2AI - APPLIED ARTIFICIAL INTELLIGENCE LABORATORY

ANNUAL REPORT 2020

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1. INTRODUCTION

The R&D Unit Applied Artificial Intelligence Laboratory (2Ai) was created in the Polytechnic Institute of Cávado and Ave (IPCA) in 2018. In January 2020, 2Ai received the Very Good classification by FCT (on a scale of Not recognized, Weak, Good, Very Good and Excellent). It pursues applied research advances on artificial intelligence (AI), namely in intelligent systems, human-AI Collaboration and robotics for health, industry, environment and security. This cross-cutting themes and multidisciplinary interface fosters the generation of value through the development of innovative products and smart services, resulting from internationally highly competitive research.

2Ai is a fully incorporated research structure within the School of Technology (EST) of IPCA. 2Ai is a research unit within the young and innovative EST, guided by values of excellence and proximity at the regional level. The research center is composed of a young group of 14 integrated members with Ph.D., and most of their members have received a Ph.D. degree in the last 10 years.

2. OBJECTIVES AND AIMS

The 2Ai scientific vision focuses on augmenting the knowledge, information and interaction at the disposal of agents, robots and humans to improve their performance at the target areas. To this end, we aim to apply machine learning techniques, spanning natural language processing, deep-learning and computer vision, to extract information and provide knowledge to potentiate intelligent decision automation systems and human-AI collaboration. 2Ai will also strongly focus on the application of gamification concepts as an engine for the development of new smart and personalized training approaches. Furthermore, the search for more natural interfaces to improve the overall control of the context environment will complete an integrated suite of research efforts, on the path towards innovative technologies and smarter services.

The creation of this type of solutions can generate new markets, and improve efficiency of existing goods and services across the 2Ai impact areas:

> **Healthcare:** The development of novel AI services aiming to provide innovative decision support systems for improved medical diagnoses. It also has potential to improve telemedicine, assist in repetitive medical tasks and enhance smart surgical rooms with robots, natural user interfaces, and augmented reality setups by combining different image sources. Additionally, smart data analysis strategies will be pursued as a key factor in order to better correlate illness evolution to their treatment. In the long-term, the goal is to provide more efficient pipelines to promote proactive and personalized clinical services.

Industry: AI services to increase production capabilities through more reliable forecast of market demand, increased flexibility in operations and the supply chain and equipment failure prediction will drive this research area. By applying these solutions, smarter, faster, cheaper production approaches are expected. Furthermore, the application of game-based learning tools, with virtual and augmented reality, collaborative robots and smart virtual assistants are expected to improve productivity and the employees' health and safety.

Environment and security: AI services, combining aerial robots and artificial vision, to perform a smart monitoring of natural environments (e.g., forests) will be pursued. These AI services can gather site-specific and timely data about different dynamic aspects of the environment, generate warnings only when and where they are needed, and create a historical record of the environment. AI can also assist in the supervision and detection of anomalous conditions, providing situational awareness for a broad range of monitoring services. Distributed sensor systems complemented with AI can further increase pattern understanding of normal conditions, and detect when the probability of change rises significantly, whether triggered by natural or human causes.

In order to fulfill these aims, 2Ai defined a research plan focused on the following main strategies:

a) - Research and development of novel and effective methods for innovative services applied to the 2Ai impact areas (S1);

b) - Development of shared public databases and prototyping tools for AI training, testing and validation (S2);

c) - Study the regional and national landscape to foster a sustainable and healthy AI R&D ecosystem, combining academia, industry and experts (S3);

d) - Prototype systems as proof-of-concepts leading to the creation of intelligent services and applications, enhance the translation of new tools and promote innovation through the creation and nurturing of new SMEs and spin-offs (S4);

e) - Contribute to the creation of a critical mass of highly skilled human resources in AI by attracting and collaborating with leading researchers, entrepreneurs, and experts active in the field (S5);

f) - Attraction of funds and investors for research (S6).

2.1. MAIN ACHIEVEMENTS DURING THE YEAR OF 2020

According to the defined strategic plan, the following achievements were obtained in 2020:

STRATEGIC AIM	OUTCOMES
S1	As a fundamental main goal, 2Ai aims to promote research in the R&D impact areas. During the last year, a total of 23 journal publications (17 in peer-review journals (ISI/Scopus indexed)), 29 proceedings in international conferences, 1 book Edition, 4 book chapters and 1 patent were published. This represents an average of 4 publications/year per integrated researcher. From the published works (ISI/Scopus indexed peer-review journals), 82% of the studies were included in top-rank journals (Q1 and Q2). Particularly, 47% Q1 and 35% Q2 journals publications were obtained. Some peer-review journals are published in collaboration with other

		european R&D centers, such as: Physics Center of University of Minho (Portugal), Algoritmi Research Center of University of Minho, (Portugal), LIACC of Faculty of Engineering of the University of Porto (Portugal), Department for Neonatology and Pediatric Intensive Care Medicine of University Hospital Carl Gustav Carus (Dresden, Germany) and Lab on Cardiovascular Imaging and Dynamics, KU Leuven (Belgium), demonstrating the good research network of 2Ai members. Moreover, a policy of fostering an active involvement of students within the 2Ai research projects, including (14) bachelor final projects, (21) master students and (10) PhD students.
	S2	It is known that the success of artificial intelligence methods is directly linked to the amount and quality of example data. As described in the original 2Ai research activity proposal, 2Ai members aim to increase the number of available databases and promote new research applications based on AI. Specifically, during 2020, two databases were publicly released.
	S3	Aiming to develop a sustainable national ecosystem in AI, 2Ai was evolved in a large consortium constituted by 13 R&D Units in the field of AI, to create the first Portuguese Associated Laboratory totally dedicated to Intelligence Systems research (LASI). Despite the scientific goals, LASI aims to promote scientific employment in Portugal, to create straight collaboration between industries and

	research and to enhance international dissemination of all R&D members. The creation of associated laboratories was defined as one of the main research programs established by the Portuguese Foundation for Science and Technology. Moreover, 2Ai members organized a total of 9 international conferences/symposium targeting 2Ai related impact areas.
S4	No relevant results were registered for this strategic goal in 2020. Nevertheless, during this period, it was promoted between the members the submission of research projects in collaboration with industries, as well as, intellectual property protection through national and international patents. In 2020, one patent was registered.
S5	2Ai offered a set of advanced courses for training in emergent technological areas, namely Fundamentals of VFX in Foundry Nuke, Introduction to Machine Learning, Natural Language Processing, Data Analysis and Affective Computing. Due to pandemic COVID-19, the contingency plan and measures enacted by the Portuguese Government after the declaration of a state of emergency, the Advanced Courses Coordination decided to postpone all Advanced Courses of the 2020 Edition for next year of 2021 (Advanced Courses - 2021 Edition). Moreover, 2Ai foster collaborations between its researchers and international partners focused on 2Ai impact areas, specifically a total of 2 research collaborations were established.

S6	To ensure medium and long-term sustainability, 2Ai actively sought, during last year, to apply to different financing calls. A total of 28 projects were submitted in 2020 targeting national, industrial cooperation and european calls. Currently, 7 projects were already recommended for funding for the next 2-3 years, with a total funding value of 1.831.070,44€, where 6 projects are already under execution. This value corresponds to an average 130k€ raised per integrated member. A total of 9 projects (requested funding >3M€) are still under evaluation and waiting for the final decision. 2Ai thus obtained, since 2020, the financing for 11 projects, currently having in its portfolio a financing for the 2020-2023 period of more than 3M€.

A summary of the scientific outcomes obtained by the 2Ai members is presented in Table 1. The outcomes are presented according to the standard guidelines of the Portuguese Foundation for Science and Technology (FCT).

