Number	LANCS-D4.1-RN-B.1	A-PI--

Title	Research Note (RN) for D4.1
Subtitle	Ethical aspects of development **B** : *Convergence of Physical, Mental and Virtual*

PROBLEM		SOLUTION	

Research Note	X	Selected Annotation	

Categories: | | |

Summary:

This note addresses and various activities in and through which convergence of physical, mental and virtual phenomena is realised. It raises questions about new forms of human-device relations.

CONTEXT

Convergence of physical, mental and virtual phenomena is primarily manifested in a set of interrelated innovation practices in the area of robotics, including advanced bionics and body/brain implant technologies. European associations of roboticists have compiled a strategic research agenda for robotics including so-called “assistive robotics” and advanced bionics (EUROP, 2009a), and they have also established a roboethics agenda (EUROP, 2009b; Veruggio, 2006). Similarly, associations of roboticists in the United States have laid the foundations of what the future of the field should look like (Christensen et al, 2009). European innovation policies on robotics development have cultivated an environment to further pursue these avenues (European Commission, 2008), the latest being the FET flagship development on Robot Companions for Citizens (RCC) (http://www.robotcompanions.eu/; see also European Commission, 2011).

(Key readings include: Arras and Cerqui, 2005; Barad, 2003; Bell et al, 2009; Bibel et al, 2004; Capurro et al, 2006; Coeckelbergh, 2009, 2010; Cortés et al, 2008; Dautenhahn, 2004; EUROP, 2009a, 2009b; European Commission, 2009, 2011; European Technology Assessment Group, 2006; Gernot Kronreif and Hochgatterer, 2005; Giordano and Gordijn, 2010; Giordano et al, 2009; Gunnarsdóttir, 2010; Heerink et al, 2006; Hsu et al, 2005; Ishii, 2006; Nordmann, 2004; RCC, 2012; Roco and Bainbridge, 2002; Rodotà and Capurro, 2005; Salter et al, 2008; Sharkey, 2008; Sparrow, 2009; Tamburrini, 2009; Veruggio, 2006; Warwick, 2000)

FACTS

The real-life conditions for which assistive robotics, advanced bionics and implant technologies are researched and developed include:

1. **Assistance to anyone under *normal* conditions** –in the home, for entertainment, learning, for working, navigating, and so on. These designs are, among other things:
    - humanoids, able to operate in densely populated environments, 'listening' and responding to humans, informing and guiding them, helping in delivering goods and helping people navigate.

- interactive, emotionally intelligent companions (robot or virtual) some of which need to operate and navigate around furniture in homes, or assist in public areas - supermarkets and airports.
- dexterous and autonomous dual-hand manipulation capabilities and human-robot coordination, for example, to help in the kitchen or coordinate with humans in general hands-on labour and teleworking schemes in hybrid virtual-physical environments.

2. **Specialised assistance under *disadvantaged* conditions** –for the elderly and disabled, and for therapy and rehabilitation, including:
    - extensive locomotive therapy with robots controlling the presence, attention and motivation of patients, exploiting structure and plasticity of the human sensory-motor systems or assisting with neuro-rehabilitation by virtue of non-invasive neural interfaces (e.g. scalp readings) and wearable exoskeletons.
    - robotic toys and game scenarios supporting socialisation and development of autistic children.
    - robotics embedded in intelligent environments, capable of combining cognitive abilities (companionship and guidance) with smart-house capabilities and for use in porter services in large public areas like e.g. airports.
    - brain-computer interaction systems, utilising brain activity on the basis of electroencephalograph signals or signals accessed with invasive brain implants in order to decipher intentions and to allow persons with severe motor disabilities to control devices directly with their mind.

3. **Assistance managing *performance-critical* conditions** –for hospital functions, surgery, driving, flying, emergency, crises, and related scenarios, including:
    - mechatronic and intelligent cooperation (robot groups or swarms) with human experts in multi-criteria reasoning and decision-making scenarios, managing and responding to emergency (detecting and warning about hazardous substances, cooperating with fire and rescue missions, (navigating, searching, identifying and warning about toxic chemicals, bombs and living beings).
    - manual task training, including teleoperations and shared control architectures for cooperation between humans and to augment human capabilities in flight and other performance-critical tasks; Using e.g. robot arms with complex sensor systems and control for surgical procedures, exhibiting rich sensory-motor skills and multi-sensory measurement for accuracy and feedback; Also, mechatronic and intelligent cooperation with surgeons, planning, negotiating and managing uncertainty during keyhole interventions on the brain.
    - robot teams developed for hospital environment - medicine dispatch, cleaning, guiding patients around, patient-doctor conferencing, patrolling facilities and detecting emergency.

4. **Assistance managing and controlling *infrastructural*/*societal* conditions** – for law enforcement, traffic management, dirt and rubbish management, and for managing e.g. water bodies, including:
    - autonomous micro helicopters with a bird’s eye view, capable of navigation, exploration, inspection, searching, monitoring and surveillance.

- synthetic on-the-ground random foraging agents for exploration, inspection, searching, monitoring and surveillance.
- robots (embedded in intelligent environments) for inner cities, able to vacuum-clean streets and transport home garbage on demand, help people navigate in the streets and help with monitoring and surveillance.
- floating sensorised robots (embedded in intelligent environments) for monitoring chemical and physical parameters in water bodies.
- underwater robot swarms for harbour safety and security.

COMMENT

Convergence of physical, mental and virtual phenomena can be viewed in terms of degree or intensity. Latest developments in robotics are greatly concerned with the assistive potential which rests on advanced mobility, sensory and monitoring capabilities. For example, the concept of *mobile manipulation* refers to the ability to recognise and respond to objects, people and changes in the environment which is essential if these assistive designs are going to be commonplace in the dynamic environments of the home. the street, in law enforcement, health, safety and military operations. Assistive technologies include machine learning, integration and predictive capabilities while embedded in the activities of humans and coping with changes in semi-structured and unstructured environments. Under these circumstances, one of the key problems centres on data management and control. However, the more intimate the human-device relationships are, physically and emotionally, other issues of ethical relevance begin to take priority, including:

1. changing perceptions of companionship and human relations (companion robotics)
2. changing perceptions of body, self and/or identity (advanced bionics and body/brain implants)
3. new tracking, monitoring and adjustment capabilities of bodies, behaviour and state of being
4. new experiential opportunities (how far can body modification be taken)
5. questions of access and distributive or commutative justice (health-related applications)

A host of ethical issues are implicated for reflection and debate:

The technicalisation of the body
Access to advanced therapies
Quality of Life
Autonomy and independent living
Brain-device interdependence
Risk management
(Ir)reversibility
Safety and liability
Human-Robot relations / intimacy
Robot empathy / companionship / deception
Human vulnerability as a tool in Human-Robot relations
The border between nature and artificiality
Human self-understanding and identity
The idea of “man”
Dignity and privacy
Human enhancement / transhumanism
Body sanctuary and body resource
Social pressure: for and against
Protection of personal data

Implants / robots for selected social groups
Implants / robots for security
Implants / robots for tracking
Implants / robots for managing health and illness
Healthcare equality
Technological 'fix'

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