Connected lifts. Value for Maintenance.

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Abstract. In the current era of communications, computing, data processing capacity and the Internet of Things, the industry in general and industrial equipment maintenance services are forced to change their operating processes to adopt and take advantage of this technology. All this represents a greater revolution than the one caused by the steam engine in the 19th century.

This revolution represents a huge technological leap whose use necessarily involves reinventing business processes and services.

In the elevation sector, there are different issues to solve:

1. Sensors: a combination between standard sensors (independent or not from lift working) and information from each controller.
2. Solving the way this information is captured within the lift, to be transmitted outside and the way to receive information to be "ordered" to the lift.
3. Communication level: specially focused on security (to avoid non-controlled traffic of information).
4. Platform to receive/analyse/send information to the lift.
5. Added value/services around the platform.

Nowadays, these are different technologies with few technological companies having the technical capacity for all of them, so the real technical value comes from the integration of all of them. The different ways of technical integration have an impact on the business model built around them and the type of services provided to the different stakeholders. From a technical point of view, the most important challenge has been the integration of all these levels that compose IoT for lifts and the capacity to act over different types of lifts.

An ecosystem was created with all these technical elements, with different technologies and partners to add value to this ecosystem.

1 TECHNOLOGY IN THE LIFT INDUSTRY

We are currently experiencing the consolidation of already known technologies, such as:

- IOT [1]
- Wifi
- LiFi [2]
- NB-OIT [3]
- 5G
- IA: Machine Learning, Deep Learning, Cognitive learning
- Computer Vision
- Augmented reality
- Services on Cloud
- Edge Computing [4]
- Virtualization
- Blockchain [5]
- Digital Twins [6]

These types of technologies are now available to small and medium-sized companies and are slowly making their way into the elevator sector, characterized by its traditional positioning.

At present, maintenance companies are beginning to connect elevators and collect data, but their use is limited and has little effect on maintenance processes.

In the future, these technologies are expected to change both maintenance itself (AI, Mixed Reality, Artificial Vision, etc.), as well as the relationship with the client (Cognitive learning, Machine Learning), from contracting services (Blockchain) to elevator design (Cloud services, Saas) and its manufacturing (digital twins). The tendency is to involve the customer in the lift's life cycle.

The main applications of IoT in elevators are:

- Predictive maintenance.
- Remote monitoring
- Fault diagnosis and prediction.
- Advanced reporting
- Connectivity management.
- Energy management.
- Smart advertising.
- Traffic management.
- Elevator access control.
- Elevator safety.
- Smarts contracts.

2 TECHNICAL CHALLENGES IN THE ELEVATION SECTOR

In the elevation sector, there are different technical challenges to be solved:

2.1 The existing fleet of lifts: high initial investments are needed in elevator modernization and IoT integrations.

Due to the enormous legacy of existing elevators, adapting them to achieve levels of connectivity for their management means carrying out total or partial modernization of the elevators.

2.2 Government support for Smart City [7] Development creating normative and standardized IoT connectivity.

Today there is no regulation for the standardization of connectivity for elevators or escalators. A standardized type of operations to be carried out through IoT on elevators does not exist, nor about the type of information to be reported by elevators. From a technical point of view, there is no regulation for standard protocols for communication with the lift.

At one extreme, the logical and physical communication protocol and even the structure and standardization of information could be regulated.

2.3 Sensors

The integration of standard sensors, whether independent or interconnected with the elevator's operation, is crucial. These sensors collect relevant data from the lift, providing valuable insights into its performance and maintenance needs. Sensors provide information. The main actuator on the lift is the lift controller.

Additionally, information from each lift controller may be collected to provide a comprehensive view of the elevator's functioning.

2.4 Connectivity IoT level [8]. Specially focused on security (to avoid non-controlled traffic of information).

Communication is a critical aspect of IoT systems, especially in terms of ensuring data security and preventing unauthorized access or tampering.

Leading industry security measures must be incorporated to protect against unauthorized access or data breaches. Utilizing encryption protocols, secure communication channels, and authentication mechanisms are essential to guarantee that the information transmitted to and from the elevator is protected from potential threats.

2.5 Platform to receive/analyse/send information to the lift.

An essential component of the IoT ecosystem is a powerful platform capable of receiving, analyzing, and transmitting data to and from the elevator.

It must serve as the central hub for managing the vast amount of data collected from elevators in real-time. It provides comprehensive data analysis, generating actionable insights for predictive maintenance, performance optimization, and operational efficiency. Additionally, the platform enables seamless communication with the elevator, allowing commands to be sent for maintenance requests, parameter adjustments, or any other necessary actions.

Another critical aspect of an IoT platform for lifts is its ability to scale and accommodate different types of elevators across various locations. The sheer volume of data generated by IoT-enabled lifts necessitates robust storage and advanced analytics capabilities.

Machine learning algorithms and predictive analytics models help identify patterns, detect anomalies, and forecast maintenance requirements. These insights empower facility managers and maintenance teams to make data-driven decisions, optimize operations, and enhance elevator performance.

2.6 Remote monitoring and control

With an IoT platform for lifts, remote monitoring and control capabilities can revolutionize the way elevators are managed and serviced.

Remote control functionality empowers technicians (and even owners) to perform certain maintenance tasks without physically accessing the elevator. For example, firmware updates, parameter adjustments, or software configurations can be remotely executed, minimizing service disruptions and optimizing maintenance operations.

2.7 Predictive maintenance and condition monitoring

One of the key advantages of an IoT-enabled lift system is the ability to implement predictive maintenance strategies and condition monitoring.

By continuously monitoring elevator performance, early warning signs of potential failures or deviations from normal operation can be detected early. Predictive maintenance algorithms analyse the collected data, identifying patterns and anomalies that indicate impending issues. This allows maintenance teams to intervene proactively, scheduling repairs or component replacements before failures occur. Predictive maintenance minimizes unplanned downtime, reduces repair costs, and extends the lifespan of elevator components.

Furthermore, condition monitoring capabilities enable real-time assessment of elevator health. By tracking parameters such as motor temperature, vibration levels, and door operations, the system can identify signs of wear and tear, enabling maintenance teams to address issues promptly and prevent major failures.

With collected data, predictive algorithms for machine learning can be trained to be integrated with an IoT platform as a separate piece of the global ecosystem.

2.8 Integration with Building Management Systems (BMS) [9]

A seamless integration between the IoT platform for lifts and the building's broader management systems enhances operational efficiency and streamlines facility management processes.

Integration with existing Building Management Systems (BMS) can enable centralized control and monitoring. Elevator data can be correlated with other building parameters, such as occupancy levels, energy usage, or HVAC [10] systems, providing a holistic view of facility operations. This integration facilitates intelligent decision-making, optimizing energy consumption, space utilization, and overall building performance.

This integration can be done through a global platform (Lift by IoT connected) with standard protocols (API REST [11] …) or locally in the building directly to the lift (SACADA [12], APIREST … proprietary protocols …)

3 CONCLUSION

The advent of IoT in the elevator industry represents a transformative opportunity to revolutionize maintenance services, optimize operations, and enhance the overall user experience. By addressing the challenges associated with sensors, data capture and transmission, communication security, platform capabilities, and value-added services, IoT solutions offer a scalable, secure, and efficient ecosystem for lifts.

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BIOGRAPHICAL DETAILS

Julio Gil Navarro is the Head of Digital Transformation for MACPUAR SA, responsible for IT systems.

He studied at the University of Seville, specialising in industrial engineering and organisation, and graduating in 1994. Before joining MACPUAR SA he worked in the energy and telecom sectors.