Delay Management with the Help of Algorithm Based Scheduling Techniques

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Abstract— In this research, an optimization technique was developed using Genetic Algorithms (GA) to optimize the schedule of construction project activities in order to minimize the total duration of the project. The GA procedure searches for an optimum solution and gives shorter duration, with minimum cost. The Genetic Algorithm was made in C programming. The results obtained by the optimization meet the goal of achieving the best schedule.

Key words: Scheduling, Genetic Algorithm, Delay Management, Optimization

I. Introduction

Delay in construction industry means extra period to complete the project. Due to which contractor have to pay compensation. To avoid this proper scheduling of activities are necessary. There are various scheduling techniques, that includes CPM, PERT, Gantt charts but there are drawbacks in this techniques, including the inability to minimize fluctuations in resource utilization levels over the project duration; consider the availability limits of construction resources during various periods of the project; analyse the impact of utilizing multiple shifts and overtime hours on construction productivity, duration, and cost; and consider the uncertainties and risks involved in construction scheduling and cost estimating. . A need arises for a new approach to optimize projects schedules which take into consideration the shortage of resource. Genetic algorithm (GA) procedure was developed and it helps to get an optimum solution and gives shorter duration.

II. Literature Survey

(1)B.Indhu Et Al., Delays can be classified according to liability by three major types: Compensable, Excusable, Non-excusable. Compensable Delay is those which is within the control of, is the fault of, or is due to the negligence of the owner. Excusable Delays are those which occur when the contractor is delayed by occurrences which are not attributable to either the contractor or owner. Non-excusable Delays are those in which the contractor's own actions and/or inactions have caused the delay. (2)Devikamalam J, Et Al., studied on GA procedure and made a GA model and implemented on GenHunter software. The case study was implemented and shows that duration for completion of project was 760 days with 200 generations. (3)Ahmed Senouci, Et Al., made a GA model for scheduling of linear construction projects. Six activities example of placing pipeline were implemented according to CPM method the duration was 37 days, but after optimization it was reduced to 14 days. (4)Marcin Klimek,(2010), presents a genetic algorithm (GA) solving the RCPSP with the objective function of minimizing makespan. They used 480 problems consisting of 30 jobs and 480 problems consisting of 90-activity instances. They have tested effectiveness of various combinations of parameters, genetic operators to find the best configuration of GA. The computational results validate the good effectiveness of their genetic algorithm. (5)Tahreer Mohammed Fayyad(2010), presents in his thesis, an optimization technique developed using Genetic Algorithms (GA) In this research, a new approach was developed in generating the populations of the genetic algorithms generations; that is the “Feasible Solutions Developer operator; (FSD operator)”. An implementation of the developed GA optimization model for resource-constrained construction projects scheduling has resulting in an application program called the CPS Optimizer.

III. Genetic Algorithm

Genetic Algorithms (GA) are inspired by theory about evolution. The GA is a global search procedure that searches from one population of solutions to another, focusing on the area of the best solution. It models with a set of solutions (represented by chromosomes) called initial population, computation is performed through the creation of an initial population of individuals and modifying the characteristics of a population of solutions (individuals) over a large number of generations followed by the evolution, a satisfactory solution is found. This process is designed to produce successive populations that mean the solutions from one population are taken and used to form a new population. This is motivated by hope that the new population will be better than the old one and so on through generations.

A. Fitness Function

The fitness function is the function to be optimized. For standard optimization algorithms, this is known as the objective function.

B. Individuals

An individual is any point to which the fitness function can be applied. The value of the fitness of an individual is its score; an individual is a single solution. A chromosome is a set of parameters which define a proposed solution to the problem that the genetic algorithm is trying to solve. The chromosome is often represented as a simple string.

C. Populations and Generations

A population is an array of individuals. At each iteration, the genetic algorithm performs a series of computations on the current population called parents to produce a new population called children. Each successive population is called a new generation. Typically, the algorithm is more likely to select parents that have better fitness values.

D. Encoding

A chromosome is subdivided into genes. A gene is the GA representation of a single factor for a control factor. The process of representing the solution in the form of a string that conveys the necessary information is called Encoding. Each gene controls a particular characteristic of the individual; similarly, each bit in the string represents a characteristic of the solution. Encoding Methods are Binary Encoding, Permutation Encoding (Real number encoding), and Value Encoding.

