Design of Signal Interpreted Petri net Based Sequential Controlled Batch plant

A thesis

Submitted in the partial fulfillment of the requirements

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CERTIFICATE

This is to certify that my work presented in this thesis entitled ***"Design of Signal Interpreted Petri net Based Sequential Controlled Batch plant"*** *submitted in partial fulfillment of the requirement for the award of the degree of* ***Master of Engineering in Electronic Instrumentation and Control Engineering*** *at* ***Thapar University, Patiala****, is an original record under supervision and guidance of* ***Dr.Mandeep Singh(Asst. professor).***

The matter embodied in this report has not been submitted anywhere for the award of any degree.

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ABSTRACT

Traditionally batch control is one of the most difficult and complex control system for implementation since it includes basic regulatory as well as logic control operating under supervisory recipe-based sequential control. In order to enhance the reliability and reusability and to enable fast reconfiguration of batch plants, a new approach for sequential control at the supervisory level is proposed in this thesis. Classical continuous Control Theory has strong mathematical foundations and purely formal design approaches. Logic controller development is closer to software development, in the sense that a special algorithm has to be developed for every new problem.

However, Computer Science offers a variety of formal methods that help to avoid errors in the software development process and allow checking and evaluating the resulting algorithms. In this thesis, concepts from Discrete Event Control Theory and Software Engineering are combined to a formal development approach for logic controllers to be used in the sequential controlled batch plant. Based on Signal interpreted Petri Nets the complete controller development process from an informal specification to the final implementation on a programmable logic controller is discussed. This process includes the steps of design, verification, validation, evaluation (measurement of quality), and implementation. Special emphasis is put on the evaluation step that is new to logic controller development.

A new approach for sequential control at the supervisory level of a batch plant is suggested here. This approach is based on the modular methodology of ANSI/ISA-S88 standard and uses Signal Interpreted Petri Nets (SIPN) and their extensions as a formal modeling and verification technique in order to enhance the reliability of the developed control system. The development of sequential control at the supervisory level of a batch plant for derivation of purified terpens is used to illustrate the approach.

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- SIPN Signal interpreted Petri net
- PN Petri net
- FS Finite state automata
- PhD Doctor of philosophy
- M_o Initial marking
- M (p) No of tokens in place
- 3D Three-Dimensional
- AD Anisotropic Diffusion
- TF Transition function
- OF Output function
- FSM Finite state machine
- P Place
- T Transition
- W Weight
- σ Firing sequence
- E Events
- CP Circuit Petri net
- STG Signal transition graph
- LBMP Level based modeled Petri net
- HLPNS High level Petri nets
- TPN Time Petri net
- SFC Signal flow chart
- RG Reachability Graph
- RC Reachability chart
- DS Dynamic synchronization
- C/E Condition and event
- GTS General Transition system
- BDD Body Decision Diagram

- IL Instruction list
- PLC Programmable Logic control