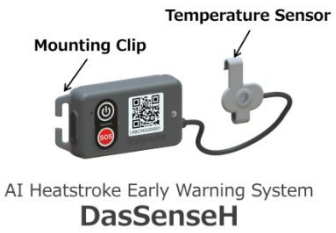
BeeInventor Ltd.
Development of a Pre-emptive Heatstroke Alert System

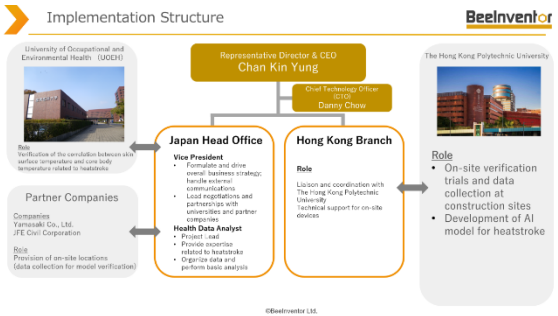
Purpose of the Project

As global temperatures rise, heatstroke risks in construction and manufacturing industries have surged, leading to increased casualties. A critical challenge has been the reliance on environmental metrics such as WBGT, which fail to account for individual factors including age, BMI, and physical condition. There is a clear market need for highly precise and individualized management tools for workers.

This project developed a "Personalized Heat Stress Estimation AI Model" utilizing the "DasSenseH" IoT device. By integrating real-time biometrics (body temperature) and workload data (acceleration), the system successfully visualizes "individual heat stress" that cannot be captured by environmental data alone. Verification results proved that biological responses vary significantly among individuals even under identical high-temperature conditions.

The uniqueness of DasSenseH lies in its retrofittable, clip-on design that leverages existing safety equipment, enabling highly accurate monitoring at a low cost. Unlike existing Japanese services that focus primarily on environmental monitoring, our solution is differentiated by using wearable technology and AI to identify each worker's physiological limits in real time, offering a higher level of individualized safety.





Details of Demonstration

This project was conducted from September 2025 to March 2026 with the aim of visualizing heat stress among construction workers and developing AI models. We established an industry-academic partnership with The Hong Kong Polytechnic University (PolyU). Under this collaboration, PolyU was responsible for experimental design, data collection and analysis, and AI model development, while our company provided IoT devices and handled system integration.

The demonstration involved large-scale data collection at construction sites between September and November 2025. We targeted workers across various roles, including rebar workers and formwork carpenters. In addition to helmet-mounted sensors, we introduced chest-band heart rate monitors for accuracy comparison and cameras for work activity analysis.

The collected data spanned a total of 3,091 hours, covering a broad age range from workers in their 20's to those in their 60's and over. From November 2025 onward, we focused on data cleansing, quality evaluation, and aligning acceleration data with work video annotations to build a prototype model for workload estimation.

Starting in January 2026, we advanced the development of the AI model by integrating these biometric datasets with worker profiles. This systematic approach contributed to the development of a robust and personalized heat stress monitoring solution.

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Project Outcome

Analysis of data obtained through this project yielded critical insights into the effectiveness of our personalized heat stress AI model.

First, a significant positive correlation was identified between the Physiological Strain Index (PSI) and the Rating of Perceived Exertion (RPE). This demonstrated that wearable sensors can serve as a promising objective metric for evaluating physiological load.

Second, the study identified a "perceptual gap" based on worker attributes. While experienced workers aged 40–50 accurately assessed their physiological load, those aged 60 and above tended to show a discrepancy (negative correlation) between subjective perceived exertion and actual physiological load during low-intensity tasks. This suggests that older workers may face unexpected physiological stress even when they perceive the work as light. Consequently, subjective judgments such as "I'm fine" can lead to overlooked risk of heatstroke, demonstrating that objective monitoring using AI is indispensable.

Third, while the system achieved high accuracy in identifying activities such as standing still and walking, challenges related to the measurement accuracy depending on the wearing condition of helmet-mounted sensors were also identified.

Moving forward, we will leverage these findings to promote the social implementation of more accurate, personalized alert algorithms to enhance safety management in the field.

Challenges and Solutions

The demonstrations identified challenges regarding alert audibility in high-noise environments and the device's heat resistance. We addressed these issues by adding a buzzer to the clip-on device and reducing its size to allow for installation inside thermal protective gear.

To address unstable communication environments, we introduced a batch registration feature for multiple sites and developed a dedicated app to simplify configuration changes. Regarding data accuracy, discrepancies were observed in heart rate measurements.

Consequently, we will prioritize highly accurate temperature sensors in the short term while aiming for future accuracy improvements through optimized sensor placement and the introduction of new technologies such as ear-canal measurement.

Future Plans

We aim to launch a low-cost "clip-on device" in the Japanese market by summer 2026. This business model, designed to reduce implementation costs, will facilitate large-scale deployment and drive monetization.

Beyond Japan, the sales will be sequentially started at our existing bases in Hong Kong and Taiwan. We will continue enhancing our AI models using data accumulated through collaborations with partners such as PolyU.

Moving forward, we plan to pursue OEM partnerships with various biometric sensor providers, expanding our safety management solutions into industries beyond construction and manufacturing, thereby driving further business growth.