Chapter 38
Thing Theory:
Connecting Humans to Smart Healthcare

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ABSTRACT

As healthcare professionals and others embrace the Internet of Things (IoT) and smart environment paradigms, developers will bear the brunt of constructing the IT relationships within these, making sense of the big data produced as a result, and managing the relationships between people and technologies. This chapter explores how PolySocial Reality (PoSR), a framework for representing how people, devices and communication technologies interact, can be applied to developing use cases combining IoT and smart environment paradigms, giving special consideration to the nature of location-aware messaging from sensors and the resultant data collection in a healthcare environment. Based on this discussion, the authors suggest ways to enable more robust intra-sensor messaging through leveraging social awareness by software agents applied in carefully considered healthcare contexts.

INTRODUCTION

Healthcare providers will enter location-aware smart environments with the expectation that their devices will integrate, their location will be incorporated, and the environment that they are within will specifically respond to their needs, as well as to the needs of their patients. Cooperation and coordination in complex environments requires people to have access to appropriate contextually sensitive information, some of which must be shared between them. To plan and design effective location-aware smart environments for healthcare, tools are required for integrating and responding to human needs and anticipating human intents and desires.

Humans depend upon successful cooperation with each other for their survival. As humans have evolved their environments, their communications structure and the messages that it produces have

become more complex. Sharing or overlap of messages becomes critical in these highly heterogeneous environments, now comprised of people with many points-of-view using a range of channels for communication in multiple languages.

A location-aware healthcare smart environment is another layer within this already highly heterogeneous system of communication. Each component in a location-aware smart environment network can generate data and send messages that must be processed, understood and responded to in some manner. In a healthcare environment, well placed software agents can help manage critical messages shared between sensors, low level software agents and the people who act on this information, improving care for patients and outcomes for providers.

The authors' propose a framework based on the agency of both humans and environmental components: Thing Theory, a logic-based agent framework that evolves discussion on how to connect humans to a healthcare environment designed to function for their benefit.

BACKGROUND: THE HEALTHCARE ENVIRONMENT

Discrete pieces of the healthcare environment can be automated with Internet of Things (IoT) technologies, lessening the risk of mistakes from the outcome of multiple, multiplexed messaging and increasing the cooperation and abilities of technology to partner with people. In ideation, smart environments in healthcare are a great idea. In practice, much must be overcome for their successful deployment (Perry et. al 2013). Healthcare is a legacy system, largely regulated by government. In healthcare, many mistakes can have serious long term consequences, or can be fatal. Thus, any automated element within the healthcare domain must be well thought-out, robust and offer redundancy to enable successful application (Fairbanks et. al. 2014).

With the IoT and healthcare there are many possible hypothetical scenarios that could be developed, from the critical, such as smart operating rooms, pharmacy services, and smart rooms for patient or psychiatric care units (Wears & Leveson 2008), to more mundane aspects of healthcare such as sections of preventative clinics or cafeteria and parking services. In healthcare, using the IoT for patient care and using the IoT to reduce costs can co-exist as mutual goals to improve healthcare quality, as joint benefits emerge from streamlining for efficiency and improvement of service quality (Chaudhry et. al. 2006). IoT strategies for healthcare should enhance and leverage legacy systems rather than reduce services as a by-product of automation.

The easiest early applications of the IoT could augment current automated elements of medical processes. An IoT within healthcare should be based on two broad concepts, distribution of functions to addressable devices where each device is responsible for a limited set of operations or capabilities, and a framework for flexibly integrating these devices so that developers, or even end users, can assemble the set of capabilities needed for some situational macro-task. Thus, IoT devices are tools that can be used for a vast range of purposes, rather than integrated systems per se. Integration emerges from instantiation of a given tool assemblage into a process through knowledge-based systems external to each device (Bradshaw et. al. 2013). This orientation largely mirrors the current situation, where space and individual tools are available for highly trained teams of individuals to integrate as needed to serve different medical procedures.

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