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TrustID

Multiplier Event

TRUSTID Project: An Overview

David Portugal, Institute of Systems and Robotics, Coimbra

ΠΑΝΕΠΙΣΤΗΜΙΟ
ΠΑΤΡΩΝ
UNIVERSITY OF PATRAS

University
of Cyprus

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.

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

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

Ambiguities

Environment
Physical and Digital

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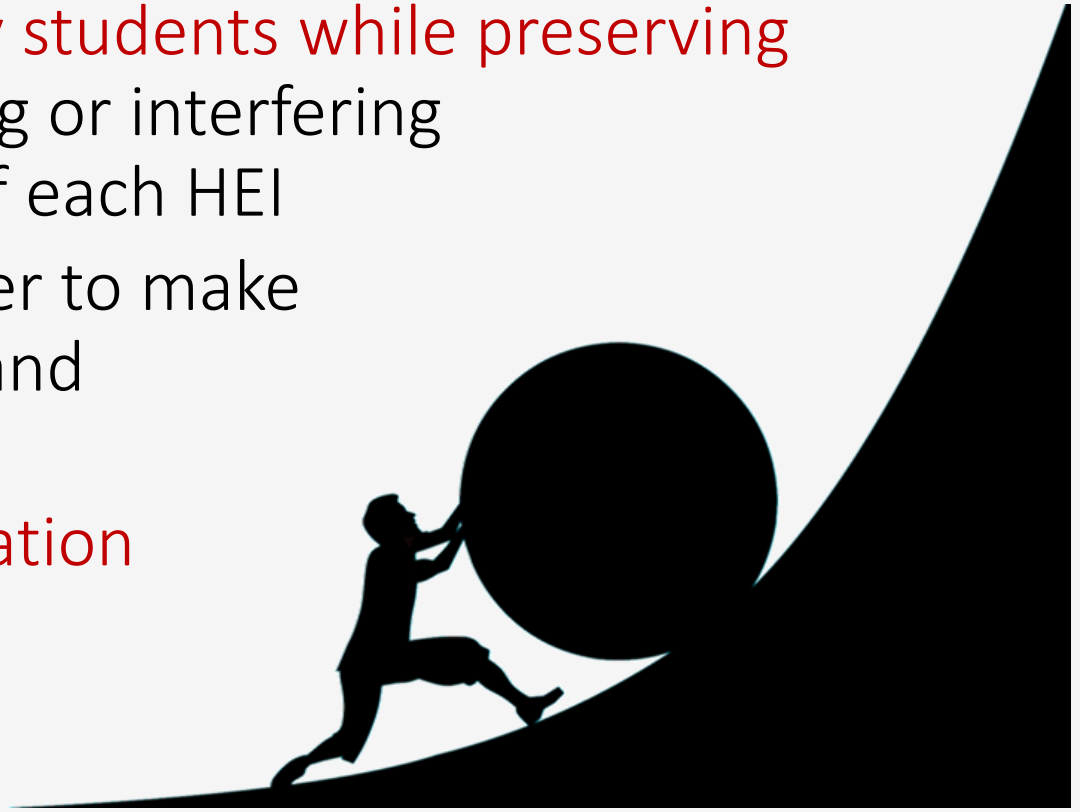
Challenges:

- 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

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- **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

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- **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

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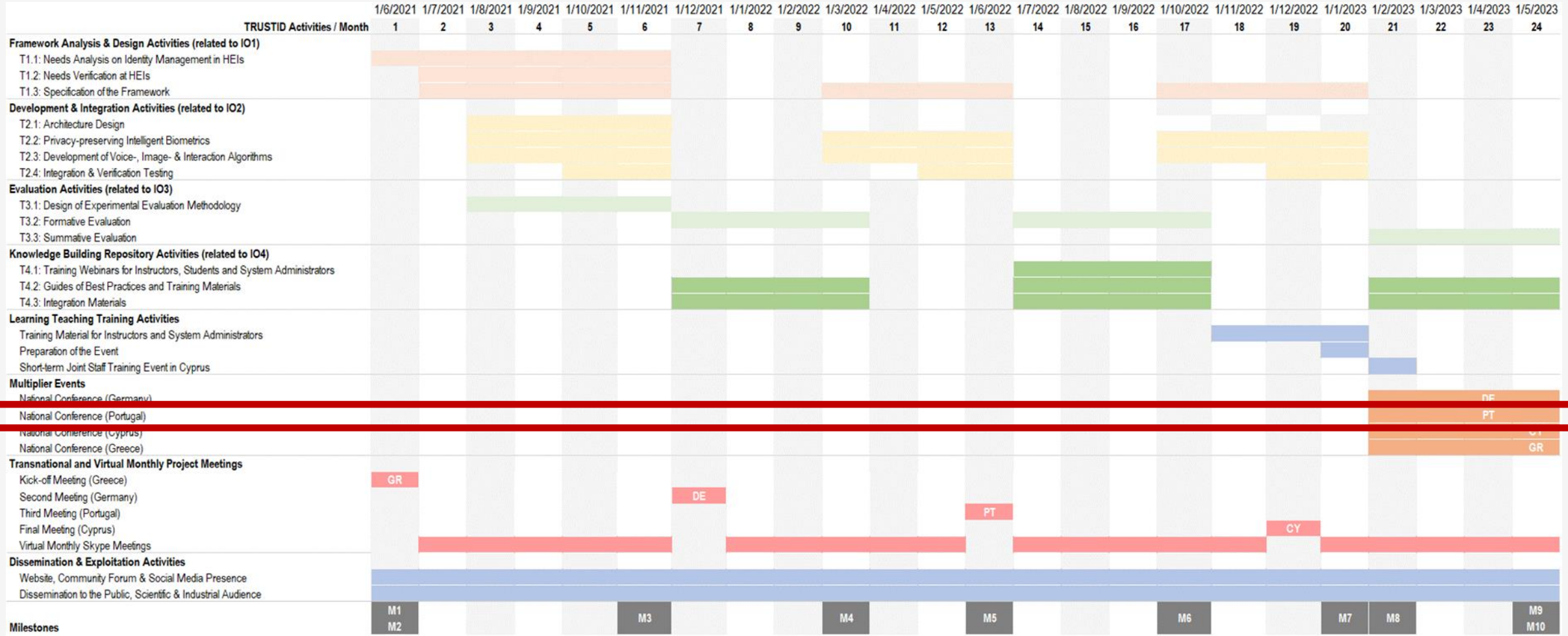

Intellectual Output 1 - Needs Analysis and Design of the Theoretical Framework for Continuous Student Identity Management

IO1 – Key Objectives

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- **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

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- 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

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- 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

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- 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

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- *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

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- **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

Perceived Credibility of Online Examinations during COVID-19

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- 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**

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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

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- *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

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- 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

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- 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

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

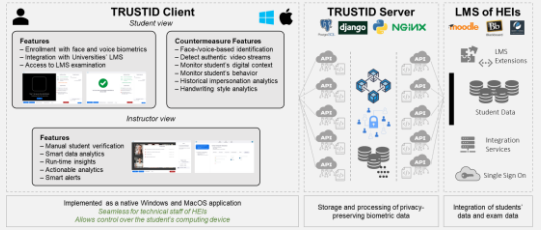
Output: Publications, Other, Dataset

- 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

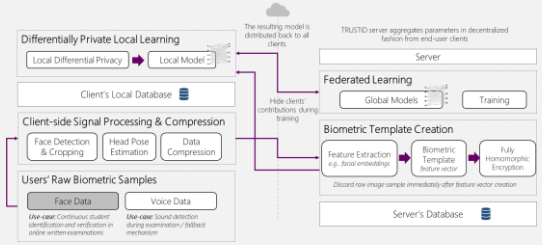
Specifications of the TRUSTID framework

- 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

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- 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)

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- 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)

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- **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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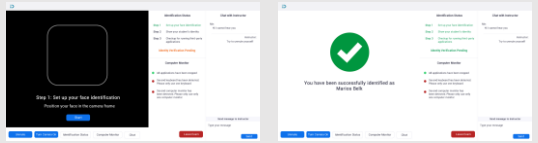
TRUSTID Client

Student view

Features
– Enrollment with face and voice biometrics
– Integration with Universities' LMS
– Access to LMS examination



Countermeasure Features
– Face-/voice-based identification
– Detect authentic video streams
– Monitor student's digital context
– Monitor student's behavior
– Historical impersonation analytics
– Handwriting style analytics

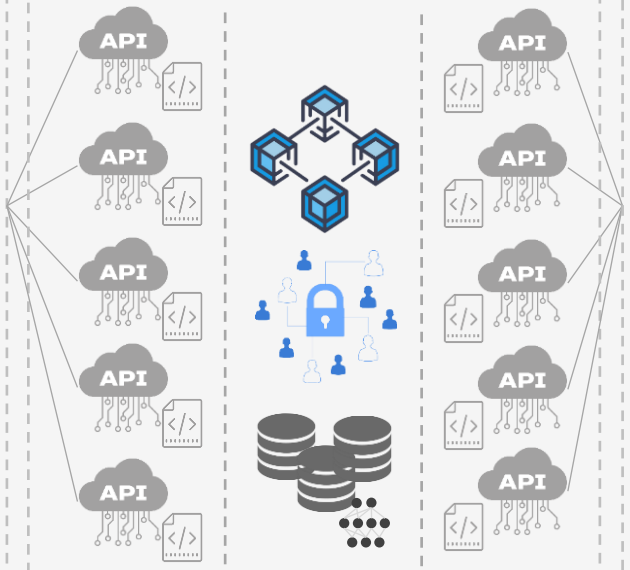
Instructor view

Features
– Manual student verification
– Smart data analytics
– Run-time insights
– Actionable analytics
– Smart alerts

Implemented as a native Windows and MacOS application
Seamless for technical staff of HEIs
Allows control over the student's computing device

TRUSTID Server

PostgreSQL · django · NGINX



Storage and processing of privacy-preserving biometric data

LMS of HEIs

moodle · Blackboard · openclass

LMS Extensions

Student Data

Integration Services

Single Sign On

Integration of students' data and exam data

Student Interaction

Server Architectural Design and Technology Stack

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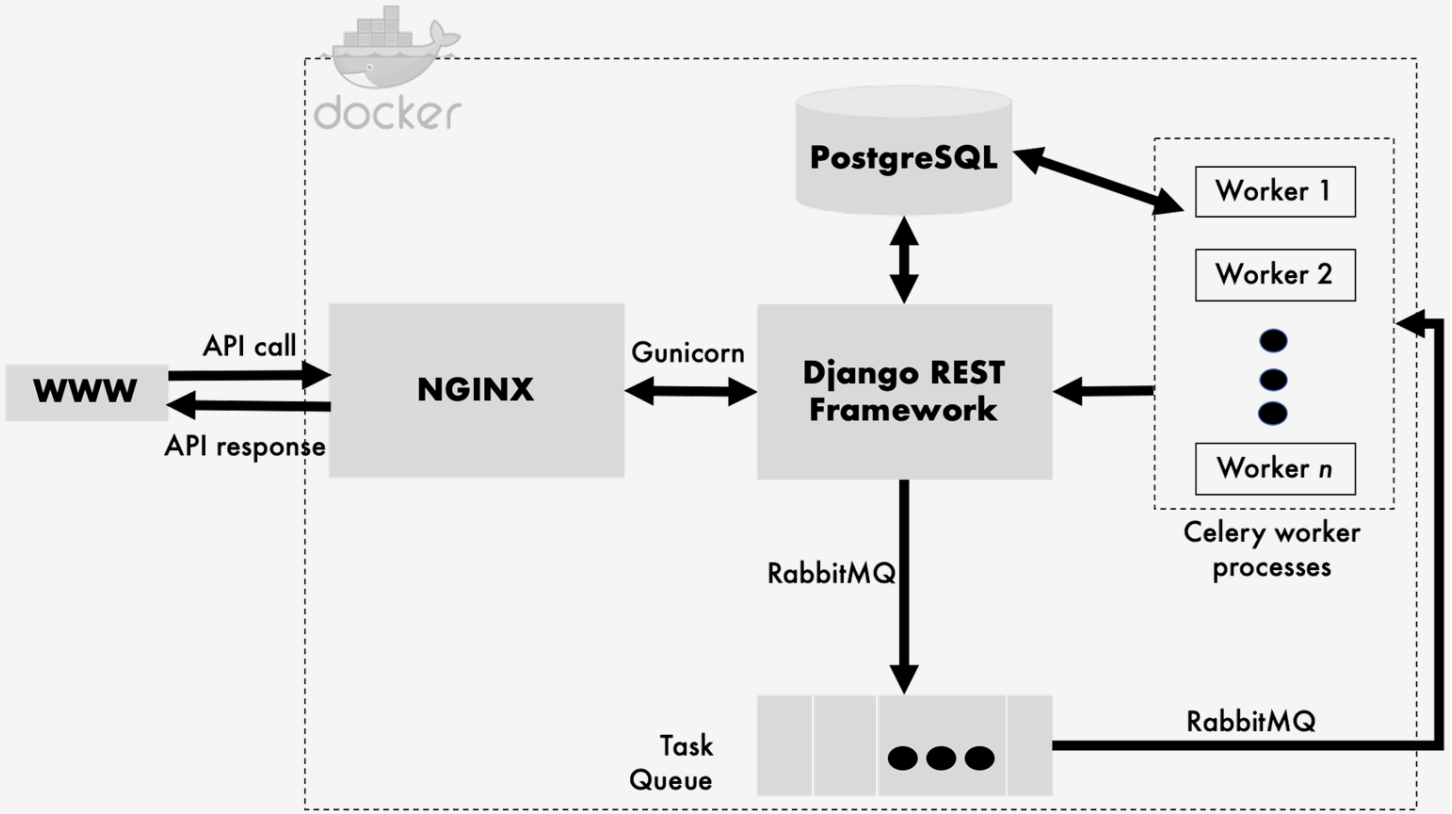
- Server-side **web API**
- **Django** REST Framework
- **NGINX** (Web server, Reverse proxy, Load balancer)
- **Gunicorn** (Application server that implements the Web Server Gateway Interface)
- **Celery** (Asynchronous task queue based on distributed message passing)
- **RabbitMQ** (Message broker)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



