Application report

Fighting Forest Fires

Modern, reliable early detection of forest fires via industrial cameras

The Portuguese resort town of Sintra protects its cultured landscape with the IQ FireWatch early detection system for forest fires from the German company IQ wireless, which is based in Berlin. Software with AI functions semi-automatically evaluates the image data provided by three industrial cameras from Baumer. The interaction works – the system combines high detection reliability and speed with a low false alarm rate.

The small Portuguese city of Sintra is a popular tourist location, not least due to its picturesque nature park and palaces, some of which are several hundred years old. As a result, it was classified as a UNESCO World Heritage Site in 1995. The danger of forest fires to the area is therefore very serious. For this reason, a system for the early detection of forest fires has been installed on the National Palace of Pena for many years – IQ FireWatch. The early detection, precise localization, and, if required, direct alarm forwarding are crucial for the prevention of catastrophes.

In January 2019, the monitoring system was modernized and equipped with three industrial cameras from Baumer. The combination of a monochrome and color camera as well as a camera with particularly high near-infrared (NIR) sensitivity ensures a monitoring radius of at least 15 kilometers, with good weather conditions even up to 60 kilometers. On site in the monitoring tower, a feature-based algorithm and AI evaluate the image data of the cameras and, in case of suspicious findings, alert an operator within approximately three minutes who then decides on the next

Figure 1

Fig. 1: From the National Palace of Pena, an early forest fire detection system from IQ wireless monitors over 15 to 60 kilometers the cultural landscape of Sintra, which was classified as a UNESCO World Heritage Site in 1995. Photo: IQ wireless

steps. The harmonious interplay between the cameras and the recognition algorithm allows the detection of forest fires shortly after they occur and minimizes the risk of false alarms.

Figure 2

Precise image capturing around the world

Sintra is not the only location to employ the state-of-the-art early detection system. Around 350 IQ FireWatch systems are active around the globe, from Brandenburg in Germany to California in the United States. The different weather conditions pose special challenges to the hardware – especially in warmer locations such as Portugal or the western United States, heat can be detrimental to cameras. A system failure would be the worst-case scenario. Other than that, high temperatures can also decrease the productive life of the equipment and lead to interference such as noise in the images, which can impede the detection of fires.

Therefore, the high operating temperature range of the VCXG-24M (monochrome), VCXG-24C (color), and VCXG-22M.R (NIR) cameras was a crucial factor in the decision: "When it comes to our components, we attach importance to a long service life of at least ten years," says Dr. Kurt Winter, managing director of IQ wireless. "If you are constantly at the edge of tolerances, you put that at risk. Therefore, the fact that Baumer cameras function at up to 65 degrees Celsius instead of the standard 50 degrees was a key argu-

ment for us." Prior to that, IQ wireless used self-constructed camera systems. Tests with cameras from Baumer and another manufacturer, however, found that the Baumer cameras clearly provided images with less noise and a very high dynamic range, which made the detection by the software system considerably more accurate and resistant to error. At the same time, the cameras can be installed as desired thanks to their circumferential M3 fastening – for mountainous regions, for example, an installation that can be rotated by 90 degrees is advantageous. "It is simply a perfect interplay of hardware and software," explains Winter. "Plus, thanks to the Baumer GAPI software development kit, the cameras could be easily and smoothly integrated into our existing system. It was therefore easy for us to decide on Baumer."

