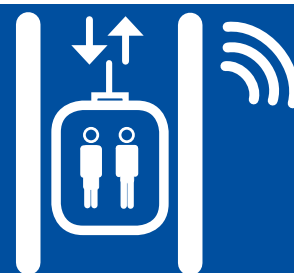


Condition Monitoring System



WEARwatcher



Founded 40 years ago

Manufacturer of measurement technology for elevators and escalators for over 20 years

Transporting people safely

A breakthrough in cloud-based condition monitoring devices has led to a path-clearing transformation in the field of lift maintenance. The demand for lift companies and technicians to carry out maintenance in the context of networked monitoring systems is now stronger than ever! At Henning GmbH, we are consistently working on putting together and developing the know-how for this.

We are making a substantial contribution to providing you with products which you are shaping the field of lift maintenance and making modern technologies available to your customers. Cloud-based monitoring devices and sensors are continually being developed and improved.

Our motto is "People in lifts - safe on every floor". With this thought in mind we develop and sell products for the safe use of lifts from our Schwelm headquarters.

Henning GmbH is renowned around the world for its long-standing experience in the measurement,



analysis and assessment of data of elevators and escalators. Our customers value our in-house development department for hardware, software and AI (Artificial Intelligence), which develops tailor-made solutions. Backed by profound knowledge of elevators and escalators and the growing demand for measurement technology, we are able to offer products that save time and costs during maintenance and servicing.

Leading edge through experience

We have been specialising in mobile measurement technology for lifts and escalators for many years. Thanks to a compilation of data based on some years of analysis of elevators/lifts and escalators, our technicians were successful in developing sophisticated algorithms from actual data and analysis of mobile acceleration measurement systems. Henning GmbH already effectively had the data used in condition monitoring.

Far ahead of the times

From the start today's **WEARwatcher** was far ahead of the times. The first condition monitoring project was successfully implemented as early as 2004 in cooperation with the BASF. This was well before intelligent networking of machines and processes with the help of information and communication technology was given a name and the designation of Industry 4.0.

Technologically, in a way we were too early to the market with our revolutionary system. In spite of this, condition monitoring continued to be internally developed in our company. In 2012, it was redesigned on the basis of the new available technologies (GSM, modems, cloud). In 2015, we presented a user-friendly system in the form of the **WEARwatcher**, where medium- and large-sized lift systems could easily be monitored.



Detecting problems and abnormalities before the lift system is negatively influenced

Thanks to our long-standing experience in elevator/lift measurement technology, we were developing trendsetting algorithms, which automatically record and assess the state of elevator/lifts and make it

possible to plan service calls by your technician in advance and to optimise them.

Problem ➡ From the perspective of the market



Qualified personnel

- Lack of qualified personnel
- Downtimes for maintenance/testing of the elevators/lifts/escalators



Original equipment manufacturer (OEM) monitoring systems for elevators/lifts

- High price
- Tailor-made for the lift of the OEM unit; not for third-party elevators/lifts/escalators



IoT elevator/lift monitoring solutions

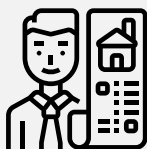
- Collected sensor data (vibration, distance, etc.) are not implemented into recommended actions

Problem ➡ From the perspective of interested parties



Supervisory authorities

- Safety defects and accidents
- Lack of specialists aggravates situation



Operators / Facility management companies

- Downtimes lead to complaints by the building occupants
- no uniform, cross-manufacturer overview of the status of elevators/lifts
- Responsible for elevators/lift safety



Management of elevator/lift companies

- Lack of qualified personnel
- Major competition for maintenance contracts
- Increasingly stricter laws and regulations



Specialists in elevator/lift companies

- Risky work environment
- Short time constraints with a high workload to minimise downtimes
- Repeat visits required due to missing spare parts or diagnosis tools

