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Implementation of Artificial Neural Network for Task Scheduling problems in Industry 4.0

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Abstract. Extensive research has been conducted in the field of Flexible Manufacturing Systems (FMSs) planning, most of it has primarily concentrated on well-established academic scheduling systems. When it comes to the selection process, which often relies on fundamental principles within the intelligent system JSSE (Workshop Planning Environment), there is a notable scarcity of literature concerning their performance within an FMS. This article aims to address this gap by examining the performance model of machine and Automated Guided Vehicle (AGV) scheduling in terms of mean flow time using the Artficial Neural Network (ANN) strategy. The study conducts experiments through an FMS simulation model, involving 40 scenarios to assess these concepts**.**

Keywords: Artificial Neural Network, Task scheduling, Artificial intelligence and Makespan

1. Introduction

This paper focuses on solving planning problems in FMS through simulation-based experiments. This problem can be considered as a problem of planning business in the market. This study includes an analysis of scheduling policies applicable to FMS and the use of the average duration of the system as a performance measure. Sen et al. (1988) proposed closed-loop scheduling policies in FMS and stated that not all scheduling policies are equally important in market conditions. Egbelu and Tanchoco (1984) investigated the programming of AGVs and machines beyond the process of programming individual machines. Acree and Smith (1985) investigated property allocation policy, but no correct basket selection policy was found in their study. In summary, Sabuncuoğlu and Hommertzheim (1989a) developed a scheduling system based on their research, emphasizing the importance of AGV scheduling compared to machine time. To improve understanding, the FMS scheduling problem is solved using scheduling rules and considering various conditions related to the transportation of goods and mechanical equipment. These planning policies can be divided into two main categories: mechanical planning policies and AGV planning policies. ANN (artificial neural network) is a simple rule to achieve good performance, especially in high-speed AGV environment.

2. ANN Design

The input data has been sourced from Bilge and Ulusoy's work in 1995. This data comprises a sequence of machines, their associated processing times, and the matrix indicating travel times between the machines. Figure 1 illustrates the setup, which consists of four CNC machines equipped with pallet changers and tools.

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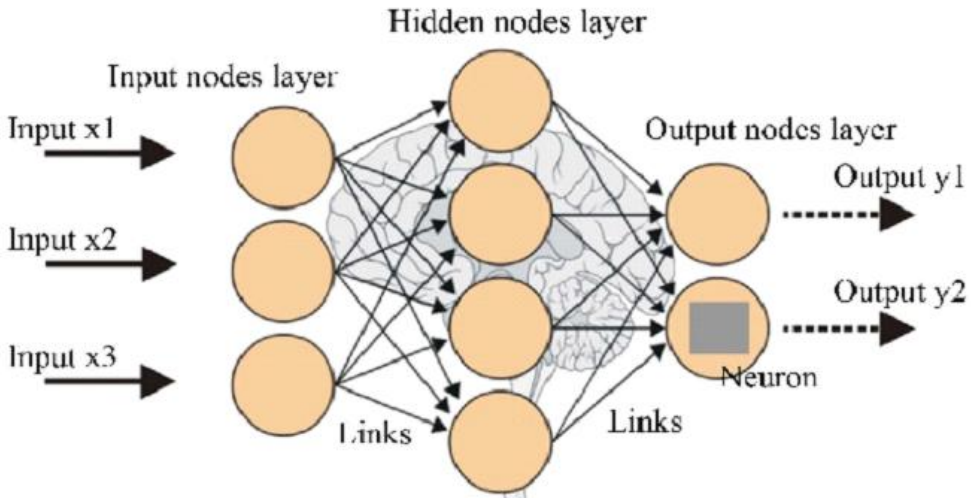

Figure 1: Basic structure of artificial neural network

2.1. Methodology

Layout 2 and Job set 4 are specifically employed to demonstrate the application of the Artificial Neural Network (ANN) rule, considering travel time as half and process time as triple. The following steps outline the ANN approach for Job set 1:

Step 1: Job set 4 is taken into consideration. Step 2: Initial placement at position '1' in the primary line results in the sequence: 1 – 2 - 3 – 4 -5 - 6 - 7 – 8 – 9 – 10 - 11- 12 –13 -14. Step 3: The maximum operational finish time is identified. It represents the potential completion time (makespan) for the given job set.

The determined values of various constraints for all activities are presented in Table 1.