Table 1 - Summary of the 2Ai' scientific outcomes

SCHOLARSHIP	Nº OF POSITIONS
A. Publications	
A1. Books/Book Chapters	1/4
A2. Scientific Publications in International Journals	23
A3. Scientific Publications in National Journals	0
B. Conferences	
B1. Proceedings in International Conferences	29
B2. Proceedings in National Conferences	0
C. Reports	1
D. Organization of conferences	9
E. Advanced Training	
E1. PhD Thesis	0
E2. Master Thesis	11
F. Mathematical Models	2
G. Computational applications	2
H. Pilot Installations	0
I. Laboratorial Prototypes	1
J. Patents	1

3. PRODUCTIVITY

3.1. PUBLICATIONS IN PEER-REVIEW JOURNALS

1. Torres H.R., Morais P., Fritz A., Oliveira B., Veloso F., Fonseca JC and Vilaça J.L.. (2020). Anthropometric Landmark Detection in 3D Head Surfaces using a Deep Learning Approach. *IEEE J. Biomed. Heal. Informatics*. DOI:https://doi.org/10.1109/JBHI.2020.3035888 *(ISI indexed journal: IF: 5.223; Q:Q1; Scopus indexed journal; Scimago (SJR): Q:Q1)*

2. Carvalho, F., Santos, G. and Gonçalves, J. (2020). Critical analysis of information about integrated management systems and environmental policy on the Portuguese firms' website, towards sustainable development. *Corporate Social Responsibility and Environmental Management*. DOI: https://doi.org/10.1002/csr.1866 *(ISI indexed journal: IF: 4.542; Q:Q1; Scopus indexed journal; Scimago (SJR): Q:Q1)*

3. Dios J. R., Gonzalo B., Tubio C. R., Cardoso J., Gonçalves S., Miranda D., Correia V., Viana J.C., Costa P., Lanceros-Méndez S. (2020). Functional Piezoresistive Polymer-Composites Based on Polycarbonate and Polylactic Acid for Deformation Sensing Applications. *Macromolecular Materials and Engineering*. DOI: https://doi.org/10.1002/mame.202000379 *(ISI indexed journal: IF: 3.853; Q:Q1; Scopus indexed journal; Scimago (SJR): Q:Q1)*

4. Abuín JM, Lopes N, Ferreira L, Pena TF and Schmidt B. (2020). Big Data in metagenomics: Apache Spark vs MPI. *PLOS ONE*. DOI: https://doi.org/10.1371/journal.pone.0239741 *(ISI indexed journal: IF: 2.740; Q:Q1; Scopus indexed journal; Scimago (SJR): Q:Q1)*

5. Borges J., Queirós S., Oliveira B., Torres H., Rodrigues N., Coelho V., Pallauf J., Brito J. H., Mendes J. and Fonseca J.C. (2020). A system for the generation of in-car human body pose datasets. *Machine Vision and Applications*. DOI: https://doi.org/10.1007/s00138-020-01131-z *(ISI indexed journal: IF: 1.605; Q:Q2; Scopus indexed journal; Scimago (SJR): Q:Q2)*

6. Pereira M. F., Prahm C., Kolbenschlag J., Oliveira E. and Rodrigues N. F. (2020). Application of AR and VR in hand rehabilitation: A systematic review, *Journal of Biomedical Informatics*. DOI: https://doi.org/10.1016/j.jbi.2020.103584 *(ISI indexed journal: IF: 3.526; Q:Q1; Scopus indexed journal; Scimago (SJR): Q:Q1)*

7. Correia, B., Dias, N., Costa, P., and Pêgo, J. M. (2020). Validation of a Wireless Bluetooth Photoplethysmography Sensor Used on the Earlobe for Monitoring Heart Rate Variability Features during a Stress-Inducing Mental Task in Healthy Individuals. *Sensors*. DOI: https://doi.org/10.3390/s20143905 *(ISI indexed journal: IF: 3.275; Q:Q1; Scopus indexed journal; Scimago (SJR): Q:Q1)*

8. Silva E, Aguiar J, Reis L.P., Sá J. O., Gonçalves J. and Carvalho V. (2020). Stress among Portuguese Medical Students: the EuStress Solution. *Journal of Medical Systems*. DOI: https://doi.org/10.1007/s10916-019-1520-1 *(ISI indexed journal: IF: 3.058; Q:Q1; Scopus indexed journal; Scimago (SJR): Q:Q2)*

9. Simões, A. and Guinovart XA. (2020). Building wordnets with multi-word expressions from parallel corpora. *Procesamiento del Lenguaje Natural*. DOI: https://doi.org/10.26342/2020-64-5 *(Not ISI indexed journal: IF: NA; Q:NA; Scopus indexed journal; Scimago (SJR): Q:Q2)*

10. Costa, R., Carvalho, S., Salgado, A., Simões, A. and Tasovac, T. (2020). Ontologie des labels de domaines appliquée aux dictionnaires de langue générale [no prelo]. *Langue(s) et Parole – Revue de Philologie Française et Romane.* URL: https://es.calameo.com/read/0038662368a28c0171ff4 *(Not ISI indexed journal: IF: NA; Q:NA; Not Scopus indexed journal; Scimago (SJR): Q:NA)*

11. Martins, T., Carvalho, V., & Soares, F. (2020). Physioland–A serious game for physical rehabilitation of patients with neurological diseases. *Entertainment Computing*. DOI: https://doi.org/10.1016/j.entcom.2020.100356 *(ISI indexed journal: IF: 1.341; Q:Q2; Scopus indexed journal; Scimago (SJR): Q:Q2)*

12. Guimarães, M., Gonçalves, J., Sousa, M. and Valenzuela, A. (2020). Dental Diversity Patterns: Relevance in Portuguese Military Population. *Acta Scientific Dental Sciences*. URL: https://actascientific.com/ASDS/ASDS-03-0740.php *(Not ISI indexed journal: IF: NA; Q:NA; Not Scopus indexed journal; Scimago (SJR): Q:NA)*

13. Mancellos, J., Guimarães, I. and Gonçalves, J. (2020). Legal Validity of Criminal Identification from the Comparative Analysis of Bitemarks. *Acta Scientific Dental Sciences*. DOI: https://doi.org/10.31080/ASDS.2020.04.0879 *(Not ISI indexed journal: IF: NA; Q:NA; Not Scopus indexed journal; Scimago (SJR): Q:NA)*

14. Santos, G., Félix, M., Doiro, M., Mandado, E., Sá, j., Gonçalves, J. and Teixeira, P. (2020). On the concept of an integrated and lean model of product development proposed for intellectual property creation and competitive economies. *International Journal of Intellectual Property Management*. DOI: https://doi.org/10.1504/IJIPM.2020.10031141 *(Not ISI indexed journal: IF: NA; Q:NA; Scopus indexed journal; Scimago (SJR): Q:Q4)*

15. Oliveira, A., Silva, E., Aguiar, J., Faria, B., Reis, L., Cardoso, H., Gonçalves, J., Sá, J., Carvalho and V. Marques, H. (2020). Biometrics and quality of life of lymphoma patients: A longitudinal mixed-model approach. *Expert Systems*. DOI: https://doi.org/10.1111/exsy.12640 *(ISI indexed journal: IF: 1.546; Q:Q2; Scopus indexed journal; Scimago (SJR): Q:Q2)*

16. Torres H. R. , Queirós S, Morais P, Oliveira B, Gomes-Fonseca J, Mota P, Lima E, D'hooge J, Fonseca JC and Vilaça J.L. (2020). Kidney Segmentation in Three-Dimensional Ultrasound Images using a Fast Phase-based Approach. *IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control*. DOI:

https://doi.org/10.1109/TUFFC.2020.3039334 *(ISI indexed journal: IF: 2.812; Q:Q1; Scopus indexed journal; Scimago (SJR): Q:Q1)*

17. Campos RP., Vázquez I. and <u>Vilhena E.</u> (2020). Clinical, psychological and quality of life differences in fibromyalgia patients from secondary and tertiary healthcare. *European Journal of Pain*. DOI: https://doi.org/10.1002/ejp.1694 *(ISI indexed journal: IF: 3.492; Q:Q2; Scopus indexed journal; Scimago (SJR): Q:Q1)*

18. Molho C., Sousa B. and <u>Vilhena E.</u> (2020). O papel das comunicações integradas de marketing no valor de uma marca: uma abordagem exploratória. *Revista Ibérica de Sistemas e Tecnologias de Informação* (RISTI). URL: https://ciencipca.ipca.pt/bitstream/11110/1985/1/risti_2020_2.pdf *(Not ISI indexed journal: IF: NA; Q:NA; Scopus indexed journal; Scimago (SJR): Q:Q4)*

19. Basto M, Abreu T, <u>Vilhena E</u>, <u>Gonçalves J</u> and Carvalho M(2020). Na Exploratory Study of the Academic Success/Failure. *Revista Contemporânea da Educação*. DOI: https://doi.org/10.20500/rce.v15i32.29056 *(Not ISI indexed journal: IF: NA; Q:NA; Not Scopus indexed journal; Scimago (SJR): Q:NA)*

20. <u>Duque D.</u>, <u>Dias N</u>. and <u>Vilaça J.L.</u> (2020). Editorial Comment: Special Issue on Serious Games for Health. *IEEE Transactions on Games*. DOI: https://doi.org/10.1109/TG.2020.3042425 *(ISI indexed journal:* IF: 1.886; Q:Q2; *Scopus indexed journal; Scimago (SJR): Q:NA)*

