2. Publishable Summary

2.1. Project Objectives

The USEFIL project aims to address the gap between technological research advances and the practical needs of elderly people by developing advanced but affordable in-home unobtrusive monitoring and web communication solutions. More specifically, USEFIL intends to use low cost "off-the-shelf" technology to develop immediately applicable services that will assist the elderly in maintaining their independence. The systems and applications that will be developed irrespective of an older person's mobility state will be able to unobtrusively record:

- elderly behavioural indicators for problems such as cognitive decline or geriatric depression
- emotional status
- health vital signs
- Activities of daily living

and provide the means to:

- supply information services;
- enable individuals to keep their social life active

Technology implementation will be based on user acceptance and an understanding of user interactions that will truly address user needs. Following Technology Acceptance Models the users adopt and use a technology if they perceive it as "ease of use" and "useful" for their needs.

Following these two pillars of adoption, the USEFIL project has the following Social and Technical Objectives:

In terms of Ease of use:

- Develop a simplified approach using ease of use unobtrusive low cost ICT solutions (provide safety and security for elderly persons in their living place using fewer devices and adopting a frugal innovation stance).
- Provide services more adaptable to individual needs and preferences (personalization)
- Promote practicality developing systems and services that their installation will not require retrofitting of the residence of the elderly people and new skills for installation activities.

In terms of Usefulness / Benefits (for end users and main stakeholders):

- Support the elderly in maintaining their social activities and increase the level of their social contacts.
- Promote "ageing well" and prevention concepts by redefining the way of treating elderly people and managing health care services using low cost ICT technologies and giving support to integrated care
- Adopt a frugal innovation approach by promoting cost and time effective health care solutions for end users and carers that are:

    - Low cost and low maintenance off the self systems (wrist wearable unit to support Mobility, a smart Web TV set, low cost video monitoring devices, a slate Tablet-PC) integrated into an operational complete platform

- Secure applications and services and decision support systems for the aforementioned devices,
- persuade and facilitate worldwide developers to generate applications for the ageing population reducing the cost the Governments have to spend for generating ICT services for the ageing community

Furthermore USEFIL has the following ambitious Research Objectives:

- ❑ To research, develop and implement self-learning solutions in relation to acoustical and optical recognition and vision-based human emotion analysis based on facial expression and body gesture analysis utilizing either two-dimension (2D) or three-dimensional (3D) information.
- ❑ To introduce unobtrusive health monitoring concepts by researching, developing and implementing health monitoring techniques and algorithms in relation to medical video monitoring using low-cost web cameras.
- ❑ To evaluate the effectiveness of computing, probabilistic and data mining techniques which will be applied on the multiple sensors' signals/data to provide low error prone analysis and decision support, taking into account that we already know from existing research that single sensor based solutions are usually not robust and reliable enough (issuing false alarms).
- ❑ To extract correlations from set of fused data and to uncover through long-term trend analysis of basic daily behavior together with vital and emotional data hidden patterns of progressive health and mental deterioration.
- ❑ To investigate the most effective and efficient user interaction modalities with the USEFIL platform taking into account the capabilities of elderly users and the impact of age and cognitive differences on this.
- ❑ To introduce unobtrusive behavioural monitoring through research and development of the concept of the wrist mobile unit. This necessitates the development of efficient algorithms to detect behavior and transmit relevant information to outside platforms for assessment/ further analysis.
- ❑ To evaluate the proposed platform in terms of user acceptance and more specifically in terms of:
  - o Different types of systems embodiments in relation to user acceptability, and the relationship between criteria for acceptance and cultures, societal demographics.
  - o the effectiveness of tele-coaching and peer group support in user adherence behavior

2.2. Expected Results

The USEFIL project teams are expected to deliver the following final results:

- ❑ A customised Web TV unit, "embedded" with applications to act as an internet gateway interface providing multiple services to the users such as applications/games for mental status monitoring.
- ❑ A customised Slate tablet-PC unit, "embedded" with applications to support the elderly in maintaining their social activities and to provide a rough classification of users' activities like standing, walking, sitting or lying.
- ❑ A video monitoring unit, featuring health and emotion awareness using computer vision and machine learning techniques to support personal health care and improving independence in living environments and the quality of life.
- ❑ An open source operating wrist mobile unit, embedded with sensors to monitor daily activities and correlate with user profile information.

