ANALYSIS OF DIGRAPH OF FLEXIBLE MANUFACTURING CELL WITH FOUR MACHINES AND THREE ROBOTS

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Abstract: In this work we take the Petri net model of a Flexible Manufacturing Cell along with two other Petri nets and convert them into digraph by changing both the transitions and places into vertices and arcs between them into edges and resulting digraph are not Euler digraph which prevents further analysis.

Keywords: Petri Nets, Flexible Manufacturing Cell, Digraph, Euler Digraph.

1. Introduction: A Petri net is a powerful modeling tool in a computer science, system engineering and many others areas. It combines a well-defined mathematical theory together with a graphical representation of the dynamic behavior of the system. The theoretic aspects of Petri net permits perfect modeling and analysis of system behavior while the graphical representation of net visualizes of the modeled system state change.

Petri net are defined in [1, 2] Changing Petri nets into digraphs are given in [4].We take three Petri net models FMC s from [3] and convert them into digraphs using the method suggested in .[4Actually none of them are Euler digraphs.

Definition 1.1: A marked Petri net is a 5-tuple N = (P, T, F, W, M_0), where P is a finite set of places, T is a finite set of transitions, with P∩T = ∅,F⊂(PxT)U (T x P) is the incidence or flow relation (each element of F corresponds to an arc in the PN), W : F —> N \ {0} is the arc weight function, and M_0: P —> N is the initial marking (a marking M : P —> N defines the distribution of tokens in places), where N is the set of natural numbers.[1,2]

Definition 1.2: Flexible Manufacturing System: A Flexible manufacturing system (FMS) is an integrated computer controlled configuration of machine tools and automated material handling devices that simultaneously process medium sized volumes of a variety of part types. Flexible manufacturing system is a discrete event dynamical system in which the work pieces Of various job classes enter the system asynchronously and are Concurrently, sharing the limited resources , viz.,workstations,robots,MHS,buffrs and so on.[3]

Definition 1.3: Diagraph A directed graph G consists of a set of vertices V = {v_1,v_2,....} and a set of edged E={e_1,e_2,....} and a mapping ψ that maps every edge onto some ordered pair of vertices (V_i,V_j).[11]

Definition1.4: Euler Digraph: In a digraph G a closed directed walk which traverses every edge of G exactly once is called a directed Euler line. A digraph containing a directed Euler line is called directed Euler digraph..[11]

Theorem 1.5: A digraph G is an Euler digraph if and only if G is connected and is balanced i.e. $d^-(v) = d^+(v)$ for every vertex v in G.[11]

2. Conversion of Petri Net Models into Digrpahs:

2.1 Petri Net Model (N,M_0): In this sub section we analyze the Petri net model given in [3].We convert the above Petri net into digraph by changing both places and transitions into vertices and arcs between them as edges as given in [4].

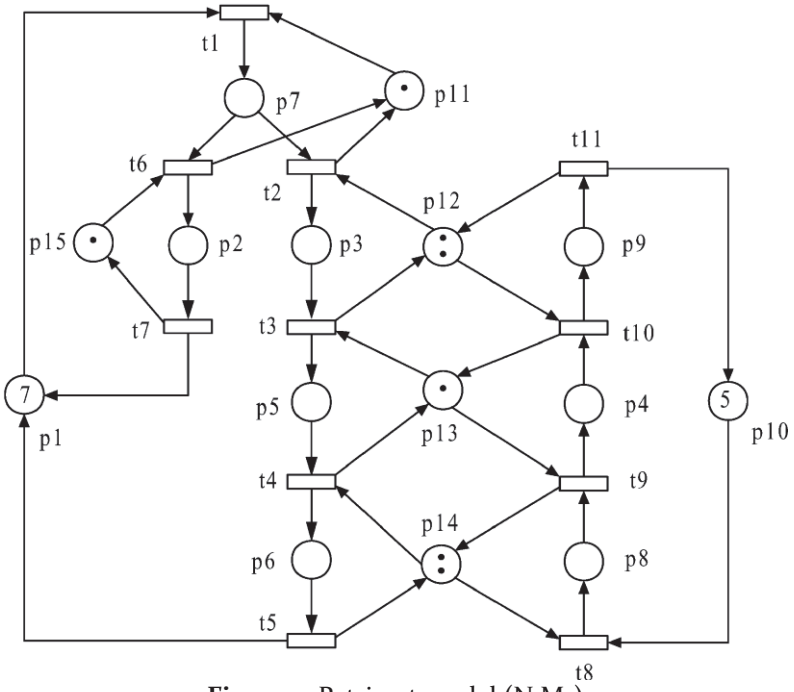

Figure 1: Petri net model (N.M_0)