21. Santos MJC., <u>Vilhena E.</u>, Antonelli RA. and Meurer AM. (2020). Desempenho Académico e características Sociodemográficas, Comportamentais, Psicológicas e de Formação Docente: Análise de Alunos Portugueses da Área de Negócios. *Contabilidade Vista & Revista*. DOI: https://doi.org/10.22561/cvr.v31i2.5286 *(Not ISI indexed journal: IF: NA; Q:NA; Not Scopus indexed journal; Scimago (SJR): Q:NA)*

22. Santos MJC., <u>Vilhena E.</u>, Antonelli RA. and Meurer AM. (2020). Diferenças no desempenho académico a partir das características socioeconómicas, demográficas, comportamentais e psicológicas de estudantes portugueses da área de negócios. *Revista Pensamento Contemporâneo em Administração*. DOI: https://doi.org/10.12712/rpca.v14i2 *(Not ISI indexed journal: IF: NA; Q:NA; Not Scopus indexed journal; Scimago (SJR): Q:NA)*

23. Putnik G, Rodrigues D, Alves C, Ávila P, Castro H, <u>Cruz-Cunha M</u>. (2020). Analysing Meta-Organizations with Embedded Brokering Services Performance Modelled as a Call-Centre for Supporting Dynamic Reconfigurability of Networked and Virtual Organizations. *FME Transactions*. DOI: https://doi.org/10.5937/fme2004725P *(Not ISI indexed journal: IF: NA; Q:NA; Scopus indexed journal; Scimago (SJR): Q:Q3)*

3.2. PUBLICATIONS IN INTERNATIONAL CONFERENCES

1. Brito J.H., Pereira J.M., Silva A.F, Angélico M.J., Abreu A. and Teixeira S. (2020). Machine Learning for Prediction of Business Company Failure in Hospitality Sector. In *Advances in Tourism, Technology and Smart Systems, Smart Innovation, Systems and Technologies*. DOI: https://doi.org/10.1007/978-981-15-2024-2_28 *(ISI/Scopus indexed International Conference Paper)*

2. Borges J., Oliveira B., Torres H., Rodrigues N., Queirós S., Shiller M., Coelho V., Pallauf J., Brito J.H., Mendes J. and Fonseca J.C (2020). Automated generation of synthetic in-car dataset for human body pose detection. In *Proceedings of the 15th International Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications VISAPP 2020.* DOI: https://doi.org/10.5220/0009316205500557 *(ISI/Scopus indexed International Conference Paper)*

3. Salgado, A., Ahmadi, S., Simões, A., McCrae, J. P. and Costa, R. (2020). Challenges of word sense alignment: Portuguese language resources. In 7*th Workshop on Linked Data in Linguistics: Building tools and infrastructure at the 12th International Conference on Language Resources and Evaluation (LREC)*. URL: https://novaresearch.unl.pt/en/publications/challenges-of-word-sense-alignment-portuguese-language-resources

4. Simões, A. and Queirós, R. (2020). bOWL: A Pluggable OWL Browser (A. Simões, P. R. Henriques and R. Queirós, Eds.). In *9th Symposium on Languages, Applications and Technologies (SLATE)*. DOI: https://doi.org/10.4230/OASIcs.SLATE.2020.18 *(ISI/Scopus indexed International Conference Paper)*

5. Simões, A., Sacanene, B., Iriarte, Á., Almeida, J. J. and Macedo, J. (2020). Towards a Morphological Analyzer for the Umbundu Language (A. Simões, P. R. Henriques and R. Queirós, Eds.). In *9th Symposium on Languages, Applications and Technologies (SLATE)*. DOI: https://doi.org/10.4230/OASIcs.SLATE.2020.10 *(ISI/Scopus indexed International Conference Paper)*

6. Simões, A. and Queirós, R. (2020). On the Nature of Programming Exercises (R. Queirós, F. Portela, M. Pinto and A. Simões, Eds.). In *1st International Computer Programming Education Conference (ICPEC 2020)*. DOI: https://doi.org/10.4230/OASIcs.ICPEC.2020.24 *(ISI/Scopus indexed International Conference Paper)*

7. Cerqueira, J. M., Moura, J. M., Sylla, C. and Ferreira, L. (2020). An Augmented Reality Mathematics Serious Game. In *1st International Computer Programming Education Conference (ICPEC 2020)*. DOI: https://doi.org/10.4230/OASIcs.ICPEC.2020.6 *(ISI/Scopus indexed International Conference Paper)*

8. Cleto, B., Sylla, C., Ferreira, L. and Moura, J. M. (2020). CodeCubes: Coding with Augmented Reality. In *1st International Computer Programming Education Conference (ICPEC 2020)*. DOI: https://doi.org/10.4230/OASIcs.ICPEC.2020.7 *(ISI/Scopus indexed International Conference Paper)*

9. Gonçalves, F., Carvalho, V., Matos D. and Soares, F. (2020). Development of a Serious Game to fight Childhood Obesity:"Barty". In *2020 IEEE Global Engineering Education Conference (EDUCON)*. DOI: https://doi.org/10.1109/EDUCON45650.2020.9125408 *(ISI/Scopus indexed International Conference Paper)*

10. Leite, P., Goncalves, J., Teixeira, P. and Silva, J.P. (2020). PBL versus Traditional Teaching Method: Case Study | Método de Ensino PBL versus Tradicional: Estudo de Caso. In *Iberian Conference on Information Systems and Technologies, (CISTI 2020)*. DOI: https://doi.org/10.23919/CISTI49556.2020.9141091 *(ISI/Scopus indexed International Conference Paper)*

11. Oliveira A., Aguiar J., Silva E., Faria B. M., Gonçalves H., Teófilo L., Gonçalves J., Carvalho V., Cardoso H. L. and Reis L. P. (2020). Assessing Daily Activities Using a PPG Sensor Embedded in a Wristband-Type Activity Tracker. In *Advances in Intelligent Systems and Computing*. DOI: https://doi.org/10.1007/978-3-030-45697-9_11 *(ISI/Scopus indexed International Conference Paper)*

12. Real, A., Miranda, D., Correia-Pinto, J., Veloso, F., Morais, P. and Vilaça, J. L. (2020). A capacitive pressure sensor for monitoring of the pectus carinatum treatment. In *6th Symposium on Modelling and Simulation in Computer Sciences and Engineering 2020 of 18th International Conference of Numerical Analysis and Applied Mathematics 2020. In Press. (ISI/Scopus indexed International Conference Paper)*

13. Veloso, F., Miranda, D., Morais, P., Torres, H. R., Laranjeira, R., Ruediger, M., Miranda, F., Pinho, A.C.M. and Vilaça, J. L. (2020). Structural Mechanical Simulation to Optimize the Sensor Arm Geometry to be Implemented on Cranial Remodeling Orthosis. In *6th Symposium on Modelling and Simulation in Computer Sciences and Engineering 2020 of 18th International Conference of Numerical Analysis and Applied Mathematics 2020. In Press. (ISI/Scopus indexed International Conference Paper)*

14. Miranda, D., Gonçalves, R., Veloso, F., Miranda, F., Vilaça, J.L., Costa, C. M. and Lanceros-Méndez, S. (2020). Lattice microstructure design for cathode electrodes for high-performance lithium-ion batteries In *6th Symposium on Modelling and Simulation in Computer Sciences and Engineering 2020 of 18th International Conference of Numerical Analysis and Applied Mathematics 2020. In Press. (ISI/Scopus indexed International Conference Paper)*

15. Coimbra N., Alexandrino Ribeiro A. and Vilhena E. (2020). Determinants of probability: a case of nonfinancial companies from Portugal. In *Proceedings of the International Conference of Applied Business and Management (ICABM2020)*. Obra digital – ISBN: 978-84-16286-73-7. *(ISI/Scopus indexed International Conference Paper)*

16. Coimbra N., Alexandrino Ribeiro A. and Vilhena E. (2020). Determinantes da rentabilidade: O caso das pequenas e médias empresas não financeiras em Portugal. In *XXX Jornadas Luso-Espanholas de Gestão Científica: cooperação transfronteiriça: desenvolvimento e coesão territorial: livro de resumos / Paula Fernandes (aut.)*, ISBN 978-972-745-273-6.

