GEOREFERENCING OF ROBOTIC BEES TO AVOID COLLISIONS BETWEEN THEM

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ABSTRACT

Bees pollinate a third of everything we eat and play a vital role in sustaining the planet'secosystems. But due to the deforestation, climate change, and many other reasons, the bees are dying. This can cause the amount of fruits and vegetables production to drop up to 50%, causing starving, high prices, and even wars. That's why we need to find a solution for this problem.

Bees fulfill an essential mission in the cycle of life, pollinate innumerable plants that serve as food for many species of animals, which in turn, serve as food for the human being. Due to modern practices, urbanization, the use of chemicals, insecticides, climate change and intensive farming, bees are dying.

2. PROBLEM

This would cause starving in animals and humans, food wars, and an environmental imbalance that would probably end much of life as how we know it, affecting both animals and plants

3. RELATED WORK

3.1 Australia leads the development of an algorithm to avoid RPAS collisions

As is logical, in the near future all unmanned aerial vehicles are going to need some form of avoiding collisions. Using LiDar technology and its 360 x 360 degrees sensor, and the Hovermap algorithm, the drones would calculate the distance between them and the obstacles in real time, avoiding collisions with other devices or obstacles

3.2 Quadtree

This is another data structure that is also used to store two dimensional coordinates, at most a branch will have four children. This detects collisions by dividing the area recursively into 4 other subregions. The subregions may be squares or rectangles but the shapes must be arbitrary. The quad tree represents a bitmap as a tree

3.3 Efficient algorithms for collision avoidance at intersections

We consider the problem of synthesising the least restrictive controller for collision avoidance of multiple vehicles at an intersection. The largest set of states for which there exists a control that avoids collisions is known as the maximal controlled invariant set. Exploiting results from the scheduling literature we prove that, for a general model of vehicle dynamics at an intersection, the problem of checking membership in the maximal controlled invariant set is NPhard. We then describe an algorithm that solves this problem approximately and with provable error bounds. The approximate solution is used to design a supervisor for collision avoidance whose complexity scales polynomially with the number of vehicles. The supervisor is based on a hybrid algorithm that employs a dynamic model of the vehicles and periodically solves a scheduling problem.

3.4 Multi-Sensor Based Collision Avoidance Algorithm for Mobile Robot

Collision Avoidance (CA) systems have been used in wide range of different robotics areas and had extraordinary success in minimizing the risk of collisions. Collision avoidance systems are mostly applied in transportation systems such as aircraft traffic control, autonomous cars and underwater vehicles etc. Collision avoidance is a critical requirement in building mobile robot systems where they all featured some kind of obstacle detection techniques in order to avoid two or more objects from colliding (two mobile robots or one robot with an obstacle).

The main purpose of obstacle avoidance is to obtain a collision-free trajectory from the starting point to the target in monitoring environments. Obstacles can be divided into two types, static where the obstacle is predefined and has a fixed position and dynamic obstacle where the position is not pre-known and has uncertain motion patterns (moving objects).

Detecting dynamic obstacles is more demanding than detecting static obstacles since the dynamic has a changeable direction and requires a prediction of dynamic obstacle position at every time step in order to achieve the requirement of a time-critical trajectory planning.

3.5 R-trees

This is another data structure based on trees. They were created by Antonin Guttman in 1984. This data structures has many uses but mainly it is used for spatial access methods, such as geographical coordinates, rectangles or polygons. In real life this tree may be used to store locations on a map like streets or landmarks. It is also very effective for finding the nearest neighbors.

4. QUADTREE

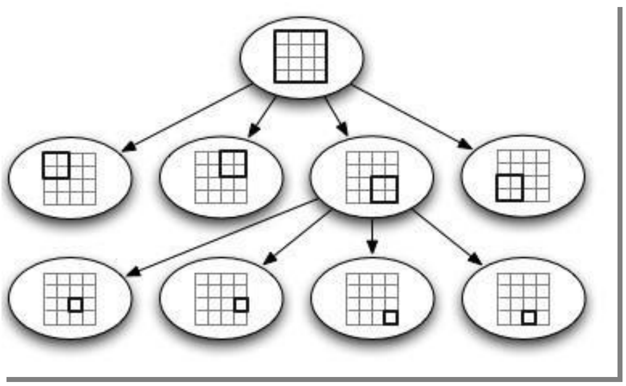

Fig. 1

4.1 Operations of the data structure

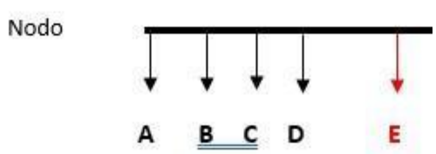

Fig. 2

Method Nodo included in class Nodo allows us to insert new bees.

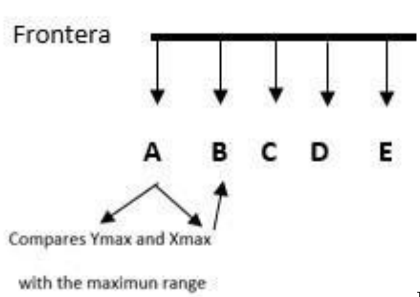

Fig. 3

Methods Frontera and enRango compares the location of the bee and the maximun range they have.

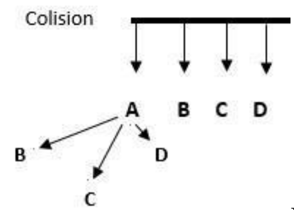

Fig. 4

This one will check for all the possible solutions.

4.2 Design criteria of the data structure

This data structure was taken into consideration due to its efficiency comparing different nodes which in this case it is very necessary because of the amount of points that must be checked. One problem with this data structure is that there are some collisions that may not be detected because they are in a different quadrant. And doing it simultaneously to avoid this problem would consume a lot of memory and time.

4.3 Complexity analysis

Method	Complexity
Insertar	O(n)
Nodo	O(n)
Colision	$O(n^2)$
Imprimir	O(n)

4.4 Time and memory analysis

Amount of data	Memory used
200000	611.5 mb
100000	81,26 mb
10000	51,8 mb
10	10 mb

Amount of data	Time
200000	50 seg
100000	26 seg
1000	3 segu
10	0.1 se

4.5 Analysis of results

By analyzing the times we see that greater the amount of bees is greater the amount of time it takes to process it.

6. Conclusions

First, we must think of how important bees are, we must take care of the environment and try to avoid as much as possible to get to a point where we would have to develop these technologies for daily use. About the project after a lot of research, hard work, and developing we came to a solution where the bees won´t collide using the Quadtree method.

We evidence that this is an optimal solution, there are more to try but for now this one works well.

6.1 Future works

In further works we would like to start working earlier so we would have time to develop other data structures to compare results.

6.2 Acknowledgements

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