Tech Brief

“Assembly Optimization”

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Introduction

Industry 4.0 Accelerator

The mission of the industry 4.0 Accelerator is to accelerate manufacturing adoption of industry 4.0 technologies to increase their global competitiveness. To achieve this mission, the industry 4.0 Accelerator helps manufacturers articulate their problem statements and identify solutions to address those problems. We do this by identifying, vetting and curating technology from around the world and making them accessible to manufacturers.

Tech Briefs

Tech briefs provide clarity on emerging categories of industry 4.0 solutions. Based on our experience, manufacturers have difficulty understanding the emerging technologies and evaluating the plethora of solutions available. Given this, it can be difficult to understand which solutions to evaluate as well as the dimensions of comparison. Tech briefs help explain emerging categories, describe benchmark solutions, explain the ways in which they are similar and highlight their points of differentiation.

Assembly Optimization

Assembly optimization is an emerging industry 4.0 solution category. It represents a comprehensive solution for modern manufacturing needs, leveraging advanced technologies to drive efficiency, quality, and agility in production processes. Assembly optimization helps operators and engineers become more efficient by enabling optimization, continuous time and motion studies, and real-time data collection through computer vision of streaming video and application of advanced analytics.

Benefits of Assembly Optimization

Operator Safety

By optimizing assembly processes, ensuring adherence to standardized work, and improving training with video, assembly optimization can reduce safety incidents.

Improved Efficiency

By using computer vision and AI, assembly optimization can optimize time and motion studies, leading to increased efficiency on the production floor. It helps operator and engineers get more done with less effort, streamlining processes and reducing waste.

Data Collection and Analysis

Assembly optimization enables the collection of valuable data that can be analyzed to gain insights into operations, identify areas for improvement, and track performance metrics.

Quality Control

By visually monitoring assembly processes, assembly optimization can help maintain high quality standards by detecting errors, deviations, or inconsistencies in real-time. This proactive approach to quality control can prevent defects and ensure product integrity.

Root Cause Analysis

Assembly optimization facilitates root cause analysis by providing visual evidence of issues or disruptions in production. This helps in identifying the underlying causes of problems and implementing corrective actions to prevent recurrence.

Training and Compliance

Video-based training materials and digital work instructions can be created using assembly optimization, improving training processes for new employees and ensuring compliance with standard operating procedures across the manufacturing facility.

Remote Monitoring and Collaboration

Assembly optimization enables remote monitoring of manufacturing processes, allowing supervisors to view operations from anywhere. This remote access promotes collaboration, decision-making, and problem-solving without the need for physical presence.

Cost Reduction

By optimizing processes, improving quality control, and reducing downtime through efficient maintenance practices, assembly optimization contributes to cost reduction in manufacturing operations. It helps in maximizing resource utilization and minimizing operational expenses.

Target Industries & Applications

Automotive Manufacturing

Automotive manufacturers use this solution to monitor assembly lines, optimize their assembly processes, detect defects in components, improve productivity, and improve quality control.

Electronics & Semiconductor Manufacturing

Manufacturers of electronics leverage this solution to inspect circuit boards, analyze chip manufacturing processes, enhance assembly line efficiency, detect defects, and ensure compliance with quality standards.

Aerospace & Defense

The aerospace and defense sectors utilize this solution for monitoring aircraft assembly, inspecting critical components, managing supply chain operations and enhancing maintenance processes to improve assembly accuracy, safety, and compliance with industry standards.

Pharmaceuticals & Life Sciences

Pharmaceutical companies rely on manufacturing software for monitoring drug production, ensuring compliance with regulatory requirements, optimizing batch processes, and maintaining product quality.

Consumer Goods and Retail

Industries producing consumer goods such as appliances, furniture, and machinery can use the solution to streamline assembly workflows, enhance product quality, and reduce production costs.

Industrial Machinery & Equipment

Manufacturers of industrial equipment and machinery utilize the software to improve assembly processes, minimize downtime, and increase overall equipment effectiveness (OEE).

Medical Devices

Manufacturers of medical devices use these solutions to ensure precise assembly of medical equipment, comply with regulatory requirements, enhance product reliability and safety.

Packaging & Printing

Companies in the packaging and printing industry utilize the software for workflow automation and production optimization in printing and packaging operations.

Heavy Equipment & Machinery

Industries involved in the production of heavy equipment, machinery, and industrial tools can benefit from the software's ability to optimize assembly procedures, reduce errors, and improve operational efficiency.

Manufacturing & Engineering Services

Service providers offering manufacturing and engineering solutions can use the software to enhance their clients' assembly processes, deliver value-added services, and drive continuous improvement initiatives.

