Nanorobot queue:

Cooperative treatment of cancer based on team member communication and signal processing

Xinyu Zhou

{297932@whut.edu.cn}

Key Word: Cancer, Nanometer scale machines, Computer Vision, Network Communications, Distributing idea, Optimization, Deep Learning, Reinforcement Learning.

Abstract

Although nanorobots have been used as clinical prescriptions for work such as gastroscopy, and even photoacoustic tomography technology has been proposed to control nanorobots to deliver drugs at designated delivery points in real time, and there have been cases of nanorobots eliminating "superbacteria" in blood, most technologies are immature, either with low efficiency or low accuracy, and they can't be mass produced, so the most effective way to treat cancer is still surgery. Patients are in pain and are unable to be treated. As a result, this study provides an ideal model of a cancer-curing therapy technique, a cooperative treatment approach based on nano robot queues, team member communication, and computer vision signal classification.(object detection)

1 INTRODUCTION

It has been 60 years since Richard Feynman proposed the idea of nanotechnology in 1959 and decades since Moore's Law (1965). So far, transistors have achieved a size of 2.5nm, and the smallest nano robot [1] has a diameter of 70nm and a length of 400nm, and its motion is controlled by a magnetic field. However, no one has been able to successfully adapt nano robots to the clinical treatment of some terminal diseases. Although related technologies have advanced significantly in comparison to nano cells, they are still unable to be efficiently detected, or point-to-point treatment is difficult to implement.

The main reason why cancer can not be cured is diffusion, because the surface adhesion is low, and hyaluronidase will be released to hydrolyze intercellular connective tissue, destroy the barrier effect, and then lead to metastasis. This is why it can be divided into benign tumor and malignant tumor, that is, there is a difference between metastasis. Therefore, even after surgery,
chemotherapy or radiotherapy remove the main lesion area, it can not be cured, Because the spread of cancer cells can also proliferate indefinitely.

Inspired by the successful cases of nano robots, and there are still various problems faced today, the author puts forward a cancer treatment method based on nano Robot Cooperative queue, combined with the great success of computer vision in image classification and the idea of distributed work and network communication

2 RELATED WORK

We will abandon the previous concept of working with a single nano robot or each nano robot doing the same work, and work with the combination of multi nano robot units as a whole queue, with division of labor and cooperation to achieve the overall task. The queue members are divided into four parts: leader, vision, treatment and power. Their respective division of labor and cooperation to achieve the purpose of the target task, and there are two tasks, one is to carry out fluid circulation around the human body to deal with the diffusion of diseased cells, and the other is to achieve point-to-point attack at the destination, complete the task or reach the specified circulation parameter setting, and then reach the intestinal tract and excrete the body through the specified route. Because communication is combined with the method of Internet of vehicles, let's imagine the nano robot as a "vehicle" to facilitate the understanding of communication.

2.1 Leader Part
The leader's job is to receive external artificial control information, guide the queue, and assign information to each member. If it is the leader of the whole body circulation part, enter the corresponding selection information of the route (the selection is realized through reinforcement learning), or directly input and select the human body fluid circulation route to the leader, so that it can travel according to the set way, but the cost of the latter may be higher.

2.2 Vision Part
This part is the vehicle with classification function (the real work is sensing interaction), that is, it has the function of identifying cancer cells after in-depth learning. Because this part is far from complete if it is directly recognized based on today's hardware conditions, we only need imaging function components and transmission components to calculate the received information in the external processor and then accept it as the result for processing. And this part is the key. It needs to have a high priority. It can be fed back to the leader part to let the leader send the broadcast in the queue (the queue can be identified through if), and the queue stops moving and starts to clear.

2.3 Treatment Part
In the processing part, that is, after we identify the characteristic cells, we adopt two methods:
1. The nano robot carries the corresponding drugs for delivery, so as to achieve the purpose of treatment.
2. Directly inactivate the identified target through the nano robot. However, obviously, compared with the first method, the cost of the second method will greatly reduce the cost and can be reused. After all, we do not need to identify diseased cells through chemicals, which is also a major reason and one of the main innovations of this paper combined with in-depth learning.

