CHILD PROTECTION CENTRED STRATEGIES TO FIGHT AGAINST SEXUAL ABUSE AND EXPLOITATION



KEY EXPLOITABLE RESULTS





16 partners, 10 countries:

3 Universities, 1 Small and Medium Enterprises, 3 Research and Technology Organisations, 5 Law Enforcement Agencies and 4 NGOs.



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5 INTERESTED?

ALUNA INTRODUCTION

Child Sexual Abuse and Exploitation (CSA/CSE) represent a serious threat to the safety and well-being of minors around the world. Despite technological and social advances, victims of these crimes continue to face significant barriers in accessing the help and support they need. Law Enforcement Agencies (LEAs), civil society organizations (NGOs), and other key actors struggle to adapt to the evolving nature of these crimes, often lacking adequate technological, legal, and psychosocial tools. In addition, the lack of coordination among the various actors reduces the effectiveness of both investigations and victim support.

To address these challenges, the ALUNA project proposes an innovative, interdisciplinary, and international victim-centered approach. Coordinated by the Complutense University of Madrid and funded by the European Union's Internal Security Fund (ISF), ALUNA aims to improve prevention, investigation, and victim assistance in CSA/CSE cases through the integration of Information and Communication Technologies (ICT) and the Social Sciences and Humanities (SSH).

The project, which runs from June 2023 to May 2025, involves a consortium of organizations from 10 countries, including EU Member States, associated countries, and third countries. ALUNA is based on close collaboration with LEAs and NGOs that work directly with victims, ensuring that the solutions developed address real needs. Through prevention campaigns, innovative technological tools, and tailored intervention strategies, ALUNA aspires to have a global impact in the fight against child sexual abuse and exploitation.



ALUNA

The ALUNA project is structured around three main components:



The ALUNA project proposes a set of innovative strategies aimed at preventing child sexual abuse and exploitation (CSA/CSE) crimes. These strategies aim to reduce the risk of victimization, increase public awareness, and promote active collaboration among the population, Law Enforcement Agencies (LEAs), and victim support organizations. Through information campaigns, training, awarenessraising activities, and the development of accessible technological tools, ALUNA seeks to empower society to detect warning signs and take preventive action against potential CSA/CSE cases.



This pillar focuses on equipping LEAs and involved other actors with advanced technological tools to more effectively combat CSA/CSE crimes. In a context where offenders exploit social media, P2P platforms, and the dark web to commit their crimes, ALUNA develops AI-based solutions that enable fast, secure, and forensically sound extraction, analysis, and exchange of information. These tools strengthen investigative capacities, inter-agency facilitate cooperation, and improve the tracking and prosecution of offenders.



VICTIM ASSISTANCE

ALUNA adopts a victim-centered approach, implementing measures that ensure protection and access to specialized resources. The project includes training programs for LEA professionals and other stakeholders, the development of guidelines and best practices for coordinated victim care, and policy development to advance the rights of CSA/CSE victims. By fostering cooperation among key actors and aligning procedures with the specific needs of victims, ALUNA aims to prevent revictimization and support their recovery and integration into the justice system in a respectful and empathetic manner.

ALUNA

The ALUNA project applies the potential of emerging technologies to transform the fight against child sexual abuse and exploitation (CSA/CSE). Through innovative solutions based on artificial intelligence, digital forensic analysis, and interdisciplinary cooperation, ALUNA strengthens criminal investigation capabilities, fosters effective collaboration among law enforcement agencies, social organizations, and policymakers, and places victims at the center by developing tools and procedures that respond to their real needs. This comprehensive approach not only improves the response to these crimes but also helps build safer and more resilient environments for vulnerable communities.

ÀLUNA 2 KEY EXPLOITABLE RESULTS

The ALUNA project has successfully developed a series of innovative Key Exploitable Results (KERs) aimed at combating online threats against children and strengthening the response to child sexual abuse and exploitation (CSA/CSE). These solutions encompass both technological tools and social initiatives, and are structured around the project's three fundamental pillars: Prevention, Investigation, and Victim Support. Among the technical developments is a mobile application powered by artificial intelligence for the early detection of grooming attempts, which alerts parents or legal guardians to potential risk situations. In addition, advanced audio analysis tools have been created to support law enforcement agencies in identifying acoustic patterns associated with child sexual abuse crimes. These tools include voice recognition modules, age and gender estimation from recordings, detection of sensitive content in audiovisual files, and forensic analysis techniques to detect tampering, as well as automated report generators for use in judicial proceedings.

