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Chapter 1- Introduction

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T

he past two decades is the era of the personal computers and information technology . The mathematical algorithm is no longer just participating with our world – they shape it. Algorithms are used in calculation, data processing and automated reasoning. From Financial market to small mobile device, everything uses a smart algorithm to reduce the complexity of some problem and make the technology looks wonderful. But there are questions that remain unanswered? How the Information Technology Field will change in the next 10 years. If we will find some algorithmic approach to solve a problem that is best suited and most optimized.

* 1. Topic of the System

The Primary goal of the project “Beacon (Hi-Tech Marine Loading and Path Detection System)” is to resolve the logical and mathematical complexities in the Logistics System. The project provides a new approach of solution to two popularly known NP-hard problems, Travelling Salesman Problem (TSP), Container Loading Problem (CLP). Beacon keeps everything organised, updated, smart and accessible.

* 1. Purpose of the Situation

The Developer is sensing immense scope and intelligent system name Beacon that uses advanced genetic and greedy approach of solving the problem, a new algorithm is generated to solve the complex and unsolvable problem. The approach results a optimize solution of the scenario.

Every Logistics company that transfer heavy goods materials to different destinations plans the routing of the vehicle (Trucks/Ships) to manage the cost of travel. This cost is very critical to the business process and can save lots of money. Route Planner is basically required here to get the optimized and shortest route. Since the number of stops are uncertain and a very large number of stoppage can cause a very problematic situation to find the best possible solution. This problem is commonly known as Travelling Salesman Problem in Algorithms.

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| --- |
| http://mathworld.wolfram.com/images/eps-gif/TravelingSalesmanProblem_1000.gif |
| Link - http://mathworld.wolfram.com/TravelingSalesmanProblem.html |
| Figure 1 Travelling Salesman Problem(Author ??,2001) |

The second algorithm developer is doing is related to marine loading. Large numbers of container are being loaded to ships and other vehicle for supply. It is always a tedious task for loading staff to manage the containers and make a optimize load plan. The load plan should be made so that the maximum number of container gets load without affecting the balance of the ship. The problem arises due to different number of containers get transported with various size of goods materials.

|  |  |
| --- | --- |
|  | Different Box are arranged in order to have maximum number of the box in the ship. |
| Link - http://www.astrokettle.com/pr23proc.html | |
| Figure 1.2 : Container Loading Problem Graph | |

* 1. Target User of the System

Target users are group of those people for whom the system is going to be developed for.

* **Shipping Companies/SMEs /Courier Company** - Organization who manages a large supply or export/import packages to move on.
* **Skilled People targeted** – Package planner, Package Loader, Insurance People, Manager, Accounts. The system also targets different worker of same enterprise according to work divided.
* **General/Typical Users -**Any person who wants to control their data can use the system.
* **Research peoples and Students** – The advance algorithm and problem solving techniques can be used in academics and research.
  1. Topic Background

The basic idea of the system is to solve the complexity in the enterprises in route mapping and container loading. Both the Idea is unsolvable due because of being a NP hard problem that cannot be solvable and verifiable in polynomial time. To solve this algorithm in the feasible time, a backtracking approach needs to be applied. Genetic algorithm is one of the way to solve the problem.

Genetic Algorithm is a search heuristic algorithm that is routinely used to generate useful solutions to optimizations and search problems. It generated solutions to optimization problems using techniques inspired by natural evolution, such as inheritance, mutation, selection and crossover. Genetic algorithms are one of the best ways to solve a problem for which little is known. ( P. Bajpai , M.Kumar 2008 , pp 1-3)

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|  |
| Wiley practical genetic algorithm page no -28 |
| Figure 3 : Genetic Algorithmic approach for optimization |

* 1. Problem Context

In the present world, Information System and calculations plays a very vital role in every place. Every real world problem can be linked as an entity and the corresponding relationships can be defined in between.

Beacon is responsible to solve the complexity of the problems and system of any logistics company. Its solves the mind jolting and tedious tasks automatically using its advanced algorithms and data flow design .Complex problems like TSP (travelling salesman problem ) CLP (container loading problem ) can’t be solved manually or any other way .Beacon keeps everything organised ,updated ,smart and accessible .

* 1. Description of the Problem Area
* To enter data of the goods to be transported and organizing the relationships between data is a complex and time-taking tasks. Every goods from nail to big industry parts are needed to be logged into the system with its specifications and related data .What are the materials going to transfer in which container and vehicle.
* The information related to the goods, transported like basic price of goods, charge of transportation, value, size, weight, owner, destination, insurance papers etc. This data are needed to be arranged in the normalized manner to solve the data redundancy and availability.
* Efficient algorithm for solving the TSP with the facility to import map coordinate or create a weighted graph. To solve the problem with the advanced genetic algorithm is also a tedious and brainy task that includes various constraints like time, amount of goods, traffic etc.
* Second most important algorithm need to generate to solve CLP of ships. To generate whole new algorithms is the research part in the project .Also the system is responsible to generate 2D/3D graphs to show the efficient container loading .This features include a high level of challenge and skills.
* Implementing the unique ID generation for the transport and the goods is also a challenge, these Ids can be used to track and update the status. Also small mobile app can also be used for the customer of the company to manage their goods.
* Features like language support and import of data through excel sheets, interactive reports are also the problem areas which are not clear.

