RESEARCH NEWS

Hannover Messe 2019: Ergonomics support for industry and logistics staff

A smart soft orthosis for a stronger back

When workers in Germany call in sick, back pain is often to blame. It frequently affects employees in logistics, manufacturing and services where physically strenuous patterns of movement are part of the daily job routine. In a bid to prevent back problems, Fraunhofer researchers have come up with ErgoJack to offer a smart soft orthosis that supports workers with real-time motion detection. A prototype of this smart vest will be presented live at Hannover Messe from April 1 through 5, 2019, at Booth C24 in Hall 17.

A welder spends long hours bent over a component. Back pain is inevitable with this kind of constrained posture. Permanent damage such as premature spine wear is not uncommon in people who do this kind of work for years but neglect to adopt proper ergonomic posture. The same goes for workers who are frequently compelled to lift heavy objects. Researchers at the Fraunhofer Institutes for Production Systems and Design Technology IPK and for Reliability and Microintegration IZM in Berlin developed ErgoJack – a smart soft orthosis – to relieve back strain and encourage workers to execute strenuous movements in a more ergonomic way. The research teams aim to mitigate the risk of downtime with this modular, wearable soft robotics system.

Real-time motion analysis distinguishes ergonomic from unergonomic movements

"Our soft robotic upper-body orthosis' unique selling point is its real-time motion analysis. Specially developed algorithms based on machine learning and AI enable the ergonomics to be analyzed. This sets this orthosis apart from commercially available exoskeletons. The latter are wearable robots that, inherently to their functional principles, amplify all types of movements – even unergonomic ones – and merely divert the load placed on the wearer from an overloaded part of the body to a less taxed area," says Dipl.-Ing. Henning Schmidt, a scientist at Fraunhofer IPK. In contrast, the IPK orthosis uses motion analysis to distinguish between ergonomic and unergonomic movements. The wearer receives real-time feedback from a vibrating alarm when he adopts postures or performs movements that are detrimental to his health. Inertial measurement units, or IMU for short, built into the vest compare pre-learned movement patterns with the worker's actual movement and assess it in real time. This takes just a few hundred milliseconds. The miniaturized motion sensors are located on the shoulders, back and thighs.

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These motion sensors are not the only in-built circuitry; the vest also features robust, miniaturized electronics, including an embedded controller, a vibration module and a rechargeable battery. Fraunhofer IZM's brief is to develop the miniaturized and comformable electronic components; Fraunhofer IPK's is to design the system layout, human-system-interface, mechanics, electronics and software including the machine learning/AI real-time algorithm. Data is processed locally on the vest. "The real-time algorithm requires complex calculations and has to be very robust, but a very small data set suffices to train the system to a new worker's movement pattern," says Schmidt, describing another feature that sets this system apart. Fraunhofer IZM scientists are now working on encapsulating the electronics and sensors in the fabric version of the orthosis so it can be washed without having to first remove components from the vest.

Available in different versions and in all sizes

Customers will eventually be able to choose between a sensory vest made purely of fabric and a version with power assistance built in. Another variant of the current system comes with a back and hip support. Its orthotic brace has the smallest surface area necessary to support the body. A locking lateral hip joint on the vest serves to switch the joint torque transmission from the back to the legs on and off. This mechanism enables the worker to alternately perform tasks while standing and sitting.

ErgoJack is suitable for use in a wide range of industries. As successful trials in the automotive industry have shown, it benefits logistics and production personnel who have to lift heavy packages off pallets or adopt a constrained posture for hours while welding.
The researchers will present a prototype of this wearable soft robotics system at the joint Fraunhofer Booth C24 in Hall 17 at the Hannover Messe from April 1 to 5, 2019.

Fig. 1: ErgoJack with a locking hip joint and leg brace supports the worker when lifting heavy loads.

Picture 2: ErgoJack in side view.

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Picture 3: ErgoJack from behind.

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