Awards for Outstanding Projects in CoE Technology Week 2004

Novel Early Cancer Detection Method

This Final Year Project is an industrial project sponsored by the Institute of Bioengineering and Nanotechnology (IBN). The purpose of the project is to overcome limitations in cancer diagnosis methods today. Currently, cancer detection techniques have the following shortcomings: long diagnosis time, and a complex and delicate diagnosis process. In some cases, the diagnosis results are subject to the specialists’ interpretation of the information, introducing the element of human error into the diagnosis. The purpose of this project is to develop an early cancer detection method that overcomes the aforementioned limitations by developing a cancer detection device that has the necessary accuracy and precision.

The biochip is a plastic-based cartridge that shortens the complicated and laborious laboratory processes from tissue sample preparation to cancerous gene detection (Figure 1). It is targeted to replace the current laboratory approach of gene detection in hospitals. The biochip itself is designed and fabricated without the inclusion of electronics. All electric signals to the biochip, which are used to control the mechanics within it, are driven by external sources. These sources will be built into a separate machine when the system is commercialized. The biochip is disposable. Since all the electronics are separate and can be reused, the cost of the biochip is minimized.

In this project, we have developed the hardware to interface with the biochip. One of the hardware systems developed was an automated controller that allows the biochip to be programmed to handle simple tasks. The pinnacle of the project was the CoE Technology week. With support from our supervisors and the staff of NTRC, we put in a great deal of effort in designing the poster and creating a theme (Breast Cancer Awareness) for our exhibition, in addition to presenting the technical details. We also printed pamphlets and made ribbons to promote awareness of breast cancer among visitors. Our hard work eventually paid off. We were lucky enough to receive a Gold award in the CoE Technology week.

The completion and success of this project would not have been possible without the assistance and guidance from important individuals, namely A/P Yu Lee Wu, A/P Shum Ping from NTU and Mr. Xu Guolin, Professor Jackie Ying and A/P Francis Tay from IBN. We would like to take the opportunity to express our gratitude to them.

Mr Nguyen Thanh Nam explains the functionality of our hardware to Professor Eh Meng Hwa, Dean, School of EEE, NTU

Audio Beam – A Novel Sound Delivery System

Imagine dining in a restaurant where you have your favorite music playing as you enjoy your meal. There is no other music but yours playing, and everyone in the restaurant can enjoy their favorite music without hearing their fellow diners’ music. Imagine when you visit a museum or an art gallery; an explanation regarding a piece of art or an exhibit that you are viewing is delivered to you personally without requiring you to wear a headphone. Imagine when you are waiting in a hotel lounge, you can select to listen to the news or any of your favorite music delivered personally to you. All of these applications are made possible with the AudioBeam speaker.

The AudioBeam speaker is a new type of sound reproduction that utilizes nonlinearity in the air to generate audible sound from ultrasonic waves. Inherent to the characteristic of ultrasonic waves, the audible sound is transmitted in a highly directional manner. This property makes it possible to project sound to specific listeners, which is analogous to projecting light from a torch. This directional sound reproduction heralds a revolutionary method of creating a private listening space.

At the DSP Lab in EEE, we have designed, developed and built several models of the AudioBeam speaker. They can be run in either a notebook/PC or as a standalone portable device. The audio or speech signal can be easily input into the device, which processes and modulates this signal with an ultrasonic carrier, before delivery to a specially designed digital amplifier, which delivers the right level of signal to the ultrasonic transducer. We have recently filed a US patent on these processing...
Biophotonic MEMS Integrated System

A MEMS research team from the Division of Microelectronics won one of the outstanding prizes at the recent CoE Technology Exhibition, held from 9-12 March 2004. A biomedical chip research work entitled “Integrated Biophotonic Chip for Cells Sorting and Disease Diagnosis” was successfully demonstrated. This project is led by Assoc Prof Liu Ai Qun from the School of Electrical & Electronic Engineering and collaborated with collaborators with Assoc Prof Peter Droge from the School of Biological Sciences.

This biophotonic system integrates micro flow and micro-optics into a single chip for real-time cell identification and manipulation. An argon laser at 488 nm passing through a microfluidic array is used to focus the laser and excite biofluorescent cell fluorescence-labeled cells suspended in solution. A spectrometer is used for detecting the fluorescence spectrum and identifying the cells. As expected, different cells are identified according to their specific fluorescence spectra. The microfluidic system exploits electroosmotic flow for cells transportation and separation. The biophotonic chip is fabricated using micromachining processes. This biophotonic integrated chip might provide a valuable application application for cells sorting and cancer diagnosis such as leukemia, AIDS and other diseases so on.

The MEMS research team was interviewed by international media during the exhibition. Zhang Xuming, who is a senior PhD student commented, that “in general, EEE provides us with a conducive research environment where we are given a chance to learn not only from our supervisor but also from other professors in different research fields. The CoE exhibition bridges the gap between academia and industry. It gives an opportunity for the students to demonstrate their research results and allows our research to meet the industry and economy’s requirements.” Xuming will also be submitting his thesis this July. Sun Yi, a first-year PhD student in the group commented that, “The research environment in the MEMS group is unique as it provides the necessary multi-disciplinary technology and collaboration that helps to create novel ideas. My supervisor, Prof Peter Droge, is very willing to share his bioscience knowledge which is important for the success of this project in CoE.” The experience from CoE allowed her to truly understand the philosophy of creating with inspiration and innovating with perspiration. Xiaojun shared that his research group members would like to join the MEMS group for a few months. Several months, "We are working so closely together with our supervisors and I am happy to see how generous our seniors are in offering their helping hands," he added. "The team spirit plays a key role in our their success for the CoE." The team which has more than 10 members including PhD students, research fellows and research associates, they also won a gold prize at the last year’s CoE exhibition.