ME 308 Project Proposal - Team Bazzingaa
Optimisation of Delivery System Routing Network for a Specified Coverage Locations

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I. PROBLEM DESCRIPTION

We are aiming at building a network for delivery vehicle transport which optimizes cost of the delivery for the company and minimizes the time taken to deliver package to the customer. Basically, we want to have our reach of delivery to a set of locations. Given the production location of a particular package and its target location, the optimal route for this package can be found using this network that will be developed. Building the network here refers to optimising the daily routine of the transport of vehicles from one warehouse to another. It doesn't depend on the package production point and the delivery point, which is a separate problem in itself.

To keep the options wide open, we would like to start considering all possible transport systems. And hence one of the parameter would be dealing with the mode of transport between cities which can be airways, railways, road transport and by ship transport. The availability of transport between the warehouses is also an important parameter. Different warehouses located in the cities and distance between the warehouses (assuming that the optimal path from a particular warehouse to another is well known, which is again an appropriate assumption since it can be found out using path planning algorithms and hence can be excluded from this problem), and cost of travel in a mode per package per hour. Objective is to get the minimum of cost of a package from departure to arrival at customer over all possible paths. We can also consider expanding our coverage base which might give higher returns than the investment, but this involves addition and removal of warehouses to be covered.

II. POSSIBLE CHALLENGES

- The network should have the capability to deliver packages even in the face of unexpected downtime/breakdown of some vehicles, i.e. even in such scenarios there should exist a path/way to deliver a package. Now this can be a little dependent on the statistics of how busy a particular route is, and hence some sort of preference can be alloted to the edges (routes) of every pair of connecting nodes (warehouses). But the challenge here can be, how many alternate routes should we provide to tackle unexpected downtime.
- Most of the routes in real life may not follow triangle inequality (non-metric graphs), but the concepts in graph theory and most of the optimisation solvers which we might be using are based on metric graphs. In this regard, we might either have to go with the assumption that this inquality holds or would have to explore solvers and algorithms that can be used for non-metric graphs.

III. DELIVERABLES

1. Draft a detailed document on the general procedure of how the delivery system functions. Once this is understood and documented, the problem will defined in terms of linear programming, i.e. the parameters, decision variables, objective function and the constraints.
2. Real-life data (if available) relevant to the LP parameters and constraints will be explored and documented
3. The problem will be solved using a suitable LP solver (which would be decided based on the defined problem) giving ouptut as the required routing network for the delivery vehicles
4. The algorithm will be tested on a few real-life samples and their robustness and scalability for its implementation in India will be discussed
5. Finally, a neat and comprehensive paper of the entire project, comprising of the LP formulation, solvers used, iterations done (if required), computation details and its robustness on real-life data will be submitted

IV. TIMELINE

- **Week 1**: The problem will be well studied and the functioning of the delivery system will be understood. So by the end of this week, the documentation of the functioning mentioned in 1st deliverable will be submitted/done.
- **Week 2**: Linear Programming formulation of the problem defined will be done in this week. Tasks will be distributed among the team members to work on individual segments of the formulation.
- **Week 3**: Working on the LP formulation of the problem. Since the problem may constitute of some concepts from graph theory (which we aren't much aware of), two weeks have been assigned for formulation. By the end of third week, deliverable-1 will be done/submitted.
- **Week 4**: If the deliverable-1 is not finished, it will be carry forwarded to week-4. Apart from this, the collection of different real-life data will be distributed among ourselves and by the end of this week, this data should be available (2nd deliverable will be done). We will explore which solver can be used for the problem we have finally defined.
- **Week 5** Simulation results with real-life data and interpretation of those results to understand the actual effect of different parameters chosen.
- **Week 6**: If required, iterations on the obtained solutions will be performed. The details of the project implementation will also be documented.