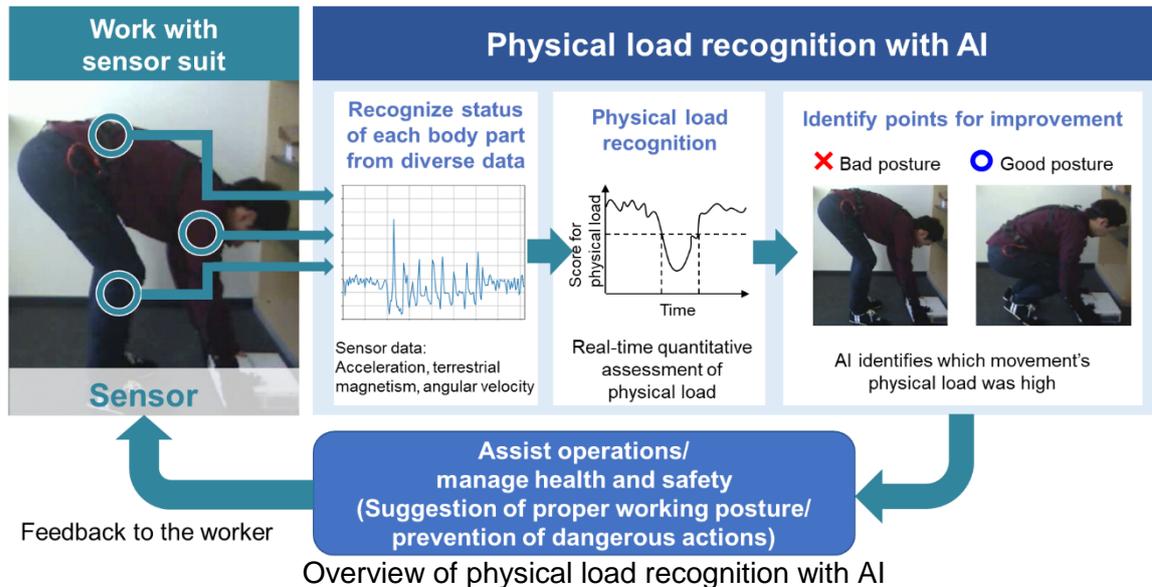


FOR IMMEDIATE RELEASE

AI technology for quantifying physical load and providing effective feedbacks using sensor suit devices

Improving efficiency, ensuring safety, and managing workers' health through standardization of work skills in production/maintenance sites



Hitachi, Ltd. (TSE: 6501, "Hitachi") and the German Research Center for Artificial Intelligence GmbH (DFKI) jointly developed an AI based technology for quantifying physical load on a worker wearing a sensor suit*1 and for providing effective feedbacks on the movement of each body part. This AI technology performs real-time recognition and quantification of physical load exerted on a worker's body during work by using the motion data of each body part obtained through sensors in wearable devices. This technology makes it possible to provide effective feedback to workers on their differences from the model worker in the movement of each body part. DFKI and Hitachi will use this newly developed AI technology to assist operations and prevent dangerous actions, thereby contributing to ensuring safety, managing health, and improving efficiency on the front line of manufacturing.

In a society in which skilled labor is in shortage and recruiting new workers is becoming increasingly difficult, maintaining the skill level of workers is becoming difficult in manufacturing industry (e.g. car factories) and in maintenance or carrier businesses. As conscious of ensuring the safety and health of workers in production sites has been increasing, assisting workers in preventing danger and maintaining health is considered very important. To keep workers safe and healthy, it is necessary to know

the level of physical load during work. In conventional approaches, fixed cameras are used to recognize workers' activities. However, since cameras are limited in the range they can measure, it has been difficult to quantitatively and stably assess physical load in complex production sites or outside places where it is hard to eliminate blind spots.

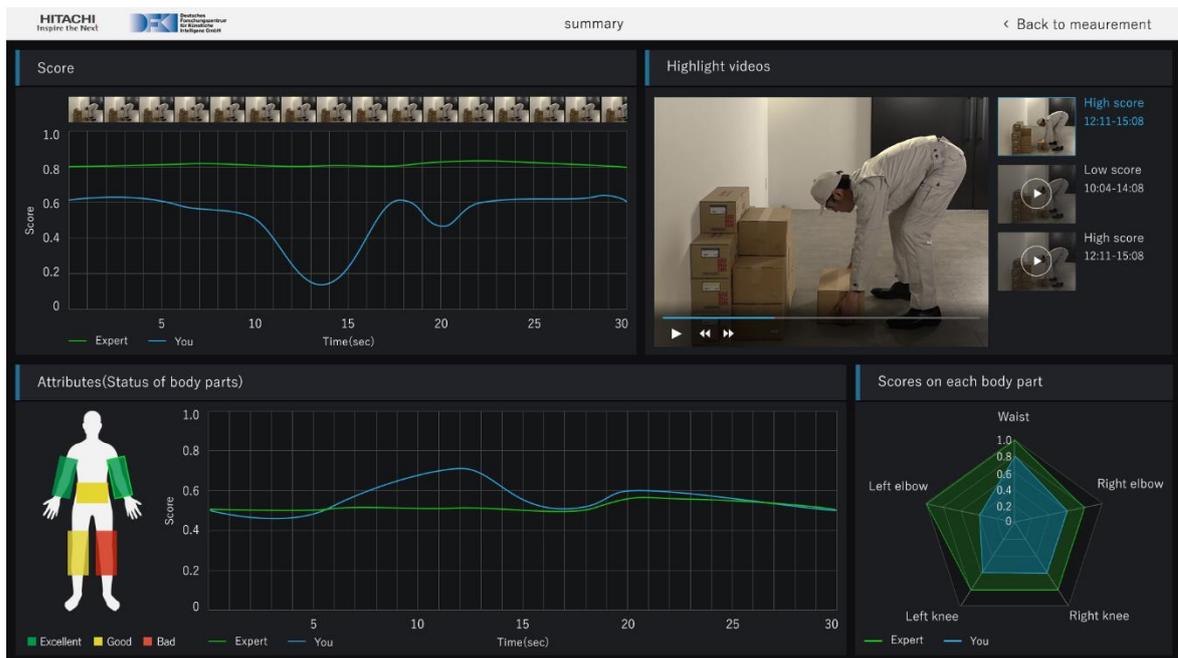
In order to address this problem, DFKI and Hitachi developed new AI based technology that uses the motion data of a worker, measured directly with wearable devices, to recognize and evaluate physical load on the worker's body. This AI based technology was advanced from the AI based technology developed in 2017^{*2}, which recognizes worker's activities (e.g. tightening a screw) using quantitative data collected through arm-band sensors and eye tracking glasses in order to prevent human errors. Combination of Hitachi's human activity recognition technology for industry and DFKI's Deep Learning technology enabled the development of this AI technology. Features of the new AI driven technology are as follows:

