LEFT: The breast self-examination device contains nine thin-film force sensors

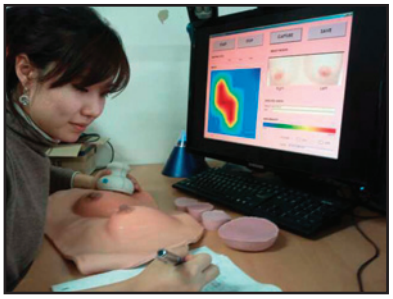
FURTHER READING
http://melab.snu.ac.kr

Page 1651
'Development of portable breast self-examination device using enhanced tactile feedback', J. Ryu, M.S. Heo and H.C. Kim

The early detection of breast tumours could soon be carried out quickly and easily at home with the development of a hand-held tactile self-examination device

a self-scan system

A simple and cheap tactile breast self-examination system that can be used in a ubiquitous healthcare environment has been demonstrated by a team at Seoul National University in Korea. Consisting of a palm-sized wireless scanning probe, a web camera and PC software, it is able to display the location of any lumps in the breast, and define if an abnormality exists. This system can help to overcome the difficulties in tactile perception and subjective interpretation that untrained women currently face in self-examination, and its low cost and portability make it suitable for widespread use in the home.



ABOVE: Jiwon Ryu and her colleagues have tested their system using breast phantoms and a range of lump sizes at varying depths

Encouraging early detection

According to the US National Cancer Institute, 1 in 8 women are diagnosed with breast cancer during their lifetime and, in 2010, over 19% of them did not survive. The American Cancer Society recommends that adult women should conduct a breast self-exam once a month, but the result in this case relies only on the individual's subjective interpretation. Visiting a hospital once a month for the early detection of breast tumours using mammography or palpation by a doctor is also inconvenient and can be an uncomfortable experience. It is for these reasons that the team from Korea have been working to develop a palpation device that can reproduce the breast self-examination procedure easily and conveniently by an untrained user.

A real-time system

There are currently two devices available that use palpation technology: one is based on pressure sensors for use in clinics, and the other is a piezoelectric sensor-based device. However, both have several limitations including a high price, large physical size and the requirement to be operated by a trained analyst. The device that the researchers from Korea have developed has a 36×36 mm^2 active area covered by nine thin-film force sensing resistors for providing sufficient tactile resolution to find breast lesions. It also contains a microcontroller for processing the results and a Bluetooth module for wireless connection to a PC. When the user presses the palm-sized probe against their breast, the detected pressure is fed back to provide a visualisation on the PC monitor of the location and hardness of any recognised lumps. A pseudo-coloured two-dimensional pressure map and real-time video captured by a web-cam for tracking the probe location are displayed throughout the breast scanning process.

Trade-off

By making a trade-off with the performance against system complexity, the team found the optimum point to make the device portable, low in cost and easy to use whilst still demonstrating a sufficient sensitivity and specificity to differentiate tumours from normal tissue. With a limited number of sensors, sufficient spatial resolution was achieved by interpolating the extracted results programmatically so that no parts of the breast were missed during the scanning process. To further develop the system, the researchers are looking at optimising the number and size of the sensors in the probe, and increasing the sensitivity and specificity. They are also looking to make the device even smaller and lighter.

Clinical trials

So far the prototype system has been tested on silicone breast phantoms. Abnormalities larger than 5 mm located at depths less than 25 mm could be detected accurately, and a detection rate of over 80% was achieved even for 5 mm lumps, compared to deterioration to less than 50% with decreasing lump size using the bare hand. The researchers are now aiming to start a pilot clinical trial to test the device's efficacy in a real setting. They would like to see their device eventually being widely used in the home to assist with increasing the early detection rate of breast cancer, and therefore increasing survival rates as well as significantly reducing related healthcare costs.

doi: 10.1049/el.2010.9145