eVIDA

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University of Deusto

The University of Deusto has a long and well established teaching and research tradition. Founded in 1886 and, since 2009, recognised as an International Excellence Campus1, the University is a hub of thirty-nine research teams belonging to six faculties (Psychology and Education, Social Sciences and Humanities, Engineering, Law, Economic and Business Sciences, and Theology) situated across three different campuses in Bilbao, San Sebastian, and Madrid. In 1987 the University embarked upon a strategy of internationalisation which has led Deusto to join ninety-four international networks, and to sign over 700 cooperation agreements with universities and research

1 The University of Deusto has been accredited as an International Excellence Campus, as a partner of the Aristos Campus Mundus 2015 project, jointly with other two Spanish Universities (Ramón Llull University and Comillas University) and three American higher education institutions: Georgetown University, Boston College and Fordham University. This accreditation recognizes the quality of academic work and trajectories, and endorses the agreement for an advanced strategic collaboration policy. One of the five focus areas of the Aristos Campus Mundus 2015 is education: innovation, competences and values.

centres from around the globe. At present, it coordinates or participates in fourteen on-going collaborative research projects funded by the European Commission.

The University offers eighteen Bachelor Degrees, thirty-four Master Programmes, seven Doctoral Programmes as well as forty-four specialised courses in Life Long Learning. Alongside these programmes, Deusto has been involved in fifty-one Erasmus Mundus External Cooperation Windows; coordinates three Erasmus Mundus Master Programmes: International Humanitarian Action, Learning and Teaching of Spanish in Multilingual and International Contexts, and Transnational Trade Law and Finance; and is partner in another three.

University of Deusto research teams have run more than 1,300 research projects with different institutions and public bodies, such as the European Commission, Spanish Ministries, the Basque Government, Universities, Enterprises (e.g. Siemens, Iberdrola, BBVA, and Gamesa, amongst many others) and Foundations. Together Deusto's researchers have published more than 1,400 books, 1,800 book chapters, 2,800 articles in scientific journals and completed more than 250 Doctorates.

eVIDA Research group

eVida Research Group (eVida), a research group within the University of Deusto Engineering Faculty, is an experienced, dynamic and diverse team of telecommunications, electronics and software engineers, physicists, mathematicians and psychologists. Founded in 2002, the group is committed to research on and development of ICT-based tools, systems and interventions for psychological, social and physical health. Over the last decade, eVida have established close working relationships with key local stakeholders including hospitals, charities, other research groups and ICT companies.

eVida -Life conduct applied research in two main areas. In the field of ICTs for Well-Being, eVida research, design, develop and test tools and systems

which enable disabled people and the elderly to live more independent lives. eVida is currently involved in creating apps and devices for informal learning and informal learning follow-up services, programmes for person-centred care, and various tele-medicine and tele-monitoring systems. Work in this area has included applied research aimed at assisting groups such as people with intellectual disabilities, people with autism, people with visual impairments, people with hearing impairments, and people with multiple sclerosis. In the field of health, eVida specialise in creating diagnostic tools and systems and interventions for people with health problems such as skin and lung cancer, laryngectomy, epilepsy, migraines, dyslexia and bed sores. This work is based on long term research in the processing of: speech, ECG, EMG and EEG signals, and MRI (colon and lung cancer, articulatory description...), neuro fMRI, dermoscopy, pressure ulcers and stroboscopy images.

In recognition of the quality of its research, eVida has been awarded with the University of Deusto-Banco Santander Research Award in 2007, the ONCE Euskadi-Solidarios Research Award in 2007, the Best Paper Award in the CGAMES'09 International Conference, and the prize for best poster in ISIVC in 2008.

The lead researcher and members of the research team form the eVIDA research team, recognized by the Basque Government since 2010. This team is part of various research networks such as the European Network of Livings Labs (ENoLL) under the name "Life Living Lab (L3Lab)" and the "Red de Espacios Sociales de Innovación (ESdI)" under the name "LS2TECH". In the field of ageing the University participates in three of the six Action Groups of the European Innovation Partnership for Active and Healthy Ageing (EIP-AHA) specifically in Action Groups A2 Personalised health management and falls prevention and D4 Age friendly environments (with Biscay Provincial Government), and in Action Group B3 Integrated care for chronic diseases (with the Basque Government). eVida are also present of the EU-recognized Basque Reference Site for good practice for innovation in active and healthy ageing (http://ec.europa.eu/research/innovation-union/pdf/active-healthy-ageing).

eVida group has extensive previous experience in both national and international projects. The results of its research and its application have been published in over fifty scientific articles in international journals and books and have been presented over than 150 international scientific conferences.

