Developing a Virtual Environment for better Sensory Perception

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***Abstract*—In sensor networks different types of sensors are used to capture events, recognize contexts, derive states of objects or monitor processes within application scenarios. The processes themselves are often very complex (e.g. in industrial applications) and a combination of sensor data from different sensor nodes is used to derive information regarding their states or properties. Sensor data is analyzed, aggregated, used for calculations and transformed to higher level contexts. The high density of sensor readings of a single sensor node and an increasing total number of deployed sensor nodes to sense complex events leads to a situation where the observation or analysis of sensor data is barely possible and the information is not directly perceivable. Thus we propose the virtual environment SensorRAUM for a better sensory perception which enables fast prototyping of sensor network applications.**

***Index Terms*—Sensor networks, sensory perception, user interfaces, information visualization**

I. Introduction

Sensor nodes are used in various application domains to capture real world events. A combination of different types of sensors (e.g. thermal, magnetic, acoustic or infrared) is used depending on the application. The sensor readings are processed and either stored directly on the sensor node for later usage or transmitted to a sink which can also be a computer with more processing power. In order to capture complex events (e.g. disturbances in chemical processes, detection of thermal bridges within buildings or motion detection) more sensor data and sensor nodes respectively are required to derive high level contexts. This leads to a higher information density. Consider, for instance, the question whether or not a context is correct. It might then be difficult or even impossible for an individual to answer this question regarding that a single context can comprise thousands of sensor readings of different sensor nodes. The high density of sensor readings of a single sensor node and an increasing total number of deployed sensor nodes to sense complex events leads to a situation where the observation or analysis of sensor data is barely possible and the information is not directly perceivable. In order to support decisions in processes with a high complexity we study the usage of graphically oriented 3D user interfaces.

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II. Technical Demonstration

We have developed a framework called SensorRAUM to investigate, define, develop, and demonstrate a user-friendly and intuitive user interface for wireless sensor networks. The framework is based on Croquet [1]. It facilitates the visualization of various sensor data sources whereby even complex contexts with a multitude of sensors can be processed.

The demonstrator visualizes temperature or light sensor readings of µPart sensor nodes [2] as color gradients on the floor of a building in realtime. A user can navigate through the building and interact with various objects (e.g. view historic sensor data or trigger events).

Fig. 1 details the development process of the application. The first step is to transfer the appearance of real world objects to the virtual world using a 3D graphics application (e.g. 3ds Max or Blender) and to import the model in the 3D environment. All further development takes place directly in the virtual world. Each sensor node is associated with one or more virtual objects. Events which initiate the coloring of the ground are registered and actuated whenever new sensor data is available. The sensor data is delivered by a bridge application which broadcasts the RF signals to the local network.

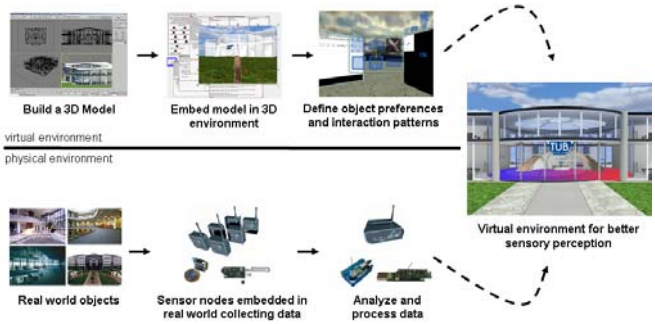

Fig. 1. Development process of the SensorRAUM framework. Temperature sensor data is visualized as color gradients on the floor of a building.

References

[1] The Croquet Consortium, www.opencroquet.org
[2] The Telecooperation Office (TecO), http://particle.teco.edu/upart