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Ingenuity for life

Orlando Eye 400-foot observation wheel uses Siemens controls

Ensures passenger safety and avoids costly downtime



Customer: Coca-Cola Orlando Eye

OEM: Intamin Amusement Rides

Challenge: Keeping passengers safe and the Orlando Eye wheel fully operating

Solution: A fully integrated Siemens SIMATIC controls system, including motion control, with SINAMICS drives and SCALANCE wireless communications

Results: Passenger safety assured, along with year-round, all-weather reliability and availability

Ask anyone living outside Orlando, Florida, what they associate most with the city, and the likely answer would be Disney World, perhaps adding any of the area's other many attractions, such as Universal Studios and SeaWorld. But a new attraction is quickly climbing up the rankings. It opened in 2015 and is commanding the city's skyline in a way the others and even its tallest buildings don't: the revolving, 400-foot tall Coca-Cola Orlando Eye. At night, its light show is visible for miles.

The Orlando Eye is one of six attractions in the I-Drive 360 entertainment complex, located on Orlando's International Drive, a main thoroughfare.

In addition, visitors can enjoy more than 15 dining locations, two nightlife venues, and six stores selling a wide range of merchandise.

Similar to its world-famous cousin, the Coca-Cola London Eye, the Orlando version's wheel-like structure supports 30 three-ton observation capsules. Each one is air-conditioned and capable of holding up to 15 passengers for a 22-minute flight to see an unobstructed 360° view of Orlando and the surrounding landscape. The experience rivals that of riding in a helicopter or light plane, but with much greater comfort and dramatically less noise.

According to Bill Kivler, vice president, Facilities and Engineering, for I-Drive 360, the Orlando Eye's owner, it's misleading to call the structure a Ferris wheel, as many people do. "Of course, the Eye's roots are in the Ferris wheel, but the movements of its wheel and passenger capsules are so well synchronized that the two experiences are not really comparable," he says. "It's really an observation wheel, and it has a lot more built-in safety and reliability than typical Ferris wheels."

Challenge: Keeping passengers safe and the Orlando Eye wheel fully operating

Open 365 days of the year, from 10 a.m. to 12 a.m. midnight, the Orlando Eye has the capacity to provide up to 1,500 passenger flights an hour and many millions of those a year. Each observation capsule facilitates loading while the wheel continues revolving and the other capsules continue their flights, which means precision motion control is critical to both the passenger experience and, most importantly, their safety.

In fact, passenger safety was by far the primary concern of the wheel's designers from initial drawings through materials specification, structural engineering, construction, testing, commissioning, operations, and maintenance. "The forces on the wheel are extreme," Kivler explains. "Torsion points, shear forces, and bending moments are all carefully calculated with the use of sophisticated metallurgical materials and engineering together providing extra measures of passenger safety."

Also, given that Orlando is in the center of Florida, which is considered the lightning capital of the U.S., the wheel is extremely well grounded against strikes. Its safeguards also include the most advanced surge suppression and lightning warning technology available, the latter capable of giving sufficient notice to offload passengers for their safety. "Lightning protection isn't just an add-on, but it's designed, engineered, and built into the entire structure," says Kivler, who came to the Orlando Eye with 23 years operations experience at nearby Disney World, where the original lightning safeguard system for its rides and facilities was deployed by Earth- Networks through a



collaborative development effort with Kivler and Disney.

Right behind passenger safety in the Orlando Eye's priorities are reliable operation and availability. Like any passenger-based business, whether airlines, railroads, or even Ferris wheels, downtime equals lost revenue opportunities. For the Orlando Eye, downtime could also lead to safety concerns. For these reasons, maintenance and self-diagnostics are critical to its reliability and availability. "Our operations staff are highly skilled and trained to keep the Eye operating as flawlessly as it was designed to be," he says. "And, we're fortunate that its builder chose to give them the tools and means to help them succeed in that mission."

Solution: A fully integrated Siemens SIMATIC controls system, with Safety Integrated, including motion control with SINAMICS drives and SCALANCE wireless communications

Based in Liechtenstein, Intamin Amusement Rides built both observation wheels for the Orlando Eye as well as the London Eye. Since its founding in 1967, the company has earned a global reputation as one of its industry's leading innovators in amusement rides of all kinds – not just wheels but also swing rides, water rides, immersive rides, vertical rides, and roller coasters. It uses advanced technology to push the limits of what's possible to deliver memorable, adrenalin-pumping rider

experiences with safety for the passengers as well as reliability and availability for their operators.

When Kivler joined I-Drive 360 in 2017, he welcomed learning Intamin deployed fully integrated automation and motion controls, plus drives and wireless communications systems in the Orlando Eye wheel. "That was good news for me, after working with Siemens products and services at Disney World, which has more than 14,000 Siemens automation products, deployed across an amusement and municipal-equivalent infrastructure spanning about 40 square miles," he says, adding that the local service and support provided by Siemens Partner AWC, Inc. is second to none.

