Adriano Cavalcanti : Medical Nanorobotics for Diabetes

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By Benjamin Melki, NanoVIP

In February, Adriano Cavalcanti and his colleagues are publishing for the first time the detailed work describing a medical nanorobot hardware architecture for diabetes (*). This new paper, published in the journal Recent Patents on Nanotechnology - Bentham Science, addresses the concept behind the use of nanorobots as pervasive monitoring devices to help in the therapy of patients with diabetes.

NanoVIP decided to interview Adriano Cavalcanti about his current and upcoming works for the gradual development and future use of nanorobots for diabetes.

NanoVIP: How nanorobots may help patients with diabetes?

Cavalcanti: The nanorobots may use embedded nanobiosensors to monitor blood glucose levels, and transmit every two hours this information through RF signals for mobile phones carried with the patient. If the glucose is eventually not inside the desired levels, the nanorobots activate a pre-programmed tune in the cellular phone, which may alert the patient to take any necessary action

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regarding the diabetes control with prescribed medicaments.

NanoVIP: What is the advantage on nanorobots for diabetes?

Cavalcanti: Nowadays patients with diabetes must take small blood samples many times a day to control their glucose levels. Such procedures are uncomfortable and extremely inconvenient. To solve this problem, the level of sugar in the body can be observed via constant glucose monitoring using medical nanorobotics. This important data may help doctors and specialists to supervise and improve the patient medication and diary diet.

This process using nanorobots may be more convenient and safe for making feasible an automatic system for data collection and patient monitoring. It may also avoid eventually infections due the daily small cuts to collect blood samples, possibly loss of data, and even avoid patients in a busy week to forget doing some of their glucose sampling.

NanoVIP: How do you expect to achieve nanorobots manufacturing?

Cavalcanti: Recent developments on nanobioelectronics described through our work show how to integrate system devices and cellular phones to achieve a better control of glucose levels for patients with diabetes. Some well established and new techniques may be used jointly for such aim. Nanoelectronics in terms of VLSI circuits have demonstrated yet feasible devices with nanometer scales. These same devices can serve in integrating nanorobots with embedded sensors and actuators to build molecular machines, through actual manufacturing techniques and currently in course innovative nanotechnology methodologies.

New techniques have been progressing most recently in 3D lithography, new materials like nanotubes, nanocrystal for sensors, antennas, and actuators. Therefore, they are together accelerating even more the downscaling of electronics manufacturing possibilities. Genomics investigation is putting also closer biologists, doctors, and engineers, through a better interdisciplinary comprehension about protein based mechanics for the the human body

metabolism processes. This same kind of information has become crucial and insightful for the investigation and development of applied transducers as nanodevices for biomedical problems.

NanoVIP: What is new about nanorobots in this work?

Cavalcanti: This work shows for the first time a system and hardware architecture with a wireless communication technique to address the interface and control upload, data transmission, and possibly teleoperation of nanorobots for diabetes. The detailed description on hardware architecture may support therefore advances towards manufacturing development of nanorobots.

The presented approach may enable practical use of nanorobots for continuously monitoring patients in a pervasive manner. This can be quite interesting for patients who suffer from diabetes, but it can be equally useful for elderly people who needs constant monitoring, and also for early diagnosis of complex diseases.

Another important and interesting aspect in our current development is the fact that, the similar architecture presented in terms of hardware and system integration, can be also used for a broad range of applications in medicine.

NanoVIP: Beyond diabetes, what kinds of other biomedical applications can benefit from this architecture?

Cavalcanti: For example, you may have the same concept being used as a basis for nanorobots in early diagnosis of cancer. Cancer can be successfully treated with current stages of medical technologies and therapy tools. However, a decisive factor to determine the chances for a patient with cancer to survive is: how earlier it was diagnosed; what means, if possible, a cancer should be detected at least before the metastasis has began.

In fact, you have a similar problem about cerebral aneurysm. A critical issue on cerebral aneurysm is to detect and locate the vessel dilation, if possible before a subarachnoid hemorrhage occurs. Nowadays about 50% of patients with cerebral aneurysm die, because it is detected only after a

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brain hemorrhage happened.

Considering the properties of nanorobots to navigate as bloodborne devices, they can help on such extremely important process of early diagnosis. Therefore, such integrated architecture may support the development of molecular machines to advance new therapies in medicine.

* Adriano Cavalcanti, Bijan Shirinzadeh, Robert A. Freitas Jr., Luiz C. Kretly, “Medical Nanorobot Architecture Based on Nanobioelectronics”, Recent Patents on Nanotechnology, Bentham Science, Vol. 1, no. 1, pp. 1-10, February 2007. http://www.bentham.org/nanotec/CurrentIssue.htm

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