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Simulation of nanobot for diagnostic application development in the field of biomedical engineering using AI and Ml Concepts

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Abstract - A brief review of how cancer is detected and cured with the help of simulation of nanobots. In this, we are doing a literature survey for the detection of cancer using the nano-technology concept is simulation-based only. The combination of nanotechnology and biology is probably going to help in the detection and treatment of cancer. Nanorobot is a vision in the field of healthcare in the future. Research in nanotechnology allows us to build artificial red blood cells called Respirocytes capable of carrying oxygen and carbon dioxide molecules. Nanorobots carry and deliver large amounts of anti-cancer drugs into cancer cells without harming healthy cells, reducing their side effects. They will detect the cancerous cell with the help of some algorithms and parameters. These nanorobots will have the capacity to repair tissues at the infected site. The work presented in this paper is the UG credit final phase project work of the undergraduate final year student that was undertaken by the UG student & just provides a brief review on how nanobots could be used in the detection and treatment of Cancer and as just a review paper, which serves as a basis for all the students to carry on this research work forward and review the advantages of nanobots in the healthcare industry.

INTRODUCTION

In the fight against cancer disease as shown in Fig. 1, early detection is a key factor for successful treatment & to save precious human life. The project work presented in this synopsis relates to such an application-oriented work w.r.t. the simulation, design & development of nanorobots for cancer cure therapy & diagnostic applications in human beings using AI & ML tools with the help of software tool studies. Nonetheless, the identification of malignancy in the beginning phase has been thwarted by the natural furthest reaches of ordinary disease analytic techniques like chemotherapy which kills not only healthy cancerous cells but also healthy cells, hair loss, loss of organs, etc.

To eradicate this problem, the idea of the nano-technology gives high affectability, and explicitness and has along these lines worked for the identification of extracellular malignancy bio-markers, mutation aspects, and cancer cells in this project abstracted synopsis work. Among the main steps towards cancer treatment, which will be used in our work are the early location of malignancy cells and medication application with high particularity to reduce poison levels. Because of expanded fundamental poison levels and unmanageability with customary disease demonstrative and helpful devices, current successful strategies like the use of nanorobots in nanotechnology are being employed to improve diagnosis and mitigate disease severity here in the project work.

The concepts that we are developing using nanotechnology are going to be used for several cancer types to reduce the invasiveness of cancerous cells while sparing healthy cells at the target site. This is made to use nanomaterials such as carbon nanotubes, polymeric micelles, and liposomes in cancer cell identification, destruction, and removal from the body. But, the current technological developments in a developing country like India hinders this growth due to the lack of infrastructural facilities. Hence, in this context, we have taken up the amalgamation of nano-technology & the nano-medicine to save the mankind from this world's most infectious disease to which a large number of people are falling prey and develop some strategies in the field of modeling, design, development of nanorobots for the cure of cancer disease.

The blend of nanotechnology into prescription is likely going to get some new troubles therapeutic treatment as the nanorobots are a heavenly vision of medication in the future. The most extraordinary nanomedicine incorporates the use of nanorobots as limited-scale experts to murder the infection. An important point among the most reasonable and practically possible achievements is the remedy for development which is one of the essential places for the examination. Nanorobots could convey and convey a lot of hostile to malignant growth drugs into dangerous cells without hurting

sound cells, diminishing the results identified with current treatments. These nanorobots will have the ability to fix tissues, clean veins and aeronautics courses, and change our physiological limits.

