

What Lupe Does

Lupe is a system developed in collaboration with the National Institute for Occupational Safety and Health to detect risk of back pain when lifting objects. It consists of 6 inertial measurement units, each with an accelerometer and gyroscope. When someone lifts an object, the data is fed into the classifier and the relative level of risk (low, medium, high) is determined. This can be performed in real-time, allowing for instant alerts.

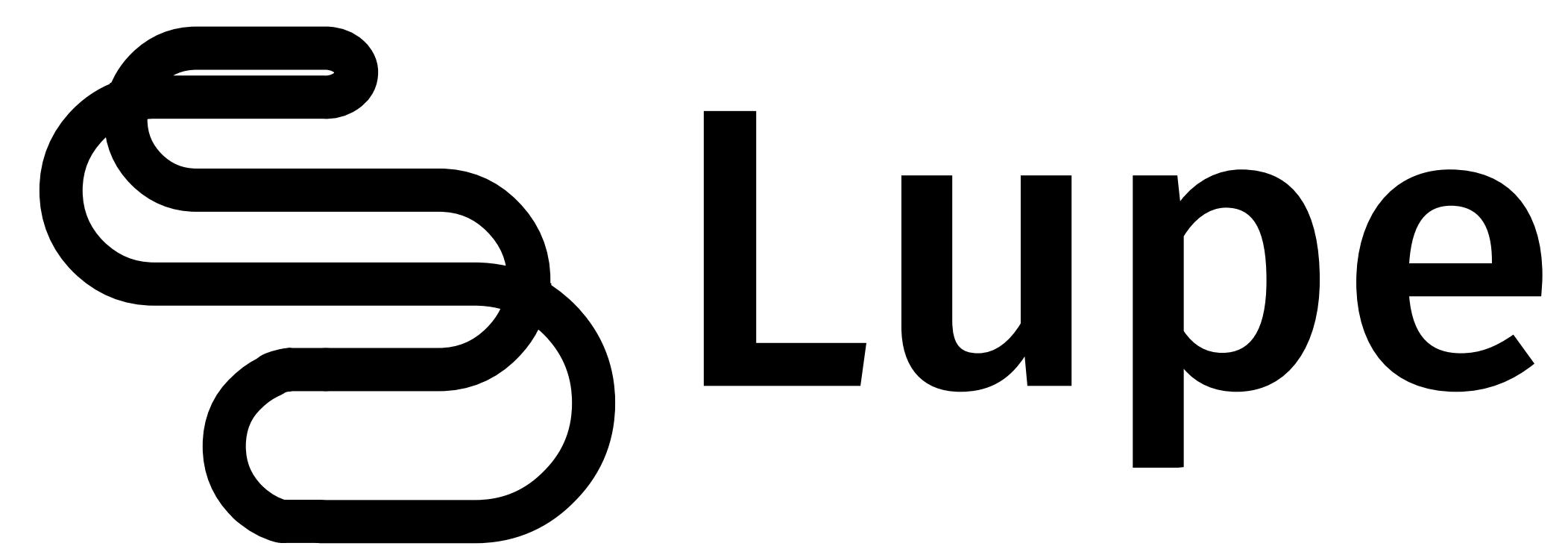
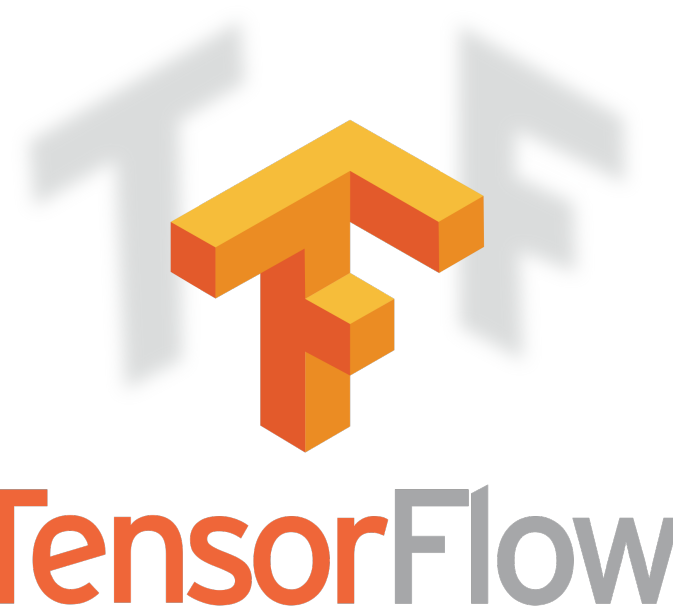
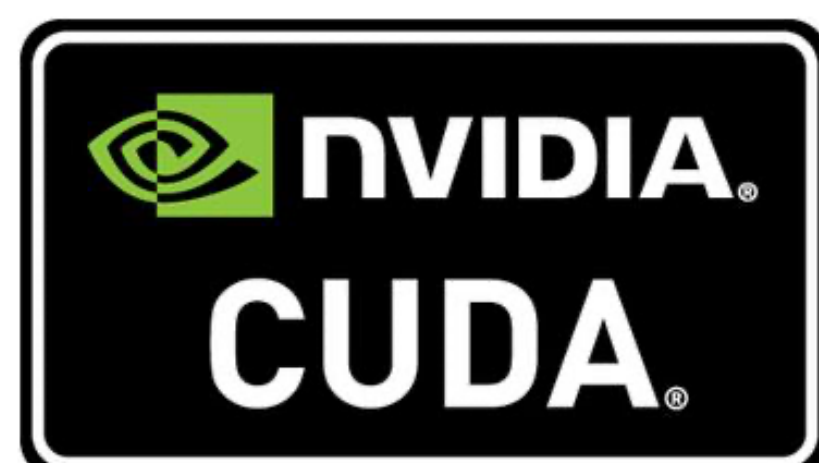
Purpose

