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SIMULATION MODELING OF AUTOMATED GUIDED VEHICLES (AGVs) IN JOB-SHOP MANUFACTURING ENVIRONMENT

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Abstract—*The just-in-time philosophy has been widely applied in production, especially when supplying parts to assembly lines. To supply parts, and to ensure the parts are fed to assembly units in time, automated transportation systems, such as the AGV system are used because they are widely considered to be an efficient transportation method. Most AGV systems use heuristic dispatching rules to control vehicle movement. However, there is no particular dispatching rule suitable for all cases. In this research we propose heuristic dispatching rules based on transportation time balanced for specific layout of an automotive assembly line environment with multiple vehicles. Simulation modeling of automotive industry assembly lines is developed in ARENA simulation environment. The facility layouts considered in the present study is flow-shop environment. In this paper, a simulation model of a hypothetical system which has a job shop environment and which is based on JIT philosophy was developed. In addition, a dispatching algorithm for vehicles moving through stations was presented in order to improve transportation efficiency. After the model had been established, it was mentioned how to perform simulation output analysis. The studied problem can be modeled as a job shop where the jobs have to be transported between machines by AGVs. A sensitivity analysis has been carried out to optimize the design manufacturing system.*

Keywords: *Flexible Manufacturing System, Automated Guided Vehicle, Scheduling.*

1. INTROOPDUCTION

Nowadays, high competition is occurring in several production industries. The flexible manufacturing system (FMS) is designed to produce a variety of workplaces in a group of machines and other workstations connected by a material transport system, under computer control, such as an automated guided vehicle (AGV) system.

As a result, a company is required to improve its production line's productivity by keeping the production line running smoothly. Strategies for scheduling become essential. In addition, one type of job scheduling cannot optimize all objectives, such as machine utilization, works in progress, and throughput. In FMS, several problems occur in parts waiting to be processed by a machine. An AGV is used to transfer parts and products along the production line, and is guided by markers on the floor. Bose (1986) suggested that, in order to maximize the efficiency of an AGV, a dispatching rule can be used, e.g., pick-up rules, drop-off rules, and unable-to-drop parts management policy. Several heuristic approaches have been considered for AGV scheduling using the traditional dispatching rule (Kato, 1995). Furthermore, AGVs can help to reduce labor costs and reduce accidents.

2. PROBLEM EXPLANATION

Present work includes the development of Simulation modeling of AGVs in Arena Rockwell software. Arena, an advanced simulation system provides an an interactive environment for building graphically animating and analyzing simulation model. Arena template is specific to particular project, company or industry.

Consider a Flexible Manufacturing system producing four types of jobs, job1, job2, job3, and job4.Its layout consists of following Distances among locations are given in **table 1.**

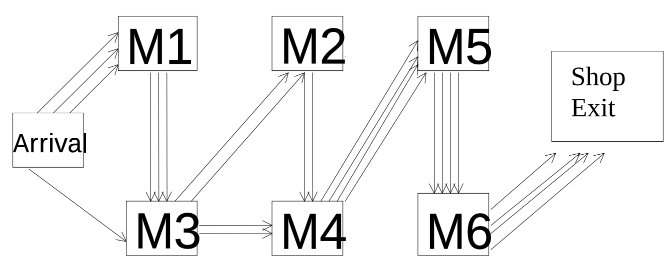

Fig. 1: Layout of the flexible manufacturing and Operation Sequence by job type

Arrival station, M1 workstation, M2 station, M3 station, M4 station, M5station, M6 station, shop exit. J1 process on machine M1, J2process on machine M2, J4 process on M4, J5 process on M5 and, J6 process on M6.

Two AGVs running at a constant speed of 100 feet/minute transport job location. Each AGV can carry only one job at a time. When a job is complete at a location, the job is placed an output buffer, AGV is requested and the job wait for an arrival of AGV. When a job is transported to the next location, it is placed in a FIFO input buffer. Ultimately, when the J6 process on machine is completed, the finished job departed from the shop exit.

2.1. Assumptions

- AGV speed is same for both loaded and unloaded.
- Works for 24 hours a day in 3 shifts at 8 hour each.

