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GATEWAY, THE MAGIC MIRROR

IoT application for lift cars

by Fabio Liberali and Alessandro Cremaschi

Gateway is an Internet of Things (IoT) technology applied to glass mirrors in lift cars. It transforms common lift-car mirrors into interactive touchscreen displays managed remotely via the internet. Unlike traditional cars' video screens, Gateway has many different purposes:

- Interactive touchscreen display
- Digital signage and communication
- Emergency connection to 24-hr. servicing (through an additional micro camera)
- Maintenance support (direct video/audio connection between headquarters and onsite maintenance personnel)

The system is extremely light and thin, with no impact on car weight and space. Gateway is a tailormade product that can be adapted to both new cars and modernizations.

Introduction

Traditional Cars

The push button in the traditional car has the drawback of limiting communication between the user and operational center to merely an audio system. Furthermore, warnings, messages and information are traditionally displayed in the car by means of posting paper notices or using closed-circuit screens exclusively devoted to this function.

The main object of Gateway is to provide a car in which, unlike traditional equipment of this type, communication is not limited to audio signals, but also includes video signals and internet to provide features allowing the user to interact with the outside world and vice versa. Another object is to provide a car having, within a single system of communication, the function of displaying notices and general information messages, both useful for the user and commercially relevant, the dimensions of which do not affect the interior design or are undesirable in the smallest cars. This feature is particularly relevant, as it provides the lift owner the possibility to sell commercial communication/advertising in the car.

The IoT Revolution

The IoT is the network of physical devices, vehicles, home appliances and other items embedded with electronics, software, sensors, actuators and connectivity that enable these objects to connect and exchange data. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing internet infrastructure.[1-3]

Experts estimate the IoT will consist of about 30 billion objects by 2020.[4] It is also estimated that the global market value of IoT will reach US$7.1 trillion by 2020.[5]

A growing portion of IoT devices is created for consumer use. Examples of consumer applications include connected car, entertainment, home automation, wearable technology, quantified self, connected health, and appliances such as washers/dryers, robotic vacuums, air purifiers, ovens and refrigerators/freezers that use Wi-Fi for remote monitoring.[6] Gateway applies such technology to lift cars.

Connect the Car to the Outside World

In traditional lift systems, cars are passive; i.e., they lack means suitable for communication, the ability to provide the user with audio and video signals, etc. If present, the auxiliary communication means (traditional TV screen, touchpad, etc.) affects the appearance and design of the space inside the car. Such devices have a limited quality in terms of design opportunities, video dimensions and brightness, and custom solutions. Moreover, TV screens and touchpads are exposed to various risks (e.g., vandalism and robbery).

Gateway provides new solutions. It hides the whole hardware behind a mirror, avoiding the above-mentioned risks. It provides architects and designers a new opportunity to create elegant lift cars. The "wow effect" is also added, deriving from the new communication and digital signage system. It also opens the door to multiple and real-time management of communication on every car from a single remote point. Its enhanced communication and interactive features are in accordance with Lift Directive 2014/33/EU and Machinery Directive 2006/42/EC.

Display Technical Specifications

	Feature	42 in.	49 in.	55 in.
Power	Power supply	100-240V, 50/60 Hz	100-240V, 50/60 Hz	100-240 V, 50/60 Hz
	Power type	Built in	Built in	Built in
	Power consumption	110 W	125 W	140 W
Display	Dimensions	949 X 555 X 32 mm	1095 X 637 X 32 mm	1230 X 714 X 32 mm
	Resolution	FHD	FHD	FHD
	Contrast ratio	1,300:1	1,300:1	1,300:1
Weight	850 X 2,130 mm	35 kg	39 kg	45 kg
	950 X 2,130 mm	37 kg	41 kg	47 kg
	1100 X 2,130 mm	41 kg	45 kg	51 kg

Table 1

Figure 1: Connecting the car to the outside world

Figure 2: Gateway rendering

Video With Touchscreen Technology

Gateway applies IoT to car mirrors, making a normal mirror a completely new multimedia tool connected to the internet. If switched off, it serves as a traditional car mirror. Optionally, it can become a full-video interactive touchscreen. This feature allows maintenance operators to read operational parameters directly on site and opens the door to many other options and services that need interaction between the system and user.

