Continuous Performance Monitoring of Elevators

by Rich Madarasz and Kathy Mutch

Old elevators are a fact of life. Two-thirds of the elevators in operation worldwide are more than 20 years old,[1] and most will not be replaced anytime soon. They are a real maintenance challenge, since documentation may be lost or limited, replacement parts may be hard to find, and sometimes the manufacturer has even gone out of business. This article describes one building owner's approach to keeping its older elevators running efficiently and reliably.

The Challenge

The 25-story building was constructed in 1984 and still had its original elevators. The owner of the building wanted to provide the best experience for the tenants by keeping these elevators running reliably until a planned upgrade in the near future.

Odd problems began occurring in the elevators that were difficult to diagnose. Of course, over the years, some of the parts had become worn, and it was likely that more than one component was contributing to the problems. The controller was built using relay logic, so mechanical wear in the relays could have been causing inconsistent control issues.

Schindler Elevator Corp. provided the maintenance for these elevators and assigned one of their most experienced technicians. The problems were intermittent and infrequent, and often, when the technician arrived on site, the elevator was running fine. Since the elevator did not have built-in monitoring or diagnostic capability, tracking down the problem was difficult and frustrating.

The Solution

The building owner installed a QarVision™ Elevator Performance Analyzer from Qameleon Technology, Inc. This unit lets the technician track and record what the elevator is doing 24/7. It is like a black-box recorder for elevators.

QarVision is a performance analyzer, which means that it detects and records what the elevator is *actually* doing, rather than what the controller is *telling* it to do. This is particularly helpful when dealing with faulty controllers or relays.

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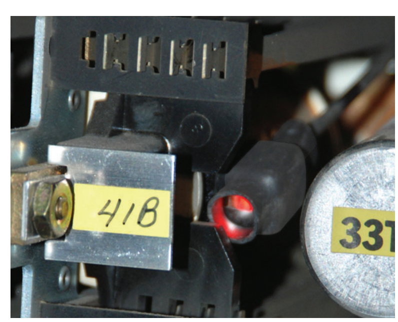
QarVision™ placed on top of elevator car

Machine room monitor installed in machine room



Magnetic sensor placed near relay

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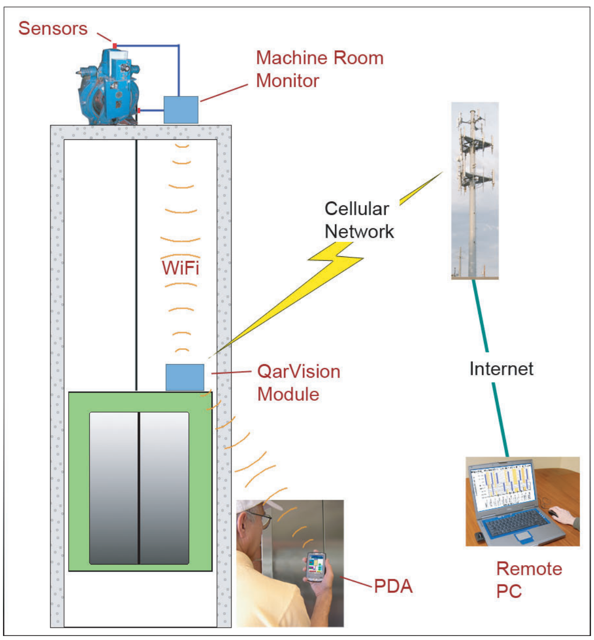
QarVision has two modules, one to monitor the elevator car, and the other to monitor the machine room equipment. The main module, located on top of the elevator car, measures the acceleration, speed and gate activity. The machine room monitor (MRM) measures motor current, motor temperature, room temperature, hydraulic pressure and relay or magnetic switching. The MRM sends all of its data via Wi-Fi to the main module, which stores the data along with its own. The technician can evaluate the elevator's performance in real time and retrieve stored data wirelessly, using a Wi-Fi-enabled personal data assistant or laptop. The system in the 25-story building also uses a cellular data connection that enables it to be operated remotely from anywhere over the Internet.



The sensor measurements are recorded for every trip this elevator makes, typically 1,700 trips per day. The retrieved data is analyzed and displayed on a personal computer. The graph in Figure 1 shows a record of some normal trips of the elevator, two trips up and two down. The acceleration and deceleration of the elevator car is shown in a set of blue or red bars. The height of the bar indicates the magnitude of the acceleration, and its width shows the duration. A blue bar is a normal acceleration or deceleration. A red bar is a short acceleration that is out of the ordinary, but not necessarily a problem.