• Proven solution

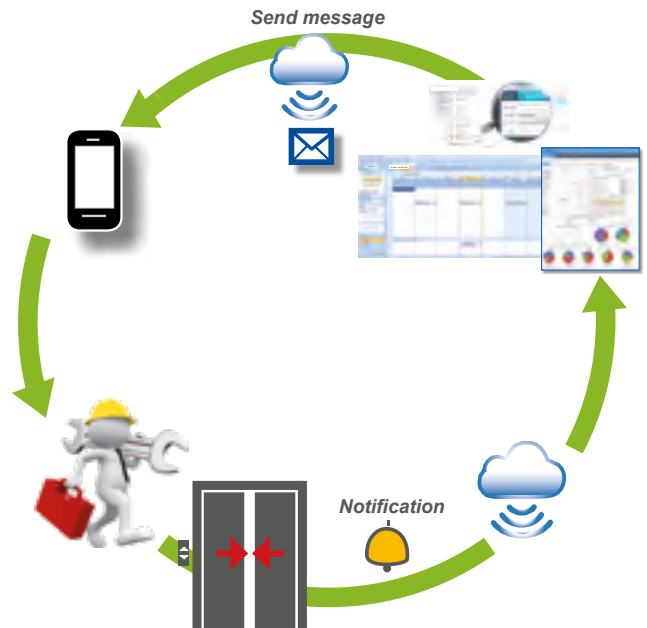
- Ride quality as per ISO 18738-1
- control-system independent monitoring for all types of elevator/lifts
- Proven with research since 2004
- Edge analytics function

• Boost in efficiency

- Real-time status monitoring
- Automatic event detection and real-time warnings
- Remote access to the sensor results
- KPIs for the elevator/lift and the maintenance recommendations
- Intelligent map view
- Inspection report for the digital elevator/lift service
- Configurable checklists for maintenance tasks
- Data history, report generation and analysis

• Future-proof and scalable

- open IoT platform, multiple Smart City applications
- Design with a view to safety



The smart solution ➡ Benefits for interested parties



Supervisory authorities

- Less safety problems and accidents
- Ride quality as per ISO 18738-1
- IoT for elevator/lift maintenance reduces inefficient staff deployment



Operators / Facility management companies

- Real-time warnings and notifications mean for faster reaction times and higher duty cycles
- More efficient operation via centralised monitoring
- 24/7 remote monitoring
- Decision-making based on data and improved information



Management of elevator/lift companies

- More issues resolved in a single visit
- Competitive advantage over companies not using IoT solutions
- Efficient spare part procurement



Specialists in elevator/lift companies

- 24/7 remote monitoring
- Early detection of wear of components
- Error diagnosis before visit to the elevator/lift
- Efficient spare part procurement

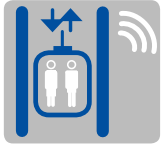


WEARwatcher

The **WEARwatcher** is an acceleration sensor combined with an integrated analysis unit. This drives condition monitoring of the most important physical parameters of the elevator/lift. Problems and abnormalities are detected by **WEARwatcher** before they negatively influence the elevator/lift system.

Thanks to the condition-oriented assessment, the use of a technician often becomes necessary only if corresponding indications are present.

- ✓ Increased availability
- ✓ Prevention of defects
- ✓ Minimisation of downtimes
- ✓ Planning maintenance
- ✓ Control-system independent
- ✓ Increasing service life of components
- ✓ Boost in service quality



Record actual condition

The **WEARwatcher** enables predictive maintenance of a lift and can be used, independent of the control system and manufacturer, on lifts of every age. Thanks to our long-standing experience in the lift measurement technology, we have been developing

trendsetting algorithms, which automatically record and assess the state of lifts, make it possible to plan service calls in advance and to optimise them.



Analyse and assess

As a real computing device, the **WEARwatcher** analyses recorded data in an in-depth manner, on site, on the elevator and sends the results in form of notifications, alarms, trends and condition

changes to the Henning **WEARwatcher** cloud. There, this data is further analysed by the use of artificial intelligence and self-learning algorithms.



Report & recommendation

For monitoring medium- and large-sized inventories of lift systems, Henning **WEARwatcher** cloud generates monthly reports, which enable easy

and efficient assessment and a ready display of recommended and needed actions.

Status reports of the most crucial physical parameters



Ride distance



Ø Drive time



Levelling



Duty Cycles



Guides



Ø Speed



Shaft efficiency



Maintenance



Drive



Ride quality



Vibrations



Traction sheaves



Doors



Load conditions



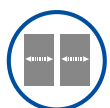
Ø Number of rides



Traction



Twisted ropes



Door reverses



Worn out grooves

Main Processing Unit

WEARwatcher

The **WEARwatcher** Main Processing Unit is an edge-processing unit installed on the car top. With a built-in sensor box to detect Acceleration, Distance travelled/ Displacement, Speed, Vibration etc. the **WEARwatcher** MPU is fitted to the cross head using screw holes in brackets on both sides and powered by 13A socket-outlet (3-pin) provided at the car top.