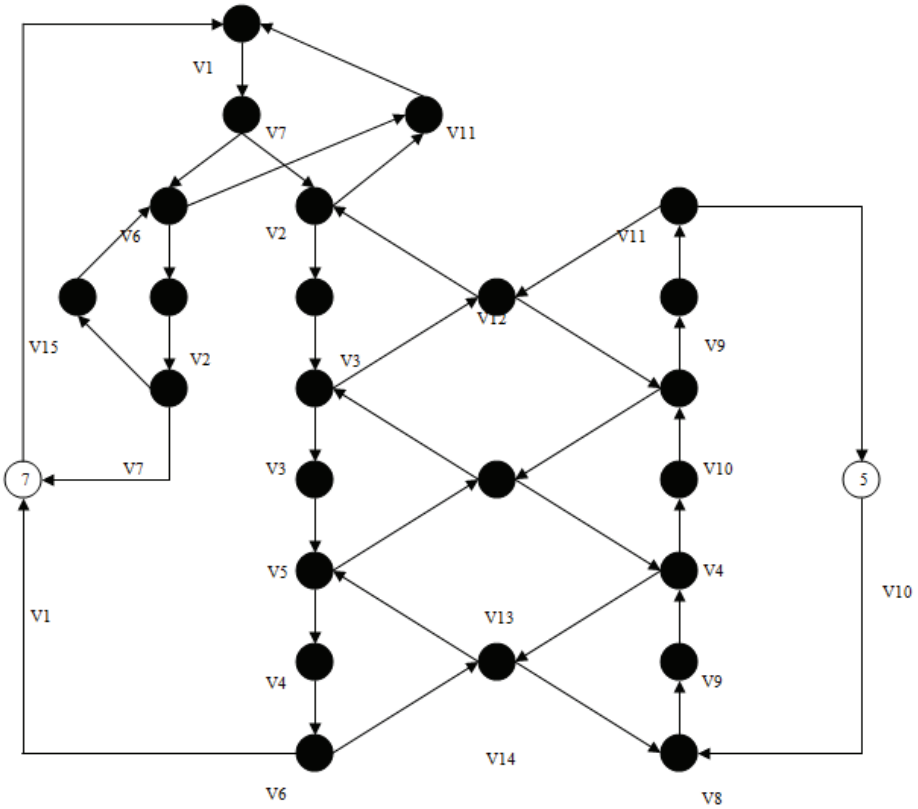

Figure 2: Digraph of Petri Net Model (N.M_0)(Figure-1)

Since $d^+(V_1) = 2, d^-(V_1) = 1$, The above digraph is not Euler digraph by theorem 1.5

2.2 Petri Model of (N,M_0) Added with Two Control Places: In this sub-section we take the Petri net model of Figure-1 added with 2 control places given in Figure-3 and convert it in to digraphs as suggested in [4] as we did previously, we get figuree-4.

