

TroublePix:

**A High Speed Digital Video Recording Troubleshooting
Solution**



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Introduction

Industrial equipment represents one of the largest, and most important investments most production companies will ever make. Not only is the equipment itself a sensitive and complicated infrastructure component, but it is also often depended upon to run at full capacity for weeks and months on end. Any interruption of service is more than just inconvenient – it can also be an expensive proposition that directly translates into lost income and missed opportunity on a larger scale.

It is obvious that the high costs associated with equipment downtime requires that companies employ the best possible system in order to troubleshoot equipment failures. The TroublePix high speed digital video recording troubleshooting system is an advanced monitoring system that takes the guess work out of diagnosing equipment failures regardless of where the problem may be located. TroublePix provides high speed video coverage of industrial machinery, laboratories or outdoor work areas that is meant to speed up the troubleshooting process when looking at a complex facility harboring many different layers of equipment and machinery. It is especially useful in areas such as industrial packaging where jams and other line errors can cause significant disruptions if they are not dealt with rapidly and effectively.

This white paper discusses the details of the TroublePix high speed digital video recording troubleshooting system and how it can be employed by workers to help troubleshoot and monitor industrial equipment.

The TroublePix System

The TroublePix system is composed of software which allows for a production facility to monitor equipment using high speed video cameras. The software uses loop-based surveillance to keep a constant eye on the footage it is fed. It also employs a trigger-oriented event system to record any incidents or issues that arise during facility operation. These recordings allow workers to perform a detailed analysis of any equipment problems monitored by TroublePix, thanks to the built-in ability to examine video or still images in detail and with full time-stamping abilities. It is also possible to export images and video for use in other applications in a wide range of formats.

TroublePix is meant to connect on a one-to-one basis with high end machine vision or scientific grade cameras. TroublePix is also versatile in that it can be installed on virtually any computer system that meets its minimum requirements. It can record directly to RAM or use a hard drive to store video data, and it is available in 64-bit and 32-bit versions.

Why use High Speed Digital Video Recording For Troubleshooting?

Using high speed video recording to troubleshoot equipment failures presents several advantages over standard video. Most production workers are familiar with the type of video quality produced by traditional surveillance or security cameras. This footage tends to be grainy and lacks the detail required for accurate analysis. Security cameras are meant to be used in situations where a broad picture of the events that are unfolding is “good enough.” However, when it comes to assessing the problems afflicting delicate and complicated machinery, a much higher level of detail is required.



Figure 1 - TroublePix provides crystal clear playback of high speed processes.

Given that packaging and other industrial equipment often operates at a high rate of speed, it is difficult or even impossible for a standard camera to produce images or video useful for diagnosing failures or other issues. It is for this reason that TroublePix is capable of interfacing with cameras that operate in a range of 60 to 2000 frames per second. This level of high speed video allows for two important tools to be used during troubleshooting. The first is an ultra-slow



motion replay of equipment operation without any blurring or distortion that could mask a potential problem. The second is the ability to freeze any video frame and view the image with crystal clarity. Each image can also be saved and archived as a lossless jpg file, with a lossy option available for easier transmission of smaller files. This allows for the pinpointing of specific problems with almost surgical precision. TroublePix also supports high definition video, which means that resolutions ranging from 640x480 pixels to a vastly expanded 4000x4000 pixels can be handled by the system, greatly increasing the fidelity of the images to be analyzed.

Advantages Of Using TroublePix For Troubleshooting

Flexibility

One of the primary strengths of TroublePix is the flexibility it provides as a troubleshooting solution. The system can be configured to fit the specific needs of any industrial packaging setup or other industrial application, and installs on most industry-standard computers. With the ability to connect with a number of different types of cameras through the GigE, Firewire A and B and Cameralink interfaces, TroublePix is capable of integrating with currently installed monitoring systems at a facility without the need for any additional technical upgrades.

TroublePix can also be wirelessly triggered from up to 46 meters away. This enables the system to effectively monitor equipment located in remote areas of a production facility. Workers can remain with the equipment while it is operating and still interact with the TroublePix software through a wireless remote control system, starting and stopping the recording process as well as triggering Pre/Post events. This is most useful for recording events that require an operator to be present.

In addition to wireless connectivity and direct access through its software interface, TroublePix can of course be completely integrated into an existing production line and run as an automated tool. This helps it to capture faults and problems in real time, regardless of when they occur.

Incident Monitoring and Recording

The automated and detailed monitoring of industrial equipment provided by TroublePix is a versatile and important tool for workers looking to diagnose a production fault. TroublePix digitally records the video fed to it by a high speed video camera on a constant basis. While this can offer a complete record of any and all activity occurring on camera, TroublePix also provides a more practical looping option which can dramatically reduce the amount of digital video storage required.