In parallel, ALUNA has promoted training programmes and educational materials that raise awareness, enhance preventive capabilities, and empower communities to act proactively against these crimes. Close collaboration between technology developers, law enforcement agencies (LEAs), and non-governmental organizations (NGOs) has been key to reaching Technology Readiness Levels (TRLs) ranging from 5 to 7. The results obtained have demonstrated both their technical feasibility and potential for implementation in real operational settings.

Nevertheless, it is essential to continue with research, development, and innovation (R&D&I) efforts to ensure the effective adoption of these solutions by end users. Comprehensive documentation and strategic dissemination of the KERs are critical to maximizing the project's impact. These results go beyond technological innovation, encompassing scientific knowledge, best practices, and policy recommendations that provide a holistic approach to protecting children in digital environments. The following sections present and analyse in detail the KERs generated within the framework of the

ALUNA project, reflecting their scope, development status, and added value.

ALUNA 3 TECHNICAL KERS

3.1 Prevention Tools

Anti-grooming mobile app (AGapp)

It allows the detection of grooming attempts in instant messaging applications, through the use of artificial intelligence models and technologies that guarantee the security and privacy of the child's data.

Partner: UCM TRL: 6





Generation of synthetic audios

Tool for multilingual and multiaccent synthetic audio generation with voice style control (such as age, gender, language and accent), from text inputs.

Partner: UCM TRL: 5

Platform integration

Integration of all the tools developed in the Aluna project that allows them to be used from the same graphical user interface, and combines their different functionalities

Partner: IDENER TRL: 7

Automatic report generator engine

Extension of the Aluna platform integration that allows generating and downloading different kinds of reports using the results of the analysis done in the platform.

Partner: IDENER TRL: 7

CSAM detection and classification

This tool involves the development of Deep Learning and audio analysis techniques for detecting sensitive content, specifically pornographic material in audio and video.

Partner: UCM TRL: 5

Audio age/Gender estimation

This tool combines a custom pre-processing pipeline with a Whisper-based audio transformer to estimate speaker age and gender.

Partner: UNIKENT TRL: 6

Multimedia Audio Forgery

This task provides a tool for forgery detection in multimedia audio files. A customized dataset of both authentic and manipulated audio recordings is used, covering various forgery techniques such as copy-move andsplicing.

Partner: UCM TRL: 5



3.2 Investigation Tools

Analysis of encrypted mobile and storage devices

This tool generates tailored password guesses based on suspect personal information, ranking them from most to least likely. It is built on a GPT-2 architecture trained on real leaked passwords, adapted to comply with modern password requirements (e.g. at least one uppercase letter, one lowercase letter, a number, and a special character).

Partner: UNIKENT TRL: 6

Cloud storage forensic

Methodological approaches to deal with distributed storage solutions and tools to allow investigators to advance in theirtasks.

Partner: ARC TRL: 6

Perceptual Hashing and Metadata Analysis

This tool applies perceptual hashing to identify manipulated or altered images and videos by comparing them to a secure database of known content.

Partner: UNIKENT TRL: 6

Audio Signatures Analysis

The aim of this tool is to help LEAs extract unique signatures from the audio of CSAM videos.

Partner: ARC TRL: 6

Speech Recognition

The tool developed is oriented towards advanced processing of audiovisual content, incorporating multilingual capabilities for the recognition of named entities in Spanish, English and Portuguese.

Partner: UCM TRL: 5

ALUNA NON-TECHNICAL KERS

1 Scientific Publications

Throughout the ALUNA project, a range of important scientific contributions have been produced, spanning various fields related to the prevention, investigation, and response to child sexual abuse and exploitation (CSA/CSE) and online threats against children. These publications highlight the project's interdisciplinary approach, integrating cutting-edge technological innovations—such as artificial intelligence, audio analysis, and forensic techniques—with insights from social sciences and victim support frameworks. The aim is to address the complex needs of victims while enhancing investigative capabilities. Below is a compilation of articles and studies published in peer-reviewed journals and presented at international conferences, reflecting the collaborative efforts and knowledge generated within the ALUNA project.



