Smart Wearables for Detecting Risks in the Industrial Floor

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ABSTRACT

Technological applications play an important role in several daily activities, so the interest for smart materials has increasingly grown. Their integration as sensing markers and/or alerts for specific situations can have high impact in important fields as industrial safety and efficiency. The innovative technologies and mechanisms that are under development in this context will be incorporated in different processes towards to implement the Industry 4.0 (I4.0). This global need of safety and health without compromising the efficiency led also the industry to look for new strategies for workers, avoiding future health problems, accidents and other issues. In short, a proactive approach and increased safety system can be developed and implemented with several sensing, actuation and communication systems.

CONTEXT

Augmented Humanity - Augmanity is a structuring project that aims to anticipate the future by developing user friendly, immersive and supportive technology for industrial manufacturing, having as global goal, the Industry (I4.0) implementation. The project is structured in 6 PPS and is expected to leverage its results in multiple sectors, through a coordinated strategy between industrial partners and research centres. On Augmanity – PPS3, CeNTI will focus their capabilities on the creation of smart wearables - development and improvement of safety shoes - with enhanced ergonomic and sensing properties, aiming to address two main challenges:

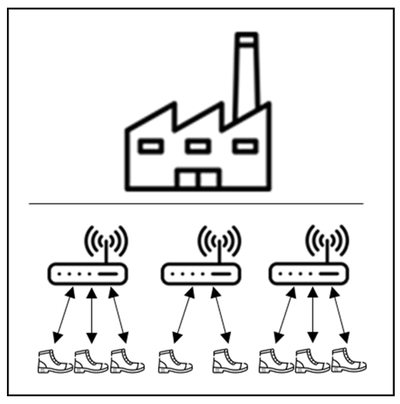
- To contribute to a real-time active monitoring system development;
- To contribute to a system development, through the integration of different technologies, able to signalise dangerous real time occurrences, into a single device.

OVERVIEW

The implementation of Industry 4.0 (I4.0) allows the management and monitorization of productive cycle and workers' issues throughout the working day.

The goal of this project is the development of sensing modules capable of measuring and monitoring production parameters as well as workers' safety and performance.

Sensory information will be sent through a communication network to a server in the cloud.



Industrial environment overview

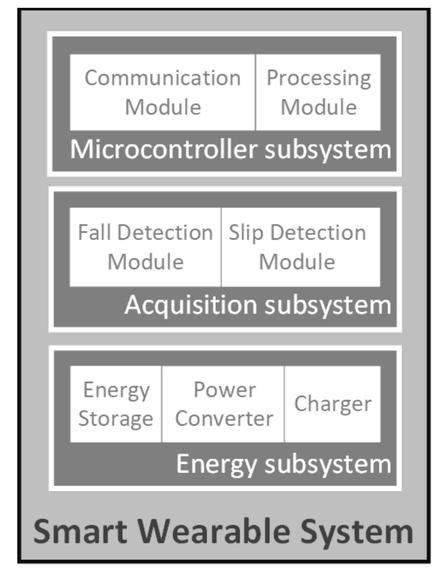
Augmanity – PPS3 intends to present a smart wearable system capable of detecting falls and slips in real time. This system will allow:

- Continuous monitorization about productive environment;
- To trigger alerts regarding dangerous or risky situations.

SMART WEARABLE SYSTEM

Wearable System composed by:

- **Microcontroller:**
  - Responsible for acquisition of detection modules.
- **Inertial Measurement Unit (IMU):**
  - Sensory information for fall detection.
- **Infrared LED and Photodiodes:**
  - Sensory information to detect fluids.
- **Bluetooth module:**
  - Communication between shoe and gateway.

