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Multi Objective Flexible Jobshop Scheduling Problem using Heuristic Algorithm

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Abstract: ***Flexible workshop problem (FJSP) is an extension of the classic job shop problem (JSP) that allows one operation that can be performed from a collection of alternative machines on a single machine. It is closer to the actual condition in manufacturing. Due to the additional conditions to assess the allocation of system operations, FJSP is more It's also a typical problem in combinatorial optimization. But the difference is that all the workers in the shop floor may or may not be handled in all the computers. In just one machine or two machines, a job can be processed or a separate task in all machines may have to go through the processing in order to be finished. Each computer has different work sequences. So it's an internet str complex. The classical workshop scheduling problem varies from the problem of the flow shop and the work flow is not unidirectional. It is more complex than JSP, combining all JSP's problems and complexities. All workers have the same operations series. In this field, in the objective of minimizing "make period time" and mean flow time, the problem is considered with bi-criteria.. nitially manual calculation is done with the question of literature and then with the method of Gantt chart for collecting industrial data.***

Keywords: Flexible jobshop, Multi-objective, Heuristic.

I. INTRODUCTION

Scheduling is one of the major problems in scheduling structures for growth. It is a kind of decision-making process that plays a key role in the manufacturing and service industries. This applies to the date of start of the project in order to complete the jobs with their due date.. The aim of scheduling in manufacturing areas is to meet the due dates, reduce the lead time, minimize setup time or costs, minimize the stock of work-in-process and minimize the use of machinery or labour.

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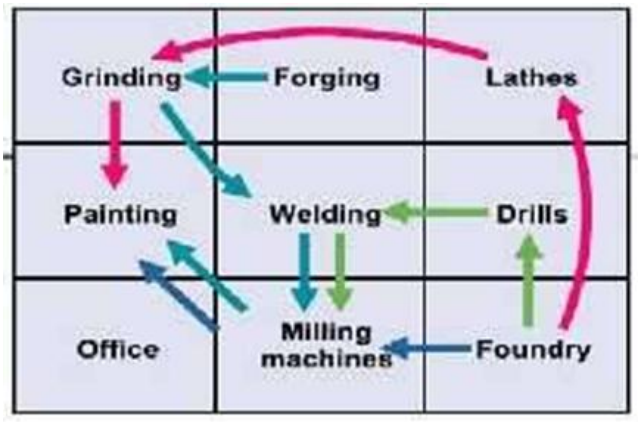
A variety of methodologies are included. Nevertheless, the field of scheduling has become a focus for the creation, implementation and analysis of combinatorial procedures, techniques and approaches to heuristic solutions.

II. JOB SHOP SCHEDULING

It is also a typical combinatorial optimization problem, but the difference is that all the jobs in the shop floor can or can not be processed in all the machines.. In just one machine or two machines, a task can be processed or a separate job in all machines can have to go through the processing in order to be done. Each computer has different work sequences. So it's a complex structure of the internet. The classical workshop scheduling problem varies from the problem of the flow shop and the work flow is not unidirectional. The problem elements are a group of m machines and a number of expected n workers. While a work can have a number of operations, the most common formulation of the job shop problem suggests that each job has exactly m operations, each machine has one. However, adapting the main ideas to general cases where a job visits the same machine more than once or skips certain machines is not difficult.

III. BLOCK DAGRAM



IV. FLEXIBLE JOB SHOP SCHEDULING

Flexible job-shop problem (FJSP) is a classic JSP extension that allows one operation to be processed from a set of alternative machines on a single machine. It's similar to that the real Situation of production.
Due to the additional conditions to assess the allocation of system operations,

FJSP is more complex Contains all the problems and nuances of JSP than JSP. The problem of scheduling jobs in FJSP could be broken down into two sub-problems: a routing sub-problem that assigns each operation from a set of capable machines to a machine and A scheduling sub-problem which sequences the assigned operations on all selected machines to achieve a feasible schedule with optimized targets. In a flexible job shop, the scheduling problem is at least as hard as the problem with the job shop, which is considered one of the most difficult problems for combinatorial optimization

V. METHODOLOGY

Initially raw materials or unfinished parts are collected before machining operations. Every computer can do one job at a time. All tasks must be carried out sequentially without overlapping between the stages. Job preemption and job splitting are not allowed at all stage.

