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MODELING, SIMULATION AND CONTROL OF FELEXIBILE MANUFACTURING SYSTEM

SIRB, V[ali] C[hivuta]; STOICUTA, N[adia] & EGRI, A[ngela]

Abstract: *This paper presents the modeling, simulation and control method of flexible manufacturing system (FMS)*
We have used a modular approach to modeling, simulation and control of FMSs, based on the integration of Petri Net (PN) building blocks, and a trace based method for translating sequential behaviors into PN subnets. For the resolve this problems we have used Visual Object Net ++, an innovative Petri-Net CAD/CAE Tool for PC.
Key words: *Fflexible Manufacturing System, Control systems, Modelling systems*

1. INTRODUCTION

For resolving some specific problems of FMS we have used a new exact modeling, quick simulation and a performed control method bason on Petri Net and Visual Object Net ++ programming environment. In figure 1 is presented a Petri net example that models servicing activity of a tool machine.

The conditions so that the tool is serviced are only referred to its disposability so as the existence of the piece in the apprehension disposition of the robot or manipulator without considering other needed conditions for a correct alimentation. The extend model for 2 machine is presented in figure 2

The mark matrix which represent the position estate before the transitions M_0 execution, so called PRE matrix and the mark matrix that synthesizes the position estate after the transitions M_1 manned POST matrix are the next

$$\begin{array}{c} \\ M_0 = \end{array}\begin{array}{c} t_1\ t_2\ t_3\ t_4 \\ \begin{bmatrix} 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \end{array}; \quad \begin{array}{c} \\ M_1 = \end{array}\begin{array}{c} t_1\ t_2\ t_3\ t_4 \\ \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \end{array} \qquad (1)$$

The incidence matrix C it's defined like the resulted matrix from the mark matrix difference POST (M_0) and PRE (M_1).

$$C = M_1 - M_0 = \begin{bmatrix} -1 & 0 & 1 & 0 \\ -1 & 0 & 0 & 1 \\ 1 & -1 & 0 & 0 \\ 1 & 0 & -1 & 0 \\ 0 & 1 & -1 & 0 \\ 0 & 0 & 1 & -1 \end{bmatrix}; \qquad (2)$$

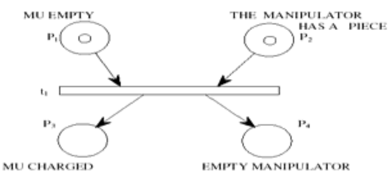

Fig. 1. Petri net models of a tool machine

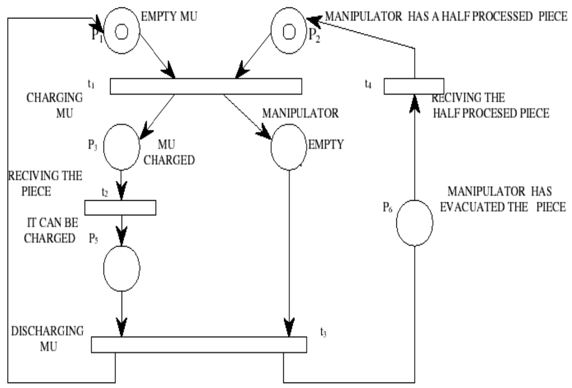

Fig. 2 Running process model for 2 machine

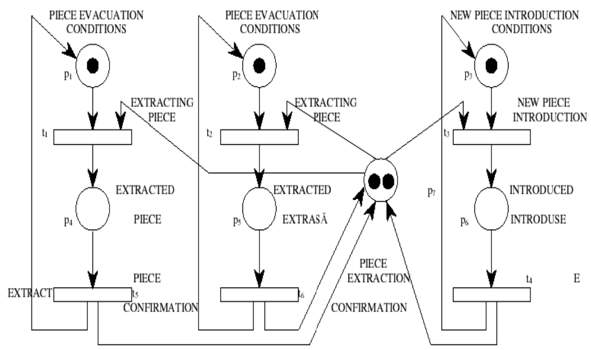

Fig..3 Petri net for I/O process modeling

2. MODELING AND SIMULATION FOR THE INPUT/OUTPUT (I/O) PROCESS OF THE PIECES. FROM F.M.S.

First we have realized the model for the I/O process of the pieces from the intermediary deposit and then simulated the input/output process of pieces (fig.3). For the number of pieces remains constant, from now and then it must supply the pieces from the deposit, sequence that can't happened in the same time whit pieces picking for servicing the tool machine. From all this it concludes that if we dispose of more than 2 manipulators for the pieces evacuation from the deposit then the capacity of the double arcs will grow up to n, and the position p7 could have n marks, after that the finite product assembling.

3. MODELING, SIMULATION AND CONTROL OF ASSEMBLING CELL

We consider the assembling cell (fig.4) composed by 3 deposits D1, D2, D3, to tool machines, to conveyors C1, C2, an assembling station and a robot R. Technological flow is composed on the next operations: C1 conveyors transports type 1 crude pieces D1 deposit on M1 tool machine, M1 (M2) processes the type 1 crude piece resulting type 1 intermediary product, when both M1 M2 processes are finish, robot R transport type 1 intermediary products from M1 to A, and then type 2 intermediary products from M2 to A and robots R transport the finite product from A to D3 deposit.

The model and the simulation (fig.5) of assembling all functioning considered as a starting point for the descending synthesis by the transitions refinement.

