# Annex 3 – EMJD ICE II Cohort Research Projects

**Project N° 1 - Multi-sensor Surveillance**
**Selection of audio-visual information for user-centric data filtering**

We are witnessing an unprecedented increase in data generated by camera (and microphone) networks installed in hospitals, care homes, and public places that are monitored by a very limited amount of personnel, thus making most of the material useful only for post-event analysis. In order to appropriately exploit the captured data, a user needs to be guided towards the interesting portions of the content in a timely manner to avoid operating conditions issues like fatigue, operational stress and change blindness for the personnel. In order to achieve this, an information filtering and visualisation step is required to detect and display interesting situations or behaviours. Instances that need further attention (such as a patient behaving in an unusual way) have to be identified. This ICE project will focus on the extraction of relevant information from microphones and cameras to summarize and present to the operator relevant information from the observed area. An appropriate user interface and visualisation tool will be designed to maximise the information transfer to the operator, based on its role (nurse, doctor, control operator) by highlighting situations with the required priority to separate from the uninteresting data those segments that require immediate attention or careful scrutiny.

**Project N° 2: People Inspired Technologies**
**Time Simulator in VR**

This project investigates the possibility using virtual reality to manipulate the perception of time in the application area in which children with learning and behaviour disorders can explore the concept of time. Several empirical studies confirm the importance of time-awareness in learning disabilities. The difficulty for processing time in its different dimensions has been shown to be an interesting universal characteristic of dyslexic people. Furthermore, other conditions like ADHD appear to be characterized by comparable dysfunctions in time orientation. Research has also demonstrated the effectiveness of VR in improving the sequential time perception for children with mental retardation and children with hearing impairment. This PhD project is to further explore the possibilities and effectiveness of VR in rehabilitation in the aforementioned area.

**Project N° 3: Design for Social Interaction**
**Detection and Awareness of Anxiety in Public Speaking**

The main objective of this project is to investigate emotion, its detection and classification. Emotion is associated with both conscious and unconscious behaviour, which involves information process of human brain. Correlation of physical signal measurements by multi-modal sensor systems to emotions could be investigated to detect and classify emotion. The target user group and application context will be studied in the research. The results of investigation will be applied to the design of interactive environments in a social context.

**Project N° 4: Assistive Technologies**
**Movement disorders analysis in Parkinson Disease patients: on-line detection of ON/OFF periods**

The symptoms of PD (Parkinson Disease) can be broadly classified in motor symptoms and non-motor symptoms. Motor symptoms include rigidity, tremor, bradykinesia (slow movement), postural alterations, tendency to fall, reduced gait speed, reduced step length, and episodes called freezing of gait (FOG), which consists of a sudden inability to start or continue walking, as if glued to the spot. It is a blockade of the motor activity. Wearing off (or OFF periods) is the term used when the effect of a medication, usually levodopa, literally ‘wears off’ or becomes less effective. During the OFF periods a set of the above symptoms becomes more evident. When people start to take medication for their Parkinson’s disease, usually levodopa, they notice that their symptoms go away for hours at a time (ON times), then the symptoms return (OFF times). The main objective of the proposed research project is to develop a set of embedded and “off-line”

algorithms for the clear detection of ON/OFF periods in PD patients, from the data contained in an ambulatory activity database, obtained from a labelled data coming from selected PD patients, including context information. The main sensors used for these records are movement sensors (mainly, accelerometers), but some other will be considered.

**Project N° 5: Assistive Technologies**
**Social Cognitive Robotics for Independent Life**

This proposal is about how to incorporate robotic services into social scenarios allowing them to anticipate to user needs by improving communication and empathy between people and embodied agents using cognitive algorithms. Robotics is placed in an upwards trend in the number of research projects and applications. The fast growth of robotics has been consolidated thanks to developments in industrial sector. However, there is a large area of robotics that is not as developed as the industrial sector, "Social Robotics". The main challenge is to change the present conception of social robotics, which is at a standstill to provide pre-established services, taking the step to create cognitive systems capable to self-reconfigure and modify its behaviour without human guidance using abilities for understanding, learning and remote access to software.

