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TrustID 

Multiplier Event

TRUSTID Project: An Overview

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cognitiveux

TRUSTID Overview

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- TRUSTID: “Intelligent and Continuous Online Student Identity Management for Improving Security and Trust in European Higher Education Institutions”.
- Part of the actions of Erasmus+ 2020 and in particular the Call “*Strategic Partnerships in **Response to the COVID-19 Situation**: Partnerships for Digital Education Readiness in the field of Higher Education (KA226)*”.
- *Duration*: June 2021 - May 2023 (**24 Months**).
- Currently pursuing **Month 24** of the project.

TrustID 

Project Partners

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- Institute of Systems and Robotics, University of Coimbra, Coimbra, Portugal (*Project Partner*)



- Department of Electrical and Computer Engineering, University of Patras, Patras, Greece (*Project Coordinator*)



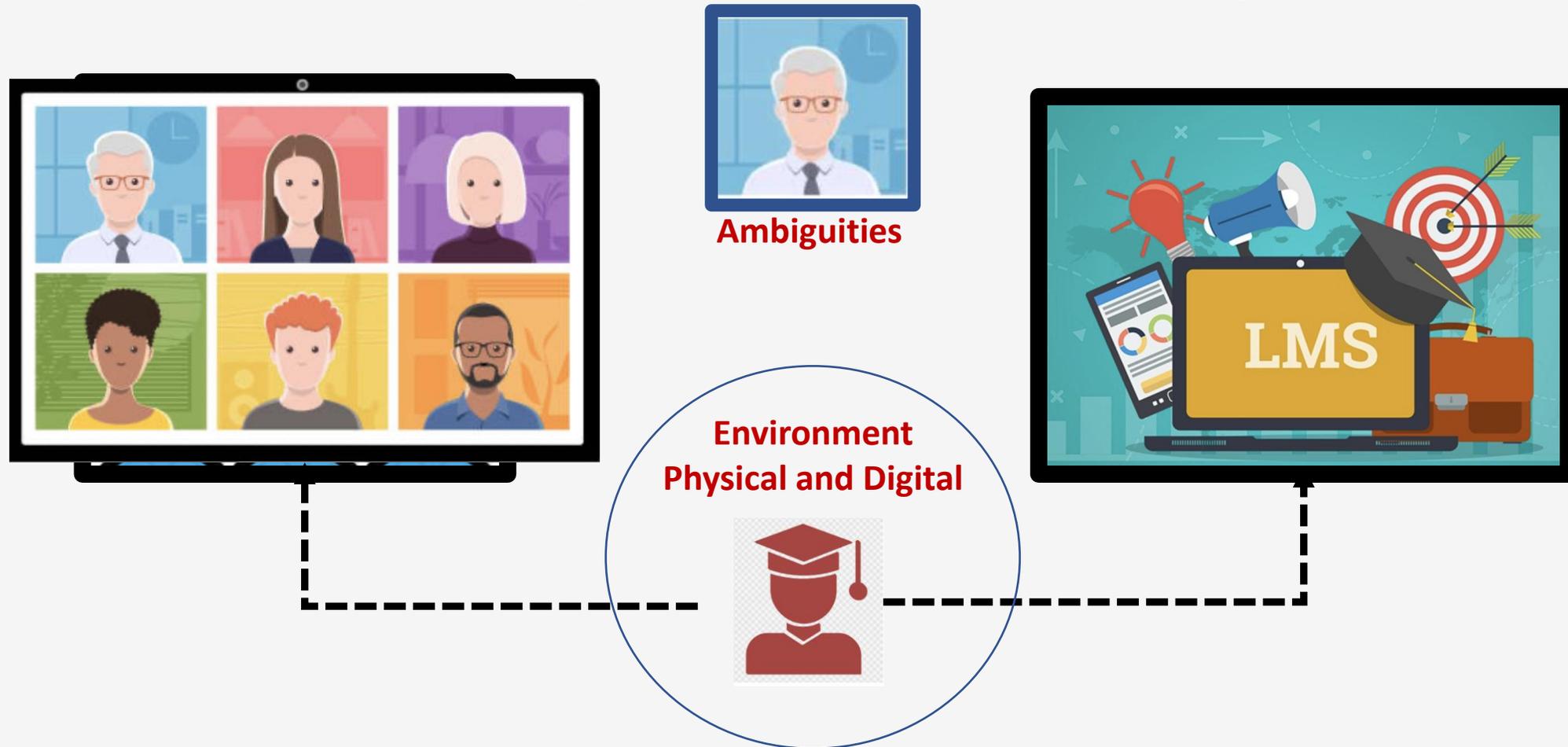
- Department of Computer Science, University of Cyprus, Nicosia, Cyprus (*Project Partner*)



- Cognitive UX GmbH, Heidelberg, Germany (*Project Partner*)

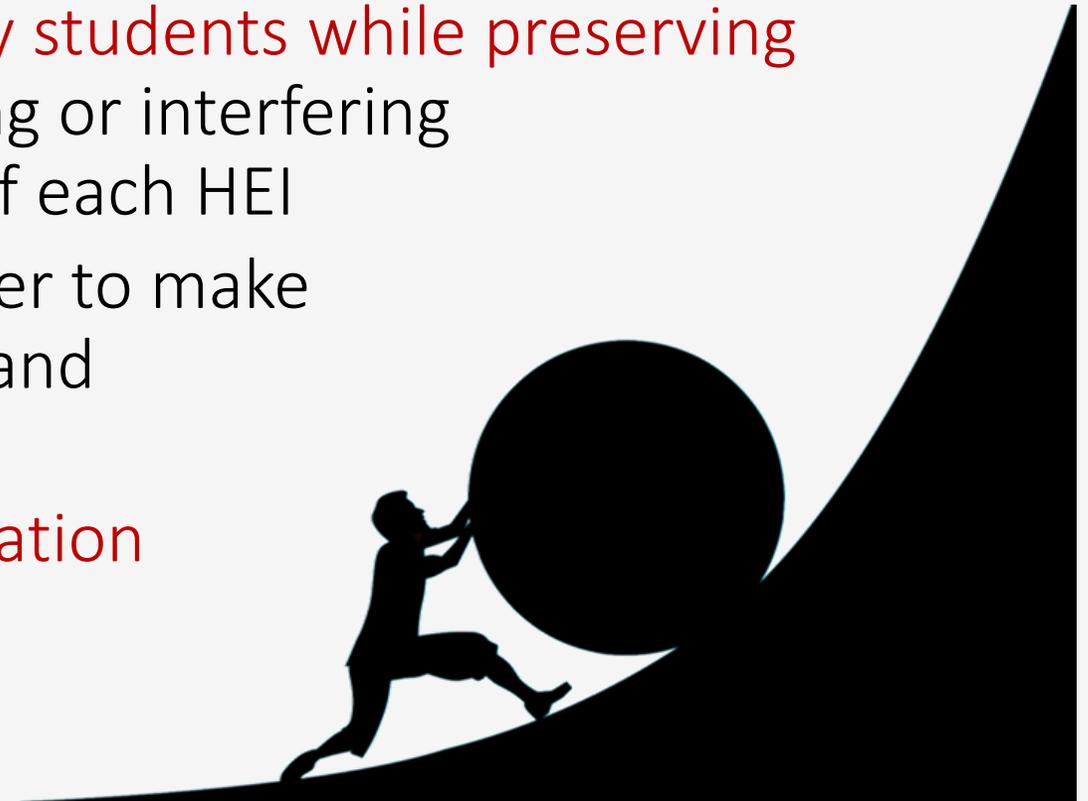
Covid-19 outbreak: Problem and Challenges in HEIs

- With the Covid-19 outbreak many HEIs followed a **blended learning** educational model



Challenges:

- Continuously and seamlessly identify students while preserving their privacy and without interrupting or interfering with the current learning activities of each HEI
- Provide insights to instructors in order to make informed decisions for their classes and attendees (e.g. misconduct).
- Provide alternative/additional integration tools to better adapt to the new requirements at each HEI



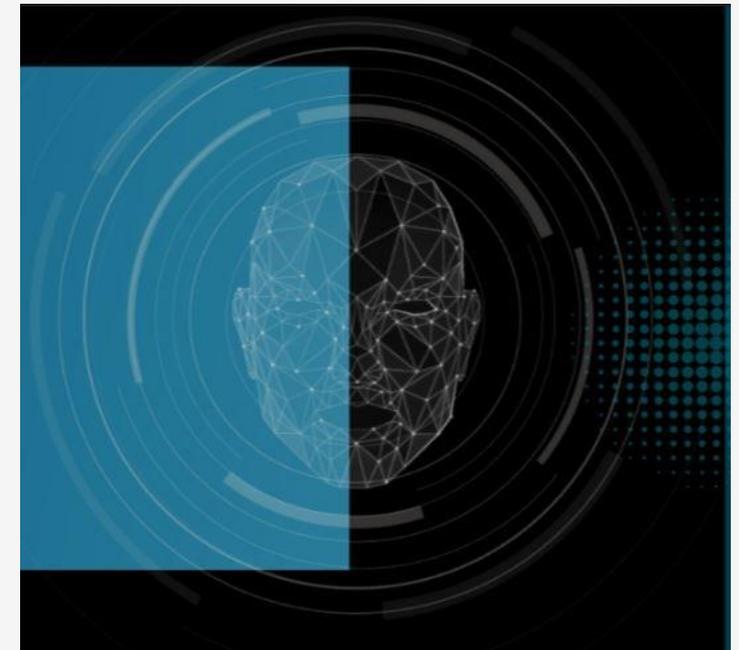
TRUSTID Vision

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Design, develop and evaluate a **multi-tier continuous student identification framework**, bootstrapped to the needs of HEIs.

Consisting of state-of-the-art **intelligent image, voice and interaction data** processing while preserving students' privacy.



Core Objectives

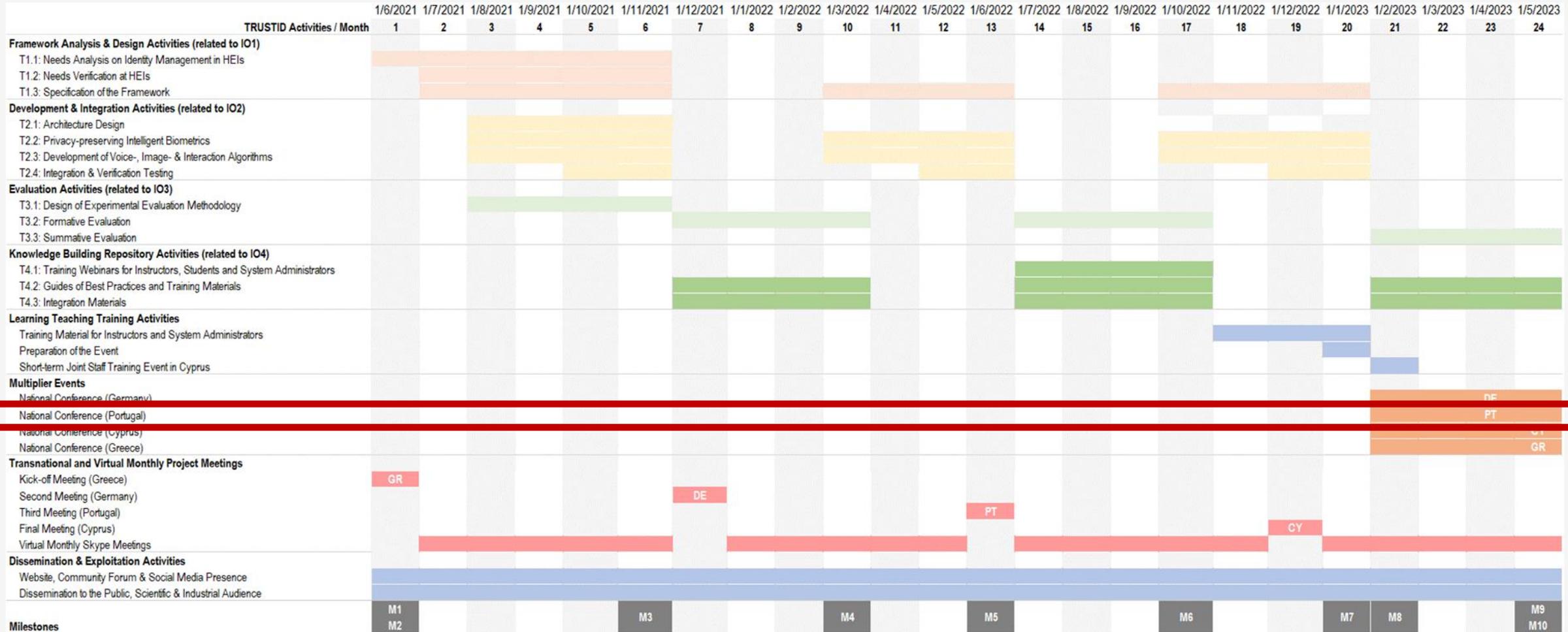
- **Literature review** on current practices and procedures related to student identity management of EU HEIs and **triangulate findings** with stakeholders' studies at the participating HEIs
- **Design and develop an integrated framework** for student identity management
- Validate the solution through a **User-Centered Design (UCD) methodology**; two formative studies during the software development process; and one summative study, after the final release of the software
- Create a **repository** that will support **knowledge building**
- **Dissemination and exploitation** activities –*papers, workshops, LTTAs, multiplier event, etc.*



Intellectual Outputs

- **Intellectual Output 1: Analysis & validation** of the TRUSTID framework for HEIs' continuous student identity management (*Conceptual*)
- **Intellectual Output 2: Implementation** of an open-source software toolkit (*Operational*)
- **Intellectual Output 3: Evaluation** and validation of three case-studies at different HEIs (*Lessons Learned and Guidelines*)
- **Intellectual Output 4: Knowledge building online community and repository** (*Sustainability*)

Gantt Chart



Intellectual Output 1 - Needs Analysis and
Design of the Theoretical Framework for Continuous
Student Identity Management

IO1 – Key Objectives

- **Conduct needs analysis** of students, teachers and academic policy makers related to continuous student identity management
- **Define security metrics and policies** for continuous student identity management
- **Set the specifications** of the framework by **considering privacy aspects** within diverse online learning/academic scenarios
- **Design a multi-dimensional user model** for continuously identifying end-users based on a variety of inputs (voice, image, user interaction)
- **Triangulate**/combine findings from literature and real-world case studies in three HEIs



IO1 - Tasks

- Task 1.1: Needs Analysis on Identity Management in HEIs
 - **Lead: Institute of Systems and Robotics Coimbra**
- Task 1.2: Needs Verification at HEIs
 - **Lead: University of Patras**
- Task 1.3: Specification of the Framework
 - **Lead: Cognitive UX GmbH**
- *Output type:* Methodologies / Guidelines for framework implementation
- *Media:* Publications, Other, Dataset

IO1 – Stakeholders



- Institutional policy makers
- Strategic planners
- Administration
- Teaching staff
- Government

- Outcomes valuable for:

- Researchers and practitioners working in the area of intelligent and continuous user identification
- Class instructors (*e.g.*, Professors, Lecturers, etc.)
- System administrators of HEIs

Task 1.1: Needs Analysis on Identity Management in HEIs

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- Started in early stages of the project aiming to lay the foundations for implementing the continuous student identification framework.
- Conduct a **thorough literature review analysis** in relevant key areas of the project:
 - Identify and analyze state of the art works of student identity management
 - Identify security metrics, policies and procedures that are currently applied in HEIs
 - Investigate state-of-the-art AI/ML approaches to continuously and unobtrusively identify end-users based on voice, face and user interaction features



Journal under review: “Continuous User Identification in Distance Learning: A Recent Technology Perspective”, Smart Learning Environments Journal, Springer, 2023.

