NG-IoT Workshop on Standardization

TERMINET: nexT gEneRation sMart INterconnectEd ioT

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Presenter: Prof. Armir Bujari

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957406.

TERMINET

Project Identity & Consortium

Project Identity & Consortium

- ✓ **Call**: H2020-ICT-2018-20
- ✓ **Topic**: ICT-56-2020
- ✓ **Type of action**: RIA
- ✓ **Total Budget**: € 8.000.000,00
- ✓ **Active period**: 1 Nov 2020 – 31 Jan 2024

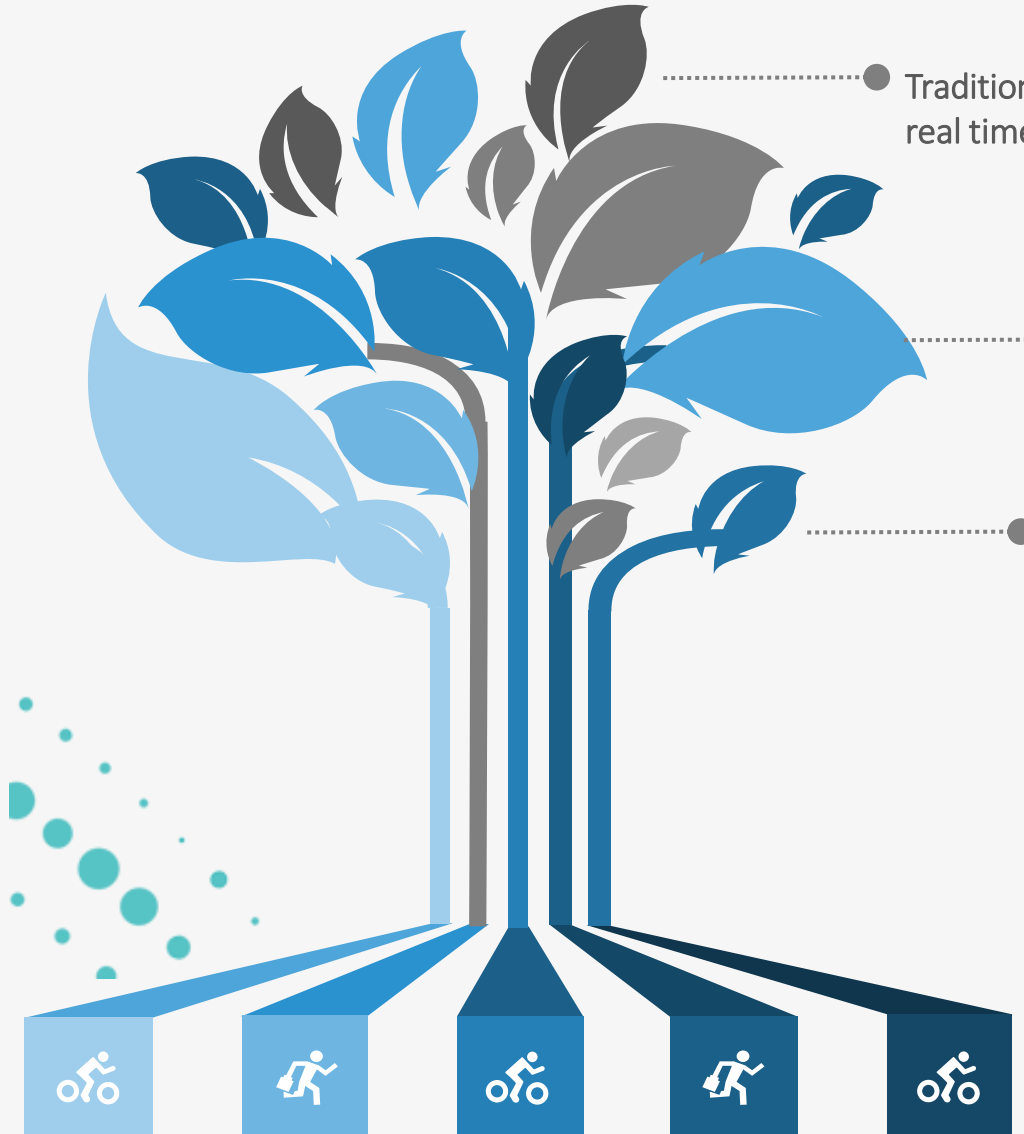
3 Industries	5 Universities	3 Research Centers	15 SMEs

Consortium (26)

TERMINET

Motivation, Challenges and Objectives

Motivation



Traditional cloud computing is not able to support real time applications.

A new cost effective approach is needed

- New IoT systems could be closer to the data source
- Low latency services and applications are viable
- Data privacy could be increased

Traditional manual configuration and device management is no longer viable.

Combination of Smart Technologies

Need for enhancing IoT

- Heterogeneous technologies, devices, and platforms
- Pervasive interconnection of people, services, and devices
- Embedded intelligence, connectivity and processing capabilities at the edge of the IoT network

TERMINET Challenges

- 10 primary challenges

Challenge #1 NG IoT reference model	**Challenge #2** Complexity reduction and interoperability increase	**Challenge #3** Employment of cost effective distributed edge solutions	**Challenge #4** Combination of AI with the IoT	**Challenge #5** Design of novel, intelligent IoT devices
Challenge #6 Application of vertical security, privacy and trust	**Challenge #7** Fostering AR/VR contextual computing.	**Challenge #8** Tactile IoT Support	**Challenge #9** Utilization of digital twins	**Challenge #10** Novel disruptive business models

TERMINET Objectives

Six Objectives

Objective #1

Flexible, open, and decentralised next generation IoT reference architecture for new real-time capable solutions.

Objective #2

SDN-enabled multiple-access edge computing environment for IoT and mission-critical and vertical solutions.

Objective #3

Moving AI to the edge by using cutting-edge ML technologies.

Objective #4

Security by design based on attestation modelling, distributed and decentralised blockchain, and enterprise-level privacy.

Objective #5

Tactile IoT model by adding human-centric perspective and sensing/actuating capabilities.

Objective #6

Design intelligent IoT devices for new generation IoT use cases, by fostering digital business development.

TERMINET

TERMINET Business Logic & Architecture

TERMINET Business Logic

Combined SDN and NFV networking architecture, utilizing containerization

SDN & NFV

Federated Learning Framework: FLF-DMLC, FLF-DMOS and FLF-DMP

Federated Learning

AR/VR Contextual Framework, Digital Twins, IoT Devices Inventory, Haptic devices

AR/VR, Digital Twins, IoT Inventory

TERMINET Secure Vertical IoT Network Framework (SV-IoT-NF): Trust, privacy and authentication among the various entities, using Blockchain

Security, Privacy & Trust

TERMINET Integrated Platform

TERMINET Architecture

Application Layer – APP-L

This layer is implemented in the cloud to offer a wide coverage.

Platform Layer - PLA-L

Platform Controller; virtualization enhancement; NFV Orchestrator; Global AI models ; Data Management/Storage

