

The IoT mirror for lift cars

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Abstract. We present here “Gateway”, IoT (Internet of Things) technology applied to glass mirrors in lift cars (Italian Patent No. 102017000031537 – 22 March 2017; European patent pending). It transforms common lift car mirrors into interactive touch-screen displays (managed remotely via internet).

Unlike traditional lift car video screens, the system has many different purposes:

- touch-screen interactive display;
- digital signage and communication;
- emergency connection to 24-hour servicing (through an additional micro camera);
- maintenance support (direct video/audio connection between HQ and maintenance personnel on site).

The system is extremely light and thin, with no impact on lift car weight and space. The whole system is a tailor-made product that can be easily adapted to all situations (new cars and modernisation).

1 INTRODUCTION

1.1 Traditional lift cars

Lift cars are traditionally equipped with pushbuttons to control the lift operation and to handle emergencies. However, these facilities in cars have the drawback of limiting communications between the user and the operational centre merely to an audio system.

Furthermore, warnings, messages, information and similar, are traditionally displayed in the lift car by means of posting paper notices or using small closed-circuit TV screens, exclusively devoted to this function.

The main object of the “magic mirror” is to provide a lift car where, unlike traditional equipment of this type, communication is not limited to audio signals but also includes video signals and internet connection, to provide features allowing the user to interact with the outside world and vice versa.

Another object of the invention 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, whose dimensions do not affect the interior design or are undesirable in the smallest cars.

This new feature is particularly relevant, as it enables the lift owner to sell commercial communication/advertising with quick pay-back on his investment.

1.2 The IoT revolution

The Internet of Things (IoT) is the network of physical devices, vehicles, home appliances and other items embedded with electronics, software, sensors, actuators, and connectivity which enable these objects to connect and exchange data. Each thing is uniquely identifiable through its embedded computing system but is able to inter-operate within the existing internet infrastructure [1],[2],[3].

Experts estimate that 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 \$7.1 trillion by 2020 [5].

A growing portion of such IoT devices are created for consumer use: i.e. connected cars, entertainment, home automation, wearable technology, connected health, and appliances (such as washer/dryers, robotic vacuums, air purifiers, ovens, or refrigerators/freezers that use Wi-Fi for remote monitoring) [6].

All these technologies are now applied to lift car mirrors.

2 CONNECT THE LIFT CAR TO THE OUTSIDE WORLD

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

The system presented here provides new solutions. It hides the entire hardware behind a mirror (see below for glass protection technical details), avoiding the above-mentioned risks. It provides architects and designers with a new opportunity to create elegant, luxury lift cars, and includes the “wow effect”, deriving from the new communication and digital signage system.

Furthermore, the system opens the door to multiple and real-time management of communication on every single lift car, from a single remote point.

The “magic mirror” invention is for the field of cars for lifts and goods lifts (Lift Directive 2014/33/EU) and the field of carriers for lifting platforms (Machinery Directive 2006/42/EC).

The system applies the IoT technology to lift car mirrors, transforming them into new, powerful, revolutionary devices. It turns a normal mirror into a completely new multimedia tool, connected to the internet.

The external aspect (if switched off) is a traditional lift car mirror, but unlike conventional systems, this new solution offers new functions never before seen in a car, coupled with an elegant layout.



Figure 1: Rendering

2.1 Video with touch-screen technology

As an option, the mirror becomes a full screen touch video which can create interaction between the passenger/user and the outside virtual world (via the web). 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 the service personnel.

2.2 System features

The system integrates a professional display, specially designed to operate 24 hours a day and 7 days a week with high brightness efficiency. The video system can be permanently active, or (depending on owner needs/requirements) it can be activated by sensors (proximity, light, weight, etc.). The touch mode can be activated/deactivated remotely or locally (depending on owner needs/requirements).

The displays features are as follows:

- Full HD (1920x1080 resolution);
- Connectivity options (either offline or online connection): LAN, Wi-Fi, HDMI, DVI-D, OPS, USB, SD CARD, IR, Audio, RJ45;
- Display dimensions (touch-screen video area - standard options): 42”, 49” and 55” (other options available);
- Display orientation: horizontal or vertical.