Biomedical signal Processing

The biomedical signal processing involves at least four stages: a) Measurement or observation: signal acquisition; b) Signal's transformation and reduction; c) Computation of the signal parameters that are clinically significant and d) Interpretation and classification of signals. eVida research group has extensive experience (more than 10 years) of development biomedical signal processing algorithms with the aim to support medical decisions making. These are applied in several fields: neuroimage processing (MRI) for dyslexia and migraine; EEG signal processing for ADHD and epilepsy; speech processing for laryngectomees; and finally, image processing for skin and lung, pressure ulcers, articulatory problems and ENT pathologies through different techniques such as dermoscopy, stroboscopy, MRI and pressure ulcer images.

Serious Games and Mobile Technologies

Since 2008, one of the main lines of research of eVida has been Serious Games aimed at health and wellbeing through innovative intelligent therapies, early detection tools, physical and cognitive rehabilitation solutions and habit training and emotional regulation games. These Serious Games have often been combined with sensors, such as biofeedback, Kinect and eyetracker. The team have had several projects funded by the Basque Government and the Biscay provincial government in this area, including projects aimed at children with ADHD, dyslexia and autism, Active Ageing, and other groups such as people with intellectual disabilities. One of the latest R&D outputs, "Kineage", a Kinect based serious game, was recently selected as one of the finalists of the Social Innovation in Ageing – The European Award 2014.

Biomedical devices

eVida also develops hardware based on sensors, robots and Set Top Boxes. These are employed in gait analysis, biomedical signal gathering and monitoring,

physical and cognitive rehabilitation and TV care. These devices have principally been developed for the benefit of elderly people and people suffering from chronic diseases.

Telemedicine and Telemonitoring

Telemedicine can help patients and physicians better manage a patient's disease and similar long-term conditions. Since 2010, telemedicine and tele-monitoring applications have been another important focus of eVida research group, and the team have received funding from the Basque Government and the Biscay provincial government for a number of projects related to multiple sclerosis/medullary disease physical rehabilitation, children with dyslexia, elderly people, and oncology group therapies, etc. Rehabilitation at home refers to telemedicine applications that enable patients to perform exercises at times and places they prefer while still being adequately supervised by professionals. The effectiveness of tele-rehabilitation has been illustrated by several research papers.

In what follows, we detail other relevant **projects, publications and intellectual property registrations** of the group in the last 5 years that represent international, national and regional activity.

Projects and Publications based on with international collaborations

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Projects

"SUNFRAIL: Reference Sites Network for Prevention and Care of Frailty and Chronic Conditions in community dwelling persons of EU Countries". Funded by the European Commission. This project is in partnership with Italy, France, Poland, UK and Belgium. HP-PJ-2014. 15/02/2015 – 15/08/2017.

“SMARTXA-BASIC: Solución tecnológica para monitorización de la marcha como parámetro de medida del estado de salud de las personas con problemas de movilidad.” Funded by Communauté de Travail des Pyrénées. 01/01/2013 – 31/12/2014.

"H-SEAT: Healthy Sleep And Exercise Analysis Tool". Funded by Lead - Era, European Commission. 01/01/2012 – 01/01/2014.

“Mejora de la calidad de vida y la salud de personas con diversidad funcional utilizando entornos virtuales y juegos de ordenador.” Funded by Spanish Ministry of Foreign Affairs and Cooperation. 01/01/2012 – 31/12/2012.

"Solución inteligente integral para AAL (Intelligent integrated solution for Ambient Assisted Living). ePERION". Funded by Lead - Era, European Commission. 01/01/2011 – 31/12/2013.

"OESOVOX: Amélioration en Temps Réel de la Voix de Personnes ayant subi une Ablation du Larynx (Voix Oesophagiennes)" Funded by Euromed - INRIA 3+3. It integrates collaborators from France, Tunisia, Morocco and Spain. 01/01/2006 - 31/12/2011.

Publications

I. Maestro Saiz, E. Lopetegui Alba, J. O’Toole, B. García Zapirain Soto, A. B. Anaya-Chen and I. Yurrebaso Santamaria. “Synchronization and Brain Connectivity in Patients With Focal Periodic Activity In Scalp EEG: Ictal Features,” in European Congress on Epileptology, Stockholm (Sweeden), 2014.