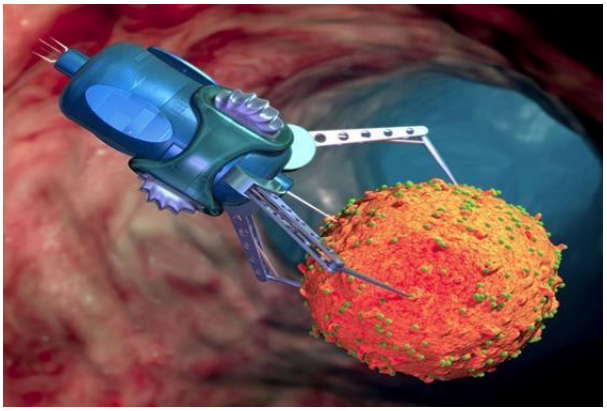

Fig 1 : Nanorobots treated to attack the cancerous cells

Literature Survey

A number of authors across the world @ the international levels have worked on the proposed project work in some of the similar areas and have produced novel contributions. The following paragraphs throws a light into such of the works done at the international levels by the international authors who have worked on the similar fields.

Koleoso worked on the micro or the nano-scale magnetic property-based robots for various types of bio-medical applications in his paper in [1]. They enhanced several biomedical applications in their work, as well as suggestions for the systems that have the ability to perform many functions. In this case, the field of small-scale robot work is highly creative, more concerted efforts are needed to improve the functionality and reliability of these machines, in these clinical applications, according to the findings of this report. Finally, further works were made in order to ensure the commercialization of these instruments in their article in [1].

Nanobots: development and future – a superb article was coined by the group of authors led by Jose Roberto Vega Baudrit*et.al.* in their article in [2]. They presented the next generation of nanodevices how they are used to revolutionize patient diagnosis and drug delivery technology They proposed several obstacles in developing this technology, not only from a mechanical, biological, and physicochemical standpoint, but also in terms of the dangers of using these nanoscale materials and technologies, as well as their contact with the environment and humans. The aim of this review article was to describe nanobots, their technologies and developments, as well as their medical applications, particularly in the field of cancer care.

In their paper [3], Yamaan Saadeh focused on Nanorobotic Applications in Medicine - Latest Ideas and Prototypes. The aim of this paper was to provide an overview of the evolving field of nanorobotics in medicine, as well as a study of nanorobotics possible applications in fields ranging from neurosurgery to dentistry [3].

In their article in [4], Saxena *et.al*. focused on the nature, architecture, and implementation of nanorobotics in the oncology field of study. The aim of this article was to describe the architecture of nanorobots and their role in oncotherapy in a concise manner. While nanorobot works is still in its early stages, the potential of such technologies is limitless.

An application of Nano-technology in Cancer Diagnosis & in the Therapy - Cancan Jin *et.al*. have taken a Mini-Review in their application-based paper [5].

The authors defined the most widely used nanomaterials in cancer diagnosis and treatment. They examined the problems associated with nanomaterials, which restricted their applications and hindered . [5]. They have highlighted the need of these nanomaterials for cancer treatment based on their biological properties. In summary, they targeted to demonstrate the main benefits of nanotechnology as well as the limitations of its use in cancer clinical needs [5].

In [6], Mitra Venkatesan worked on some of the topics of the use of nanorobots for cancer treatment. A individual seeking nanorobotic care should presume to be totally ignorant of the molecular devices at work within them, save for the rapid change in their health. As a result, the authors proposed a report on diverse approaches to cancer treatment using

nano robots in their article in [6], but there was no novelty and no new methods proposed, it just highlighted some of the works that could be done in future with the help of nanorobots.

Sarath and his colleagues focused on nanorobots as a potential diagnostic and treatment system in their paper [7]. Their paper focused on the use of nanorobots in the diagnosis and treatment of diseases such as cancer, heart disease, diabetes, and gout. This was a review paper that led us to recent nanorobot studies in biomedical applications and helped us to select the project work [7].

Devasena Umai *et.al*. conducted a study on DNA nanobots – a novel tool for cancer treatment in the Indian context in their paper in [8].

Application of Nanotechnology in Cancer was presented in a excellent article in [9] by the team of authors led by Hirendra N. Banerjee & his group. This article addressed the effect of nanotechnology on cancer, with a focus on biomarker identification, imaging for diagnosis, and its role in therapeutic action, but it did not include any detail on the methodologies that could be used for cancer detection [9].

