Chapter 11
Medical Cyber Physical System Architecture for Smart Medical Pumps

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ABSTRACT

The transformations through technological innovations have influenced the medical field. There are significant developments in medical devices in their usage. The utilization of the devices is automated in a local, remote environment. The medical devices used in the remote cyber environment uses different network protocols. These devices comprise micro, nanofabricated sensors and actuators which have the facility to communicate using network protocols. The devices that have network capability to integrate into cyberspace through physical methods are typical medical cyber physical systems (MCPS). In MCPS, medical device modelling is an important aspect. Several medical devices are available, and here in the current research, emphasis is focused on smart medical pumps in the MCPS environment. This chapter highlights the essential concepts of the smart medical drug delivery device, its architecture, control, actuation, communication, and analysis in the cyber environment.

DOI: 10.4018/978-1-7998-8161-2.ch011

INTRODUCTION

Current innovations of sensor fabrication, electronics interfaces, communication with the cyber world with physical devices enable enhancement in challenges for health care devices. Smart health care system provides primary diagnosis, timed, appropriate medical assistance, time management for better health for the patient. For the past few decades, countless wireless smart medical devices have been invented and are used by the medical fraternity. The smart medical pump is one among them and its requirement is essential in all fields of medical treatment. Research on smart medical drug delivery devices has been discussed by many researchers based on patient-controlled analgesia, Anaesthesia, insulin drug delivery devices, artificial pancreas, etc. In recent years rise of MCPS modelling for drug delivery devices has been designed based on the finite state modelling in hybrid mode. A survey on MCPS architecture on health care systems reveals that the implementation has led to the development of medical devices and its system by integrating the physical devices, hospitals, remote servers, clinicians, and patients (Haque et al., 2014). This environment has assisted the patients to undergo diagnosis and related procedures with ease. MCPS is completely based on different network architectures. In health care, cognitive techniques to transmit medical data have been performed(Kumar et al., 2019). The medical data is transmitted to the cloud using cloud-based algorithms; performance measures, reliability, and robustness are evaluated (Insup & Sokolsky, 2010).

Security issues in these architectures have been implemented and are under research in the context of health care systems, services (Park et al., 2016). Research challenges related to the Internet of Things, Wireless Sensor Networks in MCPS concept for smart health care are mainly concentrated on Quality of Service, energy efficiency, low power wireless communication, security, and safety (Gardašević et al., 2020). Safety measures for the patient by providing reduced errors in drug infusion are analysed using formal modelling with hybrid automata for anaesthesia administration (Silva et al., 2015).

The patient's information has to be handled as electronic Health Records (eHR) securely (Percival et al., 2010). When a security framework is formed, the framework for authentication in the medical process is another requirement in cyberspace (Seifert & Rez, 2016). Since the devices are connected digitally across in cyberspace, spoofing attack, vulnerability on hardware is explored.

The medical process, investigation, design needs are authentication and act as key components in MCPS (Kanjee & Liu, 2016). In MCPS, the medical device design in micro, nano dimensions, modelling, control, medical data transmission, Graphical User Interface (GUI), integration of these with the remote cloud database, servers are the focussed (Masci et al., 2014). Research in communication methods