Intelligence Layer – INT-L

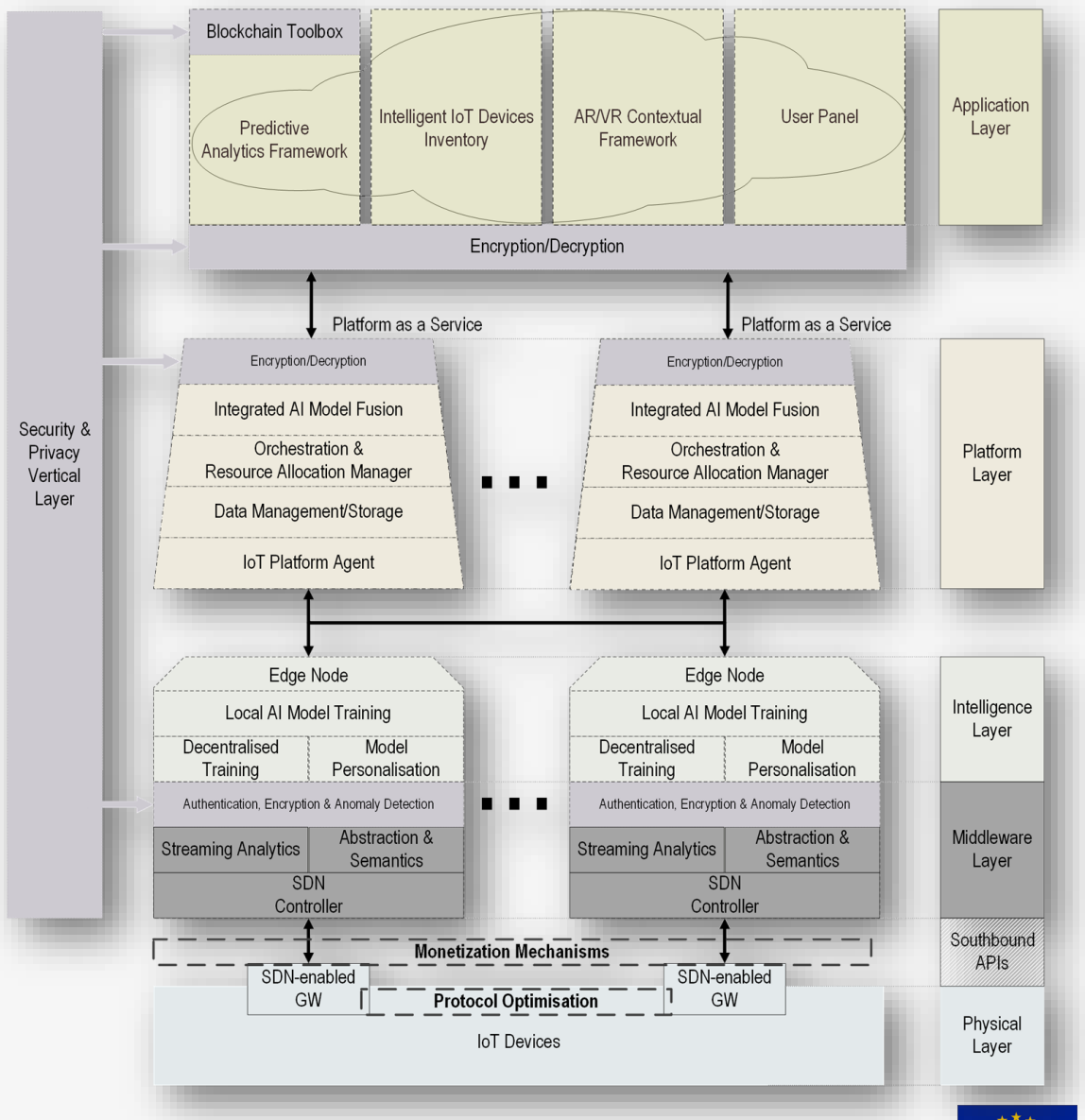
Fed by filtered IoT data streams for applying the TERMINET advanced federated learning approach.

Middleware Layer – MID-L

Intermediate layer which collects and processes the various data coming from the IoT devices at the physical layer.

Security & Privacy Vertical Layer – SPV-L

It aims to ensure the security and privacy for all layers.



Stakeholders

Platform

Infrastructure

App #1

App #2

IoT Vertical Stakeholders

Apps

OpenCall Stakeholders

TERMINET

Distributed Federated Learning Framework

Software-defined Network Fabric

Streaming Analytics for IoT Data

Heterogenous IoT Hardware support

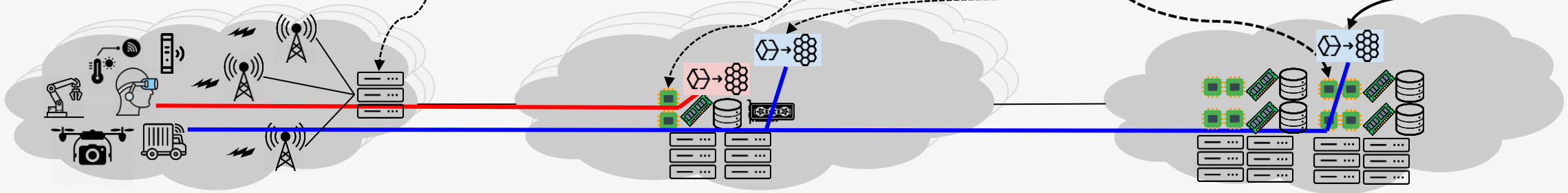
IoT to Edge to Core Cloud continuum

Multiple IoT testbeds

Collection of IoT data through software-defined gateways

Compute resources (CPU/GPU/FPGA, RAM, Storage)

Distributed AI-based IoT vertical applications



Access Domain

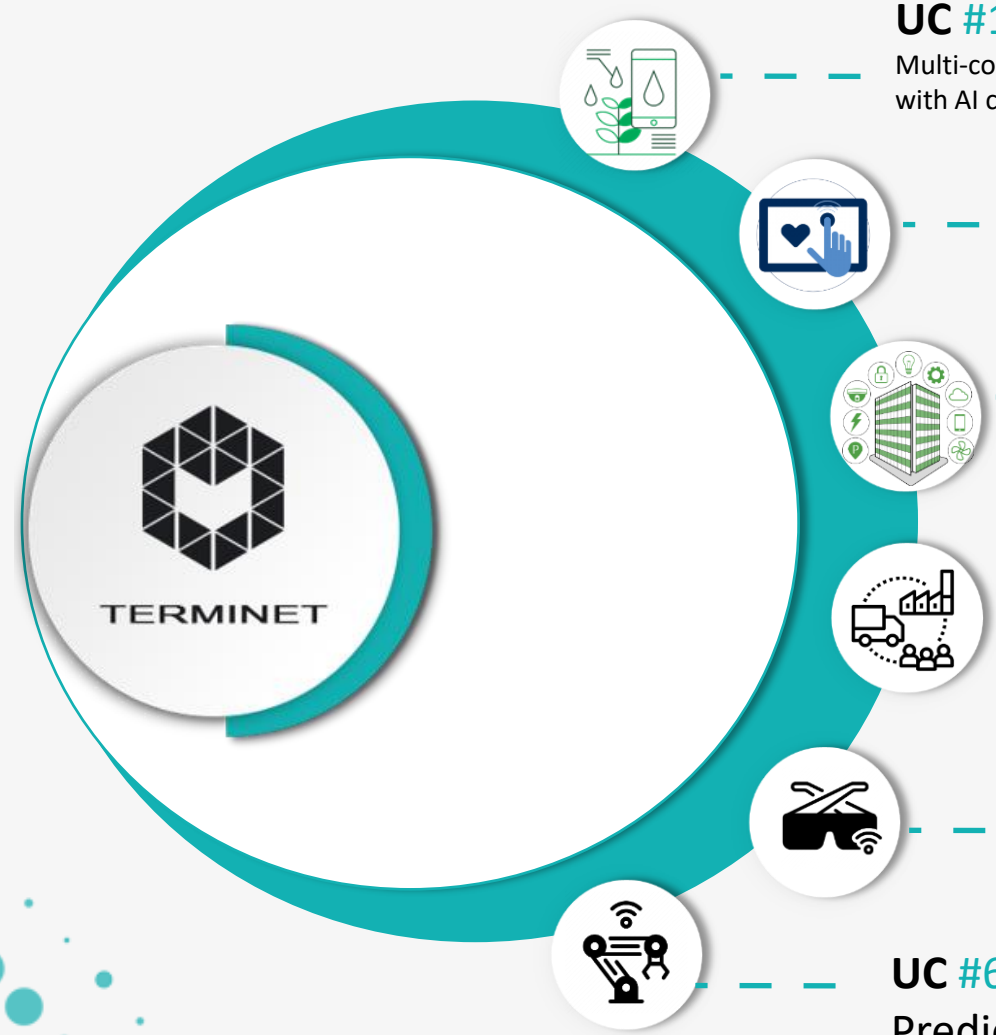
Edge Domain

Core Domain

TERMINET

TERMINET Use Cases

Use Cases



UC #1: User-Centric Devices in Smart Farming

Multi-collected and heterogeneous data coming from crops, livestock, and mixed farming systems are coupled with AI capabilities to enhance agriculture systems' sustainability.

UC #2: Pathway of Personalized Healthcare

Higher level of medical education to health practitioners, leverage diagnosis and improve patient satisfaction and safety.

UC #3: Smart, Sustainable and Efficient Buildings

Transform buildings into smart buildings and optimize their energy consumption and harvesting.

UC #4: Prediction and Forecasting System for Optimizing the Supply Chain in Dairy Products

Provide efficient supply chain forecasting, based on different types of production and sales data.

UC #5: Group Training Surgery Using VR enabled IoT Technologies

Enhance the understanding of treatment by efficiently providing a virtual training environment for medical personnel.

UC #6: Mixed Reality and ML Supported Maintenance and Fault Prediction of IoT based Critical Infrastructure

Reduce the operational costs of the end user and the burden of maintenance engineers.