A).Industrial Data Collection Company Profile

In 1985 **HI-TECH ARAI PVT LIMITED** was founded by **B.T. BANGERA** in Chinna Chokkikulam, Madurai. Today they are one of the leading Manufacturer and exporters of Oil seals, Reed valve assemblies and rubber products technically specified.

Customers and Vendors

TVS Motors, Honda, Nissan, Ford, Hyundai, Maruthi, Brakes India limited, Wheels India limited, Sundaram claytan, TVS Rubber.

Industrial Data Collected For Two Products

1. Oil seal
2. Moulded rubber part

Stages Involved in Oil Seal

- Blanking
- Punch press
- Surface finishing

Blanking procedure is done on presses and involves cutting a stamping's outer contour. Manufacturing of flat-shaped sheet metal blanks requires a single action press fitted with equipment including a punch, a corresponding die, stripper to prevent the sheet from following the punch On its upstroke and allows for successive cuts to be spaced. In the contours, which are gaps and slots, the cutting process is called piercing. Stampings combine the virtues of lightness with a high degree of uniformity and well-adapted surfaces to be protected or decorated.

Oil seal data

JOB	O_{ij}	M1	M2	M3	M4	M5	M6	M7	M8
	$O_{1,1}$	4	7	6	2	5	3	8	6
J1	$O_{1,2}$	11	3	4	8	6	5	5	9
	$O_{1,3}$	5	7	5	11	6	8	4	5
	$O_{2,1}$	3	5	7	4	11	10	6	7
J2	$O_{2,2}$	12	8	9	7	5	11	9	8
J3	$O_{3,2}$	6	1	4	5	8	11	2	3
	$O_{3,3}$	2	8	5	3	7	4	11	6
	$O_{4,1}$	6	1	8	3	4	7	2	4
J4	$O_{4,2}$	5	4	2	7	9	8	3	11
	$O_{4,3}$	3	8	5	11	8	9	6	4
	$O_{5,1}$	6	5	8	4	7	3	4	9
J5	$O_{5,2}$	5	9	7	3	5	11	7	4
	$O_{5,3}$	7	3	5	4	8	2	6	3
	$O_{6,1}$	2	8	1	7	6	3	4	5
J6	$O_{6,2}$	7	1	4	2	4	8	2	9
	$O_{6,3}$	9	3	8	1	2	5	7	6
	$O_{7,1}$	10	4	5	8	7	5	8	3
J7	$O_{7,2}$	4	5	2	7	9	11	7	6
	$O_{7,3}$	9	7	9	11	8	10	8	6
	$O_{8,1}$	8	7	10	9	11	17	6	8
J8	$O_{8,2}$	2	5	4	7	3	5	6	9
	$O_{8,3}$	7	6	9	8	9	8	11	10

B).Stages Involved in Moulded Rubber Part

- Moulding
- Cutting
- Coating

JOB	OIJ	M1	M2	M3	M4	M5
	O1,,1	5	2	2	1	4
J1	O1,,2	5	4	8	6	9
	O1,,3	14	5	9	4	8
	O2,,1	2	8	4	3	7
J2	O2,,2	7	9	6	11	5
	O2,3	9	5	4	8	7
	O3,,1	7	8	6	9	8
J3	O3,,2	8	1	4	6	7
	O3,,3	2	8	4	5	3
	O4,,1	1	5	8	4	2
J4	O4,2	4	2	2	1	3
	O4,3	2	3	8	5	7
	O5,,1	1	3	2	3	5
J5	O5,,2	4	5	4	6	1
	O5,,3	2	9	2	1	5

VI. HEURISTIC ALGORITHM

It is difficult to imagine the variety of existing computational tasks and algorithms have been developed to solve them. Heuristic algorithms are called algorithms that either give nearly the right answer or provide a solution for not all instances of the problem.

The group includes a wide range of approaches focused on both conventional and modern techniques. The core principles of conventional search algorithms are summarized for the start. The simplest search algorithm is a systematic search, which tries all possible solutions from a predetermined set and then selects the best one.