Client App: Integrated Login

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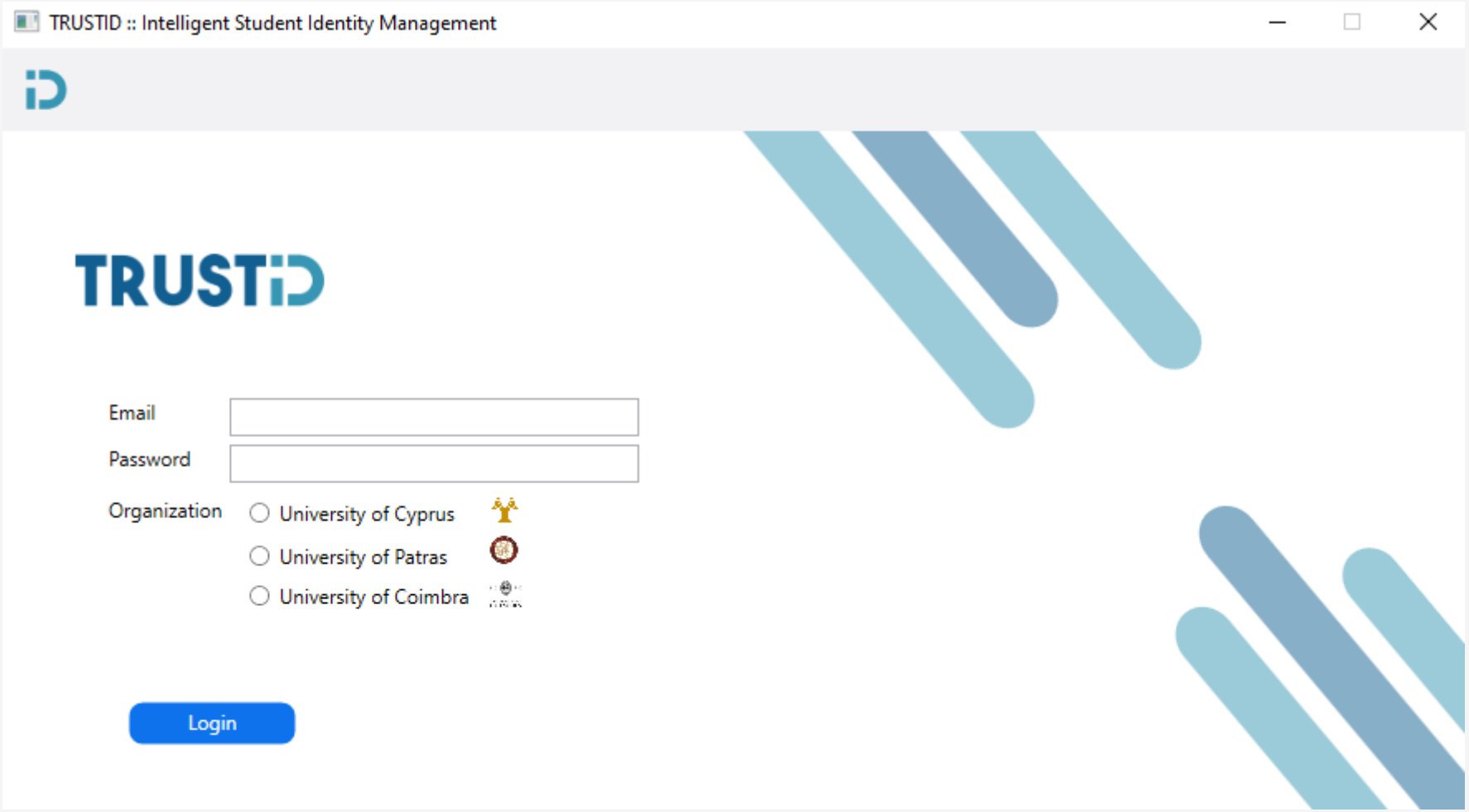

Client App: Register Face Biometrics

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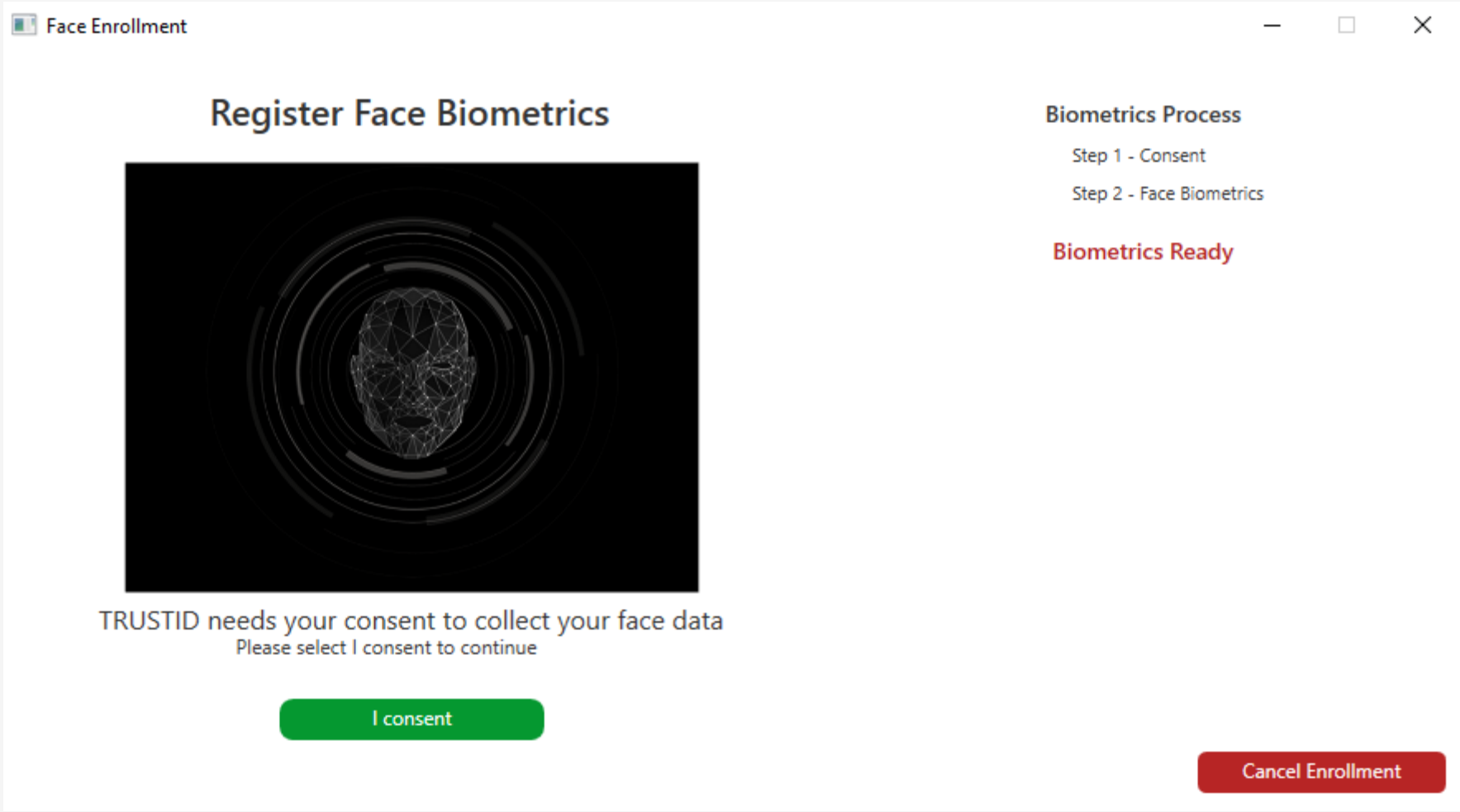

Client App: Register Voice Biometrics

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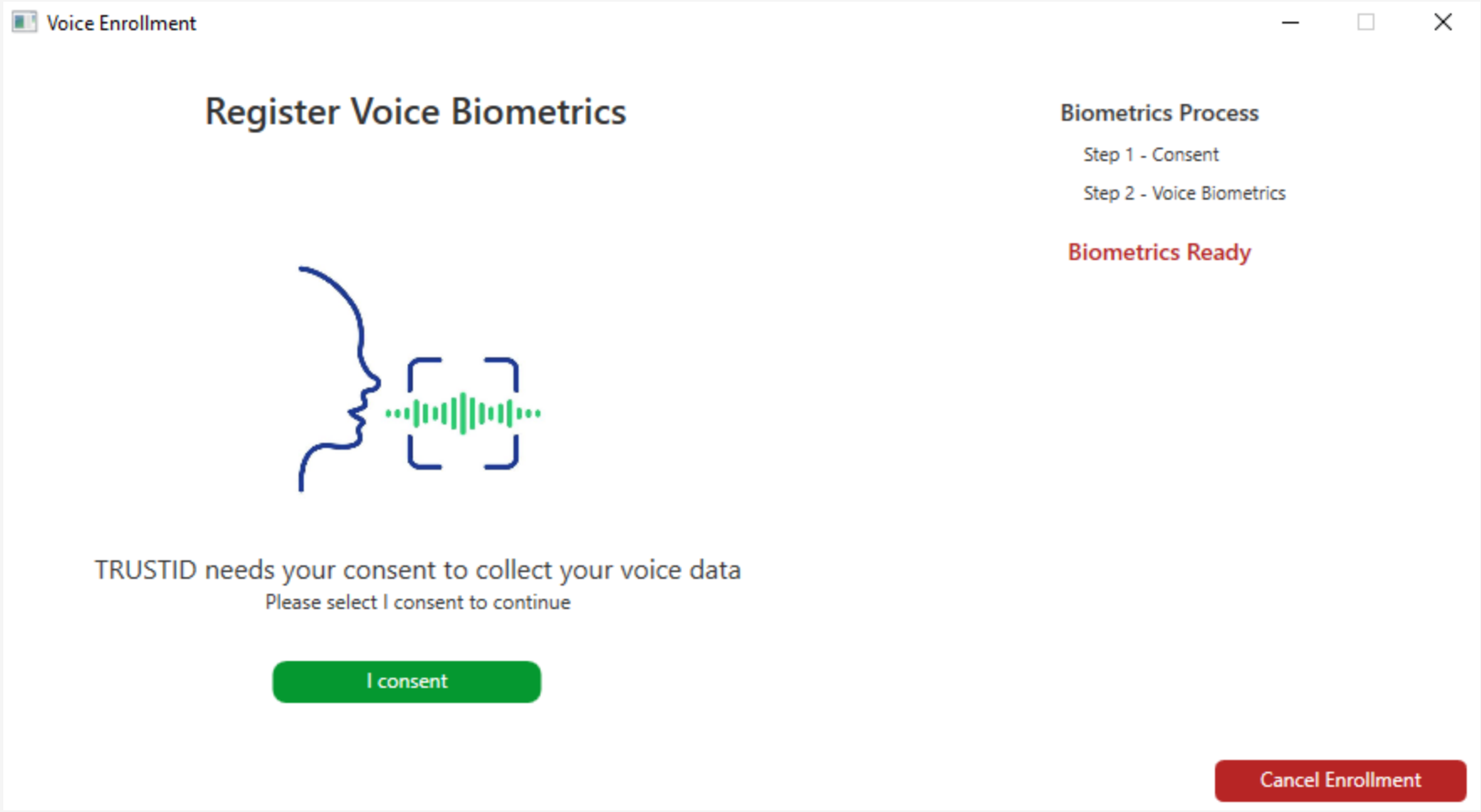

Client App: Control and Manage Biometrics

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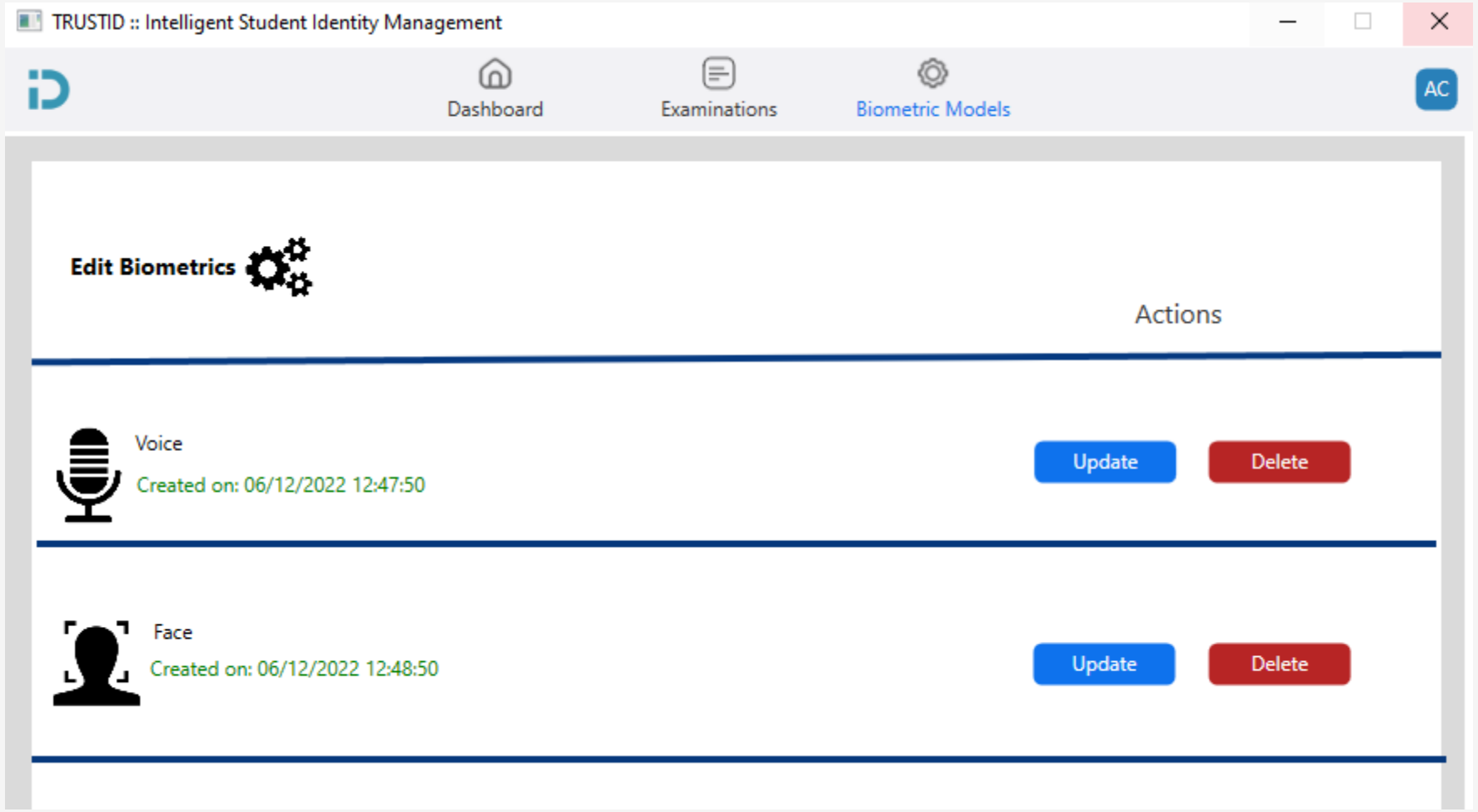