Table 1: Technical specifications

	Feature	42"	49"	55"
POWER	Power supply	100-240V~, 50/60Hz	100-240V~, 50/60Hz	100-240V~, 50/60Hz
	Power type	Built In	Built In	Built In
	Power consump.	110 W	125 W	140 W
DISPLAY	Dimensions	949x555x32 mm	1095x637x32 mm	1230x714x32 mm
	Resolution	1,920x1,080 (FHD)	1,920x1,080 (FHD)	1,920x1,080 (FHD)
	Contrast ratio	1,300:1	1,300:1	1,300:1
DIMENSIONS & WEIGHT	850 x 2130 mm	35 Kg	39 Kg	45 Kg
	950 x 2130 mm	37 Kg	41 Kg	47 Kg
	1100 x 2130 mm	41 Kg	45 Kg	51 Kg

2.3 Frame & mirror structure

2.3.1 Frame

The magic mirror is a tailor-made product that can be easily adapted to all situations (new cars and modernisation).

It has a frame made of special aluminium profiles that support the whole structure, its weight and gives the fixing point to the wall of the car. The frame holds the tempered mirror and the digital display.

It can be installed on new cars as well on existing ones (modernisation), simply adapting the fixing system. The fixing system might be personalized depending on the individual design situation. Owing to the rigidity of the whole system, fixing points are at the top and bottom transoms and their screws can be easily hidden.

The whole structure is lightweight, slim and elegant:

- negligible impact on rated load;
- negligible impact on lift car area (mirror thickness 35/40 mm).

The car frame structure is provided on the top transom with an air space to evacuate the heat generated by the electronic hardware.

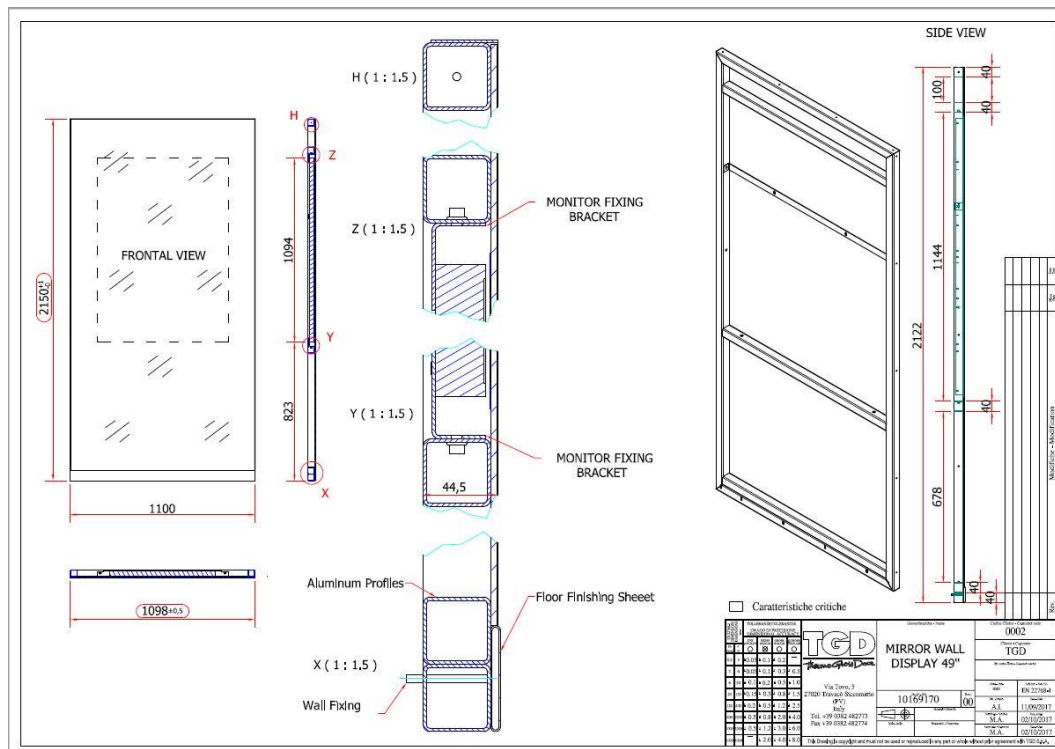


Figure 1: Frame & mirror structure (dimensions: 1100 x 2150 - 49")

