

Overview

The problem facing many strategic, high growth markets that leverage real time video is no camera is optimized to deliver high-quality actionable video in every environmental condition. The quality of the video captured from all camera 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 to deliver 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 in the market for Real Time Video Enhancement software that can be tightly integrated into industrial market solutions.

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, Healthcare, Technology, Transportation, Energy and Public Utilities. A variety of industry specific applications leveraging real time video range from Military, Medical, Security & Surveillance 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 Real Time Video Enhancement (RTVE) technology. 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 RTVE 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."

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, street light efficient 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 real-time video enhancement technology that will put the \$mart 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 and Facial Recognition. ProHawk RTVE algorithms provide a critical 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.

The Solution

ProHawk® provides real-time video enhancement technology that provides unparalleled clarity in compromised video due to lighting, weather, particles, and environmental conditions. ProHawk unlocks the highest quality enhancements with ultra-low latency, enabling users 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 video frame. Since real-time video monitoring requires human observation, perceptible latency has a strong

effect on user satisfaction and usability of the system. This requirement demonstrates the distinct advantage that ProHawk solutions provide over competitive offerings with a latency of less than 20 μ Secs. This enables high-speed mobile applications such as autonomous vehicles, autonomous aircraft, 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, eliminating the need for expensive and sophisticated optical systems. The DEF enhancement algorithm is a suite of chained enhancement methodologies including algorithms supporting dynamic range enhancement, contrast optimization, contextual color enhancement, edge sharpening, rapid movement minimization and visual noise reduction. These algorithms combined together provide 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.

ProHawk will expand its solution and services offerings by extending the core algorithms and applying it to two new software offerings:

ProHawk RVTE Software Developers Kit (SDK) will enable ProHawk technology to be tightly integrated into a variety of industrial market solutions. An Application Programming Interface (API) will enable software engineers to integrate ProHawk capabilities directly into their software system solutions. A robust Web UI provides instant integration into applications.

Software-as-a-Service will target the lucrative and high margin Software as a Service (SaaS) market. The SDK software services will be delivered as an Amazon AWS EC2 F1 and Microsoft Azure FPGA-based configurable cloud instance.

Value Proposition

ProHawk technology uniquely leads the market with four 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 because of extremely dark or bright frames and/or areas. 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 natural to the human eye.

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

Adaptive Detailed Enhancement Filter Algorithm – Patent pending in-frame processing algorithm that does not require previous video frames or histogram. Designed for extreme 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.