ANG, a family of multi-mode, low cost walking aid

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INRIA
Motivation
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- rapid increase of the number of elderly
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• 2.5 millions of fall per year
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  • in France direct consequence of a fall: 9300 deaths per year
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- 2.5 millions of fall per year
- 80% of domestic accidents
- walking pattern is a good indication of the general state of health
  - but doctors lack of tools to objectively assess the quality of walking pattern
  - they are missing rare events that indicate emerging pathologies
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- **other tasks**...
Solution
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Starting point: available **Rollator**, first step when motricity starts to fail
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- already accepted devices
- close to wheelchair $\Rightarrow$ functionalities may be transferred
- low cost hardware
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Added:

- 3D accelerometer+gyro
- GPS
- rear wheels encoders
- fit-PC+ IR interface
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• fall detection: based on abnormal velocity/acceleration
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- **fall detection**: based on abnormal velocity/acceleration
- **walking analysis**: walking aid trajectory reconstructed from accelerometer and encoders measurements
Typical records for a straight line trajectory
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Objectives

• provide a gold standard for "normal" walking patterns
  • with/without walking aid

• measure walking pattern on elderly people
  • with the walking aid
  • infer walking pattern without the walking aid

• determine indexes that are pertinent for doctors to qualify walking patterns

• detect abnormal events and report them to doctors
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Methodology
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In direct collaboration with the CHU hospital at Nice

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  - *instrumented*: accelerometer/gyro on the knees and wrists, force sensors in the shoes, video recorded
  - *records on* trajectories with/without the walking aid performed *twice, random order*
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  - instrumented: accelerometer/gyro on the knees and wrists, force sensors in the shoes, video recorded
  - records on trajectories with/without the walking aid performed twice, random order
- **second phase, currently**: trials on 30 elderly people at CHU Nice
  - not instrumented
  - same trajectories performed twice with the walker
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../../..../Texte/AEN/Experience-09-2011/Videos/walk.mpg

..../..../Texte/AEN/Experience-09-2011/Videos/walk.mpg
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Objectives:

- **fall detection**: based on abnormal velocity/acceleration
- **walking analysis**: walking aid trajectory reconstructed from accelerometer and encoders measurements
- **navigation aid**
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Navigation aid

walking aid may

• measure the slope of a sidewalk
• detect a lowered kerb
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detecting/ranking lowered kerb

![Graph showing the detection and ranking of lowered kerbs](image-url)
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Navigation aid

walking aid may

- measure the slope of a sidewalk
- detect a lowered kerb
- qualify the quality of the sidewalk surface when using a walking aid or wheelchair
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An innocuous-looking sidewalk
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An innocuous-looking sidewalk ... and how it feels with a walking aid.
In summary daily users of the walking aid in a city may provide very interesting information for itinerary planning in this city.

How can they share this knowledge?
In summary *daily users* of the walking aid *in a city* may provide very interesting information for *itinerary planning* in this city.

How can they *share* this knowledge?

Information may be used to update a *collaborative map* (OpenstreetMap).
To validate this concept we have:

- retrieved the map of INRIA at Sophia-Antipolis from OpenStreetMap
- used the walking aid all over our site
- then updated the map with the provided information
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ANG-II
ANG-II

Starting point: available Rollator

Added:

- 157W motors
- electromagnetic clutch
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- 8 multidirectionnal IR distance sensors
- Force sensors in the handles
- 3D accelerometers, GPS
- Light sensors, 2 webcams
- GPS
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- on board vacuum cleaner
- pick-up reacher
- solar panel
- interface: IR, web, radio, joystick, handle, hand motion
Conclusion

Already accepted walking aid may help to provide:

- **on-demand** mobility assistance
- **fall** detection/prevention, alarm
- walking **diagnosis tool** for doctors
- **dynamic map building** for itinerary planning
- navigation aid *(but is that necessary ?)*
- help for **transfer** (sit-to-stand)
- help for **domestic tasks**
- ...