Technology Stack

Like many industry 4.0 solutions, assembly optimization includes the integration of both operating and information technology to create cyber-physical systems which can solve production problems. The following is a list of the technologies which are often a component of assembly optimization solutions.

Computer Vision

Computer vision technology is crucial for recording and analyzing video footage and images captured from the manufacturing environment. This can involve image processing libraries, object detection algorithms, and video analytics tools that enable the software to identify objects, detect patterns, and track movements, which is essential for monitoring assembly processes and identifying issues. Hardware can include various types of cameras, such as smartphones, GoPros, or tablet PC cameras.

Artificial Intelligence (AI) & Machine Learning (ML)

AI and ML algorithms play a vital role in processing the data collected through computer vision. These algorithms can learn from the data, make predictions, detect anomalies, and analyze historical patterns and real-time inputs to identify inefficiencies, bottlenecks, and areas for improvement within manufacturing processes.

Industrial Internet of Things (IIoT) & Sensors

IoT sensors may be integrated into the solution to capture real-time data from machinery, equipment, and assembly line processes. This data can be used for monitoring performance, detecting issues, and optimizing workflows.

Edge/Cloud Computing

Edge devices at the assembly line can perform local data processing and analysis, reducing latency and improving responsiveness. While edge computing handles local processing, cloud computing infrastructure is typically used for storing and analyzing large volumes of data collected from multiple manufacturing sites. Cloud computing offers scalability and flexibility.

Augmented Reality (AR) and Mixed Reality (MR)

Depending on the application, AR and MR technologies may be integrated into the software to provide augmented views, interactive instructions, and virtual assistance for assembly tasks.

Data Analytics & Visualization Tools

The software utilizes data analytics techniques to extract actionable insights from raw data. Visualization tools such as dashboards, charts, and reports are then used to present these insights in a user-friendly format, enabling stakeholders to make informed decisions.

Data Management & Security

Robust data management systems are often required to handle large volumes of video data, AI models, and user-generated content. Data management processes ensure data security, integrity, and accessibility for analysis and decision-making.

Natural Language Processing (NLP)

NLP techniques may be used for textual data analysis, such as interpreting work instructions, generating alerts, and providing descriptive analytics based on text inputs. Large Language Models (LLM) can be used internally for NLP tasks. These LLMs assist in generating insights, recommendations, and actionable suggestions based on analyzed data and user interactions.

Workflow Automation

The software includes workflow automation features to streamline assembly processes, automate tasks, and guide workers through step-by-step instructions. Robotic Process Automation (RPA) may also be part of the automation framework.

Integration APIs

Assembly Optimization solutions often offer integration capabilities through APIs (Application Programming Interfaces) to connect with existing manufacturing systems, Enterprise Resource Planning, Manufacturing Execution Systems, and other industrial equipment. This integration with existing manufacturing systems, databases, and tools help to streamline data flows and facilitate seamless collaboration across teams.

User Interface (UI) & Experience (UX)

Assembly optimization software includes a user-friendly interface with intuitive dashboards, interactive tools, and customizable reports. The UI/UX design enhances user experience, simplifies navigation, and facilitates data interpretation for engineering and production teams.

Solution Providers Overview

Profile

Invisible AI was founded in 2018 and is headquartered in Palo Alto California. Eric Danziger is Co-Founder and CEO. Target industries include automotive and aerospace. Invisible AI has raised $21.6M.

Elevator Pitch

Invisible AI is a computer vision platform that helps manufacturers improve manual operations. Invisible AI uses real-time video and AI to analyze manual assembly tasks. This data is then used to improve production efficiency, support line rebalancing efforts, and reduce safety and quality incidents.

Tech Stack

Invisible AI offers state-of-the-art Edge AI devices with an Intel RealSense 3D Camera, and NVIDIA AI chipset, and up to 4TB SSD for on-site storage and processing without bandwidth. Invisible AI devices only require 1-3 examples of a process for deployment, unlike other computer vision vendors. Invisible AI's corresponding software platform is easy to configure and offers enterprise-grade solutions, including Ergonomics Monitoring, Root-Cause Analysis, Automated Time & Motion Studies, Automated Spaghetti Diagrams, Advanced Analytics, and more.

Summary

Invisible AI offers a comprehensive suite of benefits ranging from efficiency improvements and cost reduction to workforce empowerment, safety enhancement, scalability, user-friendliness, and support for continuous improvement. These benefits collectively contribute to optimizing manufacturing operations, driving business growth, and maintaining a competitive edge in the industry.