Client App: Continuous Face Identification

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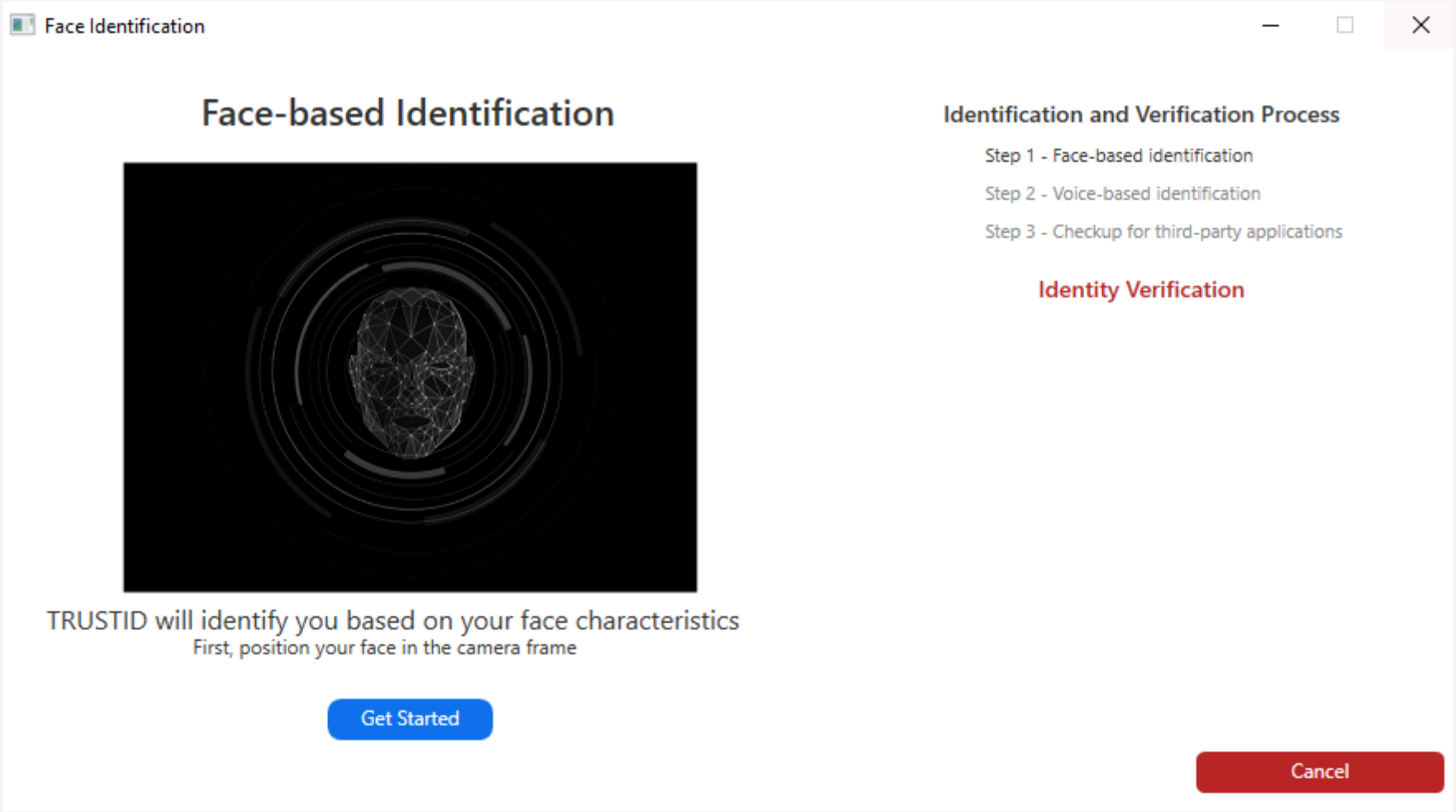

Client App: Continuous Voice Identification

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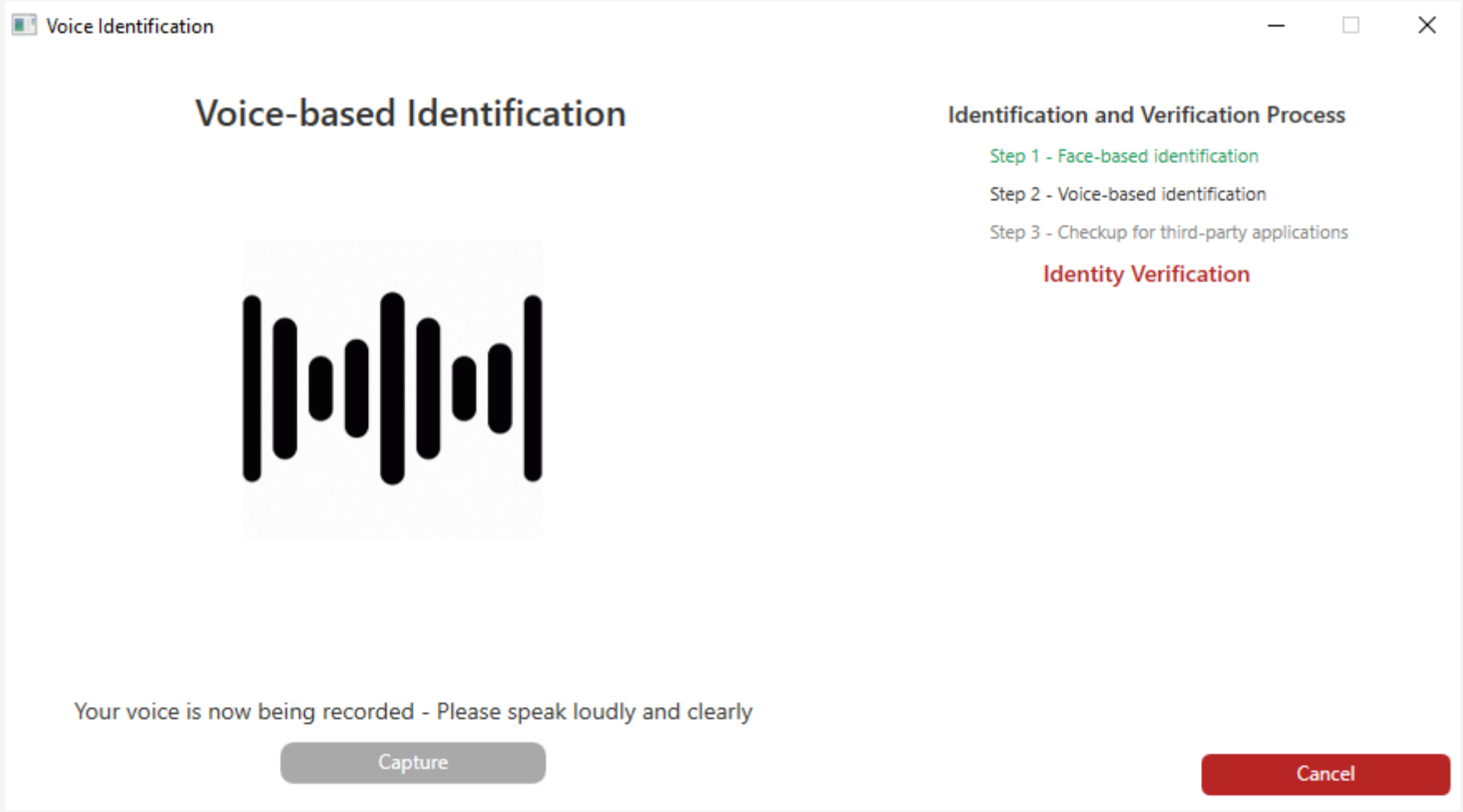

Client App: Digital Written Examination Scenario

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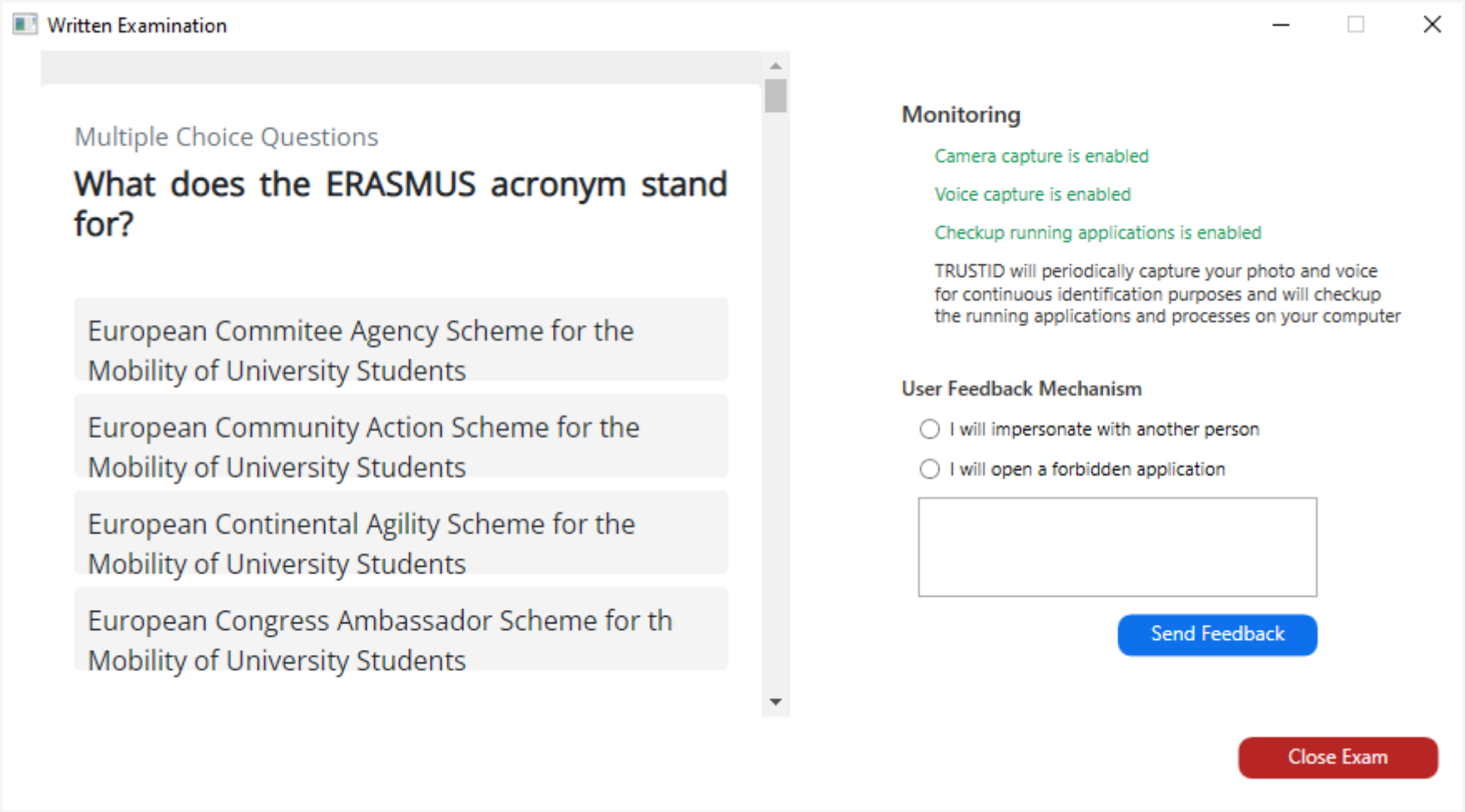

Client App: Oral Examination Scenario

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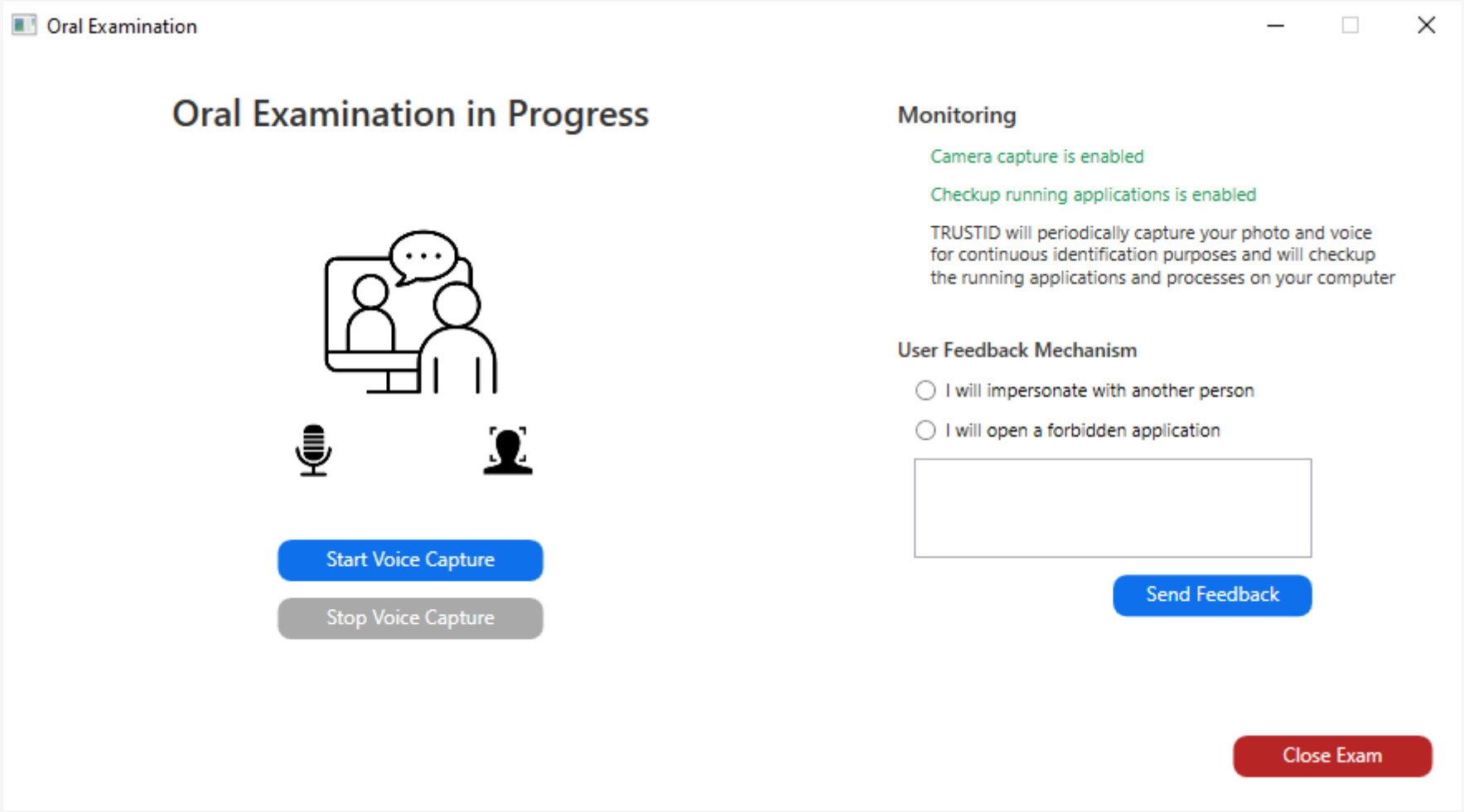