Back pain is the **#1 cause of workers compensation and missed days in the workplace (\$13.7B annually)**.

At any time, over 20% of the world suffers from it. Current solutions to mitigating back pain involve extensive training or personal monitoring, which is expensive and doesn't scale.

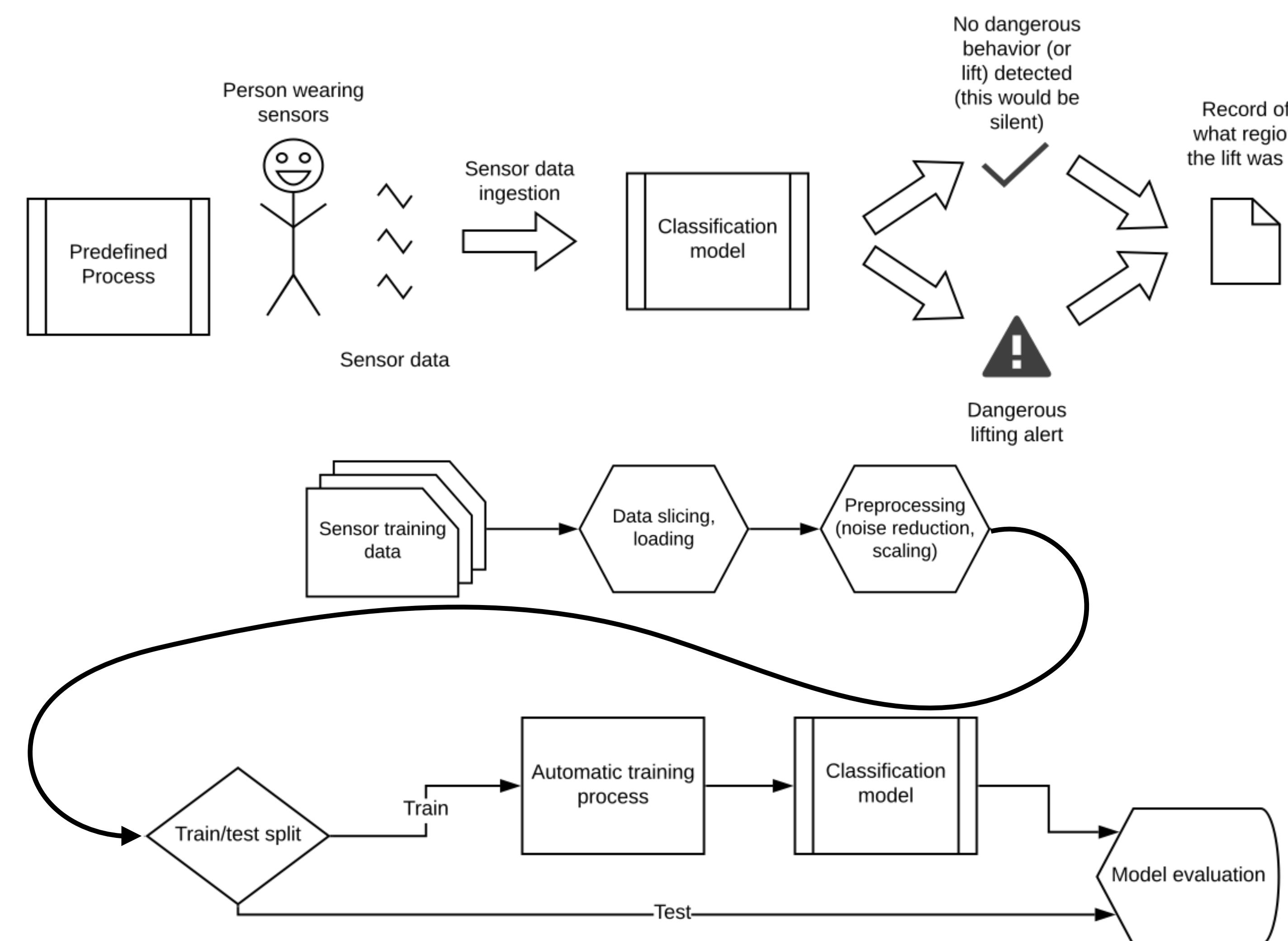
An automated solution is both relatively inexpensive and reduces the feedback loop for workers to immediate instead of when the pain happens, which can be days or weeks afterward.

