SRS

Multi-Role Shadow Robotic System for Independent Living

Small or medium scale focused research project (STREP)

DELIVERABLE **D8.1**

Project presentation; web first version available to all partners

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Coordinator: Cardiff University

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1. PROJECT INFORMATION

Project title:	Multi-Role Shadow Robotic System for Independent Living
Acronym:	SRS
Programme:	The Seventh Framework Programme (FP7)
Thematic priority:	Information and Communication Technologies (ICT)
Call identifier:	FP7-ICT-2009-4
Research areas:	ICT-2009.7.1 (ICT & Ageing)
Instrument:	Collaborative project
Reference number:	247772
Start date:	01 February 2010
End date:	31 January 2013
Duration:	36 months
Total cost:	4,662,737 Euros
EC funding:	3,300,000 Euros
Website:	http://www.srs-project.eu

2. AIM & OBJECTIVES

The project focuses on the development and prototyping of remotely-controlled, semi-autonomous robotic solutions in domestic environments to support elderly people. In particular, the SRS project will demonstrate an innovative, practical and efficient system called "SRS robot" for personalised home care.

Most elderly people want to live in the familiar environment of their own residence for as long as possible. However, not many can live with their adult children and therefore, at some stage, often late in life, have to live alone. Studies show that some forms of home care are usually required as they advance in years.

SRS solutions are designed to enable a robot to act as a shadow of its controller. For example, elderly parents can have a robot as a shadow of their children or carers. In this case, adult children or carers can help them remotely and physically with tasks such as getting up or going to bed, cleaning and setting up ICT equipment etc. as if the children or carers were resident in the house. This objective will be realised by the following SRS innovations:

1) A new intent-based remote control mechanism to enable the robots to be tele-operated over a real-world communication network robustly.
2) An adaptive autonomy mechanism to enable a highly efficient task execution for remotely controlled service robots.
3) A new robotic self-learning mechanism to enable the robots to learn from their experience.
4) A safety-oriented framework derived through extensive usability and user acceptance studies that enable service robots to be effectively deployed into home care applications.

The SRS prototypes created with EU support in the SRS project will be tested at the "S.Maria Nascente" Centre in Milano and the IZA Care Center in San Sebastián. The final solution will be further developed by industrial partners for a worldwide market with significant potential and volume.

3. WORKPLAN

The project is broken down into eight workpackages that will lead to the completion of the ultimate goal of the project.

Workpackage title	Leader
WP1 Requirements Study, Technology Assessment and System Specification	INGEMA
WP2 User Interaction Study of Remotely-Controlled Service Robots	HdM
WP3 Cognitive Capabilities of Remotely-Controlled Service Robots	Fraunhofer
WP4 Technology Integration on Shadow Robotic System	CU
WP5 Multi-Roles Operation strategies in Domestic Environment	ROBOTNIK

WP6 Proof of Concept and SRS User Evaluation	FDCGO
WP7 Dissemination and Exploitation	PROFACTOR
WP8 Project Management	CU

Table 1 SRS Workpackages

WP1: Requirements Study, Technology Assessment and System Specification
This workpackage is focused on the analysis of task requirements, environmental demands and individual user needs for a remotely-controlled, semi-autonomous robotic assistant and will evaluate various robotics & ICT technologies. General guidelines on ethical concerns will be established based on existing regulations and guidelines. A systematic review and interviews with users across Europe will be conducted and a knowledge base of user requirements will subsequently be set up. The survey will result in recommendations for new methodologies and also yield the specification for the development of the SRS. An information database of application fields and environmental requirements will be built for further marketing exploitation in WP7.