System Features

The system's display is designed to operate 24/7 with high brightness. The video system can be permanently active or activated by sensors for proximity, light, weight, etc. Its touch mode can be activated/deactivated remotely or locally. The display's features are:

- Resolution: full high definition at 1920 X 1080 (FHD)
- Connectivity options (either offline or online connection): local-area network (LAN), Wi-Fi, HDMI, DVI-D, OPS, USB, Secure Digital card, IR, audio or RJ45
- Display dimensions: 42, 49 and 55 in., among others
- Display orientation: horizontal or vertical.

Structure

Frame

The mirror is a tailor-made product with a frame made of special aluminum profiles that support the whole structure and affix to the wall of the car. The frame holds the tempered mirror and digital display. The affixing system, which can be personalized, has affixing points at the top and bottom transoms with screws that can be easily hidden. The frame provides a gap between the hardware and the wall for all heat to evacuate. The structure is lightweight and slim, and has negligible impact on rated load or car area. Mirror thickness is 35-40 mm.

Glass

The mirror glass is tough and reliable. It is based on the LU-VE Group/TGD technology used in doors for refrigerated cabinets in shops and supermarkets (heavy duty and impact resistant). The glass is tempered according to EN 12150 with thermally toughened soda lime silicate safety glass. Its tensile strength is 150 N/mm², which is about five times that of normal glass. Moreover, in case of breakage, the glass shatters into small, blunt-edged fragments to help prevent damage and injuries. Finally, it has a reflective treatment providing a mirror-like effect when the screen is dark (turned off), while it is transparent when the screen is lit (turned on).

Connectivity

The Gateway system has multiple possibilities for connection with the digital world. Once it is plugged into power with a simple

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GATEWAY - DISPLAY TECHNICAL SPECIFICATION

		55"	49"	42"
PANEL	Screen Size	54.64 inches (1387.80mm) diagonal	48.50 inches (1232.00mm) diagonal	41.92 inches (1064.67mm) diagonal
	Panel Technology	IPS	IPS	IPS
	Aspect Ratio	16:09	16:09	16:09
	Native Resolution	1,920 x 1,080 (FHD)	1,920 x 1,080 (FHD)	1,920 x 1,080 (FHD)
	Brightness	700cd/m2	700cd/m2	700cd/m2
	Contrast Ratio	1,300:1	1,300:1	1,300:1
	Viewing Angle (H x V)	178 x 178	178 x 178	178 x 178
	Response Time	1ms (G to G), 8ms (MPRT)	8ms (G to G BW) typ.	8ms (G to G BW) typ.
	Surface Treatment	Hard coating (3H), Anti-glare treatment of the front polarizer (Haze 10%)	Hard coating (3H), Anti-glare treatment of the front polarizer (Haze 10%)	Hard coating (3H), Anti-glare treatment of the front polarizer (Haze 10%)
	Life time (Typ.)	50,000 Hrs min.	50,000 Hrs min.	50,000 Hrs min.
	Operation Hours	24 Hrs / 7 Days	24 Hrs / 7 Days	24 Hrs / 7 Days
	Orientation	Portrait & Landscape	Portrait & Landscape	Portrait & Landscape
CONNECTIVITY	Input	HDMI (2), DP, DVI-D, Audio in, OPS		
	External Control	RS232C in/out, RJ45, IR / Light sensor, Pixel sensor, USB 3.0		
	Output	DP, External Speaker out		
PHYSICAL SPECIFICATION	Bezel Color	Black	Black	Black
	Bezel Width	7.4 mm (T/L/R/B even)	7.4 mm (T/L/R/B even)	7.4 mm (T/L/R/B even)
	Monitor Dimension (W x H x D)	1,230 x 714 x 32 mm	1,095 x 637 x 32 mm	949 x 555 x 32 mm
	Weight (Head)	20.7 kg	15.6 kg	12.5kg
	Monitor with Optional Stand Dimension (W x H x D)	1,230 x 776 x 298 mm	1,095 x 700 x 298 mm	949 x 618 x 298 mm
	Weight (Head+Stand)	22.1 kg	17.0 kg	13.9 kg
	VESATM Standard Mount Interface	400 x 400 mm	400 x 400 mm	400 x 400 mm
ENVIRONMENTAL CONDITION	Operating Temperature	0°C to 40°C	0°C to 40°C	0°C to 40°C
	Operating Humidity	10% to 80%	10% to 80%	10% to 80%
POWER	Power Supply	100-240V~, 50/60Hz	100-240V~, 50/60Hz	100-240V~, 50/60Hz
	Power Type	Built-In Power	Built-In Power	Built-In Power
	Power Consumption Typ.	140 W (TBD)	125 W (TBD)	110 W (TBD)
	Pow. Cons. Smart Energy Saving	100 W (TBD)	90 W (TBD)	80 W (TBD)
STANDARD (CERTIFICATION)	Safety	UL / cUL / CB / TUV / KC	UL / cUL / CB / TUV / KC	UL / cUL / CB / TUV / KC
	EMC	FCC Class "A" / CE / KCC	FCC Class "A" / CE / KCC	FCC Class "A" / CE / KCC
	ErP / Energy Star	NA / Yes (Energy Star 7.0)	NA / Yes (Energy Star 7.0)	NA / NA
MEDIA PLAYER COMPATIBILITY	OPS Type Compatible	Yes	Yes	Yes
	External Media player Attachable	Yes (MP500/MP700)	Yes (MP500/MP700)	Yes (MP500/MP700)
SOFTWARE COMPATIBILITY	SuperSign W/Lite	Yes	Yes	Yes
	SuperSign C	Yes	Yes	Yes
ACCESSORIES	Basic	Remote controller (2ea batteries included), Power cord, IR/Light sensor receiver, QSG, Regular book (depend on regional standard), HDMI cable Optional		
	Optional	SP-2100 (External speaker), ST-200T, LSW440S, AN-WF500 (Wi-Fi USB dongle), KT-OPSA (OPS kits), KT-SP0 (Pixel sensor)		
SPECIAL FEATURES		Temperature sensor, Auto brightness sensor, Tile Mode, DPM select, DPM wake up, Energy saving, Smart energy saving, File play with USB, PIP/PBP(2), Internal memory 16GB (System 4GB + Available 12GB), Wi-Fi dongle ready (802.11n) , USB		