Client App: Examination Management Dashboard

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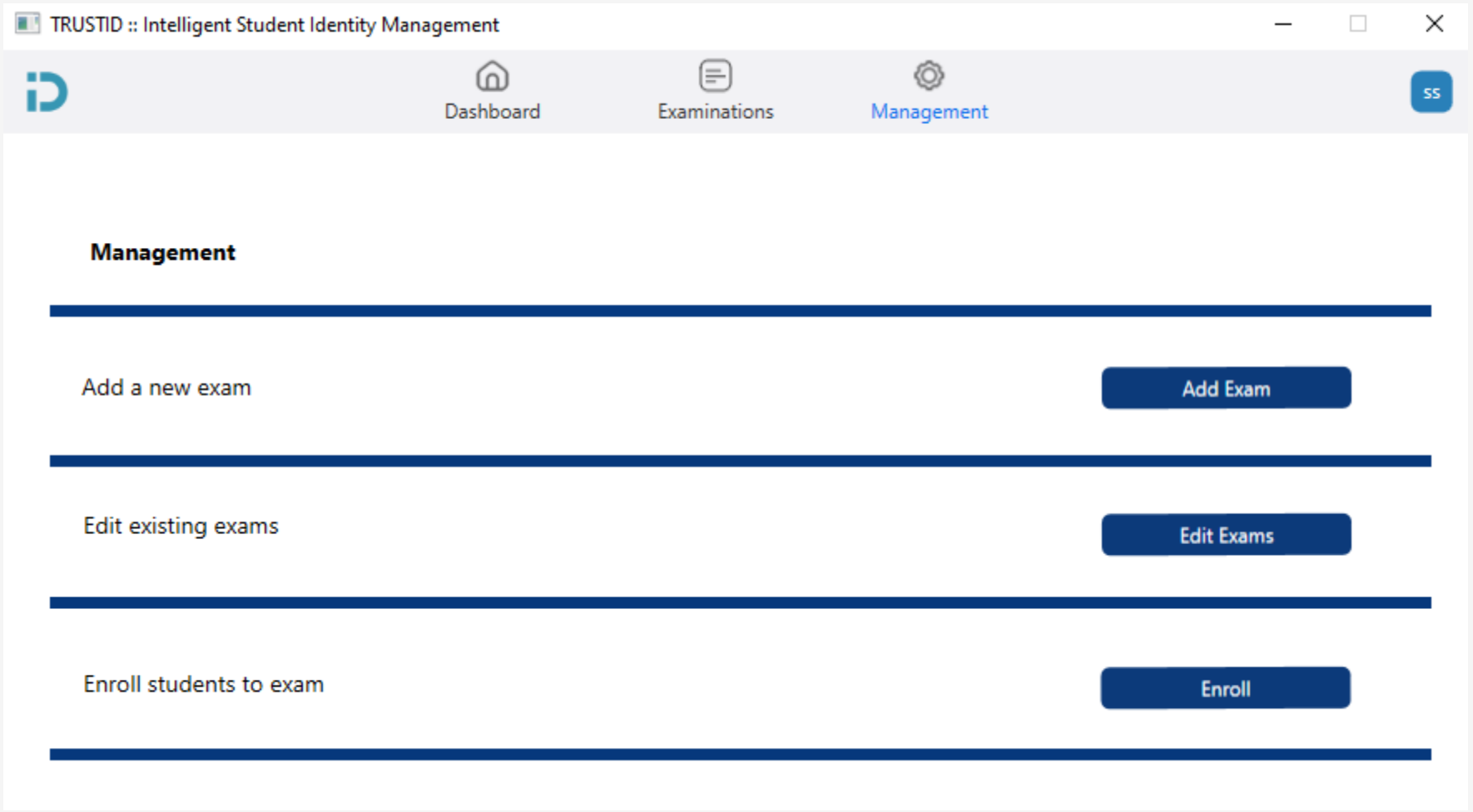

Client App: Examination Management

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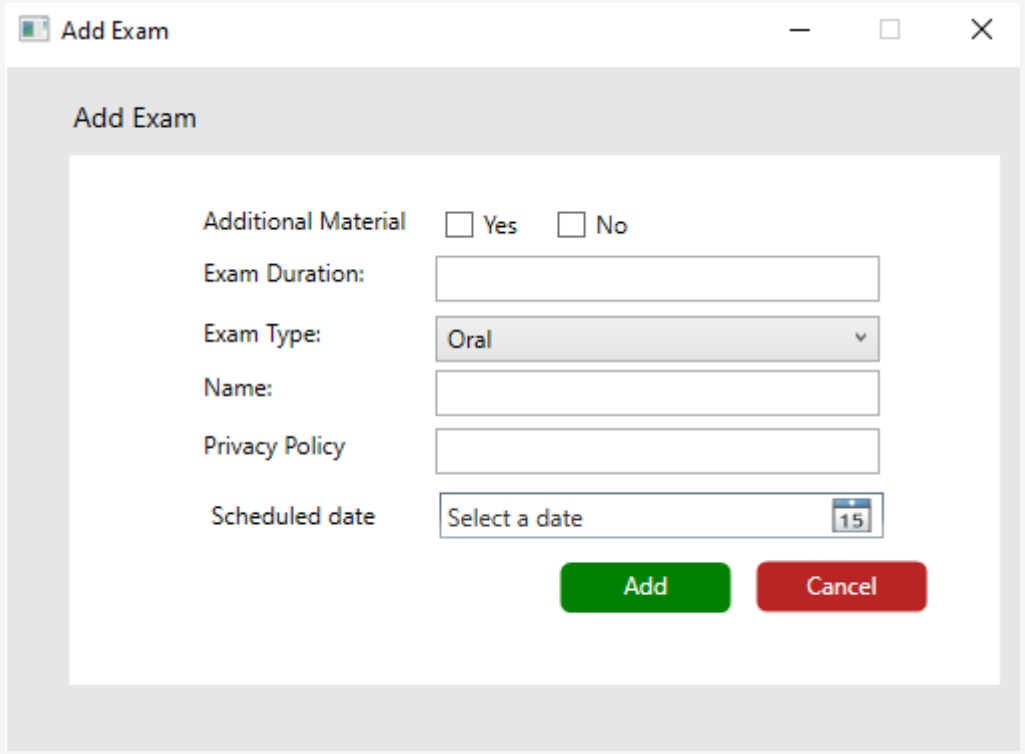

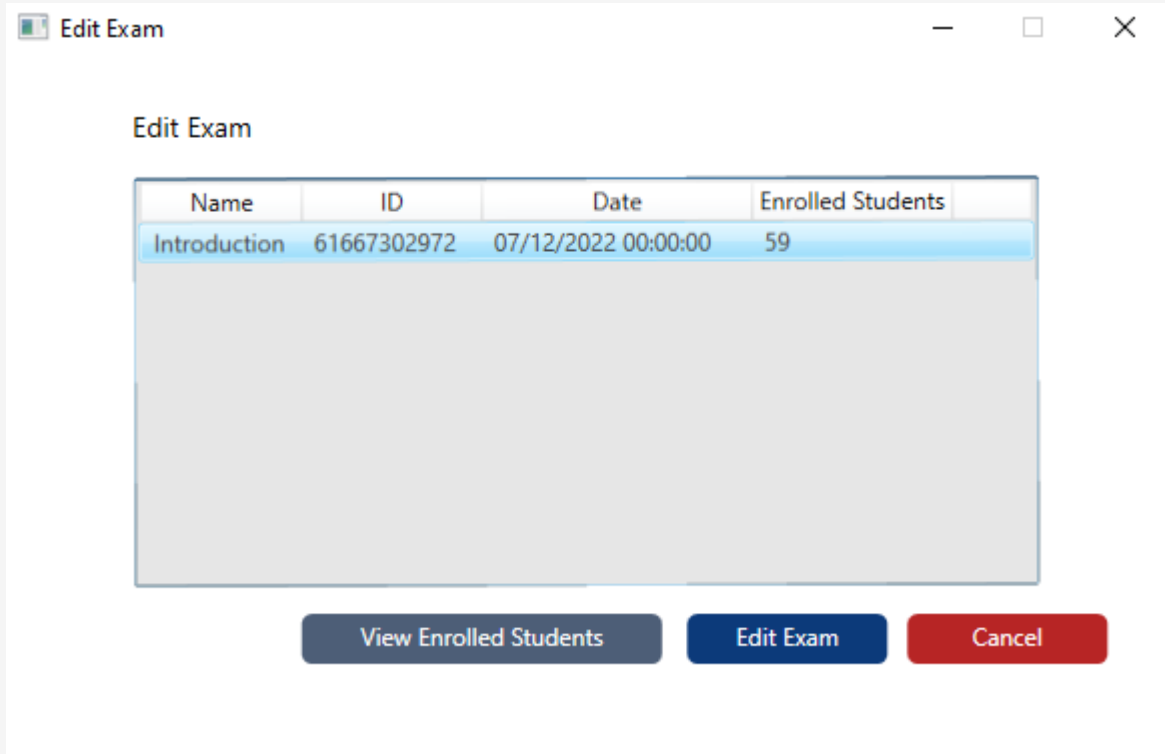

Client App: LMS Integration and Synchronization Tools

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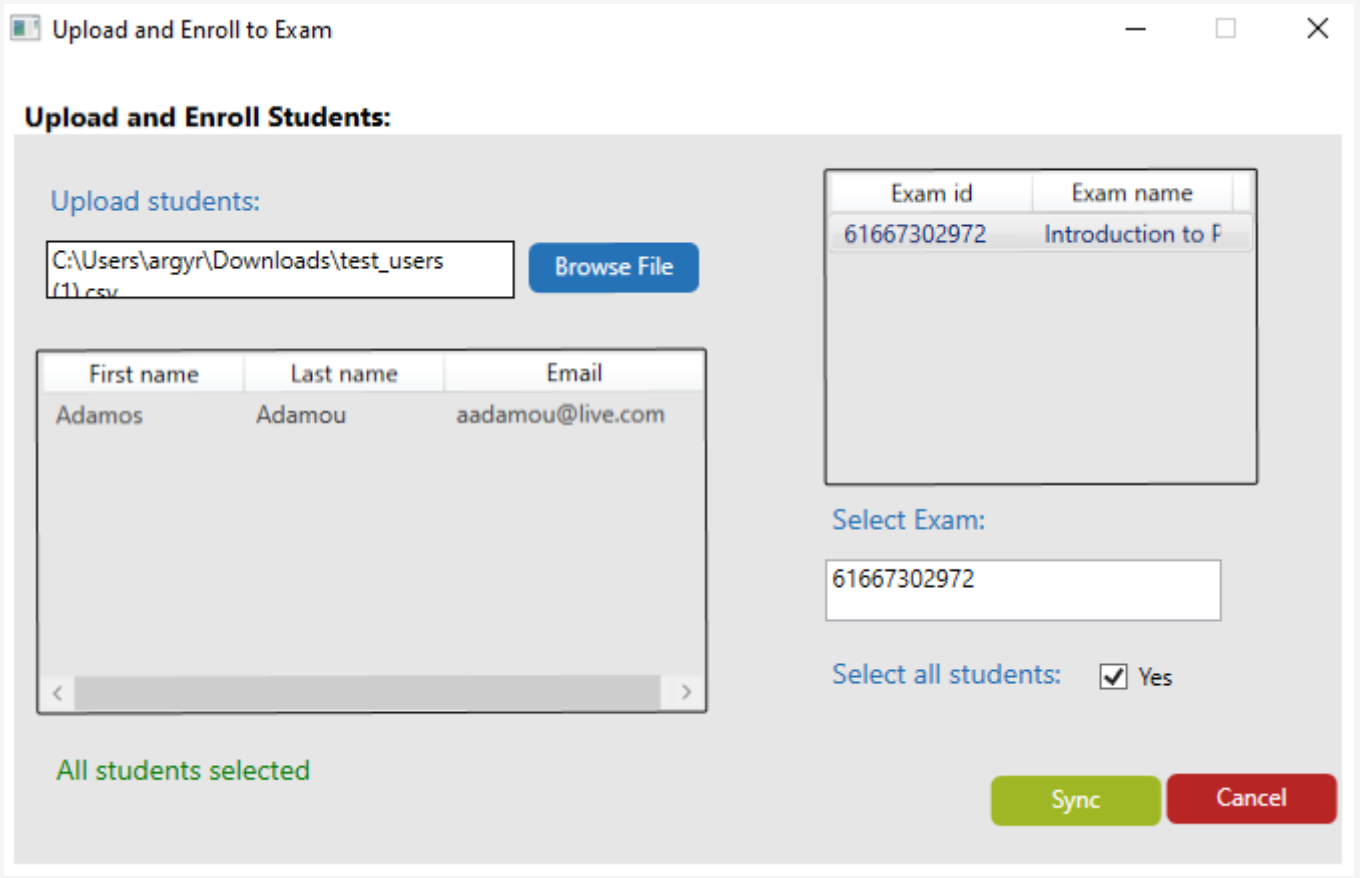