WP2: User Interaction Study of Remotely-Controlled Service Robots
The research in this workpackage is to explore the usability and safety requirements of a remotely-controlled service robotic system in domestic environment. Appropriate Human-Robot Interaction is essential for the acceptance of any domestic robotic products, especially for elderly people who might have a fear of robots or which are at least not able (and willing) to use such technology. Although they know they need help with the activities of the daily living, some of the elderly are worried that the robot can hurt them or there can be an intrusion into their privacy. SRS will be designed based on a special interaction study of elderly accessibility performed in the frame of WP2 in order to develop dedicated interaction patterns. New safety-oriented usability guidelines will be developed based on user interaction patterns to ensure safe interaction of the remotely-controlled robots in domestic environment.

WP3: Cognitive Capabilities of Remotely-Controlled Robots
The research in this workpackage focuses on the cognitive capabilities of the remotely-controlled robotic systems. Methodologies and techniques will be explored to facilitate perception and decision making capabilities for such semi-autonomous robots. In this case, for tasks that cannot be performed by robots autonomously but can be executed remotely, a robot can try and support the remote operator for as much as possible. To do so the workpackage starts with research on environment and motion perceptions. The results can lead to the robotic s*ituation-awareness*, e.g. being able to identify the intent of the Human Operator (HO); detection of objects relevant for semi-autonomous manipulation etc. In the next step, the research focuses on the decision making capabilities of the robots, Data mining, machine learning and case based reasoning techniques will be explored to enable robotic s*elf-awareness, self-reliant and adaptive behaviors.* It has to be noted that, in the unique remotely-controlled scenario of the SRS applications, the HO can always intervene the robotic decision making process to help the robots out. Therefore, the research of such is achievable and can provide practical solutions.

WP4: Technology Integration on Shadow Robotic System
The research in this workpackage is to integrate the techniques and the methodologies developed in WP2 and WP3 and to realise the four innovations of the SRS solution. First a new intent-based remote control mechanism to enable the robots to be tele-operated over real-world communication network robustly will be realised. Second, an adaptive autonomy mechanism to actually enable the semi-autonomous operation will be materialised. Third, self-learning

mechanism to enable the robots to learn from its experience based on the operator profiles will be developed. Fourth, a new "Cognitive Overload Monitoring System" and a "Safety oriented motion controller strategy" will be developed to enable the effective deployment of the SRS in home care applications. Furthermore, open peripherals interfaces and open communication interfaces will be developed for SRS, to simplify the further integration of shadow robots into various intelligent home environments. Finally, innovations realised in the workpackage will be integrated together as a SRS general framework to help future applications in this field.

WP5: Multi-Roles Operation strategies in Domestic Environment
The purpose of this workpackage is to realise prototypes for the SRS and demonstrate the SRS system can be applied to home care applications for aging well. First the software and hardware required for remote UI, communication interface and local manipulation will be modularised and integrated together as "shadow core system". The innovation parts of the core will be based on the general framework developed in WP4, and then the "shadow core system" will be integrated with existing service robotic systems. A full size model called "SRS prototype I" and a compact model "SRS prototype II" will be customised and implemented. The final system will be iteratively refined based on the feedbacks from WP6. The workpackage will also be a test-bed for new technology developed in the project.

WP6: Proof of Concept and SRS User Evaluation
The purpose of this workpackage is to test in real-life contexts the assumptions and the technologies gradually developed in the course of the project in real-life contexts. Through this workpackage the SRS robot will be validated in terms of significance for the target audience, technical functioning and effectiveness in meeting the user needs, usability, cost-effectiveness and ethical implications.

WP7: Dissemination and Exploitation
This workpackage focuses on the dissemination and exploitation of the R&D results of the project. The demonstration will be implemented through the following activities: public events/workshops and publications including patents, journal & conference papers, reports, media. Each partner will have at least one publication on average each year. WP7 will exploit the project results towards the introduction of new products and services during the project lifetime. The exploitation is driven by the profit-seeking behaviour of private commercial enterprises involved in the project and is motivated by the intrinsic search for new markets and revenues. All possibilities for individual and joint exploitation of project results will be assessed in a preliminary exploitation plan compiled in the first year of the project lifetime. Toward the end of the project, this plan will be refined and substantiated by quantifiable data leading to business planning that can attract investors and venture capitalists for those participating enterprises who wish to exploit the project results.