TERMINET

TERMINET Identified Results for Standardization

Relevant Standards Developing Organisations

- INTERNATIONAL ORGANISATION FOR STANDARDISATION (ISO)
- INTERNATIONAL TELECOMMUNICATION UNION (ITU)
- EUROPEAN COMMITTEE FOR STANDARDISATION (CEN) AND THE EUROPEAN COMMITTEE FOR ELECTROTECHNICAL STANDARDISATION (CENELEC)
- EUROPEAN TELECOMMUNICATIONS STANDARDS INSTITUTE (ETSI)
- IEEE
- IEC
- DIN
- OASIS OPEN
- INTERNET ENGINEERING TASK FORCE (IETF) AND INTERNET RESEARCH TASK FORCE (IRTF)
- WORLD WIDE WEB CONSORTIUM (W3C)
- ALLIANCE FOR INTERNET OF THINGS INNOVATION (AIOTI)
- INTERNATIONAL DATA SPACES ASSOCIATION (IDSA)
- GAIA-X
- IOT ACCELERATION CONSORTIUM
- OMA SPECWORKS
- THE OBJECT MANAGEMENT GROUP (OMG) AND INDUSTRY IOT CONSORTIUM (IIC)
- THE OPEN CONNECTIVITY FOUNDATION (OCF) AND IOTIVITY
- THE IOT SECURITY FOUNDATION (IOTSF)
- BVDA/DAIRO

UC1 Standardisation Efforts

- Following:
  - Full traceability at all stages of production and implements
    - Certified quality management systems (ISO 9001: 2008)
    - Food safety management (ISO 22000: 2005)
    - Environmental management (ISO 14001: 2004)

- Opportunities for Standardisation:
  - **Agri-food Partnership of the Region of Central Macedonia** (http://agromacedonia.gr/)
  - **AGROTECHEXPORT cluster** coordinated by the Exporters' Federation of Northern Greece (https://atecluster.gr/en/)
  - The newly established "**Mediterranean Agrofood Competence Centre**" of Crete coordinated by the Chamber of Irakleion Prefecture (http://www.macc.gr/)
  - The nation-wide "**Internet of Food Alliance" cluster** (https://inofa.gr/) with over 70 members coordinated by AFS.

UC2 Standardisation Efforts

- Following:
  - EUCROF New Technologies WG (on how technology - like ML - can improve clinical trials)
  - AI4Belgium (AI approaches for multiple industries in Belgium)
  - EUCROF AI/ML Task Force of New Technologies WG

- Opportunities for Standardisation:
  - **The joint Task Force on AI/ML by EUCROF NTWG and eClinical Forum** has the purpose to monitor the evolution of AI/ML technologies in the Life Sciences domain and address relevant topics that are of major interest for clinical research.
  - In this task force we are driving efforts in the use of data for learning models to be used in clinical studies.

UC3 Standardisation Efforts

- Following:
  - **EN IEC 62443-2-4:2019** Security for industrial automation and control systems - Part 2-4: Security program requirements for IACS service providers
  - **EN IEC 62443-2-4:2019/A1:2019** Security for industrial automation and control systems - Part 2-4: Security program requirements for IACS service providers
  - **EN IEC 62443-3-3:2019** Industrial communication networks - Network and system security - Part 3-3: System security requirements and security levels
  - **EN IEC 62443-4-1:2018** Security for industrial automation and control systems - Part 4-1: Secure product development lifecycle requirements
  - **EN IEC 62443-4-2:2019** Security for industrial automation and control systems - Part 4-2: Technical security requirements for IACS components
  - **prEN IEC 62443-2-1:2019** Security for industrial automation and control systems - Part 2-1: Security program requirements for IACS asset owners
  - **prEN 62443-3-2:2018** Security for industrial automation and control systems - Part 3-2: Security risk assessment and system design

- Opportunities for Standardisation:
  - **IEC TC 65 Industrial-process measurement, control and automation**: For industrial-process measurement.
  - **CENELEC TC 65X Industrial-process measurement, control and automation:** Target equipment and systems operating with electrical, hydraulic, mechanical or other mechanisms of measurement and control.
  - **ISO/TC 184 Automation systems and integration:** Automation and control systems, information systems and integration processes.
  - **IEC TC 56 Dependability:** Performance of reliability, maintainability and support of maintenance processes
  - **ISO/TC 69 Applications of statistical methods:** Collection (planning and design) of data, their analysis and finally, the presentation and interpretation of results.
  - **ISO/IEC JTC 1/SC 7 Software and systems engineering:** Good practices for the processes of software development and system engineering.
  - **ISO/IEC JTC 1/SC 27 IT Security techniques**
  - **ISO/IEC JTC 1/SC 38 Cloud Computing and Distributed Platforms**
  - **ISO/IEC JTC 1/WG 9 Big Data**

UC4 Standardisation Efforts

- Following:
  - ISO 9001:2015: Organisational goals and aspirations, policies, processes, documented information, and resources needed.

- Opportunities for Standardisation:
  - ISO 9001:2015
    - Establishment of federated learning models for the extraction of sales/production to forecast the data that are also going to be used for ISO 9001:2015.
    - The sales/production forecast value that is going to be generated automatically in the dedicated files thus making them part of the ISO 9000:2015 standard.

UC5 Standardisation Efforts

- Following:
  - Proprietary protocols and Standardised open protocols.
    - The open ones are: Opus, WebRTC, UDP over IP, TCP, HTTP over TCP and HTTPS.

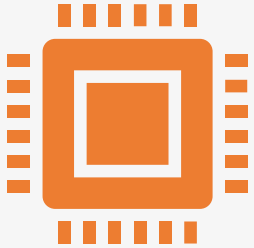
- Opportunities for Standardisation:
  - Team training in virtual reality
    - Object interactions suited for physical controller interaction or non haptic hand interaction, using inside out tracking for mobile consumer level virtual reality equipment, like the Oculus Quest.
    - Natural interaction technique. It is a control mechanism, where fingers individually can control, grasp and manipulate virtual objects in VR.

UC6 Standardisation Efforts

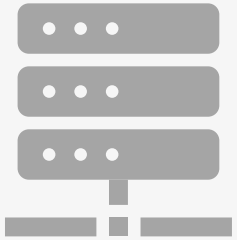
- Following:
  - ISO/IEC 20922:2016: Message Queuing Telemetry Transport (MQTT) protocol.
    - MQTT interfaces will be developed for the Remote Terminal Units (RTUs) of SCHN, allowing easier integration of RTUs with information systems for diagnosis and maintenance
  - RFC 6241: Network Configuration Protocol (NETCONF).
    - NETCONF data adapters collect measurements by fronthaul optical switches in order to be utilised for diagnosis and maintenance processes.

- Opportunities for Standardisation:
  - **IEEE 1232-2010**: Artificial Intelligence Exchange and Service Tie to All Test Environments (AI-ESTATE) specifies formal data models to facilitate and converge the exchange of diagnostic information.
  - **IEEE 1636-2018**: An implementation-independent specification for interfacing information systems containing data related to the diagnosis and maintenance of other systems.
  - **ISO 13374**: Converge data exchange and communication for condition monitoring and diagnostics (CM&D) systems

TERMINET Standardization Opportunities



Abstraction layer for digital twins, device inventories and discovery, with harmonisation across SDOs, e.g., OMG, ETSI and W3C, to reduce fragmentation and costs for integration.



Orchestration across the computing continuum, building upon Kubernetes and providing support for time sensitive and best-effort communication flows

Remote attestation for establishing trust and security in devices and software components

TERMINET- Key Identified Standardization Gaps

Unified standards for Digital Twins to counter fragmentation across SDOs → In communication with the Edge Computing Task Force concerning the RFC ‘‘A Framework for QoS-Enabled Semantic Routing in Industrial Networks’’ which is in draft status but public. https://datatracker.ietf.org/doc/draft-bellavista-semantic-sdn-mom/

Open standards for designing, developing, deploying, and testing accelerated ML algorithms to FPGA based edge or cloud systems to counter dominance by proprietary siloed solutions

Open standards relating to the gateway concept for remotely testing device → i2CAT is developing a RINA library (RINAsense) implementation for FreeRTOS, https://github.com/Fundacio-i2CAT/rinasense

Open standards for federated machine learning

TERMINET patent on MPP’s attestation technique of the (AG)

SHCN’s New Generation of RTU device – Prototype

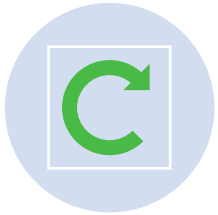
TERMINET Implementation to existing frameworks of 3rd parties

Participate to the ETSI TeraFlowSDN open-source project for aligning the TERMINET SDN activities with this software development group

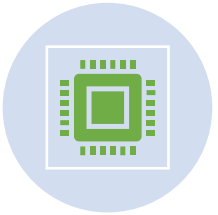
Orchestration of Intelligent UAVs Swarm: https://github.com/wcipAUTH/UAV-orchestrator

Incorporating NGSI-LD in the set of protocols and formats supported by the Web of Things. NGSI-LD is a RESTful API for accessing IoT context information expressed as property graphs.

Contributing IoT security support for logging and authorization to Hyperledger



Mobile Middleware Group Github. KuberneTSN: containerized TSN scheduler for Kubernetes Overlay Networks, 2023. [Online]. Available: https://github.com/MMw-Unibo/KuberneTSN. [Accessed 2023].



Kubernetes Network Plumbing Working Group. Multus CNI, [Online]. Available: https://github.com/k8snetworkplumbingwg/multus-cni. [Accessed 2023].