R. Ishaq, M. Shahid, B. Lovstrom, B. García Zapirain and I. Claesson. “Modulation Frequency Domain Adaptive Gain Equalizer Using Convex Optimization,” in 6th International Conference of Signal Processing and Communication Systems (ICSPCS), Gold Coast (Australia), 2012.

A. Elmaghraby, A. Méndez Zorrilla, B. García Zapirain, W. Sheta, S. el Shehaby. “Serious games and Health Informatics: A unified framework,” 17th International Conference on Computer Games (CGAMES), 2012.

A. Méndez Zorrilla, N. El-Zehiry, B. García Zapirain and A. Elmaghraby. “Pathological Vocal Folds Features Extraction Using A Modified Active Contour Segmentation,” Majlesi Journal Of Electrical Engineering, vol. 4(4), 2010.

A. Méndez Zorrilla, N. El-Zehiry, B. García Zapirain and A. Elmaghraby. “Pathological Vocal Folds Diagnosis Using Modified Active Contour Models,” 10th International Conference on Information Sciences Signal Processing and their Applications (ISSPA), 2010.

A. Méndez Zorrilla, E. M. Ismaili Alaoui, B. García Zapirain, E. Ibn-Elhaj, I. Ruiz. “Glottal space segmentation from motion estimation and Gabor filtering,” 31st IEEE International Conference on Engineering in Medicine and Biology Society (EMBC), 2009.

A. Ochoa, N. Castillo Viveros, L. Margain, B. García Zapirain and A. Méndez Zorrilla. “Blurring Organizational Issues and Social Phenomena In The Age Of Technology: A Multidisciplinary Perspective.”

National and Regional Projects

“Caracterización articulatoria tridimensional del español y su aplicación a la enseñanza de su pronunciación.” Funded by MINECO - Proyectos I+D Excelencia 2013. 01/01/2014 – 31/12/2016.

“LINFOCAD: Sistema automatizado para la detección y monitorización 3D de inflamaciones de ganglios linfáticos de cara a la mejora en los diagnósticos y tratamientos oncológicos.” Funded by Department of Industry, Innovation Trade and Tourism of the Basque Government. GAITEK Program. 01/07/2014 – 31/12/2016.

“PLAYBIT: Sistema de adaptación de recursos tecnológicos para la intervención de niños con TDAH basados en biofeedback y Serious Games for Health.” Funded by Department of Industry, Innovation Trade and Tourism of the Basque Government. GAITEK Program. 01/07/2014 – 31/12/2016.

“CASE 3D: Caracterización articulatoria de la producción de los sonidos del euskara a partir de la modelizacion 3D del tracto vocal.” Funded by Basque Government. Basic research. 01/01/2013 – 31/12/2015.

“Diseño y desarrollo de algoritmos avanzados de detección heurística y no heurística de tumores, caracterización de los mismos y modelado matemático de su evolución en 3D, de cara a la mejora en su diagnóstico y tratamiento (Detectum3D).” Funded by Department of Industry, Innovation Trade and Tourism of the Basque Government. GAITEK Program. 01/01/2013 – 31/12/2013.

“Disfunción Orbito Frontal en Pacientes con Migraña Crónica y Abuso de Analgésicos. Estudio con Resonancia Magnética Funcional (FMRI). MIGREIN.” Funded by Instituto de Salud Carlos III (ISCIII). FIS Program. 01/01/2012 – 31/12/2014.

“jolasTEA: Solución tecnológica de ayuda al tratamiento de los trastornos del espectro autista (TEA) siguiendo los criterios del DSM – V.” Funded by Regional Government of Biscay. Department of Economic Promotion. 2012 – 31/12/2013.

“Envejecimiento Activo- hábitos saludables con la Kinect para personas mayores.” Funded by Regional Government of Biscay. 01/01/2012 –31/12/2012.

“Plataforma integral de apoyo a las personas con discapacidad intelectual y del desarrollo para la toma de decisiones de la vida cotidiana y promoción de la integración social. Proinso.” Funded by Department of Industry, Trade and Tourism of the Basque Government. INNOTEK Program. 01/07/2011 – 31/12/2013.

“Análisis matemático de la periodicidad de la actividad epileptiforme periódica (PLEDS) que aparece en el EEG de algunos pacientes con sospecha clínica de estatus epiléptico no convulsivo. (ICTALPLED). ” Funded by Basque Government, Department of Social Welfare. 01/10/2011 – 31/12/2012.