- Health decision support services.
- Indoor well being and monitoring services exploiting USEFIL's state of the art web technologies and applications.
- Tele-emergency and communication services to primary (elderly citizen), secondary (carers, social workers, family) and tertiary (local health care services) users.
- Perform a paradigm shift in health care using USEFIL systems and applications to assist the elderly in maintaining their independence and their daily activities redefining the way of treating and managing health-related incidents such as emergency calls and the way first responders, carers, family, health care service providers are coordinated, thus giving support to integrated care.
- Guidelines for developers to generate relevant platforms and applications for the ageing population.
- Public Showcase and Dissemination Events.
- A two Pan-European workshops showcasing the project results to the public and especially to end users and industrial organizations.

2.3. Work Performed and Results Achieved

In the following few sections, the activities performed in the second year of the project are listed. The work is substantially in time with the timetable foreseen in the DoW. This section provides an overview of the achievements during the 2nd reporting period of the project, as contractually foreseen; for convenience of reading, results are grouped into technical, dissemination and management streams.

Management Activities

- Further refine the project management strategy
- Continuous project management activities.
- Organisation of three project plenary meetings and the review meeting.
- Organisation of project weekly telecom sessions

Technical Achievements:

- Ethical approval applications was made for the UK trials of the USEFIL project and a conditional approval was received by Biomedical and Scientific Research Ethics Committee (BSREC). Similar activities have been conducted by Macc and AUTH regarding the Israel and Greek pilots.
- Develop applications and services for the Web TV and the Slate Tablet PC
- Specify sensors' type and define procedures to analyse patients' activity, physiological and emotional data
- Develop the video/audio monitoring system and the Interactive Health Monitoring Mirror System
- Specify Wrist Wearable Unit requirements and develop an application prototype
- Design infrastructure for enabling communication between all the hardware and software entities involved in the USEFIL system
- Design USEFIL security infrastructure
- Provide data fusion tool customised for USEFIL
- Provide decision support tool developed for USEFIL
- Design and Implement software components for USEFIL Core Services

- Develop applications of USEFIL platform to be used in pilots.
- Customize and integrate with USEFIL platform external applications such as games

Dissemination and Demonstrations Activities:

- Maintain the Project Web Site and update information about partners' dissemination activities
- Further update and distribution of the dissemination materials (e.g. poster and brochure)
- Dissemination activities in conferences, workshops, exhibitions and press
- Identification and outreach of stakeholders' groups. Each partner approaches target groups and passes a clear message of project benefits according to their expertise.

The activities indicated in this list are described into detail in the Section 4 of this Report, as well as relevant Deliverables and Milestones are detailed in Section 6.

2.4. Impact

The Socioeconomic impact of the USEFIL project results will be:

Substantial reduction in costs

USEFIL provides low cost unobtrusive monitoring applications, services and systems promising substantial reduction in cost while reducing hospitalization through provision of precise assessment of health status and improved health management and treatment of the elderly people while staying independent in their residencies. Furthermore USEFIL project intends to provide guidelines for developers and a platform for them to generate applications for the ageing population reducing the cost the Governments have to spend for generating ICT services for the ageing community.

Novel ageing well concepts.

USEFIL has plan to develop the necessary user friendly interfaces either through Web TV or Slate Tablet PC or through the smart phone to enable elderly people to identify easily their mental and health evolution having access to their measured parameters.

Furthermore USEFIL will exploit everyday consumer electronics and the web to provide a close-loop approach that involves elderly people, friends family members, medical professionals and carers in the same flow. Elderly and doctors (or psychologists); eldelry and carers; carers and doctors; and elderly and friends and family members will be encouraged to interact using USEFIL communication platform which will rely on security and norms for data protection.

Improved competitiveness of EU industry to become a global leader in the field of ICT and "ageing well"

USEFIL promises improved competitiveness of EU industry through proven feasibility to move the results into worldwide successful products. USEFIL promotes frugal innovation approach delivering a platform that can be commercially exploited both to developed and underdeveloped countries. The low cost but innovative services that will be developed within the realm of this project will provide the partners with opportunity to expand their activities within countries and areas with low financial resources such as China, India and others being able to become global cost leaders in the "ageing well" market providing state of the art systems and services. This will be supported by the multiculturalism nature of the USEFIL consortium since it is born from the mix of different cultural heritages and different types of living styles.

