CASE STUDY: AI-Driven Industrial Safety for Roller Mills

Transforming Tire Manufacturing Safety from Reactive to Predictive

1. Executive Summary

A **large global tire manufacturer** with production facilities across the globe sought to eliminate the high risk of hand injuries associated with **roller mill machines**. Despite old safety measures like emergency buttons, the manufacturer required a proactive, "intelligent" layer of protection. By partnering with **ManoMotion**, they implemented the **SaferHands™** platform.[1][2][3] After a successful pilot and custom AI fine-tuning, the solution is now in production and being scaled horizontally across **20 machines** in the facility, setting a new global benchmark for "Zero-Accident" safety standards.

2. The Challenge: High-Risk Interaction in Rubber Milling

Roller mills are critical in the tire industry for mixing and warming rubber compounds. However, they are inherently dangerous:

- **The Hazard:** Operators must manually feed or adjust rubber near high-torque rotating drums (pinch-points).
- **The Failure of Traditional Safety:** Physical barriers (fences) often impede productivity, while reactive systems (light curtains or belly bars) only trigger *after* a person has already entered the danger zone or sustained contact.
- **The Goal:** The Manufacturer needed a solution that could understand human intent—distinguishing between the rubber material and the operator's hands—and stop the machine *before* contact occurs. The solution must be reliable for detecting both bare hands and specific type of industrial gloves used by the manufacturer.

3. The Solution: SaferHands™ Edge-AI Platform
ManoMotion's **SaferHands™** was selected for its ability to run sophisticated hand-tracking AI on lightweight, edge-based hardware without requiring cloud connectivity.
Key Components:

- **Hardware:** Industrial-grade RGB sensors connected to an **NVIDIA Jetson** edge processor.
- **Software:** Proprietary AI/ML models capable of 3D hand skeleton tracking.
- **Virtual Safety Zones:** The operator can define "Warning" and "Danger" zones around the mill's working area. If a hand enters this regions, the system communicates directly with the machine's PLC via digital I/O.

4. Technical Journey: From Data to Deployment
The project followed a three-step technical path to ensure "Factory-Grade" reliability:

- **Phase 1: Installation & Ambient Data Capture**
  The SaferHands™ unit was installed on a primary roller mill. During initial operations, the system was set to "Passive Mode," recording video samples of standard operator behaviors, rubber movements, and varied lighting conditions. SaferHands comes with two industry grade cameras for reliable detection of hands from different angles in occluded scenarios.
- **Phase 2: AI Fine-Tuning & Customization**
  ManoMotion's engineering team used these real-world video samples to fine-tune the neural networks. This ensured the AI could perfectly identify the specific **gloves** used by the staff and ignore the complex, moving textures of the **rubber compounds**.
- **Phase 3: Millisecond-Level Response**
  The optimized model was deployed back to the edge. The system now achieves an ultra-low latency of less than 20ms, allowing it to trigger an emergency stop faster than human reaction time.

5. Results & Commercial Rollout
The pilot machine is now fully operational and integrated into the factory's safety ecosystem.

- **Zero Accidents:** No hand-related injuries or near-misses have occurred on the pilot machine since activation.
- **Increased Productivity:** By replacing bulky physical guards with "Virtual Zones," operators have better visibility and ergonomics, leading to smoother workflow.
- **Scale-Up:** Based on the success of the pilot, the Manufacturer has moved to **Horizontal Implementation**, with orders to equip **up to 20 additional roller mills** within the facility.

6. Installation and Integration timeline

- Installation of the SaferHands unit including the processing unit and cameras - plug and play including the standard software package.
- Additional on-site data collection - Few hours of recording with the embedded software features
- Fine-tuning and software update with additional data - 2 weeks
- Additional glove support - 1 month including data collection and software update

7. Why This is the Next Generation of Safety

This implementation proves that vision-based AI is the future of industrial safety for all milling and high-risk industries.

1. **Hardware Agnostic:** Can be retrofitted onto machines that are old.
2. **Predictive, Not Reactive:** It doesn't wait for a cord to be pulled; it sees the danger coming.
3. **Regulatory Compliance:** compatible with industry standards and compliant with the latest global safety standards and AI regulations.