Efficiency in Focus: FPGA Solutions for Monitoring PPE Compliance

With Innodisk's FPGA EXMU-X261, industries can leverage its versatile capabilities for various applications, ranging from PPE inspection to strong acid and alkali laboratories. This FPGA stands as a robust platform, showcasing remarkable adaptability and performance across different use cases.

Introduction

In workplace safety, the evolution of Environmental, Health, and Safety (EHS) trends is intricately linked to the progress in Personal Protective Equipment (PPE) practices. As safety standards continue to advance, a critical need arises to address potential challenges, particularly compliance issues, proactively and to establish more efficient monitoring mechanisms. This case study seeks to underscore the robust capabilities of an FPGA solution, positioning it as a transformative element with multi-channel real-time video processing and hardware acceleration. Aligned strategically with current EHS trends, the primary objective is to revolutionize the monitoring and enforcement of PPE compliance, thereby significantly enhancing workplace safety and overall well-being.

www.innodisk.com
T +886-7703-3000 / E sales@innodisk.com

innodisk

Our Roadmap to Success

Innodisk FPGA EXMU-X261

- Powered by AMD-Xilinx Kria K26 SOM
- Support InnoAgent out-of-band (OOB) remote management
- Offers PCIe M.2 2230/2242 for wireless and storage devices connection
- 1.4 TOPS of AI computing power, with a focus on the YOLO model for object detection
- Offers UART/ I2C/ CANbus/ GPIO connection through 15pin Terminal Block
- Prebuilt BSP and pre-trained AI model to accelerate system setup
- Offers 4x USB 3.2 Gen1 Ports for high-speed data transfer
- Supports hardware security TPM2.0
- Designed for edge AI and machine vision
- Provides sample code, including AI inference, platform I/O testing, multiple video streaming, and OTA
- VaiGo: A utility developed by Innodisk, offers an integrated workflow tutorial to convert pre-trained AI model to INT8 data type and .xmodel for deployment on FPGA

Challenges

- In expansive and high-stakes PPE detection sites, minimizing latency is crucial, yet costs escalate when the solution must efficiently handle multiple video streams while maintaining low latency.
- The effectiveness of artificial intelligence (AI) detection surpasses manual inspections, providing instant data reporting and analysis in PPE scenarios.
- The convergence of user behaviors, EHS practices, and PPE compliance standards in businesses, including ISO 45001, Directive 89/656/EEC, 20 CFR 1910.132, emphasizes the need for safety.

Solutions

- **Parallel Processing**

  FPGA excels in simultaneously processing multiple video streams, making it ideal for scenarios with numerous sensors or cameras used in PPE detection. Capable of managing 1 to 4 streams of 2 million pixels each at up to 20 frames per second (FPS), this capability not only enhances performance but also reduces cost, showcasing the scalability of FPGA for accommodating additional image sources.
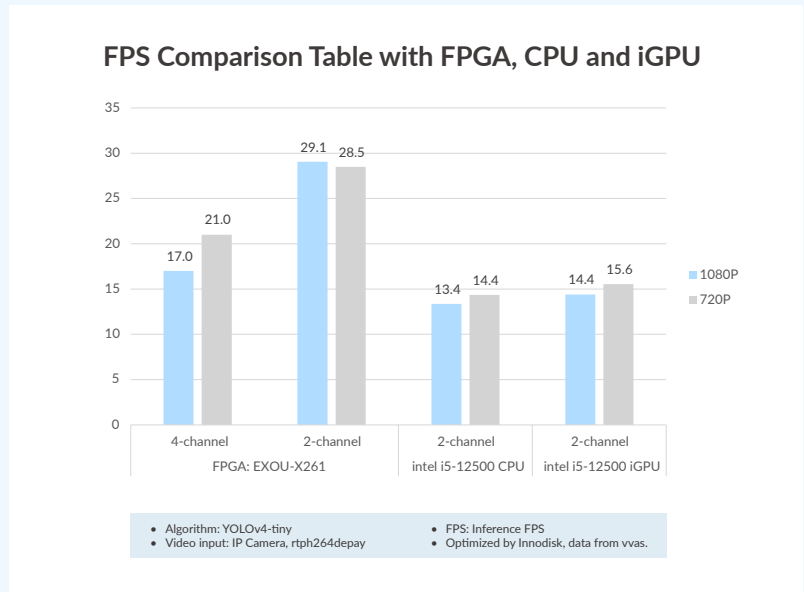

