(Fiscal Year 2004-2006)

Southern Area of Lake Biwa

Development of In-Vivo Micro Diagnosis and Treatment Robot
—Cluster Formation for Micro Medical Engineering Industries—

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Life Sciences
IT
Environment
Nanotech Materials
Others

Project Promotion

Project Director… ……Tamehiko Nishida (Vice Chairperson of the Board, Shiga Prefecture Industrial Support Center, From 1 Jul. 2004 to 31 Dec. 2006)
Hironobu Okuyama (Executive Director, Shiga Prefecture Industrial Support Center, From 1 Jan. 2007)
Chief Scientist… ……Masaaki Makikawa (Professor, Ritsumeikan University, Faculty of Science and Engineering)
Science and Technology Coordinator…Yasushi Hattori
Ohmi Takayama

Core Research Organizations

Shiga University of Medical Science,Ritsumeikan University ,
Ryukoku University, Industrial Research Center of Shiga Prefecture

Major Participating Research Organizations

Industry…SANYO Electric Co. Ltd., ZENIC Inc .,
Alfresa Pharma Corporation, NIPRO CORPORATION ,
OMRON Corporation, YAMASHINA SEIKI CO.LTD .,
Fujinon Corporation
Academia…Shiga University of Medical Science ,
Ritsumeikan University, Ryukoku University
Government…Industrial Research Center of Shiga Prefecture

Aim of research and development

Many industrial companies and three universities in southern area are located in Shiga prefecture and quite a number of research corporations and joint developments have been produced. The main purpose of this project is to develop an In-vivo Micro Robot for less invasive diagnosis and the treatment method in hospitals utilizing these industry-academia-government cooperation and original economic promotion policies of Shiga prefecture.
Moreover, various core technologies produced are expected to be applied for non-medical and medical fields and create new products in the course of development.
In the first three years, the project target was to develop an End-Bionics Robot below as well as to apply its core technologies for other new products and businesses such as new medical equipments, healthcare devices and consumer electronic appliances.
This project is expected to make the southern Lake Biwa area to be one of the excellent world-wide research centers of micro medical engineering and to further encourage mutual collaboration between industries, universities and public services to create new medical engineering industries.

Contents of research

The objective of this project is to develop an In-vivo Micro Robot that stays in abdominal or thoracic cavity of human body for a long term (n hospital) to keep monitoring and treatment of the affected organs or tissues.
In the first three years (2006-2008), an End Bionics robot that is scheduled to be developed as the preliminary stage of In-vivo Micro Robot (IMR). This robot has a guide wire connected to the controller outside the body.

1. Research & Development of Micro Intelligence of IMR

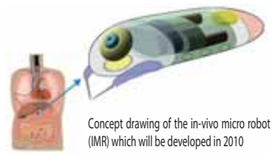
Micro Intelligence is the brain of IMR and it receives signals from micro bio-sensors, analyzes them and controls micro bio-actuators for treatment. In this project a chip size micro computer system is planned to be developed for the intelligence of IMR that manages information processing and operation control makes diagnosis and treatment less invasive. In the near future IMR will remove its guide wire and data transmission line and will act solitarily inside human body.

2. Research & Development of IMR Motion Control Technology

The main purpose of this sub-project is to develop IMR motion control technology outside the body of a patient.
Magnetic Field Generator outside body controls IMR to move and rotate inside the body. Information such as image signals and reception of operation control signal is transmitted through guide wire, which may be considered as a kind of catheter.

3. Research & Development of Micro Sensing and Operation

In this sub-project, various micro sensors and micro manipulators are studied and developed using micro/nano fabrication technologies for less invasive diagnosis and treatment.
Sensors and manipulators are selected from candidates for trial fabrication and each prototype of micro sensor and manipulator developed is evaluated in animal experiments and is modified to be set inside IMR.



Concept drawing of the in-vivo micro robot (IMR) which will be developed in 2010

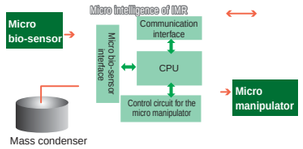


Image: Research of micro intelligence of IMR

Image: Research of IMR motion control technology

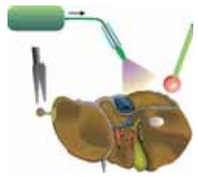


Image: Research of micro sensing and operation

The main study results

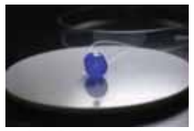
1. Micro Lens Washer Mechanism

The micro lens washer mechanism has been developed, which keeps lens clean from blood or fatty pollution. This device was tested in experiments and proved to have enough cleansing capability. This mechanism is expected to keep vision of IMR and endoscope clear for a long time.

Micro Lens Washer Mechanism

2. Micro Sucking/Fixing Mechanism on Organ Wall

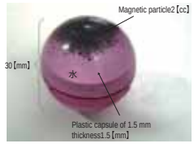
Micro sucking/fixing mechanism has been developed, which keeps IMR on the wall of internal organ at a certain location for sensing and operation.



Micro Sucking/Fixing Mechanism on Organ Wall

3. Motion control of IMR using magnetic fluid

IMR Motion control system with magnetic fluid inside and magnetic field generator set outside has been developed. This new motion control system was proved to be effective through experiments using the test model.

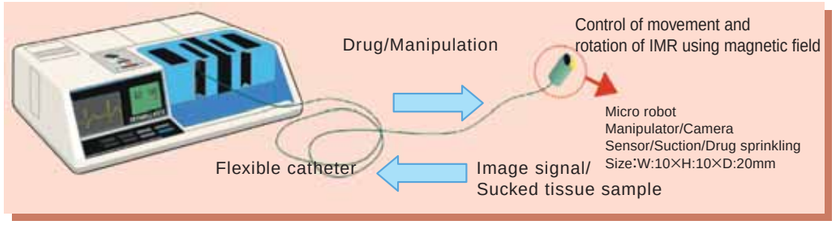


Motion control of IMR using magnetic fluid

In addition to the above, various research results were obtained, including a new image compression technology, a heating microwave applicator for cancer treatment, a micro pump for DDS, a balloon actuator for flexible catheter, and a nerve interface, etc.

Purpose of development An End Bionic Robot with minimum elements such as manipulator and camera will be developed till 2007 as preliminary model of Micro In-vivo Robot.

Function Movement and Rotation of IMR with camera and manipulator is controlled outside body using magnetic field



Industrial applications Micro In-Vivo Robot will be developed in 2010 to achieve less-invasive diagnosis and treatment, while applying various technologies produced through R & D activities of this project for micro medical devices and electric appliances for human health and preventive purposes of the next generation.By accumulating successful results of this project on micro medical engineering, there would be more opportunities to create various new technologies in electrical, mechanical and bio industries as the main industries of this area. It will also promote a dramatic progress in development of new products.