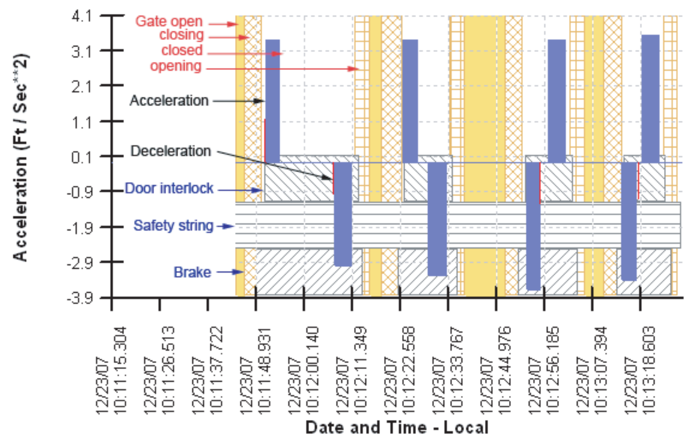


Figure 1

The yellow and white areas behind the acceleration bars show the actions of the gate. They indicate the state of the gate relative to the motion of the car. The width of the hatched areas is the time it takes for the gate to open and close.

The black horizontal bars at the bottom half of the graph show the state of some of the magnetics used in

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the elevator. The top bar is the door interlock relay, the middle bar is the safety string and the bottom bar is the brake solenoid. Small magnetic sensors are used to determine the state of the relays and solenoids, without making any electrical connections to the controller.

As with most older elevators, intermittent behaviors were occurring, usually when the elevator and building maintenance personnel were not present. One such problem happened early one morning. The graph of this behavior is shown in Figure 2. The elevator started making a normal upward trip at high speed, when suddenly the door interlock relay opened. This, in turn, caused the safety string to open and turn off the elevator. The brake coil then de-energized, causing an abrupt deceleration followed by a bouncing of the car. Then about 20 seconds later, the door interlock closed by itself, resetting the other relays and allowing the car to continue on its trip. The same behavior happened on the next trip. When the recorded data were examined, it showed that this was happening quite often.

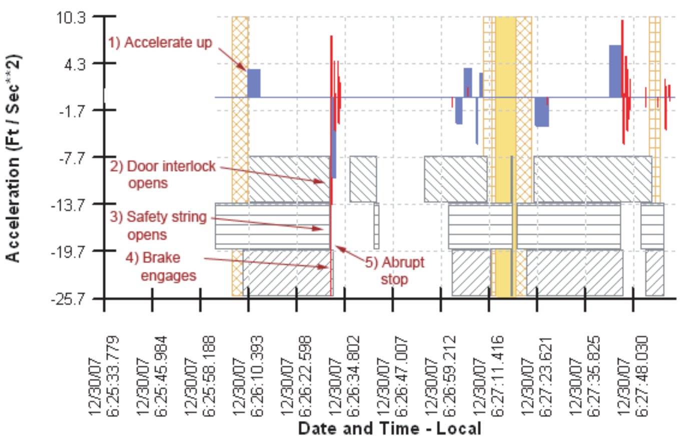

Figure 2

Using the data collected by QarVision, the technician quickly found that the problem was caused by an intermittent switch on one of the landing doors. Without the performance data, it was nearly impossible to detect this problem, because it occurred infrequently, and the elevator was either working again or shutdown when the technician arrived. Often when the problem occurred, the elevator restarted on its own, so the passengers did not report the problem.

Initially, the QarVision system did not monitor the relays and solenoids. The movement of the elevator could be clearly observed, but the cause was still a mystery. The Schindler technician needed more information about what was going on, and worked with Qameleon to perfect the magnetic sensors. These sensors, along with other suggested improvements, are now a permanent part of the system.

Summary

Keeping these older elevators operating reliably and efficiently is the result of a partnership between the building's engineering staff and the Schindler technicians. The technology has given the maintenance team new insight into the elevator's operation, and they are often able to identify a potential problem before anyone else is aware of it.

According to Tom Saugey, adjuster/troubleshooter for Schindler:

> *"QarVision provides a record of 'events' on older elevator systems, similar to the diagnostic data provided by the latest microprocessor-based systems. This information makes it possible to pinpoint and correct the source of intermittent problems that often result in [running on arrival] or momentary entrapment callbacks."*

By being proactive in using new technology, the building owner and Schindler are providing a good elevator experience for their customers.

References

1) Monika Mack, "Lift Designers Benefit from Standard Communication," ELEVATOR WORLD, March 2008, page 158.