Xilinx - Matched Throughput

Performance Critical Functions — AI Inference — Performance Critical Functions

GPU & CPU - Mismatched Throughput

CPU — GPU — CPU

Performance Critical Functions — AI Inference — Performance Critical Functions

- **Optimized Performance**

  Whole Application Acceleration

  The EXMU-X261 FPGA architecture enhances AI performance, enabling Whole Application Acceleration (WAA). This efficiency extends beyond AI inference, integrating VCU Decode and DPU Inference Engine into FPGA logic cells, minimizing memory access, reducing latency, and optimizing power consumption. The result is accelerated performance across the entire application process, highlighting the versatility and efficiency of the EXMU-X261 FPGA architecture.

www.innodisk.com
T +886-7703-3000 / E sales@innodisk.com

innodisk

Low Latency

FPGA ensures low-latency processing even when managing multiple streams concurrently, outperforming GPUs with less than 30ms latency compared to GPUs over 90ms. This efficiency extends beyond AI inference, encompassing critical functions throughout the entire process, contributing to the accelerated performance of FPGA.

FPS Comparison Table with FPGA, CPU and iGPU

- Algorithm: YOLOv4-tiny
- Video input: IP Camera, rtph264depay
- FPS: Inference FPS
- Optimized by Innodisk, data from vvas.

· Energy Efficiency

Innodisk's FPGA boasts low power consumption, averaging 18W, making it suitable for applications with power constraints. This energy-efficient feature enhances the adaptability of FPGA for diverse use cases.

· Flexibility

FPGAs exhibit versatility in image processing by high-level synthesis intellectual property (HLS IP) to preprocess inputs, thereby enhancing image sharpness. This flexibility ensures optimized performance in various applications, including PPE detection.

· Longevity

Innodisk's FPGA guarantees a product life cycle of 10 years, ensuring stability and sustained performance for applications.

Innodisk's FPGA Solutions

· Software Support:
Streamlined Setup

Innodisk facilitates quick and easy deployment by providing a pre-built image for the standardized setup of environments, eliminating the need to install and configure the operating system and software from scratch.

www.innodisk.com
T +886-7703-3000 / E sales@innodisk.com

innodisk

Customizable SDK

Innodisk provides a comprehensive software support suite featuring a Board Support Package (BSP) and Software Development Kit (SDK). The BSP includes:

- An embedded Linux system
- Essential drivers
- Pre-trained AI model applications such as Automatic Number Plate Recognition(ANPR) and defect detection

This enables testing and programming at the software level without FPGA expertise. The SDK allows efficient conversion of AI models onto the FPGA, complemented by an Over-The-Air (OTA) update tool for user-friendly model deployment and maintenance.

- **Customized Service:**
  Innodisk surpasses standard services by offering personalized solutions to meet specific customer needs. This includes the development of customized carrier boards and Board Support Packages (BSP) for diverse projects.

- **Quality Assurance:**
  Innodisk ensures quality and reliability through CE/FCC compliance, shock vibration testing, power cycling tests, and thermal testing.

- **In-House Manufacturing:**
  The solutions are manufactured in-house in Taiwan, ensuring control over production processes and quality standards.

- **Partnership:**
  Innodisk collaborates with AMD's in-house R&D engineers, offering support for the latest technology and contributing to cutting-edge advancements.

- **Diversified Applications:**
  Beyond PPE, Innodisk's FPGAs find applications in AI visual recognition scenarios, including license plate recognition, crop monitoring, and surveillance.

Our Promise

At Innodisk, we believe that any challenge can be overcome through cooperation. By maintaining a strong line of communication all the way from inquiry to implementation, we ensure a tailor-made solution that fits your application. We remain committed to innovation with our continual focus on hardware, firmware, and software integration.

www.innodisk.com
T +886-7703-3000 / E sales@innodisk.com

innodisk