RETAC: REAL TIME APPROACH TO ATTACK COVID-19 VIRUS WORLD WIDE BASED ON BARNES-HUT ALGORITHM

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ABSTRACT

The aim of ReTAC (Real Time Attack of COVID-19 virus) is to prevent persons from possible COVID-19 contamination. In addition, ReTAC is able to detect dangerous situation which necessitates closing country's frontier. Another relevant aspect of ReTAC is that the solution can be running world wide, i.e the algorithm's scope is all around the world. And finally, our approach is based on Barnes-Hut , an algorithm which has complexity log(n). We believe that with ReTAC we can rapidly save lives.

KEYWORDS

Artificial Intelligence, Social Distance, COVID-19 Virus, Attack

1. INTRODUCTION

At 2nd of march 2020 the Tunisian government has announced the diagnosis of the first case of COVID-19 virus contamination. This news has filled the Tunisian's citizen in anxiety and worry.

First we have thought that staying at home may save lives however we have discovered that this is not the right way to avoid contamination as new mutated virus popup. As there is no medicines we believe that the best solution is to co-exist with the virus.

So the Tunisian government has taken a list of measures in order to control the rapidity of the propagation of the pandemic (e.g no sportive activity, no social activity, and quarantines).

Another dangerous aspect of COVID-19 is that there may be infected person with no apparent symptoms, so the number of infected persons is not really representative of person's in danger.

As consequence we think that [3, 4, 5, 6, 7, 8, 9, 10, 11, 13] most relevant consign in order to avoid contamination is to respect social distance (1 meter, or 3 feet). This geographic measure is very relevant since it may save both infected persons lives with apparent and not apparent symptoms.

ReTAC detects all kinds of infection's (apparent or not) of persons and suggest closing frontier before the situation become dangerous. This decision may save lives.

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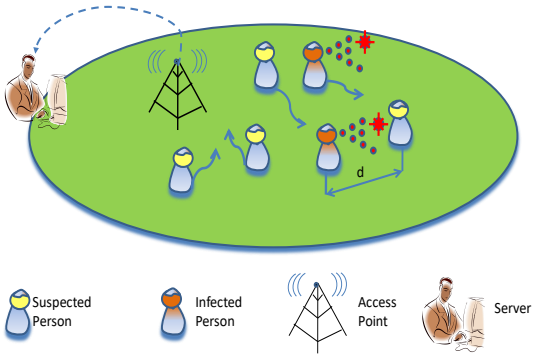

Figure 1. first consigs to avoid contamination

Our paper is organized as follows. First introduction to the main context. Next in section 2 is our contribution. Section 3 related works. Section 4 is our approach. Section 5 is experiments results. Finally, section 6, conclusion and future work.

2. CONTRIBUTION

ReTAC save lives:

1. Our approach attack COVID-19 worldwide. In fact close contact between persons can be detected wherever the position of person is in the globe.
2. Our approach can determine when the situation in country becomes dangerous and closing frontier's must be done in emergency.
3. The complexity of Barnes-Hut algorithm is log(n). The algorithm still running rapidly even with big number of persons.

3. RELATED WORKS

Boughammoura, R. [1] propose a new approach where, using Barnes-Hut algorithm, the approach attack COVID-19 virus and modelling the repartition of persons based on Quadtree. Also we have proved that the algorithm is rapid even on big number of persons.

Benreguia et al. [2] propose an approach where the goal is to help authorities to disinfect high contamination sites and confine persons even if they have no apparent symptoms. This approach also determines persons who have close contact with infected or suspected persons.

Xuran et al. [12] job aims to investigate the prediction of infectious probability. The proposed approach attack COVID-19 based on wireless edge networks. The algorithm is a stochastic geometry-based method which analyse the infectious probability of persons.

4. RETAC: REAL TIME ALGORITHM TO ATTACK COVID-19 VIRUS

We suppose that persons are moving on the globe. We can detect their position using GPS. Next we search persons with certain proximity (defined by user, e.g 1-meter) if persons are in this context, so we alert user else there is no danger.

The main idea is, given an n person set P, build a data structure so that, given a query, the number of persons of P lying in region can be determined quickly. ReTAC algorithm is running with

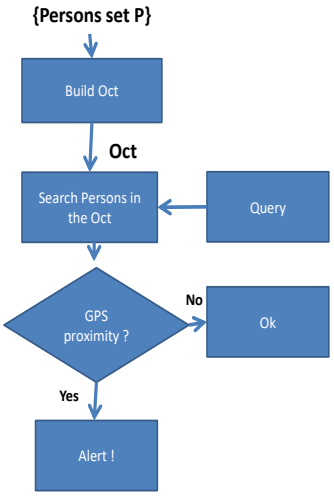

Figure 2. running algorithm principle

complexity log(n). We will show on experimentation that algorithm is very rapid even on big number of persons and query running on real world situation.