- D. Povedano Álvarez, A. L. Sandoval Orozco, L. J. García Villalba: <u>Detección de Contenido Sensible en</u> <u>Audio y Vídeo mediante Espectrogramas y Aprendizaje por Transferencia</u>. VIII Jornadas Nacionales de Investigación en Ciberseguridad (JNIC 2024). pp. 262-269. May 27-29, 2024.
- Y. Guo, S. Bettaieb, F. Casino: A comprehensive analysis on software vulnerability detection datasets: trends, challenges, and road ahead. International Journal of Information Security. V. 23, pp. 3311–3327. May 2024.
- O. Canive Huguet, L. J. García Villalba, L. A. Martínez Hernández: <u>Tool for the identification of</u> <u>persons by using convolutional neural networks</u>. Bachelor's Thesis, Complutense University of Madrid. September 2024.
- O. Zea Lavado, L. J. García Villalba, S. Pérez Arteaga: <u>Text Analysis on Android devices for Grooming</u> <u>Detection</u>. Master's Thesis, Complutense University of Madrid. September 2024.
- J. A. Sousa Torres, D. Alves da Silva, R. de Oliveira Albuquerque, G. Daniel Amvame Nze, A. L. Sandoval Orozco, L. J. García Villalba: <u>Ontology Development for Asset Concealment Investigation: A</u> <u>Methodological Approach and Case Study in Asset Recovery</u>. Applied Science. Vol. 14, pp. 9654.

ALUNA NON-TECHNICAL KERS

4.1 Scientific Publications

- E. Ruiz Huguet, L. M. Marco Simal, L. J. García Villalba, S. Pérez Arteaga: <u>An iOS App for the Detection</u> of <u>Explicit Content in Audio and Text</u>. Bachelor's Thesis, Complutense University of Madrid. September 2024.
- M. Ruano Crespo, L. J. García Villalba, S. Pérez Arteaga: <u>Tool for the Detection of Sexual Content in</u> <u>Images on Mobile Devices iOS</u>. Bachelor's Thesis, Complutense University of Madrid. September 2024.
- M. P. Marco Francia: <u>The Unbearable Lightness of Modern Sexual Slavery: Legal and</u> <u>Criminological Framework in Spain</u>. The Palgrave Handbook on Modern Slavery. ISBN: 978-3-031-58614-9. pp. 429–446. December 2024.
- F. Casino, E. Batista, A. Martínez-Ballesté, A. Solanas: <u>Integrating Audio-Based Interactions and Large Language Models into Ambient Assisted Living Environments</u>. Proceedings of the International Conference on Ubiquitous Computing and Ambient Intelligence. Vol. 12, pp. pp 176–182. December 2024.
- F. Casino, D. Hurley-Smith, J. Hernandez-Castro, C. Patsakis: <u>Not on my watch: ransomware</u> <u>detection through classification of high-entropy file segments</u>. Journal of Cybersecurity. Vol 11. April 2025.
- F. Casino, P. Lopez-Iturri, C. Patsakis: <u>Cloud continuum testbeds and next-generation ICTs: Trends,</u> <u>challenges, and perspectives</u>. Computer Science Review. Vol. 56. pp. 100696. May 2025.
- C. McHugh, H. Yuan, J. Pont, V. N. L. Franqueira, B. Arief, J. Hernandez-Castro: AGenCi: Age and Gender Classification of Audio in Forensic Investigations of Child Sexual Abuse and Exploitation. IEEE Transactions on Information Forensics and Security. May 2025.
- G. Rocha, C. Castanheira, D. Figueiredo, A. Breves: Risks of trafficking of children and adolescents in the context of international migration in Brazil: perceptions on the influence of digital technology and institutional responses in Pacaraima-RR and Guarulhos-SP. ISBN: 978-85-85193-06-5. May 2025.
- G. Rocha, C. Castanheira, D. Figueiredo, A. Breves: Segurança online para crianças e adolescentes em situação de migração internacional no Brasil Manual para apoiar instituições de acolhimento. ISBN: 978-85-85193-05-8. May 2025.
- P. A. Martín Peláez, L. J. García Villalba, S. Pérez Arteaga: Sensitive Content Detection on Android Using Deep Learning and Secure Federated Learning Techniques. Bachelor's Thesis, Complutense University of Madrid. June 2025.
- J. Sánchez López-Varela, L. J. García Villalba, L. A. Martínez Hernández: Synthetic dataset generation tool with automatic anonymisation functionalities. Bachelor's Thesis, Complutense University of Madrid. June 2025.
- J. Qiu, L. J. García Villalba, S. Pérez Arteaga: Use of artificial intelligence for the detection of audio with explicit content in Android devices. Master's Thesis, Complutense University of Madrid. July 2025.
- V. Ustimenko, L. J. García Villalba, S. Pérez Arteaga: Detecting Early Signs of Sextortion in Text Using Machine Learning Techniques. Bachelor's Thesis, Complutense University of Madrid. September 2025.