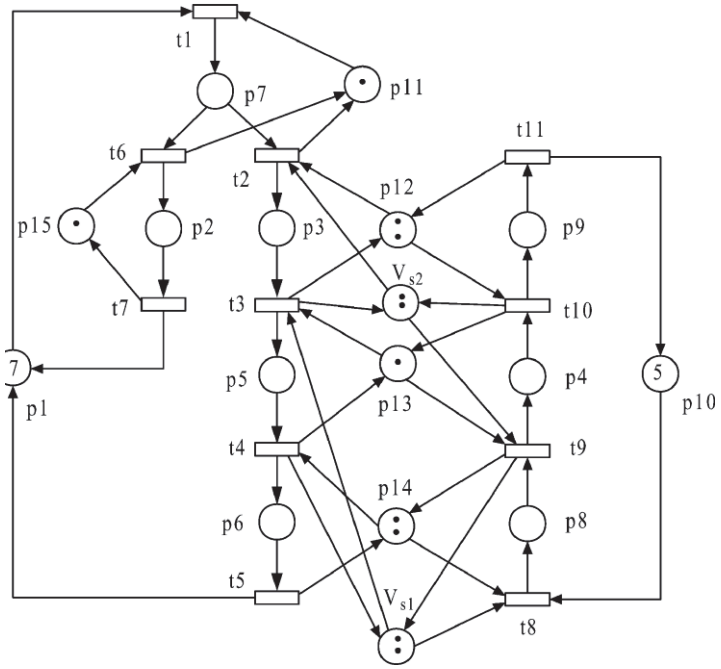

Figure 3: Petri Model of (N,M_0) Added With Two Control Places

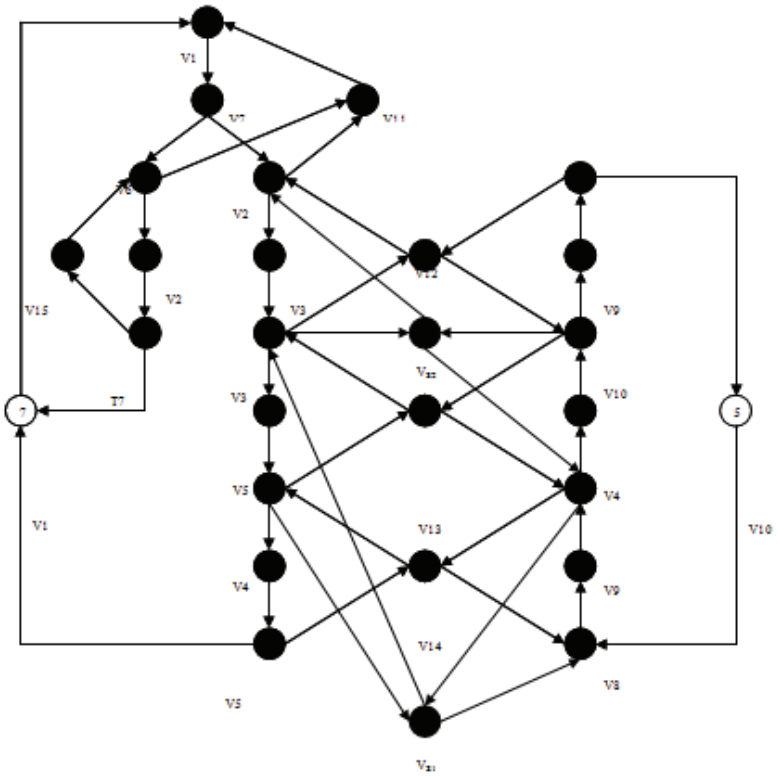

Figure 4: Digraph of Petri Model of (N,M_0) Added With Two Control Places

Since $d^+(V_1) = 2, d^-(V_1) = 1$, The above digraph is not Euler digraph by theorem 1.5

2.3 Petri Net Model of Flexible Manufacturing Cell: Consider the following Flexible Manufacturing Cell with four machines and three robots. We convert this in to digraph as above.

