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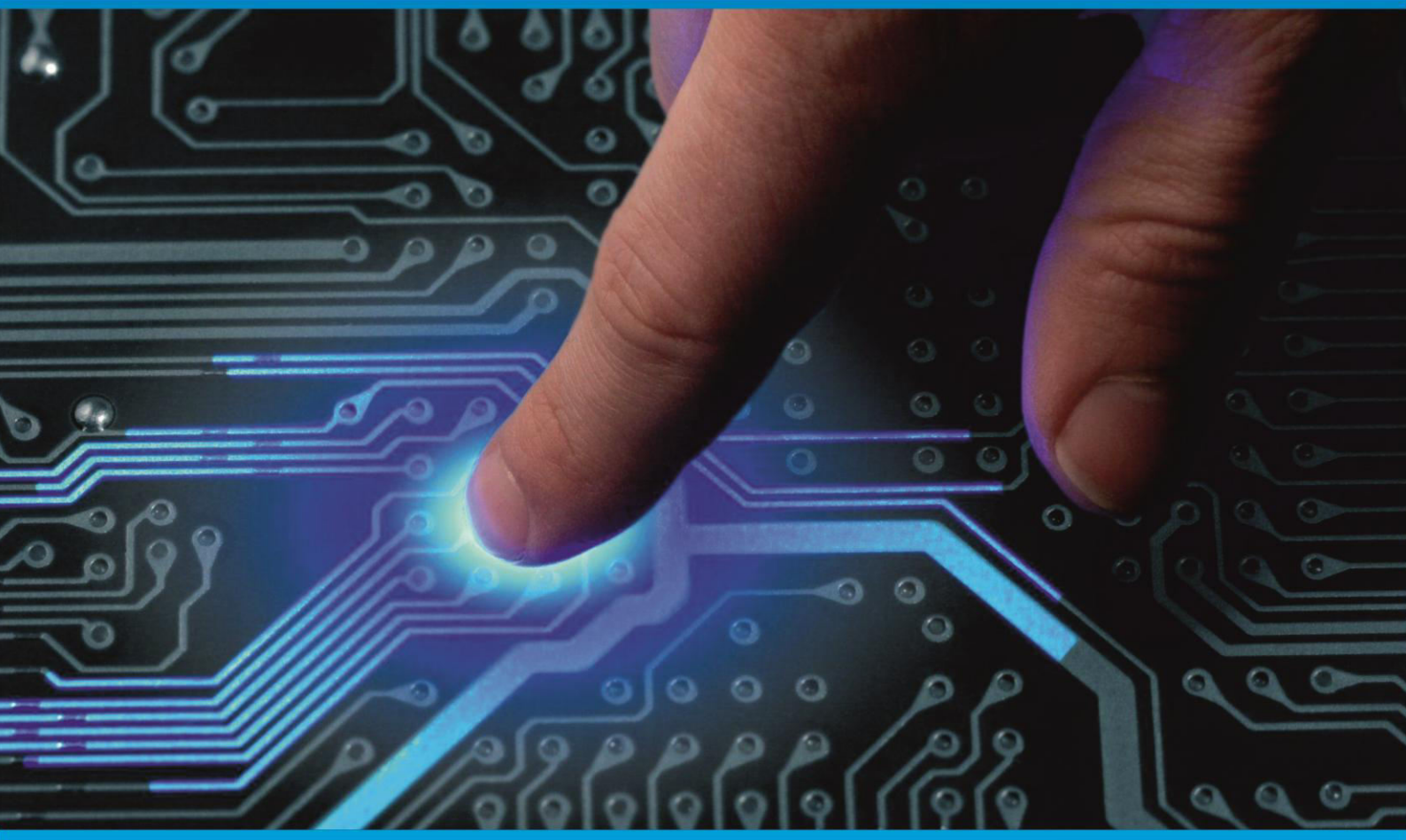

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An Approach towards Optimization of Container Loading Space Algorithm