TERMINET

TERMINET Achievements & Datasets & Scientific Publications

Scientific Publications (1/4)

1. G. Kakamoukas, P. Sarigiannidis, A. Maropoulos, T. Lagkas, K. Zaralis, and C. Karaiskou, 'Towards Climate Smart Farming—A Reference Architecture for Integrated Farming Systems', Telecom 2021, 2, 52-74. https://doi.org/10.3390/telecom2010005
2. Y. Spyridis, T. Lagkas, P. G. Sarigiannidis, V. Argyriou, A. Sarigiannidis, G. Eleftherakis and J. Zhang, 'Towards 6G IoT: Tracing Mobile Sensor Nodes with Deep Learning Clustering in UAV Networks', Sensors 21(11) - Special Issue 6G Wireless Communication Systems, 2021, https://doi.org/10.3390/s21113936
3. P. D. Diamantoulakis, P. S. Bouzinis, P. Sarigannidis, Z. Ding, G. K. Karagiannidis, 'Optimal Design and Orchestration of Mobile Edge Computing with Energy Awareness', IEEE Transactions on Sustainable Computing, 2021, https://doi.org/10.1109/TSUSC.2021.3103476
4. D. Pliatsios, A-A. A. Boulogeorgos, T. Lagkas, V. Argyriou, I. Moscholios. P. Sarigiannidis, 'Semi-Grant-Free Non-Orthogonal Multiple Access for Tactile Internet of Things', IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC), 2021, https://doi.org/10.1109/PIMRC50174.2021.9569640
5. V. Kelli, P. Sarigiannidis, V. Argyriou, T. Lagkas and V. Vitsas, 'A Cyber Resilience Framework for NG-IoT Healthcare Using Machine Learning and Blockchain', IEEE International Conference on Communications (ICC), 2021, https://doi.org/10.1109/ICC42927.2021.9500496
6. I. Sinisioglou, P. Sarigiannidis, V. Argyriou, T. Lagkas, S. Goudos and M. Poveda, 'Federated Intrusion Detection In NG-IoT Healthcare Systems: An Adversarial Approach', IEEE International Conference on Communications (ICC), 2021, https://doi.org/10.1109/ICC42927.2021.9500578
7. V. Moysiadis, T. Lagkas, V. Argyriou, A. Sarigiannidis, I. D.Moscholios, and P. Sarigiannidis, 'Extending ADR mechanism for LoRa enabled mobile end-devices', Simulation Modelling Practice and Theory, 2021, https://doi.org/10.1016/j.simpat.2021.102388
8. I. -A. Chousainov, I. D. Moscholios, P. Sarigiannidis and M. D. Logothetis, 'Multiservice Loss Models for Cloud Radio Access Networks', IEEE Access, 2021, https://doi.org/10.1109/ACCESS.2021.3105946
9. I. Siniosoglou, V. Argyriou, S. Bibi, T. Lagkas, and P. Sarigiannidis, 'Unsupervised Ethical Equity Evaluation of Adversarial Federated Networks', ARES 2021: The 16th International Conference on Availability, Reliability and Security, 2021, https://doi.org/10.1145/3465481.3470478
10. V. Kelli, V. Argyriou, T. Lagkas, G. Fragulis, E. Grigoriou and P. Sarigiannidis, 'IDS for Industrial Applications: A Federated Learning Approach with Active Personalization', Sensors 2021; 21(20) - Special Issue Emerging Trends in Wireless Sensor Networks, 2021, https://doi.org/10.3390/s21206743

Scientific Publications (2/4)

11. V. K. Papanikolaou, N. A. Mitsiou, P.D. Diamantoulakis, Z. Ding and G. K. Karagiannidis, 'Hierarchical Multiple Access (HiMA) for Fog-RAN: Protocol Design and Resource Allocation', IEEE Transactions on Wireless Communications, 2021, https://ieeexplore.ieee.org/document/9505308
12. A. Sachinidis, A. Boulogeorgos and P. Sarigiannidis, 'Dual-hop Blockchain Radio Access Networks for Advanced Coverage Expansion', 10th International Conference on Modern Circuits and Systems Technologies (MOCAST), 2021, https://doi.org/10.1109/MOCAST52088.2021.9493339
13. S. P. Sotiroudis, P. Sarigiannidis, S. K. Goudos and K. Siakavara, 'Fusing Diverse Input Modalities for Path Loss Prediction: A Deep Learning Approach', IEEE Access, 2021, https://doi.org/10.1109/ACCESS.2021.3059589
14. I. Siniosoglou, V. Argyriou, T. Lagkas, A. Tsiakalos, A. Sarigiannidis and P. Sarigiannidis, 'Covert Distributed Training of Deep Federated Industrial Honeypots', 2021 IEEE Globecom Workshops (GC Wkshps), 2021, https://doi.org/10.1109/GCWkshps52748.2021.9682162
15. P. Radoglou-Grammatikis, T. Lagkas and P. Sarigiannidis, 'Next Generation IoT Reference Solution: The TERMINET Project', Open Access Government January 2022, https://www.openaccessgovernment.org/open-access-government-january-2022/126948/
16. A. Sabbioni, et al. "DIFFUSE: A DIstributed and decentralized platForm enabling Function composition in Serverless Environments." Computer Networks, vol. 210, p. 108993, Jun. 2022, doi: 10.1016/j.comnet.2022.108993
17. D. Pliatsios, S. K. Goudos, T. Lagkas, V. Argyriou, A.-A. A. Boulogeorgos, P. Sarigiannidis , "Drone-Base-Station for Next-Generation Internet-of-Things: A Comparison of Swarm Intelligence Approaches", IEEE Open Journal of Antennas and Propagation, 2021.
18. D. Pliatsios, T. Lagkas, V. Argyriou, A. Sarigiannidis, D. Margounakis, T. Saoulidis, P. Sarigiannidis , "A Hybrid RF-FSO Offloading Scheme for Autonomous Industrial Internet of Things", IEEE INFOCOM 2022 - IEEE Conference on Computer Communications Workshops (INFOCOM WKSHPS), 2022.
19. P. S. Bouzinis, P. D. Diamantoulakis, and G. K. Karagiannidis, "Incentive-Based Delay Minimization for 6G-Enabled Wireless Federated Learning," Frontiers in Communications and Networks, vol. 3. Frontiers Media SA, Mar. 30, 2022. doi: http://dx.doi.org/10.3389/frcmn.2022.827105
20. S. A. Tegos, D. Tyrovolas, P. D. Diamantoulakis, C. K. Liaskos, and G. K. Karagiannidis, "On the Distribution of the Sum of Double-Nakagami-m Random Vectors and Application in Randomly Reconfigurable Surfaces," IEEE Transactions on Vehicular Technology, vol. 71, no. 7. Institute of Electrical and Electronics Engineers (IEEE), pp. 7297–7307, Jul. 2022. doi: http://dx.doi.org/10.1109/TVT.2022.3164846

Scientific Publications (3/4)

21. D. Pliatsios, P. Sarigiannidis, T. D. Lagkas, V. Argyriou, A.-A. A. Boulogeorgos, and P. Baziana, “Joint Wireless Resource and Computation Offloading Optimization for Energy Efficient Internet of Vehicles,” IEEE Transactions on Green Communications and Networking, vol. 6, no. 3. Institute of Electrical and Electronics Engineers (IEEE), pp. 1468–1480, Sep. 2022. doi: http://dx.doi.org/10.1109/TGCN.2022.3189413

22. A. Liatifis, P. Sarigiannidis, V. Argyriou, and T. Lagkas, “Advancing SDN: from OpenFlow to P4, a Survey,” ACM Computing Surveys. Association for Computing Machinery (ACM), Aug. 26, 2022. doi: http://dx.doi.org/10.1145/3556973

23. J. Jiang, C. Soriente, and G. Karame, “On the Challenges of Detecting Side-Channel Attacks in SGX,” 25th International Symposium on Research in Attacks, Intrusions and Defenses. ACM, Oct. 26, 2022. doi: http://dx.doi.org/10.1145/3545948.3545972

24. D. Tyrovolas, S. A. Tegos, P. D. Diamantoulakis, and G. K. Karagiannidis, “Synergetic UAV-RIS Communication With Highly Directional Transmission,” IEEE Wireless Communications Letters, vol. 11, no. 3. Institute of Electrical and Electronics Engineers (IEEE), pp. 583–587, Mar. 2022. doi: http://dx.doi.org/10.1109/LWC.2021.3136912

25. P. D. Diamantoulakis, P. S. Bouzinis, P. Sarigiannidis, and G. K. Karagiannidis, “Health Risk Assessment with Federated Learning,” 2022 International Balkan Conference on Communications and Networking (BalkanCom). IEEE, Aug. 22, 2022. doi: http://dx.doi.org/10.1109/BalkanCom55633.2022.9900733

26. A. Triantafyllou, D. Zorbas, and P. Sarigiannidis, “Time-slotted LoRa MAC with variable payload support,” Computer Communications, vol. 193. Elsevier BV, pp. 146–154, Sep. 2022. doi: http://dx.doi.org/10.1016/j.comcom.2022.06.043