When set in loop mode, TroublePix records all incoming video on a pre-set loop that is overwritten after a specific period of time. The system uses a Pre/Post triggering feature to capture and record any incidents that occur within this sliding production window. For example, TroublePix can be set to wait for a signal from the production line indicating a fault or stoppage. It can also be set to analyze an incoming video stream and trigger an event if any specific type of motion is detected, based on a reference image. Motion detection is extremely useful in situations where a trigger cannot be received from the production line, offering an alternative method for capturing a failure event. This feature can be configured within a wide range of different sensitivities using two different algorithms (mean gray and absolute difference), and it can be applied to the entire video image or focused on a specific region of the video feed.

Upon receipt of an event signal, it interrupts the loop it has been monitoring and records and archives video starting at a preset time period directly before the event, and continuing through to a preset interval past the event. This creates a video snapshot of the period of time surrounding the event trigger. Users can completely control the start and end points of the snapshot in order to gather the most useful incident information. The length of a recording is limited only by how much digital recording space is made available to the system. Upon startup, TroublePix verifies the amount of available recording space and projects the maximum length of video that can be saved dependent upon the settings chosen by the user. TroublePix can also record directly to RAM, which is useful when dealing with cameras featuring very fast frame rates.



Figure 2 - TroublePix offers detailed video capture and troubleshooting for complex production equipment.

Once an event has occurred and the system has recorded the video data related to the incident in question, it can be set to automatically re-arm and capture any future trigger events. This means that multiple events can be captured one right after the other. By focusing on storing only video related to triggered events, TroublePix avoids filling up digital recorders with hours and hours of video, helping to make searching and sorting during the troubleshooting process much simpler and faster. The system is also capable of using a descriptive marker system to keep track of events which were caused by multiple sources, making note of them in the TroublePix software itself and associating them with the video snapshot.

Playback and Analysis

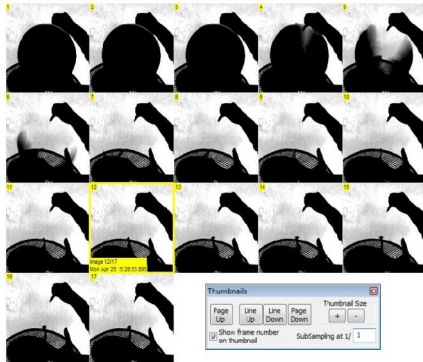


Figure 3 - TroublePix thumbnail view.

The video data that is recorded by TroublePix after a triggering event can be viewed and analyzed in a number of different ways. Straight video playback is of course provided, but far more detailed results can be used by slowing down the video frame by frame. The software also allows for a thumbnail view that freezes each frame and displays it in sequence, enabling employees to move from image to image and analyze the changes between each one.

Timestamps can be displayed over video as it plays in order to allow for more precise locating of issues, and these timestamps can also be permanently imprinted on an image for easier sorting at a later date.

TroublePix can export video in an uncompressed format, or have it encoded to AVI format to obtain more manageable file sizes. Either the entire video file or a selected time range can be exported. It can also save frames individually to the clipboard or across a wide range of industry standard image formats in order to facilitate their transmission and analysis at a later date. Quick saving of either video or images is facilitated through the automatic generation of unique filenames that can be completely customized by the user. Still images can also be printed directly from TroublePix.

Perhaps the strongest aspect of the TroublePix video viewing design is that when reviewing a particular event, the software can continue to monitor the production floor without interruption. Up to five separate past events can be simultaneously analyzed while TroublePix continues real time monitoring in the background. This triplex functionality combining live camera image display, historical access to recorded video and real-time recording ensures that no machinery will be left unmonitored while examining previous events. It also means that multiple events

Easy to Use Interface for Floor Workers

The TroublePix interface is simple to use and easy to learn. From within the software, workers can review video, configure the TroublePix system, and export or print video and still images. The software can be run on a laptop, desktop computer or even in a special full screen mode in order to take advantage of touchscreen installations. The software uses a standardized design featuring movable windows and controls which can overlay the image or video that is currently being viewed when it is displayed in full screen mode. Point and click menus feature movable sliders linked to numerical readouts which offer a fine degree of control over options and settings.

Central to the application is a tabbed viewing window that displays the videos or images that are currently being analyzed, such as the live feed from the camera or previously recorded events. Incorporated into this window are the playback controls. Just below the viewing window is a panel that indicates the video's time position, the event markers, and fine and coarse sliders that allow for navigation of the video or image stream with frame by frame granularity. This panel also displays the current timestamp being viewed.

A separate frame on the far right of the interface is capable of displaying information related to the attached camera's configuration, the incoming video feed, and the history of any previously recorded events on the hard drive. It also shows an activity log which can keep track of which actions are performed through the TroublePix system, and a button to manually start or stop recording video. A status bar on the bottom and a series of menus across the top of the application round out the interface's presentation.