What differentiates Invisible AI?

State-of-the-Art Hardware Devices

Invisible AI's hardware devices include a 3D camera, an NVIDIA AI chipset, and up to 4TB SSD for on-premise storage and processing. Our on-premise devices allow for improved customer privacy and faster processing without bandwidth.

Scalability & Deployability

Unlike other computer vision vendors, Invisible AI's tech stack is extensively pre-trained to detect and track people and objects of interest right out of the box. This allows us to deploy our solution very quickly, requiring only 1-3 examples to learn a process.

Enterprise Grade Platform

Invisible AI has deployed solutions in the best enterprise-scale manufacturers in the world. Their platform has been analyzed and tested extensively for accuracy, security, scalability and reliability.

Computer Vision Expertise

Invisible AI's engineering team studied computer vision and AI in the best schools in the world. Invisible AI's deployment team has come from the best manufacturers in the world. This mix of talent offers the ideal combination of technological, industrial, and operational expertise for the development and deployment of advanced technologies in manufacturing.

Cost Reduction

Invisible AI helps companies reduce costs associated with labor utilization, resource allocation, and operational inefficiencies. By identifying opportunities for workload balancing and process optimization, Invisible AI assists in lowering overall production costs while maintaining or improving output quality. Invisible Ai also lowers costs through streamlined root-cause analysis and proactive ergonomics monitoring, thereby reducing quality and safety incidents on the floor.

Automated Time and Motion Studies

Invisible AI automates data collection and spaghetti diagrams for time and motion studies, providing unbiased insights for industrial engineers. Use this data for kaizen prioritization, before/after comparisons, line balancing, and more.

Streamlined Root Cause Analysis

Leverage Invisible AI's advanced traceability features for investigations. Our precision search can trace any part ID or serial number and surface video footage of the product life cycle through all its workstations. Save and download videos to use for evidence or training.

Standard Work Adherence

Invisible AI algorithms flag deviance from standard work processes to help manufacturers identify training opportunities and proactively address bottlenecks, micro-stops, and missed steps.

Proactive Ergonomics Monitoring

Invisible AI's edge deviance from standard work processes to help manufacturers identify training opportunities and proactively address bottlenecks, micro-stops, and missed steps.

In-Depth Analytics and Smart Insights

Intuitive dashboards, customizable reports, and collaborative tools ensure that users can efficiently navigate the platform, interpret data insights, and take actionable steps.

Continuous Improvement

By providing real-time feedback, performance metrics, and trend analysis, Invisible AI helps companies continuously monitor and optimize their operations. This iterative approach ensures ongoing enhancement of processes, productivity, and overall business performance.

Profile

Retrocausal was founded in 2018 and is headquartered in Seattle, WA with satellite offices in Kalamazoo, MI and Dallas, TX. Dr. Zeeshan Zia is the CEO. Target industries include automotive, medical devices, appliances, electronics especially large contract manufacturers, and aerospace. Retrocausal has raised $15.2M.

Elevator Pitch

Retrocausal is the industry leader in intelligence augmentation systems that give superpowers to assembly operators, plant managers, and industrial engineers to dramatically boost the productivity, quality, and safety of shop floor processes. Retrocausal employs cutting-edge generative AI in the form of its Copilot software to elevate low-skilled labor to take on high-skilled and sophisticated tasks.

Tech Stack

Retrocausal’s tech stack comprises their proprietary and patented AI foundation models, real-time data processing, video analysis using computer vision, prescriptive analytics algorithms, cloud infrastructure, mobile integration, web-based portal development, integration with existing systems, and robust data storage and management capabilities.

Summary

Retrocausal is based on *LeanGPT*™ AI Foundation models, which leverage video, text, and sensor data to understand manufacturing assembly processes. Assembly *Copilot*™ provides real-time alerts to assembly workers, helping them avoid mistakes and improve productivity, and integrates with MES systems as well as PLCs and a variety of smart tools. *Kaizen Copilot*™ offers prescriptive analytics and instructions to optimize processes, improve efficiency, and reduce errors. The software is positioned as a process management platform, focusing on real-time proces monitoring, prescriptive analytics, video traceability, and actionable recommendations distinct from generic language models like ChatGPT.

What differentiates Retrocausal?

Prescriptive Analytics

Retrocausal emphasizes its use of prescriptive analytics within its solution. This means that the software not only provides descriptive analytics, but also offers actionable insights and recommendations on how to improve processes. This focus on prescriptive analytics goes beyond just providing data to actively helping users optimize their workflows.