The USEFIL project will have a wide impact at European level by fostering the development of a European Strategy for integrated care and independent living solutions by means of design, development and validation of low cost, off-the-shelf, open systems enabling interoperability and integration of existing and new technologies, devices and services.

USEFIL promises to strengthen Europe's potential to become a global leader in the field of ICT and "ageing well", including development of global interoperability standards in the field through standardisation.

Furthermore the project will provide added value and strengthen more the Europe's position in ICT R&D domains such as mobile processing, video protocols (MPEG), voice-synthesis recognition, mobile devices, health care systems.

The scientific Impact of the USEFIL project results will be:

Proven concepts for early detection of ageing-related risks

One of the objectives of the USEFIL project is to extract correlations from set of fused data and to uncover through long-term trend analysis of basic daily behavior together with vital and emotional data hidden patterns of progressive health and mental deterioration. More specifically the USEFIL project aims at building an innovative platform gathering various bits of data. Such data be stored in a database will be mined to uncover hidden patterns. The database that to used will support subsequent data mining using the algorithms that will be developed within the realm of the project thereby, pushing the development of the state of the art innovative algorithms to:

- Model typical human behaviour. Probabilistic techniques, i.e. Bayesian networks (or Fuzzy Cognitive modeling) may be applied to a given set of parameters in order to provide probabilistic prediction of a particular indicator which will assist the carers and doctors to detect ageing related risks.
- Extract correlations from sets of fused data (cognitive, emotional and physiological measurements).
- Provide a decision support tool capable of integrating the results of the different sensors (combination of the monitored data in order to provide the care pathways and the support measures)

Furthermore following the work of researchers, the USEFIL project explores techniques for unobtrusively monitoring naturally occurring computer game interactions in order to detect sustained changes in a user's cognitive performance. The goal of this approach to combine cognitive assessment and in-house monitoring so as to detect long-term sustained trends and and sympomatic behaviors, hoping to provide early detection of cognitive decline or geriatric depression. Metrics to enhance the sensitivity and specificity of this measurement and measures of psychomotor interactions and additional dimensions of cognition, such as attention and memory, will be studied to improve the usefulness of this technique.

2.5. List of Beneficiaries

Table 1: List of Beneficiaries

no.	Beneficiary Name	Beneficiary Legal Name	Short Name
1	National Centre for Scientific Research "Demokritos"	National Centre of Scientific Research "Demokritos"	NCSR
2	Teknologian tutkimuskeskus VTT	Teknologian tutkimuskeskus VTT	VTT
3	Universität Bremen (TZI)	Universität Bremen (TZI)	UoB
4	University of Warwick	University of Warwick	Warwick
5	Aristotle University of Thessaloniki	Aristoteleio Panepistimio Thessalonikis	AUTH
6	Fraunhofer- Gesellschaft zur Förderung der angewandten Forschung e.V	Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V	Fraunhofer (HHI)
7	TP Vision Belgium N.V.	TP Vision Belgium N.V.	TPVB
8	Maccabi Healthcare Services	Maccabi Healthcare Services	MACC
9	Philips (DELETED)	Philips	PCL
10	TPVision Netherlands B.V. (DELETED)	TPVision	TPVision

2.6. Coordinator Contact Details

Project Coordinator:		Homer Papadopoulos
	Address:	National Center for Scientific Research (NCSR) "Demokritos" Patriarchou Grigoriou and Neapoleos St. 153-10 Agia Paraskevi , Athens, GREECE
	E-Mail:	homerpap@dat.demokritos.gr,
	Tel:	+30 210 6503004
Technical Manager		Artem Katasonov
	Address:	VTT Technical Research Centre of Finland (Teknologian tutkimuskeskus VTT) Tekniikankatu 1, 33101, Tampere, FINLAND
	E-Mail:	artem.katasonov@vtt.fi,
	Tel:	+358 40 1976669

2.7. Project Logo

Figure 1: USEFIL Logo

2.8. Project Website

The project public website is accessible through: http://www.usefil.eu