2.4 Power Part
There are also two ways to travel:

1. Through magnetic field control, but it is difficult to use magnetic field control because the whole body needs to be circulated. Of course, you can write a method to change the magnetic field to realize movement.
2. Through optical tomography technology, real-time control nano robots [2], let them cycle, and then remember the cycle path for multiple cycles to prevent detection omission. Of course, if the queue can be pushed through some reactions, it is really similar to automatic driving.

The above method framework can be simulated on the computer, so it is a feasible theoretical framework, but the main reason is that the hardware conditions may still be difficult to meet and some more detailed problems, such as immunity, exist. Therefore, compared with a mature model, it still needs to be improved. This paper mainly deals with the introduction of the idea model.

3 METHOD
Although the theoretical model is proposed in this paper, communication, image recognition and communication between Nano machines have been materialized and supported by test data. The model framework has been proposed above. Therefore, here we propose the method of overall theoretical model.

3.1 Communication in the queue
We use the method that the team head unit is responsible for global information interaction and commanding the operation of team members. For example, using optical tomography technology, we communicate with the team head vehicle and give designated operations, and then the team head interacts with the team members to guide the queue and the arrangement of various work. If it is through map training, we should concretize all the body fluid veins of the human body and circulate through the set methods, Or we can learn our corresponding path through reinforcement learning (the second method is actually the method of automatic driving, which is more flexible, but we should take the human body fluid circulation route as the map training, and then take the set route for the part to the designated destination, and then cycle in a small range). Here, we configure the travel queue communication algorithm with the method in [3]. The overall algorithm content (pseudo code) is shown in [Figure 1].
Algorithm 1: SLB protocol.

```
ONSTARTUP():
    if myRole = leader then
        schedule(SENDBEACON, beaconInterval);
    end
SENDBEACON():
    sendBroadcast(getVehicleData());
    schedule(SENDBEACON, beaconInterval);
ONBEACON(beacon);
    updateCACC(beacon);
    if beacon.sender = leader then
        ONLEADERBEACON(beacon);
    end
ONLEADERBEACON(beacon);
    unschedule(SENDBEACON);
    schedule(SENDBEACON, myPosition - offset);
```

Figure 1: Communication mode algorithm pseudo code

**Interpretation:**
First of all, we allocate time to the remaining vehicles through the leader vehicle, and then send periodic self messages (allocate the time of each vehicle channel). Then, the self message of the team leader's vehicle is allocated periodically, mainly based on the team leader's vehicle. Here, we add a team leader's vehicle to send the self message when receiving the team leader's message. This is to ensure that if the message of our team leader's vehicle is lost, it is equivalent to a remedial measure. However, in this way, we will receive the information of the team leader's vehicle and new self messages in the self message room of the team leader's vehicle. Then there will be a conflict, and we need to cancel event. If it is the leader of the team, we will send a message and enter sendbeacon, and then we continue to enter after a cycle. Then sendbeacon broadcasts vehicle information and continues to maintain the cycle. After receiving beacon, we will update the required operation. If the beacon we receive is from the first team, we will enter the onleaderbeacon function. This function is the guarantee we mentioned above. If the information of the first team is lost, we also have a guarantee function. The cancel is in the second function, because the self message multiplies myposition by offset and allocates time slots with the number of the team.