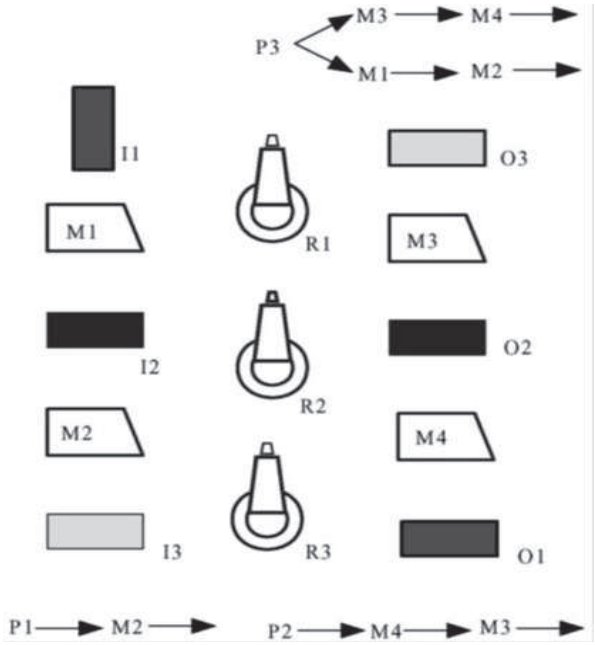

Figure 5: Flexible Manufacturing Cell

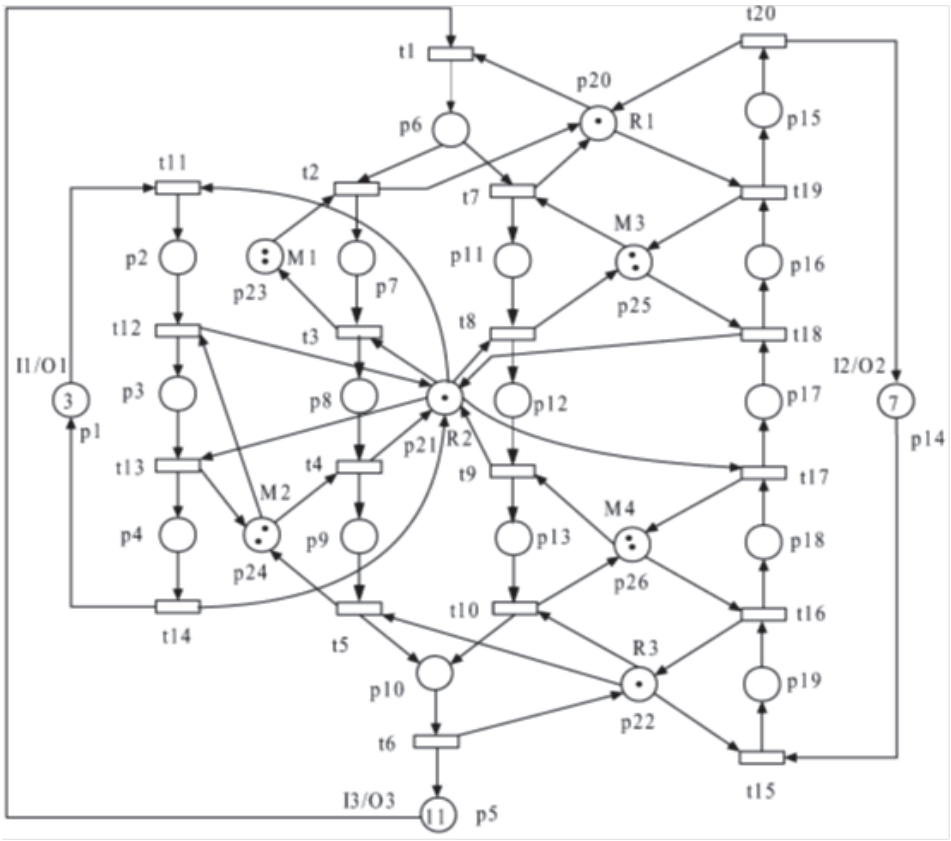

Figure 6: Petri Net Model of Flexible Manufacturing Cell

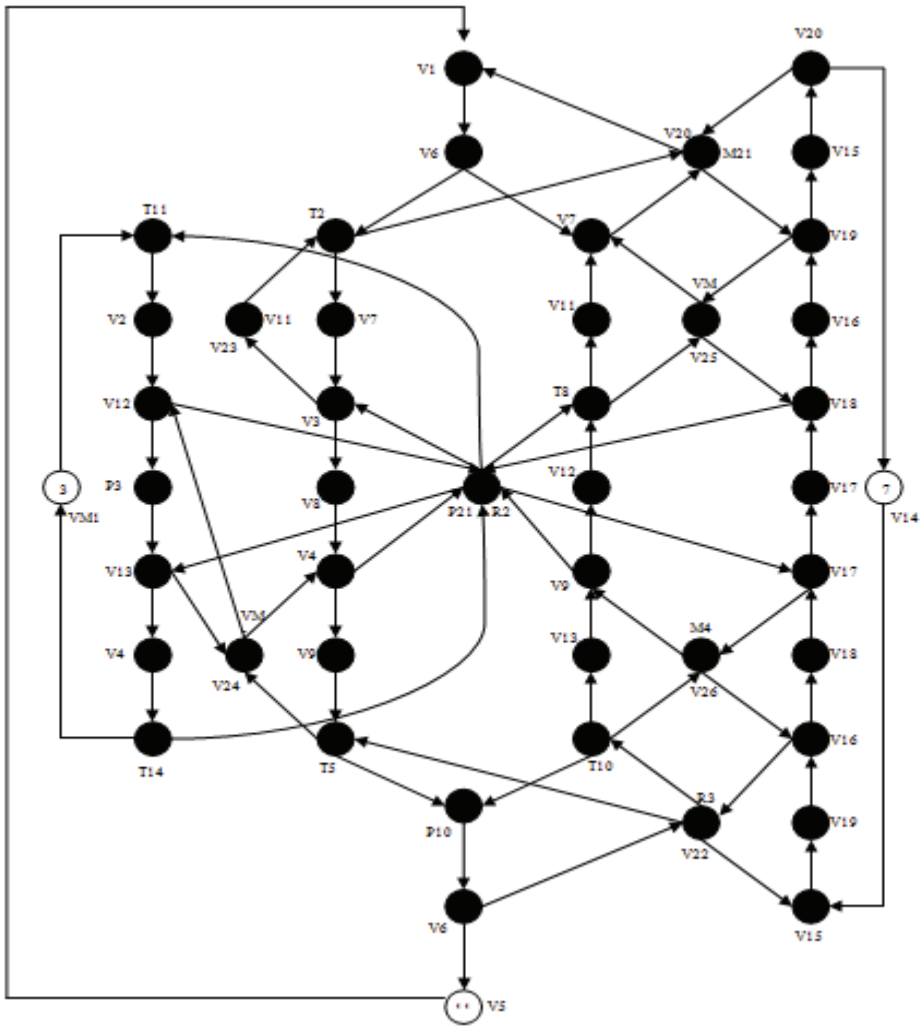

Figure 7: Digraph of Petri Net Model of Flexible Manufacturing Cell

Since $d^+(V_1) = 2, d^-(V_1) = 1$, The above digraph is not Euler digraph by theorem 1.5

3. Conclusion: In this paper we have taken three Petri net models from [3].and converted them into digraphs by using the methods suggested in [4]..None of the digraphs are Euler digraphs which prevents further discussion according to [5][6].The authors have done similar work in the references from[7] to [10].

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