Student Assignment: Digital twin for Virtual V&V

Context
The Machinaide project is a cooperation of TNO and Cordis Automation, Additive Industries, Lely and TU/e. Machinaide aims at the development of digital twins for small- and medium-sized companies. Cordis Suite is a platform for low-code software development for machine control applications developed by Cordis Automation. It provides model specification and code generation for simulation and for several PLC platforms. The model provides a platform-independent description of the functionality of the code. Machine control applications are described in a subset of UML, i.e. object, class, state and activity diagrams.

Assignment
A machine control application may involve hundreds or thousands of interacting functions. It is practically impossible to get an overview of all these functions running in parallel. Hence, it is a huge challenge to verify and validate a machine control application.

This assignment involves the development of a user-friendly methodology to apply virtual verification and validation (V&V) of large-scale machine control applications. This virtual V&V is to be achieved using digital twins that monitor operational machine control applications and automatically detect violation of desired system properties. The development of such digital twins involves a number of aspects:

- The development of a user-friendly language to specify system properties on top of an existing machine control specification. The property language should match the concepts present in Cordis Suite, e.g. state machines and logical formulas, as much as possible. Two types of system properties must be supported: behavioural properties and performance properties.
- The generation of property monitors from specified system properties. The generated property monitors detect violations of system properties. Two types of monitoring are foreseen. Property violations can be detected offline by replaying activity logs recorded from an operational system or online by observing a running simulation or operational system.
- A user-friendly method to present detected property violations to system developers. This could involve using a CAD-based visualisation of the system or the system specification.
- If time permits, the assignment can be extended with a method to trace back a detected property violations, determine its root cause and present this to system developers.

The assignment will be carried out at ESI (TNO) at the High Tech Campus in Eindhoven and will involve a cooperation with other partners of the Machinaide project.

Your profile
You are an MSc student Computer Science looking for a graduation assignment of 6-9 months. You have experience with model-driven software engineering. You think it is a challenge to work in a multidisciplinary environment and like your graduation assignment to show the benefits of scientific software development methods in a high-tech systems organisation.

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