**Setting an example** – Mr. Sharma is a famous business man from India. His company exports various things like natural resource (coal, iron ores, etc), agriculture product, couriers, vehicles and everything from ships and trucks. He needs to cut the expenses from the TSP and CLP problem in the system .Company can saves thousands of dollars if they have efficient algorithms for the best loading and supplying .And also they need the interactive system to deal with the various constraints, data and reports of every transportations.

* 1. Rationale Behind the System

As obvious from the problem context presented above the situation warrants such a system that helps reducing the complexity , solve the TSP , CLP problem that is impossible to solve in any manual way or by supercomputers . In TSP and CLP the problem grows exponentially fast in every turn that makes its unsolvable when the inputs of data is high. When the destination in TSP is more than 20 or in CLP .It’s very tough to create the optimal solution for the system.

**Setting an example**: A company like DHL is known for exports/imports business and they need the system to plan, organize and track the goods. Beacon is perfect in this situation .It’s also has small mobile app for users to track the products.

Benefits of the System

The system implemented could bring about significant tangible and intangible benefits. Given below is a list of tangible and intangible benefits expected from the system:

**Tangible Benefits**

* ***Reduced Complexity of Problem***- This system generates the optimal solution that seems impossible to solve manually or technically .TSP and CLP problems are being solved with the most efficient problem solution being designed and implemented by developer.
* ***Graphical view of route and container loading*** – The system will generate 2D/3D view of the containers to show the best loading graph in CLP and the best route graph in TSP. Its gets easier to load container using graph and route map makes the route clear.
* ***Organized Data and accessibility*** – The Data of every container is very much organized and validated during entry and can be used to plan a consignment. Also every goods/material will gets easily to track as per the unique id provided .The status can be made available for the customer in the current time.
* ***Cost Benefits*** - Cost being “the most” important factor for any organization, it’s always beneficial to adopt cost-cutting or cost-saving measures. With Beacon, cost benefits come in following ways-

Most efficient route will be produced, results in precious fuel saving hence cost cutting. Best Container loading plan optimizes the overall loading with the ships and also maxims the number of container .Hence this reduces the administration and managerial overhead results into cost benefits

* ***Time Benefits***- with Beacon, the time of container loading reduced efficiently as everything will be decided by the system will be pre-planned. Report generation and task assignments are easier to discuss and also proper planning and scheduling make the most out of work in minimum time. Trucks and ships save time by going through the shortest path provided results in more resource availability. **For Example:** More the trucks reduce the time of travelling; more the loading of trucks will be possible. Also the container loading takes the minimum time in ships.

**Intangible Benefits**

* ***Increased Employee /Enterprise productivity*** – With employee being aware about the task and work division among the organization, it results into employee task productivity. **For Example** – The Work load is very much reduced by the algorithms of TSP /CLP and also the planning tool makes the productivity easier .The Consignment planner can easily arrange every box and goods.
* ***Increased work flexibility and easier to understand and operate –*** The work load assigned are easier to plan and manage and keep track of the work progress .Also the ERP makes easier to understand the problem statement and to organize and plan the things based on different constraints. **For example -** Desirable production and better planning can be targeted as the vision of the project.
* ***Increased customer satisfaction -*** All organizations churn out some services whose final consumer is the customer .With Beacon promising to deliver so much for improving the productivity and uptimes for the businesses they are surely going deliver better results for their end customers thereby promoting customer satisfaction and customer loyalty thereby increasing business for the organizations.
* ***Reduces stress- –*** The automated advanced application that works on backtracking can automatically reduce the stress and work overhead of the users.
  1. Project Objectives
* To learn advanced programming techniques, software engineering principles, project management concepts, advanced algorithms and integration of varied technologies.
* Learn about domain area, i.e. Genetic algorithms and Greedy Approach of solving graphs in algorithms
* To implement the knowledge gained in Objective 1 to develop such a system which leads to goal mentioned above.
* To make efforts to ensure that the system being developed will fulfill all the tangible and intangible benefits mentioned in the previous section.

The Proposed system intends to allow engineers to manage their container loading provided with the unique id of every container. The system manages all the data using an integral optimum methods to organise them as the weight remain same and the overall container loading doesn’t affect the balance of the ship or anything .In second stage it provides the route map of the ship. All the input data are verified and validated with unique ID. Custom report generation, language support, data entry through excel and other are some other enhanced features. The important feature of the system is the graph generation of the container loading in 2D/3D.

The modules for the proposed system have been listed below:

***Software Module:*** This module will be installed on desktop machine of the organization .Different software are divided mainly for data entry, container loading and route map and report generators.

***Database Module:***  This module will save every single consignment for the company with details of final results of TSP and CLP.

* 1. Academic Objectives
* To learn advanced algorithmic approach like greedy algorithms, genetic algorithms and implementation of algorithms.
* To create a research paper and whole new approach to solve the travelling salesman problem and container loading problem.
* Project management concepts like methodologies, scheduling, time estimation, work breakdown techniques and tools etc.
* Implementation of the algorithms derived into visual basic to create a running application while learning the programming background of the technology.
* To make efforts to ensure that the system being developed will fulfill all the tangible and intangible benefits mentioned in the previous section.
  1. Traceability matrix between problems and functionalities

|  |  |
| --- | --- |
| **Problems** | **Solution** |
| Map Design | Editor to draw a weighted graph of route |
| Best Route | Best optimized route generator |
| Container Information | Data entry and Validate of each container |
| Optimized Load Plan | Best solution using genetic algorithm |
| Different Language | Language Support |
| Easy data entry | Using Excel sheets/Export –Import |
| Load Plan | 2D view of the final loading |
| Document Generation | Printable document generation as a report |

* 1. Assumptions

The successful implementation of the project is much depends on the understanding of the user towards the system. So as this system is developed for an logistics company so it is believed that all the users are expert user and know about it. Since developer is providing a solution based on his own research, so there may be other best possible way to solve the problem. One or more than one user may be responsible to use the system, developer is using work break structure of company. Predefined boxes and map are included in the system to show the usability, however one can change specification according to their needs. Language support is very vast. The system can be installed and ready to be used and developed to work on windows environment. The final output/result of route/load plan can be saved in image or pdf file and can be copied or used elsewhere.

