Hybrid Decision Making for Adaptive Industrial User Interfaces

Pro²Future

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MOTIVATION & GOALS

In the industrial domain, good interface design is often not a Focus. Market-driven pressures plus an engineering-driven company yield ever-increasing UI features, complexity, and confusion. This results in large, historically complex, and sometimes outdated user interfaces. This hurts a company in the middle- to long term as (i) their products are increasingly considered outdated, and (ii) due to efficiency decreases if workers' need to refer to manuals or request aid from colleagues due to unintuitive interfaces.
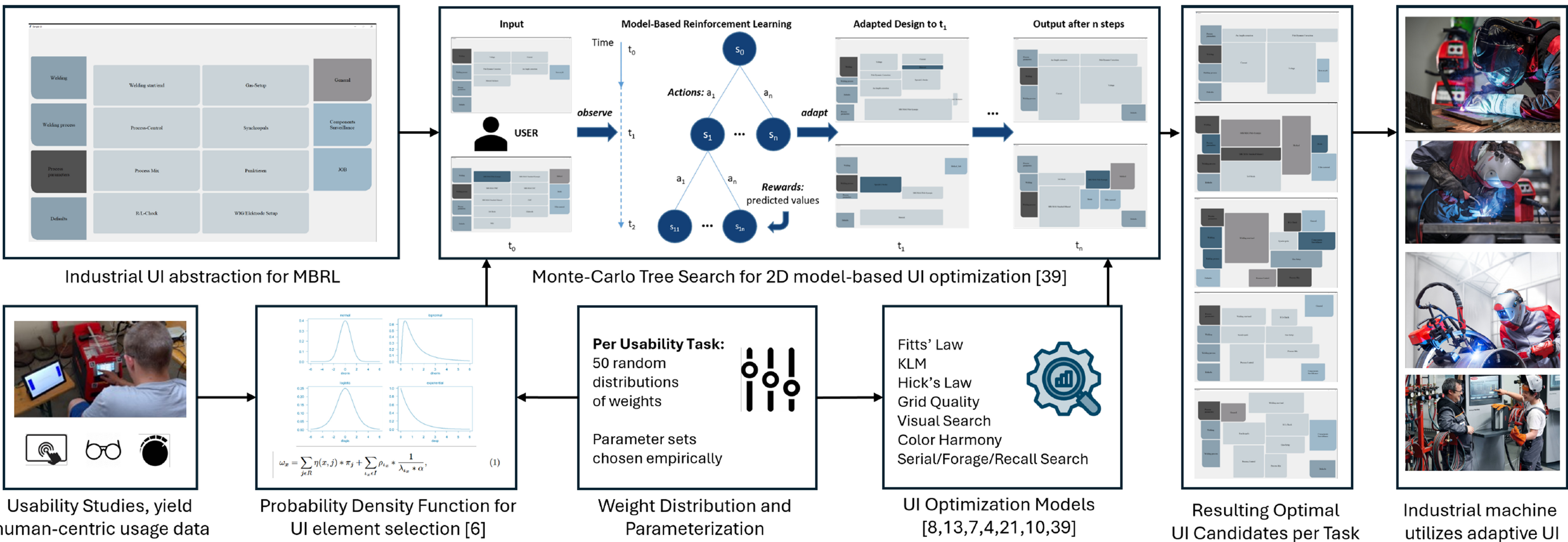
Adaptive Industrial UIs represent a cost-effective way to direct a much needed modernization that can support UX designers in finding effective changes.

Project FactBox

Project Name APECGR
Project ID MFP II 1.2
Duration 36 Months

Area 1
Area Perception

Project Lead
Univ.-Prof. Dr. Alois Ferscha

APPROACH

Usage of Model-based Reinforcement Learning and Human-centric usage data to implement Adaptive, Process-based User Interface Candidates.

Welding Device · Data Collection Devices · Touchscreen · Radial Turn Button · Tablet for UI Tasks · Study Participant

CONTRIBUTION

Scientific contribution
Combination of Human-centric usage data and model-based reinforcement learning to reify a hybrid decision making systems.

Economic contribution
Modernisation of Legacy User Interfaces.
Streamlining User Interface Design Process.

FRAMEWORK and PROTOYPE

Input · Model-Based Reinforcement Learning · Adapted Design to t_1 · Output after n steps

Industrial UI abstraction for MBRL

Monte-Carlo Tree Search for 2D model-based UI optimization [39]

Per Usability Task:
50 random distributions of weights

Parameter sets chosen empirically

Fitts' Law
KLM
Hick's Law
Grid Quality
Visual Search
Color Harmony
Serial/Forage/Recall Search

$$\omega_n = \sum_{j \in I} \eta(x, j) \cdot \pi_j + \sum_{i_u \in I} \beta_{i_u} * \frac{1}{\lambda_{i_u} * \alpha}$$ (1)

Usability Studies, yield human-centric usage data

Probability Density Function for UI element selection [6]

Weight Distribution and Parameterization

UI Optimization Models [8,13,7,4,21,10,39]

Resulting Optimal UI Candidates per Task

Industrial machine utilizes adaptive UI

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