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The Future of Human-Robot Interfaces in Factory Settings

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This short article will discuss human-robot interaction (HRI), including the evolution of HRI and the potential innovations stemming from human-robot collaboration (HRC) research. It will outline the current landscape and the potential for future developments, particularly as it applies to Industry 4.0; factories, manufacturing and logistics.

HRI is a broad field encompassing nearly all situations in which humans and robots interact. This field sits at the intersection of psychology, cognitive science, social sciences, artificial intelligence, computer science, robotics, engineering and human-computer interaction (Murphy et al., 2010). HRC is a subset of HRI research that focuses more specifically on collaborative processes between human and robot agents. This research explores how humans and robots can better work together to achieve shared goals (Landi et al., 2018; Villani et al., 2018). Many new applications for robots in factory spaces require them to work alongside people as members of human-robot teams. One of the biggest drivers for this shift has been the automotive industry (Human-Centred Factories, 2019).

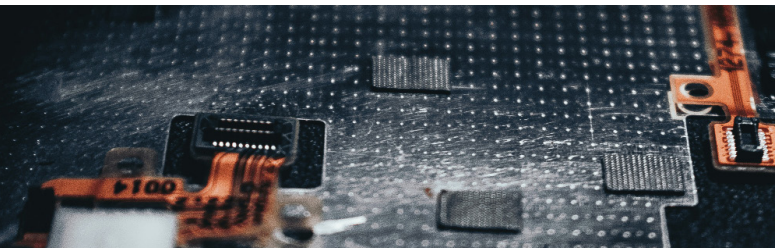

Figure 1. Circuit Board (TimSon Foxx, 2019)

The early stages of robotics use in factory spaces required robots working “alongside” humans were separated by physical barriers such as cages. As the field developed, we saw greater direct interaction between humans and robotic agents (Human-Centred Factories, 2019; Sauppé & Mutlu, 2015; Villani et al., 2018). This development introduces challenges to researchers and developers, such as collision detection and avoidance, and human-robot communication systems that facilitate understanding shared goals and intentions. These advances have introduced physical and mental health risks to human operators as they try to navigate this new landscape (Human-Centred Factories, 2019; Villani et al., 2018).

A recent area of interest is how social robotics frameworks and principles can be applied to HRI within manufacturing and logistics contexts (Landi et al., 2018). Social robotics research to date has primarily focused on domestic and medical applications and looks to find ways to establish “relationships” between humans and robots through the detection and synthesis of emotional and social information; social cues, facial expression, body language and natural speech (Jung, 2017; Landi et al., 2018). Some examples of social robotics application to commercial and industrial robotics are the Baxter Robot and Rollin’ Justin (Sauppé & Mutlu, 2015; Yang et al., 2018). These robots utilise anthropomorphic principles in their design to allow the robot to communicate in ways that are more “human” (Sauppé & Mutlu, 2015; Złotowski et al., 2015).

Figure 2. Person Holding Black and Silver Hand Tool (Cottonbro, 2020)

For the Baxter robot specifically, this has led to a large body of research exploring the efficiency of collaboration and operators’ user-experience. Research has provided evidence that robots that can communicate social information improve operator trust, enjoyment, and collaboration efficiency (Landi et al., 2018; Matsas et al., 2017; Rahman, 2019; Sauppé & Mutlu, 2015; Villani et al., 2018). However, these robots are limited in their applications and functionality within factory spaces compared to the average factory robots, which commonly do not have anything close to a humanoid form. This represents a gap in research, “How can social robotics principles be applied to non-humanoid robots?” and “Do the benefits of emotional and social information seen within research transfer to these non-humanoid factory robots?”.

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Figure 3. Engineers Developing Robotic Arm (ThisIsEngineering, 2020)

These are some of the questions being explored at BMW + QUT Design Academy as part of the MPhil research program. The hope is to identify and validate new forms of human-robot interactions by exploring this research gap. There is potential within this research to generate more natural communication and feedback systems for non-humanoid robots that allow for richer forms of collaboration and elevate robotic systems from tools to “co-workers”. The benefits of such discoveries would extend beyond the automotive industry and factory workers. They could benefit the design and development of human-robot interactions in domestic, commercial and medical fields.

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