Semi-automated fire detection

Currently, a 360-degree detection in Sintra requires between 4 to 6 minutes in the daytime and approximately 12 minutes at night. For this purpose, the three cameras are installed on the top of a tower of the national palace in a pan and tilt head and operate according to the principle of divided roles – the monochrome camera handles the visual inspection of large ranges, while the camera with high NIR sensitivity is used especially in bad light conditions and at night.
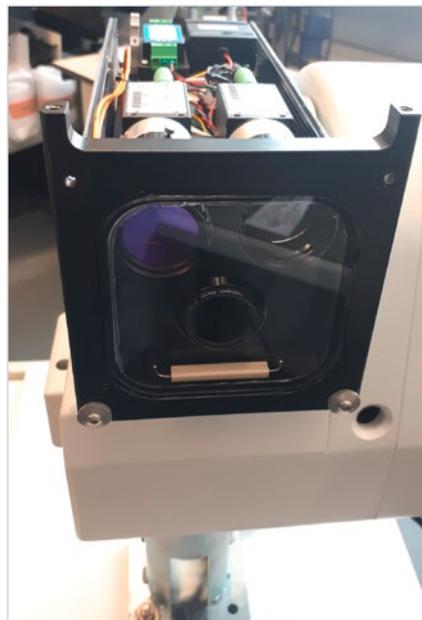
Fig. 2: Three industrial cameras from Baumer are concealed in a pan and tilt head. A 360-degree detection requires between 4 to 6 minutes in the daytime and approximately 12 minutes at night. Photo: IQ wireless

Figure 3

Fig. 3: Regardless of use during day or night, with good or bad lighting and visual conditions – the combination of monochrome and color camera as well as a camera with high NIR sensitivity of the CX series from Baumer delivers noise-free images with a high dynamic range around the clock. Photo: IQ wireless

Figure 4

Fig. 4: While still in the monitoring tower, a feature-based algorithm and AI in Sintra evaluate the image data from the cameras and, in the case of suspicion, alert an operator within approx. three minutes, who then decides on the further course of action.
Photo: IQ wireless

At this time, the images of the color camera are used mainly to offer the operator an additional orientation aid for making the decision whether a message really concerns a fire. In future, however, its data will also be included in the automated detection.

The processing unit uses a feature-based algorithm to separate the different characteristics of smoke, clouds, and fog, thus allowing them to be differentiated. The combination with an AI in the form of an artificial neural network that is constantly trained with new information and data further increases the accuracy of the detection. Only when the processing unit identifies a fire with a high degree of certainty is a message issued to an operator, who uses the captured images to decide whether to instruct the system to inform the fire department.

An award-winning solution

The basis for this system was laid 20 years ago in a collaboration between IQ wireless and the German Aerospace Center (DLR) and allows knowledge gained from space travel to be used on earth. For the Rosetta mission, the DLR developed a solution to determine the material composition of the Rosetta comet, especially based on the gases it emits. This quickly led to the idea that this solution could also be used on earth to detect forest fires. After, all these can also be detected by the gas they emit – first the evaporating liquids of the forest floor, then the smoke particles and combustion gases. This idea resulted in a collaboration between DLR and IQ wireless, which resulted in the IQ Fire-Watch system that was first installed in the late 1990s in the Brandenburg Forest. In 2012, the collaboration partners for this successful application of space technology on earth were included in the US Space Foundation hall of fame.

Managing director Dr. Kurt Winter is proud of this recognition, which was awarded for the first, and so far only, time to an non-US technology. He is equally pleased to have found the ideal complement in the Baumer cameras on the hardware level. "In such systems, reliability is a top priority – after all, human lives are at stake," he explained. "With their robust design, low energy consumption, and extensive operating temperature range, the cameras from Baumer offer exactly the characteristics we are looking for. In addition, their precision makes the system reliable in the sense that we are able to limit the number of false alarms to a minimum." Of course, it is equally important for the support team to react quickly and competently. "When it comes to this in particular, our development engineers are full of praise because all inquiries can be resolved quickly, competently, and helpfully."

The IQ FireWatch system is already providing more safety in Sintra and at many other locations around the globe, while being constantly improved at the same time.

![Baumer – Passion for Sensors]

Figure 5

Fig. 5: With more than 115 models, the CX series from Baumer offers GigE and USB 3.0 cameras with cutting-edge global and rolling shutter CMOS sensors as solutions for cross-industry applications.

In the future, for example, weather data will be incorporated into the detection algorithm to increase the accuracy and to improve further the already effective and efficient system for protecting human beings, nature, and culture.

More information:
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