Parallel Session B: Workshops

Camera and Sensor based approaches

EU Falls Festival

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Outline of the session

- Some ideas on sensor based approach
  - Overview on the status
  - Complimentary technology implementing improvements
  - Some products in the market

- Camera based approach

- Future of the technology in the Fall detection and prevention scenario.
Sensors use in Fall Detection domain

- There exist many technological solutions to be used as sensors for the correct detection of occurring falls of people. Most interesting:
  - Inclinometers
  - Accelerometers
  - Gyroscopes
  - Barometric pressure
  - Smart carpets

- Additional and possible sensors:
  - Presence (infrared, RF tag, …)
  - Bed presence

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Sensors use in Fall Detection domain (2)

- We have two main types of Fall Detectors based in electronic sensors:
  - **Passive sensors**, based on the body position (mainly using inclinometers or passive accelerometers)
    - They are measuring the body inclination
    - They exhibit a very low power consumption, due to the concrete operating mode.
    - The **drawback** is that they **present a high rate of false positives**.
  - **Active sensors**, based on movement and frequent measurement methods (mainly based on accelerometers)
Active sensors are based on “active accelerometers”, collecting measurement samples very often (millisecond range).

- This technique means a “**continuous monitoring**” of the person stability or equilibrium.
- Monitoring is mainly based on the detection of **patterns** associated to the occurring falls.
- When a positive pattern is identified, an **alarm is generated**.

- Continuous sampling
- Analysis of patterns
- Generation of alarms

- Use of additional electronic processing systems
- Need of a communication channel
The associated electronic circuit usually has an implemented embedded algorithm.

For FATE project, UPC developed their **own algorithm** based in a **learning process**:

- Database with 332 different patterns of falls and 72 different patterns of activity
- Validation tests performed by UPC (evaluation of false positives):
  - More than 180 falls were tried and only 2 were not detected (effectiveness of more than 98%)
  - Activity tests were specifically designed. 175 trials were performed and only a 10% were generating false positives
Sensors use in Fall Detection domain (and5)

Main advantages of active sensing:

- Precision
- Low rate of false positives
- Based on learning algorithms, they don’t use simple level triggered decisions.
- Possible inclusion of behavioral analysis for detection improvement

Drawbacks:

- **Sensor position** (must be fixed in the waist)
- Power consumption (depends on the communication use). Usually, batteries are with a capacity of 600 mAH
- Possible need of a daily recharge of batteries
Additional sensors and functionality

- Alarms are generated and probably must be transmitted.
  - Together with the alarm, a geo-localization tag should be useful (in-doors and out-doors).
  - Devices have built-in communication capacities or just have active link with a Smartphone (providing the gateway functionality).

- GPS module
- Bluetooth module
- ZigBee module
- DECT communication
- GSM/GPRS communication
Communication options

- **Integrated communication solution:**
  - The device contains the communication module as an embedded part or subsystem.
  - Some available possibilities with current technology:
    - **DECT/400 - 800 MHz band**
      - Advantage: Low power consumption.
      - Disadvantage: Low range (indoors).
    - **GPRS/3G/4G/5G**
      - Advantage: Global communication (outdoors).
      - Disadvantage: High power consumption.
    - **Sigfox**
      - Advantages: Low power, global communication.
      - Disadvantage: Subscription service, certification.
Communication options

- **DECT - Digital Enhanced Cordless Telecommunications** (Digital European Cordless Telecommunications) is a standard primarily used for creating cordless phone systems.
  - Solution usually used for communicating devices and base station in indoors solutions.

**Short Range Wireless Technology DECT**

Our single-chip family comprises the industry’s first fully integrated, monolithic DECT / DCT / CAT-iq processor ICs. These flexible ICs combine powerful baseband processing and radio functionality, providing a platform for creating a complete range of DECT / DEC-T6.0 / K-DECT and ISM band 2.4 GHz models.
Communication options

- **SIGFOX**: provides a cellular style network operator that provides a tailor-made solution for low-throughput Internet of Things and M2M applications.