Table 1.

S.NO	Beginning Station	Ending Station	Distance
1	Arrival	M1	140
2	Arrival	M2	140
3	M1	M2	200
4	MI	M3	150
5	M1	M4	250
6	M1	M6	400
7	M2	M3	250
8	M2	M4	150
9	M2	M5	400
10	M3	M4	200
11	M3	M5	150
12	M3	M6	250
13	M4	M5	250
14	M4	M6	150
15	M5	M6	200
16	Arrival	M3	250
17	Arrival	M4	250
18	Arrival	M5	400
19	Arrival	M6	400
20	M2	M6	300
21	M5	M1	300
22	Shop Exit	M5	400
23	Shop Exit	M6	400
24	Shop Exit	Arrival	660
25	Shop Exit	M1	500
26	Shop Exit	M2	500
27	Shop Exit	M3	300
28	Shop Exit	M4	300

Table 2: Operation plan for job by type

Job Type	Operation Sequences	Processing Time (Minutes)
Job1	M1	20
	M2	15
	M3	13
	M4	10
	M5	8
	M6	12
Job2	M1	10
	M3	9
	M4	8
	M5	4
	M6	7
Job3	M2	12
	M3	8
	M4	7
	M5	3
	M6	10
Job4	M3	11
	M4	14
	M5	6
	M6	4

2.2. Objective

- Multi objective task scheduling of AGVs in FMS environment using Simulation techniques.
- To study the scheduling approaches.
- Utilization of AGVs.
- Utilization of machines.

The operation sequences of job types are depicted in

3. SIMULATION MODELING OF AGVS SYSTEM

The given system is modeled using ARENA Simulation software. The ARENA model for the job consisting of four main segments is Job Arrivals, Job Transportation, Job Processing, Job Departure.

4. SIMULATION MODEL TRANSLATION

The ARENA model is simulated for a period of one month. Parameters like Replication length and hour per day etc. While running in simulation, we can movement of entities (jobs) through different facilities, waiting for processing, transfer between machines etc. The process time flow as assign DISC (40, 30, 20, 10%). The following parameter ware specified

(1) Length of each simulation run= 43200minutes (one month).
(2) Number of independent simulation runs = 50 replication

After completing the Simulation, report is generated automatically. From the report, we can find job flow times, Job delays at operations location, Machine utilization and AGVs utilization of the system.

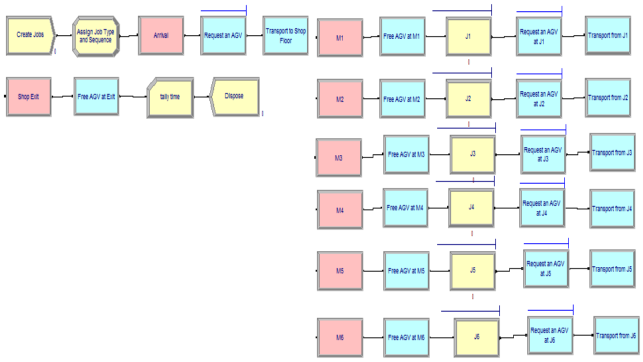

Fig. 2: Arena Model for the Job Manufacturing

5. VERIFICATION AND VALIDATION

Verification concerns with the operational model (whether it is performing properly). It is done to ensure that:

- The model is programmed correctly.
- The model does not contain errors, oversights, or bugs.

AGV in the system the percentage utilization of resources was greatly improved by introducing AGV system.

6. RESULTS AND DISCUSSIONS

Analysis of the Simulation results that the utilization of AGVs in job-shop manufacturing environment as possible as 76.32 percent ,scheduling of six machine utilization are 61.13, 46.66,58.96,51.16,31.10,51.68 respectively, and minimized of waiting time of each machine. This study pointed to the importance of the appropriate choice of both number of AGVs and AGVs dispatching rule to improved transportation efficiency. The result of this study based on ARENA Simulation software. AGV in the system thus the performance of job production was also improved, thereby the efficiency of the whole system improved significantly. The model could be developed for more number of machines and more job types. Selection and optimize of number of machine and job.

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