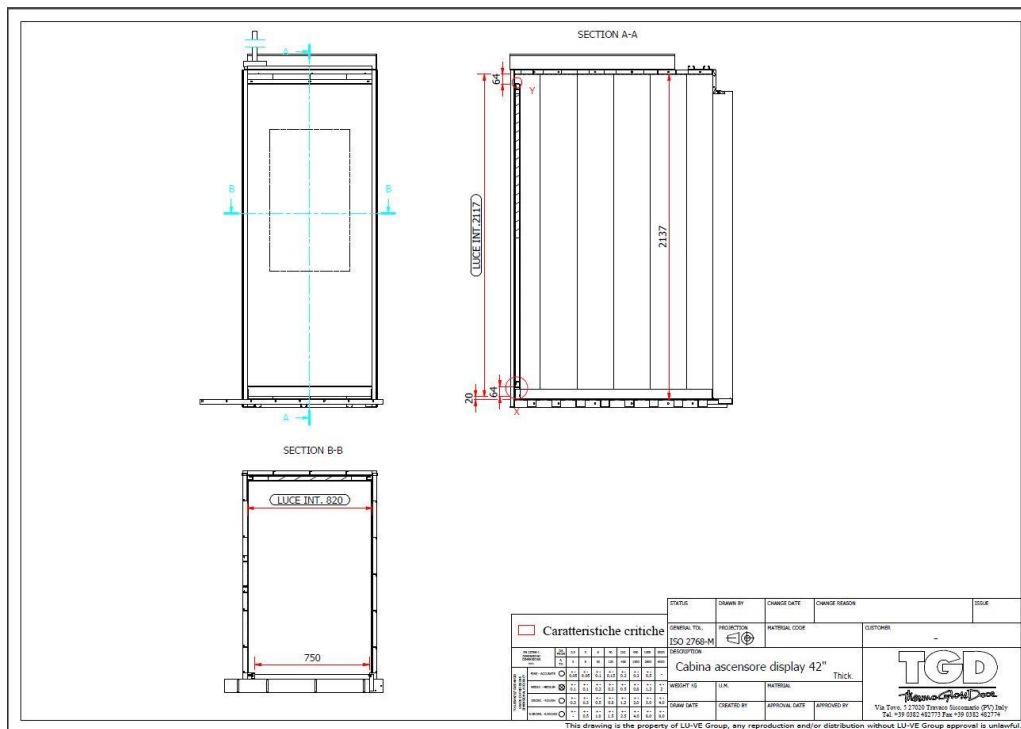


Figure 2: Mirror car integration (dimensions: 820 x 2137 - 42")

2.3.2 Glass

The mirror glass is tough and reliable. It is based on a technology already applied to glass doors for refrigerated cabinets, in shops and supermarkets (intensive use, impact resistant, high reliability over time). The glass is tempered according to EN12150 (Glass in buildings – Thermally toughened soda lime silicate safety glass) which is specific for the tempering of flat glass (it also complies with ANSI Z97.1 Safety glazing materials used in buildings). The tensile strength of the tempered glass is 150N/mm^2 , which is about five times that of normal glass. Moreover, in case of breakage, the glass shatters into small blunt-edged fragments that do not cause damage and injuries to people.

The glass panel has a reflective treatment providing a mirror-like effect when the screen is dark (or turned off), while it is transparent when the screen is lit, i.e. turned on.

2.3.3 Adaptable design

The system design is customizable both for the mirror and for finishing. Elegance and adaptability are a very important aspect of the structure design, as the magic mirror is supposed to be installed in high-end lift systems. It is also possible to customize the mirror serigraphy (screen printing), according to the customer's needs and requirements (e.g. logo).

3 CONNECTIVITY

The “magic mirror” has multiple possibilities of connection with the digital world. Once it is plugged in to the power source with a simple PC cable, it can be connected to local network (by LAN or Wi-Fi) and then have access to the internet.

Once it is connected, the system becomes a real interface that displays an infinite variety of contents that can be managed on three different levels.

3.1 Entry level

On connection to the local LAN (by cable or Wi-Fi), the system runs basic software with a certain number of templates which can be customized through a remote PC connected to the same network. Once the contents are completed, the system asks for the scheduling times and duration and transfers the contents to the display. It is possible to schedule many different contents at different times. At this level it is possible to personalize only the existing templates, with pictures and videos (no connection to RSS feed).