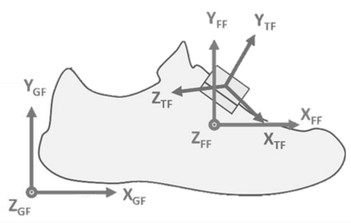


Device structure under development

METHODS AND TECHNIQUES

Fall detection

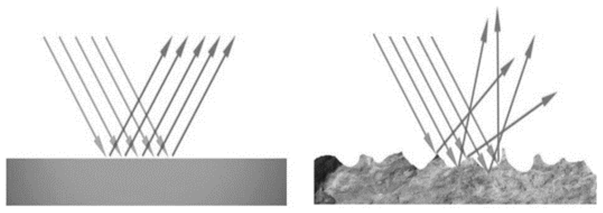
- IMU on foot: to validate axis rotations from unexpected accelerations.



Representation of the orientation of the IMU

Slipping detection

- Beam lights reacts differently according with the material on which the light is reflected.



Representation of specular and diffuse reflection

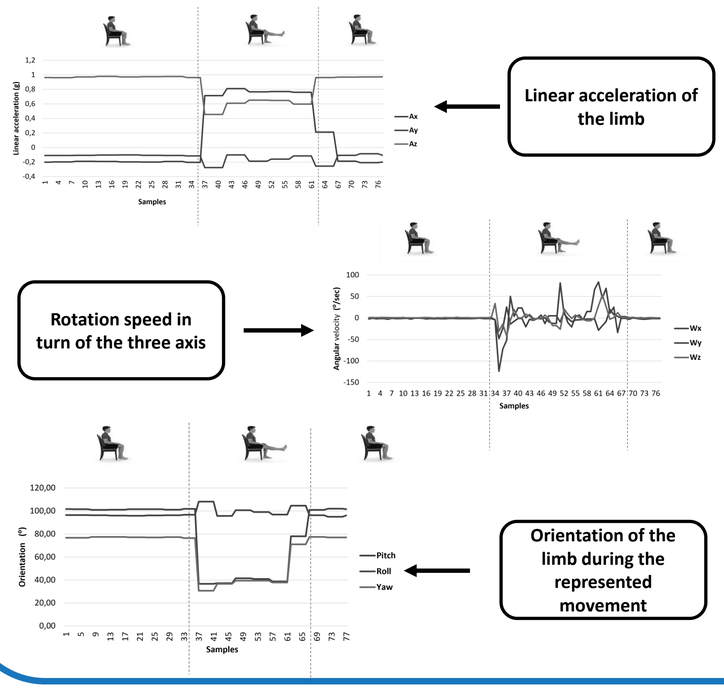
FINAL REMARKS

- This work presented the basic functionality of a smart wearable system with a fall detection system and a slipping detection system;
- Regarding the fall detection system, the data obtained with an IMU to evaluate movements like falls was presented;
- Regarding the slipping detection system, an IR LED and a photodetector was encapsulated and the detection of liquids on the floor by the sensors, was proved;
- As future work, it can be identified:
  - Literature review related with falls;
  - Implement driver interface for the IMU;
  - Implement system to track person's movement;
  - Implement algorithms to detect person's falls;
  - Implement algorithms to detect different liquids and distinguish them;
  - Power system development.

EXPERIMENTAL RESULTS

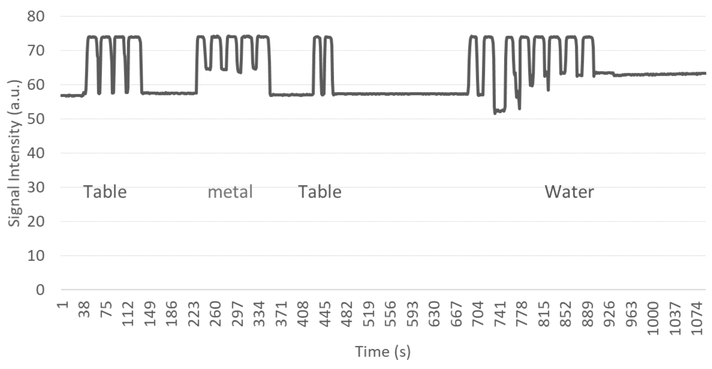
Fall detection results

Charts of data received by IMU.



Slipping detection results

- Validation of IR sensors to detect liquids;
- Sensor reacts differently according with the material on which the light is reflected;
- It was possible to distinguish the signal between wooden, metal and water.



Sensor output in different surfaces, including water

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