“Estudio de la función cerebral en reposo mediante resonancia magnética en pacientes con migraña crónica. MRESTIG.” Funded by Department of Industry, Trade and Tourism of the Basque Government. SAIOTEK Program. 01/10/2011 – 31/12/2012

“Algoritmos de análisis y procesado de señales EEG para el estudio y caracterización del trastorno por déficit de atención e hiperactividad a través de las neuronas espejo.”

Funded by Basque Government, Department of Education, Universities and Research. 09/2011 – 31/12/2013.

Selected Scientific Outputs

Publications in journals

A. Lopez-Basterretxea, A. Méndez-Zorrilla, B. García-Zapirain. "Eye/Head Tracking Technology to Improve HCI with iPad Applications." *Sensors, vol.* 15(2), 2244-2264, 2015.

J. A. Urigüen and B. García Zapirain, "EEG artifact removal – State-of-the-art and guidelines." *Journal of Neural Engineering* (in press).

I. Saralegui, J. M. Ontañón, B. Fernandez-Ruanova, B. García-Zapirain, A. Basterra and E. Sanz-Arigita. "Reading networks in children with dyslexia compared to children with ocular motility disturbances revealed by fMRI." *Frontiers in Human Neuroscience*, vol. 8, 2014.

L. Lopez-Samaniego, B. García-Zapirain and A. Méndez-Zorrilla. "Memory and accurate processing brain rehabilitation for the elderly: LEGO robot and iPad case study," *Bio-Medical Materials and Engineering*, vol. 24(6), 3549-3556, 2014.

Y. García Chimeno, B. García Zapirain, I. Saralegui Prieto and B. Fernandez-Ruanova. "Automatic classification of dyslexic children by applying Machine Learning to fMRI images." *Bio-Medical Materials and Engineering*, vol. 24(6), 2995-3002, 2014.

R. Ishaq, B. García Zapirain. "Optimal Subband Kalman Filter for Normal and Oesophageal Speech Enhancement." *Bio-Medical Materials and Engineering*, vol. 24(6), 3569-3578, 2014.

G. Eguiluz-Pérez, B. García-Zapirain. "Comprehensive Verticality Analysis and Web-based Rehabilitation System for People with Multiple Sclerosis with Supervised

Medical Monitoring," *Bio-Medical Materials and Engineering*, vol. 24(6), 3549-3556, 2014.

M. Viqueira Villarejo, J. Maeso García, B. García Zapirain and A. Méndez Zorrilla. "Technological solution for the objective gait parameterization using pressure sensors: case study Multiple Sclerosis patients," *Bio-Medical Materials and Engineering*, vol. 24(6), 3549-3556, 2014.

M. Viqueira Villarejo, B. García Zapirain, A. Méndez Zorrilla. "Shoe-integrated sensors in physical rehabilitation," *Bio-Medical Materials and Engineering*, vol. 24(6), 3549-3556, 2014.

F. Jorge-Hernandez, Y. García Chimeno, B. García-Zapirain, A. Cabrera Zubizarreta, M. A. Gómez Beldarrain and B. Fernández-Ruanova. "Graph Theory for feature extraction and classification: a migraine pathology case study," *Bio-Medical Materials and Engineering*, vol. 24(6), 3549-3556, 2014.

N. Aresti Bartolomé and B. García Zapirain. "Technologies as support tools for persons with Autistic Spectrum Disorder: A systematic review." *International Journal of Environmental Research and Public Health*, vol. 11(8), 2014.

I. Sánchez-Rola and B. García Zapirain. "Mobile NBM – android medical mobile application designed to help in learning how to identify the different regions of interest in the brain's white matter." *BMC Medical Education*, vol. 14, 2014.

A. Lopez Basterretxea, A. Méndez Zorrilla and B. García Zapirain. "A Telemonitoring Tool based on Serious Games Addressing Money Management Skills for People with Intellectual Disability." *International Journal of Environmental Research and Public Health*, vol. 11(3), 2361-2380, 2014.

A. Muro de la Herran, B. García Zapirain and A. Méndez Zorrilla. "Gait Analysis Methods: An overview of wearable and non-wearable systems, Highlighting Clinical Applications." *Sensors*, vol. 14(2), 3362-3394, 2014.

M. Frutos Pascual, B. García Zapirain and A. Méndez Zorrilla. "Adaptive Tele-Therapies Based on Serious Games for Health for People with Time-Management and

Organisational Problems: Preliminary Results." *International Journal of Environmental Research and Public Health*, vol. 11, 749-772, 2014.