Task 1.2: Needs Verification at HEIs

- Triangulate results of the literature review analysis:
 - Conduct a **series of semi-structured interviews with key stakeholders** of the participating universities (*e.g.*, policy makers, administrators, security officers, etc.)
 - **Identify the currently applied procedures and policies** of identity management and authentication, the technologies and online learning platforms that are currently used in each university



Task 1.2: Needs Verification at HEIs

- Aims

- Verify the needs analysis with the active involvement of the participating HEIs
- Identify the current authentication and identity management practices and their drawbacks within the online/distance learning domain

- Conduct a series of semi-structured interviews with stakeholders with the university partners

- *Sample:* 31 stakeholders participated from all partner HEIs

Stakeholder Group	Higher Education Institution 1	Higher Education Institution 2	Higher Education Institution 3
Students	2	3	3
Instructors	3	4	3
System Administrators	2	2	2
Decision Makers	2	1	1
Data Protection Experts	1	1	1
Total	10	11	10



Journal published: “Ensuring Academic Integrity and Trust in Online Learning Environments: A Longitudinal Study of an AI-centered Proctoring System in Tertiary Educational Institutions”, Education Sciences, 2023.

Deployed tools during critical academic activities

- **University of Coimbra:** In-house developed LMS (UCTeacher/UCStudent).
- **University of Patras:** Nation-wide developed LMS
- **University of Cyprus:** Off-the-shelf (e.g., Moodle) LMS
- LMS used during the COVID-19 period, progressively adapted to the pandemic situation

- All universities have a common pattern for student identification purposes
 - Tools for conducting meetings are used for student identification purposes, *e.g.*, Zoom, Microsoft Teams, etc.

- Identified three main type of examinations
 - Oral
 - Written online
 - Written hardcopy

Phases in an Online Examination

Student Identity Verification

Examination Session

- Consensus among all participants/stakeholder groups that the current workflows and deployed ICT tools **embrace vulnerabilities**, which threaten the credibility of critical online academic activities, such as, online examinations
- **Absence of validated procedures during COVID-19** compared to pre-COVID-19 validated procedures in which critical academic activities occurred within controlled physical settings
- Decision makers are **aware of limitations of the current examination methods** and are **working towards improving LMS features** to address malicious activities (e.g. plagiarism detection).
 - One policy maker stressed that the current online procedures entail a high number of threat scenarios, which makes this attempt very difficult to reach the standards of physical examinations.

Perceived Credibility of Online Examinations during COVID-19

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- Instructor responses revealed that the online procedures had an **effect on their emotional and ethical aspects** since they could not assure the **fairness** among students who were well-prepared and students who misused the limitations of online exams.
- All students **agreed about questioning the current procedures** within critical online academic activities. Yet, some students admitted that the online-based procedure was **easier and more convenient than the conventional physical examination**



Phases in an Online Examination

Student Identity Verification

Examination Session

Threat Scenarios

- **Impersonation activities**, refer to actions of a person imitating or replicating the behavior or actions of another person.
- These scenarios can happen **during the student identification phase** or even **throughout the examination session**, *e.g.*, subject fakes his/her identity proofs during enrolment
- **Forbidden collaboration and/or communication scenarios with other persons**, either within the physical or remote context
 - **In-situ collaboration activities**: related to suspicious activities that take place in the subject's physical context
 - **Computer mediated collaboration activities**: related to suspicious activities that involve remote collaboration and/or communication with other persons
- **Forbidden access to material**, either within the physical or remote context

Task 1.3: Specification of the Framework

- *Aims*

- Define the methodology and conduct an analysis, elicitation and validation of the security measurements, metrics and policies of the framework
- Define, at a conceptual level, a multi-dimensional user model for continuous identification of end-users
- Framework and model based on input from T1.1 (literature analysis) and T1.2 (semi-structured interviews with stakeholders of HEIs)
- **Algorithms identified and designed** for continuous identification based on a combination of voice, image and interaction behavior data
- This will **guide the development** of the corresponding intelligent user identification mechanisms in IO2.

Impersonation Threats

- Impersonation threats, i.e. replace the user with another person, can be addressed by analyzing the students' biometric data (physiological and behavioral):
 - Impersonation threats during *student examination enrolment* can be addressed through **automatic student verification based on ground truth biometric data**
 - Impersonation threats during the *examination session* can be addressed based on **continuous student identification based on biometric data**
 - Impersonation threats can be identified *after an online examination* has completed through **intelligent data analytics based on historical biometric data**
 - **Countermeasures:** face-/voice-/interaction-based identification.

Communication, Collaboration and Resource Access

- Communication, collaboration and resource access threats can be addressed by analyzing the students' behavioral data:
 - **Analysis of face expressions, eye gaze, voice signal processing**
 - **Monitoring the student's computing device** (applications, websites access, etc.) **and physical context**



Such threats are primarily present during examinations

Aim:

- Detect whether students are communicating and/or collaborating with another person.
- Detect whether they are attempting to access forbidden resources

Intellectual Output 1 – Tasks and Achievements

IO1 - Needs Analysis and Design of the Theoretical Framework for Continuous Student Identity Management

Output: Publications, Other, Dataset

- Task 1.1: Needs Analysis on Identity Management in HEIs
- Task 1.2: Needs Verification at HEIs
- Task 1.3: Specification of the Framework

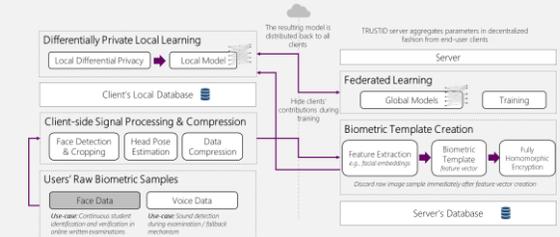
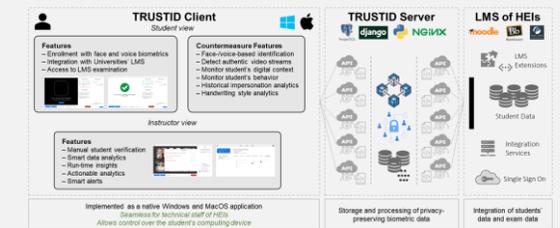
Achievements and Outputs

Specifications of the TRUSTID framework

- Refined the framework
- Specifications for the face, voice and interaction identification mechanism
- Specifications for LMS integrations of TRUSTID at UPAT, UCY, UC sites

Privacy-preserving architecture for continuous student identity management

- Designed the privacy-preserving architecture
- Defined the privacy-preserving smartphone wallet
- Defined the flow between client and server applications of TRUSTID towards achieving privacy-preservation of users' biometric data



Intellectual Output 2 - Design and Implementation of
Open-source Privacy-preserving Toolkit and Application
Programming Interfaces

IO2 - Tasks

- Task 2.1: Architecture Design
 - **Lead: Cognitive UX GmbH**
- Task 2.2: Privacy-preserving Biometrics
 - **Lead: University of Cyprus**
- Task 2.3: Development of Voice-, Image- and Interaction-based Algorithms
 - **Lead: Cognitive UX GmbH**
- Task 2.4: Integration and Verification Testing
 - **Lead: Cognitive UX GmbH**

Summary of Outcomes (1/2)

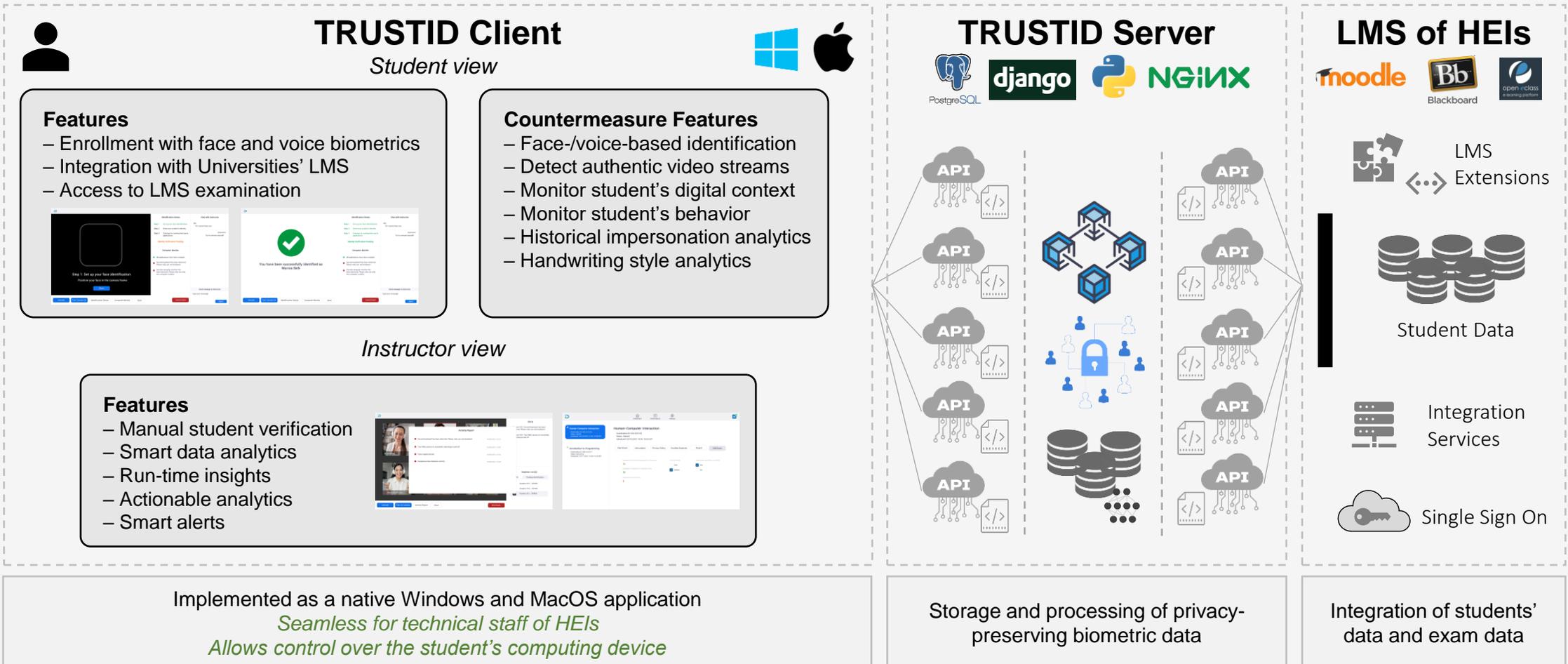
- Designed and developed the final version of the TRUSTID platform and associated tools and mechanisms for continuous student identification
- **Native client software applications** (implemented Windows and MacOS applications), enabling students and instructors to interact with the mechanisms of TRUSTID
- **Robust Back-end system**, which consists of an **Application Programming Interface**, which exposes a series of system end-points of TRUSTID
- **Architecture for privacy-preservation**
- **Integrated all the technologies** under interoperable platform

Summary of Outcomes (2/2)

- **Face identification enrollment (Native vs. Web-based) enabling end-users to enroll in the TRUSTID system** through recording of face-based images used for training the identification models
- Mechanism for **LMS integration** (e.g., Moodle authentication) and examination management
- **Machine learning-based algorithms** and mechanisms for face-based identification
- **Machine learning-based algorithms** and mechanisms for voice-based identification and interaction-based identification
- Privacy-preserving **wallet smartphone** application

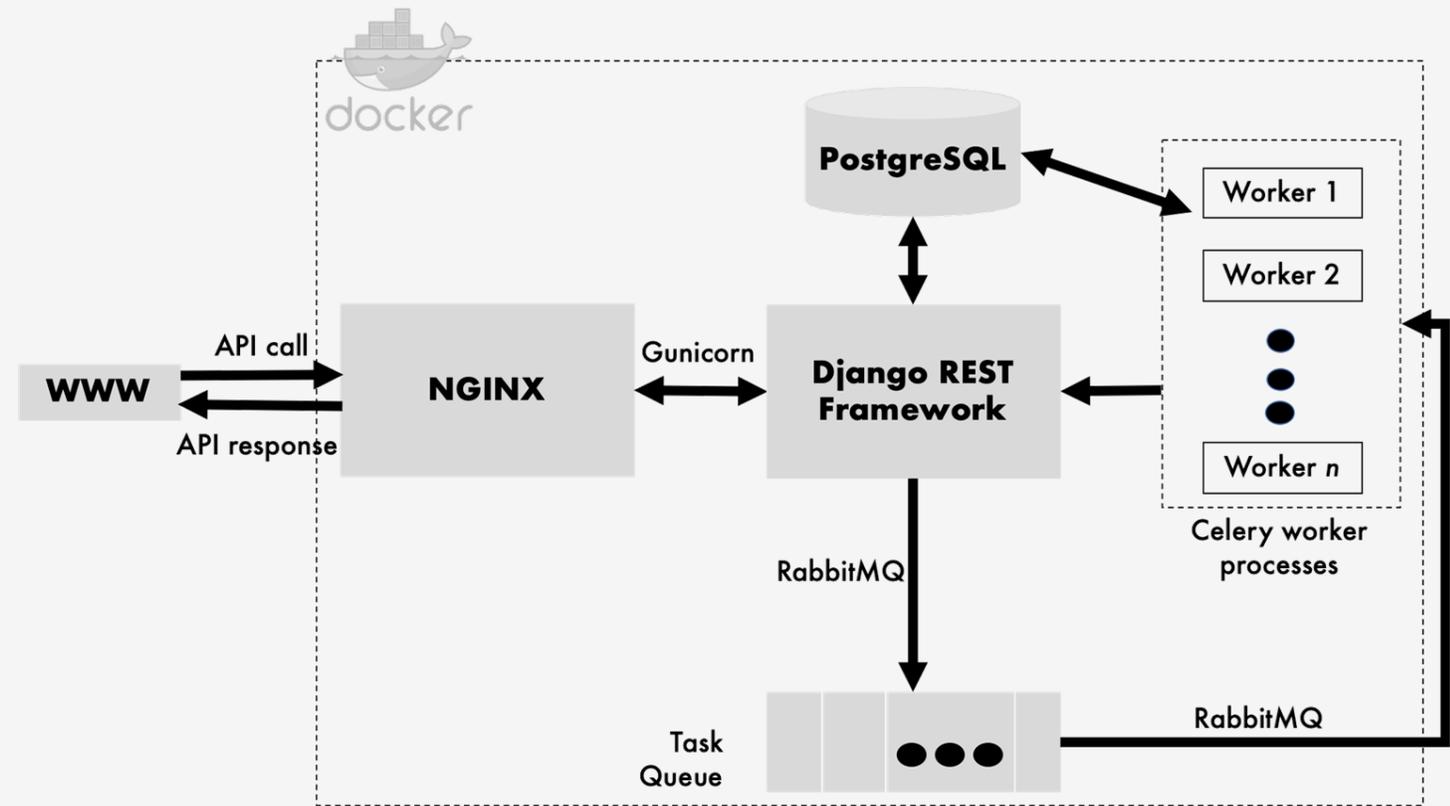
TRUSTID High-level Framework

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Server Architectural Design and Technology Stack

