

Towards a deep collaboration between human and digital operators on industrial assembly lines.

Context

The recent progress of AI and sensors has allowed cyber physical systems (CPS) to be more and more efficient and to bring more and more added value in smart factories. These CPS or Digital Operators (DO) can now perform storage operations in warehouses, check the contents of packages to be delivered but also verify the compliance of complex products at the end of a production chain. Buawei is involved in this context and currently offers mobile equipment (<https://www.pokaiok.fr>) for the supervision/verification of manufacturing or assembly stages within a production line.

Many observers of the field (as well as Buawei) note that even if DOs are already very efficient, they still have a huge margin of progress. And an important part of it refers to a stronger cooperation with the human operators (HO).

The PhD proposal focuses on this cooperation.

Issues

The way that DOs work often relies on complex algorithms and/or by learning through training data that «teaches» the tasks to perform. Unfortunately, this way of working makes little use of the valuable knowledge and experience of the HOs regarding these tasks.

Moreover, if the DOs behave less and less like black boxes, the presentation of their operating principles inaccessible to HOs, and most of the time no explanation of their decision is provided. That does not constitute a good context for fostering a trust relationship between the HO and the DO (essential for an efficient collaboration).

Finally, when cooperative practices between the DO and the HO (and his/her whole environment) have been established, it is still unfortunately difficult to transfer installation settings or efficient practices of collaboration to other sites which would present structural differences.

The PhD proposal aims at proposing an approach that would address these 3 issues which are currently significant barriers to a harmonious HO/DO cooperation: Contribution of Human Operators, Trust and Collaboration, and Transfer of Good Practices.

Goal

The work of the thesis will first consist in studying the notion of trust between HO and DO and what this implies when designing Interactions between HO and DO. Notions such as attractiveness, explicability or transparency will be central to this study. Trust is a concept that has been extensively studied for recommender systems, a domain that will be able to feed this study [1][2].

The PhD student will study the principles of Interactive Machine Learning (IML) [3]. IML consists in providing users a deeper way to interact in the digital learning processes in order to better control them.

We think that these studies on Trust and IML are essential and constitute an important background for defining an answer to the previous problems. It is particularly true in the context of the Buawei company, i.e. the cooperation between human and digital operators on industrial assembly lines.

A privileged track consists here in an approach similar to end-user oriented programming (or End-User Software Engineering [4]) in order to allow HOs to have at their disposal an important expressiveness power. From this perspective, software modeling (BPMN, UML, MVC) will be a relevant candidate as it has strong industrial experience over the last 20 years. The use of software models as interaction artifacts can be explicit but also implicit. The idea is first to crystallize « software-ly » the cooperation elements in an explicit and navigable format. Their presentation and manipulation can be done through very simplified interfaces (form, storyboard, Scratch-like interfaces) and above all adapted to the work context and where the notion of models could even be absent.

Buawei has already started to address the 3 previous issues. The current feedbacks from human operators is very encouraging. This is why Buawei wishes to deepen these issues and generalize its approach in order to 1) have knowledge allowing it to adapt to new types of industrial infrastructures and 2) to contribute to the associated scientific community. A conceptual framework and a highly reusable software library are logically the expectations of the thesis. The working method is classical to a thesis: exhaustive state of the art, experiments and communications.

The Carbon team (<https://www.cristal.univ-lille.fr/equipes/carbon/>) which will co-lead this work has been interested for a few years in the notion of assistance and trust in the context of software engineering [5]. But the problems of collaboration and presentation of complex data constitute the core of this team [6][7][8].

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Salaire :

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