J. L. García Arroyo and B. García Zapirain. "Detection of pigment network in dermoscopy images using supervised machine learning and structural analysis." *Computers in Biology and Medicine*, vol. 44, 144-157, 2014.

G. Eguiluz Pérez and Begoña García Zapirain. "Use A Time-Of-Flight Camera With Omek Beckon Framework To Analyze, Evaluate And Correct In Real Time The Verticality Of Multiple Sclerosis Patients During Exercise." *Advances In Telehealthcare, A Special Issue Of International Journal Of Environmental Research And Public Health*, vol. 10(11), 5807-5829, 2013.

F. Grenez, M. Viqueira Villarejo, B. García Zapirain and A. Méndez Zorrilla. "Wireless Prototype Based on Pressure and Bending Sensors for Measuring Gate Quality." *Sensors*, vol. 13, 9679-9703, 2013.

M. Viqueira Villarejo, B. García Zapirain and A. Méndez Zorrilla. "Algorithms Based on CWT and Classifiers to Control Cardiac Alterations and Stress Using an ECG and a SCR." *Sensors*, vol. 13, 6141-6170, 2013.

M. Viqueira Villarejo, B. García Zapirain and A. Méndez Zorrilla. "A Stress Sensor Based on Galvanic Skin Response (GSR) Controlled by ZigBee." *Sensors*, vol. 12, 6075-6101, 2012.

B. García Zapirain, A. Méndez Zorrilla, I. Ruiz Oleagordia and J. Vicente Sáez. "Enhancing Communication Theory Learning in the European Higher Education Area," *International Journal of Electrical Engineering Education*, vol. 49, 114-126, 2012.

G. Isasi, B. García Zapirain and A. Méndez Zorrilla. "Melanomas non-invasive diagnosis application based on the ABCD rule and pattern recognition image processing algorithms." *Computers in Biology and Medicine*, vol. 41, 742-755, 2011.

Books and chapters

J. L. García Arroyo and B. García Zapirain. “Comparison of image processing techniques for reticular pattern recognition in melanoma detection,” in Dermoscopy Image Analysis. CRC Press/Taylor & Francis, 2014.

M. Viqueira Villarejo, B. García Zapirain and A. Méndez Zorrilla. “Ocular Movement and Cardiac Rhythm Control using EEG techniques,” in Medical Imaging in Clinical Practice. InTec, 2013.

A. Méndez Zorrilla and Begoña García Zapirain. “Vocal Folds Stroboscopic Image Processing for Otolaryngology,” in Medical Imaging in Clinical Practice. InTech, 2013.

A Simancas, Amaia Méndez Zorrilla and Begoña García Zapirain. “Augmentative Communication Application For People With ASD Using Android Devices,” in Advances In Medicine And Biology. Nova Science Publishers, 2013.

J. L. García Arroyo and Begoña García Zapirain. “Automated Detection Of Melanoma In Dermoscopic Images,” in Computer Vision Techniques For The Diagnosis Of Skin Cancer. Springer, 2013.

N. Aresti Bartolome and B. García Zapirain. “Detection Of Gaze Atypical Pattern: A Systematic Review Of Eye Tracking In The Autistic Spectrum Disorders,” in Advances In Medicine And Biology. Nova Science Publishers, 2013.

M. Viqueira, B. García Zapirain, A. Méndez and I. Ruiz Oleagordia. “Wavelet Transform for the analysis of EEG signals in patients with oral communications problems,” in Advances in Wavelet Theory and their applications in Biology and Geoscience. In-Tech, 2012.

I. Ruiz Oleagordia and B. García Zapirain. “Improvement of shimmer parameter of oesophageal voices Using Wavelet Transform,” in Advances in Wavelet Theory and their applications in Biology and Geoscience. In-Tech, 2012.

B. García Zapirain, I. Oleagordia Ruiz, A. Méndez Zorrilla and M. Mendezona. “Oesophageal Voice, Objective Quality Assessment,” in Speech Processing and

Auditory Processing Disorders: Causes, Diagnosis and Treatment. Nova Science Publishers, 2011.

Relevant presentations at seminars and conferences

J. M. O'Toole, B. García Zapirain, I. Maestro Saiz, A. Beatriz Anaya, I. Yurrebaso Santamaria. "Estimating the Time-Varying Periodicity of Epileptiform Discharges in the Electroencephalogram." ISSPA, 2012.