

Overview

The problem facing many strategic, high growth markets that leverage real time video is no optical system or camera is optimized to deliver high-quality actionable video in every environmental condition. The targeted market that Prohawk Technology Group's Instant Visual Clarity™ technology is uniquely positioned to service grows from \$593 Billion in 2018 to \$3.7 Trillion by 2027, and includes: Security & Surveillance, Artificial Intelligence, Computer and Machine Vision, Autonomous Vehicles, Urban Traffic Monitoring, Smart Cities and Video Analytics. The quality of the video captured from all optical systems is compromised by a variety of factors. Even the most advanced wide-dynamic range, high-definition, thermal or infrared cameras are restricted by optical physics and environmental challenges. The following conditions have the most significant effects on capturing high quality, actionable video:

Adverse Lighting caused by night, low light, backlight and extreme contrast like sun glare, headlights and infrared imaging are challenging environments that distress the quality of video. These conditions significantly impact the image quality taken by all camera systems, rendering them ineffective and incapable of delivering meaningful and actionable video.



Extreme Weather conditions impact the visibility of all camera systems. The image quality from cameras operated outdoors can be severely compromised by the effects of severe rain, snow, dense fog, mist or haze removing any chance of capturing actionable data.



Airborne Particles in the environment can also negatively impact the quality of the imagery delivered by the camera. Representative challenges in this area include the impact of sandstorms, smoke, smog, dirt and dust, all of which degrade visibility and the camera's ability to capture quality video.



There is a need for ProHawk Instant Visual Clarity software solutions which can be easily integrated into systems throughout our identified markets.

Markets

The demand for high quality, actionable, real-time video is rapidly increasing throughout global markets. Real-time, actionable video requirements are expanding across all industries including: Government, Military, Law Enforcement, Healthcare, Maritime, Industrial, Transportation, Agriculture, Retail, Energy and Public Utilities. A variety of industry specific applications leveraging real time video range from Security & Surveillance, Artificial Intelligence, Computer Vision and Machine Vision to Autonomous Vehicles, Urban Traffic Monitoring, Smart Cities and Video Analytics.

Governments and industries are committing significant additional resources to Security & Surveillance. Governments across the world are investing in high quality Video Surveillance Systems as part of their border control, security and anti-terrorism infrastructure. All Security & Surveillance applications can instantly benefit from ProHawk technology and the instantaneous visual clarity it provides. This market was valued at \$30.37 Billion in 2016 and is forecasted to increase by a 15.4% Compound Annual Growth Rate (CAGR), through 2022, when it will be valued at over \$75.64 Billion.

The global autonomous vehicle market is expected to grow at a CAGR of 39.6% reaching \$126.8 Billion by 2027. Autonomous vehicles employ embedded software, sensors, and communications systems trending towards advanced Artificial Intelligence (AI) technology. True level 5 autonomous driving, full autonomy in ***any and all conditions***, will not be achieved without ProHawk technology. Elon Musk, CEO of a leading autonomous vehicle company, Tesla, has said publicly, "Once you solve cameras for vision, autonomy is solved: if you don't solve vision, it's not solved...You can absolutely be superhuman with cameras."

Artificial Intelligence (AI) is intelligence demonstrated by machines: any device that perceives its environment and takes action that maximizes its chance of successfully attaining its goal. AI problems include reasoning, planning, learning, perception, and the ability to move and manipulate objects. For example, Artificial Intelligence enables autonomous planning or calculations for robotic systems to maneuver through an environment. Information about the environment is being provided by computer vision systems, acting as a vision sensor for the robot. Computer Vision addresses how computers can be utilized to derive a high-level understanding (from digital images or video) to automate tasks and enhance the performance of the organic, human visual system and analytical process.

Computer Vision is concerned with the theory behind artificial systems that extract information from images. Computer vision systems leveraging ProHawk can extract substantially better data for scene reconstruction, event detection, video tracking, object recognition, 3D pose estimation, learning, indexing and motion estimation. According to a new market survey by Markets and Markets, the Computer Vision Market is expected to be valued at USD \$11.94 Billion in 2018 and is likely to reach USD \$17.38 Billion by 2023, at a CAGR of 7.80% between 2018 and 2023. The growth of the market is mainly driven by the increasing adoption of computer vision in autonomous and semiautonomous vehicles, military, industrial and consumer drones; and the rising adoption of Industry 4.0 manufacturing automation and data exchange.