27. N. A. Mitsiou, P. N. Gavriilidis, P. D. Diamantoulakis, and G. K. Karagiannidis, “Wireless Powered Multi-Access Edge Computing with Slotted ALOHA,” IEEE Communications Letters. Institute of Electrical and Electronics Engineers (IEEE), pp. 1–1, 2022. doi: http://dx.doi.org/10.1109/LCOMM.2022.3211190

28. M. Simos, P. S. Bouzinis, P. D. Diamantoulakis, P. Sarigiannidis, and G. K. Karagiannidis, “Hierarchical Federated Learning for the Next Generation IoT,” 2022 18th International Conference on Wireless and Mobile Computing, Networking and Communications (WiMob). IEEE, Oct. 10, 2022 [Online]. Available: doi: http://dx.doi.org/10.1109/WiMob55322.2022.9941355

29. N. Kolokotronis, M. Dareioti, S. Shiaeles, and E. Bellini, “An Intelligent Platform for Threat Assessment and Cyber-Attack Mitigation in IoMT Ecosystems,” 2022 IEEE Globecom Workshops (GCWkshps).IEEE, Dec. 04, 2022 doi: http://dx.doi.org/10.1109/GCWkshps56602.2022.10008548

30. P. S. Bouzinis, N. A. Mitsiou, P. D. Diamantoulakis, D. Tyrovolas, and G. K. Karagiannidis, “Intelligent Over-the-Air Computing Environment,” IEEE Wireless Communications Letters, vol. 12, no. 1. Institute of Electrical and Electronics Engineers (IEEE), pp. 134–137, Jan. 2023. doi: http://dx.doi.org/10.1109/LWC.2022.3219250

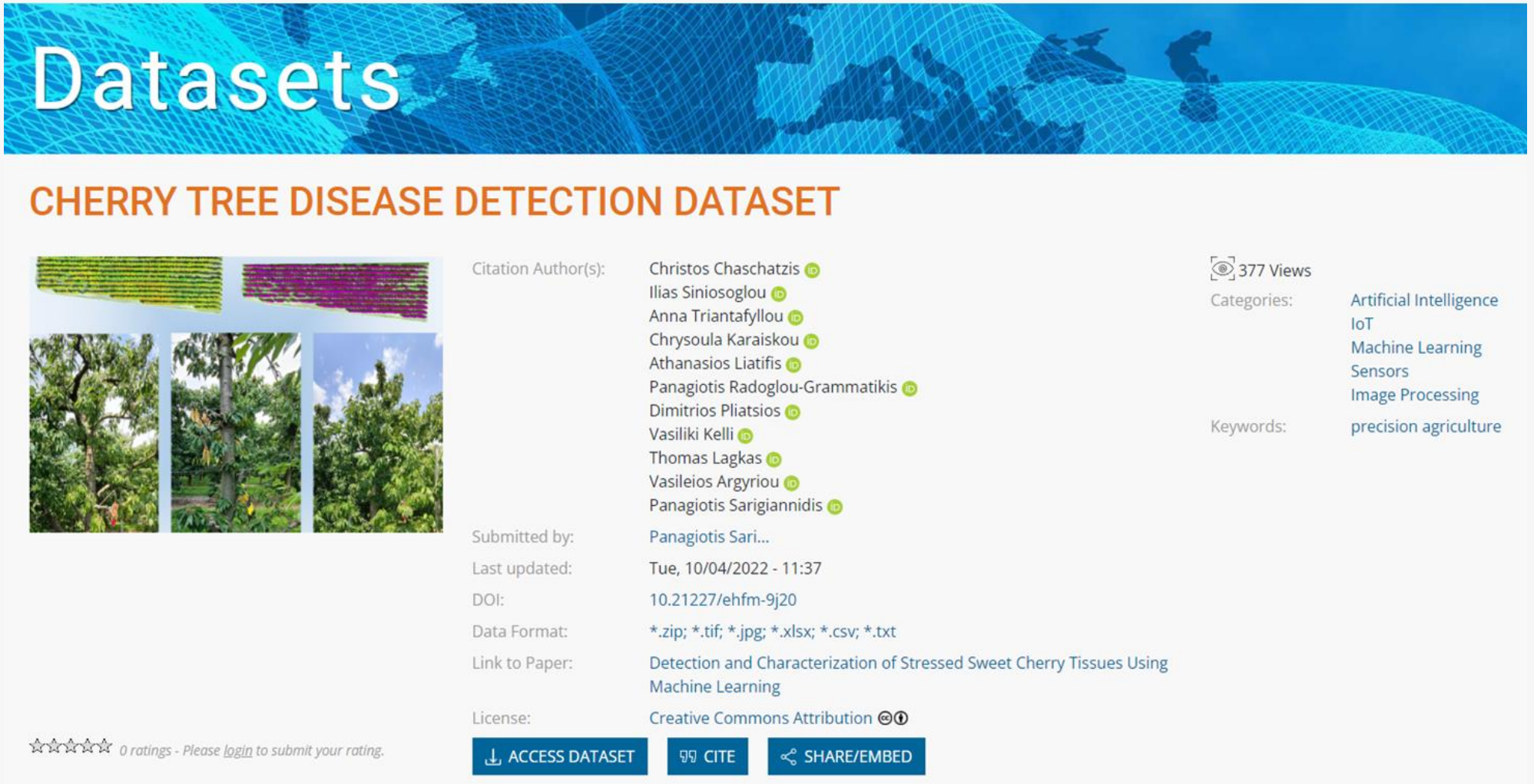
31. D. Tyrovolas, P.-V. Mekikis, S. A. Tegos, P. D. Diamantoulakis, C. K. Liaskos, and G. K. Karagiannidis, “Energy-Aware Design of UAV-mounted RIS Networks for IoT Data Collection,” IEEE Transactions on Communications. Institute of Electrical and Electronics Engineers (IEEE), pp. 1–1, 2022. doi: http://dx.doi.org/10.1109/TCOMM.2022.3229672

32. G. Siachamis, Ch. Kaliakatsos, G. Stavropoulos, K. Votis, D. Ioannidis, a nd D. Tzovaras " A Decentralized Secured Data sharing Framework for IoT Networks CERTH," 2022 IEEE 8th World Forum on Internet of Things (WF-IoT), Yokohama, Japan, to be published

Scientific Publications (4/4)

33. E. Villar-Rodriguez, M. A. Pérez, A. I. Torre-Bastida, C. R. Senderos, and J. López-de-Armentia, “Edge intelligence secure frameworks: Current state and future challenges,” Computers & Security, vol. 130, p. 103278, Jul. 2023, doi: 10.1016/j.cose.2023.103278.
34. D. Sarabia-Jácome, E. Grasa, and M. Catalán, “RINAsense: A prototype for implementing RINA networks in IoT environments,” in 2023 6th Conference on Cloud and Internet of Things (CIoT), Mar. 2023, pp. 70–76. doi: 10.1109/CIoT57267.2023.10084905.
35. D. Sarabia-Jácome, E. Grasa, and M. Catalán, “RINA-based Multilayer QoS for support Tactile Internet,” in IoTworldForum2023,
36. D. Sarabia-Jácome, E. Grasa, and M. Catalán , “SDN Architecture and Southbound Interface Driver for RINA Network in IoT Domains,”
37. A. Liatifis et al., “Evaluating SDN applicability in the Edge,” in ICC 2023,
38. I. Siniosoglou et al., “Applying Federated Learning on Decentralized Smart Farming: A Case Study,” in ICC 2023,
39. A. Garbugli, L. Rosa, A. Bujari, and L. Foschini, “KuberneTSN: a Deterministic Overlay Network for Time-Sensitive Containerized Environments.” arXiv, Feb. 16, 2023. doi: 10.48550/arXiv.2302.08398.
40. A. Liatifis, D.Pliatsios, P. Radoglou-Grammatikis, T. Lagkas, V. Vitsas, N. Katertsidis, I. Moscholios, S. Goudos, and P.Sarigiannidis, ‘’Edge Intelligence with 5G/6G Networks’’, EU-IoT & ICT-56 OA Book: Shaping the Future of IoT with Edge Intelligence: How Edge Computing Enables the Next Generation of IoT Applications, Accepted by River Publishers
41. I. Siniosoglou, S. Bibi, K.-F. Kollias, G. Fragulis, P. Radoglou-Grammatikis, T. Lagkas, V. Argyriou, V. Vitsas, P. Sarigiannidis, ‘’Federated Learning Models in Decentralized Critical Infrastructure,’’ EU-IoT & ICT-56 OA Book: Shaping the Future of IoT with Edge Intelligence: How Edge Computing Enables the Next Generation of IoT Applications, Accepted by River Publishers
42. V. Kelli, A. Triantafyllou, P. Radoglou-Grammatikis, T. Lagkas, V. Vitsas, P. Fouliras, I. Kotsiuba, and P. Sarigiannidis. Achieving Security and Privacy in NG-IoT Using Blockchain Techniques. Part III: Blockchain Solutions for Trusted Edge Intelligence in IoT Systems, EU-IoT & ICT-56 OA Book: Shaping the Future of IoT with Edge Intelligence: How Edge Computing Enables the Next Generation of IoT Applications. Accepted by River Publishers