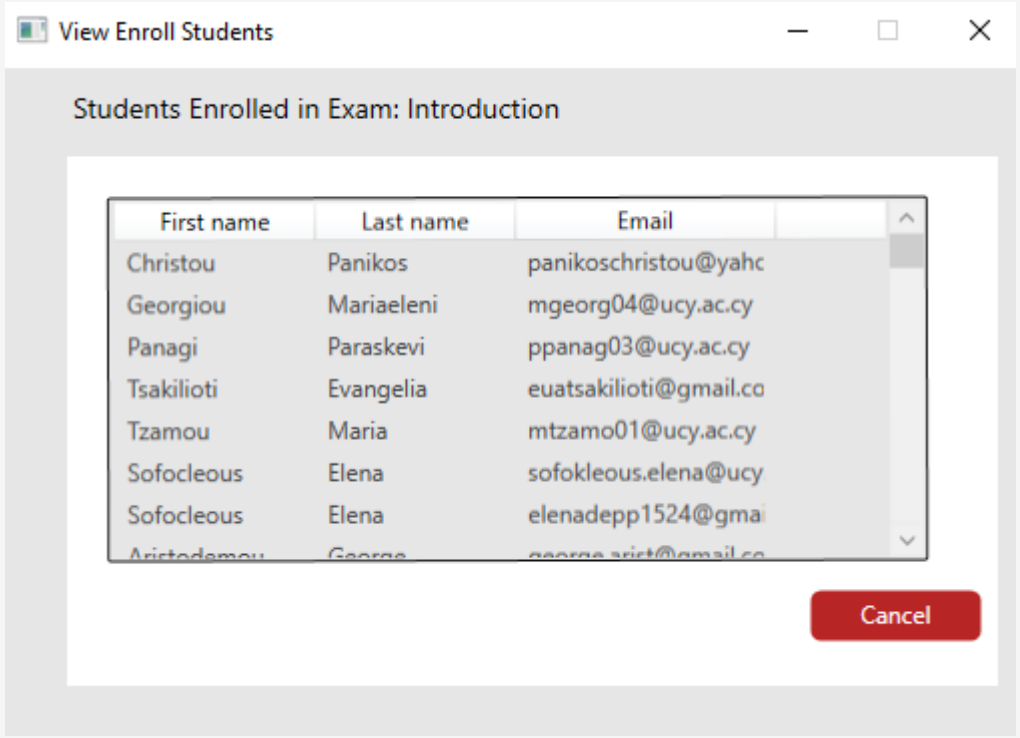

Smartphone App: Wallet for biometrics models

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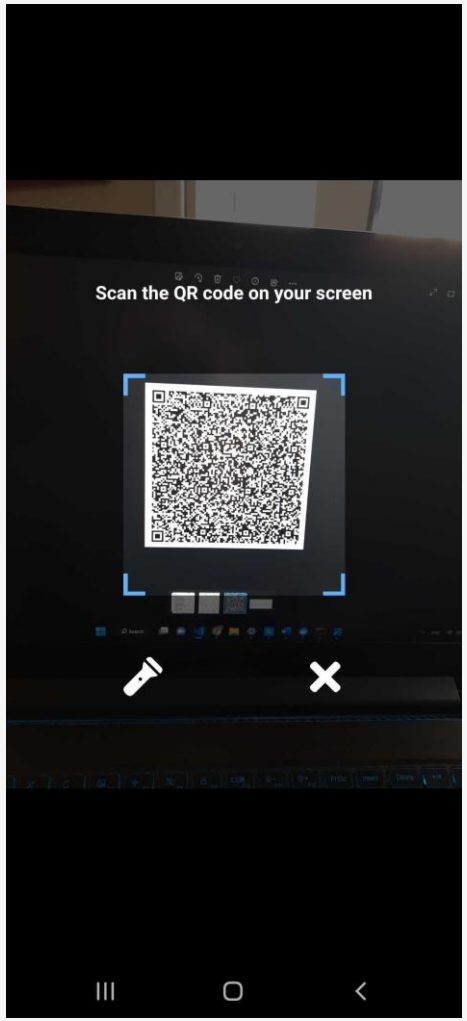
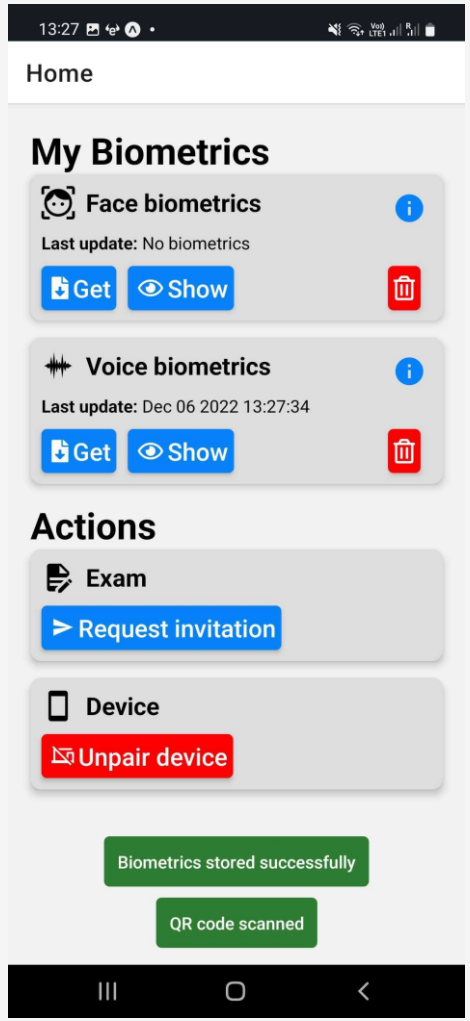
- Pair mobile application with TRUSTID system to fetch and store the biometric models locally





Smartphone App: Wallet for biometrics models

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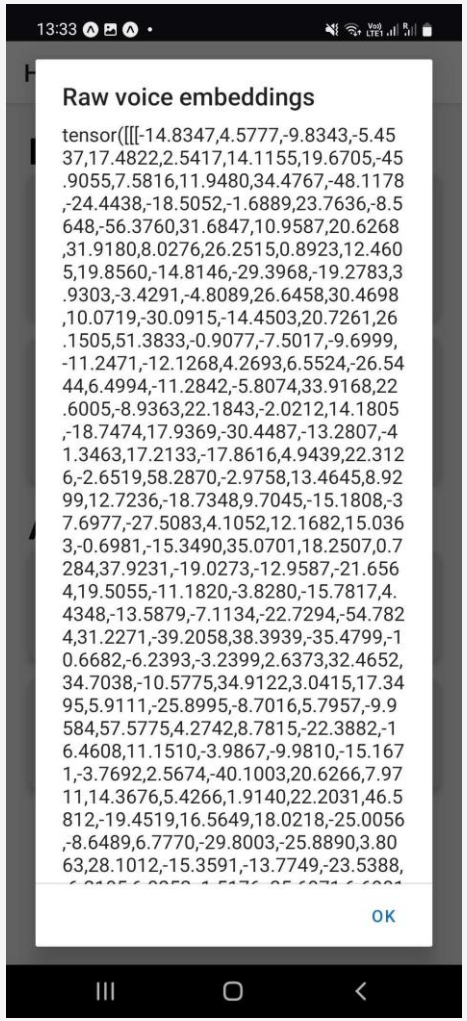
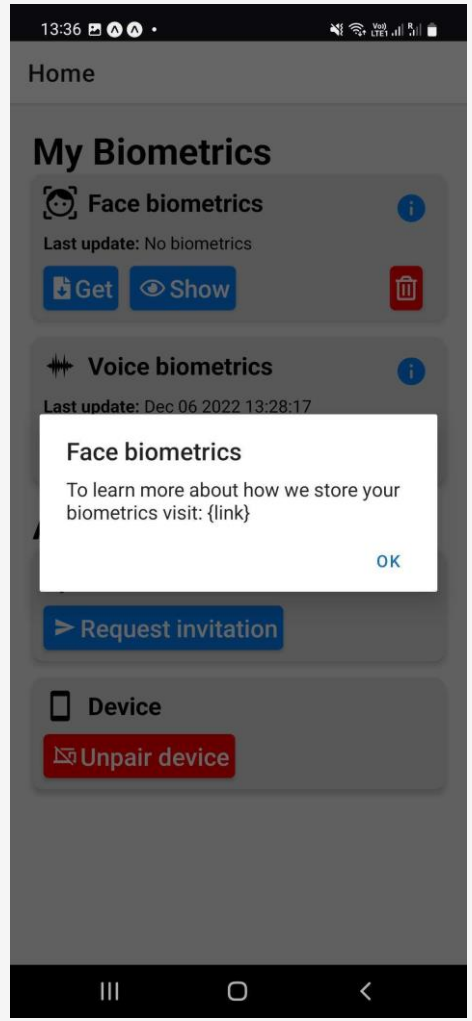
- Management of biometrics models
  - Display
  - Delete
  - Privacy policy





Smartphone App: Wallet for biometrics models

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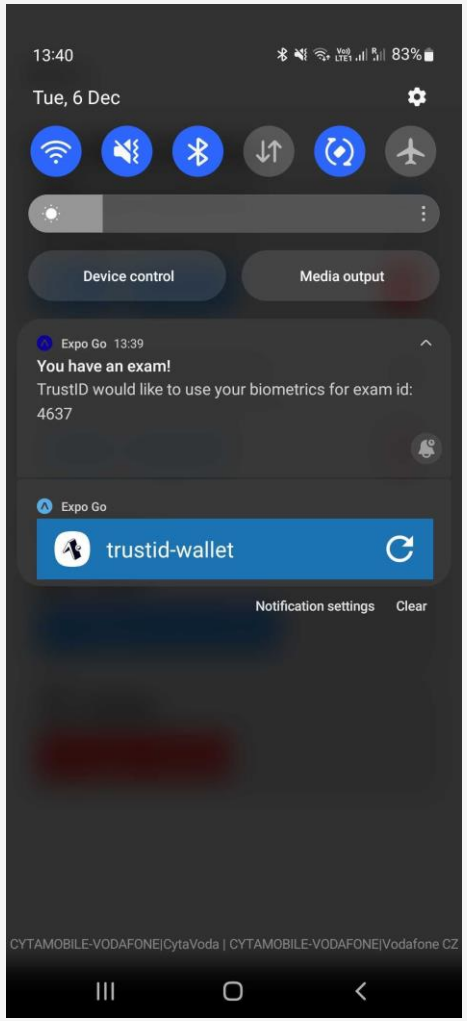
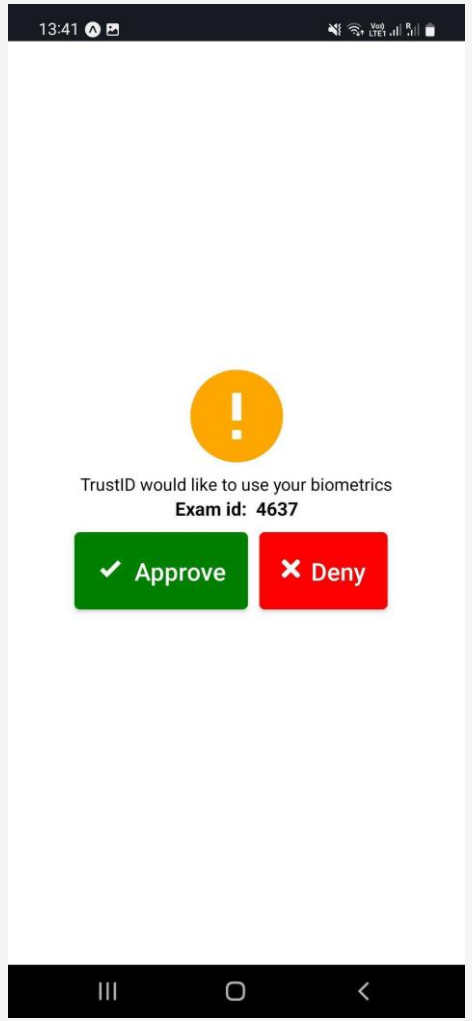
- Push notification for approval of sharing of biometrics models during online examination





Intellectual Output 2 - Tasks and Achievements

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

Output: Software, Services, Publications

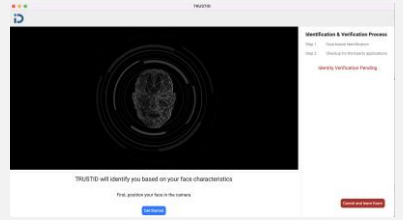
- Task 2.1: Architecture Design
- Task 2.2: Privacy-preserving Biometrics
- Task 2.3: Development of Voice-, Image- and Interaction-based Algorithms
- Task 2.4: Integration and Verification Testing

Achievements and Outputs

Face-based identification mechanism enrollment and continuous user identification

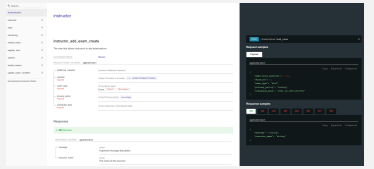
Voice-based and interaction-based identification mechanisms

Implemented a new **architecture for privacy-preservation**



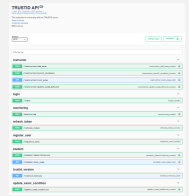
Prototype designs and implementations

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

Co-funded by the
Erasmus+ Programme
of the European Union

- 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

Co-funded by the
Erasmus+ Programme
of the European Union

- 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

Co-funded by the
Erasmus+ Programme
of the European Union

- **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

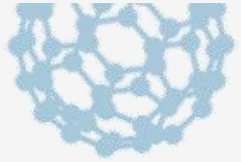
- Two types of studies:
  - **Formative**, conducted at early stages of the project, which aim at validating initial prototypes of the platform and get initial user feedback on likeability, perceived usability and security
  - **Summative**, conducted during the last months of the project to evaluate the effectiveness and feasibility of the proposed approach