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ABSTRACT: Various industries, supermarkets, and logistic agencies face a lot of problems regarding container space loading optimization. Proper arrangement and placements of items, bins, goods in the container is a very difficult task. Due to the improper arrangement of goods and the unavailability of proper optimization techniques, space gets wasted, and there are high chances for the damage of goods in the container. Many industries are interested in optimizing the loading process to reduce cost and obtain good efficiency. Unfortunately, most industries have to pay more due to improper volume utilization of the container. So it is very essential to optimize a storage system to support the full utilization of the available storage space. This paper is used to survey different optimization techniques or approaches for container loading space optimization algorithms. To utilize the maximum occupancy of the container, the optimization algorithms are designed, which are based on several factors like the dimensions of the container (base, height, and width), dimensions of the items, the weight of the items, and many more. Here, containers are assigned with retention values. These retention values may be dynamically modified based on a modification function associated with the containers. The sole purpose of this project is to find new ways to tackle container loading space optimization problems with the help of algorithms and operation research.

KEYWORDS: FFD, Genetic, Heuristic, LAFF, Operation Research, Optimization, Tabu-Search.

I. INTRODUCTION

The container loading problem is sometimes called a packing problem and is used in the logistics industry for the transportation of goods and services. In, today's world shipping of goods and services is always in demand and there is a need to minimize the number of costs for the respective organizations and optimization is part of the operational research. The operation is defined as the activities carried out in an organization. The process of observation and testing the systematic investigation into and study of materials and sources to establish facts and reach new conclusions is called research. It can be any situation, problem statement, construction of a model, validation of the system, experimentation.

So the OR is a problem and system-oriented management approach. OR is problem-oriented. Operation research is a problem-solving approach. OR is the research which helps for better decision making. It helps to identify the optimum solution for a particular problem. OR is the use of optimization techniques to improve decision-making and involves a wide range of problem-solving techniques and methods applied for the improvement of decision-making and the quality of the solution for an optimization.

Optimization is the discipline within applied mathematics that deals with optimization problems or so-called mathematical problems. It is the tool that is used to find the optimized solution for the given optimization problem. In logistics, the decision-making to loading and arrange the cargo in a given container size is most difficult. To get the optimized solution with minimum wastage of space and get a maximum container to volume utilization is the purpose of this project to be implemented in Operation Research or find new ways to approach the problem and open up to new field and domains is the purpose of this project.

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Figure 1: Comparison between poorly loaded and optimally loaded truck

II. EXISTING SYSTEM

A. Optimization of Heterogeneous Container Loading Problem, Nov- 2018.

This system uses an adaptive genetic algorithm to solve the problem of determining the load position and place rotation in the container.This is done to maximize space utilization with basic geometric constraints. Here the cargo used is a regular rectangle and it is assumed that the cargo must be parallel to the container wall. This algorithm searches for the best combination of cargo sequence and rotation through a genetic algorithm which provides a large search space for the algorithm to find the better optimal solution.

B. Hybrid Greedy Algorithm and Simulated Annealing for Single Container Loading Problem: A Case Study, Dec-2018

The methodology used here is a hybrid greedy algorithm and simulated annealing. The approach here is to develop a hybrid heuristic and meta-heuristic method to solve a single container loading problem.Since this is an NP-hard model, a greedy algorithm and simulated annealing are used to solve the model. In simulated annealing encoding method is used where the solutions are coded into row strings where the first row represents the loading sequence into a container and the second row represents the position of the boxes and representsa binary number.

C. A Two-Phase Approach for Single Container Loading With weakly Heterogeneous Boxes, March-2019

Here random key genetic algorithm is used for combinatorial optimization. Combinatorial optimization means it helps in finding an optimal object from a finite set of objects. In this work, they have considered two constraints one is orientation and the other is stability constraints. The idea behind this algorithm is to decompose the container loading problem into two sub-problems namely the 3-dimensional problem of generating a set of blocks of boxes and loading a subset of boxes on the container floor.

D. Container Space Optimization using Excel VBA,May-2017

To utilize the maximum occupancy of the container the optimization algorithm, simple algorithm, LAFF-Largest Area First Fit with weight consideration is proposed. Here, the proposed system has an efficiency rate of increase in loading volume space utilization from 84-87% to more than90%. Future work can be done on the design of proper space optimization algorithms (heuristic algorithms) and CAD models for cargo by considering the dimension of the container like weight, height so the maximum space can be used for further optimization.

