Industrial Processes Automation

MSc in Electrical and Computer Engineering
Scientific Area of Systems, Decision, and Control

Winter Semester 2011/2012

2st Laboratory Assignment [1]

Handling Faults in Keyboard Reading

This laboratory assignment aims at studying Discrete Event Systems (DESs) in the aspects of modeling, analysis of properties and synthesis. Synthesis will be based on a recent methodology in the framework of supervised control. This assignment further develops the previous assignment in the keyboard reading component by introducing fault handling mechanisms.
The tools to be used in this work are MATLAB and a Petri Net editor. In the last part of the work the Schneider PLCs will be used once more to validate the proposed methodologies.

Part C

Discrete Event Systems synthesis – Supervised Control

The main purpose of the second laboratory assignment is the modeling and analysis of a discrete event system, based on a Petri net. That is in close relation with the fist laboratory assignment.

The main objective of this last phase, part C, is the application of the *Supervisory Control* theory to diagnose and isolate a failure on the system. The failure to detect occurs when the user presses two keys simultaneously. In other words, the main objective of part C consists in designing and implementing a supervisor that detects the *multiple keys pressed error* and resumes the normal operation of the system.

Note: see in the course webpage tools helping this part of the assignment, namely the Matlab toolbox "spnbox" which allows, for example, showing invariant places of a Petri net. The toolbox is distributed as a ZIP file "spnbox.zip".

[1] 2008-2010 original guide by Prof. Paulo J. Oliveira, 2011 rev. by Prof. José Gaspar

Q1. Design a new Petri net that, instead of reading keyboard keys, as the net proposed in part A, simply detects there are multiple keys pressed at the same time. Draw the Petri using the editor PN_Editor. Please indicate clearly the specific place of the net chosen to flag multiple keys detected. Simulate a sequence of events demonstrating the functionality of the net.

Q2. Considering μ_p and D_p the state and incidence matrix of the Petri net designed in part A, and considering μ_d and D_d the state and incident matrix of the Petri net designed in Q1, show that an enlarged net with state $\mu=[\mu_p^T \ \mu_d^T]^T$, running the two nets simultaneously, has an incidence matrix which is a function of the other two matrices, i.e. $D=f(D_p, D_d)$.

Q3. Design a supervisor controller to recover from the *multiple keys pressed error*. Specify the linear constraint(s) that must be used. Solve the problem resorting to the place invariant methodologies studied in this course.

Q4. Design the complete resulting Petri net, identifying the supervisor.

Q5. Discuss briefly the properties relevant for the resulting DES based on the original Petri net and on this supervisor

Order of importance	Property
1	
2	
3	
4	
5	
6	
7	

Q6. Discuss the implementation on the PLC of the supervisory control synthesized. To tackle this problem, modify your routine that detects the key pressed. Moreover modify the validation program to include this new supervisor.