Tools



Lifting risk detection for the workplace

Architecture



The system in practice is relatively simple: 30-second slices of time are fed into the model that output whether the lift is relatively risky. The training process has multiple steps, but revolves around preprocessing, splitting the dataset into training and testing sets, and finally evaluating it on the test set.

Challenges

Model development - specific activity recognition is largely a new field and existing approaches didn't work in most cases.

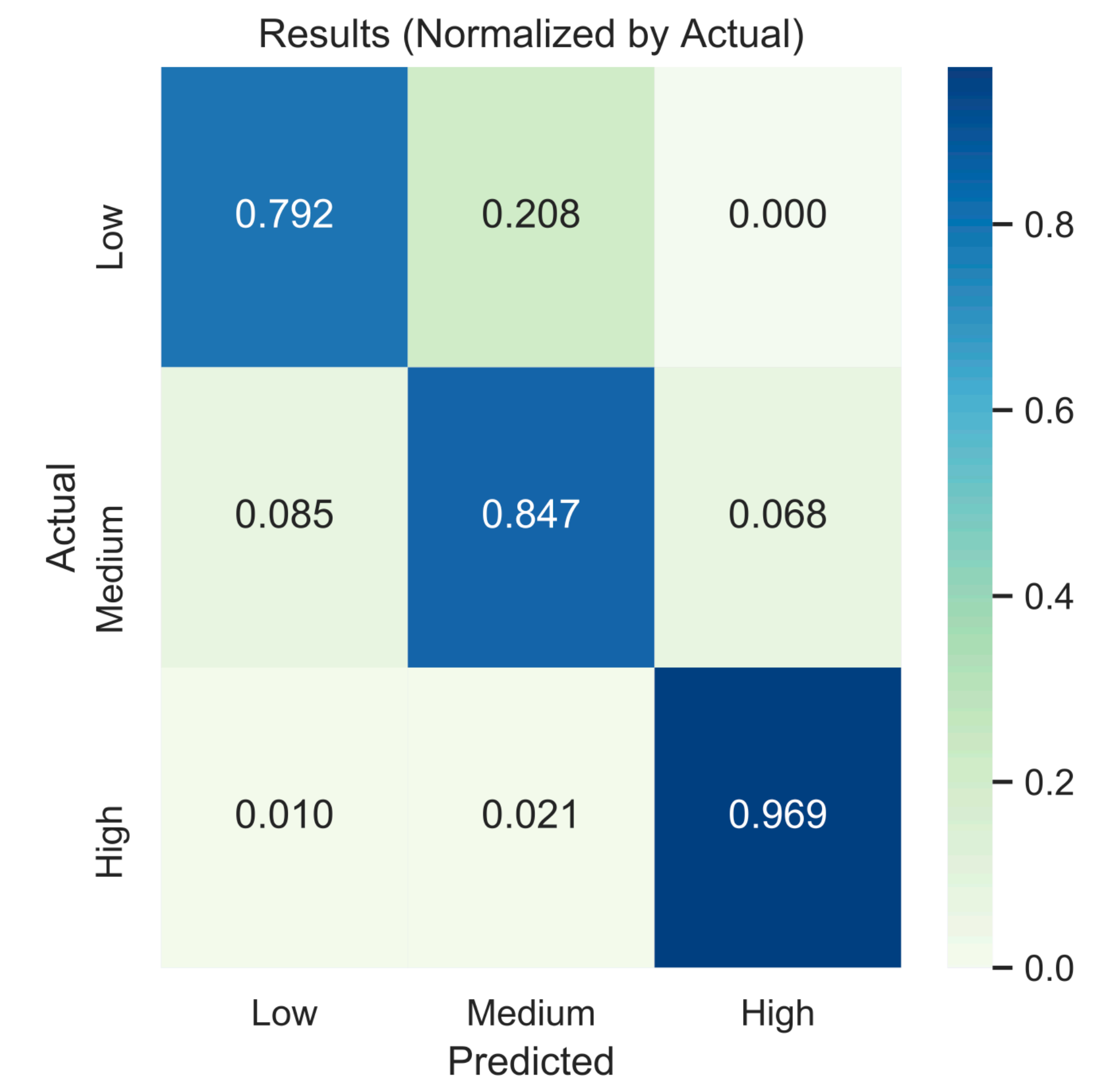
Determining whether the model was truly working - it was very easy to simply accept that high performance meant it was doing a good job.