17. Vilaça J. and D. Duque (2020). Pre-diagnostic of visual acuity through a serious game. In *IEEE 8th International Conference on Serious Games and Applications for Health (SeGAH 2020)*. DOI: https://doi.org/10.1109/SeGAH49190.2020.9201725. *(ISI/Scopus indexed International Conference Paper)*

18. Pereira M., Prahm C., Kolbenschlag J., Oliveira E. and Rodrigues N. (2020). A Virtual Reality Serious Game for Hand Rehabilitation Therapy. In *IEEE 8th International Conference on Serious Games and Applications for Health (SeGAH 2020)*. DOI: https://doi.org/10.1109/SeGAH49190.2020.9201789. *(ISI/Scopus indexed International Conference Paper)*

19. N. M. C. da Costa, E. G. Bicho and N. S. Dias. (2020). Priming with mindfulness affects our capacity to self-regulate brain activity?. In *IEEE 8th International Conference on Serious Games and Applications for Health (SeGAH 2020)*. DOI: https://doi.org/10.1109/SeGAH49190.2020.9201841 *(ISI/Scopus indexed International Conference Paper)*

20. Miranda F., Abreu C. and Miranda D. (2020). Preface of the "5th Symposium on Modelling and Simulation in Computer Sciences and Engineering". In *AIP Conference Proceedings.* DOI: https://doi.org/10.1063/5.0026557 *(ISI/Scopus indexed International Conference Paper)*

21. Alves, F., Mateus-Coelho, R. M. and Cruz-Cunha, M. M. (2020). Encryption File System Framework - Proof of Concept. In *Proceedings of CENTERIS - International Conference on ENTERprise Information Systems / ProjMAN - International Conference on Project MANagement / HCist - International Conference on Health and Social Care Information Systems and Technologies 2020. In Press. (ISI/Scopus indexed International Conference Paper)*

22. Bessa, D., Rodrigues, N., Oliveira, E., Kolbenschag, J., Prahm, C. (2020). Designing a Serious Game for Myoelectric Prosthesis Control. In *IEEE 8th International Conference on Serious Games and Applications for Health (SeGAH 2020)*. DOI: https://doi.org/10.1109/SeGAH49190.2020.9201812 *(ISI/Scopus indexed International Conference Paper)*

23. Pacheco, P., Santos, F., Coimbra, J., Oliveira, E., Rodrigues, N. (2020). Designing Effective User Interface Experiences for a Self-Service Kiosk to Reduce Emergency Department Crowding. In *IEEE 8th International Conference on Serious Games and Applications for Health (SeGAH 2020)*. DOI: https://doi.org/10.1109/SeGAH49190.2020.9201858 *(ISI/Scopus indexed International Conference Paper)*

24. Ávila. P, Mota, A., Bastos, J., Patrício, L., Castro, H., Cruz-Cunha, M. M and Varela, L. (2020). Framework For A Risk Assessment Model To Apply In Virtual / Collaborative Enterprises. In CENTERIS - International Conference on ENTERprise Information Systems / ProjMAN - International Conference on Project MANagement / HCist - International Conference on Health and Social Care Information Systems and Technologies, CENTERIS/ProjMAN/HCist 2020, Procedia Computer Science. In Press. (ISI/Scopus indexed International Conference Paper)

25. Mateus-Coelho, N., <u>Cruz-Cunha, M. M.</u> and <u>Ferreira, L</u>. (2020). Security in Microservices Architectures. In CENTERIS - International Conference on ENTERprise Information Systems / ProjMAN - International Conference on Project MANagement / HCist - International Conference on Health and Social Care Information Systems and Technologies, CENTERIS/ProjMAN/HCist 2020, Procedia Computer Science. In Press. (ISI/Scopus indexed International Conference Paper)

26. Alves, F., Badikyan, H., <u>Moreira, A.H.J.</u>, Azevedo, J., Moreira, P.M., Romero, L. and Leitão, P. (2020). Deployment of a Smart and Predictive Maintenance System in an Industrial Case Study. In 2020 IEEE 29th International Symposium on Industrial Electronics (ISIE), Delft, Netherlands. DOI: https://doi.org/10.1109/ISIE45063.2020.9152441. (ISI/Scopus indexed International Conference Paper)

27. D. Rocha, <u>V. Carvalho,</u> F. Soares and E. Oliveira, "A Model Approach for an Automatic Clothing Combination System for Blind People", EAI DLI 2020, 5-6 November 2020, Aalborg, Denmark (cyberspace). (ISI/Scopus indexed International Conference Paper)

28. Gonçalves D., <u>Ferreira, L.</u> and Campos N. (2020). Enterprise architecture for high flexible and agile company in automotive industry. In CENTERIS - International Conference on ENTERprise InformationSystems / ProjMAN - International Conference on Project MANagement / HCist - International Conference on Health and Social Care Information Systems and Technologies, CENTERIS/ProjMAN/HCist 2020, Procedia Computer Science. In Press.(ISI/Scopus indexed International Conference Paper)

29. Lima B., <u>Ferreira, L.</u> and Mouro, J. M. (2020). Helping to detect legal swimming pools with Deep Learning and Data Visualization. In CENTERIS - International Conference on ENTERprise InformationSystems / ProjMAN - International Conference on Project MANagement / HCist - International Conference on Health and Social Care Information Systems and Technologies, CENTERIS/ProjMAN/HCist 2020, Procedia Computer Science. In Press.(ISI/Scopus indexed International Conference Paper)

3.3. BOOK CHAPTERS

1. Gonçalves, G., Fernandes, J. and <u>Gonçalves, J</u>. (2020). "Learning Hypothesis Testing Through a Project Work Methodology" *from Developing Technology Mediation in Learning Environments*. IGI Global. DOI: https://doi.org/10.4018/978-1-7998-1591-4.ch013

2. J. Coelho, <u>V. Carvalho</u> and T. Martins, "A Serious Game for Geo-education in the Arouca Geopark Territory", chapter 8 in book Multidisciplinary Perspectives on New Media Art, edited by Célia Soares and Emília Simão, IGI-Global, Hershey, 2020. DOI: http://doi:10.4018/978-1-7998-3669-8.ch008

3. Putnik, G. D., Shah, V., Putnik, Z., <u>Ferreira, L.</u> (2020). "Machine learning in cyber-physical systems and manufacturing singularity – it does not mean total automation; human is still in the centre: Part I – MANUFACTURING SINGULARITY AND AN INTELLIGENT MACHINE ARCHITECTURE". Journal of Machine Engineering. DOI: https://doi.org/10.36897/jme/131000

4. Cleto, B., Sylla, C., <u>Ferreira, L.</u>, Moura, J. M. (2020). "Play and learn": exploring CodeCubes, Lecture Notes of the Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering, LNICST, Volume 307 LNICST, 2020. DOI: https://doi.org/10.1007/978-3-030-40180-1_4

3.4. BOOK

1. <u>Cruz-Cunha M.</u> and Mateus-Coelho, N. R. (eds.) (2020). *Handbook of Research on Cyber Crime and Information Privacy*. IGI-Global, Hershey (PA). ISBN: 9781799857280

3.5. PATENTS

1. Leão P., Ribeiro A., <u>Vilaça JL</u> and Sousa N (2020), Laser Pointer device for use in a laparoscopic surgery procedure. WO/2020/225792 https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2020225792

3.6. ORGANIZATION OF COURSES/WORKSHOPS

2Ai Summer School – The 2Ai Summer School took place between 20 July 2020 - 19 October 2020 (3 months) with the participation of 18 students who received a research grant funded by the Foundation for Science and Technology (FCT) with a total amount of 25.538,00€. 2Ai organized the 2Ai Summer School which aimed to promote the development of in-person R&D activities focused on the artificial intelligence field by 18 young researchers. The 2Ai Summer School took place on the premises of the 2Ai Laboratory, at the School of Technology (EST) of Polytechnic Institute of Cávado and Ave (IPCA). The training plan for this summer school was divided into two components: training and research. The training component was based on short in-person thematic courses taught by integrated researchers and 2Ai collaborators. These courses focused

on emerging themes of research and technological development (namely, natural language processing, deep learning for computer vision, Tiny AI, collaborative robots, simulation and, additive manufacturing) and training in basic research components (namely, research methodologies, data analysis, scientific writing, preparation of scientific pitches and funding opportunities). URL: https://2ai.ipca.pt/2ai-summer-school/.

2Ai members: Vilaça J.L., Moreira A., Gonçalves J., Brito H.J., Morais P., Miranda D., Carvalho V., Vilhena E, Simões A.

4rd Winter School on Artificial Intelligence for Games – 12/13 November, 2020 – The two days included talks on different artificial intelligence topics, and included invited lecturers Tiago Loureiro, Gabriella Barros, João Dias and Vicent Breton. URL: http://ai4g.ipca.pt/2020/

2Ai members: Simões A.

