

Chapter 10


Harnessing Real–Time Data for Intelligent Decision–Making in Cyber–Physical Systems

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ABSTRACT

Cyber physical systems are already transforming different fields, including smart communities and energy systems. These technologies enable CPS to process large volumes of data and come up with insights that enhance processes of taking preventive actions for situations that require quick responses. In addition, we explain how both 5G and edge computing are set to disrupt data handling and transmission as well as outline how both concepts will fit well together in a resource limited environment. Points regarding data quality issues, system architecture, and security

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threats; resource capacity and the degree of persistence, respectively, are included. For these challenges, we offer solutions like Data management, Modularity or System Decomposition, Security in Layers, and Light-Weight Processing for Improved System Resilience. Lastly, the chapter discusses the current and potential advances in real-time decision making for CPS and the need for CPSs to be interoperable with other CPS.

1. INTRODUCTION

1.1 Brief Definition of Cyber-Physical Systems (CPS)

Cyber-Physical Systems (CPS) transform the cyber and physical systems into an integrated system in which cyber components interact with the physical components to monitor or control other systems. CPS refer to the integration of physical substrates, be they machinery, vehicles, structures, or even whole infrastructures with computational or communication substrates (Rajkumar, 2023). These interactions create complex systems that are capable of inputs from the physical world, processing, making decision and self-correcting in the event of change. CPS thus has at its core systems and networks of sensors that communicate information from the physical environment to a computational environment. It allows physical systems to adapt to changes in a surrounding environment; it increases systems' production capability/decreases human interference, and generally increases the robustness of a system. CPS are core components of solutions like self-driving automobiles, power utility, industries, hospitals, and above all the smart city. As physical and computational systems become interconnected at the core of automation, CPS are becoming ubiquitous in the development of urban environment, manufacturing, transportation, and many other spheres (Quincozes et al., 2022) (Hoffmann et al., 2021). In Table 1, it will be possible to present brief information on the major components of a CPS and their purpose. Figure 1 described the system architecture of the cyber physical systems. Accordingly, excited techniques like edge computing, 5G, the AI-identification of abnormal data, and unique cybersecurity models play a critical role in addressing major issues in CPS namely data explosion, delay, distorted data, and cyber threats. These innovations guarantee that the CPS handles wanted actual-time data efficiently and safely in the modern purposes. Figure. 1 refers Overview of Cyber Physical Systems.

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