**For Instance:** [Figure2]:
For example, at 0-0.5, the team leader sends a message (0), and at 0.5, all the team members receive it. At this time, it is judged that the message received is the leader's message, so we enter the function, so there is a self message at 0.5-1, and then enter beacon. There is another self message at 1-101, but there will also be a self message at 100.5-101, so there is a conflict, so we want to cancel the self message at 1-101. This is based on the message at time 0-0.5, so what we actually use is the allocation newly sent by the team leader in the time period of 100-100.5, so the previous one is equivalent to a backup. If the team leader information is not lost, it will not be used all the time. If it is lost, it will be applied according to the previous one. However, different from the original algorithm, our vision part has the highest priority. When cancer cells are to be
identified, we send a message to the leader, the whole team stops processing tasks, and then the leader transmits the received information to the treatment part to inactivate or decompose the cells. Among them, when the leader sends the processing message, other passing queues will also receive the task, but it is determined that it is not the command of the head of the team, so it will continue to cycle to find diseased cells to prevent conflict and reduce efficiency.

Figure 2: It can be seen that the vehicle self message is blocked because the first (1) conflicts with the third (1). See x in the time period 100.5-101.

3.2 Object detection on the cancer cells
This part is another core work besides the communication method. It is also the core of the main innovation and the method model. It mainly does target detection, that is, identify our target cells (or viruses, as long as we know what they are). This part mainly depends on our vision part.

However, in fact, our detection of cells may not be based on visual information or other modal information. At this time, we can also learn from this information by imitating ordinary target detection, which can only be known when we actually observe, because now most of the cells are detected and identified by receptors or other biochemical reactions (very slow, and mostly fixed-point). This paper hopes to find out whether the cell type can be judged efficiently and immediately by some physical method or combination. For example, the swin network in general target detection may be directly borrowed or combined with medical biological knowledge to effectively change the network for real-time prediction of in-depth learning.
3.3 Computing
Because the deep learning of recognition and the reinforcement learning of communication decision-making require a large number of parameter neural networks and computing power, we only retain the sensing and communication functions, transmit and output the sensing information outside the body for calculation, and then return to the receiving to make decisions. For example, when the team leader sees an intersection ahead, we will transmit the known information to the outside server, run on the server to get the decision, and then return to the team leader. The team leader then communicates and coordinates with the team members. In the vision part, the perceived cell information is transmitted to the in vitro server on its own working time slot for time target detection and image classification, so that when cancer cells are identified, it can communicate with the head of the team and interrupt the queue for cell processing.

4 CONCLUSION
We have built the overall algorithm to be applied and operated with the idea of queue, and the corresponding subtask framework has been supported by very good data results. Although it is still only a theoretical model, it can be simulated on the computer, whether it is communication, image classification or the whole work.

However, we still have some problems and challenges. The first problem is how to realize the signal interaction with the outside world without interfering with each other, because each queue sends and receives information asynchronously. The second question is, although the technology has become more and more mature, when can we have the hardware requirements to meet the theoretical model? The third problem is the time slot arrangement. How to arrange the time slot application more efficiently and reasonably, reduce the cycle cost and improve the efficiency. The fourth question, although it also belongs to the second question, is more detailed and important. How can we obtain imaging data? Here I put forward an idea to the fourth question. Can the corresponding characteristics of cells be obtained in some way? (for example, information is obtained by ultrasonic and other methods) because neural network is feature extraction, even if we can't recognize it, we can classify it through training.

But in general, with the passage of time, technology (especially computer) is developing rapidly. Just like transformer pre training model, the model is not saturated with the increase of pre training data set. I believe that in the near future, we can put this theoretical model into practice and save thousands of suffering and desperate cancer patients in the world. If it is realized, it is not for cancer, but for diseases that behave differently from normal cells. Although it may cost a lot in the initial stage because of the requirements for computing power and hardware cost, I believe that when the corresponding hardware is mass produced, The medical field will achieve a qualitative leap, and the future can be expected!
5 REFERENCES:

[1] Nanopropellers and Their Actuation in Complex Viscoelastic Media.201 ACS,2014
[2] A microrobotic system guided by photoacoustic computed tomography for targeted navigation in intestines in vivo SCI-Robot,2019
[3] Toward Communication Strategies for Platooning Simulative and Experimental Evaluation ITVT,2015.