CHERRY TREE DISEASE DETECTION DATASET



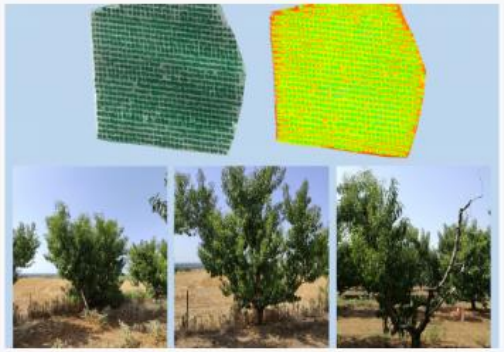
https://ieee-dataport.org/documents/cherry-tree-disease-detection-dataset

PEACH TREE DISEASE DETECTION DATASET

Datasets

Standard Dataset

PEACH TREE DISEASE DETECTION DATASET



Citation Author(s): Christos Chaschatzis, Ilias Siniosoglou, Anna Triantafyllou, Chrysoula Karaiskou, Athanasios Liatifis, Panagiotis Radoglou-Grammatikis, Dimitrios Pliatsios, Vasiliki Kelli, Thomas Lagkas, Vasileios Argyriou, Panagiotis Sarigiannidis

Submitted by: Panagiotis Sari...

Last updated: Wed, 11/23/2022 - 14:34

DOI: 10.21227/w67n-0q72

Data Format: *.zip; *.tif; *.jpg; *.xlsx; *.csv; *.txt

Link to Paper: A compilation of UAV applications for precision agriculture

License: Creative Commons Attribution

62 Views

Categories: Artificial Intelligence, IoT, Machine Learning, Sensors, Image Processing

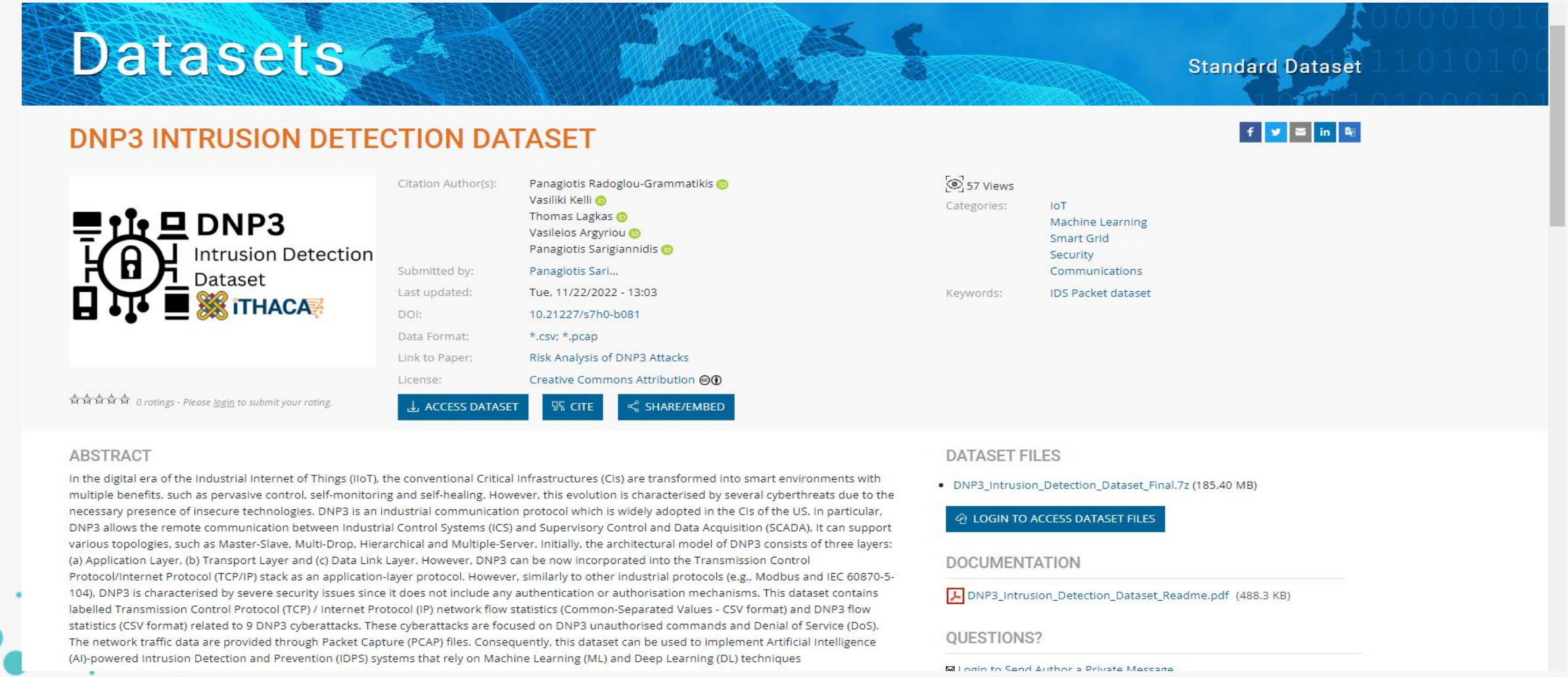
Keywords: precision agriculture

☆☆☆☆☆ 0 ratings - Please login to submit your rating.

ACCESS DATASET | CITE | SHARE/EMBED

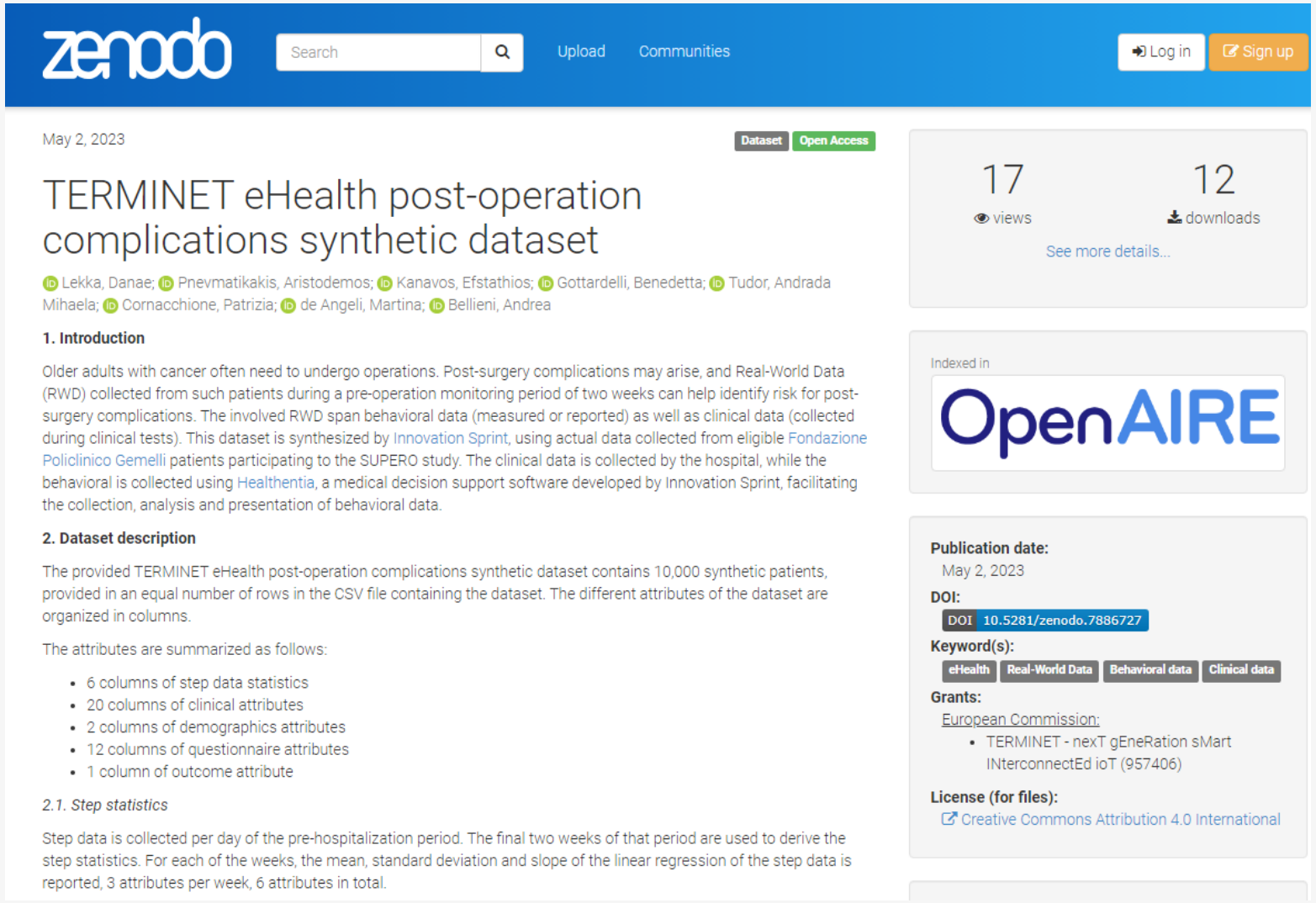
https://ieee-dataport.org/documents/peach-tree-disease-detection-dataset