Preprocessing the data - wanted to keep it simple and, ideally, done in far less than real-time.

Advancements

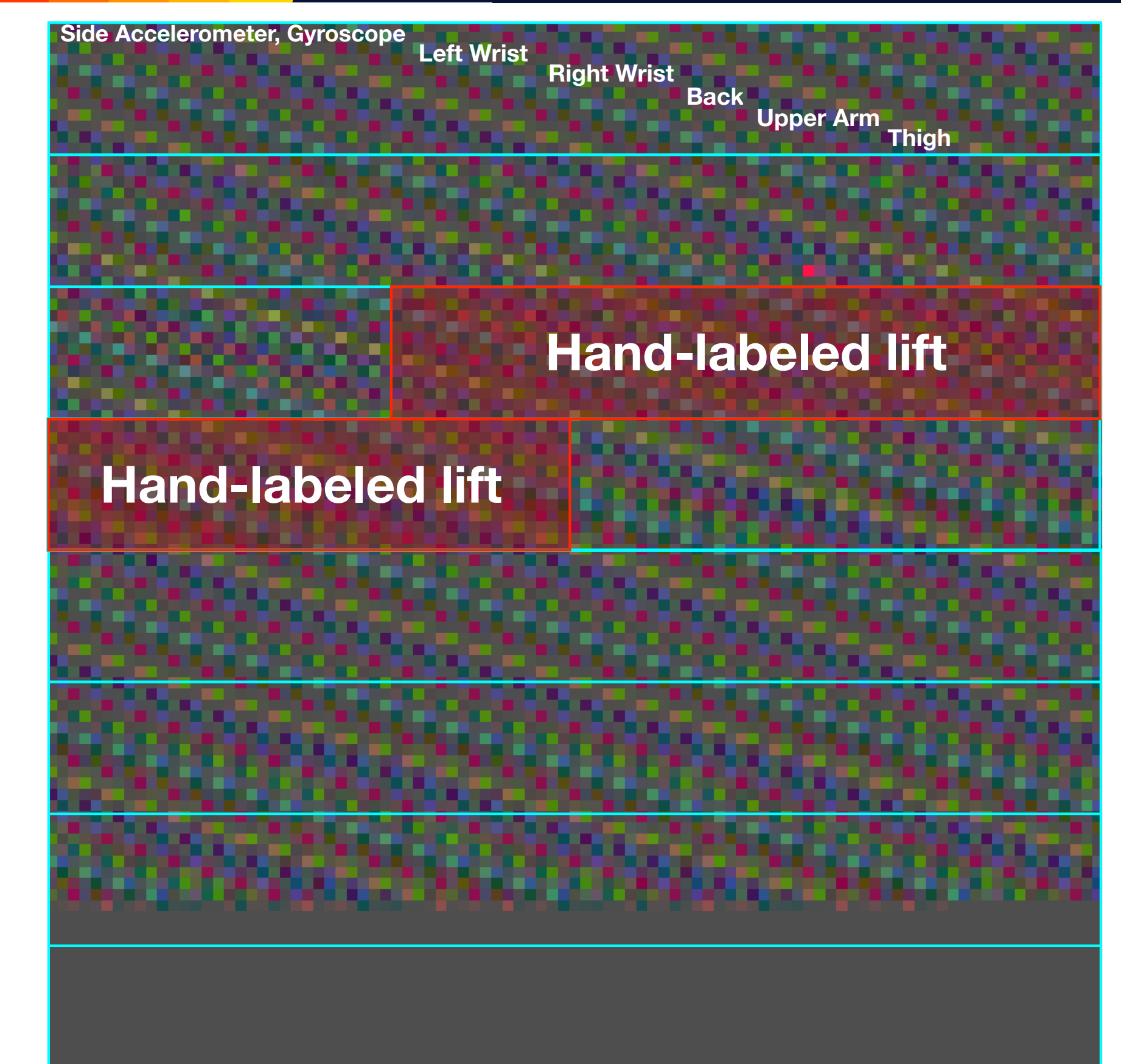
Lupe represents the development of a new way to classify activities with convolutional neural networks. It can significantly lower the barrier to niche human activity recognition (HAR) due to its use on a relatively small dataset (under 750 trials). Lupe is a system that, ideally, will further democratize HAR and also provide real-time safety for workers to reduce their chance of occupational injury.

Results



Lupe achieved 90.6% testing accuracy, correctly identifying 96.9% of high-risk lifts, 84.7% of medium-risk lifts, and 79.2% of low-risk lifts. It misclassified zero low-risk lifts as high-risk and only a single high-risk lift as low-risk, which are the most important misclassifications in practice.

Ex. Lift



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