"It's not just my familiarity with how Siemens products work, but also knowing every component is smartly designed, engineered, manufactured, and supported with safety, reliability and self-diagnostics built into it from the start. Although choosing Siemens might cost a bit more initially, it more than pays for itself in the long run. With many automation and controls vendors, you truly get what you pay for. With Siemens, you always get much more than you pay for."

Specifically, Intamin combined the following Siemens components into a fully integrated, end-to-end system of automation and motion control, including drives and wireless communications in the Orlando Eye observation wheel:

• **SIMATIC S7-1500 Software Controller.** These extremely powerful controllers are PC-based automation solutions that can be used for both standard and safety-oriented applications. For the Orlando Eye's controls, including capsule motion control, Intamin deployed SIMATIC S7-1500 Software Controllers on dual, redundant PCs from a top-tier manufacturer, each with automatic failover. These controllers have functional independence from the Windows 10 operating system – ensuring its continued operation during a Windows restart or even its failure.

The PCs reside in a control booth, where three highly trained technicians provide human oversight of the wheel's operation. The technicians have full view of the wheel, inside and out, via video in each capsule and from key overlapping fields of view from cameras mounted on the wheel's superstructure. They also have radio voice communications with the person loading passengers into each module. E-stop functionality is just a click away, backstopped by automated pre-sets if certain conditions occur.

The control booth personnel also monitor use the PLC software to monitor a wide range of operating parameters, including wheel and capsule speeds, motion control drive status, capsule weight, motion, and A/C temperature, and many others. The S7-1500 Software Controller is the first TÜV-certified fail-safe software controller. It also includes integrated safety functionality, certified in accordance with

EN 61508, for communications with the SIMATIC ET 200SP Remote I/O, which provides local control of the Siemens SINAMICS drives on each capsule.

• **SIMATIC ET 200SP remote I/O.** These modules reside in a small panel in each passenger capsule, communicating with the S7-1500 controls over PROFINET via Siemens SCALANCE wireless technology. These provide local motion control together with 14 Siemens SINAMICS S120 and G120 motor drives, which are arranged in a 7x7 counter-opposed configuration. This configuration keeps capsule motion to a minimum, so passengers can fully enjoy the views and flight experience. The wheel itself operates using a 7kW electric motor, which has two redundant backup generators available to immediately switch on, should local utility power fail.

• **SCALANCE W wireless communications.** The SIMATIC ET 200SP remote I/O modules in each passenger capsule communicate with the master SIMATIC S7-1500 Software Controller via an industrial wireless LAN (WLAN). It consists of Siemens SCALANCE W 802.11n radio access points and client modules transmitting over the PROFINET industrial Ethernet protocol.

The Siemens SCALANCE W family of wireless components offer a combination of capability, reliability and security in a solid-state, ruggedized aluminum package well-suited for the Orlando Eye's application. Using MIMO (multiple-input, multiple-output) technology

to multiply the capacity of their radio channels, they can achieve bandwidth throughputs of up to 450 Mbit/s, more than enough for the wheel's requirements.

The access points and client modules feature Power-over-Ethernet (PoE) to minimize cabling. Protection against unauthorized access is provided by advanced firmware mechanisms for user authentication and data encryption. The Orlando Eye safe guards both its wireless and wireline networks with a layered, defense-in-depth cybersecurity scheme recommended by experts worldwide.

Results: Passenger safety assured, along with year-round, all-weather reliability and availability

As Kivler sees it, the Intamin decision to sole-source the Orlando Eye's controls, remote I/O, drives, and communications from Siemens greatly simplifies the wheel's operation, maintenance, sparing, and operator training. "With multiple vendors tied into your infrastructure, you have an integration nightmare, with much more potential for sub-optimal performance of your overall systems," he says.

"Of course, when something goes wrong, troubleshooting the root cause becomes one big game of finger-pointing," he adds. "With Siemens components, everything is so well integrated and self-diagnostics in the components are so deep and wide, problems get resolved in a small fraction of the time, compared to what a multivendor environment would require, with all the guessing and trial-and-error going on."



“With Siemens, you always get much more than you pay for.”

In addition to the self-diagnostics, the end-to-end integration of the Siemens components, most from its Totally Integrated Automation (TIA) portfolio, the software engineering was done in the SIMATIC TIA Portal.

This provides a common framework for programming the functionality of all the components using an easy-to-use, drag-and-drop interface and tapping into turnkey libraries of proven software code.

Intamin saved weeks of controls programming time in the Orlando Eye's development, while its engineers and service technicians can remotely dial into the SIMATIC S7-1500 Software Controller and work with Kivler's team to provide guidance in troubleshooting and addressing any operational issues.

"I've been in the amusement and entertainment industry for 43 years, and the amount of value that Siemens packs into every one of its automation products never ceases to amaze me," he says. "With Siemens controls, drives, and communications in the Orlando Eye's wheel, our confidence in passenger safety and the wheel's reliability and availability couldn't be stronger."

For more information about the SIMATIC S7-1500, please visit: www.usa.siemens.com/s7-1500

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