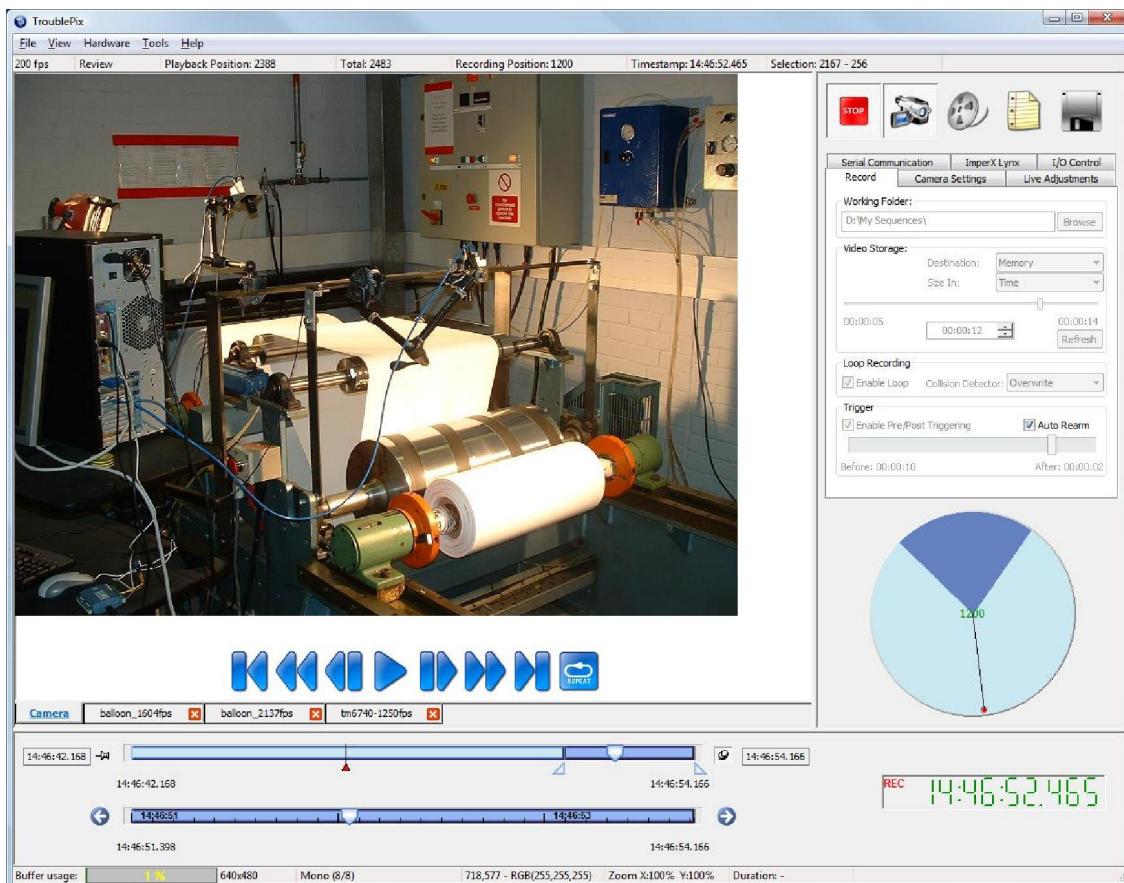


Figure 4 - The TroublePix GUI provides a clear and useful troubleshooting interface.

A number of hotkeys linked to the most often used features of the TroublePix software also make it easy to use the software without requiring the use of a



mouse or touchscreen. Keyboard shortcuts can be used to control video flow (start/stop playback, frame ahead / frame back, move to full screen view, toggle color balance), annotate video that is currently being shown (add a marker, show the status panel / marker list, show / hide timestamp overlay) as well as manipulate the image that is being shown (zoom in, zoom out, print current image, toggle thumbnail view, quick save). This broadens the number of different systems that TroublePix can be installed on, as it simplifies the input devices needed to fully use the software.

Conclusion

Troubleshooting equipment failures or production issues requires that workers have access to the most detailed and up to date data possible for the facility in question. Real-time, high speed video monitoring of equipment provides a valuable window onto the information needed to accurately and quickly diagnose production faults with a high degree of certainty.

The TroublePix system provides the ability to monitor equipment in real-time and analyze video without interrupting or impeding concurrent video recording. Its multi-faceted approach to troubleshooting offers workers and managers strong options when it comes to problem solving and issue mitigation. TroublePix takes the speculation out of troubleshooting and allows decision makers to base their maintenance and repair assessments on hard evidence. The peace of mind offered by a comprehensive solution like TroublePix provides production facilities with the safety net they need in order to maintain their equipment's operational status, maximum facility uptime and strong line throughput without having to make any sacrifices.