Real-time Guidance

Retrocausal's solution includes real-time guidance for workers during assembly processes. This feature allows workers to receive immediate feedback and alerts if they make mistakes, helping them correct errors promptly and improve efficiency. This real-time guidance sets Retrocausal apart from competitors that focus solely on providing instructions without real-time feedback.

Video-Based Analysis

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Automated Time and Motion Studies

Retrocausal automates time and motion studies without the need for manual training of machine learning models or extensive labeling of video data. This automation further streamlines the process of analyzing assembly tasks, identifying bottlenecks, and suggesting optimizations. Their solution also accelerates predetermined motion time study including *MODAPTS, MTM-1, and MOST.* In addition, Retrocausal provides *Automatic Line Balancing (AB)* functionality, again, coupled with automatic strategic alternative line balances.

Ergonomics Capabilities

Invisible AI automates data collection and spaghetti diagrams for time and motion studies, providing unbiased insights for industrial engineers. Use this data for kaizen prioritization, before/after comparisons, line balancing, and more.

Integration and Compatibility

The software integrates seamlessly into existing workflows and systems, providing compatibility with PLC systems and other industrial equipment. This is a significant advantage for manufacturing environments seeking a unified platform rather than multiple disjointed tools.

Profile

Khenda was founded in 2021 and is headquartered in Turkey with a US Office in Ann Arbor, MI. Aykan and Cagkan Ekici are the co-founders. Target industries include automotive and appliances. Khenda has raised $1M in venture capital.

Elevator Pitch

Khenda is an AI-Powered Continuous Improvement Platform for the manufacturing industry to achieve operational excellence. Our solutions automize and digitize continuous improvement activities to minimize waste and increase efficiency.

Tech Stack

Khenda’s technology stack combines vision technology, cloud computing, AI algorithms, data management, UI/UX design, customization capabilities, integration tools, and continuous improvement mechanisms to deliver a comprehensive and effective platform for manufacturing process optimization.

Summary

Khenda empowers manufacturing plants with data-driven insights, cost-effective solutions, and a worker-friendly approach, leading to enhanced efficiency, productivity, and operational excellence. Khenda's solutions incorporates mechanisms for continuous improvement, such as real-time feedback loops, performance monitoring, trend analysis, and adaptive AI models. These mechanisms support ongoing optimization efforts and enable agile responses to changing manufacturing dynamics. Khenda aims to increase efficiency, lower labor costs, optimize workload, and improve safety. Engineers can record processes using simple cameras like smartphones or GoPros, which are then uploaded to the platform. AI analyzes the video, highlighting areas for improvement.

What differentiates Khenda?

Limited Hardware Requirements

Unlike solutions that require extensive hardware installations, Khenda operates with minimal hardware needs. It only requires simple cameras like smartphones or GoPros for recording processes, reducing initial investment costs and deployment complexity.

Real-time Analysis

Khenda provides real-time analysis and actionable insights within 24 hours of uploading video recordings. This quick turnaround time allows teams to promptly address inefficiencies, make data-driven decisions, and implement optimizations without lengthy delays.

Worker-Friendly Approach

While traditional monitoring systems may raise concerns among workers about privacy and surveillance, Khenda's limited-time video recording and AI analysis create a worker-friendly environment, focusing on process improvement rather than individual performance monitoring.

Customizable Solutions

Khenda offers customizable solutions tailored to specific customer needs. Its AI algorithms can be fine-tuned with customer specific data, enabling personalized recommendations, analysis, and insights that align with unique manufacturing processes and challenges.

Scalability

Khenda's platform is scalable and adaptable to different manufacturing environments, production scales, and industry sectors. Whether a small or a large-scale production plant, Khenda's solutions can flexibility accommodate varying requirements and complexities.

User-Friendly Interface

Khenda features a user-friendly interface with intuitive dashboards, customizable reports, and collaborative tools. This ease of use ensures seamless integration into existing workflows, efficient navigation, and enhanced user experience for engineering and production teams.

Focus on Operational Excellence

Khenda's primary focus lies in operational excellence. Its AI-powered platform targets efficiency improvement, cost reduction, workload optimization, and process enhancement, aligning closely with manufacturing plants' core objectives.

Profile

Foxconn iAI was established in 2019 by Dr. Jay Lee as the industrial AI (iAI) division of Foxconn. The company is headquartered in Milwaukee, WI, and is led by Haotian Deng, Director of Operations. Foxconn iAI concentrates on exploring and adopting new technologies internally while also promoting Foxconn developed solutions externally.