Table 1. Completion Times with the ANN Rule

Order	Machine	Vehicle	TT	Job Ready	Job Reach	Makespan
1	3	1	0	4	4	40
2	2	2	40	46	46	76
3	4	1	76	78	78	102
4	4	2	50	53	102	135
5	1	2	135	139	139	169
6	2	1	169	170	170	191
7	1	2	142	144	169	196
8	2	2	196	197	197	218
9	4	1	218	220	220	244
10	2	2	244	249	249	279
11	3	1	279	280	280	304
12	2	2	253	256	279	300
13	3	2	300	301	304	334
14	1	1	334	339	339	366

Table 1 displays the activity sequence planned using the ANN rule for Job set 2 designs, resulting in an operational completion time (makespan) of 290.

Total completion time = 2954

Average flow time = Total completion time / Total number of operations = 2954 / 14 = 211

3. Results and Discussion

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Results should be clear and concise. Show only the most significant or main findings of the research. Discussion must explore the significance of the results of the work.

The workshop scenario for Flexible Manufacturing Systems (FMS) presented here features Job Set Model 8 and Layout 4.

Model Number	ANN No	MFT
M1	11	177.92
M1	22	170.84
M1	33	170.92
M1	44	179.38
M 2	11	156
M 2	22	145.13
M 2	33	146.93
M 2	44	159.06
M 3	11	187.93
M 3	22	179
M 3	33	179.25
M 3	44	188.68
M 4	11	224.52
M 4	22	213.84
M 4	33	216.73
M 4	44	228.84
M 5	11	135.23
M 5	22	128.15
M 5	33	128.23
M 5	44	137.23
M 6	11	258.55
M 6	22	250
M 6	33	250.11
M 6	44	260.11
M 7	11	161.84
M 7	22	149.78
M 7	33	151.73
M 7	44	166.21
M 8	11	265.04
M 8	22	257.6
M 8	33	257.8
M 8	44	268.15
M 9	11	279.35
M 9	22	274.52
M 9	33	274.58
M 9	44	284.11
M 10	11	363.61
M 10	22	361.52
M 10	33	362.79
M 10	44	368.09

In the optimal arrangement of Automated Guided Vehicles (AGVs) and machines, priority rules are used for three different processing time values, as presented in two tables. An evaluation of makespan and mean flow time across various job sets and layouts is depicted graphically in Figures 2.

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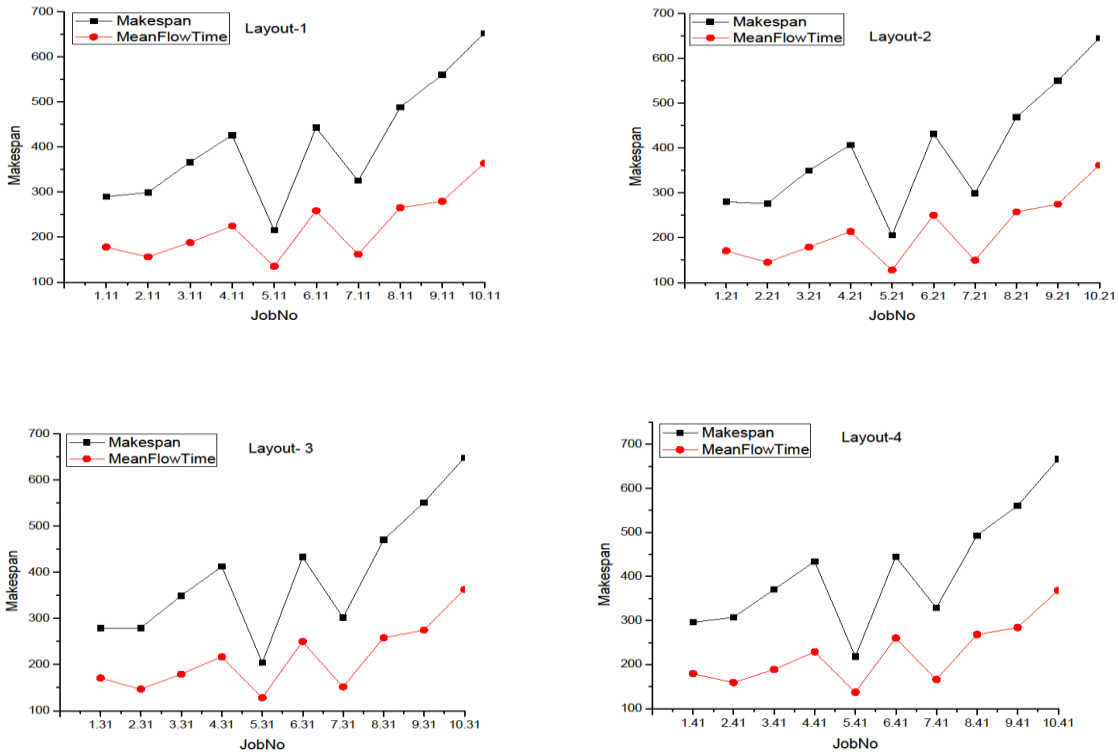