IPCA GAMEDEV WEEK 2020 – Lectures/workshops/ with professionals involved in the most prestigious national and international productions. The IPCA GAMEDEV WEEK 2020 was held virtually (Zoom conference) on June 5th, 2020. URL: http://gamedevweek.ipca.pt/

2Ai members: Duque D.

3.7. ORGANIZATION OF CONFERENCES

8th International Conference on Serious Games and Applications for Health, IEEE SeGAH 2020 to be held in Vancouver, Canada, from 12 – 14 of August 2020, at the Ritsumeikan Center for Games Studies. The overall objectives of the conference are the discussion and sharing of knowledge, experiences and scientific and technical results, related to state-of-the-art solutions and technologies on serious games and applications for health and healthcare, as well as the demonstration of advanced products and technologies. URL: http://www.segah.org/2020/

 2Ai members: Duque D, Dias D, Rodrigues N, Vilaça JL

Symposium on Languages, Applications and Technologies (SLATE 2020) - 13/14 July, 2020 - SLATE is an international symposium dedicated to researchers and professionals interested in the study of languages. Since this is a very broad subject, the symposium is divided into three main tracks, each one focusing on a specific aspect of languages (Human-Human Languages, Human-Computer Languages and Computer-Computer Languages). The SLATE 2020 Conference was held virtually (Zoom conference). URL: http://slate-conf.org/2020/home

2Ai members: Simões A

1st International Computer Programming Education Conference (ICPEC) - 25/26 June, 2020 - ICPEC aims to be a space frequented by teachers and researchers to discuss topics that promote new methodologies, best practices, trends, techniques and tools to improve the teaching-learning process of computer programming. The ICPEC was Virtual Conference (Zoom conference). URL: https://icpeconf.org/2020

2Ai members: Simões A

6th Symposium on Modelling and Simulation in Computer Sciences and Engineering (MSCSE 2020) of 18th International Conference of Numerical Analysis and Applied Mathematics 2020 (ICNAAM 2020) which took place in Rhodes (Greece) from the 17th to the 23rd of September, 2020. The main symposium theme focuses on Modelling and Simulation applied to computer sciences and engineering. Is an exciting investigation field that brings together the power of computers and the physical sciences. Computer-based simulations and graphical visualization now play a key role in mathematical models, scientific investigations and engineering design. URL: https://sites.google.com/view/mscse2020/

2Ai members: Miranda D

1st Symposium on Mathematical Methods for Artificial Intelligence (MMAI 2020) of 18th International Conference of Numerical Analysis and Applied Mathematics 2020 (ICNAAM 2020) which took place in Rhodes, Greece, from 17th to 23th September, 2020. The symposium theme is Artificial Intelligence (AI). AI is an area of computer science that makes it possible for machines to learn from experience, adjust to new inputs, and react like humans. Several mathematical methods, and numerical algorithms, have been devised and developed to support the growth of AI to better teach machines to behave like a human. The activities of the symposium included the discussion of actual mathematical methods and numerical algorithms for AI, where theoretical studies and experimental results were presented. URL: https://sites.google.com/view/mmai2020/

2Ai members: Miranda D

CENTERIS – International Conference on ENTERprise Information Systems. Already in its twelfth edition, the conference took place in Vilamoura, Algarve, Portugal, from 21 to 23 of October 2020. During this 3-day conference, under the leitmotiv of Enterprise Information Systems, academics, scientists, IT/IS professionals, managers and solution providers from all over the world have the opportunity to share experiences, bring new ideas, debate issues, and introduce the latest developments in the largely multidisciplinary field embraced by the Enterprise Information. URL: http://centeris.scika.org/

2Ai members: Cruz-Cunha M, Ferreira L

8th International Conference on Virtual and Networked Organizations Emergent Technologies and Tools - ViNOrg'20. The conference took place in the University of Minho - Guimarães, Portugal, from 2 to 4 of December 2020. The overall objectives of the conference are to contribute to the development, implementation and promotion of advanced emergent Information Systems and Technologies and to be used in future Virtual and Networked Organizations, through the discussion and sharing of knowledge as well as experiences and scientific and technical results. URL: https://2100projectsassoci.wixsite.com/vinorg20

2Ai members: Cruz-Cunha M, Ferreira L

6th Applied Statistics and Data Analysis using Computer Science (ASDACS 2020) Between the 7th and 10th of April 2020 at Budva, Montenegro (at WorldCist'20) This workshop will provide researchers and practitioners with a forum for exchanging ideas, experiences, problems understanding and visions for the future. The workshop will also

provide a platform for researchers and developers to present results using the available tools and software packages for data analysis and to identify the problems in the theory and practice of empirical research recognizing future developments. Applied Statistics and Data Analysis are areas that include a vast number of techniques developed in Computer Science such as numerical analysis, data visualization, machine learning and statistics.   URL:http://www.worldcist.org/2020/index.php/54-6th-applied-statistics-and-data-analysis-using-computer-science-asdacs-2020

2Ai members: Goncalves J.

ASDACS 2020 - 7th Applied Statistics and Data Analysis using Computer Science
Between the 24 th and 27 th of June 2020, at Sevilla, Spain (at CISTI'2020). This workshop will provide researchers and practitioners with a forum for exchanging ideas, experiences, problems understanding and visions for the future. The workshop will also provide a platform for researchers and developers to present results using the available tools and software packages for data analysis and to identify the problems in the theory and practice of empirical research recognizing future developments. Applied Statistics and Data Analysis are areas that include a vast number of techniques developed in Computer Science such as numerical analysis, data visualization, machine learning and statistics.

URL:http://cisti.eu/2020/index.php?option=com_content&view=article&id=86&catid=8&Itemid=120&lang=en

2Ai members: Goncalves J.

3.8. OTHERS

3.8.1. PUBLIC DATABASES

- **Dual-modality kidney phantom:** A dual-modal CT/US kidney phantom model was created for developing and assessing solutions for image-guided percutaneous renal access.
  Link: https://2ai.ipca.pt/kidneyphantom/

- **3D synthetic infants heads models:** A set of 3D surfaces of infant heads to promote the use of artificial intelligence methods in head deformity clinical evaluations.
  Link:https://myneurogrowth.ipca.pt/index.php/the-expected-outputs/3d-synthetic-head-model-datasets/

3.8.2. MATHEMATICAL MODELS

- **Head Analysis:** A new deep learning model to accurately estimate the head landmarks in infant's 3D scanners.

- **Orthosis Modelling:** A new mathematical formulation based on surface alignment to semi-automatically design the personalized orthosis.

3.8.3. COMPUTATIONAL APPLICATIONS

- **SmartOrthosis software:** A new software to automate head deformity analysis and orthosis modelling using artificial intelligence.

3.8.4. LABORATORIAL PROTOTYPES

- **Head Mock model:** An experimental scenario to evaluate the level of personalization of the developed orthosis.

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3.8.5. COMPLETED MASTER THESES

1. Ernesto Ferreira, Big Data Streaming Analytics, master's in informatics engineering, School of Technology, IPCA (supervisor: Ferreira L.)

2. Bruno Lima, Visualização e Análise em Observações Aéreas por Inteligência Artificial, Master in Informatics Engineering, School of Technology, IPCA (supervisor: Ferreira L.)

3. João Bernardo, A contribution for data processing and interoperability in Industry 4.0, master's in systems engineering, Minho University (supervisor: Ferreira L.)

4. Bárbara Cleto, Manipular, Jogar, Aprender: Exploração de jogos digitais com interfaces tangíveis como ferramentas educativas, Master's in engineering and Development in Digital Games, School of Technology, IPCA (supervisor: Ferreira L.)

5. José Cerqueira, O jogo footmath – funções básicas da matemática com realidade aumentada, Master's in engineering and Development in Digital Games, School of Technology, IPCA (supervisor: Ferreira L.)

6. Duarte César Silva Gonçalves, Enterprise Architecture of Bosch Car Multimedia Portugal, master's in informatics engineering, School of Technology, IPCA (supervisor: Ferreira L.)

7. MOBEYBOU – Interfaces Tangíveis para Desenvolvimento Cognitivo, Master in Electronic and Computer Engineering, School of Technology, IPCA (supervisor: Carvalho V.)

8. Carina Queiros, A Fiscalidade e a Capitalização das empresas. O Benefício Fiscal da Remuneração Convencional do Capital Social em Portugal, Master in Taxation, IPCA (supervisor: Vilhena E.)

9. Manuel Rego, regime fiscal de apoio ao investimento em portugal: o caso das sociedades do distrito de viana do castelo, Master in Taxation, IPCA(supervisor: Vilhena E.)

