



WEARABLES

State of Art

(source: innovation community)



Technology overview

"Wearables", i.e. wearable devices, are technological devices, usually connected (e.g. Glasses, watches, cuffs and helmets or clothing) worn on the body as clothing or accessories, which can perform a number of functions including, but not limited to, recording, reporting, analysis and communication of data, but also intervene with actions based on the processing of information collected with local sensors (Body Sensor Network). These devices provide the wearer with real-time contextual information that can help make decisions and/or improve the experience or allow for easier and safer interaction.

The following categories of devices are defined, in addition to Smartglass which are the subject of a dedicated Innovation Community and exoskeletons ("wearable robots") which are dealt with in the Robotics Innovation Community:

Smartphone: very interesting category because these devices with high computing power and flexible functionality thanks to the many sensors on board have very low costs and are already available to staff;

Smartband: a band worn on the wrist that may or may not have a screen and can be used to control a device, play sounds or record physical data for fitness and other purposes (see for example Mudra, in this case reliability is a sensitive aspect);

Smartwatch: a watch with an operating system that allows you to download or use applications and also allows you to connect and control information with smartphones via Bluetooth or have built-in mobile phone functionality to function as a standalone intelligent device for dedicated applications (Samsung and other retail manufacturers);

Smart clothing: clothing designed to incorporate sensors, computing capabilities or other electronic components such as connectivity or actuators embedded in the fabric to collect data, improve wearer performance or take action (Safety Jacket or thermo-controlled clothing);

With this last category, there are in particular three solutions in the field of safety:

Safety Jacket: A new generation of Personal Protective Equipment (PPE), which protects the upper body (shoulders, back and sternum) from possible impacts generated by falling from above (heights less than 1 m without the use of a harness and more than 2 m with the use of a harness) developed by Dainese's D-Air Lab start-up.



Several wearable technologies have been adopted in a structured way within a solution developed and patented by I&N called Active Safety at Work which concerns the active monitoring of the use of Personal Protective Equipment during the performance of the different work activities by the operators. The system is designed to support personnel in the choice of the correct set of PPE in the execution of specific activities typical of distribution (electrical work off voltage, work under voltage, work in elevation, etc.). It is also possible to monitor the continuous and constant use during the working phases, being able to change the set-up by the operator interacting with the system in a simple and immediate way.

Project partially in production (problem on sensors, alarm management) the whole could be made obsolete by AI development for the recognition of the use of PPE

A theme involving different technologies and devices (wristband, smartwatch, wearable sensors and cameras) is that of fatigue monitoring.

Systems for detecting the state of fatigue of people are based on the active monitoring of certain biometric parameters or the use of cameras that monitor the movements of certain parts of the body and give indications of the person's state of rest, wakefulness and/or attention. This can be useful in the case of people involved in high risk activities for themselves or people in the vicinity, finding possible applications for drivers of operating machines, truck drivers, shift workers or others.

On this topic are involved startups or producers of smartband or other wearables accessories able to take information from the person or companies that work on image recognition through Artificial Intelligence in order to estimate the state of fatigue or stress of a person. Many manufacturers or hirers of operating machines, as well as site or truck operators are interested in such services to reduce the risk of accidents. The technology is mature enough for monitoring while physical state assessment algorithms are emerging now. It is necessary to evaluate the respect for privacy of the employer-employee relationship and to what extent it is possible to enter into the life of individuals (monitoring also extra-hours of work on a voluntary or involuntary basis).

A widely established IoT technology that can be used in low cost wearable devices is RFID. This technology can be used for the purpose of improving safety on construction sites and in general in the workplace, for anti-collision systems with operating machines on construction sites or for presence and access control in confined areas inside or outside, in this regard is being tested with the company AME (Advanced Microwave Engineering).

MAIN APPLICATION

The main applications detected by Enel are in the field of safety, O&M support and potentially security (access control).



The ASW (Active Safety at Work) system is perhaps the project that embraces the widest range of technologies and devices in the field of Wearable in Enel. This system involves the association of special sensors (active tags), equipped with Bluetooth connectivity, able to talk, through a special app, with the operator's smartphone. The latter device is a tool for ordinary use by personnel for the management of the activities entrusted to them (Work Force Management, Dynamic Work Assignment, Programming of Electronic Counters, etc.), so it was easy to adapt it to the ASW system's 'central' communication system.

The system basically consists of:

Android application running on the smartphones supplied to the operating staff

Back end system on a server accessible via desktop with dashboard for management of operator-associated PPE databases.

New generation PPE incorporating the active tag able to connect wirelessly with the smartphone (Bluetooth Low Energy communication protocol).

The principle on which the system is based is to carry out a constant monitoring, from the start of the activity until the end, of the actual use of all the PPE by the operator, through a continuous dialogue via Bluetooth between the operator's smartphone and the tags associated with the PPE worn. The PPE layout is proposed to the operator through the integration of the work assignment apps with the ASW app.

Each job assigned to the operator is characterized by a unique coding by type, therefore, having a priori associated the risks to the individual activities, the system can identify which PPE is required for its execution. The operator can take on board the proposal or modify the initial PPE set-up according to the actual plant engineering situation. ASW verifies that the operator wears them at the start of work and monitors that during the entire duration of the activity, they are permanently used. In case of detection of the absence of a PPE foreseen for the specific activity, the smartphone emits an alarm sound that calls the operator to correct the lack (it is the same principle as the seat belt alarm not worn when starting the car or while driving if the car is unhooked).

All events involving PPE (alarms, attitude change during activity) are recorded on the smartphone.

The PPE with tags, monitored by the system, are those associated with the main risks (electrical and falling from above) present in activities on distribution networks:

- Helmet with visor
- Jacket resistant to the thermal effects of the electric arc
- Insulating gloves
- Fall arrest harness with height positioning belt Work footwear

After an initial testing phase, the system was put into operation for about 1200 operators from 14 different areas throughout the country.



Important work was carried out with the PPE manufacturers to involve them in the project. In fact, a requirement that was safeguarded in the implementation of the system was not to reduce the performance in terms of protection due to the fact of applying additional objects on the PPE that could interfere with the required characteristics.

An accurate project of tag insertion in each PPE has been carried out and all the tests of compliance with the requirements of the technical reference standards have been carried out in order to extend the certifications.

Constant developments on sensor hardware are oriented to improve performance in terms of motion sensitivity, lifespan and miniaturization.

At the same time, additional system functionality is being studied to meet the needs of detecting alarms for man-on-ground situations or the presence of live parts in the vicinity through connectivity with other devices (e.g. Personal Voltage Detector helmet).

The use of the ASW system through a smartwatch is also being studied, to further simplify its use without interaction with the smartphone.

For I&N SmartWatch are the basis of some ongoing experiments including:

- Detection of the main vital parameters (heart rate, blood pressure, blood oxygenation, temperature) in order to determine states of fatigue but also the drop in attention or the approach of dangerous thresholds for health.
- Detection, independently or in conjunction with dedicated sensors, of the approach to electric/electromagnetic fields
- Emergency applications and panic buttons easier and more immediate application of equivalents on SmartPhone

It is also possible to integrate with sensors to be inserted in the footwear (insoles) able to determine the degree of gait stability, a parameter that can be correlated to the others already detected for a better determination of risk states and to measure possible electrocution or, also in this case, to warn against approaching high electric fields.