EDGE AI SOLUTION FOR INDUSTRY 4.0

Real-time Helmet Detection
REAL-TIME HELMET DETECTION

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**WHAT IS INDUSTRY 4.0?**

Industry 4.0 represents the fourth industrial revolution, but more specifically refers to the currently ongoing digital transformation in industries. Unique from its preceding industrial revolutions, Industry 4.0 focuses on an information driven interconnectivity between people, devices, and systems, which is used to enable enhanced decision making in industrial processes.

**BENEFITS OF INDUSTRIAL 4.0**

1. **Improved Operational Efficiency**  
Automated processes with Industrial IoT-enabled machine to machine communication also reduces the need for operator intervention, allowing engineers to instead focus on optimisations and improvements.

2. **Faster Improvement Cycles**  
Real-time and historical data from edge Industrial IoT devices allows process supervisors to respond to operational demands, such as promptly dealing with supply bottlenecks or under-utilised resources.

3. **Reduced Operational Down Time**  
Maintenance can occur predictively and in a timely manner, which reduces operational down time while avoiding collateral damage associated with complete component failures.

4. **Enhanced Industrial Safety**  
Workplace safety is another key area that Industrial IOT strives to improve. By using automated inter-communication and fail safe sensors, we can ensure that high risk tasks are followed according to procedure, or are automatically aborted if a risk of human injury is detected.

**EDGE AI AND IOT HELP ENHANCE INDUSTRIAL SAFETY**

With Edge AI, IoT devices are becoming smarter. What does that mean? Well, with machine learning, edge devices are now able to make decisions. They can make predictions, process complex data, and administer solutions. For example, edge IoT devices can process operating conditions to predict if a given piece of machinery will fail. This allows companies to perform predictive maintenance and avoid the larger damages and costs that would have been incurred in the event of a complete failure.
Safety, always the central concern to the industrial environment, can be enhanced by edge AI. The Occupational Safety and Health Administration (OSHA) requires businesses to provide personal protective equipment (PPE) to protect employees from hazards that could cause injury, where OSHA Regulation 1910.135 states that employers should ensure that each affected employee wears a protective hard hat while working in areas where there is a risk of head injury from falling objects.

Edge devices embedded with AI are capable of monitoring PPE including hard hats compliance in the work environment in real-time and signaling any PPE violations to safety and maintenance. Computer vision combined with machine learning can automate the process of monitoring PPE compliance.

About Edge Impulse

Edge Impulse is the leading development platform for machine learning on edge devices, free for developers and trusted by enterprises. Get started today.

Edge Impulse made ML development easier. Combining compact power-efficient AI systems, the process to deploy the edge AI solving specific workplace safety needs becomes faster and more flexible.
**Hardware**

Seeed's reComputer edge AI devices based on NVIDIA Jetson Nano/Xavier NX system.

![reComputer J20, with Jetson Xavier NX module.](image)

**Get Started Quickly And Easily for Hard Hat Detection Deployment**

Follow our wiki tutorial, create an account at Edge Impulse, start from model training to final deployment. This project also has been publicly released. Clone the project, go through every step to get a better understanding. You can use it, modify it and integrate it into a complex application.

**Software**

- **Edge Impulse Studio** to upload dataset, acquire custom data, visualize the data, train the machine learning model and validate the inference results.
- Part of the Flickr-Faces-HQ (FFHQ), (under Creative Commons BY 2.0 license) to rebalance the classes in our dataset.
- **Edge Impulse Linux SDK** and **Edge Impulse command line interface (CLI)**.

* Train your custom model at Edge Impulse Studio

You can also clone this [Hard Hat Detection Github repository](#) for environment setting up and downloading datasets, however, we will more recommend you use Edge Impulse to build a custom dataset using a camera with Jetson Nano/Xavier NX edge devices or your PC. Therefore, the accuracy will much more match with real scenarios.
About Tryolabs

Tryolabs, leading platform for AI transformation with AI experts team of advisors, strategists, and engineers focused on making an impact with AI-powered solutions. For example, they AI solutions for:

- Monitoring helmet usage in different scenarios leads to useful insights to take preventive actions, saving time and resources. It is possible to monitor the usage of safety helmets in different environments from an edge device using state-of-the-art detectors, creating a more efficient and affordable alternative than the more ordinary and rough manual process.