3.2 Pro level

This level has all the features of the Entry Level, but has a wider range of templates. It also provides the opportunity to create new content lay-out and connection to RSS feed. It still operates on a local network but the system can manage a group of displays logged on to the same network. The owner can manage the contents distribution, from a single PC for all the connected devices, giving different scheduling and layout to every single device.

3.3 Advanced level

This level has all the features of the Pro Level and in addition provides the opportunity to manage a network of devices that are connected to different local networks and are physically located far away from each other (e.g. international hotel chains). Using dedicated hardware and software, it connects all devices through the internet, so it allows the owner to create, schedule and distribute contents from a central office. This level is mandatory when the system integrates a micro TV camera or any other interface system controlled from a remote place.



Figure 3: First magic mirror delivered
(courtesy: Wittur Group)

4 APPLICATIONS & FUNCTIONS

The magic mirror is a new clever solution for lifts installed in hotels, shopping malls, office buildings, high-rise buildings, public buildings, cruise ships, airports, railway stations, hospitals, exhibition centres, high-end private lifts and home lifts, etc.

4.1 Communication and digital signage

Digital signage is 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]

Digital signage is a sub-segment of electronic signage. Digital displays use technologies such as LCD, LED and projection to display content such as digital images, video, streaming media, web pages, weather data, restaurant menus, texts, etc. They can be found in public spaces, transportation systems, museums, stadiums, retail stores, hotels, restaurants, and corporate buildings etc., to provide wayfinding, exhibitions, marketing and outdoor advertising [9].

In this case, the magic mirror becomes a communication and digital signage device opening the lift car to the outside world. The mirror becomes a new channel of communication towards users. The system is able to transmit information, photographs, videos, web pages, advertising and much, much more, with the possibility of remotely changing the contents in real time.

The passenger/user can also ask and receive customised information, focused on his/her needs, within the services provided by the manager.



Figure 4: Communication example

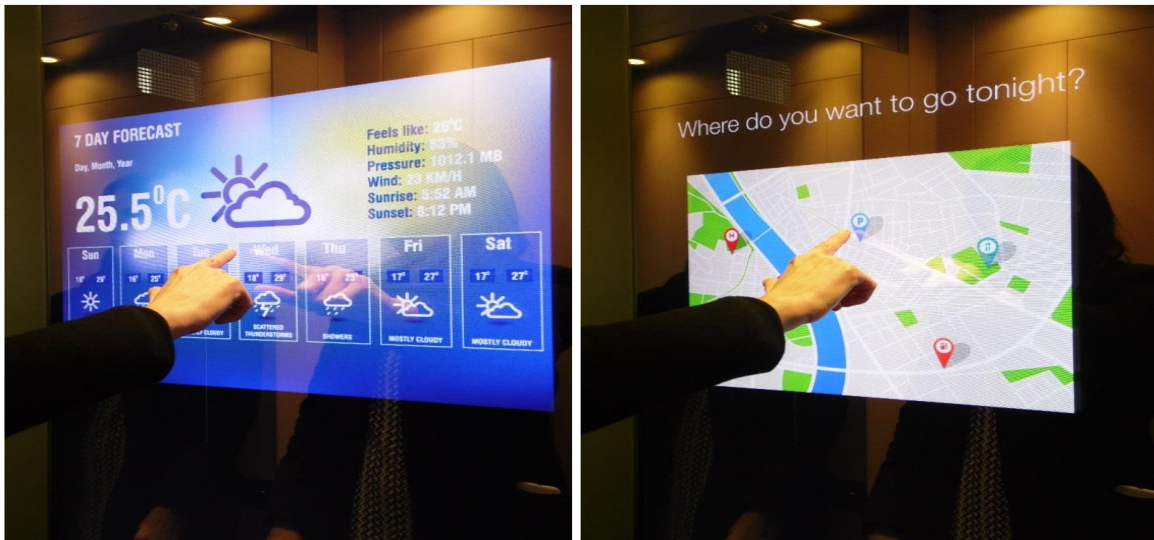


Figure 5: Touch-screen feature

4.2 Emergency mode

Calm passengers are safe passengers. In the event of an alarm, the new system can improve the safety of users, becoming a new bi-directional communication channel between the passenger and the outside world (emergency connection to 24-hour rescue service).

