

# Human-Robot Collaboration Systems: Components and Applications

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**Abstract** - Collaborative robots (cobots) have emerged as a technological solution for enhanced manipulation of objects while allowing safe interaction with a human counterpart. Although substantial developments in Human-Robot Collaboration (HRC) systems have taken place in the last decade, no conceptual framework of their composition is available. The literature provides an unclear process of how to integrate human-robot interaction levels and their roles with safety and communication technologies into HRC systems. To design an ergonomic HRC system (in its physical and cognitive dimensions) a clear identification and categorization of its components is required. This paper presents a literature review analysis that identifies the tendencies of HRC in the manufacturing sector. An initial distinction between application by type of industry and task is carried out. Afterward, interaction levels in HRC systems are examined, both individually and collectively, depending on the application area. Work roles of humans and robots, safety settings, and communication interfaces are also analyzed as part of the interaction levels in the primary composition of HRC systems. Their presence and distribution along 50 selected cases are also explored. The analyzed data, results, and observations presented in this paper demonstrate clear tendencies for specific components that were identified as necessary for improving future designs of human-centered HRC systems.

**Keywords:** Cobots, Safe Human Robot Interaction (HRI), Cognitive workload, Human Robot Cooperation.