Heuristic algorithms are typically used to solve problems that can not be solved easily. Complexity classes of time are specified to distinguish problems by their "hardness." Class P consists of all the problems that can be solved in polynomial time on a determinist Turing machine from the size of the input.

Turing machines are an abstraction that is used to formalize the notion ofComplexity of algorithms and computations. You will find a detailed overview of them in[3]. Class NP consists of all the problems that can be solved on a non-deterministic Turing machine in polynomial time. Since such a computer does not exist, this basically means that for an NP problem an exponential algorithm can be written, nothing is assumed as to whether or not there is a polynomial algorithm.

A NP subset, category NP-complete contains problems such as a polynomial algorithm For one of them, polynomial algorithms could be transformed to solve all other NP problems Eventually, the NP-hard class can be understood as the category of NP-complete or more difficult problems. NP-hard problems have the same characteristic as NP-complete problems, but they do not belong to the NP group.

Even problems for which there can be no algorithms at all. We prove that the problem belongs to the classes NP-complete or NP-hard to justify the application of some heuristic algorithm. Most likely there are no polynomial algorithms to solve such problems; therefore, for sufficiently great inputs heuristics are developed

Heuristic

Heuristic implies by trial and error to find (or) to discover. In a reasonable amount of time, solutions can be sought. There is no guarantee of achieving optimal solutions

Firefly algorithm

Firefly algorithm (FA) is a metaheuristic algorithm that is inspired by the fireflies ' flickering actions. The primary purpose of a firefly's flash is to draw other fireflies as a signal system.

Assumptions

Each firefly is unisexual. So that all other fireflies can attract some single fireflyThe attractiveness of any two fireflies is proportional to their light. The lighter one is going to attract the less bright one. The frequency (apparent brightness) however decreases as its mutual range decreases. If no fireflies are brighter than the firefly in question, it will move randomly.

Fireflies-Behaviour

Purpose of flashing Attract mating partners. Attract possible mechanism for prey defense alert. They have unique flashing pattern. In the same species, females respond to a male unique flashing pattern. As the distance increases, light becomes weaker, and air absorption becomes weaker.

Pseudo-Code

READ: n // no of machines
READ: m // no of jobs
READ: k // operations of each job For

i=1 to k do

For j=1 to m do READ A [1….k] [1….m]

For i=1 to k do For j=1 to m do

SET MIN = A [i] [1]
If A [i] [j] < min then SET MIN = A[i] [j]

SET MNO= j
End if End for

Print (“The minimum time MIN”)
Print (“The machine which takes minimum time in MNO”)

VII. RESULT ANALYSIS

Purpose of flashing Attract mating partners (communication).Attract potential prey Protective warning mechanism. They have unique flashing pattern .Females respond to a males unique pattern of flashing in the same species. As the distance increases, light becomes weaker and weaker becomes absorption by air. Thus makespantime & meanflow time is minimized in a time period

PROBLEM NO	SEQUENCE		MINIMUM MAKESPAN	
	GANTT CHART	FIREFLY ALGORITHM	GANTT CHART	FIREFLY ALGORITHM
1	1-2-3-4-5-6-7-8-9-10	8-1-6-3-10-4-2-7-5-9	12	8*
2	1-2-34-5-6-7-8	6-2-3-5-1-7-4-8	14	11*
3	1-2-3-4-5	2-3-1-5-4	11	8*
4	2-1-3-4-5	3-2-4-1-5	11	9*
5	5-2-1-3-4	2-4-5-1-3	12	10*
6	2-1-3-5-4	4-1-2-3-5	11	9*
7	3-2-5-1-4	5-2-1-3-4	13	9*

*** Indicates minimum makespan**

VIII. CONCLUSION

Flexible job shop scheduling problem is solved using Gantt chart. This algorithm has been applied to the industrial data and Literature problems and their results are tabulated. The measurement results obtained and the time indicated the efficacy of the proposed solution. And to check the efficiency of the proposed solution technique using heuristic algorithm, a more rigorous computational analysis should be performed.

APPENDIX

FJSP	Flexible Job-shop problem
M	Machine
J	Job
HE	Heuristic
Oij	jth operation of job i
m	Total number of machines **n** Total number of jobs
Cmax	Make span Time

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