Table 2: Gateway technical specifications

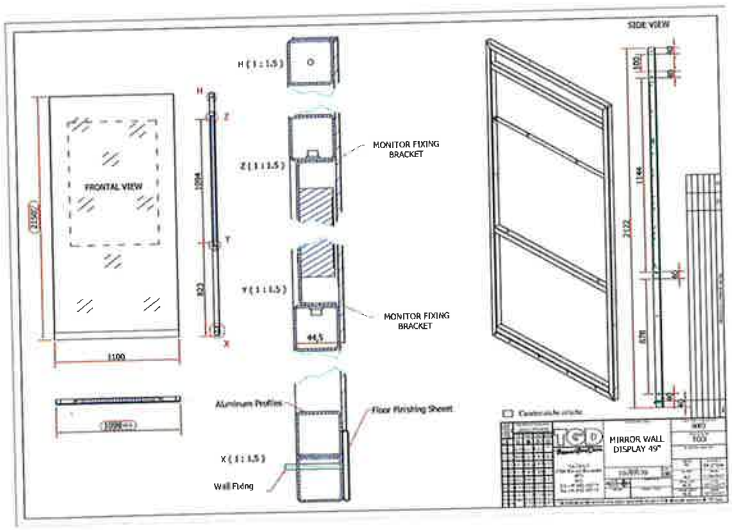

Table 3: Frame and mirror structure for 49-in. model (dimensions: 1,100 X 2,150 mm)

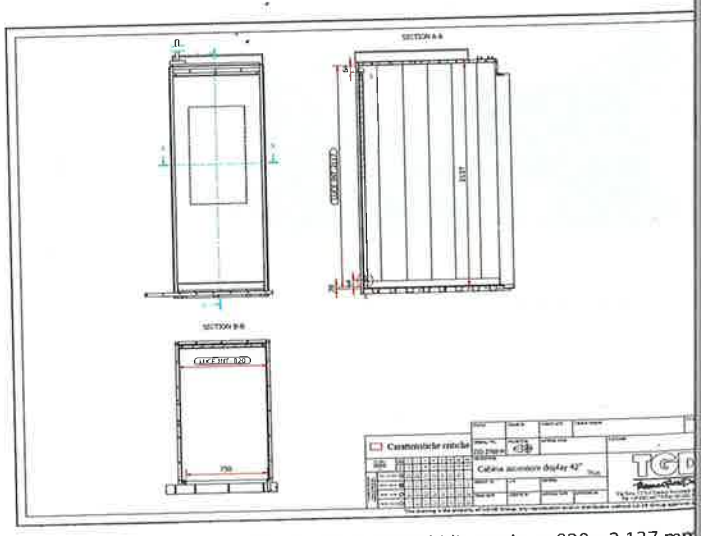

Table 4: Mirror car integration for 42-in. model (dimensions: 820 x 2,137 mm

Figure 3: First Gateway delivered; photo courtesy of the Wittur Group

PC cable, it can be connected to the local network by LAN or Wi-Fi and access the internet. Once connected, the system becomes a real interface that displays a variety of content that can be managed on three different levels.

