



**H.F.R.I.**  
Hellenic Foundation for  
Research & Innovation

**Description of the funded research project**  
**1st Call for H.F.R.I. Research Projects to Support Faculty**  
**Members & Researchers and Procure High-Value**  
**Research Equipment**

**Title of the research project: A novel, dynamic, adaptive approach for Automatic human aCtIVity rEcongition – ACTIVE**

**Principal Investigator: Konstantinos Votis**

**Reader-friendly title: ACTIVE**

**Scientific Area: Engineering Sciences & Technology**

**Institution and Country: Centre for Research and Technology Hellas (CERTH), Greece**

**Host Institution: Centre for Research and Technology Hellas (CERTH), Greece**

**Collaborating Institution(s): -**

**Project webpage  
(if applicable): [www.active-project.org](http://www.active-project.org)**



**Budget: 189,262.04 EUR**

**Duration: 36 μήνες**

## Research Project Synopsis

The ACTIVE project focuses on the major research field of automatic Human Activity Recognition (HAR); a field that constitutes the fundamentals of Ambient Intelligence (AmI) and Assisted Living Applications (AAL). In domestic AAL-oriented applications, HAR is typically performed through the processing of data derived from sensing modalities which build upon: (a) wearable sensors, (b) static IoT sensors and (c) dynamic sensors, such as sensors of mobile robot units. The ACTIVE project aims to advance the State-of-Art in the field of multimodal HAR, by (a) investigating a novel, adaptive and context-dependent fusion method for data derived from wearables and static IoT sensors of a smart home and (b) introducing a novel approach for fusing wearables and static IoT sensors with a mobile-robot based dynamic sensing modality within the smart home. More specifically, our research starts with investigating a new hierarchical, multi-level approach for dynamic fusion of multiple sensing modalities, specifically based on wearables and static IoT sensors of the smart home environment. On top of this, we are developing a novel goal-oriented, ensemble coordination framework, capable to steer the efforts of the integrated system so as to enhance both (a) the effectiveness of activity recognition and (b) the level of detail and robustness in behavior understanding. The proposed methods for human activity recognition and behavior understanding through the fusion of (a) wearables and IoT data and (b) wearables, IoT and mobile robot vision, will be systematically evaluated in the course of the project. By the end of the project, we will establish a proof-of-concept integrated wearables/IoT/robot system, capable to operate with our proposed methods in a real smart home. This will be used for the final validation of the proposed approach, which will take place in the CERTH-ITI smart home, utilizing also the RAMCIP robot.

## Project originality

The ACTIVE project focuses its research on a novel, dynamic & multi-level Human Activity Recognition (HAR) approach. The project aims to develop novel modeling, multimodal fusion and classification schemes able to incorporate the spatio-temporal structure of the sensing data and capitalize it, while dealing with insufficient amounts of training information and nuisance factors. In this line, the main goal of ACTIVE is to develop novel methods to reliably recognize and understand complex activities in smarthomes, even upon violations of static assumptions about sensor availability and characteristics of the environment. ACTIVE picks up on the key essential methodological underpinnings of Smart Home AAL scenario, specifically targeting state of art advances towards more detailed and robust recognition (and understanding) of domestic user behaviour within its context, through the fusion of static and dynamic sensors; specifically, unobtrusive IoT sensors, wearables and sensors of a mobile service robot.

In this line, the main goal of our work is to deliver a novel, multi-level adaptive framework for automatic activity recognition through multiple data modalities, capable to advance the level of detail and robustness of state-of-the-art Human Activity Recognition approaches on a variety of real domestic scenarios. To this purpose, we intend:

- To investigate a novel, adaptive and context dependent fusion method for data derived from wearables and static IoT sensors of a smarthome.
- To investigate a novel approach for fusing wearables and static IoT sensors with a mobile-robot based dynamic sensing modality within the smarthome.
- To conduct systematic performance evaluation of the proposed HAR methods and establish a proof-of-concept system within a real smart home.

## Expected results & Research Project Impact

**ACTIVE aims to introduce in the area of HAR for AAL systems: (a) a novel method for activity recognition and behavior understanding based on the adaptive fusion of wearable, IoT and robot sensors –derived data and (b) a novel approach for context-aware dynamic sensing coordination, where, on the basis of monitoring needs inferred in runtime, observations augmentation plans will be devised and executed, engaging when and as appropriate, extra units that can provide more detailed user monitoring; in our specific case a mobile service robot.**

**Through this above scientific impact, the project work is expected to provide advances in the field of AAL, with a focus on more effective and robust HAR for assistive solutions that can better operate in real domestic, smarthome environments and thus, have increased potential for future adoption in the real practice. While the world population is ageing, the ratio of older individuals to younger population, who can act as caregivers, either formal or informal, is increased through the years. As such, there is a major need for new technological solutions that can support the elderly in their daily life, helping alleviate some of the burden of caregivers, their families and financial costs burdening healthcare systems.**

**Smarthome, ICT and robotics technologies, which can assist the older person in daily activities and help maintain or improve her/his quality of life despite ageing, facilitating at the same time the caregiver in demanding tasks, thus reducing the caregiving burden, can have a major impact towards active and healthy ageing at home. At the same time, key challenges for future AAL technologies, “smart enough” to be widely adopted, concern advanced system perception capabilities, enabling robust and thorough, automatic user activity and behaviour understanding and on that basis, optimized assistive system decisions and actions, towards which the ACTIVE project works.**

## The importance of this funding

The H.F.R.I. funding provides us, through the implementation of the ACTIVE project, with a great opportunity to perform research that is particularly focused on the major aspects of detailed and robust, multimodal activity recognition and context-aware dynamic sensing coordination. It helps our team to perform excellent research in these domains, framed in the context of PhD studies that are being supported by the project funds.

As such, the funding received by the H.F.R.I. allow our efforts to particularly: (1) focus on major research topics, highly important towards future systems that can help in the societal challenge of population ageing and (2) be oriented around novel technologies that can have major impact towards further advanced, personal assistants that significantly extend the personalized, proactive support provision capabilities of contemporary, highly valued ones.



**H.F.R.I.**  
Hellenic Foundation for  
Research & Innovation

## COMMUNICATION

185 Syggrou Ave. & 2 Sardeon St. 2  
171 21, N. Smyrni, Greece  
+30 210 64 12 410, 420  
communication@elidek.gr  
[www.elidek.gr](http://www.elidek.gr)