* 1. Success Criteria

Success Criteria depends upon the depth of understanding and experience gained from this project and how efficiently developer solves the problem described above.

* 1. Project Scope

The proposed solution is desktop-based standalone application for solving to algorithmically complex task. The system can be downloaded or used by directly installing into the windows machine. The final output or result produced by using the application can be used as image or word files and can be used later

The features of the application are –

* **Editor for graph Design:** This will be the simple editor to design a weighted graph on the system .It includes toolbox and other specification of node and path in the graph.
* **Route Optimizer Module:**  This is particularly the **research part** in the system .It create the major algorithmic approach that will take data from the editor or predefined map and solve the problem to create the best optimized path.
* **Data entry and Validate Module:** This module can be used to create new specification of boxes (weight, size etc) and the good contained in every box. All the entry must be verifiable cannot exceed the specification.
* **Loading Planner Module:**  This module is the main feature and research **part** in the system that used advanced algorithmic approach to solve the loading plane based on the data entry and validate module. This will result a best optimized load plan for the ship or trucks.
* **Graph generator Module:**  The final 2D /3D graph of loading is generated in this module using the load planner module.

**Language Support Module:**  More than 3 languages support are provided in the system. All the name, word will be changes by selecting one option.

* 1. Limiting the Project Scope
* The application is strictly desktop based standalone application include no support from the external source or web. Although the result of route and load can be used as image or word file.
* There is no support for third party application or Google map.
* There is no major database role in the system, it can use some simple excel file or MS Access records.
  1. Functionalities of the System

CORE FUNCTIONALITIES

|  |  |
| --- | --- |
|  |  |
| Functionality | Description |
| Data entry and Unique ID | The information about each goods and container need to be logged in the system with unique identification. |
| New Algorithms for TSP  ( Research Paper ) | Genetic Algorithm, simulated annealing or Ant Colony Optimization (ACO) to determine the shortest and the best path for transportation. |
| Implementation of TSP | Implementation of TSP problem on graphs taking co-ordinates from a real world scenario |
| New Algorithms for CLP  (Research Paper) | Integral Optimal Algorithms for CLP that provides the maximum container loading and ship balance. |
| Implementation of CLP | Implementation of Container loading for a ship with various box of different size |

ENHANCED FUNCTIONALITIES

|  |  |
| --- | --- |
| Functionality | Description |
| Language Support | Different Major Language Support for the system. |
| Excel Data Entry | Data entry through excel sheet. |
| Interactive Report and Document Generation | Automatic and downloadable Insurance , Bill , Transport Agenda and other report generation |

SPECIAL FUNCTIONALITIES

|  |  |
| --- | --- |
| Functionality | Description |
| 2D /3D view of CLP | Loading Plan of containers |
| Map Editor for TSP | Map Editor for TSP |

* 1. Feasibility Analysis

Feasibility studies addresses things like where and how the business will operate. It provides in-depth details about the business to determine if and how it can succeed and serve as a valuable tool for developing a winning business plan.

**Schedule Feasibility Report**

It consist of assess the work to which the time frame and the completion date for all major activities within the project that meets organizational deadlines and constraints for affecting change.

The main part of schedule feasibility report is-

**Gantt Chart** - Developer has used this chart for the time estimation.

**Technical Feasibility**

Technical Feasibility mainly involves the hardware and the software requirements of the system regarding all the tasks of the system to be done

Minimum Hardware Requirement

* ***CPU***: 2.0 GHz Pentium IV or above,
* ***Memory***: RAM 512 MB
* ***Disk Space***: 5 GB space(at least)
* ***Monitor***: Any Standard Monitor
* ***Peripherals***: Mouse, Keyboard

Software Requirement

* ***Operating System*** : Windows® 7 ,Windows XP,
* ***Software Development Tools***: Microsoft Visual Studio 2010
* ***Project Management Tools*** : Microsoft Project, Visio 2007
* ***Case Tools***: Smart Draw, Visual Paradigm 6.0
* ***Graphic Design Tools***: Adobe Photoshop CS4

**Operational Feasibility**

It may be defined as, the process of assessing the degree to which a proposed system solves business problems or takes advantage of business opportunities. Problems addressed and advantages of this system are provided in the documentation.

**Economic Feasibility**

The purpose for assessing economic feasibility is mainly to identify the financial benefits and costs associated with the development project. Economic feasibility is referred as cost and benefit analysis for any system.

Once the technical feasibility is established, it is important to consider the monetary factors also. Since it might happen that developing a particular system may be technically possible but it may require huge investments and benefits may be less. Cost Benefits are included under Rationale by the developer.