E. General Cargo Yard Storage Allocation Optimization Based on Layout

In this paper, a two-dimensional rectangular layout theory and three heuristic algorithms are employed to solve the problem of remaining storage allocation in general cargo yards. The article first analyzes the characteristics of the general cargo stacks, describes the problem of yard storage allocation, then establishes the mathematical model of the problem and designs the algorithm structure to solve the model using BL and BF algorithms. But they are not so efficient when compared to genetic techniques of optimization.

F. Simulation in a container to reduce wasted space with first-fit decreasing and largest area fit methods

In this paper, the combination of LAFF and FFD algorithms is used. FFD algorithm is used in determining the orderof goods. While the LAFF algorithm is used to determine the position of goods. In this paper, they have developed a simulation of the arrangements of goods. This simulation will be 3D-shaped with three kinds of items that can be selected, i.e. cylinder, sphere, and box. This study has succeeded in making a simulation website along with giving a better result in the combination of two packing methods, FFD and LAFF. However, a database can be used to store the

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simulations and add the number of containers.

III. PROPOSED SYSTEM

To overcome the problems faced in the various industries of transport and logistics of goods and services and we have come up with a new optimized approach on the optimization of container space loading problem using operation research.

Operation research is an analytical method of problem-solving and decision-making that is useful in the management of an organization. In operation research, the problems are broken down into basic components and then solved in defined steps by mathematical analysis. Optimization is finding out the best available values for the pre-defined assumptions and constraints and proving that this process is one of the ways of approaching new problems related to optimization of container loading space algorithms.

In our system, we are using a new approach towards optimization of container loading space algorithm and to implement many algorithms as stated in the literature survey and convey their performances and choose the maximum and least efficient algorithms and in which position our new proposed methodology stands the existing performance of optimization algorithms using heuristic algorithms, genetic algorithms, and tabu-search algorithms also with the combination of LAFF and FFD algorithms of operation research.

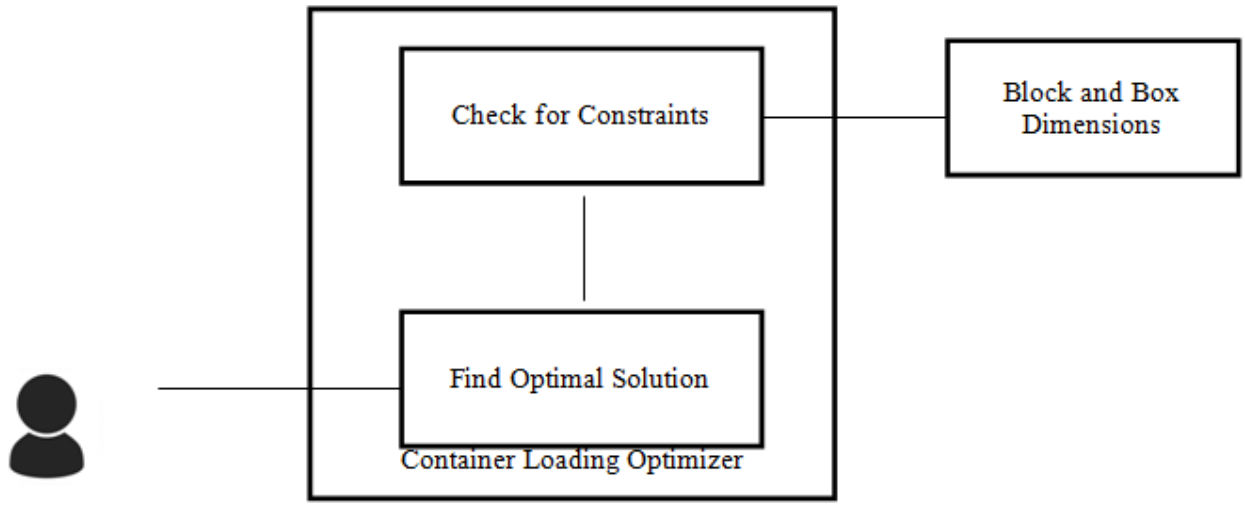

Figure 1: Block diagram of the proposed system.

IV. SYSTEM ARCHITECTURE

System design is the process of defining the architecture, components, modules, interface, and data for a system to satisfy specified requirements. System design could see it has the application of systems theory to product development. There is some overlap with disciplines of system analysis, system architecture, system engineering.

