ViRob

An Autonomous Crawling Micro-Robot

The Technion, Technology institute, Israel,

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ViRob Overview

ViRob is an autonomous revolutionary crawling micro-robot controlled by electromagnetic fields. The ViRob was developed by leading experts at the Technion Institute.

The ViRob platform Miniaturization is made possible since actuation and control are not onboard. Actuation power is given due to an external magnetic field subjected onto the robot, while crawling velocities are determined using different external magnetic field frequencies.

Medical Micro-Robots

In recent years focus has been set on research of miniature robots for minimally invasive medical treatments and diagnosis within the body.

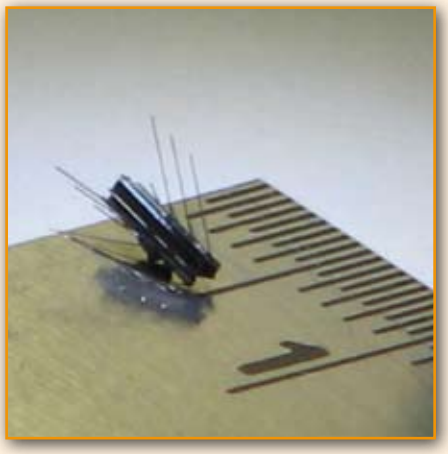
Micro-robots for medical use can be categorized into two main groups, those that are designed for swimming and those that crawl, gripping the inner pipe walls. The first group might suit medical applications where almost no flow is applied on the robot, While crawling micro-robots may theoretically withstand even massive bloodstream flow present in the human blood vessels. Nevertheless crawling robots that had been designed and fabricated are of impractical sizes for medical use.

Another approach is a passive in-a-capsule system, which advances through peristalsis alone (a natural muscular motion). Note that such systems are thus applicable solely in the gastrointestinal system.

The robot hereby presented has the ability to crawl within cavities with similar characteristics as the typical human body's veins and arteries. The miniaturization achievement is unprecedented, as is the ability to control the robot's activity for an unlimited period of time, for any medical procedure.

ViRob - A Crawling Micro-Robot

The new robot consists of a central torso from which tiny arms stretch out, allowing the robot to strongly grip the vessel walls. The operator can manipulate the robot to move in increments, and its unique structure allows it to crawl within a variety of vessels with differing diameters.



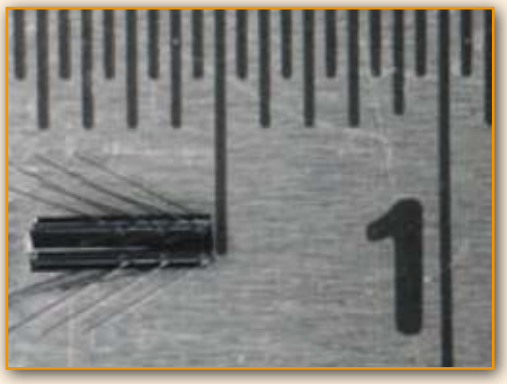
As indicated, different human body's cavities differ from each other in diameter, making it extremely important for the robot to be able to adjust accordingly.

The robot has been fabricated using MEMS technology and as depicted, having a diameter of 1[mm] and can be further reduced.

Miniaturization is made possible since actuation and control are not onboard.

Furthermore, the robot advances regardless of the magnetic field actuation direction, which dismisses the need for exact localization and direction retrieval.

The small cross sectional area of the robot allows fluids to flow with minimal interference, thus in vascular motion can be made feasible.



The Opportunity

A UNIQUE OPPORTUNITY EXISTS FOR EVALUATING THIS TECHNOLOGY AND DEVELOPING THE COMMERCIALIZATION PLATFORM IN THE MEDICAL SECTOR.

ViRob was tested in numerous settings and presented robustness in velocity performance.

Performance

Actuation is applied by an oscillating external magnetic field of 2[mT] while the magnetic field source is located at about 150[mm] from the robot's location.

The robot is capable of crawling up to 9[mm/sec] if applied into bent or non-bent ventricles having diameters ranging from 3.175[mm] up to 4[mm].

ViRob can also be applied to bent or non-bent submersed ventricles with similar geometries while demonstrating the same crawling velocities.

It should be noted that the above capabilities also apply to biological tissues like veins and arteries.

It is worth noting that one can easily modify the robot's dimensions, to alter the range of ventricles diameters in which ViRob is applicable to, thus adjusting it for a given desired medical procedure

Potential Medical Applications For ViRob

- **Targeted Drug Delivery procedure**
- **Diagnostic**
- **Neurosurgery**
- **Imaging**
- **Guide wire pulling**

- Neurosurgery – for example, treatment of post-hemorrhagic hydrocephalus in preterm infants. In these cases, excessive cerebro-spinal fluid (CSF) does not permit proper development of cerebral tissue and must be drained via a peritoneal shunt, inserted in a surgical procedure. ViRob may assist in clearing a route through which CSF may be drained, eliminating the need for a permanent shunt.
- Brachytherapy – a relatively new approach of providing anti-cancer therapy directly to the afflicted region. The anti-cancer treatment whether radiotherapy or chemotherapy, may be administered directly to the lung or to the prostate using ViRob. Moreover, several robots may be used simultaneously for the treatment of several metastases.
- Images from within - Camera attached micro-robots may be used to travel inside the spinal canal, ureter or bronchii to a given target point, and used to produce video images for diagnosis.

It should be noted that the low frequency magnetic field does not have any medical implications.

The Team

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