* 1. Project Planning

### Project Management

“*process of planning, directing and controlling the development of an acceptable system at a minimum cost within a specified time frame.” (Whitten et al, 1994)*

### Time Management

Project started on date and will be completed on the date specified in the academic requirement. Start and End Date is already specified in the Project Development Plan. After estimating the time, activities were sequenced to create the Gantt chart. Activities can be adjusted to meet the academic dead line through change control process. (For Gantt chart see Appendix Section)

### Deployment Plan

V-Mode has five stages these are: are Concept and operation, Requirement and Architecture, Detail Design, ImplementationElaboration Phase, Construction Phase and Transition Phase. Below it describes, how there phases are involving in my project. (Time Division for Deployment Plan is fully explained in 4.2.3.3 Section).

* 1. Ethical Issue

It ensures that the project won’t do any harm to the society or anyone in anyways. It contains issues like no animal harm & no copying of data without prior permission etc and to ensure that the developer has filled up an ethical form and it will be provided in documentation.

Chapter 2- Problem Descriptions

|  |
| --- |
| **An Overview** |
| Introduction to the Problem Area |
| Problem Identifies |
| Problem Importance and Justification |
| Challenges in the Project |
| New Concepts, Theories and Technologies to be Learnt |

2.1 Introduction to Problem Area

In this era of Information Technology and Computation ,every little work is expected to done smartly and speedily .Sorting is by no means the only computational problem for which algorithms have been developed .Practical Applications of algorithms are ubiquitous and include various problems like Travelling Salesman Problem and Container Loading Problem

2.2 Problems Identified

Beacon is going to solve many real time problems that companies face on daily basis such as –

* **Easy Data Entry** – Co-ordinate of map need to be easily entered. Specifications of Containers are different and must be defined by shape and weight.
* **Route Map Plan** - Best optimized path of travelling with downloadable plan. Easy solvable for large number of problems.
* **Load Plan** – 2D /3D view of optimized container loading for a single consignment.
* **Path Editor** – Easy Path Editor so that destination can be altered accordingly
* **Language Support** – Different Language Support
* **Consignment Planner** – Easy Planner for each consignment and goods on go.

2.3 Problem Importance and Justification

* **Easy Data Entry** – Since the number nodes entered in route planner is huge, it should be easy and portable. Same in Load planner, there are various boxes of different sizes and shapes. Excel file based entry makes data easier to input. Also the graphical user interface are need to be with the design principle of human interaction .The information entered must be validated and crosschecked before getting a final output.
* **Route Map Plan** - Best optimized path of travelling with downloadable plan. Easy solvable for large number of problems. There’s no solution that is verifiable within the polynomial time to solve this problem because it grows exponentially at every step. In any Logistics company, the problem is same as Travelling Salesman Problem. The possible paths can be predetermined and can be solved to get the best way when the number of destination is high.
* **Load Plan** – 2D /3D view of optimized container loading for an every consignment need to generate. This is the main feature plus the most tough and complex problem of the project. It is very hard to map a large number of uneven containers into an algorithm to get a 3D model of optimized load. Also the loading include longitudinal balance of the vehicle /ship and the mass must be distributed evenly.
* **Path Editor** – Editor is the graphical feature and challenging to develop. The entire route can be defined manually in the editor by drawing a weighted graph. It includes direction and weight in the graphs same the distance and direction of the road map.

**Language Support** – More than 1 language support are provided to the software, so that it can be used by different users who differs in their demographic background.

2.4 Challenges in the Project

The development of Beacon calls for numerous challenges to be faced by the developer which includes learning curve of new concepts, learning new development tools, mastering already known tools, domain analysis, new programming languages etc.

**Challenges**

The development of **Beacon** (Hi –tech Marine Loading and Path Detection), calls for numerous challenges to be faced by the developer which includes learning curve of new concepts, learning new development tools, mastering already known tools, domain analysis and new programming languages etc.

2.5 New Concepts, Theories and Technologies to be learnt

**Concepts:** Various new concepts includes in the project mainly in the research part. Genetic algorithms, Greedy Approach, Heuristic approach of algorithms are the new concepts in the algorithm. Concepts include generation of algorithm, mapping it into programming and generation the right user interface. It includes matching of real word problem as an entity to the scientific approach of problem solving followed by defining the relationship between them to get a best optimized solution.

**Theories:**  The theory is very complex to map with the algorithms and solvable approach. To map the real world problem into the binary or any data structure and generating a backtracking approach is real tough task. All the best solution comes after mutation and theory of natural selection in the genetic approach.

Next challenge is to map this solution of the real world problem into the programming language. It includes various graphs theory and complexity of the programming modules. The parameters of data entry and entity are identified by the data gathering and research theories.

**Technologies**

**Programming Language Skill**

**Visual Basic 10** – The application running on the windows machine is going to be developing using visual basic. Mastering Visual Basic is a significant challenge given the steep learning curve it requires with pre-requisites involving skills of working with graphs, procedures, class, libraries and implementing algorithmic approach in it.

**Graph Technology -** The identification, generation and working on a graph is the tough task especially when it is random and created by some logics. The graph of TSP is created using edit and the final output of the CLP is some 2D or 3D graph .This part is very hard and need constants learning curve.

