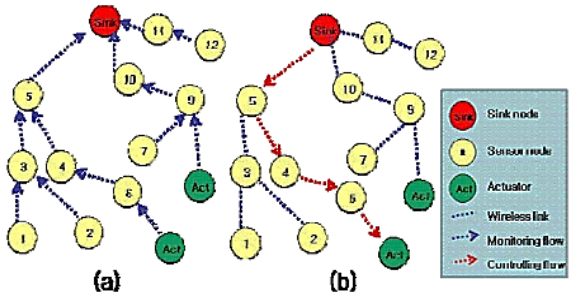

Fig.2. Data flow in sensor network

We have defined controlling packet as communication between a sink and a sensor or an actuator device (see Table 1). In a generated sensor network, this packet is usually used for delivering some parameters and values which are called Profile ID and Data in the table to actuator device from sink for controlling of devices.

Controlling packet can be used for sensor's device controlling. Dst ID is used to identify destination address of sensor node and to transmit its packet. ID can be 0x0001 ~ 0xFFFE. The value of 0x0000 is reserved for broadcasting of controlling packet to all sensor nodes from sink node.

Table 1: Controlling packet structure

Dst. ID	Seq	Flags	Num	Payload			
2 Octets	1	1	1	1	1	1	N
0x00: Br. Cast 0x01~0xFFFE: Dst. ID	Sequence Number		Number of Payloads	Profile ID	Sub-Profile ID	Length	Data

Introduce Some Nodes

Door Control Node

While this node is capable of detecting motion and doorbell button, it is also responsible for ope [1] and locking the door. The hardware in Figure 3 is designed to demonstrate and simulate the automatic door control system. Tmote Sky has two expansion connectors that are 10-pin and 6-pin [6, 8].

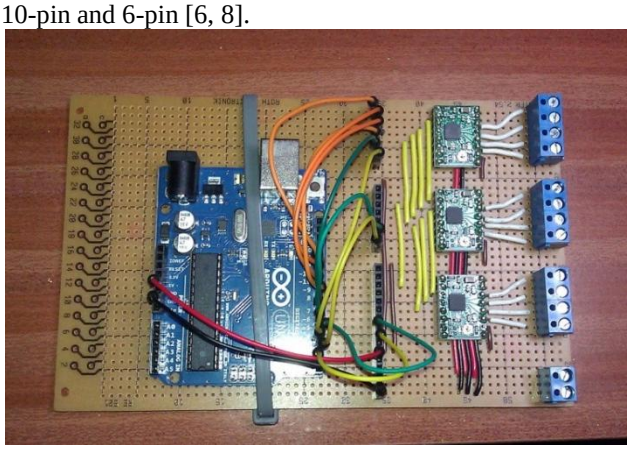

Fig.3. Door Control Node

Gas Detector Node

Table 2 shows the communication protocols and baud rates of the devices used to affect gas safety management system interconnection, and Figure 8 shows both wired (solid lines) and wireless (dotted lines) signal flow in the system. The wireless sensor network is configured by classifying the sensor nodes as, variously, micom gas meters, automatic fire-extinguishing system, smoke and CO detectors, or sink nodes (e.g., wall pads), and inner protocols are interfaced between the nodes and appliances (Table 2).

Table 2: Protocol and baud rates of devices and nodes

Devices	Protocol	Nodes/connection
Micom gas meters	RS-232 (9,600 bps)	Sensor nodes
CO detectors	RS-232 (9,600 bps)	Sensor nodes
Smoke detectors	RS-232 (9,600 bps)	Sensor nodes
Automatic fire-extinguishing system	RS-232 (19,200 bps)	Sensor nodes, Routers
Wall-pads	RS-232 (9,600 bps)	Sink nodes
A wall-pad ↔ a USB port	RS-232 (38,400 bps)	Internal connections
Wall-pads ↔ a server	WLAN (54 Mbps) BcN (100 Mbps)	Wireless and wired networks

Human Node

This is the node that should be carried by human. It enables communication of other nodes with the human and detecting the identity of human. Every human node is programmed with different node id.

There is an extra peripheral device that is a small vibration motor connected to human node as shown in the Figure 4. It is controlled with the expansion connector of the node. It enables to warn human -especially deaf human- physically when there is something to warn.

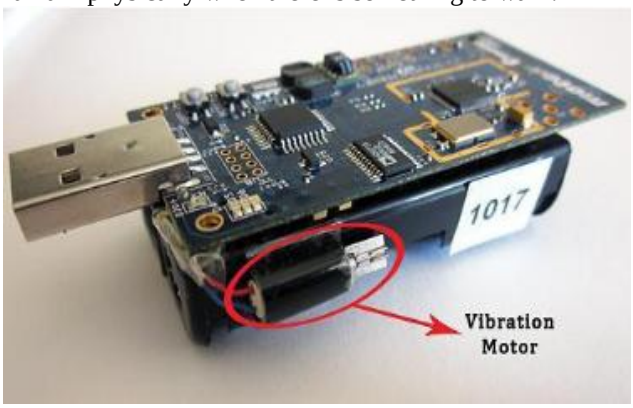

Fig.4. Human Node with vibration motor

Wired versus wireless

Wireless technologies have clear advantages and drawbacks when applied to the smart home environment. Among the advantages, flexibility and easy installation are clearly important characteristics in this type of networks. Among the drawbacks, clearly safety and security can't reach the levels which can be obtained with wired networks, deterministic response times are not possible and RF emissions might cause some user concern. Research investigating spread spectrum techniques in the 2.4 GHz range which allow a protected transmission to solve the security problem are being conducted [1, 2, 9].

Three different network families are currently used to support smart homes:

Traditional RF Home automation networks:

These are usually based on relatively low frequency carriers and modulation techniques are usually quite basic, thus available bandwidth is usually very small (a few kbits/s or lower). Examples of these protocols include X10 over RF (at 200MHz) or KNX over RF (at 868MHz). Many proprietary networks based on RF remote control frequencies (433MHz) are also widely used.

Wideband RF protocols:

These protocols were originally designed for computer networks and provide relatively high bandwidth (currently up to hundreds of Mbits/s). They usually operate at 2.4GHz or 5GHz. currently the most popular among these type of networks is the WiFi family (IEEE802.11a/b/g). These networks are very useful for relatively complex devices but for simple devices, the costs per node and especially power consumption rule them out.

Generic Low power networks:

These networks have been designed very specifically for mobile device and optimized for low power usage. Bluetooth is currently the most widely used but its protocols are relatively complex and its power requirements are not suitable for devices that have to run on a small battery for years (or get the power somehow from the environment). Zigbee is a new type of very low power, low complexity network with some built in localization capabilities that seems to be very promising for smart home applications.

User interaction

The advent of smart homes is part of the overall pattern of convergence that is occurring in technology. Through the exploitation of advances in high tech networks, the smart home allows the convergence of the different environments of an individual's life, the personal, leisure, workspace and educational environments.

The greatest advantage of the smart home is that it uses non-intrusive technology that can be completely personalized to the individual. During the past years the user has taken a more central place in the development of smart home technology. This is only logical since the acceptance of products depends mainly on the reaction of the user.

III. CONCLUSION

Smart homes for the disabled and elderly are at work. Especially when that someone is holding them. Protocols for wireless networks, enabling easy implementation, it for the smart home installation provides makes. Therefore with the progress of sensor networks is expanding its work in this regard and the smart home improvement, enhance the reliability and increase the functionality of the houses of great help to people with disabilities and older.

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