Annex 3 – EMJD ICE I Cohort Research Projects

N°1 Project N° 1: Assistive Technologies
Ambulatory Mobility Characterization using Inertial Body Sensors for Therapeutic

The main purpose of the proposal is basic research in ambulatory monitoring and characterization of people's movement. In general, the proposal aims to identify and discriminate the different types or patterns of movement that a person performs in the course of their daily activity such as walking, sitting, lying down, getting up, going up and down stairs, etc… to be able to assess changes in patterns of motion or activity that may occur after interventions or incidences affecting mobility. More in detail, the proposal aims to (1) detect alterations in the gait and balance of elderly people or people suffering from chronic diseases that affect mobility, e.g. Parkinson's patients, and (2) assess the progress in recovery of people who have had surgery for pathologies that affect their mobility such as surgery of the knee, hip or back.

Project N° 2: Assistive Technologies
Assisted Health

Health monitoring systems through wearable devices and home sensors capable to communicate autonomously with a caregiver in case of an emergency is one of the main objectives of the Ambient Assisted Living research area. Design adaptable systems, acceptable for any kind of users improving their daily life activities needs the joint effort of different techniques as Distributed Computing, Intelligent Computing, Embeded systems design, Usability and Emotional Computing.

Project N° 3: Networked Embedded System
Self-organized coordination in massively networked embedded systems

Recently, massively networked embedded systems – consisting of hundreds or thousands nodes capable of sensing, processing and communicating – have emerged from the well-known sensor networks. The autonomous coordination of the network's resources is an important and challenging research question, since a static or human controlled approach is not feasible in such dynamic networks. We investigate self-organizing methods for autonomous and emergent coordination. Examples of such distributed methods include multi-agent control as well as consensus and game theoretic algorithms.

Project N° 4: Networked Embedded System
Distributed and adaptive signal processing for cognitive environments

In sensor networks typically constraints are imposed on the communication capabilities between nodes. This project aims at investigating distributed adaptive algorithms, which support to collectively estimate the state of a dynamic system from the measurements conducted by a number of sensors under certain rate and/or communication performance constraints. The quality of different algorithmic approaches shall be compared with the help of analytical investigations and numerical simulations, and shall additionally be verified by building a prototype system.

Project N° 5: People Inspired Technologies

Building 3D virtual environments for the simulation, training and testing of intelligent systems relying on distributed sensor networks. Applications in the field of security, education and health-care.

Project N° 6: People Inspired Technologies
Evolutionary Bayesian Networks for interaction modeling

The use of Bayesian Networks (BNs), a probabilistic tool for modeling and learning from experiment interactions patterns, is a major issue of future intelligent cognitive environments. This thesis will explore the joint use of evolutionary genetic algorithms together with coupled BNs as a basic mechanism to process sensory data in smart spaces. Applications in the field of multisensor surveillance and people inspired technologies will be considered.

Project N° 7: Design for Social Interaction [Design Intelligence]
Enhancing Awareness in Dynamic Research and Education Activities

This project focuses on a distributed multi-agent system to enhance the awareness of the activities in a dynamic education and research environment. A possible relevant application is activity/traffic monitoring; for example, in the context of an university department, a network of simple sensors (e.g. light, acoustic or magneto-sensors) may provide temporal information on activity patterns, either at the group or individual level. Such an architecture can be a perfect example of an ambient intelligent system with distributed sensors and actuators: scattered sensors collect the data from the environment and the actuators present the information to the environment, while feedback theory can be applied to adjust how the sensory data should be gathered and interpreted and to adapt the system behavior rendered by the actuators.

Project N° 8: Design for Social Interaction [Design Intelligence]
Automatic Modelling of Users' Mental Models

This project focuses on computer-based generation of mental models, based on summaries of sequential data to assess the user's task and product related knowledge structure. The main aim of this project is the further development of AMME to analyse most of the available logfile information to support the development of a reliable and valid construction of a diagnostic schema for usability problems. The aims of this project are twofold: (1) to develop a tool that can assess automatically the users' knowledge in a reliable and valid manner, and (2) to develop a tool that can support the diagnosis of usability problems.

Project N° 9 - Multi-sensor Surveillance
Object identification in multi-camera systems

An important pattern recognition problem is matching objects across multiple overlapping and non-overlapping views. This project will aim at identifying and matching objects across cameras observing a wide area scene from different viewpoints and from different locations. The research will consist in investigating appropriate camera calibration and pattern recognition algorithms. The latter will include matching objects such as people or vehicles that are partially visible or at varying distances. Real-world CCTV footage will be used to develop, train and test the algorithms.

Erasmus Mundus Joint Doctorate in
Interactive and Cognitive Environments
(EMJD ICE)

Project N° 10 - Multi-sensor Surveillance
Multi-sensor environment learning

The estimation of semantic information about the environment where the objects can move is of great importance in multi-sensor settings. In particular, the location of entry and exit points of the monitored environment, static obstacles and the knowledge of an overall map of the area are very useful for improving the performance of detection and tracking algorithms. This research aims at investigating algorithms for on-line learning and developing algorithms that estimate the map of an environment. The availability or estimation of such information is fundamental for identifying outlier behaviours or for path estimation for autonomous robots such as unmanned ground vehicles (UGV)