- PPE compliance also includes gloves, masks, goggles, etc. Once you finish custom model training, you can also wrap everything into an image, directly deploy the full PPE detection pipeline right at the workplace. Contact us at edgeai@seeed.cc for more information for solution inquiry!

- Run Your Real-time Detection

The deployed edge AI devices can enable real-time monitoring of hard hats with respect to the work environment and can send alerts in case of any violations.

* send alerts in case of any violations of wearing hard hats

**Step further on particular application**

Regarding the particular scenario, we will more recommend you use a public dataset, combining a custom dataset at Edge Impulse studio. Therefore, the accuracy will much more match with real scenarios.

**APPLICATION 02**

**DETECTING SAFETY HELMETS IN REAL-TIME**

**Challenge**

Monitoring helmet usage in different scenarios leads to useful insights to take preventive actions, saving time and resources. It is possible to monitor the usage of safety helmets in different environments from an edge device using state-of-the-art detectors, creating a more efficient and affordable alternative than the more ordinary and rough manual process.

Please read full details for helmet detection solution at Tryolabs.

- Price Optimization
- Product Matching
- Predictive Maintenance
- Custom AI
The goal was to leverage Seeed reComputer edge AI device built with Jetson Xavier NX module, and develop a computer vision analytics solution that tackles a challenging task in today’s industry 4.0 field. Tryolabs have been working on predictive maintenance projects for a while now and love to dive into challenging projects that take AI solutions to the edge. If you have a business need that you think could benefit from AI on the edge, please don’t hesitate and contact tryolabs.com.

Hardware Components

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The model: YOLOv5

YOLOv5 is one of the most used algorithms for object detection. Not only is it capable of computing extremely accurate detections, but it also runs lightning fast, allowing its users to create real-time object detection applications. A YOLOv5 Medium architecture was trained to continuously monitor the use of safety helmets on construction sites and factories. The detector can locate the faces of the people on a frame and classify them into the categories of “helmet” and “no helmet”. Given that for a specific person on a video, this category should be highly correlated through consecutive video frames. Tryolabs’ open-source tracking library Norfair allows us to get a more robust and less noisy criteria for this classification. By leveraging video tracking, we implemented a system of votes using the label associated with several consecutive detections in order to make confidently decide if a person is wearing a helmet or not. Therefore, evidence for several frames is needed to classify each person. A single misclassified detection is not enough to change the category in which a person is placed.

The Dataset: GDUT-Hardhat Wearing Detection

Quintillions of bytes of data are created every day, and AI models are taking advantage of this fact. The number of images uploaded to the internet daily has made possible the existence of public datasets for a wide variety of applications. Of course, having access to these images is not the only requirement for creating a dataset, when working with supervised learning it also takes time and human effort to label each image with the right annotations so that our computers can recognize the patterns that we need them to learn.

Fortunately for us, public datasets are already available to distinguish faces with and without helmets, such as the dataset GDUT-Hardhat Wearing Detection, that we selected to use on this project. This dataset includes 3869 images, from which a subset of 2916 images is selected for the training set, another 635 images are chosen for validation, and the remaining 318 images are set apart for testing purposes.
Deploy And Optimize The Inference Pipeline with NVIDIA DeepStream

NVIDIA Metropolis framework and more precisely the DeepStream SDK toolkit allow the developers to build pipelines for AI-based video analytics, while also boosting development time and achieving an outstanding throughput for several applications, such as object detection, segmentation, and image classification.

By leveraging DeepStream SDK, the inference time was boosted to a staggering 0.012 seconds for each image (82.8 FPS) on the reComputer powered by NVIDIA Jetson Xavier NX.