Edge Predictive Capability

The **WEARwatcher** device is able to do predictive analysis via a multi-threading application. The process of the measurement data acquisition reads the sensor data from the different sensors and stores it temporally in real-time. Complex and computationally intensive processes read the ride indices and the acceleration data and evaluate the data. Among other things in this process, evaluations based on ISO18738 (ride quality) and further analyses including frequency analysis are performed. The system is also able to detect abnormalities and defects. The results of these evaluations are sent as notifications to the cloud.



Hardware Advantages

- IP65 Protection
- Optional 3.5" TFT-Display
- Optional Gesture Control
- WiFi LongRange Connection
- LTE via internal modem and Ethernet for cloud communication
- Up to 4 Core 64Bit system, 4x1.8GHz
- 32bit security/realtime CPU
- 32bit realtime measurement CPU
500mips
- FPGA 1.2k LUTs
- Bluetooth 4.2 dual mode Classic/LE
- 2 GB RAM LPDDR4, 12.8GB/s bandwidth, bandwidth optimized interleaved addressing



Satellite Pre Evaluation Unit

WEARwatcher

The **WEARwatcher** satellite (PEU) is installed at the top of the elevator/lift shaft to collect data from sensors at the top of the hoistway and motor room. In case of multiple suspension, the rope load sensors are connected to a PEU on top of the hoistway (usually in the machine room). The PEU sends its data to the MPU, where the complete processing takes place.

The PEU requires a 13A outlet (3 pin) at the top of the elevator/lift shaft. The PEU data is transmitted to the MPU via proprietary 802.11LR protocol for security and reliable long distance communication.



Hardware Advantages

- IP65 Protection
- Optional Display
- WiFi LongRange Connection
- 32bit realtime measurement CPU 500mips
- Plus FPGA 1.2k LUTs
- Bluetooth 4.2 dual mode Classic/LE

Magnetic Door Switch(es)



The door movement switch(es) are able to detect door status ('door open' and 'door close'). This

is used to determine number and time of door movements/cycles and detection of possible jamming doors or defects at the door operator as well as light grids/light barrier. They are mounted at the edge of cabin at door side. The corresponding magnet has to be mounted to the moving part of the cabin door. The door movement switch(es) directly connected to the MPU.

Door Current Sensor



The current sensor is used to detect problems during the actual door cycle on opening and closing. Problems with the drive itself, the door guides and possible contamination that block the door movement are detected and reported via differences in current data.

A status of 'door is opening' and 'door is closing' can be retrieved from this measurement as well. Sensors are simply placed as a current probe around one of the live cables to the door operator without the cable needing to be cut.

Rope Load Sensor

The Henning rope load sensor LS1 works and is based on a patent protected measuring principle. This proven measurement principle allows the sensor to be fully factory calibrated, and provides an absolute measurement signal. Calibration of the rope load sensor system on site is not necessary. The patented design of the rope load sensor compensates external electrical, temperature and humidity influences. No need for complex calibration on the elevator/lift with weights, making the rope sensor ready for immediate use.

The load measurement sensor consists of one absolute measuring rope load sensor per suspension rope. These load sensors are installed at a 1:1 roped elevator just above the car top and directly connected to

the MPU. For a multiple suspension elevator they are located close to the fixing point of the ropes (hoistway top) in the rope section above the car and connected to the PEU.

With connected Henning rope load sensors, the Rope tension software wizard function is included in **WEARwatcher** and **WEARwatcher** satellite. This feature can be used to set even rope tension in all ropes. Furthermore **WEARwatcher** algorithms can detect worn out grooves in traction sheaves.



