

CASE STUDY

Expanding a Human Pose Dataset to Augment a Manufacturing Vision Platform



A Vision Platform that Ensures Safety and Productivity

One of the most pressing questions for manufacturing workers and employers centers around safety: How does a workplace keep employees safe as they work with heavy machinery, tools, and assembly items? This question then becomes one of efficiency: How does a workplace supervise dozens, even hundreds, of cameras to ensure workers are safe and productive?



These are problems that Invisible AI solves. Invisible AI, an Austin, Texas-based company, automates factory supervision with an AI-powered visual monitoring system. In other words, Invisible AI's products track human motion to help workers operate more safely, efficiently, and accurately. For example, one Invisible AI product instantly detects and alerts supervisors if a worker is using incorrect form to lift heavy items. Another product mistake-proofs processes so that common assembly mistakes are caught and fixed before it causes costly rework.

At the core of this software solution is a human pose dataset that Alegion customized to Invisible AI's computer vision model by adding millions of labels.

Machine Learning Magic, aka Expanding Pose Estimation Datasets

To develop its software, **Invisible AI** used a publicly available pose estimation dataset, **COCO**, which is based on 250,000 data points. The dataset enabled the company to attain a high level of accuracy with a weighted **f1 score** of 0.74.

To augment the model accuracy further—with a goal of attaining an unparalleled accuracy in its product category—Invisible AI computer vision engineer Stephen Welch enlisted the help of Alegion. “We had our own basic data labeling software—most companies do—but after a while it didn’t make sense for us to do it in house. It wasn’t the best use of time and money, so we sought out a data labeling service that could get us to the next level of performance,” said Welch.

The original open source dataset did not capture the complexity of auto manufacturing environments. For Invisible AI's model to understand edge case scenes, like where a human was partially obscured by a car part, the model needed more labeled human pose data in the target environment, along with different lighting conditions and from different angles.

Alegion's Data Labeling Solution for Manufacturing Software

To begin the video annotation process, Alegion data scientists first determined the following requirements:

- 1** An annotation density of every third frame would suffice in combination with entity persistence and object tracking to automatically label all frames in between the manually annotated frames.
- 2** In the workflow, 17 key points were annotated to capture the full body skeleton. An inclusion threshold was set at 50% visibility, meaning that humans were annotated if their bodies were at least 50% visible and larger than 200 pixels.
- 3** The ontology would comprise of key body parts: right ear, left ear, right eye, left eye, nose, right shoulder, left shoulder, right elbow, left elbow, right wrist, left wrist, right hip, left hip, right knee, left knee, right ankle, left ankle.
- 4** Alegion pre-processed footage to mark annotation frames for annotators, trained annotators to use key point visualization tools, and identified two workflow stages for maximum efficiency.

Throughout the process, Alegion proved to Invisible AI that it was a highly flexible annotation partner. "Alegion was the right partner because of the great customer service. When I had a question for our Alegion project manager, I would get a response in 5 minutes," said Welch.

A Highly Tuned Model Combining Labeled Data with Great Architecture

The Invisible AI Weighted Limb f1 Score

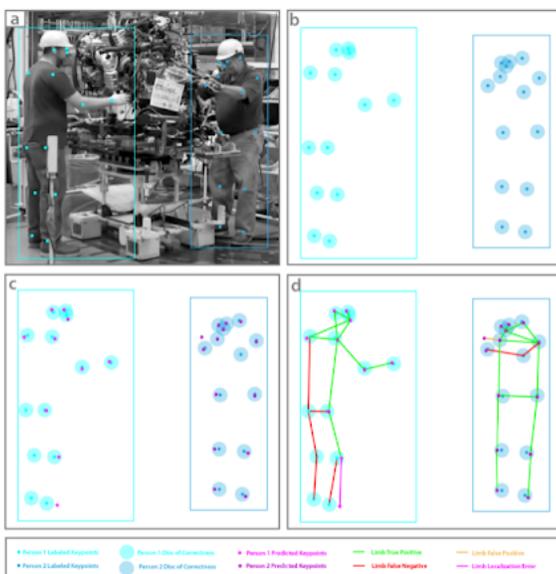


Figure 1. Invisible AI Weighted Limb f1 Score. Source: https://www.youtube.com/watch?v=h_uu1n7cOU

Welch compares ground truth data with the model's new output in his Medium article, "How good is Invisible's AI, really?"

With the help of Alegion's global workforce of annotators, project managers, and data experts, Invisible AI received 3,432,000 labels for its open source data points in just 11 months. The resultant 79% accurate pose estimation model contributes to a vision platform that is 98% accurate overall. To find the change in model performance, Welch compared ground truth data with the model's outputs, finding a 4% increase in F1 score from 0.74 to 0.79.

Invisible AI estimates that Alegion's data labeling services saved the company years of time. "Annotating data yourself is a huge time sink. Alegion gave us back approximately 10 years of time to focus on our core strengths in machine learning model design and development," said Welch.

Advanced Datasets Return a Market Advantage

Invisible AI's highly performant vision platform has been able to gain market advantages since its data re-training. Not only does the manual work tracking software increase retention due to a lower risk of injury and new career opportunities, but it also creates accurate and efficient workplaces with higher quality output and, in turn, greater profits.

For example, factories that use robot arms can use Invisible AI's technology to monitor the accuracy of robot assembly. Together, this automated workforce and automatic supervision can relieve workers of doing tedious, repetitive tasks and instead, use these same workers for higher level, problem-solving roles that require human subjectivity. With the US's ongoing **shifts in labor**, using AI to ease fatigue and staff turnover is more important than ever. Invisible AI's machine learning technology, trained on Alegion-labeled datasets, makes its product attractive to not only manufacturers, but also human capital supply chain experts.

A Continued Data Labeling Partnership in a World of Change

As a result of Alegion's results-proven approach and responsive service, Invisible AI plans to continue partnering with Alegion to launch new training data projects as well as maintain existing ones. In the case of maintaining existing models, Alegion supports clients by labeling new datasets to help prevent model drift caused by a shift in visual inputs. For Invisible AI, this may mean labeling additional publicly available footage of new assembly processes, different safety gear, new products, and new machines to keep existing models at peak performance.

As machine learning and the world around it develops, Welch is part of a new frontier of engineers who believe the future of AI lies in high quality data. "There was this belief that model performance would get better as long as you pump in more data, but it's more about the quality. We are using a proven deep learning process that relies on a sizable—but not infinite—amount of data. For us, Alegion is a key part of that process."

Alegion offers data labeling services for software, manufacturing, and many other industries. To learn more about how Alegion **Fully Managed Services** or the **Alegion Labeling Platform** can address your high-volume labeling needs, **request a consultation** with a data expert.

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