Chapter 3- Literature Review

|  |
| --- |
| **An Overview** |
| Research Methods |
| Advanced Preliminary |
| Depth of Secondary Research |
| Programming Language Research |
| Market Value of the Project |

3.1 Literature Review

A literature review is a description of the literature relevant to a particular field or topic. It gives an overview of what has been said, who the key writers are, what are the prevailing theories and hypotheses, what questions are being asked and what methods and methodologies are appropriate and useful. As such, it is not in itself primary research, but rather it reports on other findings.This contains following things-

3.2 Advanced Preliminary

The Idea of this project came into developer mind while he was learning the applications of algorithms and capability of doing smart stuffs. The idea has been derived in the process of learning a blog on genetic algorithm and its application. Developer thought of this idea could be implemented for big and small logistics company that can be a highly cost and time beneficial .Also developer was quite interested in learning the advanced and scientific approach of algorithms that he knows a little bit from course module.

The developer performed an extensive research of the topic & found IEEE research papers that guided the developer towards the logic and approach on algorithms design and implementation

The **excerpts from these research papers** are given below-

**“The Single Container Loading Problem (CLP) is a three-dimensional packing problem in which a large parallelepiped has to be filled with smaller parallelepipeds, available in different sizes and limited quantities, so that empty space is minimized**

**When speaking about real-world container loading problems space usage is the most important objective, but other issues have to be taken into account, such as cargo stability, multi-drop loads or weight distribution. Among these additional considerations, cargo stability is the most important one.**

**In this paper we present a new algorithm for the container loading problem that is based on an original heuristic enhanced by a GRASP solution space search strategy. “** (F Pareno and R. Alvarez ,2009, pp.1-3)

**“For solving TSP,numeric, heuristics, genetic, hybrid or other algorithms may be used, as this problem is not easy to solve for large number of cities, the computation is often deployed on multi processor or clustered hardware**

**The problem has to be coded into data structure, which can be handed like a chromosome.**

**For TSP, the chromosome is set of ordered indexes of cities, through which the traveler goes. For other problems, it could be integer or real number, for difficult tasks, there is idea of using Neural Networks for coding the problem”**(Dusan Saiko ,2005 pp. 1-4)

The Developer knew few things before developing the project:

1. 2D load Packer- It is popular application that is used for creating load plan. It uses some algorithmic approach to solve the problem of loading while taking care of the longitudinal balance of the vehicle in terms of weight. Tasks, Containers and Boxes are entered, edited and manipulated . It generated a load plan in 2D after getting all the validated input from the user.

|  |
| --- |
| http://www.astrokettle.com/2dlp1.gif |
| http://www.astrokettle.com/pr2dlp.html |
| Figure 3.1 2D load packer application |

3.3 Depth of Secondary Research

The developer conducted secondary research from various Books, Websites and Magazines etc. to find out about the development process of proposed system and for this the developer needed to find about following areas-

**Domain Research**

**Topic Background**

Algorithms are the key change process in any problem in the market that result into various benefits in today scenario of computation. Particularly genetic approach of solving problem with natural selection is applicable in most of the NP problem and treated as the best approach of solving discovered in most of the cases. Marine Loading and Path Detection is such a system.

**“All the fun is powered by algorithm, we may not realise it but we live in the algoworld “**

(Kevin Slavin, TEDGlobal 2011 Conference )

**Conclusion Drawn:**  Advanced algorithms are a smart changing key to change the way anything computes . It makes the things readable and processed smartly at the same time , that is not possible in any other way .They acquire the sensibility of truth because they repeat over and over again. And they ossify and calcify and they become real.

**Travelling Salesman Problem**

"If there are n cities a salesman must visit, and the distance between each pair of these cities is given, find the shortest tour where each city is visited exactly once and returning to your starting point." **(travellingsalesmanproblem.com).**

This problem in the route planning of Logistics Company is exactly same as in TSP. To find the best route between different destination could be best found using genetic algorithm.

**Container Loading Problem:** a genetic algorithm (GA) for the container-loading problem. The main ideas of the approach are first to generate a set of disjunctive box towers and second to arrange the box towers on the floor of the container according to a given optimization criterion. The loading problem may include different practical constraints. The performance of the GA is demonstrated by a numerical test comparing the GA and several other procedures for the container-loading problem. ( Gehring, Borltfeldt 2008, pp 1)

**Design Principle:** The design principles that need to be studied in order to provide are as follow:

* **Visibility****:** Visibility is one of the most important design principles and what it means is that, as and when the user looks on the system screen he/she may feel the possibility for action. The developer will keep an eye on this principal in order to provide better visibility.

**Conclusion****:** The developer will provide color schemes in a way that users of this system can easily find suitable content.

* **Feedback****:** Feedback is the response to the user of the action performed.

**Conclusion****:** The developer will provide appropriate message box and notification to provide feedback.

* **Constraints****:** Constraints are some universally accepted conventions which notify some specific actions.

**Conclusion:** Inclusion of warning messages to show the errors.

* **Consistency:** Consistency means maintaining similar color schemes, backgrounds, font color and size etc.

**Conclusion:** The developer will provide Consistent Color, Same background, same font size and color for the whole application

* **Affordances:** Affordance means expected behavior like cursor of mouse changes into hand symbol on roll-over the link.

**Conclusion:** The developer will provide features like double clicking etc on editor.

3.4 Programming Language Research

**C#**

C# is easy but very powerful programming language.

Best suited to design graphical interface and connect them to handler functions provided by application. The graphical user interface of the C#-IDE provides intuitively appealing views for the management of the program structure in the large and the various types of entities (classes, modules, procedures, forms.)

