University of Waterloo looking for insight insights with AI

Researchers at the University of Waterloo have been using artificial intelligence (AI) technology to gain new insights that may help reduce workplace injuries on skilled construction workers and boost their productivity.

Bricklayers and masons of various experience levels were decked out in motion suits with sensors to track their movements and the load on their joints. The information was then relayed to a central database where AI programs and software crunched the data and analyzed their activities and patterns.

The aim? To help researchers better understand the movements of the workers so they can come up with superior ways of doing the work and develop best practices for those entering the Masonry trades.

The research project was overseen by Carl Haas, a professor of civil and environmental engineering, and his partner Eihab Abdelrahman, a systems design engineering professor at the university.

It was yet another example of industry innovation, specifically how motion sensors and artificial intelligence (AI) software can identify expert techniques that can then be passed on to apprentices.

“We got like literally a terabyte of data now,” explained Haas. “It’s not such a huge proposte of artificial intelligence, but in this case it was useful to do data analytics to try to pick out any patterns.”

“We picked out patterns of movement and posture that efficient and skilled masons use and then we contrasted those with patterns that the novices use. We found that sometimes those patterns are static in terms of natural posture and sometimes they’re dynamic in terms of sequences and stuff.”

In the first part of the study, bricklayers were asked to build a wall. In the second part, masons were studied to figure out how they work so efficiently. Up to 17 motion units were installed on each suit. They were strategically located on certain parts of the workers’ bodies to accurately gauge movement.

“These motion suits are pretty flexible, in terms of what you can get out of them,” explained Haas. “They literally sense the motion of body parts that they’re on.”

After studying the data, researchers came up with some interesting findings — that expert bricklayers use previously unidentified techniques to limit the loads on their joints.

“We came up with some good identifiers and some good feedback in terms of learning to help people move more effectively on the job,” said Haas. “The people in skilled trades learn or acquire a kind of physical wisdom that they can’t even articulate. It’s pretty amazing and pretty important.”

The sensors gave researchers a read on the load on joints of workers at a speed of a hundred times a second, allowing them to do a more precise and correct analysis.

Computer software interpreted the data and replicated exactly what the body was doing at the time a load was hoisted. Because researchers know the weight or the load, they were able to analyze such things as stress on a certain joint or muscle while blocks were being lifted by the workers.

“If you know what the load is on a hand or hands, the math and the software will basically tell you what the loads are on all the joints,” said Haas.

Interestingly, the data showed that the experienced bricklayers and masons in the study don’t follow standard ergonomic rules taught to novices. Instead, they develop their own ways of working quickly and safely and, in the process, put less stress on their bodies while doing more work.

Researchers discovered that, in some instances, the posture and motion used by the bricklayers on the job is actually distributing the load better than if they’d followed proper ergonomic guidelines.

The analysis of the data showed that the ergonomics are not always correct, said Haas, and that workers on the job are naturally finding better ways to do the work that put less strain on their bodies.

“They have a physical wisdom they can’t articulate,” he said.

In the case of bricklayers and masons, researchers found they do more swinging of blocks and less bending of their backs to actually lift them.

“They generate motion that might be dangerous for a novice, but because of their experience and expertise they control it and it reduces the load on their bodies. It takes some experience and co-ordination.”

The challenge for researchers now, he said, is to come up with ways to help the lesser-skilled bricklayers and masons get up to speed and through that “burn-in hump” without injuring themselves, and also figure out new methods to ease the workload, stress and energy requirement.

Some aids are already being used, he said, such as elevated work platforms and self-levelling pallets that have a spring on the bottom and allow the platform to move up as the bricklayers piled up to lift them.

“It turns out that they’re really effective for improving productivity and reducing stress and reducing the workload and reducing energy requirements,” said Haas.

“It allows a bricklayer to pick the bricks up easily and it makes a big difference because if you’re leaning over to pick up a 27- or 30-pound masonry unit from the ground and you’re doing it over and over again it takes a toll.

“It seems like such a small thing, but it makes a huge difference in terms of reducing the workload.”

Haas said researchers are still digesting the results of the study and, going forward, plan to do more in-depth research that will delve deeper so they can come up with specific the best practices and training.

“The way we can do an analysis and say, ‘Hey, if you want to save energy and your joints, do it this way.’”

University of Waterloo researchers are using artificial intelligence technology to better understand how the wear-and-tear of construction work on workers can be reduced and increase their productivity. With the use of motion suits with sensors researchers are collecting a variety of movement data.

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CURRENT TECHNOLOGICAL ADVANCEMENTS HAVE PROVIDED THE CONSTRUCTION INDUSTRY WITH HAND-HELD SOLUTIONS TO TRACKING THE LOCATION AND MONITORING THE MAINTENANCE STATUS OF CONSTRUCTION TOOLS AND ASSETS. SOFTWARE COMPANY TENNA (LEFT) HAS CREATED A SYSTEM WHICH USES BLUETOOTH, GPS, AND CELLULAR TO MANAGE AN OVERALL PLATFORM FOR ASSET MANAGEMENT. DEWALT (RIGHT) HAS A BLUETOOTH DRIVEN TRACKING SYSTEM WHICH USES THEIR FREE SOFTWARE APPS SUCH AS TOOLCONNECT.

Tracking the location and monitoring the maintenance status of construction tools, equipment and high end assets was a hand-written, labour-intensive activity for decades. However, since the mid-1980s, technology has stepped up, providing increased levels of asset management for trades, sub-trades and contractors. And it’s all possible from a hand-held device.

At the same time, the variety of technology choices means addressing key questions to determine the appropriate level of tool and equipment management. Is tracking required simply for anti-theft and security? Are status reports needed for maintenance and control?

Is real-time location information important for trades, sub-trades and contractors. And it’s all possible from a hand-held device. On the other hand, the systems offer a valuable role for any size of operation, and add-on modules can also be applied to individual tools to monitor maintenance issues such as annual calibration or required service intervals.

Once a company owns a multi-million dollar fleet of vehicles and mixed equipment assets from numerous manufacturers, a corresponding higher level of asset management is required. Software developer Tenna, headquartered in Edison, N.J., offers a wide range of broadcast technology solutions such as Bluetooth, GPS and cellular that can be managed over one platform. The mix of technologies ultimately recommended by Tenna is the result of an analysis of client needs.

"We usually start by reviewing the asset fleet, digging into the client’s main goals, and making general recommendations," says company co-founder Jose Cueva. "Most companies have a particular area of interest or pain point they need to solve. For example, it could be increasing safety and vehicle inspections to reduce accidents.

"It could be equipment utilisation of high value assets to make sure those assets are being highly utilized in order to be profitable. It could even include relatively inexpensive tools that are an absolute must for a particular trade in order to get production of the day done.”

Power consumption and cost will also influence the choice of the asset management system most appropriate. GPS is the most power-hungry and most expensive, followed by Bluetooth systems. Passive RFID requires battery power in the systems reading device alone. Labels are comparatively low in cost.

Continued technology developments will mean that asset management systems will play a valuable role for any size of operation, and perhaps become a company’s most important piece of equipment in terms of safety, utilization and security.

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