PREVENTING COLLISIONS BETWEEN ROBOTIC BEES USING DATA STRUCTURES AND ALGORITHMS

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data structure designed

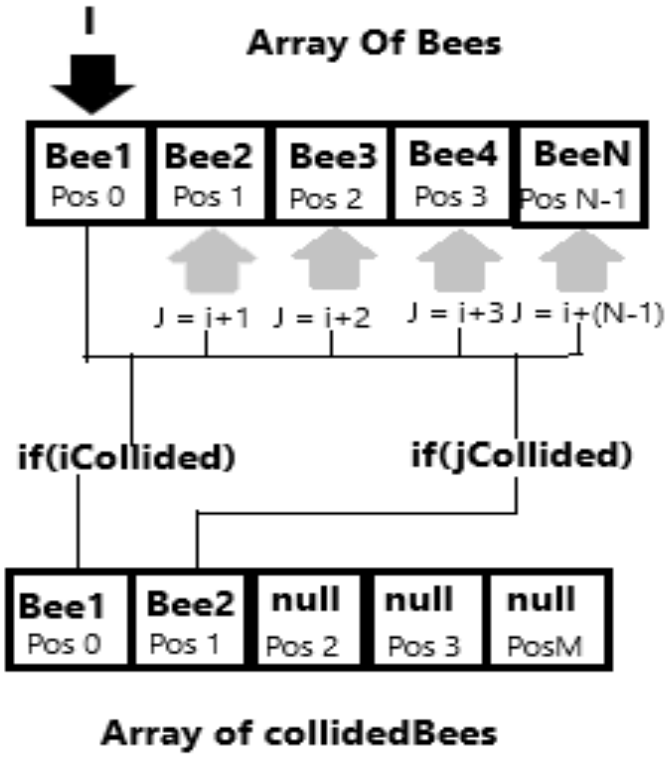

Figure 1: Prevention process of collided bees, from searching arrays, Each Bee has attributes as longitude, latitude, height and collision.

Data Structure Operations

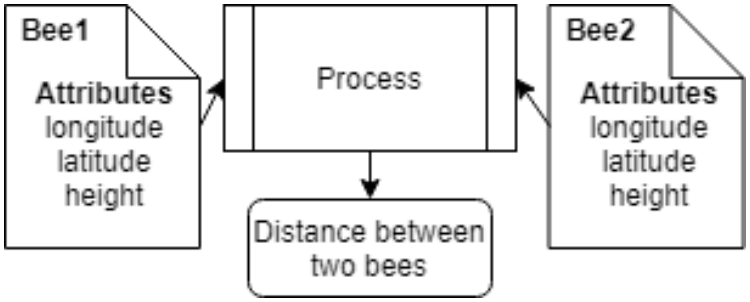

Figure 2: Process of calculate the distance between two bees

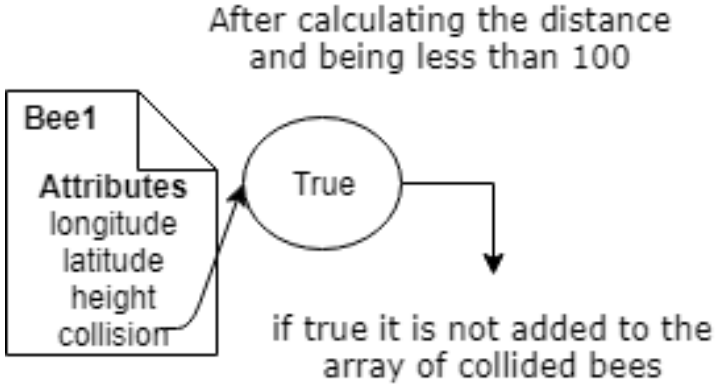

Figure 3: Process of evaluate if a bee is in danger of collision

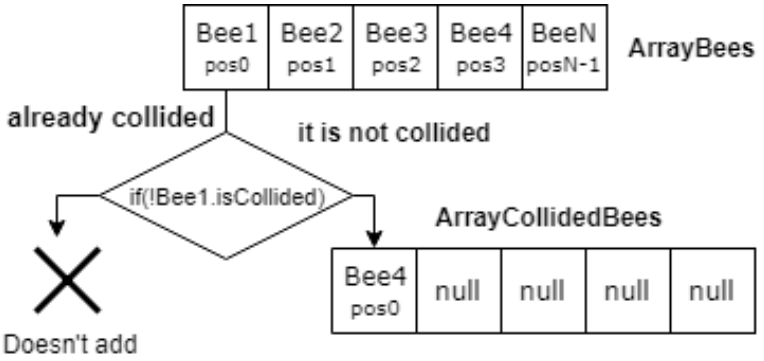

Figure 4: Process of add a bee to another array

Method	Complexity
Distance	O(1)
ReadFile	O(n)
DetectCollisions	$O(n^2)$
SaveFile	O(n)

Table 1: Complexity of operations of the data structure

Design Criteria of the Data Structure

- It is easy to interpret
- It is easy to implement
- It is efficient for small values
- It is efficient in memory consumption

this things help the program in general to be efficient in the time it takes to execute the respective operations.

Time and Memory Consumption

Data set (Number of bees)	Best time (ms)	Worst time (ms)	Average time (ms)
4	0	1	0
10	0	1	0
100	1	2	1
1000	6	8	6
10000	569	683	631
100000	Undefined	Undefined	Undefined
1000000	Undefined	Undefined	Undefined

Table 2: Execution time of the data structure for each data set.

Data set (Number of bees)	Best memory (bytes)	Worst memory (bytes)	Average memory (bytes)
4	75498	95486	79876
10	86256	102608	87560
100	98840	146548	91465
1000	624344	729936	694671
10000	1985088	2043568	2036378
100000	Undefined	Undefined	Undefined
1000000	Undefined	Undefined	Undefined

Table 3: Memory used for the data structure for each data set.

Implementation