Fault prediction / notifications to users

- **Car**
 - Detect Maintenance Service
 - Roll-back detection
 - Anomalous movement of the car detected
 - Emergency car stop
 - Missing door movement after end of journey
 - Car empty / Standard Load / Full Load / Overload
- **Motor & Guides**
 - Shaft efficiency low
 - Anomaly at 'acceleration / deceleration' detected
- **Car Door / Landing Door**
 - Unusual high use of current for the door engine detected
 - Too many door movements
 - Door open / close time too long
 - Anomaly at 'door opening / closing' detected
- **Suspension Means**
 - Slack rope
 - Rope tension difference
 - Critical traction behaviour recognized
 - Worn out groove/rope detected
- **Driving unit**
 - Car not levelled in floor XX
 - Upper / lower speed tolerance exceeded. Anomaly at 'constant travel' detected
 - Rail joints, frequency inverter issues and rail misalignments
 - Anomaly detected in travel speed during constant travel



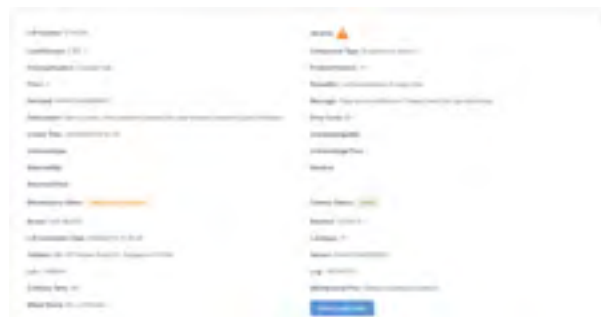
Reporting/Analyzing



WEARwatcher

Lift KPI Report

Automatic event detection and real time notifications

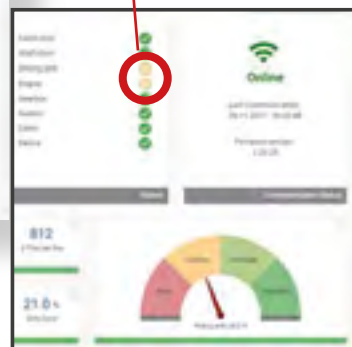
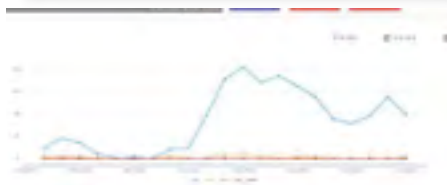


Statistics & Analysis:

Condition monitoring

Error analysis

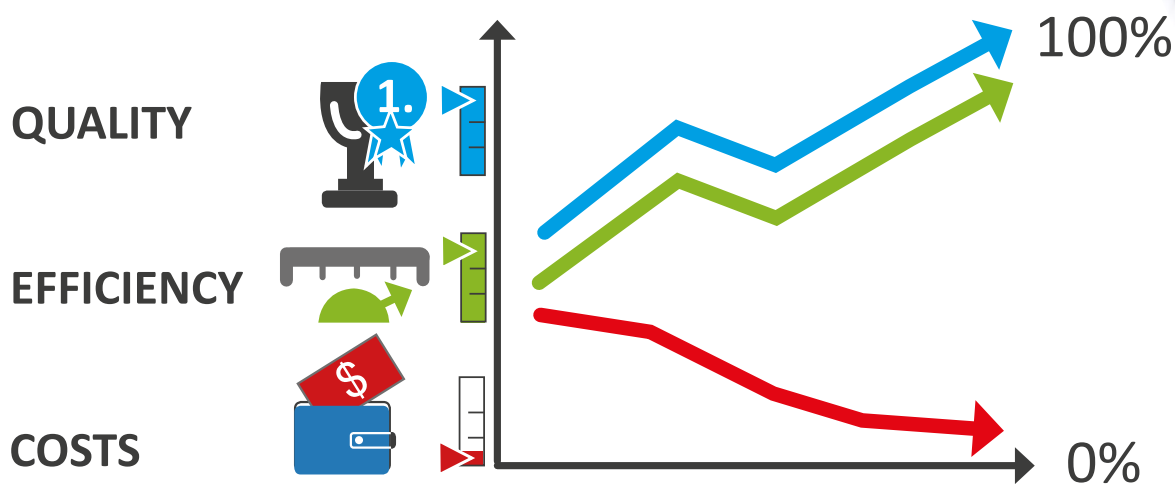
Optimized lift maintenance



WEARwatcher

Advantages at a glance:

- Increased availability
- Defect avoidance
- Minimizing downtimes
- Optimizing elevator maintenance
- Increasing the lifecycle of components
- Autonomous and independent from elevator control system
- Increased overall service quality



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