- Server-side **web API**
- **Django** REST Framework
- **NGINX** (Web server, Reverse proxy, Load balancer)
- **Gunicorn** (Application server that implements the Web Server Gateway Interface)
- **Celery** (Asynchronous task queue based on distributed message passing)
- **RabbitMQ** (Message broker)
- **PostgreSQL**
- **Docker**



Client App: Integrated Login

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TRUSTID :: Intelligent Student Identity Management

TRUSTID

Email

Password

Organization

- University of Cyprus 
- University of Patras 
- University of Coimbra 

Login

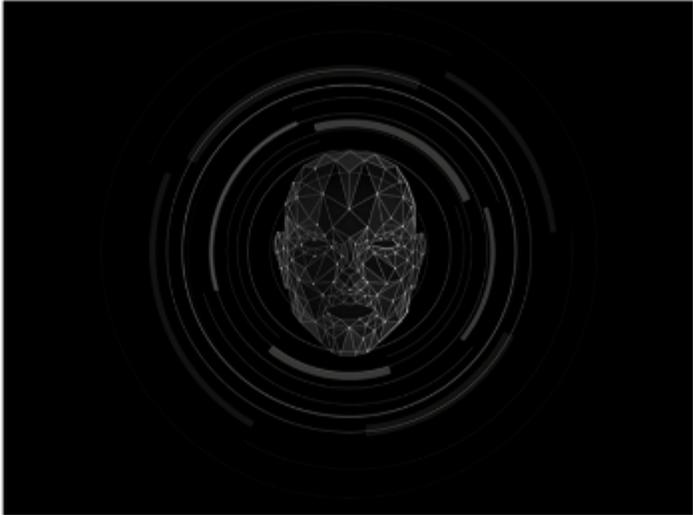
Client App: Register Face Biometrics

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Face Enrollment

Register Face Biometrics



TRUSTID needs your consent to collect your face data
Please select I consent to continue

I consent

Cancel Enrollment

Biometrics Process

- Step 1 - Consent
- Step 2 - Face Biometrics

Biometrics Ready

Client App: Register Voice Biometrics

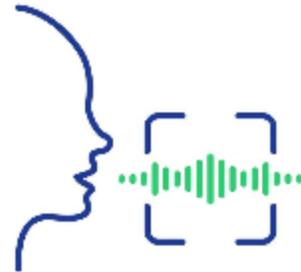
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Voice Enrollment



Register Voice Biometrics



TRUSTID needs your consent to collect your voice data
Please select I consent to continue

I consent

Biometrics Process

Step 1 - Consent

Step 2 - Voice Biometrics

Biometrics Ready

Cancel Enrollment

Client App: Control and Manage Biometrics

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TRUSTID :: Intelligent Student Identity Management

Dashboard Examinations **Biometric Models** AC

Edit Biometrics

Actions

 Voice Created on: 06/12/2022 12:47:50	Update	Delete
 Face Created on: 06/12/2022 12:48:50	Update	Delete

Client App: Continuous Face Identification

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Face Identification

Face-based Identification



TRUSTID will identify you based on your face characteristics
First, position your face in the camera frame

[Get Started](#)

[Cancel](#)

Identification and Verification Process

- Step 1 - Face-based identification
- Step 2 - Voice-based identification
- Step 3 - Checkup for third-party applications

Identity Verification

Client App: Continuous Voice Identification

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Voice Identification

Voice-based Identification



Identification and Verification Process

- Step 1 - Face-based identification
- Step 2 - Voice-based identification
- Step 3 - Checkup for third-party applications

Identity Verification

Your voice is now being recorded - Please speak loudly and clearly

Capture

Cancel

Client App: Digital Written Examination Scenario

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Written Examination

Multiple Choice Questions

What does the ERASMUS acronym stand for?

- European Committee Agency Scheme for the Mobility of University Students
- European Community Action Scheme for the Mobility of University Students
- European Continental Agility Scheme for the Mobility of University Students
- European Congress Ambassador Scheme for th Mobility of University Students

Monitoring

- Camera capture is enabled
- Voice capture is enabled
- Checkup running applications is enabled

TRUSTID will periodically capture your photo and voice for continuous identification purposes and will checkup the running applications and processes on your computer

User Feedback Mechanism

- I will impersonate with another person
- I will open a forbidden application

Send Feedback

Close Exam

Client App: Oral Examination Scenario

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Oral Examination



Oral Examination in Progress



Start Voice Capture

Stop Voice Capture

Monitoring

Camera capture is enabled

Checkup running applications is enabled

TRUSTID will periodically capture your photo and voice for continuous identification purposes and will checkup the running applications and processes on your computer

User Feedback Mechanism

- I will impersonate with another person
- I will open a forbidden application

Send Feedback

Close Exam

Client App: Examination Management Dashboard

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TRUSTID :: Intelligent Student Identity Management

Dashboard Examinations **Management** SS

Management

Add a new exam Add Exam

Edit existing exams Edit Exams

Enroll students to exam Enroll

Client App: Examination Management

Add Exam

Add Exam

Additional Material Yes No

Exam Duration:

Exam Type:

Name:

Privacy Policy

Scheduled date 

Edit Exam

Name	ID	Date	Enrolled Students
Introduction	61667302972	07/12/2022 00:00:00	59

Client App: LMS Integration and Synchronization Tools

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Upload and Enroll to Exam

Upload and Enroll Students:

Upload students:

C:\Users\argyr\Downloads\test_users (1).csv Browse File

First name	Last name	Email
Adamos	Adamou	aadamou@live.com

Exam id	Exam name
61667302972	Introduction to F

Select Exam:

61667302972

Select all students: Yes

All students selected

Sync Cancel

View Enroll Students

Students Enrolled in Exam: Introduction

First name	Last name	Email
Christou	Panikos	panikoschristou@yahc
Georgiou	Mariaeleni	mgeorg04@ucy.ac.cy
Panagi	Paraskevi	ppanag03@ucy.ac.cy
Tsakilioti	Evangelia	euatsakilioti@gmail.co
Tzamou	Maria	mtzamo01@ucy.ac.cy
Sofocleous	Elena	sofocleous.elena@ucy
Sofocleous	Elena	elenadepp1524@gmai
Aristodemou	George	george.arist@gmail.co

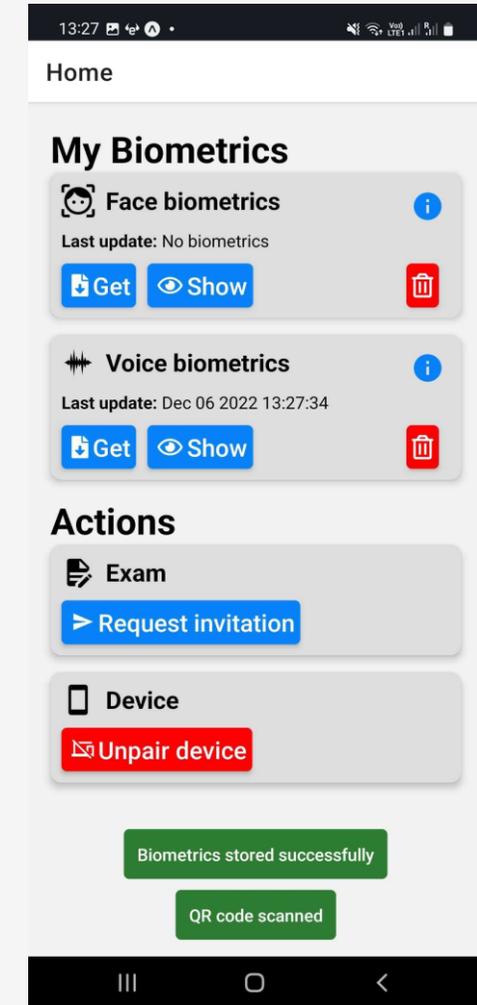
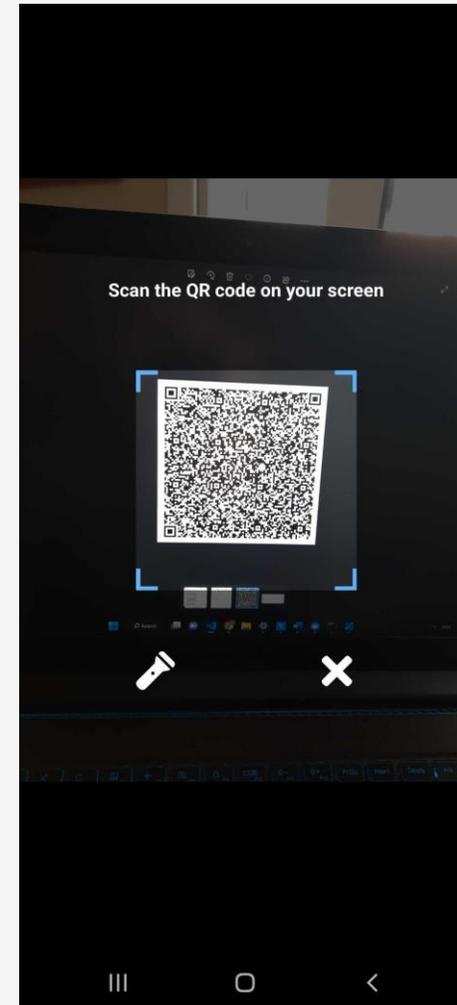
Cancel

Smartphone App: Wallet for biometrics models

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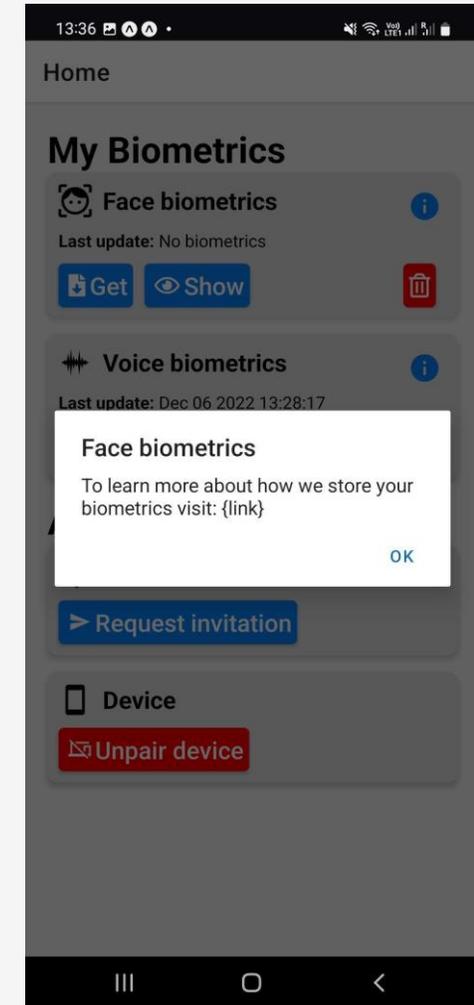
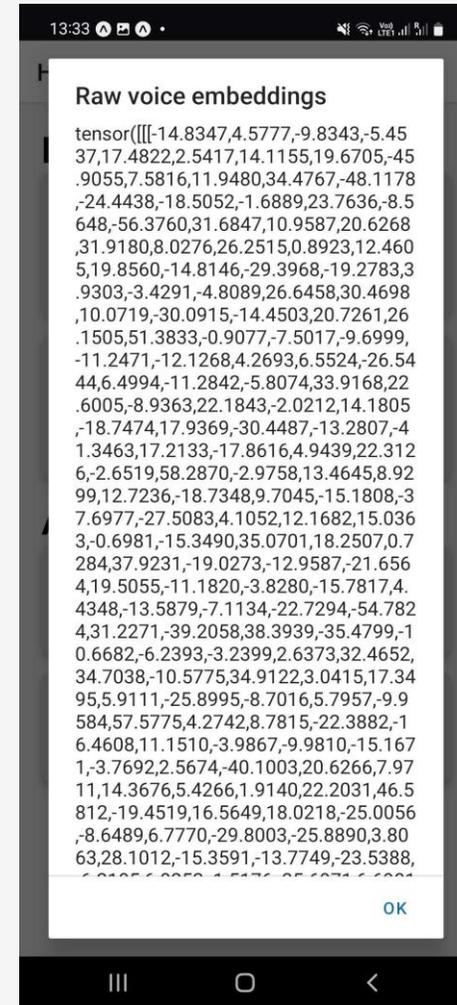


- Pair mobile application with TRUSTID system to fetch and store the biometric models locally



Smartphone App: Wallet for biometrics models

- Management of biometrics models
 - Display
 - Delete
 - Privacy policy

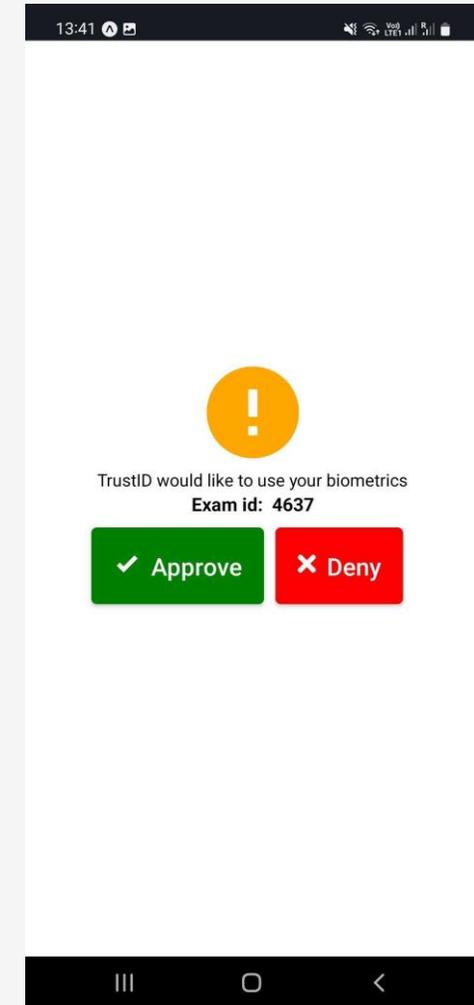
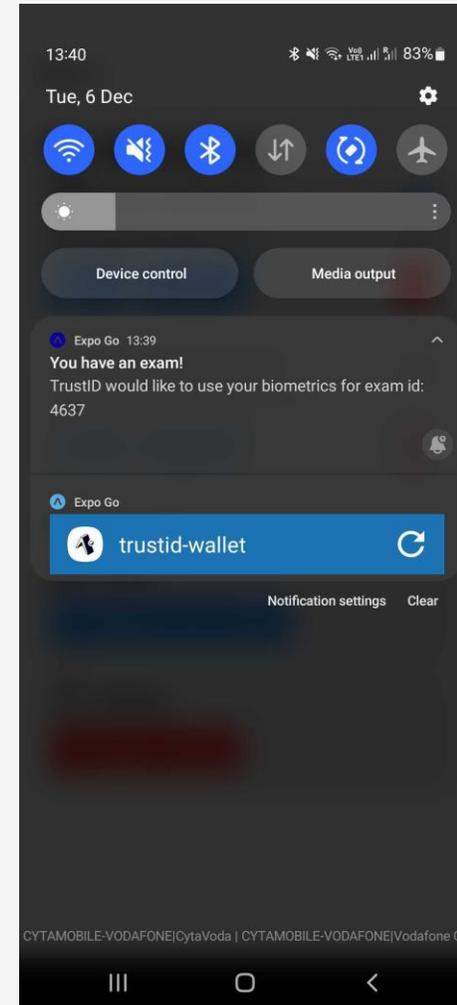


