Chapter 16

Solving Instances of an Order Picking Model for the Second-Hand Toy Industry Combining Amalgam Case-Based Reasoning and PSO Algorithms

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ABSTRACT

An increasingly large community—mainly from emerging economies—collects and buys “click toys” (i.e., scalable and adjustable toys composed by many pieces); this type of toy has been used for educational purposes; low-cost toys can be obtained from second-hand cargoes of separate parts, but it requires solving an order-picking problem where the primary guideline is that pieces could fit together. This is a common concern of logistical applications with limited resources. In general, providers of this type of service implement a handmade routing system in which a route is selected based on the pieces and customization required. Using this system, it is difficult to generate effective routes to pick-up pieces; for example, in many situations, the same routes are used for a long time, and new provisions on traffic behavior or new routes available to ensure the correct supply of each piece are not considered. In this chapter, the authors propose an amalgam model using case-based reasoning and an algorithm based on the behavior of birds to solve the problem.

DOI: 10.4018/978-1-5225-8131-4.ch016
INTRODUCTION

The main problem then is stated by the inadequate location of order picking problem demands or management. This ill management of resources is translated in high costs of maintenance of order picking algorithm. Another situation is the prolonged time workers spend in the order picking algorithm while being taken to require pieces or back to another assembly section of a complete click, already with the pieces in their integrating part.

In a previous research (Ho & Lin, 2017), the authors stated a variation of a Vehicle Routing Problem (VRP) called Order Picking (OP) associated with the distribution of products. This problem can be divided in five sub-problems:

1. **Data Preparation**: It defines the data required to set up the stop allocation, the route definition and the scheduling.
2. **Stop Selection**: Consists in allocating all the workers in a toy factory in different areas to the nearest assembly section.
3. **Route Generation**: It covers the decision on the order in which order-picking algorithm will visit each step.
4. **Arrival Time**: It covers the setting of time for which the workers in a toy factory must arrive in a section with more pieces to organize.
5. **Schedule of Route**: Deals with the allocation of order picking algorithm routes that best fit, taking under consideration the time for which workers in a toy factory must arrive at next section of the assembly, while establishing plans to allow each order picking algorithm transport workers in a toy factory from any stock of pieces to their particular section of the assembly.

We consider that order picking is a process of retrieving items from storage locations in response to specific customer requests. The order-picking process is the most laborious in a typical warehouse with up to 55% of warehouse operating costs (De Koster et al. 2007); and it directly affects the order accuracy and delivery time. As stated in Ho & Lin (2017), the problem has more restrictions:

1. **Order Picking Algorithm Capacity**: The maximum number of workers in a toy factory.
2. **Maximum Travel Time**: The maximum time that a worker can stay in the truck.
3. **Time Window**: The time it takes to arrive.
4. **Homogenous Capacity**: Exist order picking algorithm whit different capacity.
5. **Mixed Load**: Different workers in a toy factory from different section of assembly.

Here, it is proposed a novel algorithm to solve the order-picking problem based on Scholz & Wäscher (2017). The required pieces could have different color, additional components and variations in design, section to assemble with other pieces, shape and thickness for the adjustment of section. For instance, Figure 1 shows a click toy composed of eight different pieces; the piece called “soul” – that connects and assembles the rest – has different color.
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