Entry Level

Once connected, the system runs a basic software with a certain number of templates that can be customized through a remote PC connected to the same network. Once the contents are completed, the system asks for the scheduling time and duration, and transfers the contents to the display. It is possible to schedule a variety of content at different times and personalize (only existing) templates with pictures and videos (no connection to an RSS feed).

Pro Level

This level has all the features of the entry level but with a wider range of templates. It also provides the opportunity to create new content layouts and connect to an RSS feed. It still operates on a local network, but the system can manage a group of displays logged on the same network. The user can manage content distribution for all the connected devices from a single PC, including giving different scheduling and layout to each device.

Advanced Level

This level has all the features of the pro level, adding the opportunity to manage a network of devices connected to different local networks, regardless of physical location. It uses dedicated hardware and software to connect all the devices through the internet. This level is mandatory when the system integrates a TV camera or any other interface system controlled from a remote place.

Figure 4: Alessandro Cremaschi and Gateway at Interlift 2017

Applications and Functions

Communication and Digital Signage

Digital signage is a subsegment of electronic signage defined as a "remotely managed digital display typically tied in with sales, advertising and marketing"[7] or as "a network of electronic displays that are centrally managed and individually addressable for the display of text, animated or video messages for advertising, information, entertainment and merchandising to targeted audiences."[8] They can be found in public spaces, transportation systems, museums, stadiums, retail stores, hotels, restaurants, corporate buildings, etc., to provide wayfinding, exhibitions, marketing and outdoor advertising.[9]

In this case, the Gateway becomes a communication and digital-signage device, opening the car to the outside world. It can transmit information, photos, videos, websites, advertising and more, and remotely change the content in real time. The user can also ask and receive customized information, limited only by the services provided by the manager.

Emergency Mode

Calm passengers are safe passengers. In the event of an alarm, the new system might improve the safety of users, becoming a ne bidirectional communication channel between the passenger and

Contin

Figure 5: Communication examples

Figure 6: Touchscreen feature

outside world. A micro webcam enables audio/visual communication between the safety/assistance service and passenger. The safety operator might see what's going on inside the car: health emergency, special needs (i.e., writing messages on the screen for hearing-impaired passengers), presence of children, etc. On the passenger side, the possibility to see a human face (rather than just have an audio conversation) might reduce panic and fear, and better understand communication from the safety/assistance service.

Maintenance Support

Given the possibility to transform the mirror into the touchscreen of a remote computer (i.e., servicing headquarters, control room, etc.), Gateway can support maintenance personnel onsite. Maintenance staff can connect to the service center and access such files as manuals, instructions, documents, etc. It might also provide technical information regarding the lift system on its touchscreen.

Due to its interactivity, Gateway might also become a powerful device to support programmed- and predictive-maintenance service, displaying useful information/tools (graphics, video recordings, working parameters, etc.) to the onsite technician.

Conclusions

Gateway applies IoT technology to car mirrors, transforming them into new, powerful, revolutionary devices. The system can be installed not only inside the car, but also in the lift lobby to provide:

- Digital signage (product information, advertising and promotion, brand building, etc.)
- Audience measurement systems (number, gender and age group of passengers; opening/closing cycles; etc.)
- User activity (gaming, marketing, interaction activated by proximity sensors, mobile social engagement, etc.)

Some, if not all, of these features might be applied to lift cars to improve information, safety and maintenance. Lifts might provide real-time, user-friendly:

- Public and internal information (news, weather forecast, building directory and map, corporate messages, etc.)
- Local advertising
- Interactive video, which might reduce perceived wait time, both in cars and the lift lobby

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- Safety information (emergency exit, building map, passenger behavior guidelines, etc.)
- Maintenance (user-friendly and easy-to-access technical information during service operation, remote file access, diagrams, functions display, etc.)
- Passenger tracking (gender, age group, boarding modes, etc.)
- Ask and receive customized information/service focused on the user's needs (e.g., turning the touchscreen into a very large push button for people with impaired view)

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