Smartphone App: Wallet for biometrics models

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- Push notification for approval of sharing of biometrics models during online examination



Intellectual Output 2 - Tasks and Achievements

IO2 - **Design and Implementation** of Open-source Privacy-preserving Toolkit and Application Programming Interfaces

Output: Software, Services, Publications

- Task 2.1: Architecture Design
- Task 2.2: Privacy-preserving Biometrics
- Task 2.3: Development of Voice-, Image- and Interaction-based Algorithms
- Task 2.4: Integration and Verification Testing

Achievements and Outputs

Face-based identification mechanism enrollment and continuous user identification

Voice-based and interaction-based identification mechanisms

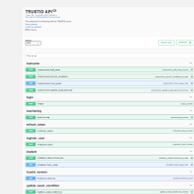
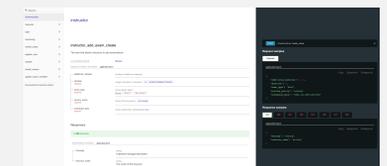
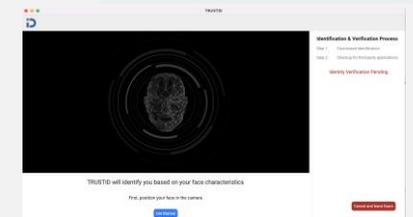
Implemented a new architecture for privacy-preservation

Prototype designs and implementations

Development and integration of new features in the native Windows and MacOS applications

Mechanisms for LMS integration

Application Programming Interface, end-points for service integration



Intellectual Output 3 - Evaluation Reports on Efficiency,
Effectiveness and User Acceptance of TRUSTID in Three
European HEIs

IO3 – Key Objectives

- Organize and execute **standalone studies and pilot trials**
 - **Assess the effectiveness and accuracy** of the intelligent biometric methods
 - Evaluate the overall effect of the project on **usability and security**
 - Produce **evaluation reports**
 - **Define personas** including the characteristics of the most representative end-users
 - **Define different evaluation scenarios** of TRUSTID
-
- *Output type:* Studies / analysis – Data collection / analysis
 - *Media:* Dataset, Publications



IO3 - Tasks

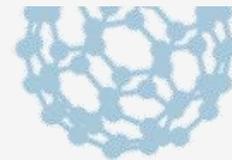
- Task 3.1: Design of Experimental Evaluation Methodology
 - *Lead: University of Patras*
- Task 3.2: Formative Evaluation Report
 - *Lead: University of Cyprus*
- Task 3.3: Summative Evaluation Report
 - *Lead: University of Cyprus*

Task 3.1: Design of Experimental Evaluation Methodology

- **Design the overall experimental methodology** to be followed throughout the project
- **Ecological validity** (design a study that approximates real-life contexts)
 - Design a series of user studies in which real users perform real-life tasks in their natural environment
- Studies with **balanced** gender (male/female), students, faculty and administrative staff of the University of Patras, the University of Cyprus and the University of Coimbra
- Two types of studies:
 - **Formative**, conducted at early stages of the project, which aim at validating initial prototypes of the platform and get initial user feedback on likeability, perceived usability and security
 - **Summative**, conducted during the last months of the project to evaluate the effectiveness and feasibility of the proposed approach

Task 3.2: Formative Evaluation Report

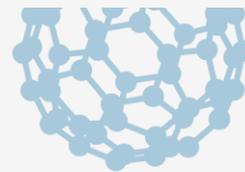
- On completion of the low-fidelity development, we have conducted studies (PoC1) with semi-structured interviews to gather **qualitative user feedback for the low-fidelity release**
 - Based on feedback gathered from the previous cycle, we refine IO1 and IO2
- Upon completion of the second round of development, we conduct a second round of studies (PoC2) to:
 - investigate whether the proposed system **improves identity and authentication usability and security**
 - evaluate **user acceptance** with Technology Acceptance Models to validate the developed work



Formative
Evaluation

Task 3.3: Summative Evaluation Report

- We conduct the final evaluation aiming to **evaluate usability and user acceptance** of the proposed framework.
- Various metrics are measured, focusing on capturing **qualitatively and/or quantitatively** the user's perceived usability and security, likeability and user acceptance.
- The measurements are collected through **user feedback** (e.g., post-study questionnaires, interviews), and by examining **user interaction patterns** during user identification through user tracking equipment (e.g., Web cameras, microphone, etc.)



Summative Evaluation

We conducted a user study (*Proof of Concept #2*) aiming to evaluate:

- i) the **resilience of TRUSTID to impersonation attacks** during an online examination by evaluating the implemented face- and voice-based identification mechanism;
- ii) **usability and user experience** of end-users based on their interactions with the TRUSTID system; and
- iii) **perceived security and privacy** of users towards the TRUSTID system



Type of study

- Studies were held virtually
 - Researchers from each partner HEI communicate with the participants through an off-the-shelf communication tool, Zoom

Sample size, user profiles and duration

- Recruit 133 students and/or instructors per HEI
- *Duration:* ~20-30 minutes

Preparation phase

- Participants invited through the following URL:
 - https://trustid-project.eu/participate_upat.php
 - https://trustid-project.eu/participate_uc.php
 - http://trustid-project.eu/participate_ucy.php



Evaluation Phase

- **Step 1:** Participants download and install the TRUSTID client application (Windows or MacOS)
- **Step 2:** Instructors enroll participants in the user study and they receive their login credentials in their email
- **Step 3:** Evaluate specific threat scenarios and functionalities
 - *Type of examination:* Digital oral, Digital written
 - *Impersonation threats*
 - Perform the student verification step based on *face-based* and *voice-based* identification
 - Continuous student identification based on *face* and *voice* data
 - *Collaboration/communication threats*
 - Monitoring the students' computing device's running applications and processes
 - *Other functionalities:*
 - Management of biometric models (Enroll/Update/Delete)
 - Modular integration of the face-based identification using gRPC
 - Management of Examinations and LMS integration
- **Step 4:** Semi-structured interviews and focus groups to get feedback about their experience with TRUSTID

Study Registration

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The screenshot shows the TRUSTID website with the following content:

- Navigation:** WELCOME, ABOUT TRUSTID, CONSORTIUM, VIDEOS, INTELLECTUAL OUTPUTS, NEWS, PUBLICATIONS
- Header:** TrustID logo, "Intelligent Student Identity Management for Higher Education Institutions", and links to Knowledge Repository, GitHub Repository, and Community.
- Main Content:**
 - Section:** Participation in a User Study in the frame of the TRUSTID Project
 - DESCRIPTION:**
 - Invitation to participate in the Second Proof of Concept Evaluation Study of TRUSTID.
 - Details about the survey process, including a short session held online and synchronously via ZOOM.
 - Instructions on how to participate, including downloading and installing the TRUSTID application.
 - Requirements for participation: a computer and a Web camera.
 - Information about receiving specific instructions by email.
 - Subscription information for the user study.
 - Thanks from the TRUSTID Team.
- LATEST NEWS:**
 - Biweekly Meeting (September 2022)
 - Dissemination Workshop (July 2022)
 - Invited talk at APPS workshop held in conjunction with ACM UMAP 2022 (July 7, 2022)
 - Third Transnational Meeting (June 24, 2022)
 - Knowledge Repository and Community Forum live (March 31, 2022)
 - Ongoing PoC1 (March 08, 2022)
 - User Studies: PoC1 (February 04, 2022)

The screenshot shows the TRUSTID website with the following content:

- Navigation:** WELCOME, ABOUT TRUSTID, CONSORTIUM, VIDEOS, INTELLECTUAL OUTPUTS, NEWS, PUBLICATIONS
- Header:** TrustID logo, "Intelligent Student Identity Management for Higher Education Institutions", and links to Knowledge Repository, GitHub Repository, and Community.
- Main Content:**
 - Section:** SUBSCRIBE ON BEHALF OF THE UNIVERSITY OF COIMBRA, INSTITUTE OF SYSTEMS AND ROBOTICS
 - Form:**
 - Fields for FULL NAME, EMAIL, and OPERATING SYSTEM.
 - A SUBSCRIBE button.
 - RESEARCH ETHICS AND PRIVACY OF PERSONAL DATA:**
 - Information about data handling, including compliance with research ethics and privacy regulations.
 - Details about the user study and data processing.
 - Information about leaving the user study and removing data.
- Right Sidebar:**
 - TRUSTID has a new logo (December 22, 2021)
 - Congratulations for UC Teacher elected as best education project (December 16, 2021)
 - Paper Acceptance (November 30, 2021)

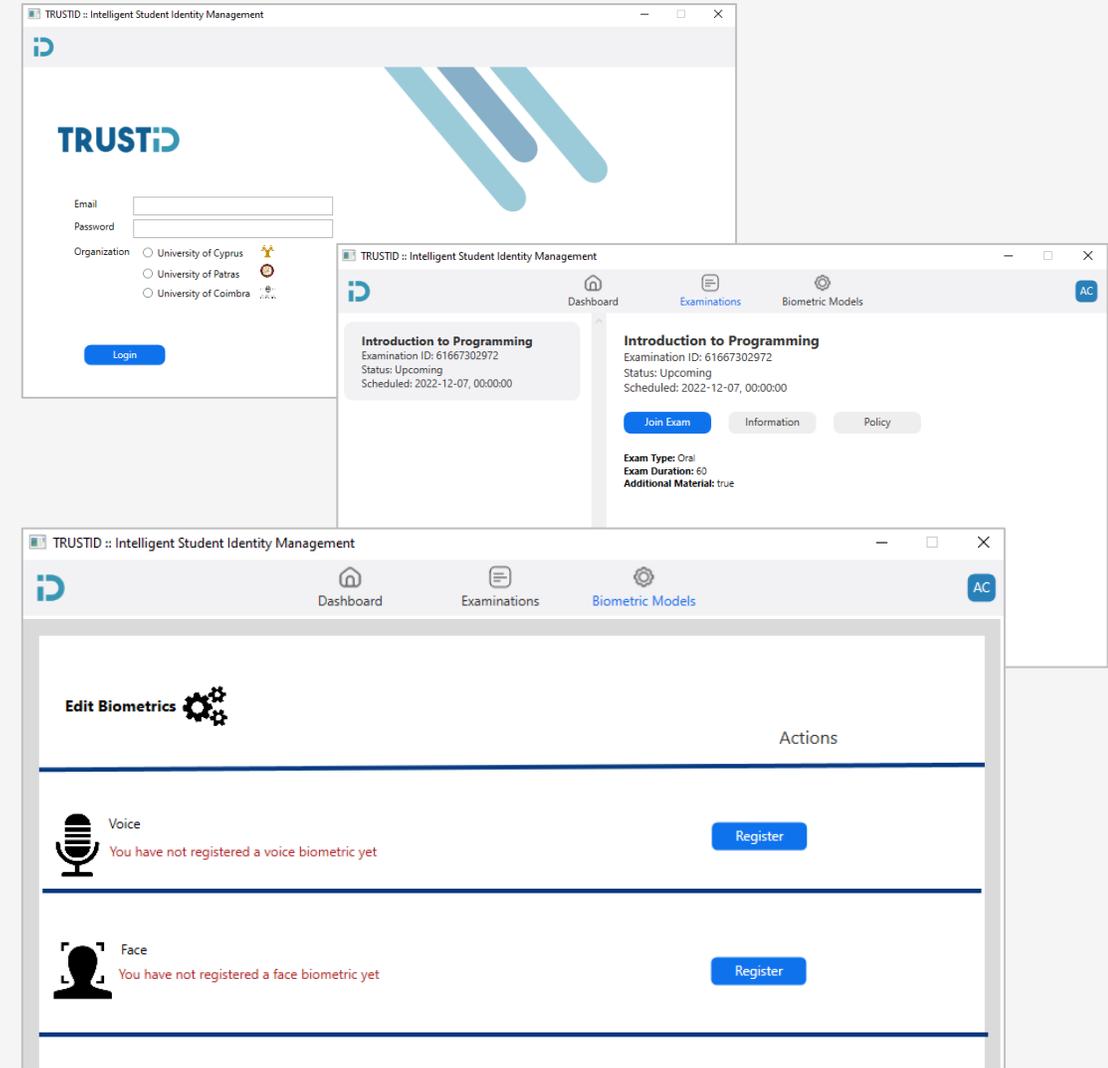


Student Biometrics Enrollment

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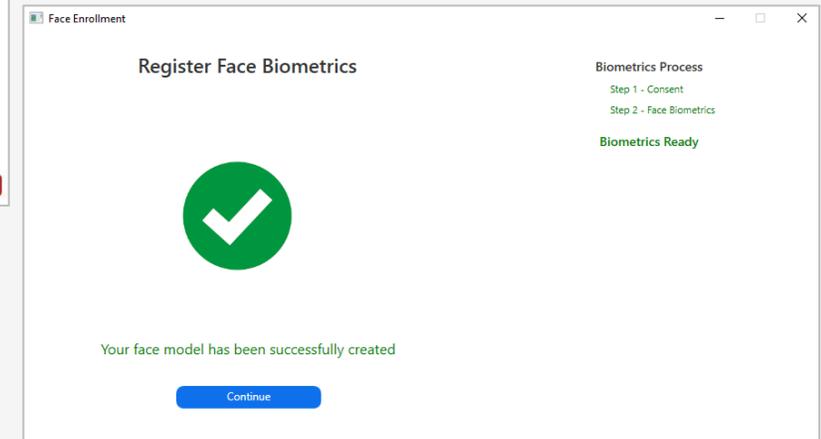
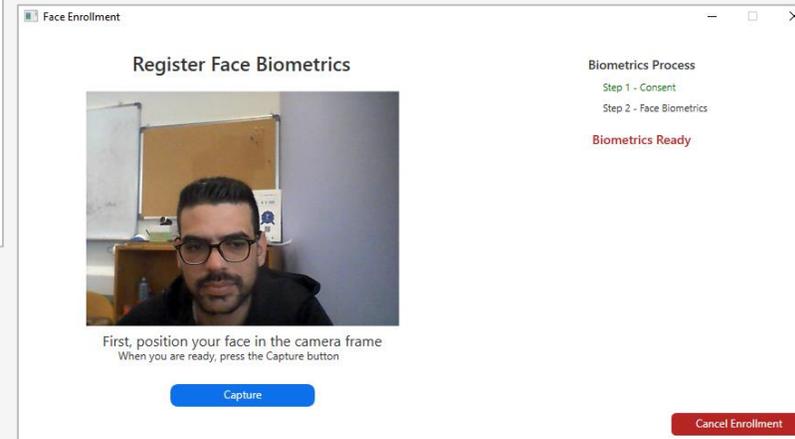
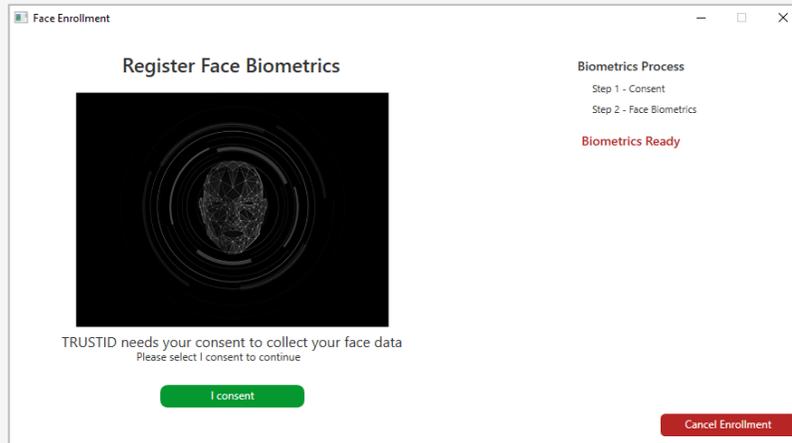