The LE51-868 S is a high performance certified Short Range to Long Range module designed to cover the 863-870 MHz band working with the Telit Proprietary protocol and acting as a SIGFOX gateway.
Communication options

- Assisted communication using an additional device (a companion smartphone is needed)
  - Advantage:
    - No need to handle low-level communication infrastructure.
    - Easy upgrade to new communication standards.
  - Disadvantage:
    - Need of specific app.
    - Reliability of communication with the smartphone (Bluetooth).
    - Need of a separate device with its own charging needs.
Combining and generating a product

- Technology, together with a strategy usually generates a product.

- In the telecare and telemonitoring market there exist many technical solutions for falls detection of people.

- Two possible business models: with or without care service (usually, a monthly fee required).

**List of characteristics analysed in FATE project**

- Country
- Competition
- Potential Partner
- Business Model
- 24/7 monitoring
- Attachment
- Certification
- Telephone
- Waterproof
- Battery
- Check-in service
- Languages supported
- Installation price
- Total cost
- Coverage
- Worn while sleeping
- Technology
- How does it work
- Result
- Advantage
- Inconvenient
- Weight
- Dimensions
- How to use
Combining and generating a product (2)

- More than 30 products were evaluated and analysed.
- Among them, a set of 10 products in the market were selected and carefully considered (European and US market)

<table>
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<tr>
<th>Name</th>
<th>Medical Guardian</th>
<th>Philips Lifeline GoSafe</th>
<th>Tunstall</th>
<th>AT&amp;T</th>
<th>SafeGuard</th>
<th>Tynetec</th>
<th>Alvolution</th>
<th>Vigi' Fall</th>
<th>CareTech</th>
<th>MobileHelp</th>
<th>FATE</th>
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<td>Fall sensor/Fall detection system/Call centre</td>
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</table>
Combining and generating a product (3)

- The case of Tunstall: offering a fall detector in pendant format, but with a possibility to be worn in the waist.

Standard communication base:

Detection of falls occurred in-doors

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Ivi Intelligent Pendant
Manufactured by Tunstall Healthcare (UK) Ltd

Vearing options
The iVi offers a choice of wearing options:

- Neck cord: with safety break links and adjustable length
- Brooch clip: allowing the user to attach the pendant to their clothing on the chest, rotating to enable numerous orientations on clothing.
- Belt clip: allowing the user to attach the pendant to their clothing on the waist. Note, this requires the wearing option setting to be changed on the programming menu.
Combining and generating a product (4)

- The Vigilio case: a patch detecting falls.

- Fall detector permanently attached to the skin.
- Connected to a communication base
- For in-doors detection
- Telecare service model

Le 1er patch qui détecte les chutes

Vigi’Fall Family pour le domicile
A partir de 49 €/mois

- Fiabilité et sécurité
- Centre d’appel

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Philips is one of the providers in the US market.

- **Good technology**
- **In-doors and out-doors detection**
- **Different communication solutions implemented**
- **Service based**

**Six Locating Technologies:** Our GoSafe system is packed with a variety of locating technologies to help locate you in an emergency, including:

1. **Two-Way Voice:** The pendant has a built-in speaker and microphone so you can talk with our Response Center or Emergency Services hands-free, directly through the pendant, and provide location information.
2. **Global Positioning System (GPS):** Satellite navigation technology can locate you whenever there is an unobstructed line of sight to four or more GPS satellites.
3. **Intelligent Tracking:** When you move, this technology uses the path you take to leave a trail. This path can then be accessed by our Response Center in the event that your last-known location is helpful.
4. **WiFi:** This technology utilizes a growing database of WIFI hotspots to locate you, particularly if you're indoors.
5. **Audio Beacon:** Feel confident even in remote areas. The Mobile Help Button comes with an alarm that can be activated by our call center so audible "you’re getting closer!" information can be heard by first responders.
6. **At Home:** If you are within range of your home Communicator, we'll know that you are either at home or very close to home.
Combining and generating a product (and 6)

- From FATE project, a new product emerged.

