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A review/survey paper on Nanobots in Medical Applications for kidney curing in humans

[1]Deekshitha P. (USN : 1DS21LVS01)
[2]Dr. Pavithra G., [3]Dr. Sindhu Shree M., [4]Dr. T.C.Manjunath,
[5]Aditya T.G., [6]Sandeep K.V., [7]Rajashekar M. Koyyeda,
[8]Dr. Suhasini V.K., [9]Dr. Vijayakumar K.N.

[1]Second year PG M.Tech. student, VLSI Design & Embedded Systems Specialization,
Dept. of Electronics & Communication Engg.,
Dayananda Sagar College of Engineering, Bangalore, Karnataka
[2]Associate Professor, ECE Dept., Dayananda Sagar College of Engineering, Bangalore
[3]Assistant Professor, ECE Dept., Dayananda Sagar College of Engineering, Bangalore
[4]Professor & HOD, ECE Dept., Dayananda Sagar College of Engineering, Bangalore
[5]Second year BE (CSE) Student, PES University, Bangalore
[6]Assistant Professor, Electronics & Telecommunication Engg. Dept., DSCE, Bangalore
[7]Assistant Professor, EEE Dept., Tatyasaheb Kore Inst. of Engg. & Tech., Kolhapur, Maharashtra
[8]Prof. & Head, Mechanical Engg. Dept., DJ Sanghvi College of Engg., Mumbai
[9]Principal & Prof., Dept. of MCA, Bharati Vidyapeeth's Inst. of Mgmt. & Info. Tech., Mumbai

Abstract
A review or survey on Nanobots in Medical Applications is presented in this paper. Nanorobotics is the science and technology of designing and manufacturing nanoscale machines, especially robotic machines. Nanorobots would constitute any "smart" structure capable of actuation, sensing, signaling, information processing, intelligence, manipulation and swarm behavior at nano scale (10-9m). More specifically, nanorobotics (as opposed to micro robotics) refers to the nanotechnology engineering discipline of designing and building nanorobots with devices ranging in size from 0.1 to 10 micrometers and constructed of nanoscale or molecular components. The first useful applications of nanomachines is in nanomedicine. The biological machines are used to identify and destroy cancer cells. The work given here is a project that is taken up as a part of the curriculum completed by electronics and communication engineering post-graduate student in the second year of the electronics & communication engineering department at Dayananda Sagar College of Engineering in Bangalore.
Keywords : Nanorobot, Medicine, Intelligence.

1. Building nanorobots for medical applications

The three main factors that need to be taken into account, according to the study's author Hariharan, are navigation, power, and how the nanorobot would navigate through blood vessels. Ultrasonic signals direct the nanorobots to the cancerous cells [1]. These ultrasonic pulses are detected by ultrasonic sensors. The nanorobot can also be equipped with a tiny, miniature camera, provided that it is not designed to passively float through the bloodstream. For nanorobots to move throughout the body, some form of propulsion is required. The propulsion device may have to move against the blood flow, thus it must be relatively powerful for its small. Additionally, the patient's security must be considered; the system must be able to move the nanorobot without putting the host in danger [2].

2. NMR/MRI

Using this method, a strong magnetic field is applied to the body, and the response of the body's atoms to the field is then examined. It normally takes a long time to see results, often many hours, hence it is not appropriate for real-time applications [4]. Even while the performance can be substantially increased, the resolution is intrinsically low since it is difficult to flip over huge magnetic fields quickly. As a result, even though it may be appropriate in some circumstances for the initial diagnosis, it is currently only of very limited use to us [3].