10. Alcindo Nunes, importância da ISO 14001:2015 na economia circular dentro das organizações, Master in Integrated Management Systems: Quality, Environment and Safety, School of Technology, IPCA (supervisor: Vilhena E.)

11. Nuno Coimbra, Determinantes da Rentabilidade: O caso das empresas não financeiras portuguesas, Master in Accounting and Finance, IPCA (supervisor: Vilhena E.)

4. FUNDING

4.1. FUNDING APPLICATION

4.1.1. R&D INDUSTRIAL PROJECTS IN NATIONAL CALLS

InjectID4.0: Automatic insertion of RFID systems in the plastic injection process
Call: AVISO Nº 17/SI/2019.
2Ai Members: João L. Vilaça (PI), António Moreira, Daniel Miranda, Pedro Morais, Fernando Veloso.
Industrial Partners: Lucemplast (Proponent)
Requested Funding to 2Ai: 332.793,43€
Status: Recommended for funding.

HowMI (How am I?) - HOme Wearables and Monitors Integrated
Call: AAC 15/SI/2020
2Ai Members: Vitor Carvalho (PI), João L. Vilaça, António Moreira, Pedro Morais.
Industrial Partners: Intellicare (Proponent).
Total Funding of 2Ai: 122.514,00€
Status: Recommended for funding.

MAIA - Media Audience Intelligent Analysis
Call: AVISO Nº 17/SI/2019.
2Ai Members: Nuno Lopes (PI), Joaquim Gonçalves, Luis Ferreira, Joaquim Silva, João Carlos Silva
Industrial Partners: TWA (Proponent)
Total Funding of 2Ai: 288.843,56€.
Status: Under Evaluation.

IMPACTV - Impacto eMocional e Previsão de Audiências de Cinema na TV
Call: AVISO Nº 17/SI/2019.
2Ai Members: Estela Vilhena (PI), José Brito.
Industrial Partners: Mindprober (Proponent) and NOS
Total Funding of 2Ai: 167.844,00€.
Status: Under Evaluation.

iPhobia - Sistema de tratamento da Fobia Dentária
Call: AVISO Nº 17/SI/2019.
2Ai Members: Eva Oliveira (PI), Vítor Carvalho, Alberto Simões, Duarte Duque.
Industrial Partners: Medical Art Center (Proponent)
Total Funding of 2Ai: 295.841,67€.
Status: Under Evaluation.

PT Piracy 2020
Call: AVISO Nº 17/SI/2019.
2Ai Members: José Brito (PI), Alberto Simões, João L. Vilaça, Vítor Carvalho.
Industrial Partners: WEDO (Proponent) and NOS
Total Funding of 2Ai: 233.155,50€.
Status: Under Evaluation.

IOTextile - Integrated defect detection system for the textile industry
Call: AVISO Nº 17/SI/2019.
2Ai Members: Duarte Duque (PI), João L. Vilaça.
Industrial Partners: Smartex (Proponent) and João António Lima Malhas, Lda.
Total Funding of 2Ai: 294.408,73€.
Status: Under Evaluation.

ClinicDataON - Intelligent platform for automatic and alarmistic clinical diagnosis
Call: AAC 12/SI/2020
2Ai Members: João L. Vilaça (PI), Pedro Morais, António Moreira, Vítor Carvalho, Duarte Duque
Industrial Partners: F3M(Proponent)
Academic Partners: IPVC.
Total Funding of 2Ai: 328.797,41€
Status: Under evaluation.

SAFHE - Safe Health Elderly Monitoring
Call: AAC 12/SI/2020
2Ai Members: Pedro Morais (PI), João Vilaça, António Moreira, Vítor Carvalho.
Industrial Partners: Plux(Proponent)
Academic Partners: IPP
Total Funding of 2Ai: 212.195,33€
Status: Under evaluation.

4.1.2. R&D PROJECTS IN NATIONAL CALLS

SmartHealth - Artificial Intelligence for Lifelong Personalized Patient Care
Call: NORTE-45-2020-21
2Ai Members: João L. Vilaça (PI), Alberto Simões, António Moreira, Daniel Miranda, Duarte Duque, Estela Vilhena, Joaquim Gonçalves, José Henrique Brito, Luís Ferreira, Maria Manuela Cunha, Nuno Dias, Pedro Morais, Vítor Carvalho, Teresa Abreu, Patrícia Leite, Natália Rego, Mariana Carvalho, Mário João Basto, João Carlos Silva, Eva Oliveira, Bruno Oliveira, Fernando Veloso, Helena Torres
Academic Partners: IPVC, ISEP, IPP and IPB.
Total Funding of 2Ai: 989.407,36€
Status: Recommended for funding.

GreenHealth - Digital and biological asset-based strategies to improve well-being and promote green health
Call: NORTE-45-2020-21
2Ai Members: Vítor Carvalho, Duarte Duque
Academic Partners: IPB(Proponent), ISEP, IPP and IPVC.
Total Funding of 2Ai: 38.708.86€
Status: Recommended for funding.

Cybers SEC IP - Strengthening scientific skills and the potential for innovation in cybersecurity
Call: NORTE-45-2020-21
2Ai Members: Nuno Lopes
Academic Partners: IPP(Proponent), ISEP, IPB and IPVC.
Total Funding of 2Ai: 40.801,49€
Status: Recommended for funding.

Tech - TECH-Tecnologia, Ambiente, Criatividade e Saúde
Call: NORTE-45-2020-21
2Ai Members: Joaquim Silva, Nuno Lopes
Academic Partners: IPVC(Proponent), ISEP, IPB and IPVC.
Total Funding of 2Ai: 36.507,30€
Status: Recommended for funding.

OncoNavigator - Intelligent system for personalized navigation and mapping of oncological interventions
Call: Norte-45-2020-75
2Ai Members: João L. Vilaça (PI), Pedro Morais, Vítor Carvalho, António Moreira, Estela Vilhena, Luís Ferreira, Bruno Oliveira, Fernando Veloso, Helena Torres
Total Funding of 2Ai: 587.995,42€
Status: Under Evaluation.

Bons Velhos Dicionários: Uma abordagem ecológica à lexicografia
Call: FCT I&D Projects
2Ai Members: Alberto Simões (PI)
Requested Funding: 163.280,00€
Requested Funding to 2Ai: 101.162,50€
R&D Partners: Algoritmi
Status: Not Recommended for Funding.

SmartLAAC - Intelligent System for patient-specific planning, guidance and post-intervention assessment of cardiac left atrial appendage occlusion interventions
2Ai Members: Pedro Morais (PI), João Vilaça, António Moreira, Daniel Miranda, Bruno Oliveira, Fernando Veloso, Helena Torres
Call: FCT I&D Projects
Requested Funding: 249.994,20€
Requested Funding to 2Ai: 224.474,20€
R&D Partners: ICVS/3B's Associated Laboratory PT
Status: Not Recommended for Funding.

LASERNAVI - Sistema colaborativo inteligente para tratamentos baseados laser
2Ai Members: João Vilaça (PI), Pedro Morais, António Moreira, Bruno Oliveira, Fernando Veloso, Helena Torres
Call: FCT I&D Projects
Requested Funding: 249.756,80 €
Status: Not Recommended for Funding.

AI Supervisor System for Implant-Supported Prosthesis
2Ai Members: António Moreira (PI), João Vilaça, Pedro Morais
Call: FCT I&D Projects
Requested Funding: 199.248,00 €
Status: Not Recommended for Funding.

SPERTA - Real-time evaluation system for taekwondo athletes
2Ai Members: Vitor Carvalho (PI)
Call: FCT I&D Projects
Requested Funding: 249.642,99 €
Status: Not Recommended for Funding.

ASA - Active Aging Supported by Apps
<u>2Ai Members:</u> João Silva (PI)
<u>Call:</u> FCT I&D Projects
<u>Requested Funding:</u> 231.429,50€
<u>Requested Funding to 2Ai:</u> 158.642,50€
<u>R&D Partners:</u> Algoritmi
<u>Status:</u> Not Recommended for Funding.

Leveraging Artificial Intelligence Improve Minimally Invasive Inguinal hernia repair in children
<u>2Ai Members:</u> João Vilaça
<u>Call:</u> FCT I&D Projects
<u>Requested Funding:</u> 250.000,00 €
<u>Requested Funding to 2Ai:</u> 24.630,00 €
<u>R&D Partners:</u> ICVS/3B's Associated Laboratory PT (Proponent)
<u>Status:</u> Not Recommended for Funding.