DNP3 INTRUSION DETECTION DATASET



https://ieee-dataport.org/documents/dnp3-intrusion-detection-dataset

TERMINET EHEALTH POST-OPERATION COMPLICATIONS SYNTHETIC DATASET



zenodo Search Upload Communities Log in Sign up

May 2, 2023 Dataset Open Access

TERMINET eHealth post-operation complications synthetic dataset

Lekka, Danae; Pnevmatikakis, Aristodemos; Kanavos, Efstathios; Gottardelli, Benedetta; Tudor, Andrada Mihaela; Cornacchione, Patrizia; de Angeli, Martina; Bellieni, Andrea

1. Introduction

Older adults with cancer often need to undergo operations. Post-surgery complications may arise, and Real-World Data (RWD) collected from such patients during a pre-operation monitoring period of two weeks can help identify risk for post-surgery complications. The involved RWD span behavioral data (measured or reported) as well as clinical data (collected during clinical tests). This dataset is synthesized by Innovation Sprint, using actual data collected from eligible Fondazione Policlinico Gemelli patients participating to the SUPERO study. The clinical data is collected by the hospital, while the behavioral is collected using Healthentia, a medical decision support software developed by Innovation Sprint, facilitating the collection, analysis and presentation of behavioral data.

2. Dataset description

The provided TERMINET eHealth post-operation complications synthetic dataset contains 10,000 synthetic patients, provided in an equal number of rows in the CSV file containing the dataset. The different attributes of the dataset are organized in columns.

The attributes are summarized as follows:

- 6 columns of step data statistics
- 20 columns of clinical attributes
- 2 columns of demographics attributes
- 12 columns of questionnaire attributes
- 1 column of outcome attribute

2.1. Step statistics

Step data is collected per day of the pre-hospitalization period. The final two weeks of that period are used to derive the step statistics. For each of the weeks, the mean, standard deviation and slope of the linear regression of the step data is reported, 3 attributes per week, 6 attributes in total.

17 views 12 downloads

See more details...

Indexed in OpenAIRE

Publication date: May 2, 2023

DOI: DOI 10.5281/zenodo.7886727

Keyword(s): eHealth Real-World Data Behavioral data Clinical data

Grants:

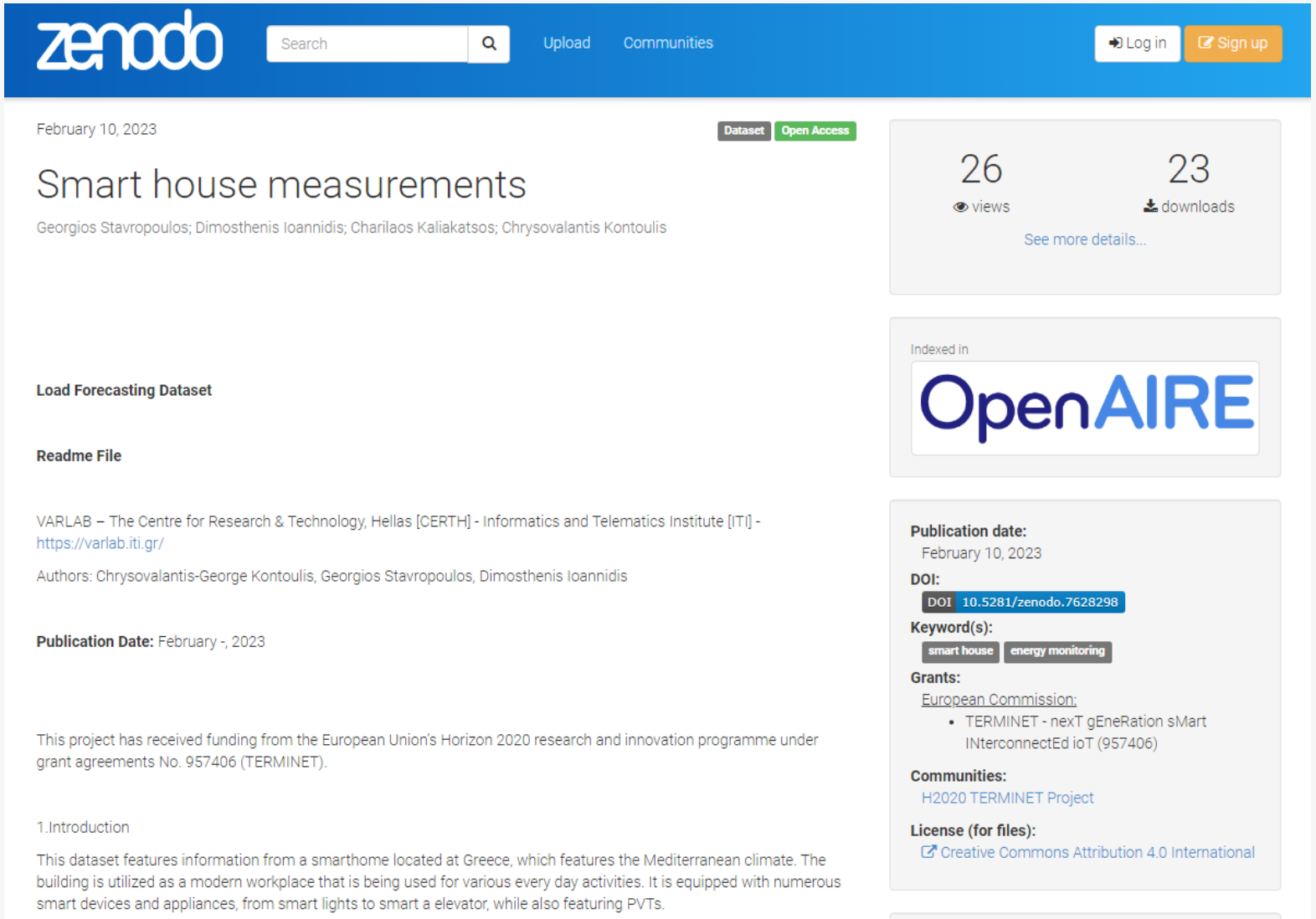
European Commission:

- TERMINET - nexT gEneRation sMart INterconnectEd ioT (957406)

