Smart fabrics make clever (medical) clothing

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(PhysOrg.com) -- European researchers have developed a smart fabric that can monitor muscular overload and help prevent repetitive strain injury or RSI. But that is just the beginning. The team is also exploring a pregnancy belt to monitor baby's heartbeat, clothing to help coach hockey, and shirts that monitor muscle fatigue during training.

Smart fabrics promise to revolutionise clothing by incorporating sensors into cloth for health, lifestyle and business applications. In the long term, they could consist of circuits and sensors that provide all of the typical electronics we carry around today, like mobile phones and PDAs.

Current, first-generation applications are far more modest, and pioneering medical smart fabrics are used to monitor vital signs like heart rate and temperature. But two crucial hurdles – unobtrusiveness and reliability – impede widespread adoption of such clever clothes.

Now one European research team has developed groundbreaking medical-sensing smart fabrics, and its work could lead to pregnancy monitoring belts, sports clothing that provides training tips, a wearable physical game controller, and a vest that helps to prevent repetitive strain injury.

The Context project initially sought to develop an RSI vest to tackle a serious work safety issue. Repetitive actions can, over time, lead to permanent injury and the problem costs billions of euros a year. It affects over 40 million workers across the continent and is responsible for 50 percent of all work-related ill-health.

Muscle contraction, the very quiet metric

The team had to tackle three challenging problems. First, they were using a relatively novel sensor that demanded sophisticated electronics located in the clothing. Second, they were aiming to measure muscle contraction, a very 'quiet metric'. Third, they were venturing on a research path seldom trod: muscle contraction as a predictor for stress. Long-term, low-key stress is the leading risk factor for RSI.

"Each of the issues was very difficult. We chose to use a capacitative sensor, because it does not need to be attached to the skin, like resistive sensors do, which adds to the comfort. It needs controlling electronics close to the sensor to work effectively, and that presents a real challenge for textile integration," explains Bas Feddes, Context's coordinator.

Similarly, measuring electromyography, or electrical activity in the muscle, is more subtle and tricky than electrocardiography, which measures the heart. The rustle of clothing caused by movement can drown out the signal.

Context has gone a long way to solving that problem but it is not as robust as they would like.

Finally, medical understanding of muscle stress as a predictor for RSI is not a mature field of research, so it is difficult to say with certainty that specific activities could lead to RSI.

Despite these hurdles, the team successfully designed an RSI vest, and they are currently improving its reliability.

Context's ambitious programme tackled pioneering and very complex issues in smart-fabric research, which resulted in a useful, unobtrusive and reliable RSI vest that can warn wearers to take a recuperative break.

Baby onboard

More importantly, perhaps, the work was finished on time and under budget, so Context has scope to explore other potential applications enabled by the system. The team is eager to extend this work. “We also have some ideas for improving bio-feedback for the prevention of RSI problems, and we will pursue them as well,” notes Feddes.

But other applications may prove even more compelling in the short term. For example, the team is looking at a pregnancy belt to monitor a baby’s heart rate. “In the short term, this would be more of a lifestyle application, rather than a medical one, but that work could lead to a belt that helps monitor difficult pregnancies,” Feddes believes.

In the meantime, parents could enjoy the peace of mind monitoring their child’s heartbeat, perhaps with a heart-shaped light keeping the rhythm. But reliability will be paramount, suggests Feddes, as false warnings could be nerve wrecking for parents.

Muscle stress during sports training is another potential application, and one consortium partner will pursue a swing-monitor for hockey players.

“Hockey coaches find it difficult to give feedback to their players, so they would be very interested in clothing that details the path of their stroke. The shirt would track the order in which muscles engaged during the swing. It is an application that could apply to golf, too,” Feddes explains.

One of the most interesting and intensively investigated applications is a physical game controller. Controlling a computer game by wearing a garment that continuously probes your muscle activity is attractive, not only because of the fun-factor but also because it promotes exercise by children.

The garment again requires the expertise of all partners to develop the sensors, and integrate them into the textiles, and to measure and interpret muscle activity.

“It is an interesting area with many potential applications and the project partners were very engaged so we got a lot of work done. We would like to pursue other areas together in a future project, if possible, and we will be discussing potential research areas over the coming months.”

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This is part two of the three-part special feature in October on smart textiles (see related articles).

Part 1: www.physorg.com/news143298276.html

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