WP8: Project Management
This workpackage concerns all the management aspects of the project and monitoring of progress towards the ultimate objectives, identifying shortcomings and recommending remedial action where necessary. The coordinator will oversee action plans and monitor their timely execution, within the given resources. The consortium members will meet every six months to report project progress. The Steering Committee, Executive Board and Workpackage Groups will meet at the same time. WP8 will be led by Cardiff University (CU)

4. CONSORTIUM MEMBERS

CU - Cardiff University, Manufacturing Engineering Centre (United Kingdom)

Cardiff University was ranked 7th among the 110 British universities in a nation-wide analysis of research quality. The proposed research and coordination activities will be carried out by the Manufacturing Engineering Centre (MEC). The MEC conducts world-class research and development in all major areas of Advanced Manufacturing and uses the output to promote the introduction of new manufacturing technology and practice to industry. Over 100 industrial partners including Daimler, Hewlett-Packard, IBM, Mitutoyo, Parametric Technology, SAP, Silicon Graphics, Siemens and Zeiss have supported research at the Centre which has collaborative projects with more than 22 countries in Europe, Asia and the Americas. We also actively engage with industry in Wales. As a Centre of Excellence sponsored by the Welsh Assembly Government (WAG) and the European Regional Development Fund (ERDF), we focus on helping manufacturing industry, particularly SMEs to develop competitive instruments, machines or products that enjoy increased margins and that compete successfully in existing and new markets. Since 1996, we have completed thousands of projects with local companies.

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CLMI-BAS - Bulgarian Academy of Sciences - Central Laboratory of Mechatronics and Instrumentation (Bulgaria)

The Central Laboratory of Mechatronics and Instrumentation (CLMI-BAS) was founded in 1994 after the reorganisation of the Institute of Mechatronics (founded in 1990). The Institute of Mechatronics was founded on the base of the Assembly Robotics department of the Institute of Technical Cybernetics and Robotics (ITCR) which was established in 1979. The Central Laboratory of Mechatronics and Instrumentation employs 70 specialists.

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FDCGO - Fondazione Don Carlo Gnocchi Onlus (Italy)

The Fondazione Don Carlo Gnocchi ONLUS is the largest private non-profit Organisation in the field of rehabilitation in Italy. Currently it runs 28 medical and social rehabilitation centres, providing medical, social and vocational rehabilitation to individuals of all ages with a variety of physical, sensory and mental disabilities. It employs over 4100 persons including medical, paramedical, technical and administrative personnel. Funding is based mainly on provision of medical and vocational rehabilitation services, according to the current National Health Service and Regional policies. Two Centres of the

Foundation ("S.Maria Nascente" in Milano and "S.Maria degli Ulivi" in Firenze) are acknowledged as IRCCS (public clinical research institutes acting on behalf of the Ministry of Health). The Foundation is very active in Scientific Research, with 33 research projects currently in operation, over 150 articles published every year in scientific Journals (with 250+ impact factor points according to JRC), and 85 courses organized in the latest two years approved by the National Training-in-Medicine programme.

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Fraunhofer IPA - Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V. (Germany)

The Fraunhofer-Gesellschaft undertakes applied research of direct utility to private and public enterprise and of wide benefit to society. Its services are solicited by customers and contractual partners in industry, the service sector and public administration. The Fraunhofer-Gesellschaft maintains roughly 80 research units, including 58 Fraunhofer Institutes, at over 40 different locations throughout Germany. A staff of some 12,500, predominantly qualified scientists and engineers, works with an annual research budget of over one billion euros. Of this sum, more than € 900 million is generated through contract research. Roughly two thirds of the Fraunhofer-Gesellschaft's contract research revenue is derived from contracts with industry and from publicly financed research projects. The remaining one third is contributed by the German federal and Länder governments, partly as a means of enabling the institutes to pursue more fundamental research in areas that are likely to become relevant to industry and society in five or ten years' time. The Fraunhofer Institute for Manufacturing Engineering and Automation IPA develops solutions for organizational and technological functions in the production sector of industrial companies form the main areas of research and development work. The institute also addresses issues resulting from developments and changes in the service sector.