The authors of [10], led by Kumar Biswajit and his colleagues, experimented on the principles of Nanotechnology in Cancer Drug Delivery and Targeted Targeting and came up with positive findings. Their study focused on nanoparticles' ability to recognize cells using a variety of techniques with novel distinguishing properties that set them apart from previous

anticancer treatments. It also addressed how nanoparticles carry particular drugs within cells, citing numerous promising studies, and how nanoparticles eliminate the side effects of traditional cancer treatments with targeted cancer care [10].

Similarly, a number of authors had worked in the similar area, but only the best of them have been highlighted in this context, but many of them have lot of drawbacks or dis-advantages which were posing a serious threat to the mankind. Some of them

have been identified & novel algos will be created in order to neutralize the same and propose some novel concepts in the design & development of nanobots to cure cancer disease in human beings.

From individual nanoparticles to nanomachines and nanorobots, nanomaterials are being used to cure cancer was studied by lexandreLoukanov*et.al.* in [11]. As discussed in [11], the aim of this important analysis was to concentrate on the latest use of clinically accepted nanoparticles for cancer theragnostic, nano vaccines, and gene therapy delivery platforms,

which included inorganic, metal, and polymer nanoparticles, nanocrystals, and various drug delivery nano systems (micelles, liposomes, microcapsules, and so on). Arizona State University (ASU) scientists, working in conjunction with authors from

the Chinese Academy of Sciences' National Center for Nanoscience and Technology (NCNST), have successfully programmed nanorobots to shrink tumors by cutting off their blood supply.

Shaolong Shi *et.al*. developed Nanorobots-assisted Multifocal Cancer Detection with a Multimodal Optimization Perspective in [13]. When the biological target feature is aligned with the blood flow velocity profile triggered by tumor-induced angiogenesis, the authors proposed a detailed numerical illustration to illustrate the efficacy of the NGA-inspired MCDP. However, they did not work on enhancing the algorithm's efficiency in order to detect all cancer areas with a sufficient number of nanorobots, it was also necessary to investigate the effect of nanorobot nonidealities such as finite lifetime, imprecise guiding, and unreliable monitoring.

The authors of [14], led by Tianshu Chen *et.al*., focused on DNA Nanotechnology for Cancer Diagnosis and Treatment, showing how DNA could be used to identify and destroy cancer cells. The authors outlined recent advances in DNA nanotechnology for the fabrication of practical and intelligent nanomaterials, as well as the technology's potential applications in cancer detection and treatment [14]

In [15], RouhallahRavanshad*et.al*. investigated the use of Raman scattering-based methods to diagnose cancer using Sir C.V. Raman's famous scattering phenomenon.

The key aim of this article was to incorporate some of the most common nanotechnological cancer detection methods using Raman techniques. Furthermore, they have reviewed some of the more common and even more studied cancers, such as breast and colorectal cancer, as well as several interesting nanostructures, especially as SERS nano-tag, special cancer biomarkers, and related approaches. Their key goal was to use Raman techniques to apply the most common nanotechnological approaches in cancer detection [15].

METHODOLOGY

The proposed methodology (Fig. 2&3) that may be used in our project work is presented in this section. The proposed methodology that may be adopted in the present project work is shown here in a very highly abstracted manner with various blocks in the vertical & horizontal fashions.

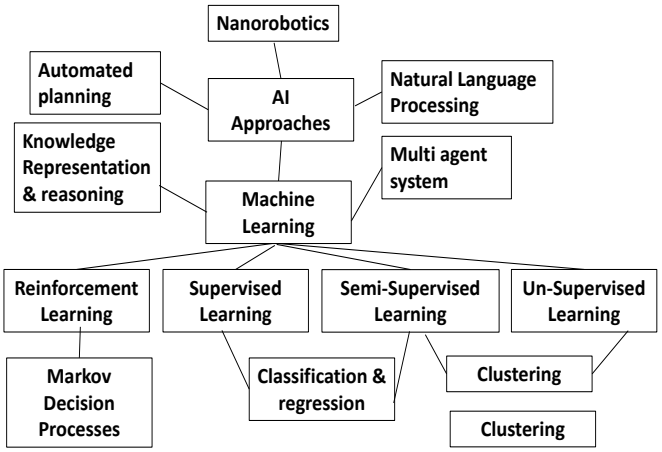

Fig. 2: Use of AI & ML approaches for the training purposes

Concepts of AI, ML & DL approaches:

The concepts of AI-ML-DL algorithms are going to be used in the proposed project for the design of the nanorobot & its interaction with the infected cancer cell. Different training algorithms based on ANN CNN RNN are going to be used for training the nanorobots to hone it to the correct target after detecting the infected cell using on-board sensors & beams. The

training approaches are similar to a teacher training the student in a particular subject. Once the system is being trained, it will be able to deliver its goods correctly.

ABC ALGORITHM (ARTIFICIAL BEE COLONY ALGORITHM)

In the Artificial Bee Colony algorithm, the population of food positions and the artificial bees move on these food positions over a period of time. This algorithm used some agents called honeybees to find the right solution.

1. The honey bees in ABC can be categorized into three groups: employed bees, onlooker bees, and scout bees.
2. The employed bees exploit the food positions, while the onlooker bees are waiting for information from the employed bees about nectar amount of the food positions.
3. The onlooker bees select food positions using the employed bee information and they exploit the selected food positions.
4. Finally, the scout bees find new random food positions. The given solution in the search space consists of parameters that represent the food source position.
5. The number of employed bees is equal to the number of food sources.

The taste of food sources is called its “fitness value” and it is linked to the position.

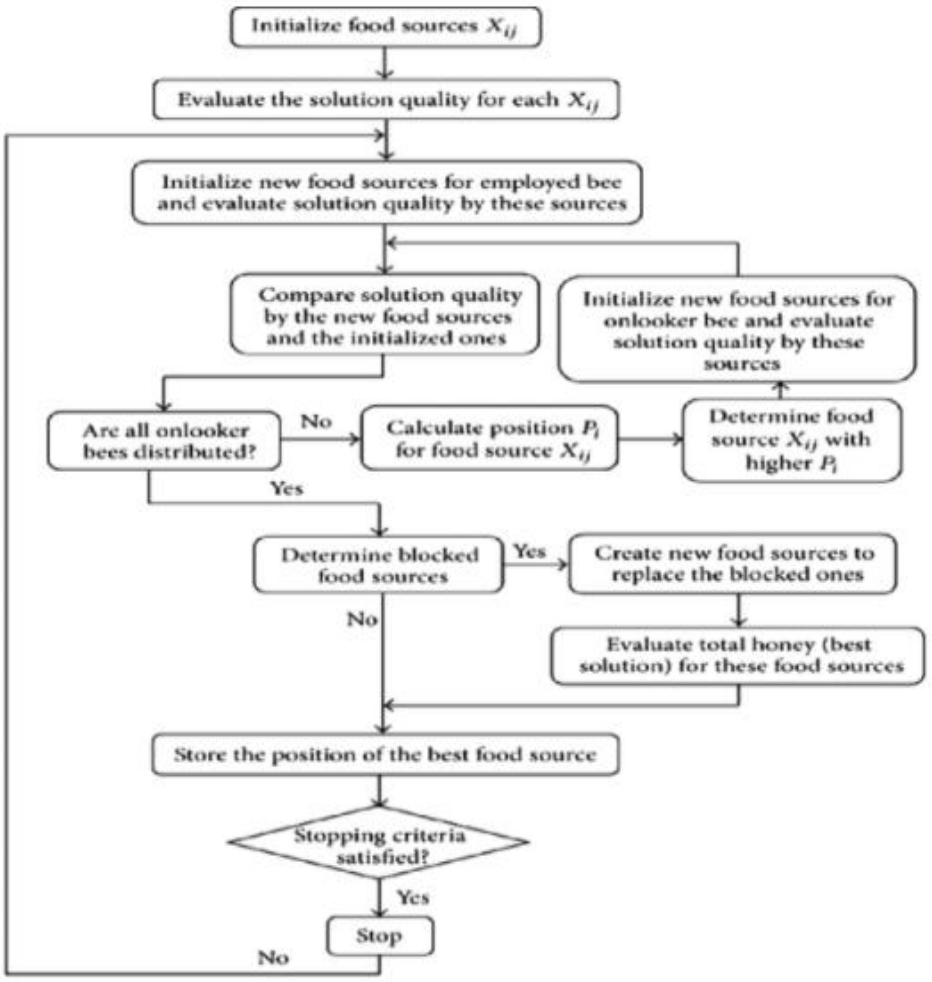

Fig. 3: Flow chart of the proposed algorithm for the implementation of nanorobot.

ANT COLONY OPTIMIZATION ALGORITHM:

Ant Colony Optimization Algorithm is identified by the foraging behavior of ants. At this behavior, it is the indirect communication between the ants with the help of chemical pheromone trails, which helps them to find the shortest paths between their nest and food sources.