- Once the students log in to the system with their credentials, they select their examination through the TRUSTID dashboard
- Students are asked to enroll their biometrics (e.g., face, voice) through the biometrics management screen



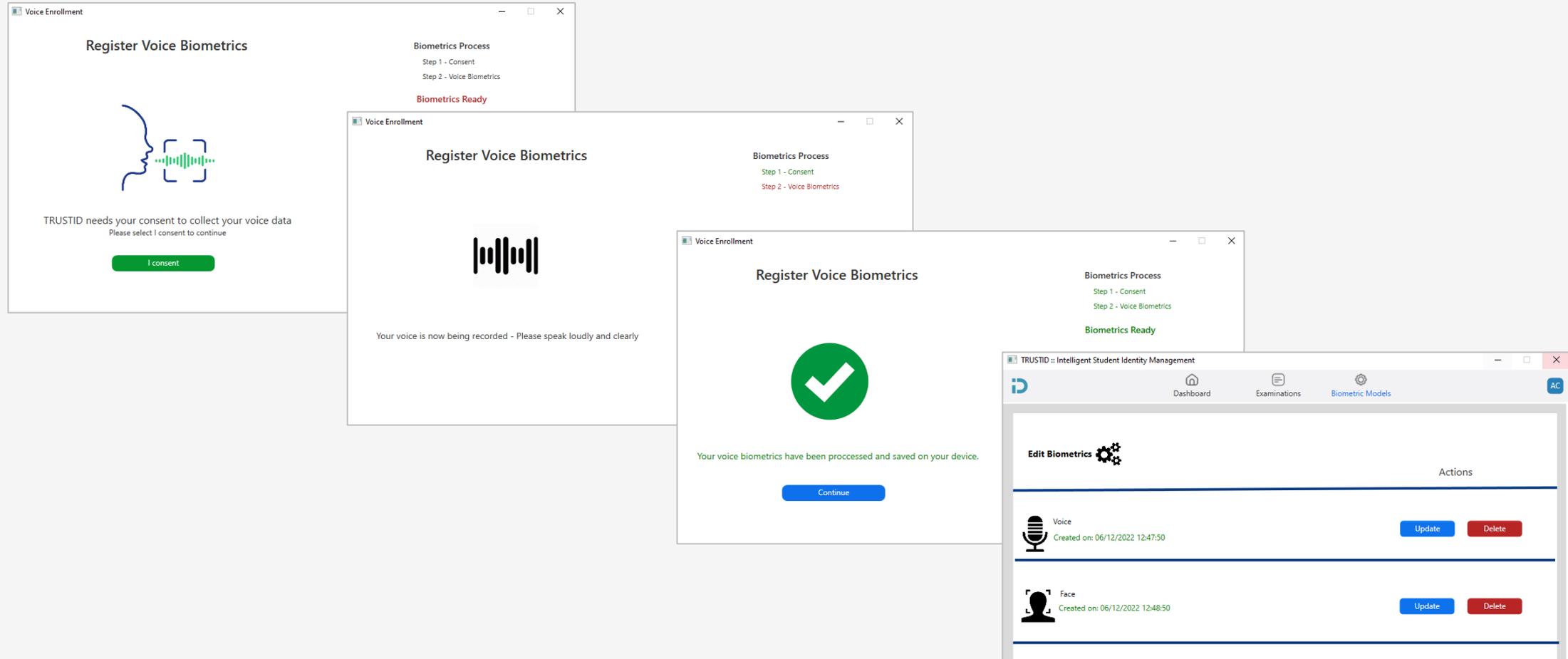
Student Biometrics Enrollment (Face)

- The TRUSTID app captures student's face data and generates the face model



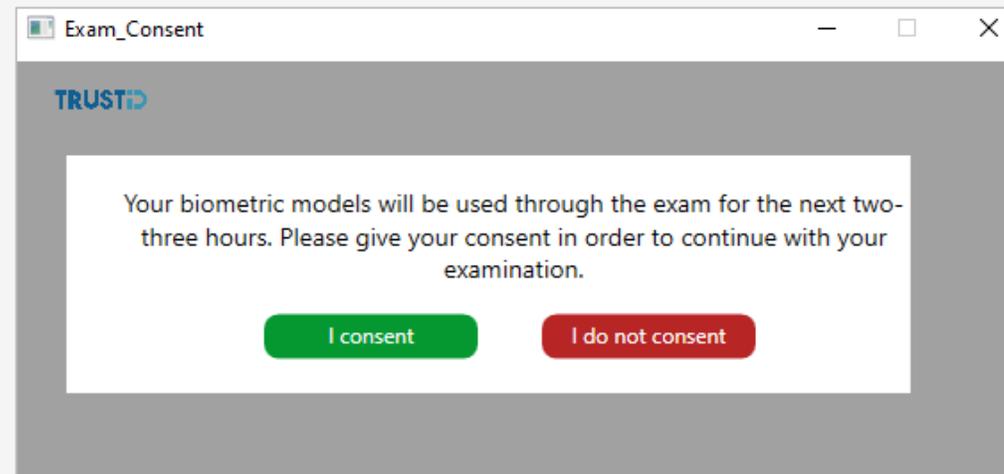
Student Biometrics Enrollment (Voice)

- The TRUSTID app captures student's voice data and generates the voice model



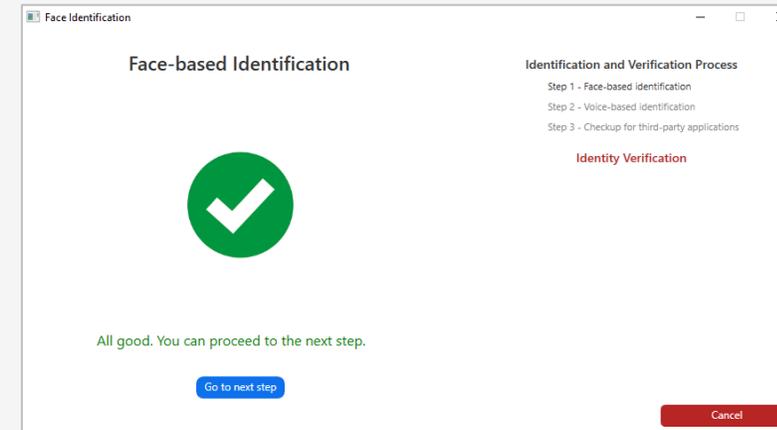
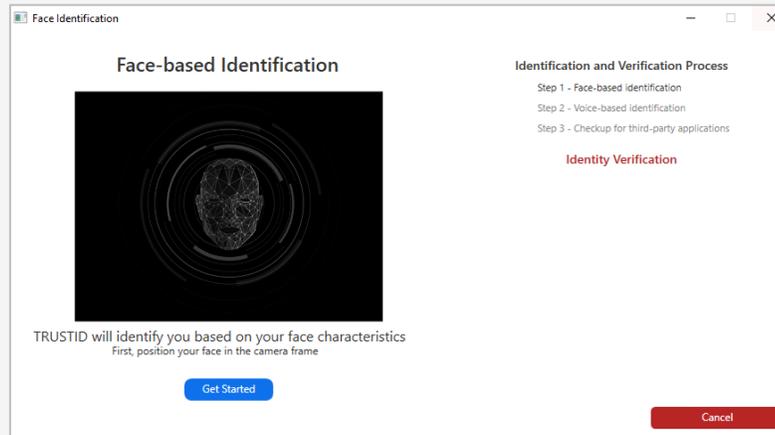
Student Identity Verification

- Before starting the exam, the students provide their consent to use their biometric models and go through the identity authentication step to be identified through the face- and voice-based verification mechanisms.



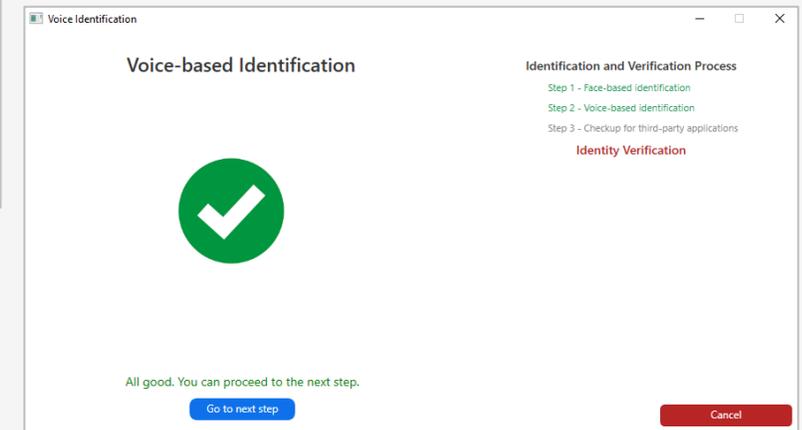
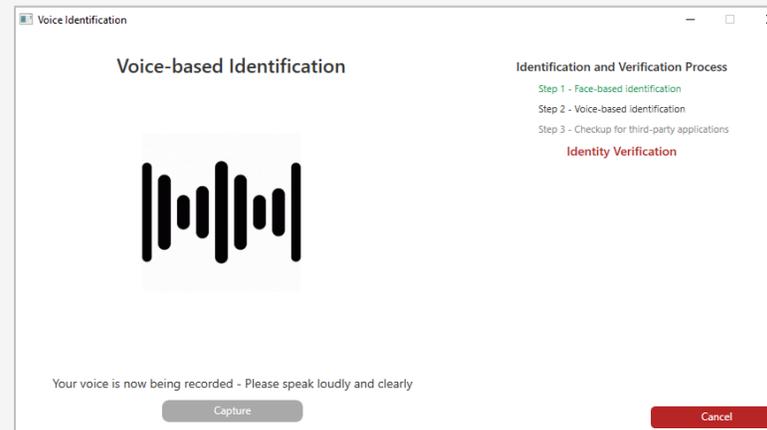
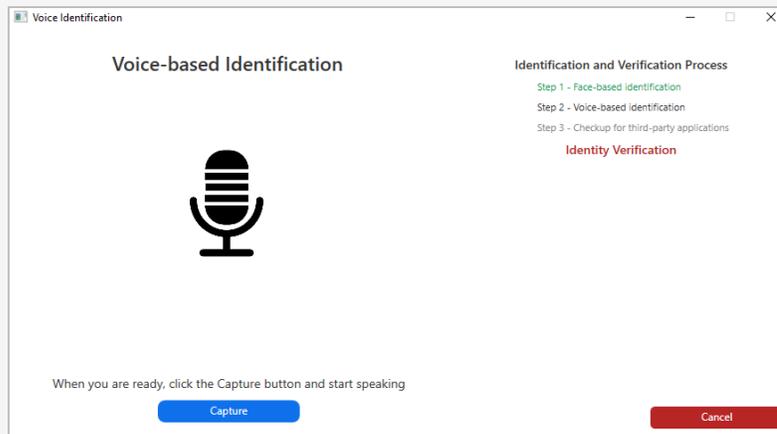
Student Identity Verification (Face)

- Students are requested to misuse the system, e.g. by doing impersonation, in which another person sits in front of the camera to verify their identity.



Student Identity Verification (Voice)

- Students are requested to misuse the system, e.g. by doing impersonation, in which another person speaks to verify their identity.

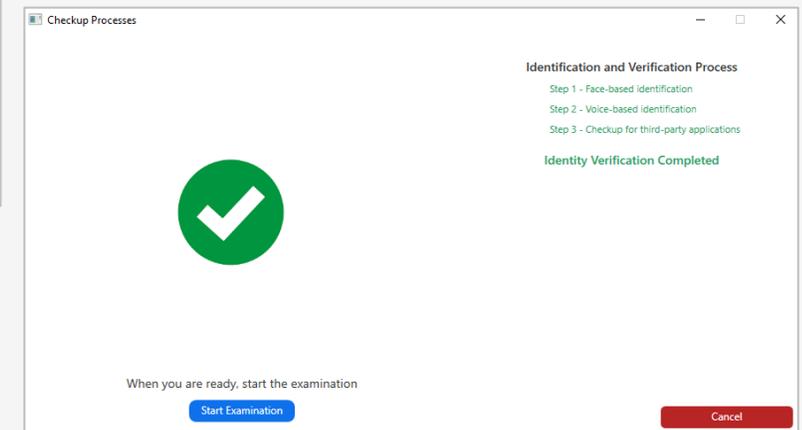
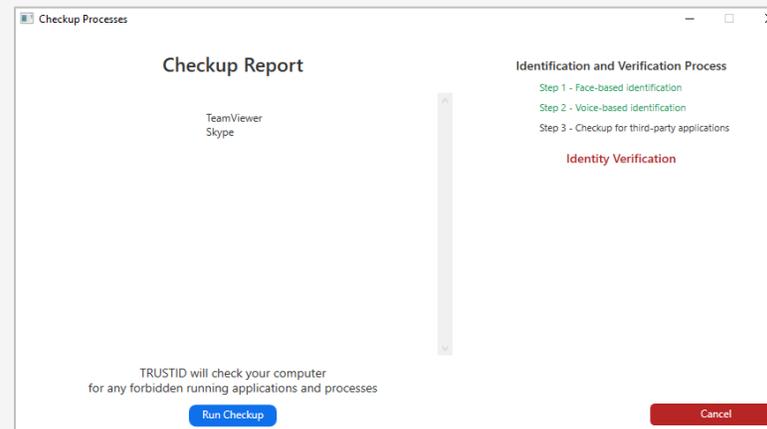
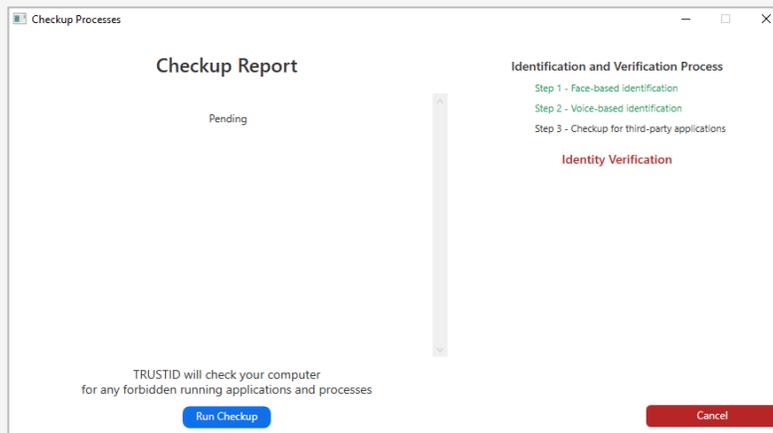


Student Identity Verification (Check Forbidden Apps)

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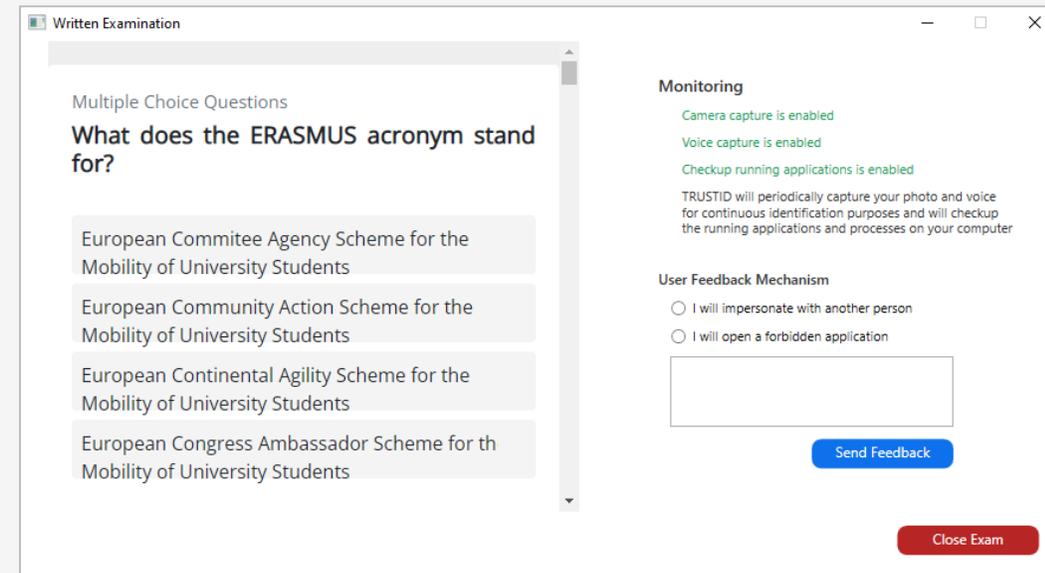


- Students are requested to misuse the system, e.g., use communication/collaboration tools prior to joining the examination.