**Research on Similar Systems**

|  |  |
| --- | --- |
| **Contents** | **Description** |
| **Product Name** | **2D Load Packer** |
| **Description** | 2D Load Packer (2DLP) is the unique space optimizer designed to help you plan quickly and easily the best compact arrangement of a number of different size 2D rectangular objects ("Boxes") within one or more 2D rectangular Container. 2DLP is based on the truly two-dimensional original packing algorithm. |
| **Functionality** | * The overall load weight limit and truck axle weight limits can be taken into account as the additional constraints or actual optimization factors. * The program has a facility for specifying the associated cost for each box (part) / container (sheet) item in order to calculate totals and affect the optimization as an additional priority factor. Optimizer goal and other main settings are adjustable. * The program can optimize over multiple containers (sheets) in multiple sizes at the same time, taking into account overall item set considered, as well as allowed item orientations specified for each item separately or for all together * The Image Page presents  2D views of the container (sheet) layouts and Area / Weight utilization diagrams. Layout patterns are displayed graphically as the complete adjustable full-color images. You can observe step-by-step load sequence and print any image view, as well as other task and solution data reports. * The system supports network data sharing and has some specific DB export / import facilities, allowing a user to exchange selected task / solution data with another 2DLP system. |
| **Limitations(if any )** | The program takes generates only 2D image of the final loading as it takes only one surface to load on.  Suited for container of same height only. |
| **User Review** | User rated it with 3 stars, but algorithms ,speed and designs are really appreciable . |
| **Link -** | http://www.astrokettle.com/pr2dlp.html |

Conclusion:

* Container includes the size and amount of goods inside it to the file.
* 2D application can be generated if the height are the same but it is a limitation
* Sample Container can be defined and used further.

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| --- | --- |
| **Contents** | **Description** |
| **Product Name** | packVol (Optimization software for load planning) |
| **Functionality** | * In ***automatic mode*** you can deal quickly and efficiently with complex load planning problems. * In ***manual mode*** you can modify or even create the entire load plan with the ease of a paint program. * The program can generate and save (in pdf format) a graphical representation of the load sequence, by blocks of identical items or by longitudinal sections of the load. * You can visualize, print and save (in html format) the packing list and the loading manifest. * For each container, you can analyze the weight distribution along the longitudinal axis. * Data can be stored in an embedded database and can be imported from Excel files or from any database supporting ODBC. * A panel permits to visualize and to impose the loading rules for a package in a easy and intuitive way. |
| **Limitations** | * No Language Support * Required training to use |
| **User Review** | Users have given excellent comments for this software. It almost fulfils all the demand and need required within the load plan. |
| **Link -** | http://www.packvol.com |

Conclusion:

* To deal with high number of container it requires connecting with some database.
* Weight distribution can be analyzed along the longitudinal axis.
* Loading rules can be imposed using panel permit or something.

3.5 Market Value of the Project

There is no product in the market that solves both route complexity problem with travelling salesman problem. The approach of and the solution is still not identifiable as the best possible. Genetic approach is hard to apply but it gives a near to optimized output for larger number of products

Effland from Denmark rate CLP as five star in terms of complexity with average budget of $500 at website(freelance.in) .

|  |
| --- |
| 17 Bids  $750  **Freelancer.in, A leading freelancing website**    Only half of the functionality of this Final year project |

Chapter 4 - Research Methods

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| **An Overview** |
| Primary Research |
| Secondary Research |
| Academic Research |

4.1 Primary Research

The chapter focused on primary of the project. Developer has done this in the initial stage primarily for gathering the information from the potential user of the system. The information is critically analysed and documented so that at the end it is user acceptable. Primary researches are done through following techniques.

4.1.1 Questionnaires

Questionnaire (Refer to appendices for questionnaires) is a part of data gathering technique in which a series of questions designed to gather specific information. Questionnaires will specially be designed for users who would use the system which will include people who are either staff of the logistics company or on crew of ship. They have few advantages as Questionnaire –

* Can be used to collect both qualitative and quantitative data
* Can be distributed manually or electronically
* Can reach a vast number of people regardless of physical location or geographical dispersion
* Can be distributed quickly and cheaply
* Can be used when human and financial resources are not available to conduct interviews

**Why Questionnaire?**

As this application is basically targeting to a specific group of professional who are going to use the proposed system, so they are huge and difficult to contact, so it is not possible to take interview of them because it will be huge time consuming. There are some reasons for using Questionnaires-

* The analysis of questionnaire is most efficient than other techniques as we can draw the graphs and analyze the data.
* It can reach a vast number of people regardless of physical location or geographical dispersion.
* It can be distributed quickly and cheaply.

4.1.2 Interviews

Interview (Refer to appendices for Interview) is a part of data gathering technique in whicha series of question asked face to face from users of the system, designed to gather detailed information. They have few advantages as Interview –

* Can be used for evaluating information needs as interview will allow us to gather detailed information about functionalities of project
* Can be used for gathering knowledge about perceptions of the staff about the application.

**Why Interview?**

* It provides us with immediate an response which saves the developer’s precious time
* It allows participants to express themselves in their own words
* It allows the collection of a large volume of rich data
* It allows discussion, probing and unexpected insights

It is best for investigating problems

4.2 Secondary Research

Secondary research means finding information from third-party sources such as marketing research, websites, magazine articles, and other sources that is already published or gathered by somebody. Books, journal articles and research paper those are necessary in order to understand the project.

**4.2.1 Technical Research**

This part is going to research the proposed system technically means what programming language the system is going to use. As the proposed system is an algorithmic application, so only few languages to choose from and these are C++, C#, and Java. To choose the best suitable development language for the proposed system, developer carried out a lot of research on different languages.