3. Radium-colored dye

Essentially, this method is one of illumination. A fluoroscope or another radiation-sensitive imaging system is used to monitor the spread of a radioactive fluid throughout the body after it is injected into the circulatory system [5]. The primary benefit of this method is that it travels exactly the same route that our microrobot would use to get to the operation location. It would give the microrobot useful guidance data if the imaging system's resolution was sufficiently improved and enough data were collected to create a three-dimensional map of the path [6]. The active version of this technology would include including a tiny amount of radioactive material in the microrobot. This would make it possible to monitor its location constantly throughout the body. The method would also make the design of the microrobot more simpler because it wouldn't require the microrobot to use any power or any kind of mechanism. Despite the hazards associated with radiation, the quantity of radioactive material utilised is far less than that required for radioactive dye diagnosis. Additionally, as electronic sensor technology develops, less radiation will eventually be required for tracking. In reality, infrared sensing methods have improved to the point where we may completely hide the radioactive chemical and simply monitor its heat [7].

4. X-ray

X-rays as a method offer advantages and disadvantages. The fact that they are strong enough to penetrate tissue and detect changes in tissue density is an advantage. As a result, they are especially helpful for identifying breaks and fissures in tough, dense tissue, such bones and teeth [8]. However, because they penetrate soft tissue so much more readily than hard tissue, an X-ray scan intended to reveal bone breaks just passes through soft tissue without revealing much detail. On the other hand, if there is any bone in the way of the x-rays, a scan intended for soft tissue cannot pass through [9]. Another issue with x-rays is that it is extremely challenging to produce a narrow beam, and even if one did, utilising it to scan an area in great detail would need a lengthy exposure. As a result, x-rays are only suitable for broad diagnosis, for which several of the methods mentioned above are far more appropriate [10].

5. Radio/Microwave/Heat

Again, both passive and active modes can be employed with these techniques—which are essentially just variations of the same strategy. The passive mode of the procedures relies on the body's various tissues producing signals that external sensors may pick up on and decipher. The body does produce some very low frequency radio waves, but because of their enormous wavelength, they are essentially useless for the kind of diagnostics we are interested in [11].

6. Bodily heat

With this technique, the microrobot would be powered by body heat, thus employing the entire body as a power source. The fundamental issue with this is that a power source needs an energy gradient to work properly. In order to set up a power flow between the two sections, we would need two areas with differing temperatures. This need would be challenging to meet because our microrobot would need to be mobile and capable of performing at its best in a variety of conditions [12].

7. Energy derived from the blood

Three options exist for this situation. In the first scenario, the microrobot's exterior casing would feature electrodes that would interact with the electrolytes in the blood to create a battery. The voltage would be modest as a result, but it would persist until the electrodes were exhausted. This method's

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drawback is that there may not be enough blood flow to maintain the necessary power levels in the event of a clot or arteriosclerosis [13]. Additionally, power would drop to zero and remain there if the electrodes were ever encased in anything that prevented them from accessing the blood. This implies that having a backup would be necessary [14].

8. Utilization of Nanobots

An strategy is developed by the author based on many simple molecules that collectively form a robot in place of developing a single complicated molecule to identify various aspects of a cell surface. The first step was to build three different molecular robot components in order to recognise a cell that possesses three distinct surface proteins. Each component was made up of an antibody that was tailored to one of the surface proteins and a piece of double-stranded DNA [15]. The antibody portions of the robot bind to each of these parts and cooperate when they are combined with a group of cells. A robot is operational on cells where all three components are joined, and a fourth component starts a chain reaction among the DNA strands [16]. A DNA strand is exchanged between each component until the last antibody receives a fluorescently labelled DNA strand at the conclusion of the swap [17]. In a sample of human blood, only cells bearing the three surface proteins are labelled with the fluorescent marker at the conclusion of the chain reaction, which takes less than 15 minutes [18].

9. Conclusion

In this paper, we have presented a brief review of the nanorobots that were being used in the biomedical engineering or curing of the deadliest disease in the world, that is cancer. Biological systems are an existing proof of molecular nanotechnology. Rather than keep our eyes fixed on the far future, let us start now by creating some actual working devices that will allow us to cure some of the deadliest ailments known, as well as advance our capabilities directly, rather than as the side effects of other technologies.

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