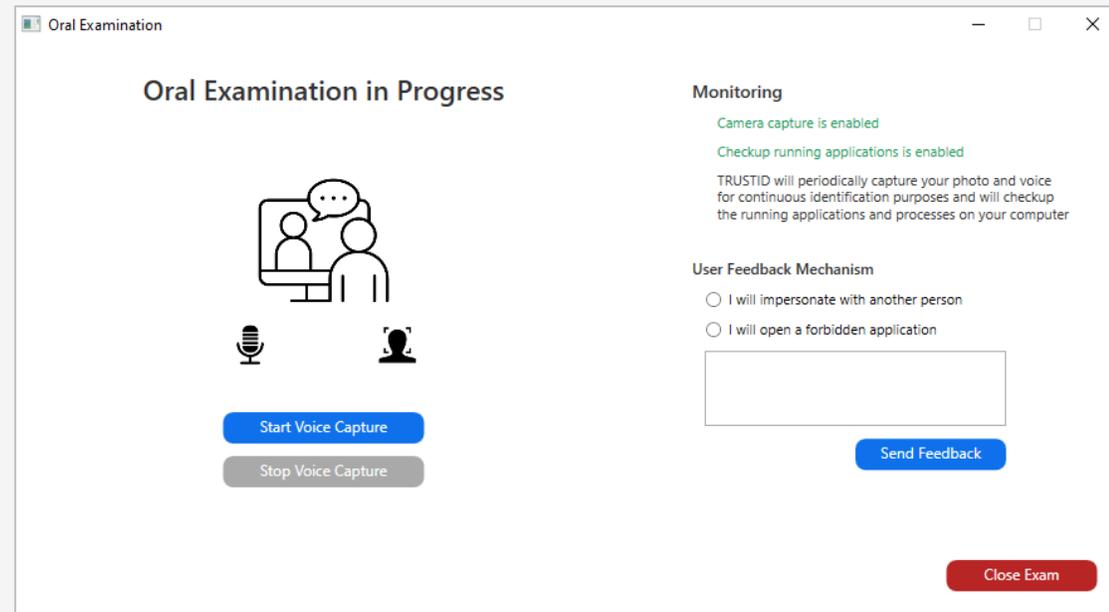
Continuous Student Identification

- The system continuously identifies the students through the face- and voice-based identification mechanism
 - Students are requested to misuse the system, e.g., conduct impersonation, engage in conversation with another person, etc.



Monitoring the Student's Computing Device

- Monitoring the students' computing device's running applications and processes
 - Students are asked to misuse the system, e.g., by asking them to open communication/collaboration tools during the examination session



Examination Management for Instructors

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- Add/Update examination

TRUSTID :: Intelligent Student Identity Management

Introduction to Programming
Examination ID: 61667302972
Status: Upcoming
Scheduled: 2022-12-07T00:00:00

Start Exam Information Policy

Introduction to Programming
Examination ID: 61667302972
Status: Upcoming
Scheduled: 2022-12-07T00:00:00

Exam Type: Oral
Exam Duration: 60
Additional Material: True

TRUSTID :: Intelligent Student Identity Management

Management

Add a new exam Add Exam

Edit existing exams Edit Exams

Enroll students to exam Enroll

Add Exam

Additional Material Yes No

Exam Duration:

Exam Type:

Name:

Privacy Policy

Scheduled date

Add Cancel

Update Exam: Introduction to Program

Additional Material Yes No

Exam Duration:

Exam Type:

Privacy Policy

Scheduled date

Update Cancel

LMS Integration

- Moodle integration
 - Fetch students' information and automatically enroll to TRUSTID
- Instructors upload .csv with students' information exported from other LMS

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The image shows two overlapping windows from the TRUSTID system. The top window is the login page, titled 'TRUSTID :: Intelligent Student Identity Management'. It features the TRUSTID logo and a login form with fields for 'Email' (containing 'aconst12@ucy.ac.cy') and 'Password'. Below the password field are radio buttons for 'Organization' with options: 'University of Cyprus' (selected), 'University of Patras', and 'University of Coimbra'. A note states 'Instructor's login is handled via Moodle'. A blue 'Login' button is at the bottom. The bottom window is titled 'Upload and Enroll to Exam'. It has a 'Select Course:' dropdown menu set to 'Introduction to Computer Science'. To the right is a table with columns 'Exam id' and 'Exam name', containing one row: '41668601770' and 'Introduction to C...'. Below the table is a 'Selected Exam:' field with the value '41668601770' and a 'Select all students:' checkbox checked. A table below shows student details:

First name	Last name	Email
Taoufik	Sousak	tsousa01@cs.ucy.ac.cy
Loucas	Papalazarou	lpapal03@cs.ucy.ac.cy

At the bottom of this dialog, it says 'All students selected' and has 'Sync' and 'Cancel' buttons.

This screenshot shows the 'Upload and Enroll to Exam' dialog box. The 'Upload students:' section has a text field containing the file path 'C:\Users\laryr\Downloads\test_users (1).csv' and a 'Browse File' button. Below this is a table with student information:

First name	Last name	Email
Adamos	Adamou	aadamou@live.com

To the right, the 'Exam id' field contains '61667302972' and the 'Exam name' field contains 'Introduction to F...'. The 'Select Exam:' dropdown is set to '61667302972'. The 'Select all students:' checkbox is checked. At the bottom, it says 'All students selected' and has 'Sync' and 'Cancel' buttons.

Resilience to Impersonation Attacks

Summary of the sample and the collected data

Mock Examination Type	# of Participants	# of Face Images	Audio Samples Length (in minutes)
<i>Online Written</i>	65	1804	75.68
<i>Online Oral</i>	68	1530	123.47
Totals	133	3334	199.15

Summary of the sample and the collected data for **impersonation attacks**

Mock Examination Type	# of Participants	# of Face Images	Audio Samples Length (in minutes)
<i>Online Written</i>	24	391	31.04
<i>Online Oral</i>	32	582	52.73
Totals	56	973	83.77

Summary of the results for each identification case

Identification Case	Face Recognition (Success Rate)	Voice Recognition (Success Rate)
<i>Student identification in order to join examination</i>	100%	100%
<i>Continuous student identification prior to performing an impersonation attack</i>	94.80%	91.36%
<i>Continuous student identification while performing an impersonation attack</i>	76.57%	78.53%

Failures mainly occur due to:

- i) face occlusion,
- ii) inappropriate lighting conditions
- iii) specific head poses

Key Findings

PoC2 Strengths:

- The System Usability Score was 78, which is a high score (scores > 68 are considered above average [1]).
- Face enrollment performance.
- Face identification in both the registration and continuous monitoring phases.
- Continuous monitoring of running processes and detection of forbidden communication/collaboration tools.

Improvements for PoC3:

- Voice enrollment and voice identification issues in some cases.

“The voice registration wasn't successful the first few times”

“The voice registration did not work, I had to change my default microphone input in windows for it to work”

“Voice recognition didn't work at first, but worked once I put headphones on, even though the microphone used was always the same, an independent one from the headphones”

[1] <https://www.usability.gov/>

Intellectual Output 3 - Tasks and Achievements

IO3 - **Evaluation Reports** regarding Efficiency, Effectiveness and User Acceptance of TRUSTID in Three Case Studies at Higher Education Institutions across Europe

Output: Dataset, Publications

- Task 3.1: Design of Experimental Evaluation Methodology
- Task 3.2: Formative Evaluation Report
- Task 3.3: Summative Evaluation Report

Achievements and Outputs

Successfully completed the PoC1 and PoC2 study with 93 and 133 participants, which participated in the user evaluation study in which they interacted with various mechanisms of TRUSTID.

Planned and organized the **final summative evaluation study**

Running the final summative formative user study to test the final proof of concept (PoC3) and evaluate its usability and accuracy of implemented identification mechanisms (face, voice, interaction).

Intellectual Output 4 – Knowledge Repository



Knowledge Repository

- Contains: Training Webinars, Guides of Best Practices, Integration Guidelines, Training Materials and Forum Discussions on how to Adopt and Deploy Continuous Student Identity Management Solutions in HEIs.
- The **knowledge repository** serves as **training and learning material** based on the outcomes of the project, and as a dissemination tool.
- **Webinars** for the training of system administrators and instructors.
- **Design of guides describing best practices** on adoption of continuous student identification methods and techniques in online learning environments.
- **Design of system integration guidelines** for system administrators to utilize the developed API to integrate the TRUSTID solution into existing LMSs.

IO4 - Tasks

- T4.1: Training Webinars ← July 2022 – Feb 2023
 - *Lead: Institute of Systems and Robotics (ISR)*

- T4.2: Best Practice Guides ← Until EoP (May 2023)
 - *Lead: Institute of Systems and Robotics (ISR)*

- T4.3: System Integration Guidelines (through an Application Programming Interface)
 - *Lead: Cognitive UX GmbH*



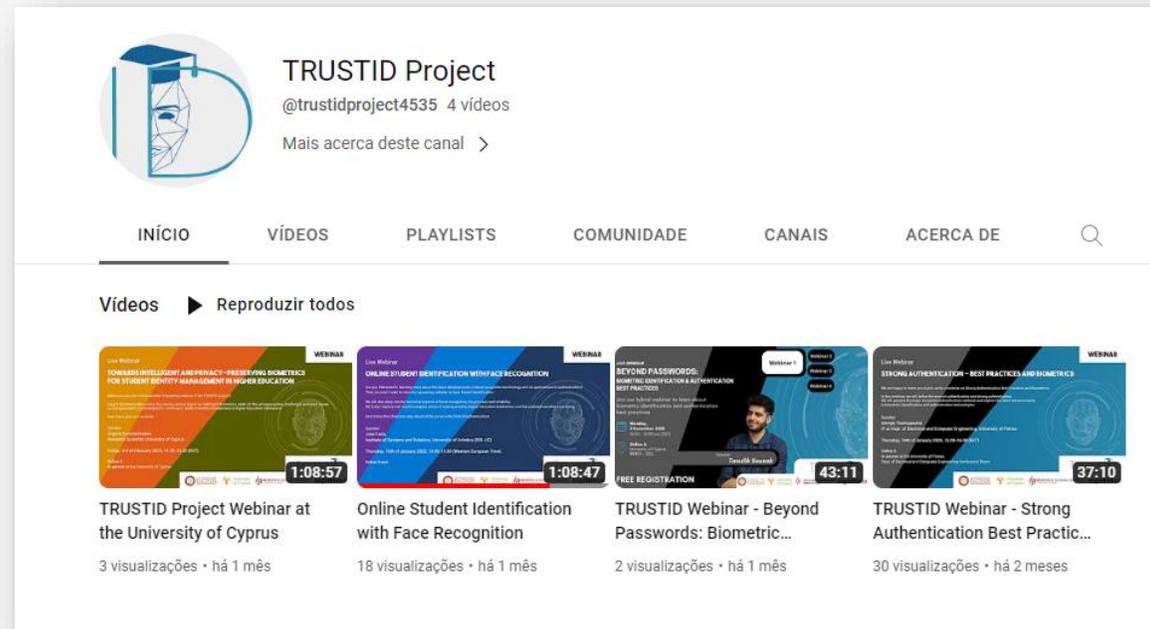
T4.1: Training Webinars

- The **Training Webinars** consisted of focused sessions to demonstrate the TRUSTID technology from a **user** perspective (instructors) and from a **technical/integration** perspective (system administrators).
- Designed to inform HEIs stakeholders on **why, when** and **how** to adopt continuous student identification.
- **Four webinars** were conducted: one by **each partner organization**.



T4.1: Training Webinars

- **Evaluation and piloting tool** to improve the system design based on **feedback** received after the webinars.
- **Dissemination tool** through **live video** recorded sessions, which are **publicly available**.



T4.2: Best Practice Guides

- **Innovative and practical design guidelines**, recommendations/policies to provide useful indications on how current practices in identity management and online learning systems can be improved.
- Guidelines are made **publicly available** (through publications and open repositories) to be used by interested researchers and practitioners as a stepping-stone for further exploitation.
- What are we producing?
 - *Format: Documents and presentations (e.g., pdfs, pptx)*
 - Practical design guidelines
 - Recommendations
 - Policies
 - Experimental results

T4.2: Best Practice Guides – Actions Done in Stage 1

Deployment of Knowledge Repository v1

- TRUSTID Webpage with links for Wiki pages hosted on Slite.
Available at: <https://trustid-project.eu/kr.php>
including Educational, Training and Course Material.



Deployment of the TRUSTID Community Forum v1

- Based on WordPress. It was available at: <http://forum.trustid-project.eu/>
Barebones version with “Developers” and “General” Discussion Topics.