The primary objective of the analysis is to improve the optimization of the container loading problem. For this optimization, certain strategies and OR methods are used such as position strategy, orientation strategy, and block strategy. By doing primary assumption we are implementing a new approach for container loading space optimization. The goal of the space optimization algorithm is to use different algorithms to optimize the space and derive the results and compare the analysis of all the algorithms to conclude our study in this domain.

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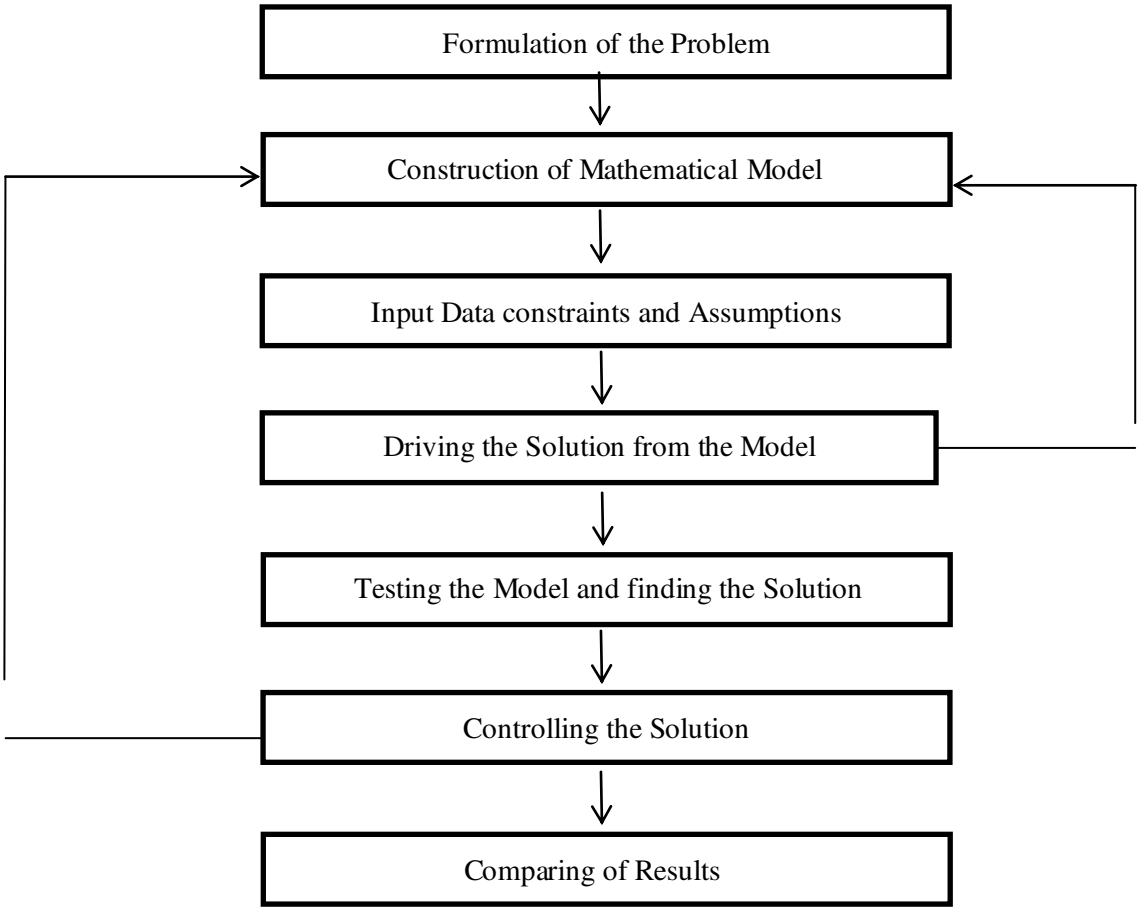

Figure 2:System Design Diagram

A. The Data Flow Diagram provides a visual representation of the flow of information within a system. By drawing a Data Flow Diagram, you tell the information provided to someone who takes part in the system processes, the information needed to complete the process, and the information needed to be stored and accessed.

B. A container and number of cartons are specified and certain assumptions are made and according to the assumptions we have made we define the block and box length, width, and height, and according to the constraints defined we provide the input of processing the number of boxes to be loaded onto the container. Optimization algorithms are run and then we get the accuracy of each of the algorithms that we have taken into consideration.