* real-time inference with reComputer Edge AI devices with Jetson Xavier NX
NVIDIA Jetson™ is the world’s leading platform for autonomous machines and other embedded applications. Jetson is compatible with cloud-native workflows across NVIDIA platforms, and delivers the performance and power-efficiency for intelligent machine OEMs, start-ups and AI application developers who want to bring next-gen AI products to market.

NVIDIA® Jetson AGX Orin™ Developer Kit: Next-Level AI Performance for Next-Gen Robotics

The NVIDIA® Jetson AGX Orin™ Developer Kit is built with high-performance, power-efficient Jetson AGX Orin module, delivering up to 275 TOPS and 8X the performance of NVIDIA® Jetson AGX Xavier™ in the same compact form-factorand .

Jetson AGX Orin™ Developer Kit supports JetPack 5.0 will install Ubuntu 20.04 on Jetson AGX Orin. With the JetPack offered end-to-end AI pipeline acceleration, Jetson AGX Orin is made for next-gen autonomous machines for manufacturing, logistics, retail, agriculture, smart city, and healthcare.

Learn More at Seeed Studio →
SEEED FEATURED PRODUCTS FOR JETSON PLATFORM

reComputer powered by NVIDIA Jetson Nano/Xavier NX system, starting from $199.

reComputer are a series of hand-size edge AI devices built with Jetson Nano / Jetson Xavier NX product module. The device is built with rich set of IOs, aluminium case, passive heatsink, pre-installed JetPack System, ready for your next AI application development and deployment.

Seeed reServer and reComputer series come with Jetson production-grade System on Module (SOM) that includes a GPU, CPU, memory, power management, high-speed interfaces, and more. The devices also are pre-installed with the NVIDIA JetPack™ system for accelerating software-defined autonomous machines.

reServer: Powerful Inference Center at The Edge AI Center, with up to 275 TOPS AI performance

- Built with Jetson Xavier NX/ AGX Xavier/ AGX Orin
- Pre-installed Triton Inference Server and Jetpack
- Chill 24/7 with Vapor Chamber heatsink (AGX Orin only), - 40% more effective thermal performance
- Rapid network access and hybrid connectivity - 2.5Gbes, 4G, 5G, LoRa, BLE and WiFi (modules not included)
- Built-in storage for multiple concurrent AI application
- Rich IOs ready for AIoT - USB 3.2 Type-A port, USB 2.0 Type-A port, HDMI port and DP port

• Edge AI box fit into anywhere
• Embedded Jetson Module
• Pre-installed software for click-to-deploy
• Rich set of IOs
• Stackable and expandable

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Edge Box
JOIN SEEED EDGE AI PARTNER PROGRAM

Faster, flexible, scalable AI deployment for everyone. We aim to cover all kinds of AI scenarios at our open-source platform to accelerate industries' AI transformations. We are looking forward to leveraging local and global resources to accelerate next-gen AI product together with you.

Apply Here

Please contact cooperation@seeed.cc for more partnership information.

Transform Your Business Delivering Real-World AI Together

Integrate your unique AI technique into our current hardwares: resell or co-brand licensed devices at our channels.

Build your next-gen AI product powered by the NVIDIA Jetson module and bring your product concept to the market with Seeed's Agile Manufacturing 0-∞.

Co-inventing with Seeed

Combining our partners' unique skills and Seeed's hardware expertise, let's unlock next AI ideas powered by Seeed's wide selection of hardware for proof-of-concept from Edge devices, Carrier boards, LiDARs, Cameras, and Rich Extension boards compatible with NVIDIA Jetson Platform.

Enjoy Seeed’s benefit as Edge AI Inventor:

- Free Jetson powered devices opportunity
- Early access to the latest hardware
- Exclusive discount for Seeed hardware

Work With Seeed Amazing Ecosystem Partners
Seeed studio

Edge AI Solution for Industry 4.0