Processamento Computacional de três Línguas Bantu Faladas em Angola (K2UP)
<u>2Ai Members:</u> Alberto Simões
<u>Call:</u> FCT I&D Projects
<u>Requested Funding:</u> 232.402,50 €
<u>Requested Funding to 2Ai:</u> 103.740,00 €
<u>R&D Partners:</u> Algoritmi (Proponent)
<u>Status:</u> Not Recommended for Funding.

4.1.3. INSTITUTIONAL PROJECTS

OPAS – Permanent Observatory of Abandonment for School Success
<u>Call:</u> 2025/POCI/SI/2019
<u>2Ai Members:</u> Joaquim Gonçalves, João L. Vilaça, Vítor Carvalho, Alberto Simões, Estela Vilhena
<u>Total Funding of 2Ai:</u> 244.800,00€
<u>Status:</u> Recommended for funding.

4.1.4. EUROPEAN PROJETS (HORIZON2020)

myNeuroGrowth - AI-based tools to support personalized clinical diagnoses and treatments for optima long-term neuro-cognitive development
Call: SC1-BHC-06-2020.
Partners: Technische Universität Dresden (Germany, Proponent), Erasmus Universitair Medisch Centrum Rotterdam (Netherlands), Fundacion BCMaterials (Spain), Deutsche Stiftung Kranke Neugeborene (Germany), Warszawski Uniwersytet Medyczny (Poland).
2Ai Members: João L. Vilaça (), Pedro Morais, António Moreira, Daniel Miranda, Estela Vilhena, José Brito, Nuno Dias, Helena Torres, Fernando Veloso, Bruno Oliveira.
Total Funding of 2Ai: 2.004.094,55€.
Status: Not Recommended for Funding.

alw_EDI - Active Living & Working (in health care system) by early detection & dynamic intervention
Call: SC1-DTH-02-2020.
Partners: AIT Austrian Institute of Technology GMBH (Austria, Proponent), Harald A. Kviecien GmbH (Austria), Symptoma GMBH (Austria), Naprej Center Za Osebe S Pridobljeno Mozgansko Poskodbo Maribor (SI), Technical University of Varna (Bulgaria), Univerza v Mariboru (Slovenia), Obudai Egyetem (Hungary), Elektronikas un Datorzinatnu Instituts (LV), Fundacion Instituto Internacional de Investigacion en Inteligencia Artificial y Ciencias de la Computacion (Spain), Fundacion Instituto de Estudios de Ciencias de la Salud de Castilla y Leon (Spain), Aarhus Kommune (Denmark), Racunarstva I Informacijskih Tehnologija Osijek (Croatia), Prevencontrol S.A. (Spain).
2Ai Members: António Moreira (PI), João L. Vilaça, Pedro Morais, Vitor Carvalho
Total Funding of 2Ai: 497.406,75€
Status: Not Recommended for Funding.

Digester Plus
Call: Interreg Sudoe.
Partners: CESGA (Spain, Proponent), INRA (France), CVR (Portugal), FEUGA (Spain), NORVENTO (Spain), SimDouro (Portugal), Energylab (Spain)
2Ai Members: Luis Ferreira (PI), António Moreira, João L. Vilaça, Pedro Morais, José Brito
Total Funding of 2Ai: 164.454,00€
Status: Not Recommended for Funding.

AIcSA - AI-centric Systems Analysis

Call: Eureka Clusters AI Call

Partners: Profen Group (Turkey, Proponent), Arcelik (Turkey), Pursula AI (Turkey), Sistrade Software Consulting (Portugal), ISEP-GECAD (Portugal), 2021-AI (Denmark), University of Oulu (Finland), Playsign.net (Finland), Coreorient.com (Finland), Sysgo GmbH (Germany), Arxum Gmbh (Germany), GT-ARC gemeinnunutzige Gmbh (Germany), Technische Universitat Ilmenau (Germany).

Status: Not Recommended for Funding.

4.2. FUNDED PROJECTS

SmartHealth - Artificial Intelligence for Lifelong Personalized Patient Care

Aims: SmartHealth aims to create new efficient and intelligent technologies to support different stages of the medical treatment, namely the prevention, diagnosis, surgery, rehabilitation and patient follow-up.

Principal Investigator: João L. Vilaça (Proponent).

Reference: NORTE-01-0145-FEDER-000045.

Period: 2020-2023.

Partners: IPVC, ISEP, IPP and IPB.

Total Funding: 1.609.551,14€.

Total Funding of 2Ai: 989.407,36€

GreenHealth - Digital and biological asset-based strategies to improve well-being and promote green health

Aims: The GreenHealth project is focused on digital and biological technologies and their interaction with human health, environmental sustainability and economic development of territory-based assets.

Principal Investigator in 2Ai: Vítor Carvalho

Partners: IPB (Proponent), IPVC and IPP.

Reference: Norte-01-0145-FEDER-000042

Period: 2020-2023.

Total Funding: 1.630.139,00 €

Total Funding of 2Ai: 38.708,86€

Cybers SEC IP - Strengthening scientific skills and the potential for innovation in cybersecurity

Aims: The project aims to strengthen the scientific competences and the innovation potential of the North region, to face the challenge of cybersecurity, by investing in a focused set of research and development areas, relevant in the socio-economic context of the region.

Principal Investigator in 2Ai: Nuno Lopes

Partners: IPP (Proponent), IPVC and IPB.

Reference: Norte-01-0145-FEDER-000044

Period: 2020-2023.

Total Funding of 2Ai: 40.801,49€

Tech - TECH-Tecnologia, Ambiente, Criatividade e Saúde

Aims: The TECHNOLOGY, ENVIRONMENT, CREATIVITY AND HEALTH project will be implemented in a holistic approach to the social challenges defined in Horizon 2020 and to the regional problems identified by institutions and Community partners. Using digitally based technologies, it deals with the prevention and promotion of the health and well-being of the population (HEALTH TECH), new technologies for agriculture and food production processes (FOOD TECH) and (e-) governance and integrated environmental policy (ENVIRONMENT TECH).

Principal Investigator in 2Ai: Nuno Lopes

Partners: IPP (Proponent), IPVC and IPB.

Reference: Norte-01-0145-FEDER-000043

Period: 2020-2023.

Total Funding of 2Ai: 36.507,30€

HowMI (How am I?) - HOme Wearables and Monitors Integrated

Aims: This project aims to develop new technologies focused on the needs of COVID-19 by integrating them into an innovative, complete and integrated system that already exists that continuously monitors the health status and well-being of the elderly/with chronic problems.

Principal Investigator in 2Ai: Vitor Carvalho.

Reference: Project 53284 (call AAC 15/SI/2020).

Period: 2020-2021.

Partner: Private Industry – Intellicare (Proponent).

Total Funding: 190.502,74€.

Total Funding of 2Ai: 122.5140,00€

OPAS – Permanent Observatory of Abandonment for School Success
Aims: This project has as main objective the creation of computer applications based on artificial intelligence and the development of processes that support the creation and implementation of a Permanent Observatory of Abandonment and Promotion of School Success.
Principal Investigator in 2Ai: Joaquim Gonçalves
Reference: 2025/POCI/SI/2019
Period: 2019 – 2021.
Total Funding: 244.800,00€.

InjectID4.0: Automatic insertion of RFID systems in the plastic injection process
Aims: The project is intended to develop a new and innovative insertion methodology of miniaturized RFID tags into plastic injection parts, easily and effectively adaptable to existing plastic injection machines, with minimum impact on the production cycle and associated costs.
Principal Investigator in 2Ai: João L. Vilaça
Reference: POCI-01-0247-FEDER-047195
Partner: Lucemplast (Proponent)
Period: 2021-2023.
Total Funding: 1.037.564,90€
Total Funding of 2Ai: 332.793,43€

5. RESEARCH COLLABORATION AGREEMENTS

1. A memorandum of understanding was established between 2Ai/IPCA and Technische Universitat Dresden (Carl Gustav Carus Faculty of Medicine) for applied artificial intelligence research in pediatry.

2. A memorandum of understanding was established between 2Ai/IPCA, *Academia das Ciências de Lisboa* and the University of Lisbon to promote the share of information and development of scientific projects in the fields of Lexicography and Terminology.

6. SCIENTIFIC RECRUITMENT

6.1. SCHOLARSHIPS

During this year, 2Ai opened multiple tenders in order to increase the critical mass in the R&D unit. Different scholarship typologies, according to the researcher's degrees, were offered. A summary of the research opportunities can be found in Table 2. All scholarships were funded by ongoing projects in the R&D. Research positions in all scientific levels (as defined by the Portuguese Foundation for Science and Technology) were offered. It must be emphasized that a total of 6 scholarships (3 funded by the Portuguese Foundation for Science and Technology and 3 funded by private partners) for PhD candidates were also released.

