TEXTILE & DESIGN LABORATORY
CASE STUDY 02/2008

PROJECT TITLE: INTEGRATED BIOHARNESS DEVELOPMENT
T&DL PARTNER: ZEPHYR TECHNOLOGY LIMITED
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PROJECT PERIOD: AUGUST 07 - SEPTEMBER 08

BACKGROUND: Zephyr Technology is an Auckland based physiological and biomechanical monitoring technologies business. A relationship with the Textile & Design Lab was formed in mid 2007 at a time when Zephyr were looking to redesign and further develop their Bioharness, a wearable product that is capable of measuring heart rate, respiratory rate and body temperature. Zephyr was encouraged by the T+DL to apply for R&D funding through Textiles NZ's Transform initiative, which resulted in them being awarded around $90,000. The T+DL would be sub-contracted to undertake the redesigning of their existing Bioharness product and to develop a garment that would integrate with their body monitoring technology. The T+DL's potential income from this project was estimated at around $30,000 plus material costs.

PROJECT METHODOLOGY: The project was divided into 4 phases for completion within a period of 14 months. Phase 1 involved researching potential sources of raw materials, primarily conductive yarns that would meet Zephyr's performance criteria. Around 12 conductive yarns were sampled from suppliers in Europe, the USA, China, Australia and NZ. Knitted samples in 14 gg were produced on the lab's Shima SES machine and submitted to Zephyr for conductivity testing. A short list of 3 yarns was selected following the tests, one of which was sourced locally.

The second and third phases of the project involved the refinement of the existing Bioharness wearable strap, the integration of the Bioharness technology into a sports vest or shirt, and carrying out relevant tests and evaluations. At this juncture, it was decided that the existing cut and sew method for the strap should be maintained as the product consisted of woven materials in the areas where dimensional stability was critical. Whilst efforts were made to reproduce a knitted structure to afford a similar degree of stability, this fell well short of the mark. Refinements were made to the existing strap design and submitted to Zephyr for assessment. These improvements were focused on wearer comfort, aesthetics and product labeling, which culminated in the submission of several prototypes. From these, an approved style was selected and a local manufacturer was located to take on the production of the redesigned product.

With regard to the development of an integrated knitted garment, the greatest challenge was to find a way in which to combine 2 separate conductive zones on the inside of the front panel, 2 'pockets' that would need to accommodate some small foam pads, and a plain knitted exterior to the same panel. A programme was created using the Shima SDS One design system and initial samples were knitted using fine merino yarn in conjunction with one of the selected conductive yarns. The main criticism of these panels was the 'woolly' nature of the fabric which was deemed unsuitable for a sports garment. An example of a competitor's garment was acquired by Zephyr and this was analysed by T+DL staff. It was determined that the garment was made from a fine gauge warp knitted fabric and was considerably finer than anything that could be knitted on a flat bed machine. However, steps to improve the appearance of the knitted fabric could be made by switching to a continuous multi filament yarn, which would eliminate the hairiness of the merino wool. Various samples were knitted using textured polyester and nylon in conjunction with the conductive yarn and a fine covered elastomeric yarn. The inclusion of the elastomeric yarn contributed to a better fit and gave the appearance of a finer gauge fabric. The final garment submitted in the second phase of the project was a combination of textured nylon, conductive yarn and covered elastomeric yarn. An assessment of this was carried out by Zephyr, which gave rise to a number of suggested improvements.

Phase four focused on product refinement. Whilst the functionality of the final sample was deemed acceptable in terms of its conductive performance, it was felt that a tighter fit, particularly in the chest region, as well as the repositioning of the conductive zones, would improve contact with the skin and result in more accurate and consistent monitoring. Zephyr also requested that some branding be applied to the garment, as well as a sleeve pocket that could accommodate a Bluetooth cell phone, which would facilitate remote transfer of monitoring data. We also decided to change the base yarn from regular nylon to Tactel to afford a softer handle, added comfort and reduce snagging, which was evident in the regular nylon product,

LEARNING OUTCOMES: This was the first T+DL R&D project involving the use of conductive yarns and it has given those involved in the project a taste of what can be achieved in the apparel arena with smart technology, enabling us to approach future similar projects with a good deal of confidence. The project also helped us to expand our knowledge of the Shima programming and SES machine knitting capabilities. Teamwork and our

combined knowledge of fibres, yarns, design, programming, machine knitting and garment technology were vital contributors to the successful outcome of the project.

FEEDBACK: The final garment was submitted to Zephyr on the 6th of October and its functionality with regard to accurate heart rate monitoring will be tested within the next 2 weeks. Assuming Zephyr is satisfied with its performance, we have suggested that we undertake a sub-project with a view to further enhancing the design and aesthetics of the garment. Zephyr have also agreed to work with AUT Communications to compile an article and associated PR around the project.

Zephyr's Bioharness Strap -
redesigned by the T+DL R&D project team

The new integrated Zephyr garment using
smart Bioharness heart monitoring technology