4.2 Research Datasets

BENCHMARKING DATASETS

As part of the ALUNA project, the use of benchmarking datasets has been essential to ensure scientific rigor, model validity, and their ability to generalize in real-world scenarios. Each technical module was trained and evaluated using carefully selected datasets, chosen for their relevance, quality, linguistic diversity, and suitability to the challenges involved in protecting children from sexual exploitation and abuse in digital environments. These datasets supported the training of AI models in tasks such as automatic speech recognition, age and gender estimation from audio, forensic analysis of encrypted devices, detection of sensitive content, synthetic audio generation, and early grooming detection in mobile applications. While some datasets are publicly available and widely adopted by the scientific community, others were adapted or selected for their specific relevance to the project. The following is a list of the main datasets used across ALUNA's key developments.

Age and Gender Estimation from Audio

<u>Common Voice 16.1</u> | Diverse speech samples with age and gender metadata | Audio <u>OGI/CSLU Kids' Corpus</u> | Children's speech recordings for age and gender identification | Audio

Age and Gender Estimation from Audio

<u>Kaonashi 2019</u> | Modified dataset with increased representation of relevant character types, used for forensic analysis of encrypted data | Text & File System Metadata

Perceptual Hashing and Metadata Analysis

Kinetics-400 | 400 video classes of human actions for visual pattern analysis | Video

Synthetic Audio Generation

<u>LibriTTS-R</u> | High-quality speech corpus for text-to-speech tasks | Audio <u>CML TTS</u> | Multilingual dataset for TTS model training | Audio <u>Common Voice 18.0</u> | Crowd-sourced multilingual speech dataset | Audio

Anti-Grooming Detection in Mobile App

<u>NSFW Dataset (Perverted Justice)</u> | Chat transcripts used for identifying grooming behaviors | Text

Speech Recognition

Judicial Sentences (Spain)| Legal texts for ASR model training (Spanish) | TextCoNLL| Annotated text corpora for natural language processing (English) | TextParamopama| Portuguese textual data for NLP tasks | TextLibriSpeech| Audiobooks with aligned transcriptions for speech recognition | AudioCommon Voice| Multilingual speech corpus with crowd-sourced transcriptions | AudioVOICES| Speech dataset with background noise conditions for robustness testing | AudioCoVoST| Multilingual speech-to-text corpus for translation and ASR | AudioMediaSpeechs| Audiovisual material for speech recognition and speaker analysis | Audio



SSH Prevention Solutions

Report on the legal and ethical issues about the use of undercover investigation to fight CSAM/CSEM.

Partner: VUB



Deliverable 5.7 examines the legal and ethical implications of using undercover investigations (UIs), particularly online, to combat child sexual abuse and exploitation. It explores how UIs intersect with fundamental rights such as privacy and the right to a fair trial, analyses risks like entrapment and psychological harm to law enforcement agents and assesses current practices across different jurisdictions. Drawing on fieldwork interviews and legal analysis, the report proposes safeguards and recommendations—particularly in relation to ALUNA tools—to ensure UIs are effective, rights-compliant, and ethically sound.



Report on the characterization of the dynamics of CSA/CSE associated with migration contexts.

Partner: RENACER



Based on the NGOs' experiences in identifying girls, boys, and adolescents at risk and victims of sexual abuse and exploitation in vulnerable cities, a document was prepared to enable the analysis of the contexts of greatest vulnerability to these crimes, as well as the social, family, and individual factors that guided the formulation of recommendations to decision-makers for strengthening prevention, protection, and prosecution policies regarding these exacerbated crimes in the context of migration.



SSH Investigation Solutions

Strengthening of Specialized Units for Online Child Sexual Abuse Investigation.

Partner: ICMEC



The activities led under this task sought to support specialised units in Portugal and Romania to better respond to CSA/CSE crimes by providing technology, training, and strengthening synergies amongst relevant actors. Following a situational status and assessment of needs with both specialised units, activities delivered include:

- Two CSAM Investigations Vicarious Trauma Workshops,
- One CSAM Investigations Cooperation workshop,
- The facilitation of the institutional access of the Romanian Police to our online, free <u>e-learning on demand Agents of Change</u>
- The facilitation of the participation of the specialised unit to the Pilot of ALUNA's sister project, HEROES
- The participation of the Romanian police to the ALUNA Final Conference in May 2025
- The co-organisation of a VID training focusing on the Griffeye tool



Strenghtening of hotlines for reporting CSAM.

Partner: ICMEC



The activities led under this task sought to support hotlines in Portugal and Romania to better respond to CSA/CSE crimes by providing training and strengthening prevention efforts and synergies amongst relevant actors. Following a situational status and assessment of needs with both hotlines, activities delivered include:

- Two CSAM Investigations Vicarious Trauma Workshops,
- One CSAM Investigations Cooperation workshop,
- The facilitation of the participation of the Romanian hotline to the Pilot of ALUNA's sister project, HEROES
- The participation of the Romanian hotline to the ALUNA Final Conference in May 2025
- The creation of an Interactive Storybook "Choose Your Digital Path". The interactive story-based game is designed to teach children and teens how to stay safe online. Through five everyday digital scenarios, players make choices that show the impact of their actions—good decisions earn badges, while wrong turns offer helpful tips. The game blends storytelling, interactivity, and positive reinforcement to make online safety engaging and memorable.