- Commercialization prepared from SENSE4CARE (UPC start-up)

- Fall detection for occasional use. This situation corresponds to a person who is cared by a relative but that sometimes, and only for a short period of time (ranging from hours to a couple of weeks), is unattended. No subscription or monthly fees are required.

- Simple and unobtrusive sensor. This implies that it should be light and small enough in order to not be detected by external observers.

- Extremely simple user interface and maintenance. No buttons or switches and powered by replaceable batteries, so that there is no need for a dedicated charger.

- The sensor should be managed by the user’s smartphone by means of a specific application, so that there is no need for a dedicated one. The sensor communicates with the smartphone by means of a Bluetooth wireless link.

- Inexpensive system. The target price for the fall sensor and the associated smartphone application should fall below 100 €.

- The sensor should be purchased by means of standard consumer channels (pharmacy,
A new product in the market

- Commercialization done by SENSE4CARE (Spin-off company from UPC)
  - The Fall Detector is a unique personal device based on a tri-axial accelerometer and a specific algorithm.
  - These features are complemented by a telecommunications layer involving Bluetooth technology, able to send alarms when falls occur. Standard AAA batteries power the system, with a 3 months life.
  - Highly discreet, it can be worn in a customized or on a normal daily belt
  - No buttons needed. All user/device interactions are executed through a clever and simple APP for Android smartphones.
A new product in the market

The role of the mobile phone is to carry out automatically the communication with the emergency services in the case a fall occurs and also to provide geolocation when the user is outdoors.

How it works

- **user falls**
- **automatic detection**
- **automatic APP response**
- **assistance**

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A new product in the market

- More than 2 months of autonomy
- Wear it & turn on in just one click
- Coverage in-house and outdoors
- Affordable: Get one for less than 100 euros

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What must be done in the future?

- To increase the usability of the new product
- To introduce new functionalities in the wearable device:
  - Embed the communication module
  - Embed the localization GPS module
  - The use of the mobile phone not necessary

Remaining issue: power consumption
Open and final questions

- It seems that **technology helping to detect falls is mature** and is already **in the market**.

- Some issues remain still open for detection solutions:
  - Must be necessarily related with a care service?
  - Who must provide the telecare service? Is this the real business model for that companies?
  - When the detection of falls generate alarms sent to public services (as in Catalunya, for instance), how to implement a correct protocol for reacting and answering automatic generated alarms?
Main question: can technology help us to prevent falls? Is it possible to anticipate a fall in a people with risk of falling?

Technology can help in several ways:
  - Using passive solutions for a mitigation of falling consequences

Wearable airbag designed to protect seniors when they fall

A sensor is detecting the risk of falling and inflates the airbag
Open and final questions

- Technology can help in several ways:
  - Using **active solutions** for trying to anticipate falls

**DynaPort MoveMonitor**

Use of sensors and gait analysis

**Physical Activity monitoring for up to 7 days**

**Products**

- **The MoveTest** will enable you to do short physical performance tests using one small device to be attached around the waist of the patient. Specially developed software will assist you in efficiently performing the different tasks of which a test can be composed. The MoveTest consists of the hardware, managing software, and one or more chosen modules:
  - Body Sway
  - Gait Pattern analysis
  - Short Physical Performance Battery
  - Sit To Stand
  - Timed Up and Go

- **The MoveMonitor** will enable you to easily assess the physical activity status of your patients. With one small device, worn in an elastic strap on the lower back, you will be able to measure your patients' physical activity for up to 7 days. The MoveMonitor consists of a hardware unit, the acquisition software, and one or more chosen analysis modules, accessible through our web service:
  - Physical Activity (PA)
  - Energy Expenditure
  - PA recommendations
  - Sleep Movements
Open and final questions

- Probably, technology could help more if correctly applied:
  - Prevention must be done on a **personalized basis**
  - **When a fall has occurred, the probability of falling again is higher**

- Rehabilitation strategies can be organized
- Personalized intervention must be done
- Complementary health intervention must be considered (exercise, lose of weight, change of some habits...)

- In fallen people, a good detection could be very beneficial in order to prevent major related injuries (break of hip, long-lie problems,...)

*Technology will help very much in all these cases*