Figure 2: Make span Vs Mean flow time (t/p<0.25)

4. Conclusions.

The FMS problem is solved by developing a neural network (ANN) method and time scale. Four layouts were considered, each with four identical machines and two transport machines. This study includes not only the scheduling of machines but also the scheduling of AGVs and the results are as follows: The study found that the increase in average process is directly related to the increase in technology and the use of computers. AGV. Completion time in FMS is greatly affected by the time between transactions. Average processing time is important when planning rules for AGV and conveyor systems. This is because the use of the FMS system is increasing, and delays are also increasing. The ANN rule has been tested on 40 problems using the average time of the process and is one of the best options, especially when combined with the AGV rule. This study demonstrates the need to develop and implement new rules specifically for the FMS environment and continually test them across a wide range of operational objectives.

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References

1. P.J. Egbelu, "Pull versus push strategy for automated guided vehicle load movement in a batch manufacturing system," Journal of Manufacturing Systems, vol. 6, no. 3, pp. 209-221, 1987.

ISSN PRINT 2319 1775 Online 2320 7876
 Volume 11, Iss 8 , 2022

2. P.J. Egbelu and J.M.A. Tanchoco, "Characterization of automated guided vehicle dispatching rules," International Journal of Production Research, vol. 22, no. 3, pp. 359-374, 1984.
3. P.A. Kumar et al., "Scheduling of machines and automated guided vehicles in FMS using scatter search algorithm," International Journal of Mechanical Engineering and Technology, vol. 8(5), pp. 471-481, 2017.
4. K.V. Subbaiah, M. Nageswara Rao, K. Narayana Rao, "Scheduling of AGVs and Machines in FMS with Make Span Criteria Using Sheep Flock Heredity Algorithm," International Journal of Physical Sciences, vol. 4(2), pp. 139-148, 2009.
5. M. Nageswara Rao, S. Vara Kumari, P. Manohar, B. Madesh, P. Naveen Krishna, R. Suraj Krishna, "Simultaneous Scheduling of Machines and AGVs in FMS Through Ant Colony Optimization Algorithm," International Journal of Engineering and Advanced Technology, vol. 9(3), pp. 1392-1397, 2020.
6. M. Nageswara Rao et al., "Simultaneous Scheduling of Machines and AGVs in FMS through Simulated Annealing Algorithm," International Journal of Innovative Technology and Exploring Engineering, vol. 9(4), pp. 2235-2240, 2020.
7. M. Nageswara Rao, et al., "Application of BPSO in flexible manufacturing system scheduling," International Journal of Mechanical Engineering and Technology, vol. 8(5), pp. 186-195, 2017.
8. M. Nageswara Rao and K. Narayana Rao and G. Ranga Janardhana, " Integrated Scheduling of Machines and AGVs in FMS by Using Dispatching Rules," Journal of Production Engineering, vol. 20(1), pp. 75-84, 2017.
9. M. Nageswara Rao and K. Narayana Rao and G. Ranga Janardhana,. "Machines and AGVs Scheduling in Flexible Manufacturing System with Mean Tardiness Criterion," International journal of Advanced Materials Manufacturing and Characterization, vol. 4, pp. 100-105, 2014.
10. M. Nageswara Rao, K. Dileep, Shaik Khadar Basha, Vara Kumari S., "Modrak Algorithm to Minimize Completion Time for n-Jobs m-Machines Problem in Flexible Manufacturing System," International Journal of Emerging Trends in Engineering Research, vol. 8(8), pp. 4560-4566, 2020.
11. M. Nageswara Rao, et al., "Simultaneous Scheduling in FMS through priority rules," Journal of Advanced Research in Dynamical and Control Systems, vol. 9, pp. 1995-2008, 2017.
12. M. Nageswara Rao, K. Dileep, Shaik Khadar Basha, Vara Kumari S., "Application of BPSO in flexible manufacturing system scheduling," International Journal of Mechanical Engineering and Technology, vol. 8(5), pp. 496–503, 2017.
13. M.Nageswara Rao et al., "Scheduling of Machines and Automated Guided Vehicles in FMS using Shuffled Frog Leap Algorithm," International Journal of Mechanical Engineering and Technology, vol. 8(5), pp. 496–503, 2017.
14. M. Nageswara Rao, "Simultaneous Scheduling through Heuristic Algorithm," International Journal of Engineering & Technology, vol. 7 (2.32), pp. 125-130, 2018.
15. M. Nageswara Rao and K. Narayana Rao and G. Ranga Janardhana, "Machines and AGVs Scheduling in Flexible Manufacturing System with Mean Tardiness Criterion," International journal of Advanced Materials Manufacturing and Characterization, vol. 4, pp. 100-105, 2014.