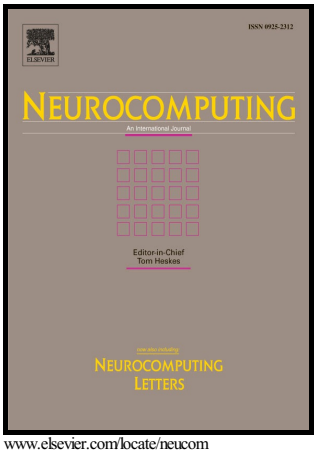

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Automatic Agent Generation for IoT-based Smart House Simulator

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Abstract

In order to evaluate the quality of Internet of Things (IoT) environments in smart houses, large datasets containing interactions between people and ubiquitous environments are essential for hardware and software testing. Both testing and simulation require a substantial amount of time and volunteer resources. Consequently, the ability to simulate these ubiquitous environments has recently increased in importance. In order to create an easy-to-use simulator for designing ubiquitous environments, we propose a simulator and autonomous agent generator that simulates human activity in smart houses. The simulator provides a three-dimensional (3D) graphical user interface (GUI) that enables spatial configuration, along with virtual sensors that simulate actual sensors. In addition, the simulator provides an artificial intelligence agent that automatically interacts with virtual smart houses using a motivation-driven behavior planning method. The virtual sensors are designed to detect the states of the smart house and its living agents. The sensed datasets simulate long-term interaction results for ubiquitous computing researchers, reducing the testing costs associated with smart house architecture evaluation.

Keywords: Virtual environment; autonomous agent; ubiquitous computing; GUI tool; behavior planning

1 Introduction

A smart house provides an intelligent home management interface and a comfortable living environment. Smart houses have recently become important research topics in the Internet of Things (IoT) [1][2][3]. A variety of IoT-based sensors connected by wireless networks are installed in smart houses, to enhance the life of the home's residents [4][5][6][7][8]. Smart house architectural engineers desire the ability to intuitively configure their smart houses and meet user needs before construction begins. Therefore, reliable, low-cost test beds are required in order to examine the architecture design.

In addition, smart houses must monitor interaction between users and house components in order to provide appropriate services [9]. Sensors detect various kinds of environmental datasets [10]. However, individual sensors work independently and report simple information. In order to apply reliable ubiquitous computing and detect the living situation, multiple sensors must be mounted [11]. However, hardware reconstruction for this type of interface installation substantially increases the cost.

Therefore, in order to provide a low-cost, effective test bed, we present a simulator that creates a virtual smart house and simulates action recognition in the virtual environment. In the simulator, a virtual smart house is created with independent virtual sensors, which record environmental information, including user location and house temperature [12]. The simulator provides designers with a graphical user interface (GUI) in order to help them arrange house components and sensors. The smart house situation and user state are then estimated using these sensed datasets [13].

In addition, an autonomous agent generator is provided for defining virtual agent behaviors and action effects. Virtual simulation must mimic the real world. Therefore, in order to simulate an actual person within the smart house, we create an intelligent agent, which autonomously executes behavior planning based on various motivations [14]. The interactions between virtual agents and the house are recorded and visualized. After a long-term test, the recorded information is provided and used as a reference by smart house researchers in order to ensure convenient, desirable services.

The rest of this paper is organized as follows. In section 2, we discuss works related to smart house simulations and behavior planning. Section 3 describes the simulator's structure, sensor-based simulation techniques, and the