License (for files): Creative Commons Attribution 4.0 International

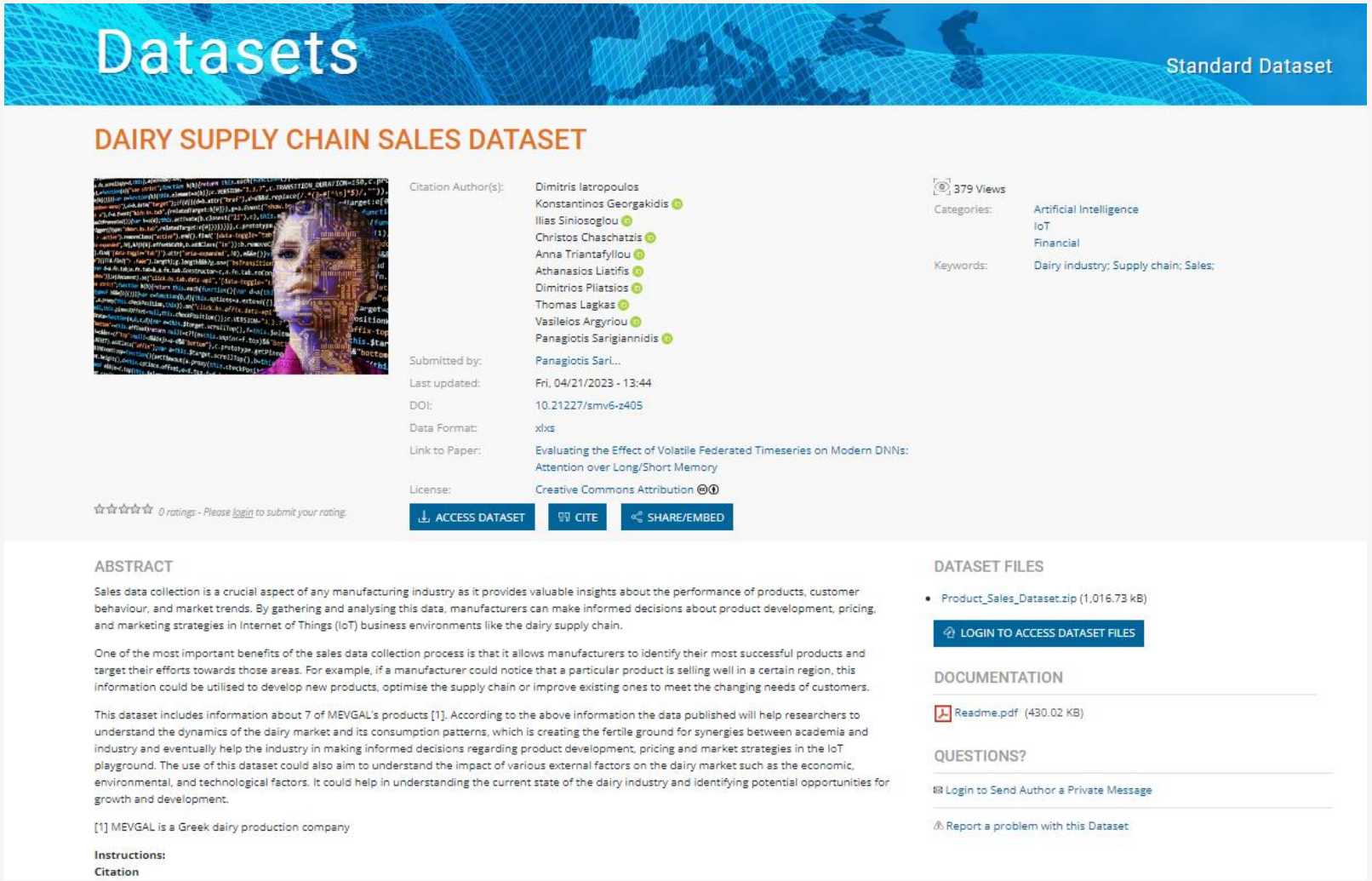
https://zenodo.org/record/7886727

SMART HOUSE MEASUREMENTS



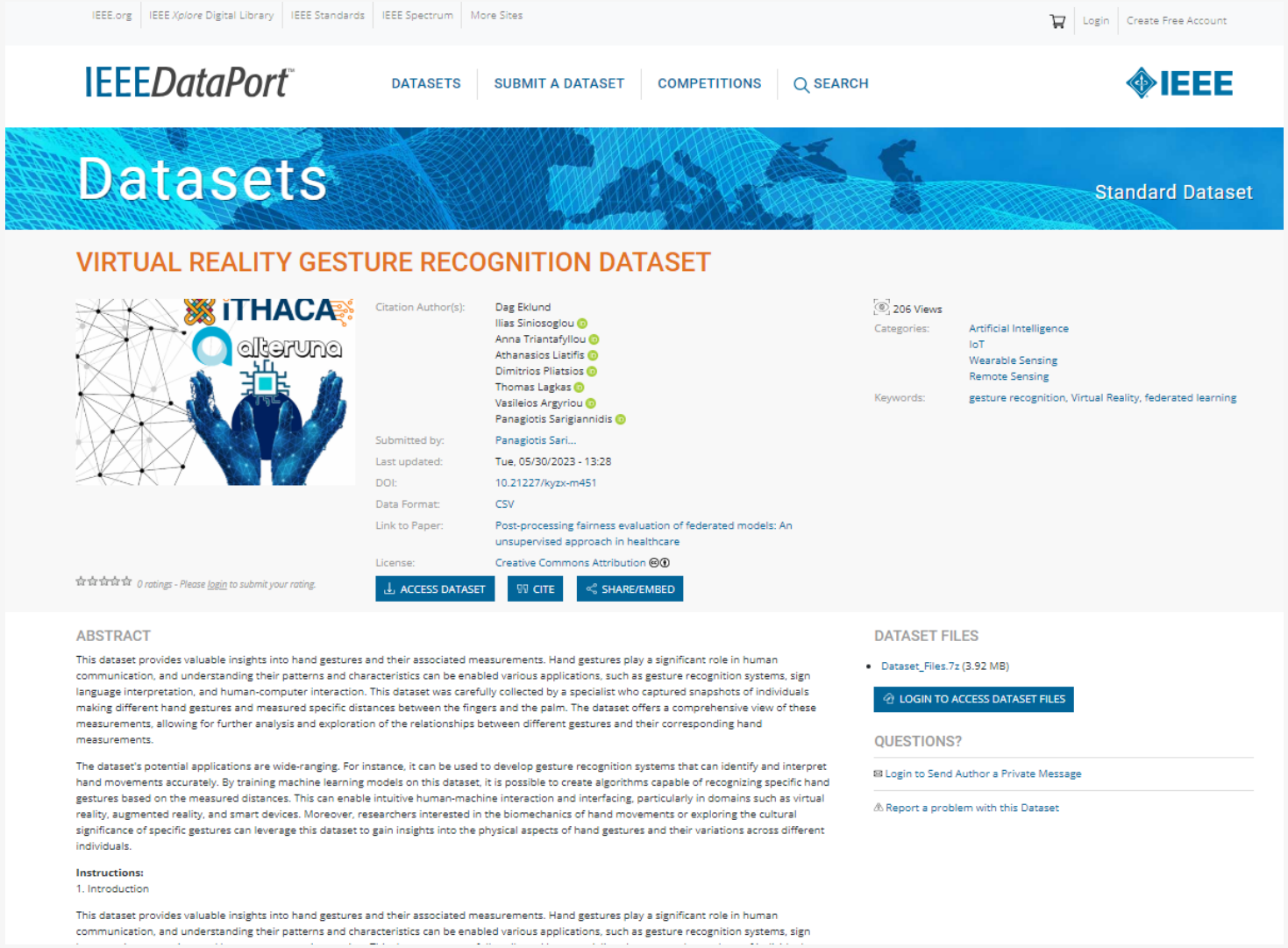
https://zenodo.org/record/7628298

DAIRY SUPPLY CHAIN SALES DATASET



https://ieee-dataport.org/documents/dairy-supply-chain-sales-dataset

VIRTUAL REALITY GESTURE RECOGNITION DATASET



IEEE.org | IEEE Xplore Digital Library | IEEE Standards | IEEE Spectrum | More Sites

Login | Create Free Account

IEEE DataPort™ DATASETS | SUBMIT A DATASET | COMPETITIONS | SEARCH IEEE

Datasets

Standard Dataset

VIRTUAL REALITY GESTURE RECOGNITION DATASET

iTHACA alteruna

Citation Author(s): Dag Eklund, Ilias Siniosoglou, Anna Triantafyllou, Athanasios Liatifis, Dimitrios Pliatsios, Thomas Lagkas, Vasileios Argyriou, Panagiotis Sarigiannidis

Submitted by: Panagiotis Sari...

Last updated: Tue, 05/30/2023 - 13:28

DOI: 10.21227/kyzx-m451

Data Format: CSV

Link to Paper: Post-processing fairness evaluation of federated models: An unsupervised approach in healthcare

License: Creative Commons Attribution

206 Views

Categories: Artificial Intelligence, IoT, Wearable Sensing, Remote Sensing

Keywords: gesture recognition, Virtual Reality, federated learning

☆☆☆☆☆ 0 ratings - Please login to submit your rating.

ACCESS DATASET | CITE | SHARE/EMBED

ABSTRACT

This dataset provides valuable insights into hand gestures and their associated measurements. Hand gestures play a significant role in human communication, and understanding their patterns and characteristics can be enabled various applications, such as gesture recognition systems, sign language interpretation, and human-computer interaction. This dataset was carefully collected by a specialist who captured snapshots of individuals making different hand gestures and measured specific distances between the fingers and the palm. The dataset offers a comprehensive view of these measurements, allowing for further analysis and exploration of the relationships between different gestures and their corresponding hand measurements.

The dataset's potential applications are wide-ranging. For instance, it can be used to develop gesture recognition systems that can identify and interpret hand movements accurately. By training machine learning models on this dataset, it is possible to create algorithms capable of recognizing specific hand gestures based on the measured distances. This can enable intuitive human-machine interaction and interfacing, particularly in domains such as virtual reality, augmented reality, and smart devices. Moreover, researchers interested in the biomechanics of hand movements or exploring the cultural significance of specific gestures can leverage this dataset to gain insights into the physical aspects of hand gestures and their variations across different individuals.

Instructions:

1. Introduction

This dataset provides valuable insights into hand gestures and their associated measurements. Hand gestures play a significant role in human communication, and understanding their patterns and characteristics can be enabled various applications, such as gesture recognition systems, sign

DATASET FILES

- Dataset_Files.7z (3.92 MB)

LOGIN TO ACCESS DATASET FILES

QUESTIONS?

Login to Send Author a Private Message

Report a problem with this Dataset

https://ieee-dataport.org/documents/virtual-reality-gesture-recognition-dataset

Thank you for your attention!

TERMINET website : https://terminet-h2020.eu/

LinkedIn: https://www.linkedin.com/company/terminet/

Twitter: https://twitter.com/Terminet_H2020

Contact information

- psarigiannidis@uowm.gr
- atriantafyllou@uowm.gr