Elevator Pitch

OPTIMO is a cutting-edge tool that leverages AI technology to go beyond traditional time and motion studies. It is capable of recognizing human motion, thereby digitizing manual operations and providing data and analysis 24/7. Unlike traditional measurement tools that offer only a snapshot, OPTIMO offers a full picture of manual operations, making it a valuable management tool.

Tech Stack

Foxconn's iAI technology stack likely comprises a combination of data science tools, AI/ML algorithms, computer vision capabilities, edge or cloud computing infrastructure, data security measures, and software development frameworks tailored for specific applications in manufacturing and operations optimization.

Summary

Foxconn AI possesses a team of in-house data scientists, AI experts and industrial engineers who are dedicated to developing innovative algorithms and solutions. They constantly improve these algorithms based on customer feedback and industry-specific requirements, with a focus on tailoring and optimizing them to meet the unique needs of each client. While the solution offers pre-trained models, it also allows for customization with customer datasets to ensure data security for local implementations.

What differentiates Foxconn iAI?

Access to User Feedback

Foxconn iAI possesses an internal manufacturing infrastructure where they can implement, test, and validate OPTIMO. They also have easy access to user feedback, enabling them to address real issues faced by both internal and external customers and provide a clear direction for product improvements. This user-centric approach helps them effectively cater to the needs of their customers.

Cost-Effective AI Deployment

Foxconn iAI prioritizes cost-effectiveness in AI deployment, optimizing their algorithms to reduce GPU requirements. This optimization enables edge and cloud-based solutions without requiring expensive hardware, making their solution more accessible to clients.

Customization & Adaptability

Foxconn iAI offers pre-trained models but allows for extensive cutomization with customer datasets. This adaptability ensures that their solution can be tailored to meet specific client needs, whether for productivity improvement, error log management, or efficiency enhancement.

Data Security

Foxconn iAI prioritizes data security, especially for local deployments. By ensuring that all training and analysis data remains within the clients firewall and by not accessing sensitive data, they provide a high level of security and privacy assurance.

Industry Expertise

Foxconn iAI leverages its extensive industry expertise, particularly in electronics manufacturing and contract assembly. Their knowlede and experience enable them to comprehend and tackle the distinct challenges faced by clients in these sectors. They offer customized solutions that drive significant improvements in operational efficiency.

Continuous Innovation

Foxconn iAI introduces features like factory overview for comprehensive visibility into operations and explores emerging technologies like generative AI for enhanced data collection and analysis.

Similar Solutions

nFlux

nFlux delivers the next generation computer vision co-pilot for assisting human workers in their daily assembly tasks, and enlightening manufacturers on operational blindspots. AI and computer vision amplifies human workers while radically revolutionizing quality assurance, training and operational management in manufacturing.

Leela ai

Leela Platform is a manufacturing productivity platform that acts as a continuous time and motion study spanning multiple workstations and facilities.

Dori AI

Dori Ai enables enterprises with a no-code platform to transform images and videos into actionable insights. Our technology distills visual data into people, processes, and assets and provides businesses with real-time metrics and analytics.

Sensable

Sensable is a vision AI-based solution that provides always-on visibility into daily workforce interactions with machines and materials across all the shifts, in both standard and non-standard (unstructured) environments.

Adjacent Solution Categories

Time & Motion Analysis

Timer Pro

Timer Pro is the complete video-based measurement solution for those involved in Continuous Improvement, Automation Modeling, Lean Manufacturing, Industrial, Manufacturing and Process Engineering, Ergonomics, Operator Training, Six Sigma, Kaizen, SMED and 5S initiatives.

ProPlanner

Proplanner's Assembly PLM solution is the only Assembly-Focused PLM system available in the market today. While generic PLM systems provide toolkits for companies to develop an Assembly PLM environment, this effort takes a great deal of time, money, and rare talent that could be spent on product development efforts.

EHS/Ergonomics

Intenseye

The Intenseye Core AI module equips EHS teams to proactively mitigate workplace incidents by providing real-time visibility into unsafe acts, hazardous conditions, and other leading safety indicators.

Voxel

Voxel's site intelligence platform empowers safety and operations leaders to make strategic decisions.

Digital Work Instructions

Augmentir

Augmentir helps manufacturers onboard workers faster, reduce time to productivity, enable targeted reskilling and ups killing support workers with digital guidance based on individual needs.

DeepHow

Leading solution for knowledge capture, management, and transfer powered by AI

Error Proofing

Detect-It

Detect-It is AI Software and neural net technology that smartly powers processes that accomplish a virtually unlimited range of tasks quicker, easier and more efficiently.

Pico MES

Integrate tools, devices, and systems across the shop floor into a common platform to error-proof assembly operations.