TRUSTID GitHub Open Source Code Repository

- Available at: <https://github.com/cognitiveux/trustid>

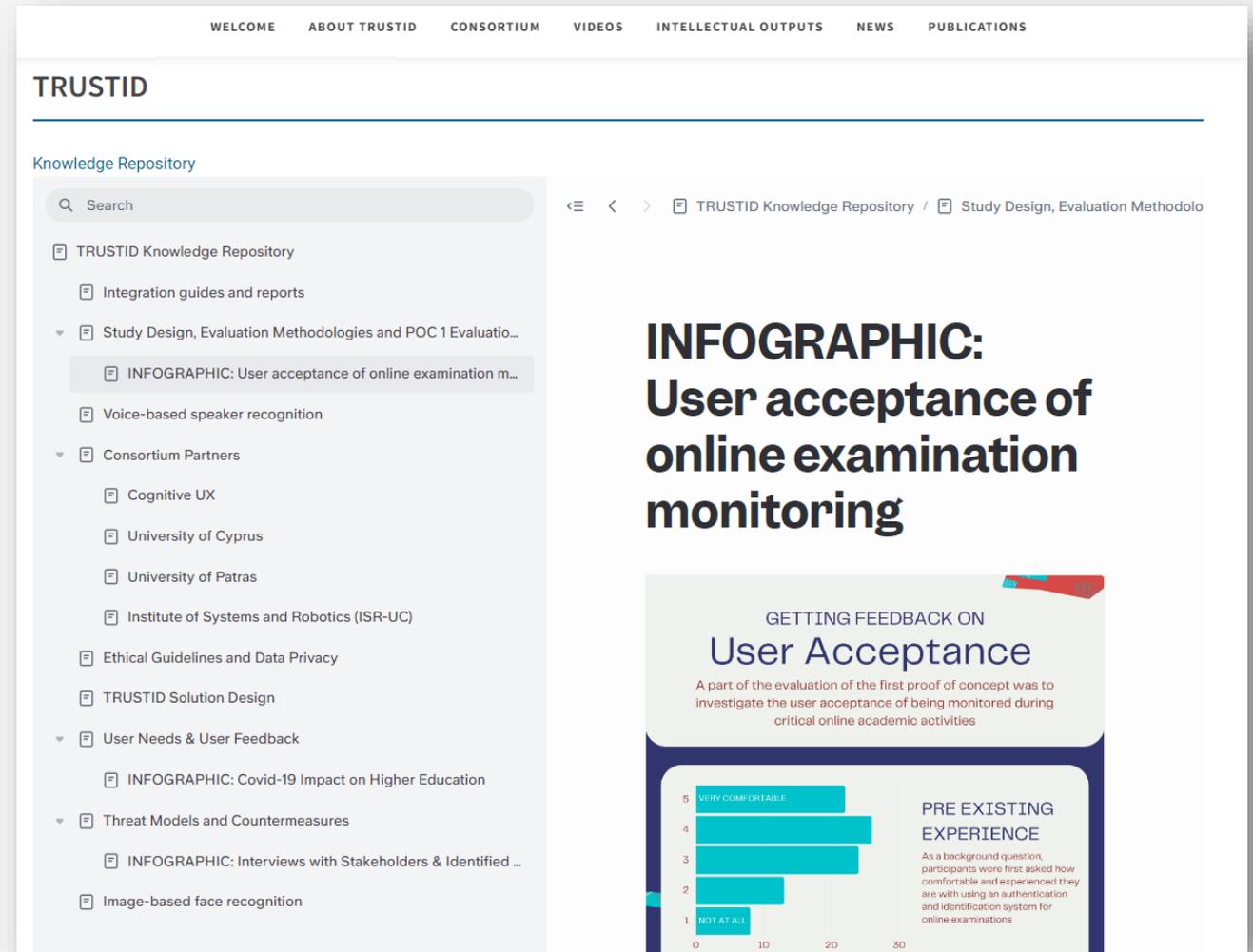


T4.2: Best Practice Guides – Actions Done in Stage 2

Deployment of Knowledge Repository v2

TRUSTID Webpage with new [Wiki pages](#) hosted on Slite

- Integration guides and reports
- Study Design, Evaluation Methodologies and POC 1 Evaluation Results
- Voice-based speaker recognition
- Update of previous wiki pages (e.g. Image-based face recognition)
- INFOGRAPHIC: User acceptance of online examination monitoring



The screenshot shows the TRUSTID Knowledge Repository webpage. The navigation menu includes: WELCOME, ABOUT TRUSTID, CONSORTIUM, VIDEOS, INTELLECTUAL OUTPUTS, NEWS, PUBLICATIONS. The main content area is titled 'TRUSTID Knowledge Repository' and features a search bar and a list of categories. The selected category is 'INFOGRAPHIC: User acceptance of online examination monitoring'. The infographic itself is titled 'GETTING FEEDBACK ON User Acceptance' and includes a bar chart showing 'PRE EXISTING EXPERIENCE' with a scale from 1 (NOT AT ALL) to 5 (VERY COMFORTABLE).

Experience Level	Count
5 (VERY COMFORTABLE)	20
4	25
3	25
2	15
1 (NOT AT ALL)	5

T4.2: Best Practice Guides – Actions Done in Stage 2

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TRUSTID Project Brochures

What is TrustID?
In TRUSTID, we envision to design, develop and evaluate a multi-tier continuous user identification framework, bootstrapped to HEIs' contexts that will consist of state-of-the-art intelligent image, voice and interaction data processing.

FUNDING
The project is funded by the European Commission (Erasmus+ 2020) and IKY with a budget of €291,310

Learn More
Visit our website:

<https://www.trustid-project.eu>

Expected Results

- Validate a Framework for HEIs' Continuous Student Identity Management**
The TRUSTID framework will be both theoretical and practical and will scaffold different HEI stakeholders to sustain credibility of online education learning activities
- Implementation of an open-source software toolkit**
The aforementioned framework will be supported by an open-source toolkit that will be designed and developed during the project.
- Evaluation and Validation Reports in the context of three case-studies at different HEIs**
Evaluation reports assessing the project results in general, aiming at the provision of recommendations for the long-term implementation of continuous identity management of online learning and teaching activities at the partner organizations, based on the evaluation outcomes
- Knowledge Building Online Community and Repository**
An online repository that will support knowledge building through guides with best practices for different methods and tools to apply continuous user identification for online activities of HEIs

Also On:

Logos: University of Patras, Instituto de Sistemas e Robótica, University of Cyprus, cognitiveux

What is TRUSTID

TrustID
European Commission IKY

Improving trust in academic activities

Contact Us:
info@trustid-project.eu

How can I help?

To evaluate the second Proof of Concept, we will run user studies where participants can download the software and take it for a test drive! At the end you will be asked about your experience. We want to hear from you so we can improve our solution.

Sign up:

Learn More
Visit our website:

<https://www.trustid-project.eu>

What is TrustID?

In TRUSTID, we envision to design, develop and evaluate a multi-tier continuous user identification framework, bootstrapped to HEIs' contexts that will consist of state-of-the-art intelligent image, voice and interaction data processing.

Logos: University of Patras, Instituto de Sistemas e Robótica, University of Cyprus, cognitiveux

User Recruitment

T4.2: Best Practice Guides – Actions Done in Stage 2

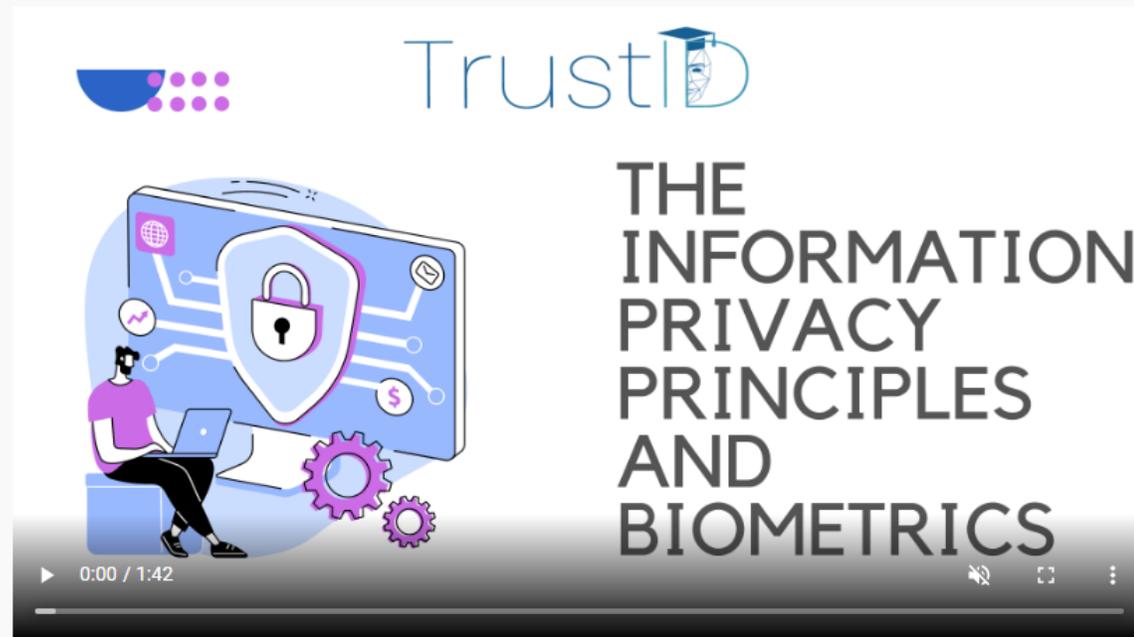
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Best Practice Videos

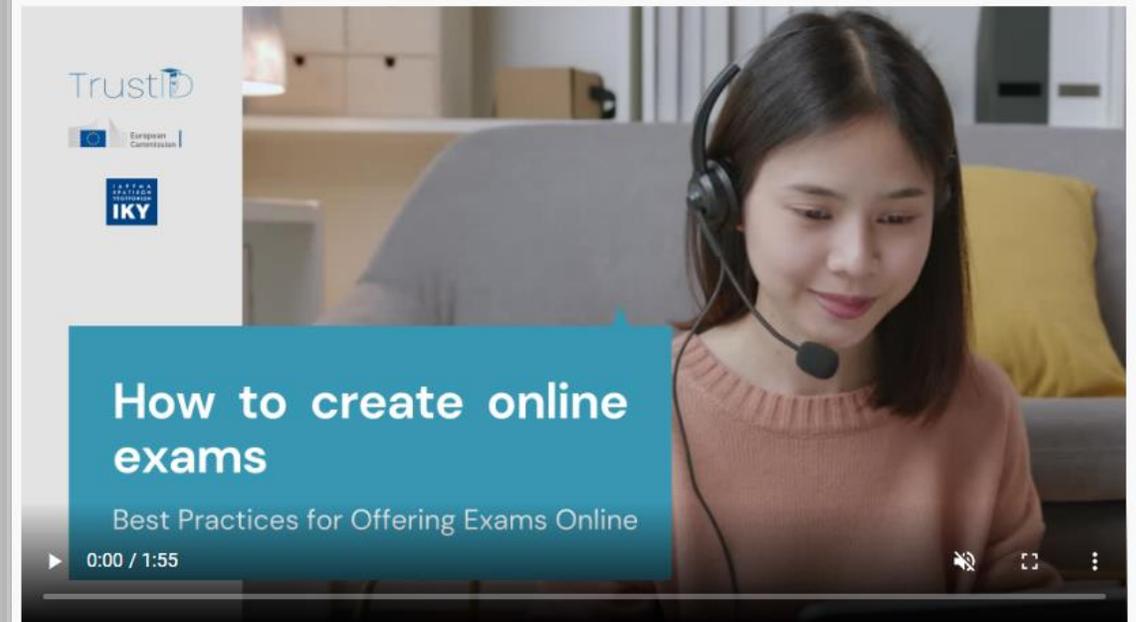
The Information Privacy Principles and Biometrics

Watch this best practices videos about privacy preservation when it comes to biometrics



Online Examination Best Practices

Best practices and extra tips when it comes to online evaluation activities.



T4.2: Best Practice Guides – Actions Done in Stage 2

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TRUSTID Community Forum v2

*Embedded in the TRUSTID
website*

*Based on **tribe**, a customizable
community platform for
businesses*



TrustID

Search...

Log in Sign up

Home

Members

Spaces

Spaces

General

Technical Discussions

© Copyright 2022, TrustID Project

Powered by Tribe Platform

Sort by latest

SS Stylianos Sofokleous
2 months ago

Excellent idea but...

Although this idea seems great for academia, do you believe students from appropriate fields (i.e., computer science) will accept this or will they see it as a challenge and try to trick the software to prove themselves capable pen. testers?

1

Like Follow Share

G What are your thoughts?

LP Loukas Papalazarou

Join ...

Feed Members

About

9 members

5 posts

Created 2 months ago

T4.2: Best Practice Guides – Actions Done in Stage 3

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Webinars Webpage

*Embedded in the TRUSTID
website*

ABOUT TRUSTID CONSORTIUM INTELLECTUAL OUTPUTS WEBINARS LEARNING TEACHING TRAINING (LTTA) NEWS PUBLICATIONS

Webinars

TRUSTID WEBINAR - BEYOND PASSWORDS: BIOMETRIC IDENTIFICATION & AUTHENTICATION BEST PRACTICES

Mr. Taoufik Sousak from Cognitive UX GmbH gave a speech at the first TRUSTID webinar discussing various important topics on biometric identification and authentication best practices.

TRUSTID Webinar - Beyond Passwords: Biometric Identification & Authentication Best Practices

BEYOND PASSWORDS: BIOMETRIC IDENTIFICATION & AUTHENTICATION BEST PRACTICES

In our hybrid webinar to learn about biometric identification and authentication best practices

Monday, 5 December, 2022
14:00 - 15:00 pm (EET)

Online & Hybrid
University of Cyprus, GEE01 - 202

Speaker
Taoufik Sousak

Ver no YouTube RATION

Webinar 1
Webinar 3
Webinar 4

TrustID

UNIVERSITY OF PATRAS University of Cyprus INSTITUTO DE SISTEMAS E ROBÓTICA UNIVERSITY OF COIMBRA cognitiveux

T4.2: Best Practice Guides – Actions Done in Stage 3

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Learning Teaching Training Activities (LTTA) Webpage

*Embedded in the TRUSTID
website*



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TRUSTID / Intellect

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T4.2: Best Practice Guides – Ongoing Actions

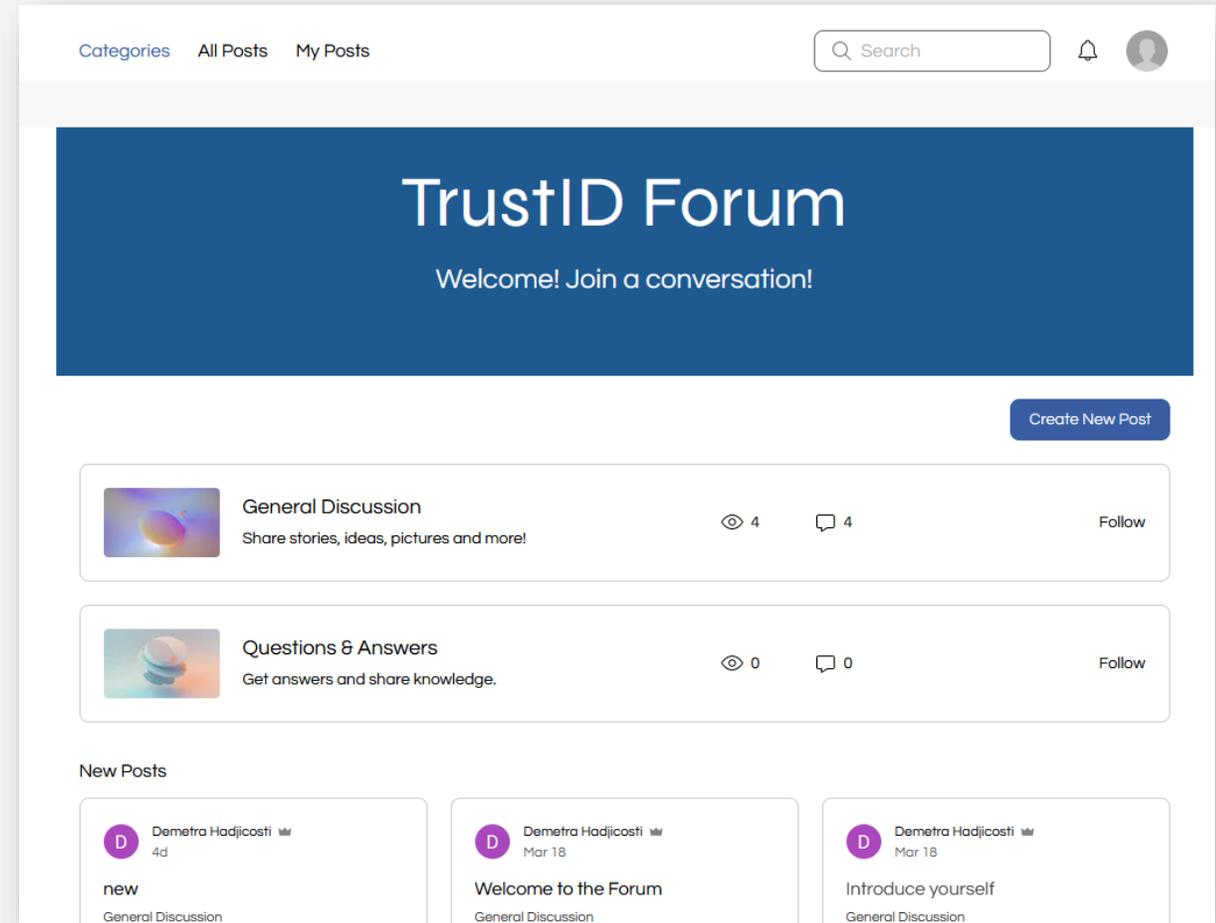
Co-funded by the
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TRUSTID Community Forum v3