E. *Basic outline of Genetic Algorithm*

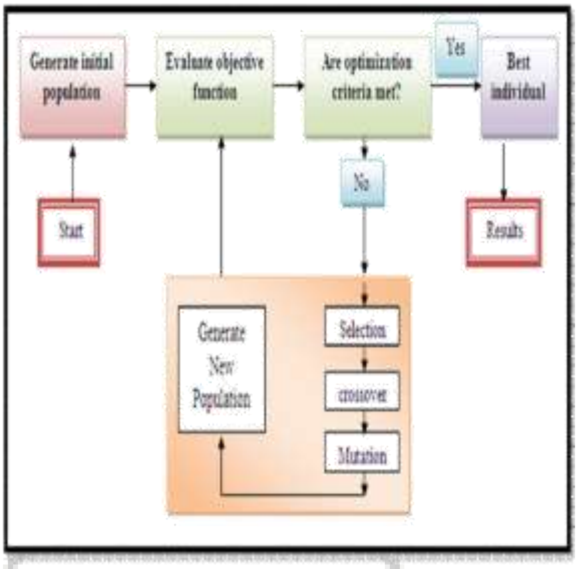


Fig. 1: Flowchart of Genetic Algorithm

IV. CASE STUDY

A. *Objective function*

The objective function is to find the best schedule that gives minimum total project duration (T),
Minimize T
T= maximum (Si + Di)
Where T is the total duration of the project,
Si is the starting date of activity i,
Di is the duration of activity i,

B. *Determination of the fitness function*

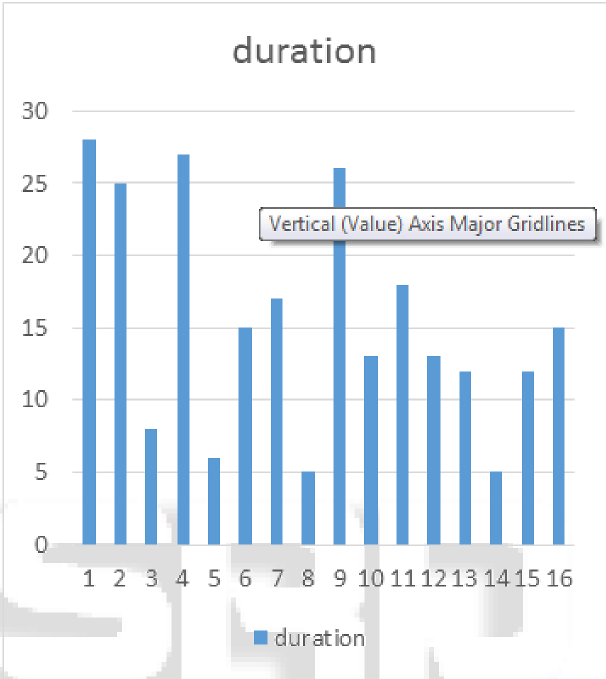
The fitness indicates how good the solution is. In the current study, good solutions have minimum project duration, so that the solution is more fit if it has a lesser duration. This is reflected in the fitness function which is decided to be the reciprocal of the total duration of the project. The fitness function of this study is defined as follows:
F(i)=1/T(i)
Where f(i) is the fitness value of chromosome i , and T(i) is the total project duration defined by chromosome i.
Data of a project with sixteen activities is as below

Activity	Predecessor	Duration
1	-	28
2	-	25
3	-	8
4	1	27
5	2	6
6	3	15
7	4	17
8	6	5
9	4	26
10	5,7,8	13
11	6	18
12	9	13
13	10	12
14	11	5
15	12,13,14	12
16	15	15

Table 1

V. RESULTS

Implementation of this problem in MSP with unlimited resources gives total project duration as 174 days.



CPM solution of this problem gives 124 days to complete the project.
Problem is executed by using many generations, in GA model. The result obtained was T = 118 days.
Comparison of three results are as under

	Days
CPM	124
MSP	174
GA model	118

Table 2

VI. CONCLUSION

An implementation of the GA developed model for resource-constrained project scheduling has resulted in optimized output with reduced cost. A real time project solved using this optimization software shows that best converging result can be obtained.

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