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HdM - Stuttgart Media University, Usability Research Lab (Germany)

Stuttgart Media University educates media specialists. With effect from 1 September 2001, it combined the know-how of the former Hochschule fuer Druck und Medien – a traditional education centre for print and media technology – and the Hochschule fuer Bibliotheks- und Informationswesen. Stuttgart Media University is the only educational institute in Europe to cover every media field and regards itself as a full-service university for the media industry. Its range of courses extends from printing through to the Internet, from design through to business administration, from library science through to advertisement, from media contents through to packaging technology, and from computer science and publishing through to electronic media. These contents are reflected in 17 courses of studies organised in three faculties: Print Media, Electronic Media as well as Information and Communication.

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HPIS - HEWLETT-PACKARD ITALIANA SRL (Italy)

HP is the largest consumer IT company, the world's largest SMB IT company and a leading enterprise IT company. In response to customer needs and the changing market conditions, HP technology now ranges from consumer handheld devices all the way to some of the world's largest and most powerful supercomputer installations. We have dynamic Revenues reached $79.9 billion for the fiscal year 2004. President and CEO Mark Hurd leads HP, which has corporate headquarters in Palo Alto, California. Our annual R&D investment of nearly $4 billion fuels the invention of products, solutions and new technologies, so that we can better serve customers and enter new markets. We produce an average of 11 patents a day worldwide.

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INGEMA - Fundación Instituto Gerontológico Matia (Spain)

INGEMA FOUNDATION (MATIA GERONTOLOGICAL INSTITUTE FOUNDATION), is a research institute with a wide expertise in research on aging and disability and with close contact with this population. Within its objective of offering the best quality in attention and services for the users and their relatives, Ingema Foundation develops multiple research and activities with the state-of-the-art in socio-sanitary and psycho-social models of attention. A highly qualified professional team with wide expertise in social sciences and clinical psychology with elderly and disable people carry out research projects, in order to offer the best attention, most specialized and most close to the user and its relatives at the same time. INGEMA FOUNDATION research lines are focused on the promotion of active ageing, the prevention of dependence, rehabilitation and compensating for fragility and dependence, e-health and physical activity, gerotechnology and, finally, quality of life and quality of attention.

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PROFACTOR - PROFACTOR GmbH (Austria)

PROFACTOR GmbH has been founded in 1994 by the Association for the Modernisation of Manufacturing Technologies in Austria (VPTÖ). The mission is to stimulate advanced research in manufacturing sciences, as well as to enable the development and application of new manufacturing concepts, techniques and technologies. Currently 100 academic scientists from all technical fields are employed and work

in close collaboration with industry. In addition to the competence in manufacturing technology PRO has rich experience in the research area of Service Robotics. Main focus is on development of robotic solutions especially for service, rehabilitation and medicine - in particular addressing the translation of scientific results into stable, robust as well as practicable solutions. Current projects in this area are dealing with the development of a playing assistant for severe physically handicapped children as well as a 9DOF exoskeleton for physical therapy for post-stroke rehabilitation. PROFACTOR also has participated in the EC-FP6 research project "MOVEMENT" which targets at the development of a modular versatile mobility enhancement system. The core of this setup is formed by an intelligent mobile (robotic) platform which can attach to a user definable selection of application modules (e.g. chair, manipulator, ICT Terminal) on demand. Responsibility of PROFACTOR has included development of robot navigation, sensor development as well as development of application modules – PROFACTOR also has been responsible for the overall technical management of the project.

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ROBOTNIK - Robotnik Automation S.L.L. (Spain)

Robotnik is a company dedicated to automation and robotic engineering services, so as industrial machinery production and R&D projects development. They offer high quality engineering services for regional and national reach. Robotnik engineer team is qualified in several sector branches (robotics, informatics, industrial, telecommunications...).