1. Create ants (nanorobots) and put them on the entry level.
2. Each ant (nanorobot) senses and monitors the concentration of E-cadherin molecules in the blood.
3. On recognizing it, nanorobots move towards higher concentration of E-cadherin.
4. Each ant (nanorobot) communicates with other robots (swarm intelligence) just like ants leave a trial of pheromone behind as it reaches the target site. If trial is long the pheromone gets evaporated before any ant follows it.
5. If the trial is short, it is followed before pheromone gets evaporated.

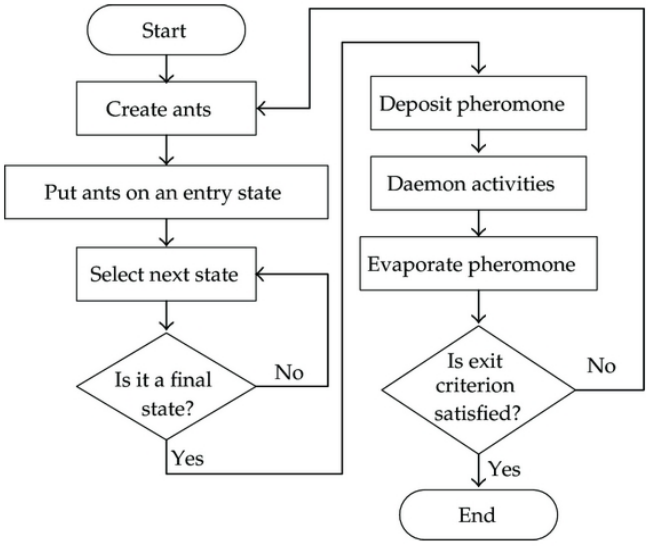

Fig. 4: Flow chart of the proposed algorithm for the implementation of nanorobots in search of cancer cells.

SCOPE

This paper addresses the three important research objectives,

i) To simulate a nano-robot prototype to detect the cancerous cell using simulation tools like nano-hive & cadence tools using the following concepts such Locomotive parts, Power actuator, Sources within the body, generation of power from the bloodstream in the body.

ii) Studying the behavior of the cancerous cells & to halt their behavioral growth by detecting that the cell is being affected with the cancer disease.

iii) To kill or dis-infect the cancerous cell by injecting anti-cancerous nano-particle & to make it inactive.

CONCLUSION

A brief review of the work related to the project work undertaken was depicted in the previous sections in the form of introduction, followed by literature survey. The objectives of the project work were also explored & arrived at the definition of the project problem that had to be tackled with. Methodology is proposed in the form of a block diagram to solve the above defined problem using software & hardware tools, which may change in due course of the project work.

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