It’s suppose that exist a big enough number of crude pieces in D2 and D3 dispose of enough space for stoking its being elaborated Petri net type model by the descending synthesis whit position refinement, starting from the extended (fig.7) model which doesn’t include all functionary details.

The results of modeling with Petri Net, graphic simulation and control using Visual Object Net ++ for assembling cell is presented in figure 6 and for extended system in figure 7.

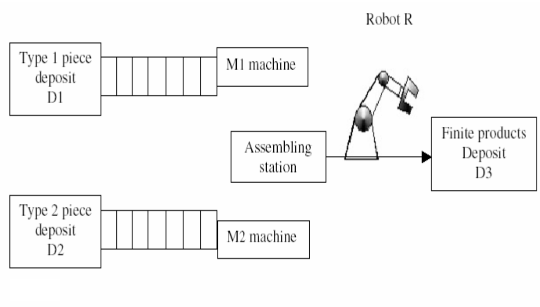

Fig. 4. The structure of the assembling cell

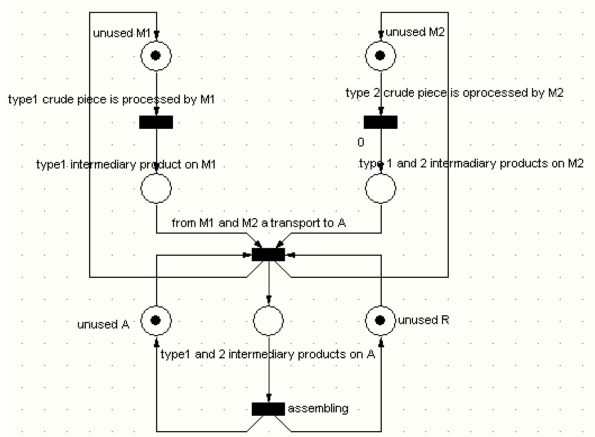

Fig. 5. The model of assembling cell

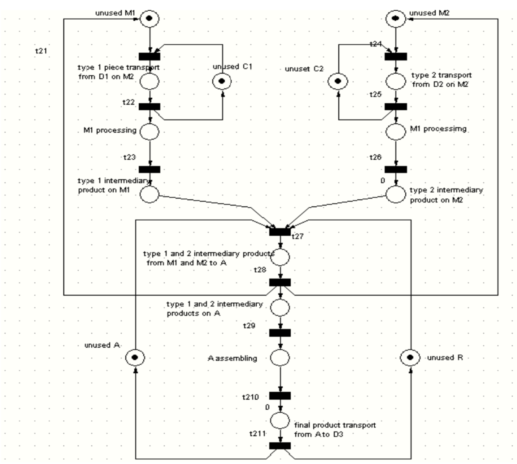

Fig. 6. The model of extended system

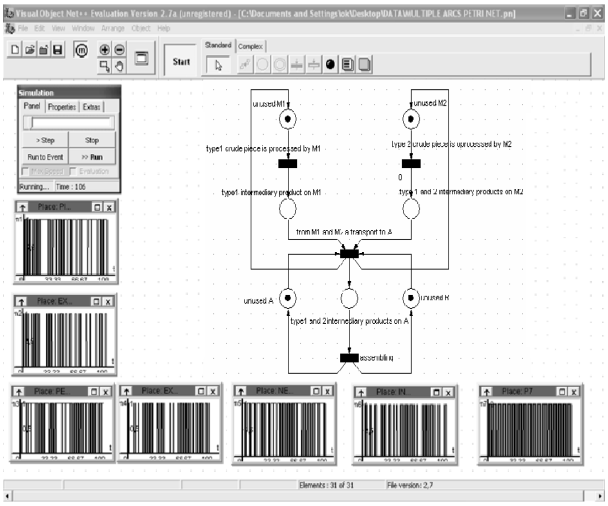

Fig. 7. Simulation and control for assembling cell

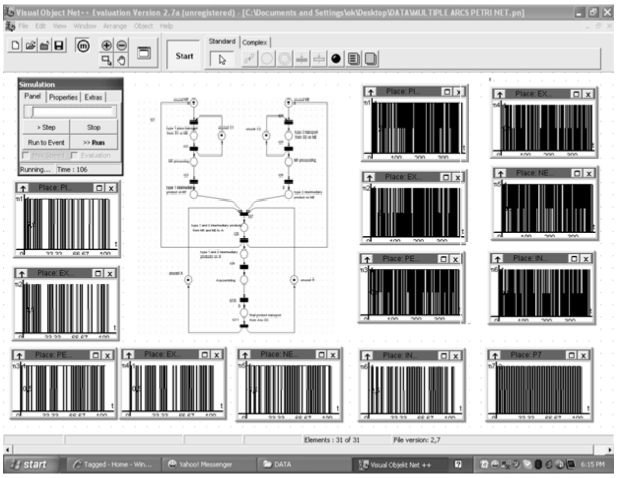

Fig. 8. Simulation and control for extended system

5. CONCLUSION

We have resolved the control problem of F.M.S. using a modular approach to modeling and simulation of FMSs, based on the integration of PN standard building blocks, and a trace based method for translating sequential behaviors into PN subnets. and for the resolve this problems we have used Visual Object Net ++ , an innovative Petri-Net CAD/CAE Tool for PC that supports mixed continuous and discrete event Petri-Nets. During developing this software, a special attention was directed to intuitive usability because of easy modeling quick simulation and a performed control .

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