**4.2.1.1 Programming Language Research**

This part is going to research the proposed system about the programming language, the system is going to use.

**C#, Java and C++ comparison based on project**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **C#** | **Java** | **C++** | **Python** |
| **Learnable** | Very Easy | Hard to Easy | Easy to Hard | Easy |
| **Graphic generation and Support** | Best suited for Graphics and editor designing of Project | Can be used using Libraries, Need extra effort to learn | Very Hard to implement in C++ | Tedious task |
| **OOP feature and Exception handling** | Fulfills totally | Fulfill | Fulfill | Fulfills |
| **Error Elimination** | Easy | Hard | Hard | Hard |
| **File Stream and Database** | Easily compatible with Ms Excel | Hard | Very Hard | Very Hard |

**Features of ASP.NET**

In addition to hiding scripting commands, ASP.NET has the following feature that can help developer to build robust web applications

* **Compiled Code** – Code written in ASP.NET is compiled and not interpreted. This makes ASP.NET applications faster to execute then other server side script that are interpreted, such as script written in previous version of ASP.
* **Power and Flexibility**  - ASP.NET application are based on common language runtime (CLR) therefore, the power and flexibility of the .NET platform is available to ASP.NET application developers. ASP.NET application enables you to ensure that the .NET frame work class library and data access solutions are seamlessly accessible over the Web.
* **Simplicity** - ASP.NET enables you to build user interface that separates application logics from presentation content. In addition CLR simplifies application development by using managed code services, such as automatic reference counting and garbage collection. Therefore ASP.NET makes it easy to perform common task running from submission and client authentication to site configuration and deployment.
* **Manageability** - ASP.NET enables you to manage web applications by storing the configuration information in an XML file you can open the XML file in the Visual Studio .NET IDE.
* **Scalability** - ASP.NET has been designed with scalability in mind. It has featured that help improving performance in multiprocessor environment.
* **Security** - ASP.NET provides a number of options for implementing security and restricting user access to a web application. All these options are configured with in the configuration file.

**Reasons for choosing ASP.net as the programming tool:**

* ASP.Net has built in support for data grid reports and as reports are very much required for my project it would be a good decision to use ASP.net as the programming tool. This is very difficult to achieve in other programming language like Java/PHP which does not provide any such support.
* ASP.net is compiled and the new concept of code behind file adds to the security of the web system. As the information on the server is very important so it’s of utmost importance to keep it secure and ASP.net would let the developer do it easily.
* There is also a very comprehensive range of security and other libraries like App\_Local Resources, App\_Global Resources available to .NET, making it especially useful for enterprise data applications.
* ASP.net has full- featured integrated support for XML and Web services and these can be easily used using ASP.net as compared to other languages like PHP where there is no inbuilt support for such services.
* ASP.net provides with the roles and membership classes with built in support for the security measures. As the developer needs to incorporate security features, therefore ASP.net is indispensable.

**C#** has been selected by developer for the development of the required project.

There are 2 things I can think of that is nice about C# not having to do with managed code: (1.) No header files. You write a .cs file and that's the end of it; (2.) The keyword "partial". You can declare a class as "partial". This allows you to split up what would be a very lengthy source file into multiple files. The keyword "partial" indicates to the compiler that you do intend to declare the same class in more than one file, and then merges them into a single class at compile time. In developer’s project also there is need for partial class since the code will be very large and difficult to maintain at a single place this will split up the code in different files and compiles them together.

**4.2.1.2Database Chosen**

**4.2.2 Methodology: Advanced Waterfall**

**4.2.2.1 Description**

The Advanced waterfall provides an orderly sequence of development steps and helps ensure the adequacy of documentation and design reviews to ensure the quality, reliability, and maintainability of the developed software.

Requirements Analysis

|  |
| --- |
| Usability Testing Design  System Design  System Testing  Architecture Design  Integration Testing  Module Design  Unit Testing  Implementation |

**Figure V-Model**

Advanced waterfall methodology follows V model in development stages.

**4.2.2.2 Justification**

After some deliberation and discussion the developer settled upon using Waterfall Model for the development of this system. The most tempting factor for selection of Waterfall model is-

* Stable project requirements: As in our project most of the user requirements are freeze at the time of PSF so it indicates a stable project requirements and Waterfall methodology completely supports a project which has requirements decided in advance.
* Progress of system is measurable: After each step it produces the documentation and as the structure of our Final year project we need to submit the documentation after each phase so it will be best suitable.
* Strict sign-off requirements: As the developers goal will be to satisfy the user and until the user will be satisfied the developer will be providing the user desired functionalities and proper features so this methodology will be best suitable.
* The emphasis on requirements and design before writing a single line of code ensures minimal wastage of time and effort and reduces the risk of schedule slippage, or of customer expectations not being met.
* In modified waterfall model life cycle phases are permitted to overlap. Because of the phases overlap, a lot of flexibility has been introduced in the modified waterfall model in software engineering. At the same time, a number of tasks can function concurrently, which ensures that the defects in the software are removed in the development stage itself and the overhead cost of making changes to the software before implementation is saved.
* Making changes to the basic design is also possible, as there are a number of phases active at one point of time. In case there are any errors introduced because of the changes made, rectifying them is also easy (Testing can be done). This helps to reduce any oversight issues. The modified waterfall model diagram does not differ from the traditional waterfall model diagram, as to every phase of the model verification and validation step has been added.( [Bhakti Satalkar](http://www.buzzle.com/authors.asp?author=30779), 2010)