Machine Vision is the technology and methods used to provide imaging-based analysis for applications that include: automated inspection, process control, and robotic guidance, usually in industry. The global Machine Vision Market is expected to reach USD \$19.22 Billion by 2025, at a CAGR of 8.5%, according to a new report by Grand View Research, Inc. The increasing adoption of robots across industrial sectors is leading toward the application of vision-guided robotic systems. Industrial verticals, such as automotive, pharmaceutical, packaging, and food & beverage, are prominent sectors where robotic systems are used, eventually fueling the demand for machine vision systems.

Successful implementation of smart city projects heavily depends on technologies – data communications, cloud, mobility, and sensors that seamlessly tie together to form an IoT ecosystem. Typical smart city projects target traffic flow optimization, public safety violence eradication, efficient street light utilization, and parking. Smart cities are enabled by smart cameras that will make sense of what they see in real time. ProHawk provides the underlying technology that will put the Smart in cities. The smart cities market is expected to grow at a 23.1% CAGR from \$424.68 Billion in 2017 to 1.2 Trillion by 2022.

Governments, industries, commercial organizations all use advanced video analytics for security and to improve operational efficiency. High quality actionable video is essential to key, common video analytics uses including License Plate Recognition, Object Recognition and Facial Recognition. ProHawk algorithms provide a critical, foundational technology, which can enable exponential value recognition for applications in this rapidly developing market. The video analytics market is valued at \$2.61 Billion in 2016 and is expected to grow by 33.7% CAGR through 2022 to \$11.17 Billion.

Software, Embedded & Service Solutions

ProHawk provides real-time video enhancement technology that provides unparalleled Instant Visual Clarity in compromised video due to lighting, weather, particulate matter, and environmental conditions. ProHawk unlocks the highest quality enhancements with ultra-low latency, enabling users or Computer Vision enabled AI systems to analyze optimized, actionable video in real-time.

The most critical characteristic in a real-time video enhancement solution is the latency of the system. This is the time delay between a video frame entering the system, video enhancement(s) being applied to the video frame, and receiving the enhanced, clarified video frame. Since real-time video monitoring requires human observation or AI based analytics systems with computer vision, perceptible latency has a strong effect on user satisfaction and the usability of the system. This requirement demonstrates the distinct advantage that ProHawk solutions provide with a latency of less than 20 μ Secs. This level of performance enables high-speed mobile applications such as autonomous vehicles, autonomous aircraft, autonomous water craft, urban traffic monitoring, smart cities, and military use cases.

ProHawk's patented Detail Enhancement Filter (DEF) is the core enhancement algorithm that achieves high image sensitivity. DEF is the only real-time video enhancement platform that concurrently processes six distinct enhancements algorithms, improving visual clarity and reducing the need for expensive and sophisticated optical systems. The DEF enhancement algorithm is a suite of enhancement methodologies including algorithms

supporting dynamic range enhancement, contrast optimization, contextual color enhancement, edge sharpening, rapid movement minimization and visual noise reduction. The combination of these algorithms provides finer, sharper levels of detail and clarity, static visual noise reduction, improve color representation (natural to the human eye), remove objects obscuring visibility, defined and detailed edges, reduced blurriness, all without frame skipping & white clipping.

The ProHawk Instant Visual Clarity Software product line enables partners to tightly integrate into a variety of industrial market solutions with industry standard video formats and interfaces, such as SMTPE, HDMI, & VESA standard formats, and HDMI, USB-C, DisplayPort, and Ethernet TCP/IP physical interfaces. A robust offering of Video Management Systems (VMS) integration plug-ins provides server side Instant Visual Clarity enhancements with client side visual clarity controls for market leading VMS solutions, including: Milestone, Genetec, and Geutebrück.