Task 3.2: Formative Evaluation Report

Co-funded by the
Erasmus+ Programme
of the European Union

- 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

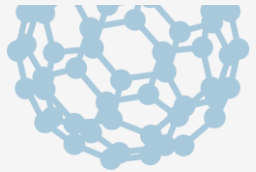


Formative
Evaluation

Task 3.3: Summative Evaluation Report

Co-funded by the
Erasmus+ Programme
of the European Union

- 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

PoC2 Evaluation

Co-funded by the
Erasmus+ Programme
of the European Union

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

Study Design 1/2

Co-funded by the
Erasmus+ Programme
of the European Union

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

Study Design 2/2

Co-funded by the
Erasmus+ Programme
of the European Union

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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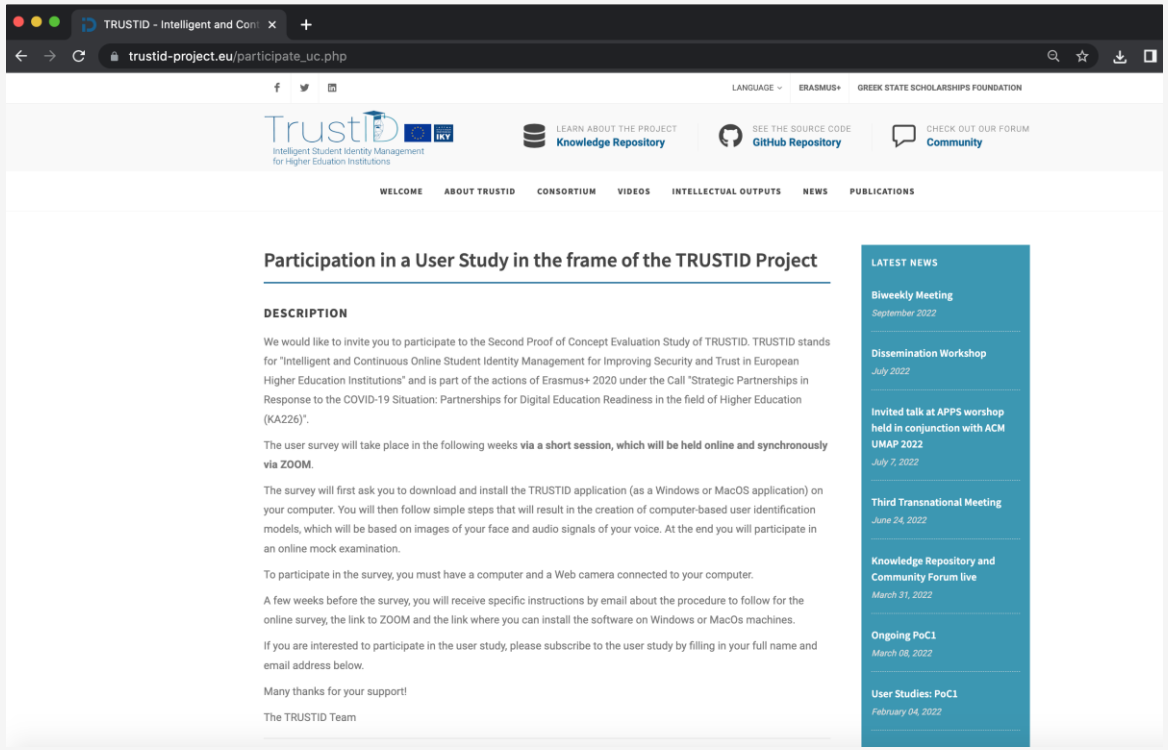
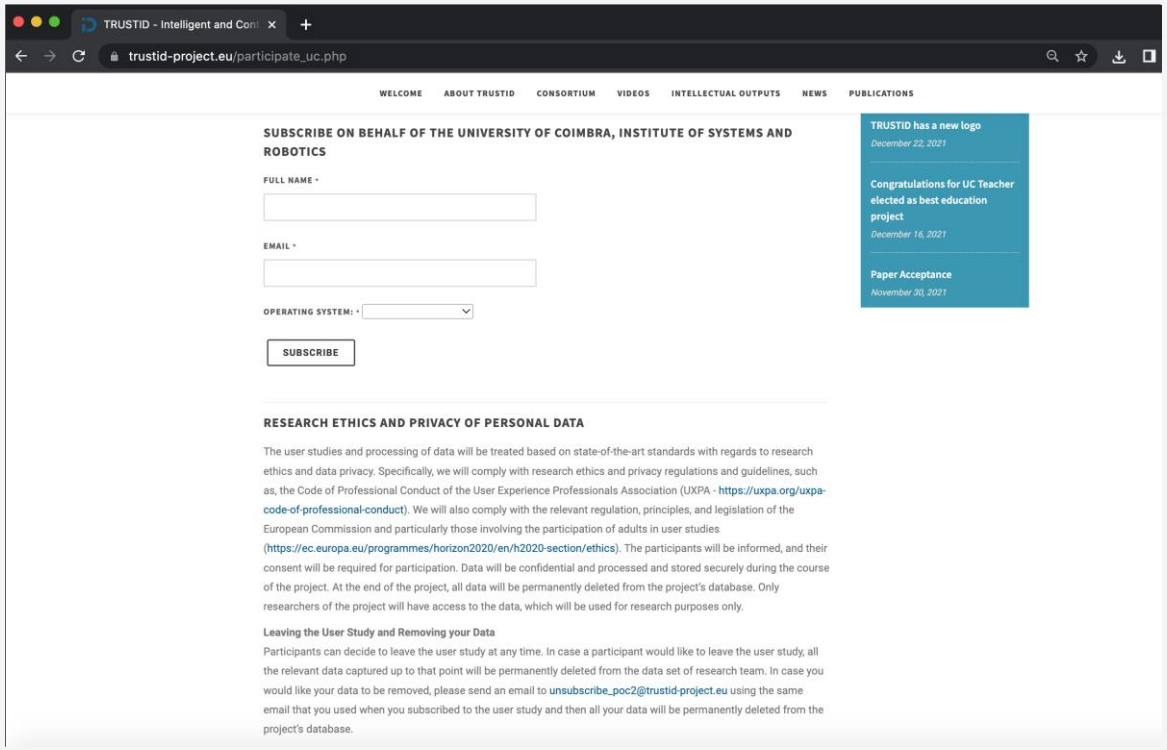


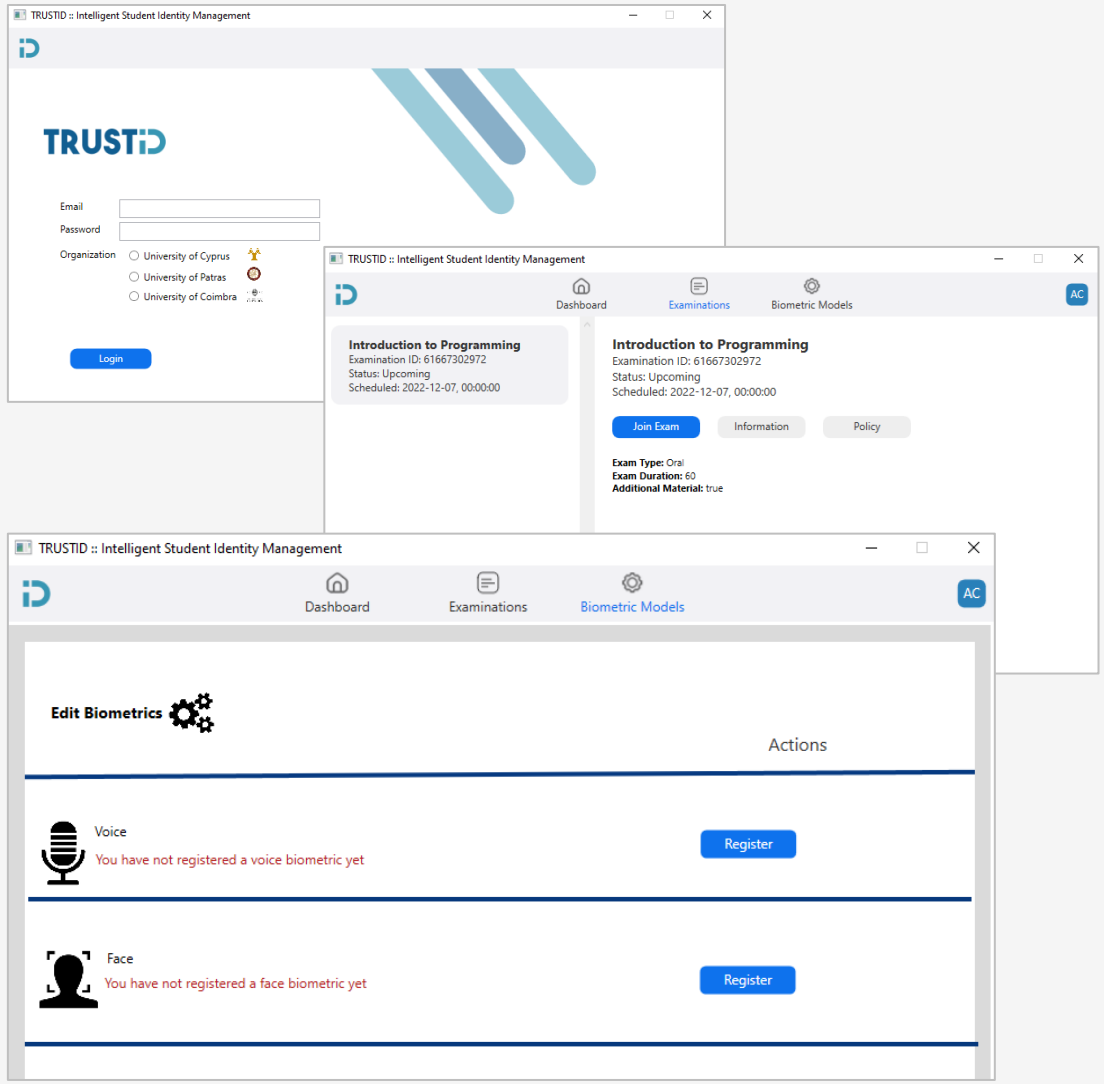


Student Biometrics Enrollment

Co-funded by the
Erasmus+ Programme
of the European Union

- Once the students log in to the system with their credentials, they select their examination through the TRUSTID dashboard

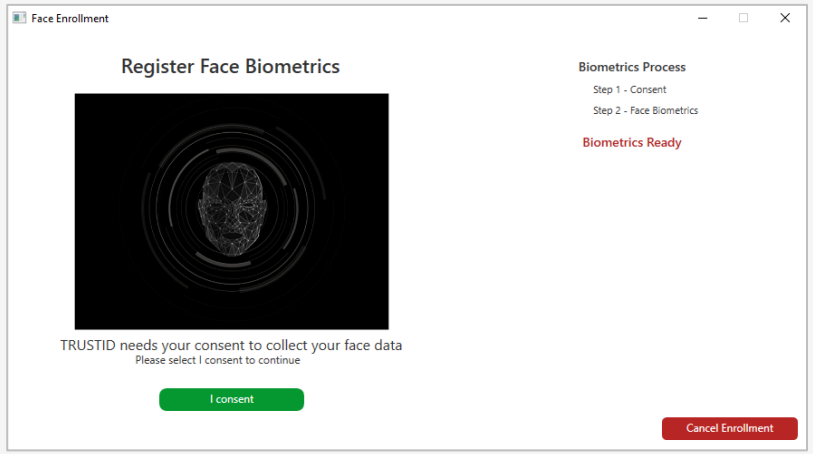
- Students are asked to enroll their biometrics (e.g., face, voice) through the biometrics management screen

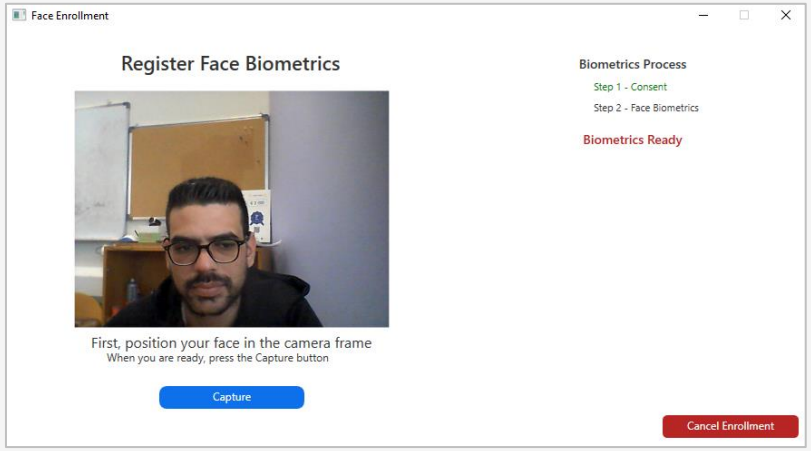


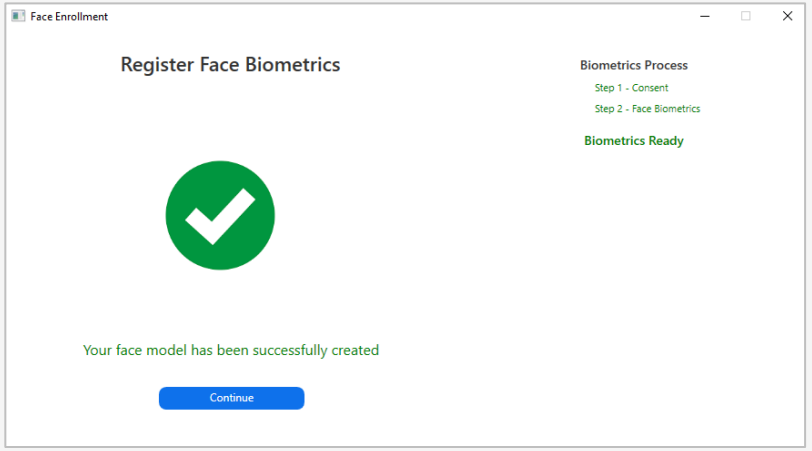
Student Biometrics Enrollment (Face)