4.2.3 Algorithms: Why particular algorithm?

4.3 Academic Research

There are varied areas in which research has to be accomplished in order to derive some deductions during the development of the proposed system. This system is going to involve all three kinds of research namely, Primary, Secondary and Academic research. Following areas have been shortlisted which needs to researched:

* Key Concepts Genetic Algorithms and Greedy approach
* Concepts of Implementation of Graph theory with data structure
* Database concepts
* Visual C# / .NET
* Software Methodology and Software Engineering
* Human Computer Interaction Principles
* Design Pattern

**Algorithmic and Genetic Algorithms**

***Books:***

1. Clifford Stein, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest ,2010,Introduction to Algorithms ; Massachusetts USA: PHI Learning.
2. David E. Goldberg ,1989, Genetic Algorithms in search, Optimization & Machine Learning, 1/e; USA ; Pearson Education
3. Steven Holzner ,2009 Visual Basic .NET Programming ;USA; Paraglyph Press

**Software Methodology and Software Engineering**

*Books:*

1. Kendall and Kendall (2005); System Analysis and Design; 4th Ed; New York: Prentice Hall.
2. Jeffry L Whittem, Lonnie Bentley (2005). System Analysis and Design; London: Mc Graw-Hill.
3. Shelly Cashman (2002). System Analysis and design; 2nd Ed. Sydney: Shelly Cashman Series.
4. Shari Lawerence Pfleeger (2002). Software Engineering; 2nd Ed; New Jersy: Pearson Education.
5. Daniel MB(ed) 2008, Software Engineering for Modern Methodologies and Technologies, IGI Global, USA
6. Shari LawerencePfleeger (2002). Software Engineering; 2nd Ed; New Jersy: Pearson Education.
7. Jeffry L Whittem, Lonnie Bentley (2005). System Analysis and Design; London: McGraw-Hill.

***PDF- ebooks:***

http://www.sdprocess.com/pdf/S1-Kruchten2004Toronto.pdf

http://www.relativitycorp.com/projectmanagement/article1.html

http://www.buzzle.com/articles/waterfall-model-advantages-and-disadvantages.html

**White Paper and Journals**

A Guide to the Project Management Body of Knowledge (PMBOK ® Guide) By Project Management Institute.

Approximation Algorithms for Deadline-TSP and VehicleRouting with Time-Windows by Nikhil Bansal.

Hybrid binary ant colony algorithm for container loading problem by Yuan Junliang

Chapter 5 - Research Analysis

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| **An Overview** |
| Questionnaire Analysis |
| Interview Analysis |
| Traceability Matrix between Questionnaire and Functioning |

5.1 Questionnaire Analysis

Refer to appendices for analysis of questionnaire.

5.1.1 Questionnaire Conclusion

After analysis of questions, the developer concluded on some points which are following –

Most of the user’s in India are unaware of the situation and complexity, although they area affected. They have no knowledge of the software and its benefits in terms of time and cost cutting.

The developer has decided to provide metaphors for increasing learning ability. Also the application has scope for lots of design principles to increase usability and interaction.

For data entry purpose, developer is not using any advanced database system but a simple excel file or csv file. Also users will be allowed to enter data directly into the application and defining the parameters (e.g. specification of boxes).

Time complexity is the crucial factor in terms of speed, Most of the companies have more than 100 consignments per day, and so without using an advanced approach of solving, the system would be very slow and result into no benefit.

5.1.2 Recommendation

5.2 Interview Analysis

Refer to appendices for analysis of questionnaire.

5.2.1 Interview Conclusion

5.3 Traceability Matrix for Questionnaire & Functionality mapping

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **RI** | **FC**  **1** | **FC**  **2** | **FC**  **3** | **FC**  **4** | **FC**  **5** | **FC**  **6** | **FC**  **7** | **FE**  **1** | **FE**  **3** | **FE**  **4** | **FS**  **1** | **FS**  **2** |
| **Questionnaires** |  |  |  |  |  |  |  |  |  |  |  |  |
| **Q5** |  |  |  |  |  |  | **X** |  |  |  |  |  |
| **Q6** | **X** |  |  |  |  |  |  |  |  |  |  |  |
| **Q7** |  |  |  |  |  |  |  | **X** |  |  |  |  |
| **Q9** |  |  |  |  |  |  |  |  |  |  | **X** |  |
| **Q22** |  |  |  |  |  |  |  |  |  |  |  | **X** |
| **Interview** |  |  |  |  |  |  |  |  |  |  |  |  |
| **I1** |  | **X** |  |  |  |  |  |  |  |  |  |  |
| **I2** |  |  |  | **X** |  |  |  |  | **X** |  |  |  |
| **I4** |  |  |  |  |  |  | **X** |  |  |  |  |  |
| **I5** |  |  |  |  |  |  | **X** |  |  |  |  |  |
| **I6** |  |  |  |  |  |  |  |  |  | **X** |  |  |
| **I7** |  |  |  |  |  |  |  | **X** |  |  |  |  |
| **I9** |  |  |  |  |  |  |  |  |  |  | **X** |  |
| **I11** |  |  | **X** |  | **X** | **X** |  |  |  |  |  |  |

Table 9 Traceability Matrix Questionnaire

**Abbreviations:**

RI- Requirement Identifiers, Q- Questionnaire, I-Interview Question, FC- Core Functionality, FE- Enhanced functionality, FS- Special functionality

Chapter 6 – System Design

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