Through the application of a micro web-cam (invisible – hidden behind the mirror), the car has an audio/visual communication between the safety/assistance service and the passenger. The safety operator might see what is going on inside the car: health emergency, special needs (i.e. writing messages on the video screen for hearing-impaired passengers), presence of children, false alarm detection, etc.

On the passenger side, the ability to see a human face (rather than just hear an audio conversation) might reduce panic and fear.

Moreover, the audio/video system significantly improves the communication quality between the passenger/user and the safety/assistance service.

4.3 Maintenance support

Given the possibility of transforming the mirror into the touch-screen of a remote computer (i.e. servicing HQ, control room etc.), the system is a new powerful tool to support maintenance personnel on-site.

Audio-video communication coupled with touch-screen technology allows maintenance staff to connect to the service centre, access files (manuals, instructions, documents, navigate technical information to facilitate and speed up operations on the lift system, etc.). It can also provide better and faster technical information regarding the lift system on a large, user-friendly touch screen.

Due to its interactivity, the system can also turn into a powerful device to support programmed and predictive maintenance service, displaying useful information/tools (graphics, video recording, working parameters, etc.) to the operator on site.

5 CONCLUSIONS

The magic mirror applies IoT technology to lift car mirrors, transforming them into new, powerful, revolutionary devices. The system can be installed not only inside the lift car but also in the lift lobby and on floor doors to inform, entertain and guide users.

The system derives from a technology already applied to glass doors for refrigerated cabinets in shops and supermarkets. In this application field, it plays a further important role for other possible applications:

- digital signage (product information, advertising and promotion, brand building, etc.);
- audience measurement systems (how many people there are in front of a fridge, gender, age group, opening/closing cycles, etc.);
- user activity (gaming, fidelity card activities, unlocking special offers, interaction activated by proximity sensors, mobile social engagement, etc.).

Some, if not all, of these new features might be applied to lift cars, to improve information, safety/emergency and maintenance.

Lifts can provide real-time user-friendly:

- public & internal information (news, weather forecasts, local information, building directory with a map, corporate messages, etc.);
- commercial advertising on promotions, sales and other services close to lift location (in building or in the area);
- information to enhance the customer service experience in special buildings (tourist and cultural attractions, museums, exhibitions, etc.);
- enhancing customer experience (an interactive video might reduce perceived waiting time, inside lift cars and in lift lobby);
- safety information (emergency exit, building map, passenger behaviour guidelines, etc);
- maintenance (user-friendly and easy to reach technical information during service operation, remote file access, diagrams and functions display, etc);
- passenger tracking (gender, age group, boarding modes, etc.);
- two-way communication of customised information/service focused on the user's needs (e.g. turning the touch screen into a very large push button for people with impaired view).

In the end, when dealing with IoT possibilities, the only limit is... imagination.

BIOGRAPHICAL DETAILS

Fabio Liberali is co-owner, member of the Board of Directors and head of the Communications and Public Relations Department at LU-VE Group (an international HVACR company, listed on the Milan Stock Exchange). He was the editorial manager of "Elevatori – The European Elevator Magazine" for some 23 years and a contributor to several international lift industry magazines. He is a member of Elevatori Technical Committee, on an honorary basis. He has been the Team Leader of the Italia Magnifica/Interlift 2013. He has been a consultant for several communication departments, trade associations, trade fair organisers, companies and others. He is the founder partner and co-owner at Ekuota (online, corporate finance risk management). He is co-owner of the Gateway patent. (www.luvegroup.com).

Alessandro Cremaschi is co-founder at TGD-Thermo Glass Doors (a member company of LU-VE Group). He is a member of the TGD Board of Directors and head of New Business Development. He holds a university degree in Civil Engineering (1992) and he has registered, as inventor, seven European Patents, regarding improvement of glass doors for refrigeration including LED technologies for product illumination and product branding and advertising. He has a 25 year-long experience in the use of glass and aluminium both for architectural applications (curtain walls – windows - interior partitions) and commercial refrigeration doors for negative and positive temperature cabinets. He is co-owner of the Gateway patent. (www.tgd.it).

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