Activities of the INRIA project-team COPRIN in at-home assistance

The robotics project-team COPRIN has decided in 2006 to change its scientific focuses from industrial applications to assistance robotics. This new orientation has been followed by an extended period of discussions with people involved in elderly care (doctors, nurses, local collectivities, elderly associations, ...) in order to determine what were the real needs of end-users and their priorities. This period has allowed us to determine guidelines for the devices we want to develop: *low intrusivity* (basically the devices should disappear if the user does not need them except in emergency cases), *connectivity* (each device should be able to communicate with the environment and other devices), *low cost* (this is a crucial point as many end-users cannot afford expensive systems. Hence only robust and standardized hardware should be used in the devices, allowing for simpler installation and maintenance. This point is important as a failure in a device with which the end-user is familiar is critical), *monitoring for prevention, interfaces* (all of the proposed devices will be used daily in repeated tasks. Sensors and interface usages may be used for an early detection of possible pathologies. As the physical and cognitive abilities of the end-users are extremely diverse and time varying a multitude of interfaces must be proposed), *adaptability* (end-users have different life habits and environment. We have to develop design methods that allow to customize the arrangement of hardware components to satisfy the end-user wishes and the constraints imposed by its surrounding), *low energy consumption* (although often neglected this is a very important point. Indeed end-users are often not very familiar with battery charging procedure and may be put in an awkward situation if a device fails), *no substitution for social exchanges* (doctors are adamant about this point. Solving an elderly problem with a specific device must not induce other problems, especially in terms of social relations).

After having established these guidelines we have started developing new devices. We have first focused on walking aids by developing two walkers, `ANG-light` and `ANG`, both being based on commercially available Rollators. The purpose of `ANG-light` is just to monitor the trajectory of the Rollator (using encoders in the wheels and a 3D accelerometer) in order to be able to detect anomalies in the gait. Still in case of an emergency `ANG-light` may be connected by wifi to a computer network and has also a phone/GPS tracker, that may be remotely activated. `ANG` is a motorized version of `ANG-light` with electromagnetic clutches and a multitude of additional sensors (distance, GPS, forces, light ...) and can be remotely controlled by radio, infra-red, smart phones and through the web via a multitude of interfaces. It has also a fall prevention system and if a fall has not be prevented it will backtrack toward the end-user for providing a support. It can also be used as a gait monitoring tool or as a rehabilitation device by providing a selective resistance when walking and is also able to lift an object from the ground. It can automatically detect lowered kerbs and their GPS location in order to update interactive town maps (e.g. OpenStreetMap) that may then be used to plan itineraries for elderly and handicapped people using walking aids or wheelchairs. When not using its motors `ANG` has an energy autonomy of about 7 days, that may extended through the on-board solar panel. The cost of the additional hardware for `ANG-light` is about 250 euros and 2000 euros for `ANG`. Both `ANG` and `ANG-light` will be submitted to extensive trials in the geriatric center of Nice hospital in May 2011.

`MARIONET-ASSIST` is an indoor low-cost wire-driven parallel crane, with 3 to 6 wires, that is installed in the ceiling. It allows for easy transfer operation (sit-to-stand, ...), may be used as an indoor walking aid but also as a teleoperated manipulator. `MARIONET-ASSIST` is integrated into our test flat that includes a kitchen, a bedroom, a rehabilitation area (where another wire-driven parallel robot is used to monitor human join motion during exercise) and toilet. In a typical morning scenario this robot will help the elderly to move from his bed position to stand up and to walk toward the kitchen table. As soon as the elderly is seated the robot may be used to fetch missing dishes (using a variety of grippers), provided that the kitchen is instrumented to allow access to the drawers.

Figure 1: `ANG-light`, `ANG` and `MARIONET-ASSIST`