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BED - University of Bedfordshire (United Kingdom)

The University of Bedfordshire (BED) is one of the new universities in the UK. Research proposed in this project will mainly carried out in the Institute for Research in Applicable Computing (IRAC) backed by the Psychology Department. The IRIC has a strong record in collaborative research. The Institute is active in the area of applying computer and AI techniques to various applications including machine learning and cognitive robotics. The recent research in cognitive robotics focuses on active learning which will enable a robot to build up high-order beliefs on its human counterpart's intention through performing experiments by itself. Research in robotics also includes GA-based robot navigation and a hybrid method of constructing roadmaps for robot motion planning. Research on drowsy driving conditions detection where fuzzy logic and HMM are used is also related to this project. Machine learning research concentrates on fuzzy rule induction and modelling using BDTs and neural networks, as well as their applications in drug detection and medicine.

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Consortium as a Whole

The SRS consortium has been carefully selected to brings together ten multidisciplinary partners from health-care, psychology, manufacturing, ICT and robotics. It ensures that SRS will not only end up answering academic questions but succeeds in producing efficient and viable results after project completion.

Partners	Short Name	Roles	Expertise of Partner	Country
Cardiff University, (Manufacturing Engineering Centre)	CU	Project coordinator, leader of WP4 and WP8, main participant of WP3	**Artificial Intelligence (AI)** **Robotics** **Manufacturing and Rapid Prototyping**	UK
BULGARIAN ACADEMY OF SCIENCES	CLMI-BAS	Main participant of WP4 and WP5	**Mechatronics** **Electronics** **Communication technology**	BG
FONDAZIONE DON CARLO GNOCCHI ONLUS	FDCGO	Leader of WP6, main participant of WP2	**Assistive Technology** **Smart-Home Environment** **Biomedical Engineering**	IT
FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V	Fraunhofer	Leader of WP3, main participant of WP4 and WP5	**Service Robotics** **Advanced Sensing and Control**	DE
STUTTGART MEDIA UNIVERSITY (Hochschule der Medien)	HdM	Leader of WP2, main participant of WP6	**Usability** **Human-Robot Interaction** **Psychology**	DE
HEWLETT-PACKARD ITALIANA SRL	HPIS	main participant of WP4 and WP5	**Electronic Engineering** **Information & Communication Technology** **Assistive Technology**	IT
FUNDACION INSTITUTO GERONTOLOGICO MATIA – INGEMA	INGEMA	Leader of WP1, main participant of WP2 and WP6	**Home Care** **Clinical Gerontology** **Psychology**	ES
PROFACTOR GMBH	PROFACTOR	Leader of WP7, main participant of WP2 and WP4	**Service Robotics** **Human-Robot Interaction** **Robotic Safety**	AT
ROBOTNIK AUTOMATION SLL	ROBOTNIK	Leader of WP5, main participant of WP4	**Robotics:** ▪ **Remotely-controlled robotic systems** ▪ **Robotic arms** **Special Machinery** **Electronics**	ES
UNIVERSITY OF BEDFORDSHIRE (Institute for Research in Applicable Computing)	BED	Main participant of WP3 and WP4	**Artificial Intelligence (AI)** **Image Processing** **Robotic Learning** **Computer Science**	UK

Table 2 SRS Consortium Members Roles and Expertises

5. PROJECT WEBSITE

Official SRS website (http://www.srs-project.eu) and a project wiki (http://wiki.srs-project.eu) have been set up by the end of month 3 for both consortium members' and public access. The websites are maintained daily during to report project activities, progress and achievements. The wiki will be used for internal collaboration. They will be globally linked to other relevant websites providing specification, report and source code download. The screenshot of the website are listed as follows:

Figure 1 SRS Project website FrontPage

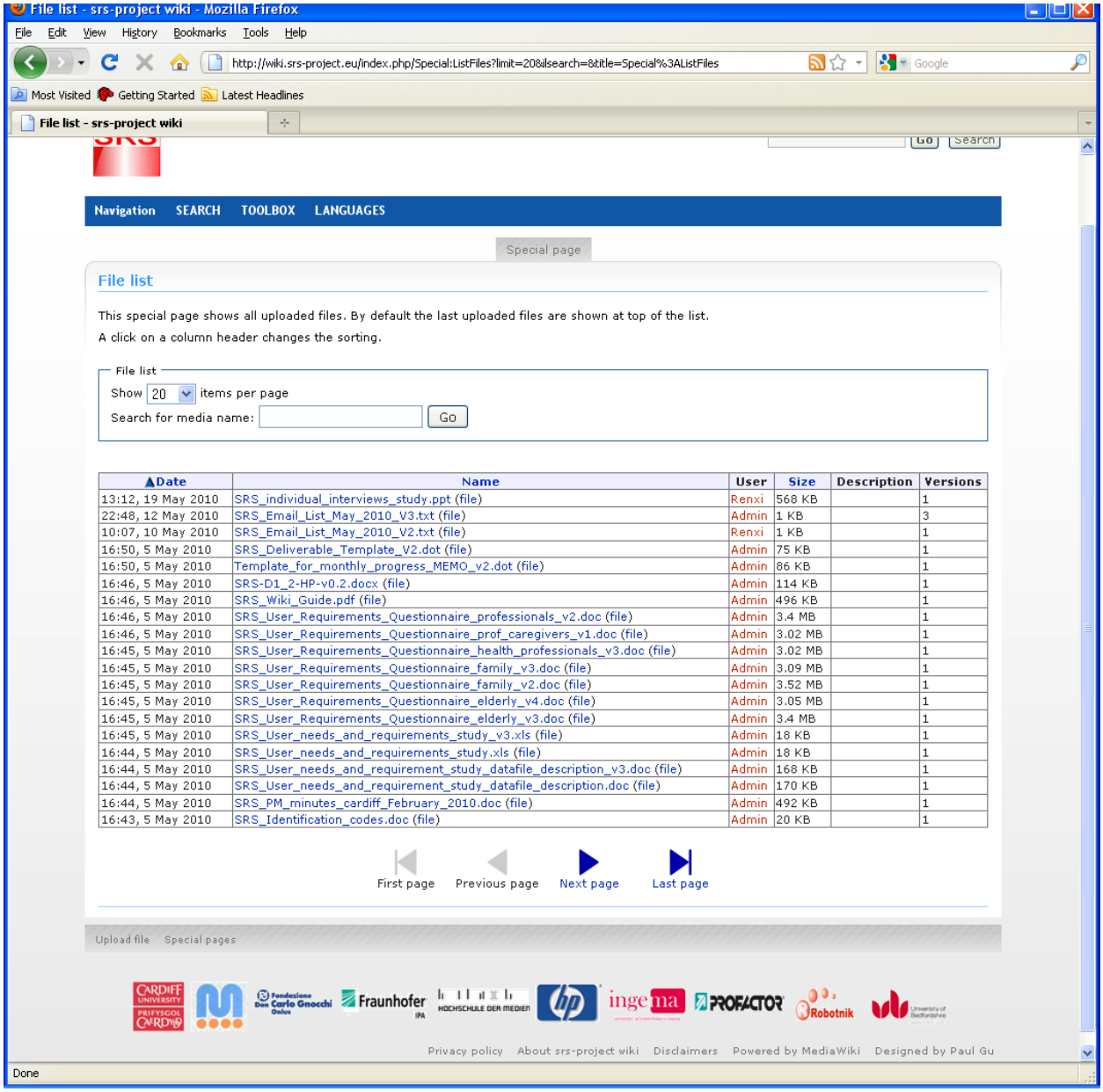

Figure 2 SRS Wiki Document List