Table 2 - Number of scholarship tenders opened in 2020

SCHOLARSHIP	Nº OF POSITIONS
Research initiation scholarship	11
Research scholarship for bachelors	20
Research scholarship for masters	1
PhD scholarships	6
Post-doctoral scholarships	1

6.2. SCIENTIFIC EMPLOYMENT

An international selection tender for recruitment in the form of an uncertain term contract concluded under the Labour Code, of 1 (one) Auxiliar Researcher position for the exercise of scientific research activities in the scientific area of Engineering, Artificial Intelligence and Biomedical Sciences was opened. It was published in the Portuguese Diary of the Republic, 2nd Serie, nº 111, with reference 8820/2020.

During the tender period, one application was received, which was selected for the Auxiliar Researcher position. The Researcher initiated its activities in September 2020.

This position was funded by the Portuguese Foundation for Science and Technology through the programmatic funding allocated to the 2Ai laboratory in the national evaluation of R&D institutions program. Moreover, it is in accordance with national politics to promote research careers in Portugal, namely the Scientific Employment program.

7. APPLICATION TO DOCTORAL DEGREE

In October 2020, a new Doctoral Programme in Games and Creative Technologies was submitted to the Portuguese Higher Education Evaluation and Accreditation Agency. This doctoral programme was developed in conjunction with 2Ai and School of Technology from IPCA and UNIDCOM and Faculty of Design, Technology and Communication from European University. The proposed doctoral program explores the interdisciplinarity of video games and digital entertainment, aiming to provide advanced and specialized training.

This PhD aims to provide its students with knowledge and methodological skills related to research activities, but, at the same time, aims to offer real experience in research and development projects. Thus, the involvement of doctoral students in research and development projects that are taking place within the research centers associated with this program, will be pursuit. In addition to research projects, there will also be an attempt to involve partners from the creative industries, with the aim of creating awareness about the role of doctoral profiles in the industry and the value they can create. In this way, it promotes applied research, whether through the use of games as a tool to deal with real-world problems, either through innovation in design, or through the development of new technologies and processes for the creative industry.

8. APPLICATION TO MASTER'S DEGREE

In October 2020, a new master's degree in Artificial Intelligence was submitted to the Portuguese Higher Education Evaluation and Accreditation Agency. This master's degree was developed in conjunction with 2Ai and the IPCA Higher School of Technology. It will be a master's degree taught in English and will work in a modular way, where each module provides for the performance of laboratory rotations of students in ongoing research projects at 2Ai. Aspect that is expected to reinforce the critical mass of 2Ai, at the same time that it will enable it to fulfill the mission of 2Ai in supporting the training of highly qualified staff within its area of intervention.

The general objectives of this master's degree correspond to the introduction of artificial intelligence concepts to its students, as well as the exploration of the use of artificial intelligence in different areas, from electronics, computer vision, processing natural language, among others.

These objectives will allow the Master in Artificial Intelligence to be incorporated in laboratories and advanced research centers, as well as in the industry that, increasingly, depends on this area for process optimization, cost reduction, and the creation of new products.

9. APPLICATION TO ASSOCIATED LABORATORY

A general overview of the associated laboratory is presented next.

> **Name:** Associate Laboratory of Intelligent Systems (LASI)
>
> **Identification:** LASI - LA/P/0104/2020
>
> **LASI Requested Budget:** 14.032.691.51€
>
> **2Ai Requested Budget:** 678.000,00€ (2021-2025), including 2 Auxiliar PhD Researcher Contract (permanent position).

Abstract: Since the dawn of times, the human being has always endeavoured to improve his quality of life. We, at the forefront of this technological evolution, must be ready to push the boundaries of knowledge and allow our world to go for a better future. No monolithic solution will, singularly, settle out all problems. Instead, the expectation is that multiple small contributions may help to answer important challenges. Ergo, the creation of the Intelligent Systems Associate Laboratory here depicted, coordinated by the ALGORITMI Centre, and composed by 13 R&D units that go from Barcelos, Braga and Guimarães to Porto, Aveiro, Coimbra, and Lisbon. All these units, strongly consolidated in the international scientific landscape, have a rich relationship with the domains of artificial intelligence and data science, going from the theoretical foundations to its practical application. Our contribution is grounded on the perception of people as active actors of the technological ecosystem, with every individual being part of a more innovative, sustainable, and inclusive society, where gender equality assumes increased importance, giving answer to challenging public policies. This aids the emergence of Smart Cities, since this connected society allows one to push the boundaries of knowledge in domains such as public administration and egovernance,public transportation systems, renewable and

green energy, public health and well-being, and go for innovative and sustainable solutions that, in the end, aim to improve the quality of life of every individual. The inclusion of people as active actors allows one to settle and develop not only Industry 5.0, but also go for Health and Society 5.0, with significant cooperation between humans and machines, and with a graceful harmony between human intelligence and artificial one. Therefore, the adopted research methodology will focus on the organization of a logical sequence of replicable, precise, and transparent procedures to build scientific knowledge and software artefacts that, by making use of multiple innovative and disruptive methods, models, and technologies, will materialize the proposed objectives. This Associate Laboratory will strongly endeavour to promote scientific employment, guaranteeing, in five years, that LASI holds, at least, 55 Ph.D. researchers under permanent contracts, with national and international talent attraction and the ability to raise competitive funding being some of our historical strengths.

10. JOIN REGIONAL UNIVERSITY NETWORK.EU - RUN-EU

2Ai through IPCA integrates, since november 2020, the Regional University Network (RUN-EU). European Universities are provided with financial support, under the Erasmus + and Horizon 2020 Programs. The project establish a consortium leaded by the Polytechnic of Leiria (Portugal) and composed by the following founding members: Polytechnic of Cávado and Ave (Portugal), Limerick Institute of Technology (Ireland), Athlone Institute of Technology (Ireland), Széchenyi István University (SZE) (Hungary), Häme University of Applied Sciences HAMK (Finland), NHL Stenden University of Applied Sciences (The Netherlands), and FH Vorarlberg University of Applied Sciences (Austria).

The Regional University Network (RUN-EU) aims to implement training programs that include the promotion of future and advanced skills for social transformation in the regions of the European Union. Higher Education Institutions will jointly develop a diverse range of teaching and learning actions, providing students with different international programs (short-term and e-learning), while international cooperation projects in the area of research and development are also implemented. In the future, students will also have the opportunity to obtain European double/multiple degrees within the framework of joint training programs.

11. IMPACT ACTIONS TO THE SOCIETY

2Ai participated in the implementation of solutions to fight the COVID-19 pandemic, namely a new solution to quickly construct face shields and a prototype of a ventilator.

The face shield was characterized as being lightweight and comfortable, enhancing its use for long periods with maximum comfort and safety. Moreover, its construction was simple and fast, only requiring simple materials, such as acetate, styrofoam, and glue. A total of 10.000 units were produced in a period of 1 week, and it was distributed by more than 30 hospitals and medical centers in the North of Portugal. The current initiative included several partner industries, namely Lucemplast, Polipop, Riopele and Adilevel.

A new concept of a ventilator was also explored and a prototype version constructed. It was characterized by its simple construction and its low-cost. The ventilator was composed of a laser-cut acrylic chassis, a linear guide and lead screw powered by a stepper motor, controlled by an Arduino, and specially developed software. The total cost of the device was under 400 euros and it can be assembled in under two hours. Moreover it was portable and easily sterilizable. A first functional prototype was constructed.

12. OUTREACH ACTIVITIES

The program of outreach activities implemented by the 2Ai focuses on a strategy to promote scientific awareness in the surrounding community on: the importance of R&D on applied artificial intelligence in health, industry, environment and security impact areas.

For that, 2Ai members participated in external national events, namely the "Encontro com a Ciência e Tecnologia em Portugal - Lisboa 2020", presenting posters with the themes "Computer Vision Algorithms for Identification and Analysis of Textile Yarn Quality in Industrial Environment''; Development of an Intelligent System of Identification and Combination of Clothing for Blind People"; "Computer Vision Algorithms for Identification and Analysis of Textile Yarn Quality in Industrial Environments". The 2Ai members participated in "Verão com Ciência nos Politécnicos - Viseu 2020", presenting the success of 2Ai Summer School 2020, as well as the activities developed and organized during this event. In parallel, the 2Ai members participated in a dissemination video of the Smartorthosis Project promoted by "O Norte Somos Nós - Comissão de Coordenação e Desenvolvimento Regional do Norte (CCDR-N)".