1. Technology to directly measure body movements in various human actions and quantify physical load

Sensors in wearable devices directly measure the movements of over 30 body parts necessary to recognize basic human actions. The collected data is analyzed by AI driven models which learned how to estimate the position of each body part in advance. AI powered technology recognizes the data of certain action from the combination of each body part's position, which allows the quantification of physical load from the action using time-series data processing technology based on Deep Learning.

2. Technology to estimate physical load in real time and present differences from proper working posture to workers

By automatically comparing the motion data of the model worker measured in advance and that of a worker for each body part, AI driven model identifies specific movements and body parts that account for significant differences between them. As a result, it indicates to the worker its assessment of body parts that are causing higher physical load in an easy manner.



Test screen showing real-time measurement and comparison/assessment of differences with the model worker

Changes in physical load evaluation with time (upper left) Video of an improper movement (upper right)

Changes in the status of body parts with time (lower left) Evaluation of each body part (lower right)

As an experiment, this AI based technology was applied to action to pick up heavy object. The results of the experiment confirmed that it can perform real-time estimation of quantitative values for the physical load of the action. In addition, for actions which contain bad movement, it was confirmed feedback on each body part could be provided, like movements of waist and knees are different from the model worker. Hitachi and DFKI plan to examine the effectiveness of giving instruction for safer operations in production sites with this technology.

Hitachi and DFKI will utilize the newly developed AI driven technology for operation assistance and prevention of dangerous actions in order to contribute to ensuring workers' safety, managing workers' health, and improving worker education in various production sites. Also, even though this AI technology was originally developed for workers in manufacturing industry and in maintenance or carrier businesses as a technology to measure and evaluate the movement of a human body, it is also expected to be applied in other industries such as sports or entertainment in the future. Moreover, drawing on previously developed human activity recognition AI, Hitachi and DFKI will aim to realize more efficient and safer working environment by contributing to the improvement of productivity.

Hitachi has been operating a transfer lab at DFKI in Kaiserslautern since April 2016 with the aim of jointly developing a cutting-edge AI technology of human-activity-recognition for industry.

Hitachi and DFKI will exhibit part of this technology at Hannover Messe 2019, hall 2, booth C59, to be held from 1-5 April 2019 in Hannover, Germany.

*1 Suit-type wearable devices equipped with sensors.

*2 "DFKI and Hitachi jointly develop AI technology for human activity recognition of workers using wearable devices"

(March 8th, 2017) <http://www.hitachi.com/New/cnews/month/2017/03/170308.html>

About Hitachi, Ltd.

Hitachi, Ltd. (TSE: 6501), headquartered in Tokyo, Japan, delivers innovations that answer society's challenges, combining its operational technology, information technology, and products/systems. The company's consolidated revenues for fiscal 2017 (ended March 31, 2018) totaled 9,368.6 billion yen (\$88.4 billion). The Hitachi Group is an innovation partner for the IoT era, and it has approximately 307,000 employees worldwide. Through collaborative creation with customers, Hitachi is deploying Social Innovation Business using digital technologies in a broad range of sectors, including Power/Energy, Industry/Distribution/Water, Urban Development, and Finance/Social Infrastructure/Healthcare. For more information on Hitachi, please visit the company's website at <http://www.hitachi.com>.

About DFKI

The German Research Center for Artificial Intelligence, with sites in Kaiserslautern, Saarbrücken, Bremen (with an associated branch in Osnabrück) and a project office in Berlin, is the leading German research institute in the field of innovative software technology. In the international scientific community, DFKI ranks among the most recognized “Centers of Excellence” and currently is the biggest research center worldwide in the area of Artificial Intelligence and its application in terms of number of employees and the volume of external funds. The financial budget in 2017 was 45,9 million Euro. DFKI projects cover the whole spectrum from application-oriented basic research to market- and client-oriented design of product functions.

About 1000 employees from 60 countries are currently conducting research focusing on Smart Data & Knowledge Services, Cyber-Physical Systems, Multilingual Technologies, Plan-Based Robot Control, Educational Technology Lab, Interactive Textiles, Robotics, Innovative Retail, Information Systems, Embedded Intelligence, Smart Service Engineering, Intelligent Analytics for Massive Data, Intelligent Networks, Agents and Simulated Reality, Augmented Vision, Language Technology, Cognitive Assistants and Innovative Factory Systems. Impact: more than 130 professorships of former DFKI employees, and more than 90 spin-off companies with approximately 2,500 highly qualified jobs.

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