URL: https://www.icmec.org/interactive-story/



4.3SSH Investigation Solutions

Creation of an inter-institutional plan of training and training modules.

Partner: ICMEC



This task focused on the development of a course called the "Fundamentals of Technology and Legal Concepts in CSAM Investigations". This free, online course targets judges, prosecutors, police, and child protection authorities in order to better equip them to detect, handle, and successfully prosecute CSAM cases while also pirotising victim care. The course also focuses on strengthening the technical and legal skills of the previously mentioned professionals.

URL:<u>https://icmec-english.tovuti.io/courses/course/fundamentals-of-</u> technology-and-legal-concepts-in-csam-investigations



Stakeholders training program



ICMEC led the training aspect of the ALUNA project. This activity focuses on activities developed in all WPs, but specifically on the ones that aim to be used by professionals and the general public, in order to support and teach them on how to use these activities. Most of the training activities focus on the tools developed as part of ALUNA, in order to enable end users to test them.

- On-demand training: the ALUNA online tools course
- Pilot in-person training
- 2-day training and workshop on mental health, vicarious trauma and multisectoral collaboration
- e-learning course ""Fundamentals of technology and legal concepts in CSAM investigations"
- The facilitation of the institutional access of the Romanian Police to our online, free <u>e-learning on demand Agents of Change</u>



SSH Victim Assistance Solutions



Report on trauma bonding in CSA/CSE crimes.

Partner: VUB



The challenge of trauma bonding is addressed through a comprehensive and actionoriented approach. The proposed solution focuses on breaking the traumatic bond that binds victims to their abusers by providing educational and emotional tools that empower victims. Through awareness programs, victims can learn to identify signs of abuse at early stages, recognize what a healthy relationship entails, and receive support in developing a personal safety plan. This approach facilitates a safe transition out of the abusive relationship, helping victims to regain their emotional autonomy and rebuild their lives in a safer, healthier environment.

The aim is not only to offer a way out, but also to create a support network that reinforces their well-being and promotes long-term prevention.



ALUNA DON-TECHNICAL KERS

What's Next?

The ALUNA project has laid the groundwork for a significant transformation in the protection of children and adolescents against grooming, sextortion, and other forms of online sexual violence. Thanks to its victim-centered approach, technological innovation, and collaboration between Europe and Latin America, ALUNA has developed concrete tools that strengthen prevention, detection, and assistance. However, the end of the project does not mark the conclusion of this effort, but rather the beginning of a new phase focused on the sustainability, scalability, and expansion of ALUNA's impact. The following

strategic lines will guide the path forward:

- Validation and deployment in new contexts: The implementation of the developed tools —such as the anti-grooming app— will be promoted in new schools, communities, and law enforcement environments in both participating and non-participating countries.
- **Strengthening the regional ecosystem:** The creation of a permanent ALUNA network will be encouraged, fostering collaboration among LEAs, NGOs, universities, and policymakers to continue sharing best practices and relevant data that enable the adaptation of solutions to different sociocultural and technological contexts.
- **Technological and ethical evolution of the solutions:** ALUNA's tools will continue to evolve to improve their accuracy and accessibility. This includes enhancing AI models and ensuring ongoing compliance with international ethical and legal standards.
- **Integration into national and regional strategies:** Work will be carried out with ministries, protection agencies, and international organizations to integrate ALUNA's results into national plans for child online safety, victim support, and digital education.
- Seeking funding and new projects: The ALUNA consortium will explore public and private funding opportunities to ensure the continuity of the initiated workstreams, as well as the formulation of new projects that broaden the thematic and geographical coverage of the impact generated.

ALUNA does not end here. The tools, knowledge, and network built over the past months are at the service of those who share the commitment to protecting children in the digital environment. We invite interested institutions to join this mission and collaborate in the next phase of the project.



CHILD PROTECTION CENTRED STRATEGIES TO FIGHT AGAINST SEXUAL ABUSE AND EXPLOITATION

ALUNA

CONTACTS

For any general inquiries or to learn more about the ALUNA project, please contact us at aluna-isf@ucm.es. For specific information regarding individual key results, you can reach out directly to our partners using the contact details provided below. We are eager to assist you and explore potential collaborations in our collective efforts to address CSA/CSE.

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