ProHawk Instant Visual Clarity Software Developers Kit (SDK) is a set of software tools that enables ProHawk technology to be tightly integrated into a variety of applications for hardware, software, and services market solutions. An Application Programming Interface (API) enables software engineers to easily integrate ProHawk Instant Visual Clarity capabilities directly into their systems and solutions. A Web UI provides instant integration into applications.

ProHawk Instant Visual Clarity FPGA Developers Kit (FPGADK) is a set of tools that enables ProHawk Visual Clarity algorithms to be embedded into an M.2, PCIe 3.0, or cloud services based FPGA. Designed for applications that require the absolute lowest possible latency, the FPGADK empowers developers to integrate Instant Visual Clarity into their real-time mission critical systems.

ProHawk Instant Visual Clarity Software-as-a-Service (SaaS) targets the lucrative, rapidly growing and high margin SaaS market. The ProHawk Instant Visual Clarity SDK, and ProHawk Instant Visual Clarity FPGADK, will be leveraged to provide ProHawk Instant Visual Clarity Software Services. The SaaS capabilities will be delivered over time and are designed to run on all major cloud service providers. For examples: Amazon AWS EC2 F1; Microsoft Azure FPGA-based configurable cloud instance; Google Cloud CPU & GPU service. ProHawk integrates in key SaaS markets such as Video Surveillance as a Service (VSaaS), Artificial Intelligence as a Service (AIaaS), and Computer Vision as a Service (CVaaS).

ProHawk uniquely leads the market with five critical patented algorithms:

Comprehensive Low Latency Detailed Enhancement Filter Algorithm – The DEF algorithm is optimized to minimize latency introduced while processing video enhancement. The DEF algorithm takes less than 20 μ s to enhance a HD-SDI 1080p60 video stream. No other image enhancement technology delivers this level of performance for real-time application support.

Clear Tone Contrast Algorithm – This algorithm provides low contrast image enhancement clarity due to extremely dark or bright frames and/or areas within frames. It divides an image into blocks to leverage a tone brightness histogram to adjust brightness for every pixel.

Contextual Color Correction Algorithm – Very small/fast algorithm to identify color in over or under exposed areas delivering improved color representation more natural to the human eye.

Rapid Motion Detection Algorithm – Removes unwanted objects obscuring visibility with noise reduction that eliminates frame skipping & white clipping. A simple 2 step bright and dark pixel processing code structure that detects rapid motion for every pixel.

Adaptive Detailed Enhancement Filter Algorithm – Patent pending in-frame processing algorithm that does not require previous video frames or histograms. Designed for rapidly moving source demands that are challenged with directional and/or target acquisition visibility difficulties. Delivers unparalleled video clarity with the lowest possible latency for autonomous vehicles, subsonic to hypersonic moving autonomous aircraft and missiles.

Value Proposition

ProHawk provides instantaneous visual clarity in time sensitive critical situations:

Instant Visual Clarity – ProHawk unlocks the highest quality real-time video enhancements with patented ultra-low latency enabling dramatically improved Instant Visual Clarity. Thereby enabling users, IoT devices, and computer vision systems to more accurately analyze and act on clarity in video data.

Visibility in Degraded Visual Environments – ProHawk provides visibility in adverse lighting and challenging environments that can leave little to no actionable data with traditional video systems. ProHawk provides Instant Visual Clarity in these circumstances enables Computer Vision AI systems, IoT devices, and humans to receive the full benefit of their video systems allowing them to take proper action quickly.

Clarity in Challenging Weather Conditions – ProHawk allows AI systems, IoT devices, and end users to see clearly through extreme weather conditions that impact the visibility of camera systems. Severely compromised video quality is eliminated with ProHawks Instant Visual Clarity Technology providing users and AI Computer Vision systems with the actionable data they require.

Improve Recognition – ProHawk is a foundation technology which enables Video Analytics, IoT devices, Artificial Intelligence and Computer Vision systems to dramatically improve event detection, object recognition, 3D pose estimation, and motion estimation.

Potential Life Saving – When clear visibility is the difference between life and death, ProHawk provides the instantaneous visual clarity required to make life-saving decisions.