**Project N° 6: Networked Embedded System**
**Robustness in Self-Organizing Networked Embedded Systems**

The concept of self-organization has found its way from natural and social sciences into the area of networked embedded systems (see, e.g., [1,2]). The main goals are to minimize the need for configuration and develop protocols that facilitate network operation. It is also believed that we can handle the increasing complexity of embedded systems by employing a higher level of self-organization, as self-organizing systems use simple components that interact only locally to perform complex functions at the system level.
Is often said that the robustness increases with an increased level of self-organization in technical systems; this argument is explained by the statement that natural systems (such as fish schools and bird flocks) show an inherent level of robustness against changes and failures. This claim has not been thoroughly investigated for networked embedded systems. Questions to be addressed are as follows (also see [3]): How do we define “robustness” in this context? To what types of changes and failures are self-organizing systems (not) robust to? What are the limits of “natural robustness,” and are these limits acceptable for embedded systems? What is a design and engineering process for robust self-organizing systems? The thesis should address these questions and apply them in the context of a real-world networked embedded system e.g. a network of unmanned aerial vehicles [4].
References
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**Project N° 7: Networked Embedded System**
**Unification of awareness concepts in distributed (smart home) user interfaces**

The Smart Home, technically a network of distributed embedded systems, can – from a user's point of view – be envisaged as a virtual "unit" or "total system" featuring a distributed user interface (thus, metaphorically, the user interacts with "the

house" rather than with its components). Currently, user interactions in such a system are quite heterogeneous, since they stem from the originating subsystems, which are not necessarily tuned to yield a well-defined, easy-to-use set of input/output modalities.
Therefore, the challenge is to identify as many as possible use cases in a smart home environment and analyze them with respect to their user awareness requirements, such as status information (windows/doors states, subsystem states, temperature states, …), flow information (current energy/water consumption on a fine level of detail, user activity, …) and other categories. From this analysis, a unified information / awareness model should be derived including a set of respective output concepts for different modalities (visualization, audio, haptics), such that interacting with and controlling "the house" becomes logical and the user's impression of the smart home as a unit is supported. Feasibility and user experience studies in prototype environments should complement the conceptual work. To this end, our experimental smart home environment needs to be complemented with more sophisticated sensory systems especially in the domain of metering (device or at least room based electricity/water/gas consumption).
References
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**Project N° 8: Networked Embedded System**
**Energy aware networking for home environments**

The goal of the project is to propose techniques, algorithms and protocols for enhancing the energy efficiency of the both terminals (PCs, tablets, TVs, …) and network devices (modems, home-gateways, set top boxes, …) in the home environment. Most of the terminal devices at home, like PCs, can switch in stand-by status when unused and modulate performances (e.g., by using clock scaling) to reduce their energy consumption during low load periods, but this is not true for the network devices. Moreover, very often, network functionalities and applications do not allow terminals to exploit these capabilities (e.g., a VoIP application waiting for calls does not allow PC to go in stand-by status). The project should study: 1) techniques for extending network devices with low-consumption state management capabilities; 2) virtualization and proxing capabilities of network applications and functionalities to allow the effective exploitation of the terminal standby status; 3) protocol extensions for supporting the proxing functionalities; 4) global control and optimization mechanisms able to minimize the home "ICT" energy consumption by preserving the service quality.

**Project N° 9: People Inspired Technologies**
**Machine Learning methods for adaptive human-centered monitoring system**

Machine Learning (ML) methods provide high-level intelligent functionalities and the necessary flexibility to implement a common computational framework to interpret and compute adaptively and autonomously the data and signals acquired by body sensors and wearable devices. This research addresses the development of tools and methodologies for the induction of appropriate models, describing the states and/or sequence of events of single/multiple human behavior, and using, for this purpose, supervised learning and State Chain Mining (SCM) approaches. The models, induced through Bayesian or frequentist approaches, will be developed through state-of-the-art algorithms like Kernel Methods and Support Vector Machines. One of the objective of the research will be the development of resource-aware (e.g. low power, low memory/computational demand) hardware-friendly reformulations of the algorithms and learning techniques, targeting

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| their implementation as close as possible to the sensing peripherals. |
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