Chapter 7
Implementation of an Artificial Bee Colony to Solve an Order Picking Problem

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ABSTRACT

The artificial bee colony (ABC) algorithm is an optimization method based on swarm intelligence which has demonstrated to be capable of obtaining satisfactory results on a diversity of optimization problems. However, the implementation of this optimization method hasn't been much explored on order picking problems, even though order picking represents up to 55% of the total operational cost of a typical warehouse. The order picking problem has even more importance on nonprofit organizations like food banks since they operate with a limited budget. In this chapter, the authors implemented an ABC algorithm to solve the order picking problem within a food bank. The goal was to determine which parameter values contribute the most during the optimization process. Experiments were conducted using nine sets of parameters for the ABC; results show that the approach is suitable for the study case.

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INTRODUCTION

The Artificial Bee Colony (ABC) is a swarm intelligence optimization method based on the behavior of honey bees. In this section, we will review how does the ABC to optimize.

In order to find the best food source (solution), the colony employs three kinds of bees: the employees, the onlookers and the scouts. First, the employed bees fly to the food sources and determine their nectar amount (fitness), every food source has one employed bee associated with it. After determining all nectar amounts of the food sources, the employed bees fly back to the hive to communicate the nectar amounts of the food sources with the onlooker bees. Then, the onlooker bees select a food source based on its nectar amount, the higher the nectar amount is, the higher the possibility of selection will be for that food source. When an onlooker bee selects a food source, it will fly to it and will proceed with the neighborhood search. If the onlooker bee finds a better solution than the employed bee, then it will become an employed bee. If the onlooker bee does not find a better solution on a predefined number of iterations, it will leave the site. When all the onlooker bees leave the site, the employed bee associated with that site will transform on a scout bee. The scout bees replace the abandoned sites with new ones. Finally, the cycle starts again, it will continue until the optimization requirements are met or if the colony does not find a better global solution on a predefined number of iterations. In Figure 1 the ABC topology is shown.

In Figure 1, the number one represents the first phase of the algorithm when the employed bees get the nectar amounts of the food sources, the number two represents the communication phase where onlooker bees chose a food source, the number three represents the local search phase conducted by the onlooker bees, finally, the number four represents the scout phase where the scout bees search for new food sources.

Order Picking (OP) is a process carried on in warehouses; it consists of collecting a set of items on specific amounts from the warehouse in order to ship them to the customer (Piasecki, n.d.). OP has been identified as the most expensive and laborious activity of warehouses, representing up to 55% of

Figure 1. ABC topology