C. After running different optimization algorithms we can figure out which algorithm provides efficient space utilization which gives the maximum volume utilization. The volume utilization criteria are defined as the ratio of the total volume of the loaded cartons over the volume container. We consider the product positioning, weight limit, orientation, and stability constraints.

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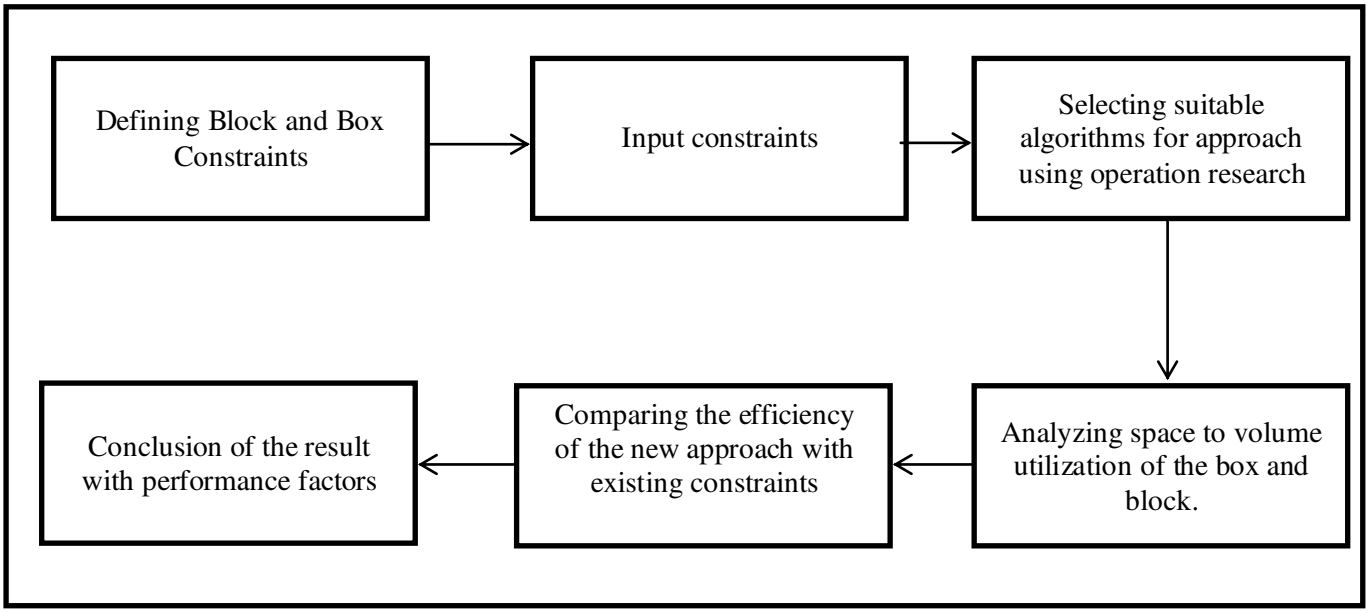

Figure 3: Data Flow Diagram

V. REQUIREMENTS

1) Functional Requirements: Assumption of the problem statement that is to be done.Assumption of certain constraints and the workingof the algorithm concerning the real-world constraints.Various, genetic and placement heuristics algorithms are implemented on the dataset. The algorithm with the highestaccuracy is chosen.

2) Non Functional Requirements: Non-Functional requirements, as the name suggests, are requirements that are not directly concerned with the specific functions delivered by the system. They may relate to emergent system properties such as reliability, response time, and store occupancy. Alternatively, they may define constraints on the system such as capabilities of I/O devices and the data representation used in system interfaces.

The non-functional requirements are as follows:

a) Usability
b) Performance
c) Portability
d) Reliability
e) Supportability

VI.CONCLUSION

Operations Research aims to optimize the existing solution/algorithm. Based on our research over different algorithms, our objective is to come up with a more efficient algorithm adopting the best parts of the existing algorithms. Upon this, our goal is to take into consideration various constraints such as the brittleness factor, weight distribution, to improve the usability of our algorithm. On successful completion of this project, this algorithm will be capable of optimizing the container loading problem considering the above constraints, with scope to consider more factors such as priority of delivery order.

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