First we build the Oct data structure. Next we query the Oct if there is some proximity than alert user else it is Ok (see figure 2).

We distinguish two type of data structure Quad and Oct:

- Quad: In 2D we can distinguish four directions:
  - **NorthWest**, **NorthEast**, **SouthEast**, **SouthWest**.
- Oct: In 3D we can distinguish eight directions (figure 4):
  - **Up_NorthWest**, **Up_NorthEast**, **Up_SouthEast**, **Up_SouthWest**, **,Down_NorthWest**,**Down_NorthEast**, **Down_SouthEast**, **Down_SouthWest**

An Oct is similar to Quad (a tree with 4 children per node), but with 8 children per node, corresponding to the eight sub-boxes (see figure 4) of the larger box.
In Quad we can detect uniform distribution of persons in 2D. While with Oct we can detect uniform distribution of persons in 3D (i.e in all the globe).

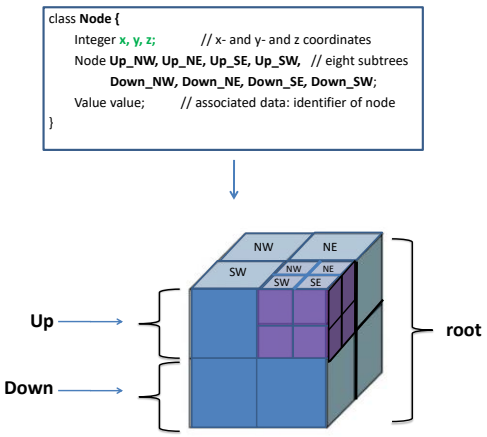

Figure 3. graphic representation of Oct data structure

```
I.   public void insert( Key x, Key y, Key z, Value value) {
II.  root = insert (root, x, y, z, value) ;
III. }
```

Algorithm 1. Procedure insert one person at the same time in Oct's root

```
1.  Public void query3D (WinaInterval3D<key> box){
2.  Query3D(root, box);
3.  }
```

Algorithm 2. Procedure which searchs persons in 3D box

```
1 .  public void main() {
2    // build the Oct
3 .  WinaOct<Integer, String> st = new WinaOct<Integer, String> ( );
4 .  for (int i = 0; i < N; i++) {
5 .  Integer x = 100 * Math.random ( );
6 .  Integer y = 100 * Math.random ();
7 .  Integer z = 100 * Math.random ( );
8 .  st.insert (x, y, z, "P"+i);
9 .  }
10   // query the Oct
11.  System.out.println(‘’ done processing ‘’ + N + ‘’points’’) ;
12.  st.query3D (box) ;
13.  }
```

Algorithm 3. Main procedure to build Oct and query it

5. EXPERIMENTS RESULTS

Our experiments strategy consists of:

- Persons are moving randomly so that (x, y, z) are chosen randomly
- Node is the basic element of Oct tree data structure characterized by (x, y, z) coordinates and certain value as identifier.
- Query: searching persons lying in some region box (see figure 4).

Given number of persons N and number of query M, we count number of found persons in (N person, M query) input.

Sometimes the number of found persons is more than number of persons (see table 1) this is due to the fact that the M queries are chosen randomly so that query q may intersects with other query.

Tableau 1. Experiments Results

#Persons (N)	#query(M)	#found
10	10	5
20	20	10
30	30	7
40	40	7
50	50	29
60	60	37
70	70	67
80	80	62
90	90	107
100	100	106
200	200	467
300	300	1004
400	400	1725
500	500	2649
600	600	3891
700	700	5319
800	800	6920
900	900	8787
1000	1000	10570

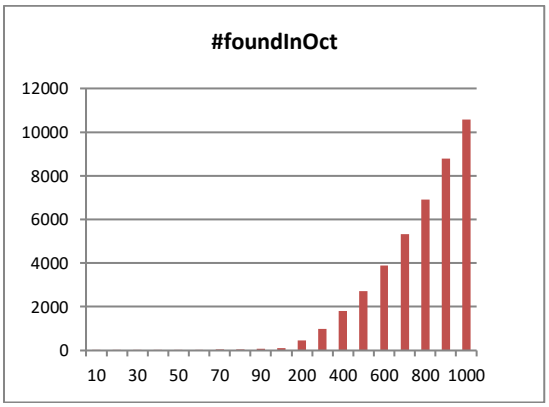

Figure 4. #Found Persons for given (N, M)

The obtained results show an increasing shape function. Parting from input (N, P) = (300,300) the number of found persons increases rapidly. Parting from this observation the situation becomes dangerous and a decision ‘’closing frontiers’’ can save lives.

6. CONCLUSION

In our paper we have proposed a new approach which avoids worldwide contamination with COVID-19 virus. Our intelligent algorithm is able to help making vital decision, like close frontier when situation become dangerous. We have found promoting results in term of complexity of the algorithm in real world context. As future work, instead of only GPS position parameter, new other parameters can be set, for example new distribution of query and persons.

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