Co-funded by the
Erasmus+ Programme
of the European Union

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



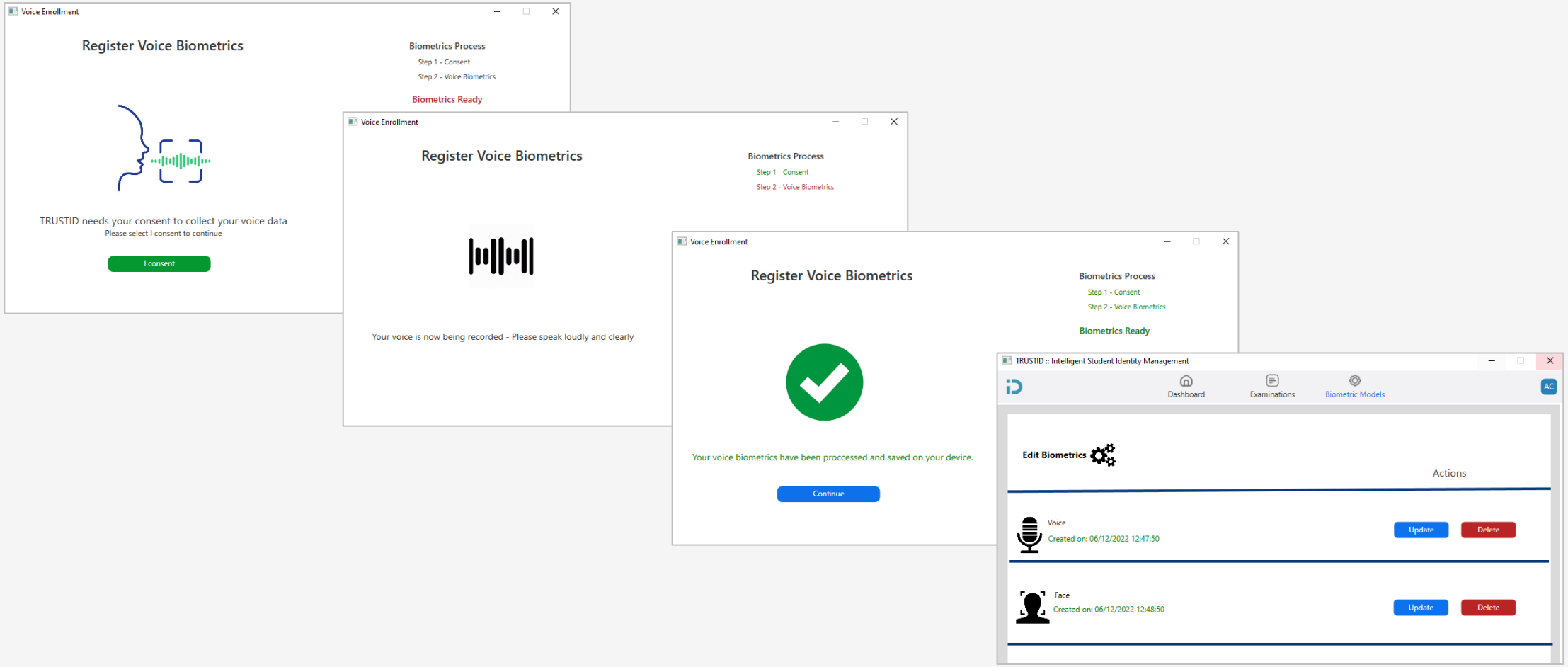




Student Biometrics Enrollment (Voice)

Co-funded by the
Erasmus+ Programme
of the European Union

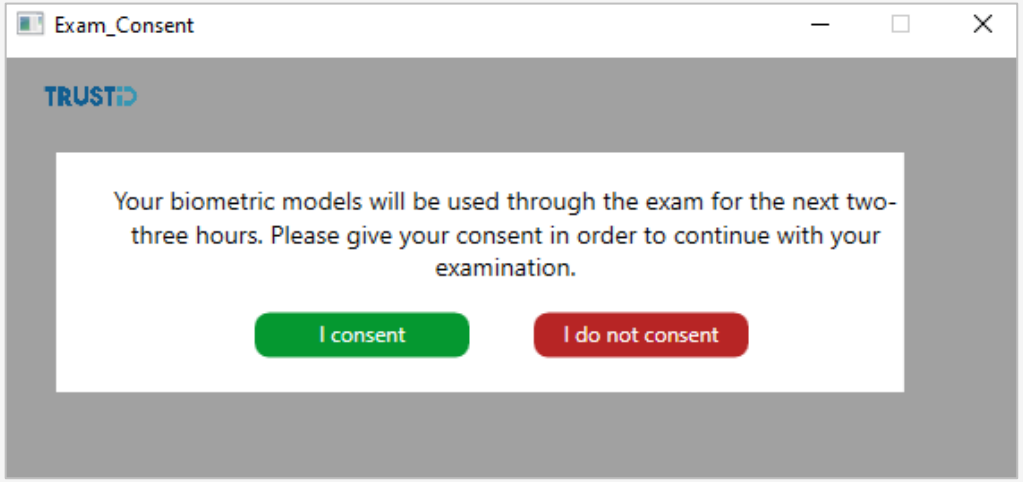
- The TRUSTID app captures student's voice data and generates the voice model



Student Identity Verification

Co-funded by the
Erasmus+ Programme
of the European Union

- 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)

Co-funded by the
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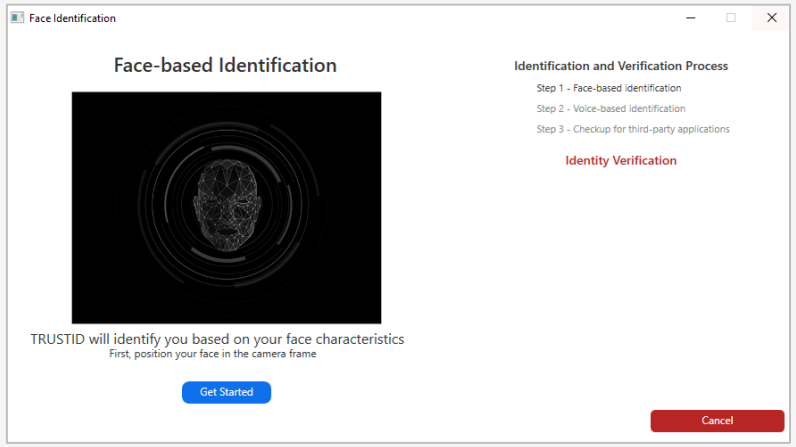
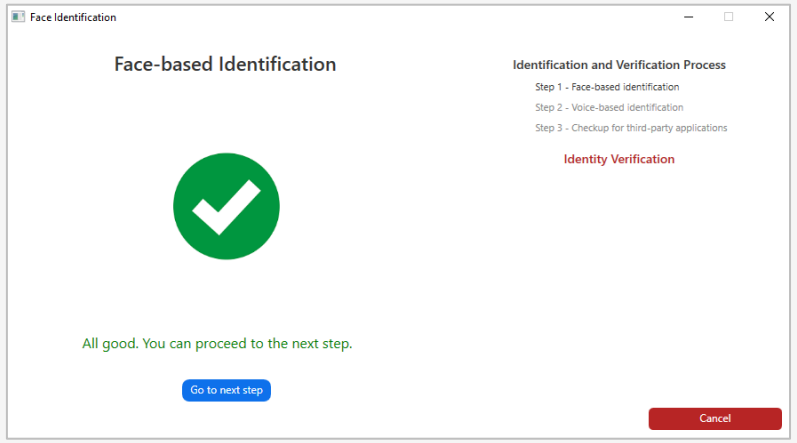
of the European Union

- 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)

Co-funded by the
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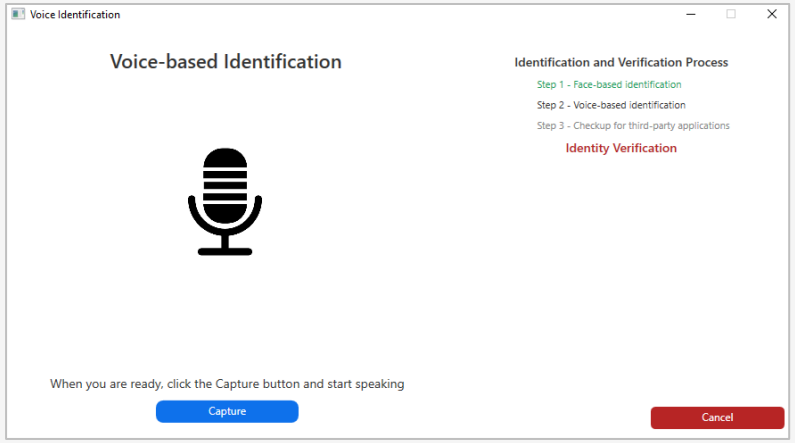
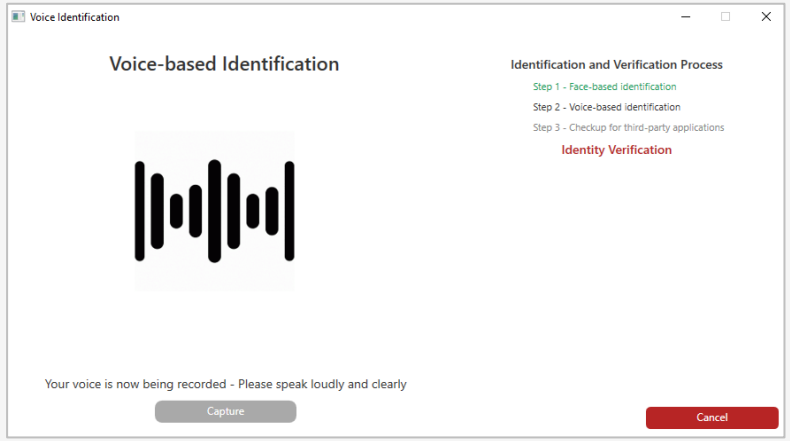
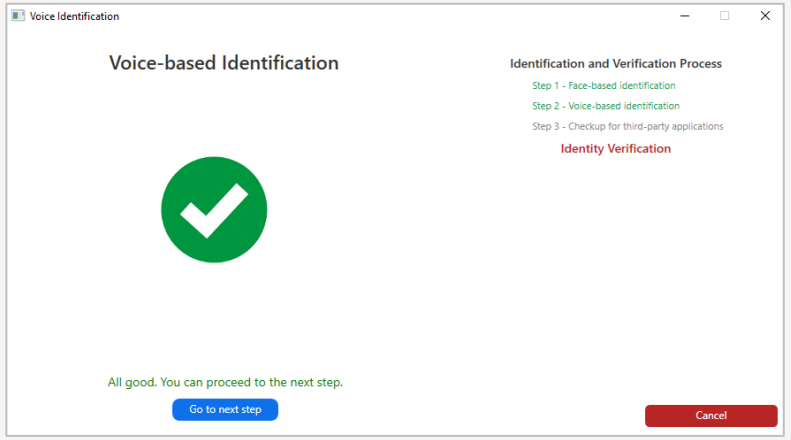
of the European Union

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



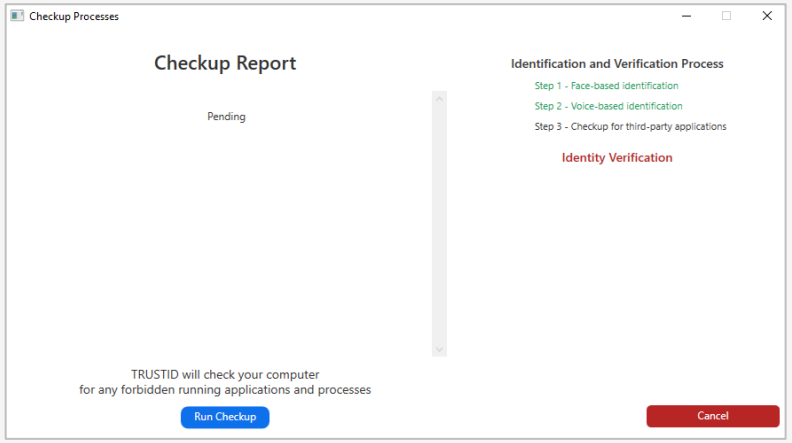


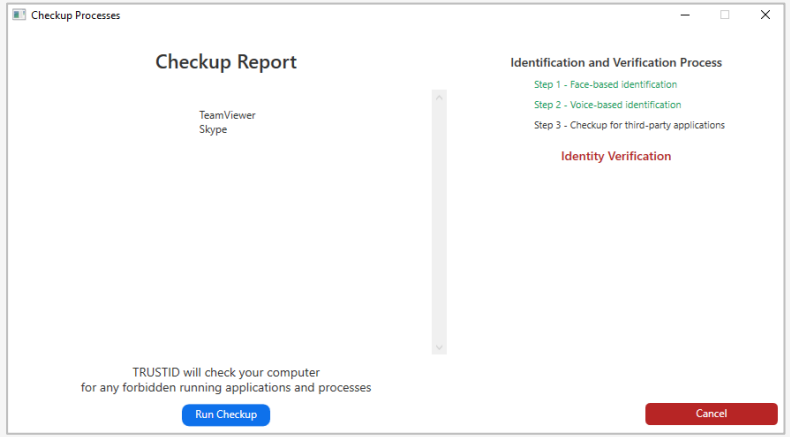


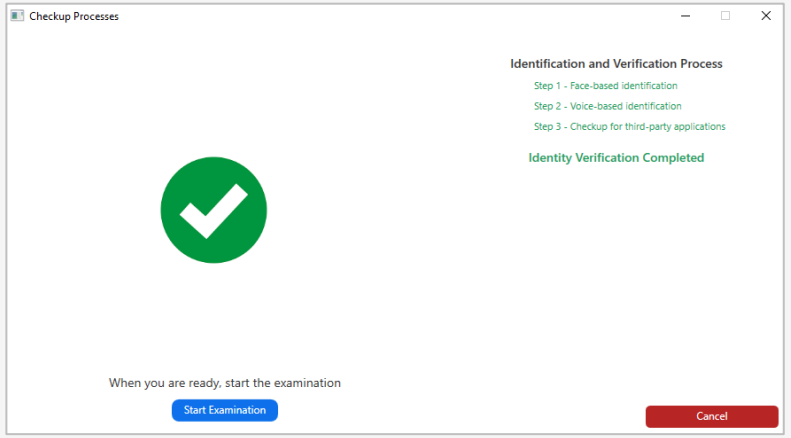
Student Identity Verification (Check Forbidden Apps)