Embedded in the TRUSTID
website: [https://trustid-
project.eu/community.php](https://trustid-project.eu/community.php)

Based on **Wix**, a cloud-based
website development platform



T4.2: Best Practice Guides – Ongoing + Planned Actions

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- Update **wiki pages** alongside project developments/new results (e.g., validation reports, PoC3 evaluation and scientific papers)
- **Dedicated page** to the Multiplier Events
- Additional **Best Practice Videos** and Infographics
- Reinvigorate the Discussion **Forum** (news, discussion points, etc.)
- **PoC 3** Final System information (update GitHub – PoC3 documentation, integration guidelines, experimental results, etc.)
- **TRUSTID Closure** Documentation, Reports, Project Evaluation

T4.3: System Integration Guidelines (through an API)

- Design **system integration guidelines** based on the developed **Application Programming Interfaces** developed as part of IO2 for exposing the intelligent continuous student identification mechanisms and user models to third-party software
- The API allows developers to subscribe and get an API key that will be used to authorize HTTPS requests for using the developed algorithms and user models in their applications
- Allows system administrators to easily integrate and customize TRUSTID to their needs and requirements



TRUSTID Backend – Web API

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TRUSTID API

Base URL: localhost:19201/backend
http://localhost:19201/backend/docs/html/index.html

The endpoints for interacting with the TRUSTID server
[Terms of service](#)
[Contact the developer](#)
BSD License

Schemes

HTTP

Django Login

Authorize

Filter by tag

instructor

POST /instructor/add_exam instructor_add_exam_create

POST /instructor/enroll_students instructor_enroll_students_create

GET /instructor/list_exam instructor_list_exam_list

POST /instructor/update_exam_details instructor_update_exam_details_create

login

POST /login login_create

monitoring

POST /monitoring monitoring_create

refresh_token

POST /refresh_token refresh_token_create

register_user

POST /register_user register_user_create

student

POST /student/identification student_identification_create

GET /student/list_exam student_list_exam_list

trustid_version

GET /trustid_version trustid_version_list

update_exam_condition

POST /update_exam_condition update_exam_condition_create

login

POST /login

login_create

Creates a JSON Web Token if the provided credentials are correct

Parameters

Cancel

Name Description

data * required

(body)

Edit Value | Model

```
{
  "email": "string",
  "password": "string"
}
```

Cancel

Parameter content type

application/json

Execute

Responses

Response content type application/json

Code Description

201 *JSON Web Token has been created successfully. The value is returned in resource_obj.*

Example Value | Model

```
{
  "message": "string",
  "resource_name": "string",
  "resource_obj": {}
}
```

Web API – Documentation



- Search...
- Authentication
- instructor >
- login >
- monitoring >
- refresh_token >
- register_user >
- student >
- trustid_version >
- update_exam_condition >

Documentation Powered by ReDoc

instructor

instructor_add_exam_create

The view that allows instructors to add examinations

AUTHORIZATIONS: **Bearer**

REQUEST BODY SCHEMA: application/json

additional_material	boolean (Additional material)
duration required	integer (Duration in minutes) [0 .. 9223372036854776000]
exam_type required	string (Exam type) Enum: "Oral", "Written"
privacy_policy required	string (Privacy policy) non-empty
scheduled_date required	string <date-time> (Scheduled date)

Responses

^ 200 Success

RESPONSE SCHEMA: application/json

message	string A general message description
resource_name	string The name of the resource

POST /instructor/add_exam

Request samples

Payload

```
application/json
{
  "additional_material": true,
  "duration": 0,
  "exam_type": "Oral",
  "privacy_policy": "string",
  "scheduled_date": "2021-12-13T13:28:55Z"
}
```

Response samples

200 400 401 403 404 405 415 500

```
application/json
{
  "message": "string",
  "resource_name": "string"
}
```

Intellectual Output 4 - Tasks and Achievements

IO4 - **Knowledge Repository** containing Training Webinars, Guides of Best Practices, Integration Guidelines, Training Materials and Forum Discussions on how to Adopt and Deploy Continuous Student Identity Management Solutions in HEIs

Output: Internet, Broadcast, Event, Publications, Video

- Task 4.1: Training Webinars
- Task 4.2: Best Practice Guides
- Task 4.3: System Integration Guidelines (through an API)

Achievements and Outputs

Deployment of Final Knowledge Repository

<https://trustid-project.eu/kr.php>

Deployment of Final TRUSTID Community Forum

<https://trustid-project.eu/community.php>

TRUSTID GitHub Open-source Code Repository

Available at: <https://github.com/cognitiveux/trustid>

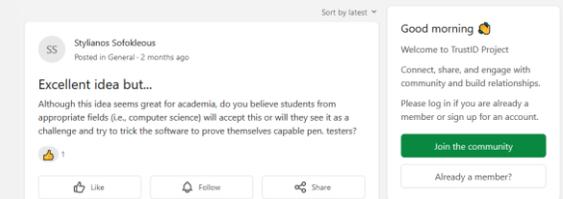
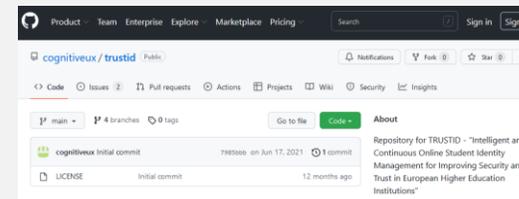
Knowledge Repository

Educational, Training and Course Material

- Ethical Guidelines and Data Privacy
- TRUSTID Solution Design
- User Needs & User Feedback
- Threat Models and Countermeasures
- Image-based Recognition
- INFOGRAPHIC - Covid19 Impact on Higher Education
- INFOGRAPHIC - Interviews with Stakeholders and Identified Threat Scenarios

Open-source TRUSTID System Code : hosted on Github

- Main GitHub branch
- TRUSTID Windows Application
- TRUSTID MacOS Application
- Face-based User Identification Algorithms



Webinar

TRUSTID Webinar Events

- UPAT Event
- CUX Event
- ISR-UC Event
- UCY Event



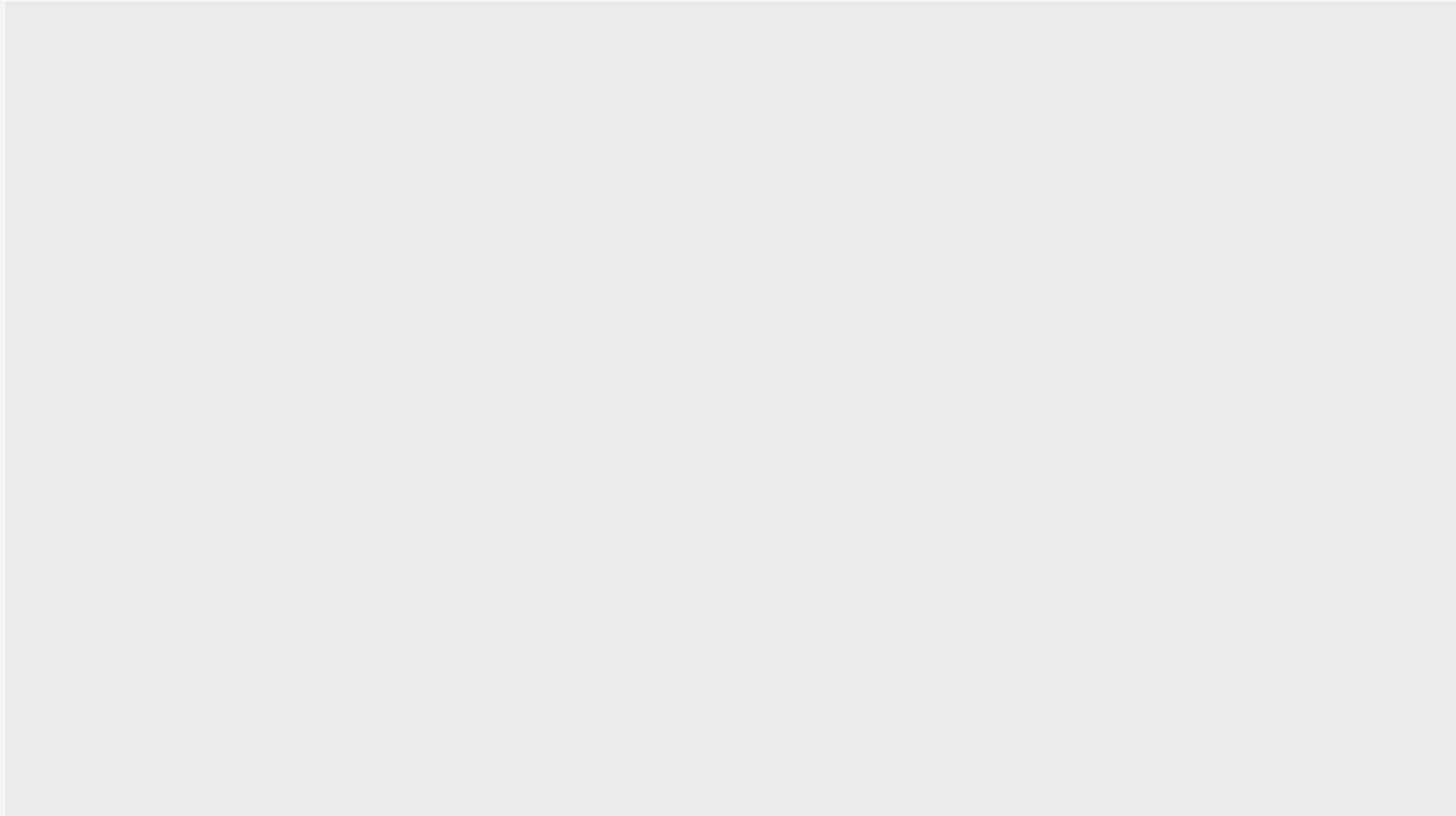
Project Milestones (M)

- M1 - Guidelines for collaboration (related to all IOs) – MONTH 1
- M2 - Analysis template and guidelines (IO1) – MONTH 1
- M3 - 1st version of framework specification (IO1); low-fidelity solution (IO2); experimental plan and design ready (IO3) – MONTH 6
- M4 - First formative evaluation (IO3); knowledge repository v1 (IO4) – MONTH 10
- M5 - 2nd version of framework specification (IO1); high-fidelity tools and solution ready (IO2) – MONTH 13
- M6 - Second formative evaluation (IO3); knowledge repository v2 (IO4); training webinars (IO4) – MONTH 17
- M7 - Final version of framework (IO1); final tools and solution (IO2); learning, teaching, training activities (LTTA) planned (IO4) – MONTH 20
- M8 - LTTA at UCY (IO4) with participants from all partners – MONTH 23



Video (Year 1) of TRUSTID

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Useful Links

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- Project's Website: <https://trustid-project.eu>
- Software source-code: <https://github.com/cognitiveux/trustid>
- LinkedIn: <https://www.linkedin.com/company/trustidproject>
- Facebook: <https://www.facebook.com/trustidproject>
- Twitter: <https://twitter.com/trustidproject>

TRUSTiD

Publications

1. C. A. Fidas, M. Belk, A. Constantinides, D. Portugal, P. Martins, A. M. Pietron, A. Pitsillides, N. Avouris, "Ensuring Academic Integrity and Trust in Online Learning Environments: A Longitudinal Study of an AI-centered Proctoring System in Tertiary Educational Institutions". Education Sciences, Special Issue on New Media and Technology in Education, 2023.
2. D. Portugal, J. N. Faria, M. Belk, P. Martins, A. Constantinides, A. Pietron, A. Pitsillides, N. Avouris, C. Fidas. "Continuous User Identification in Distance Learning: A Recent Technology Perspective". Smart Learning Environments, Springer, 2023. (Under Review)
3. J. N. Faria, D. Portugal, P. Martins, M. Belk, A. Constantinides, A. Pitsillides, C. A. Fidas, "Image-based Face Verification for Student Identity Management — the TRUSTID Case Study", In Adjunct Proceedings of the 31st ACM Conference on User Modeling, Adaptation and Personalization (UMAP 2023), Late-Breaking Results Paper, Limassol, Cyprus, June 26-29, 2023.
4. A. Constantinides, J. N. Faria, T. Sousak, P. Martins, David Portugal, M. Belk, A. Pitsillides, C. Fidas, "TRUSTID: Intelligent and Continuous Online Student Identity Management in Higher Education", In Adjunct Proceedings of the 31st ACM Conference on User Modeling, Adaptation and Personalization (UMAP 2023), Demo Paper, Limassol, Cyprus, June 26-29, 2023.
5. T. Sousak, A. Constantinides, J. N. Faria, A. Pietron, P. Martins, D. Portugal, M. Belk, A. Pitsillides, C. Fidas, "Towards Intelligent and Continuous Online Student Identity Management". Invited Talk at UMAP '22: 30th ACM Conference on User Modeling, Adaptation and Personalization, Workshop on Adaptive and Personalized Privacy and Security (APPS), Barcelona, Spain, July 04-07, 2022.
6. A. Constantinides, C. Constantinides, M. Belk, C. Fidas, A. Pitsillides, "Applying Benford's Law as an Efficient and Low-cost Solution for Verifying the Authenticity of Users' Video Streams in Learning Management Systems". In IEEE/WIC/ACM Int. Conference on Web Intelligence and Intelligent Agent Technology (WI-IAT '21). ACM, New York, NY, USA, 563-569, 2021.
7. C. Fidas, M. Belk, D. Portugal, A. Pitsillides, "Privacy-preserving Biometric-driven Data for Student Identity Management: Challenges and Approaches", In Adjunct Proceedings of the 29th ACM Conference on User Modeling, Adaptation and Personalization (UMAP 2021), pp. 368-370, Utrecht, the Netherlands, June 21-25, 2021.

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Thank you!



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