Co-funded by the
Erasmus+ Programme
of the European Union

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



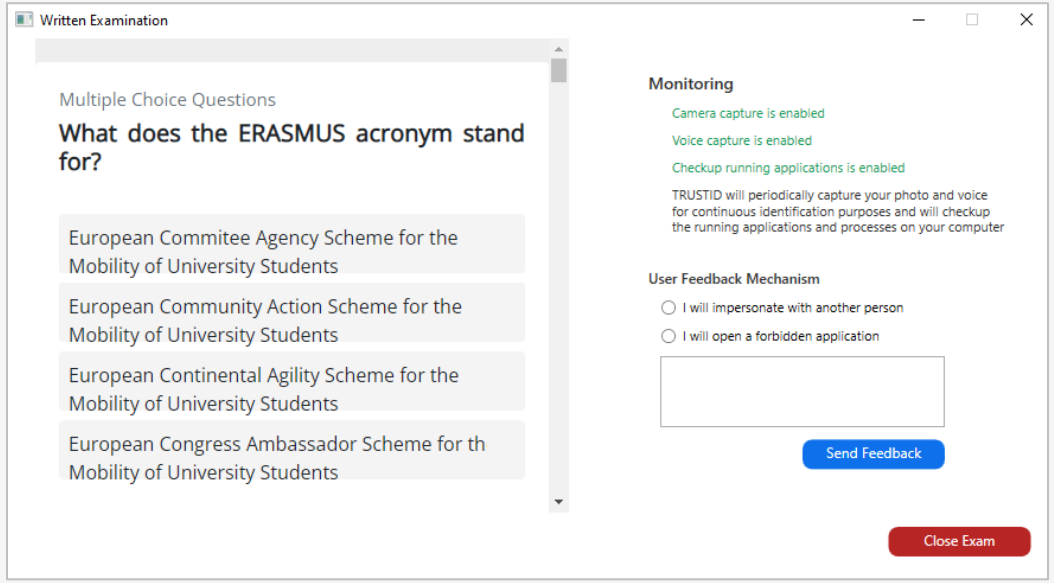




Continuous Student Identification

Co-funded by the
Erasmus+ Programme
of the European Union

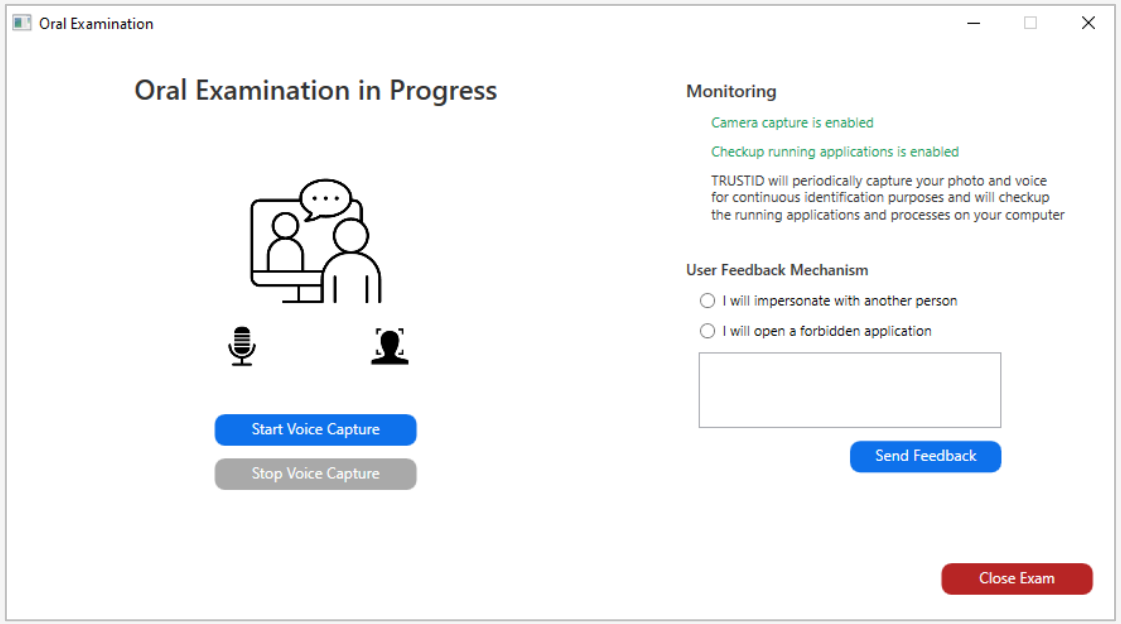
- The system continuously identifies the students through the face- and voice-based identification mechanism
  - Students are requested to misuse the system, e.g., conduct impersonation, engage in conversation with another person, etc.



Monitoring the Student's Computing Device

Co-funded by the
Erasmus+ Programme
of the European Union

- 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

Co-funded by the
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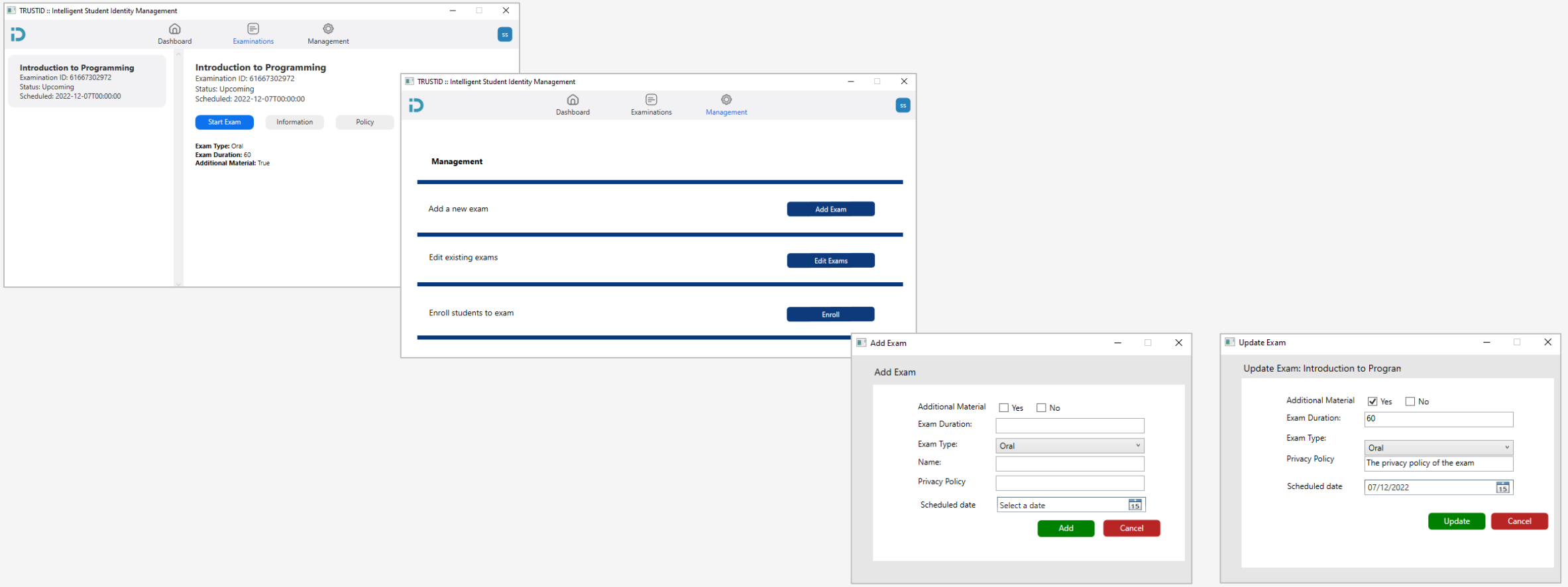
of the European Union

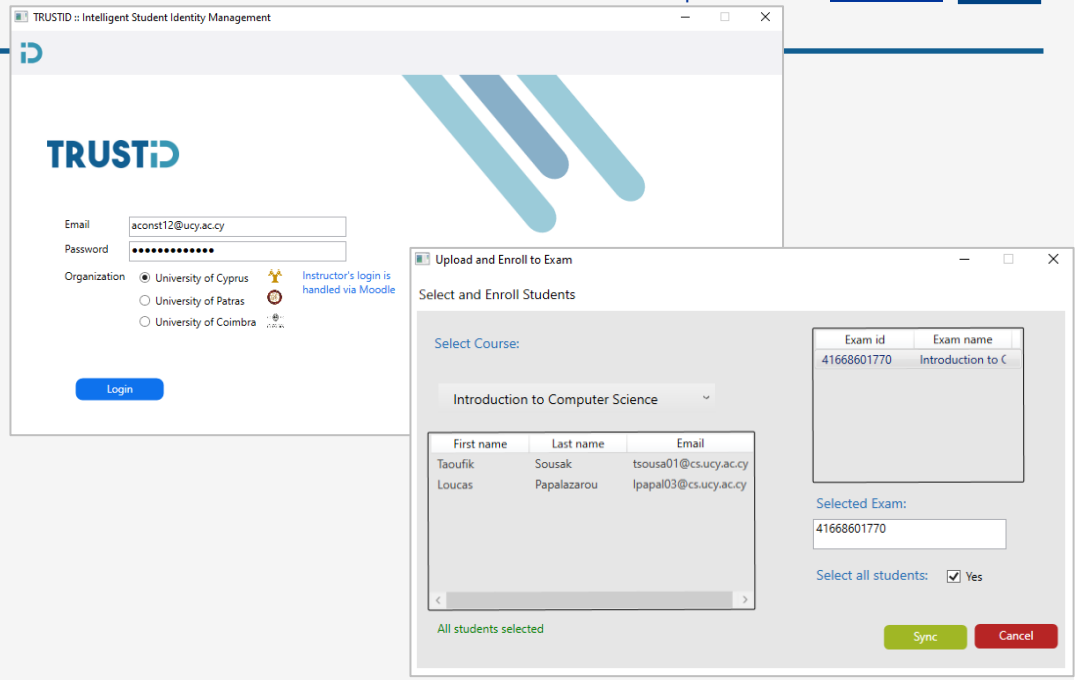
- Add/Update examination



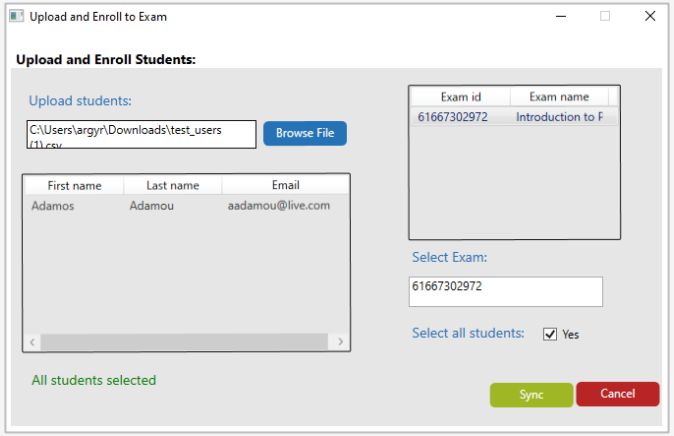
LMS Integration

Co-funded by the
Erasmus+ Programme
of the European Union

- Moodle integration
  - Fetch students' information and automatically enroll to TRUSTID



- Instructors upload .csv with students' information exported from other LMS



Resilience to Impersonation Attacks

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Summary of the sample and the collected data

Mock Examination Type	# of Participants	# of Face Images	Audio Samples Length (in minutes)
Online Written	65	1804	75.68
Online Oral	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)
Online Written	24	391	31.04
Online Oral	32	582	52.73
Totals	56	973	83.77

Summary of the results for each identification case

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of the European Union

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

Failures mainly occur due to:

i) face occlusion,

ii) inappropriate lighting conditions

iii) specific head poses

Key Findings

Co-funded by the
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of the European Union

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

Co-funded by the Erasmus+ Programme of the European Union

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

Intellectual Output 4 (IO4)

Co-funded by the
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of the European Union

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

Co-funded by the
Erasmus+ Programme
of the European Union

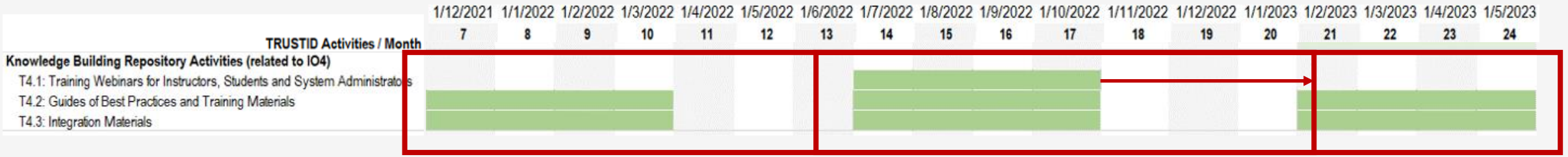
- T4.1: Training Webinars
  - *Lead: Institute of Systems and Robotics (ISR)*

July 2022 – Feb 2023

- T4.2: Best Practice Guides
  - *Lead: Institute of Systems and Robotics (ISR)*

Until EoP
(May 2023)

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



T4.1: Training Webinars

Co-funded by the
Erasmus+ Programme
of the European Union

- 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).

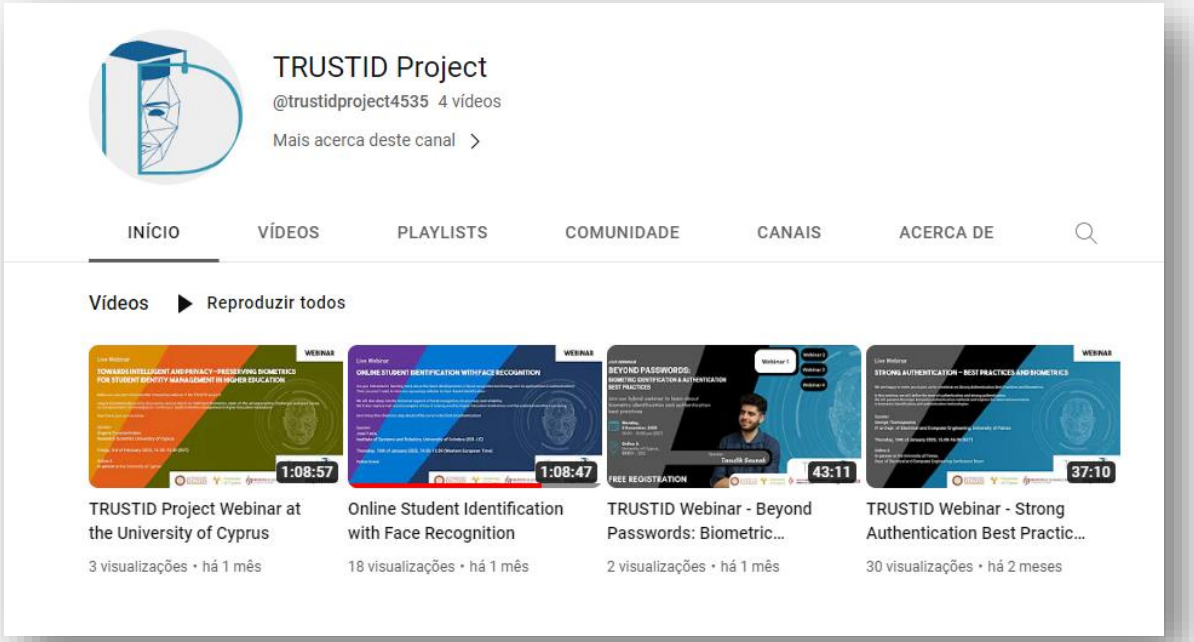
- Designed to inform HEIs stakeholders on **why**, **when** and **how** to adopt continuous student identification.

- **Four webinars** were conducted: one by **each partner organization.**

T4.1: Training Webinars

Co-funded by the
Erasmus+ Programme
of the European Union

- **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

Co-funded by the
Erasmus+ Programme
of the European Union

- **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

Co-funded by the Erasmus+ Programme of the European Union

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

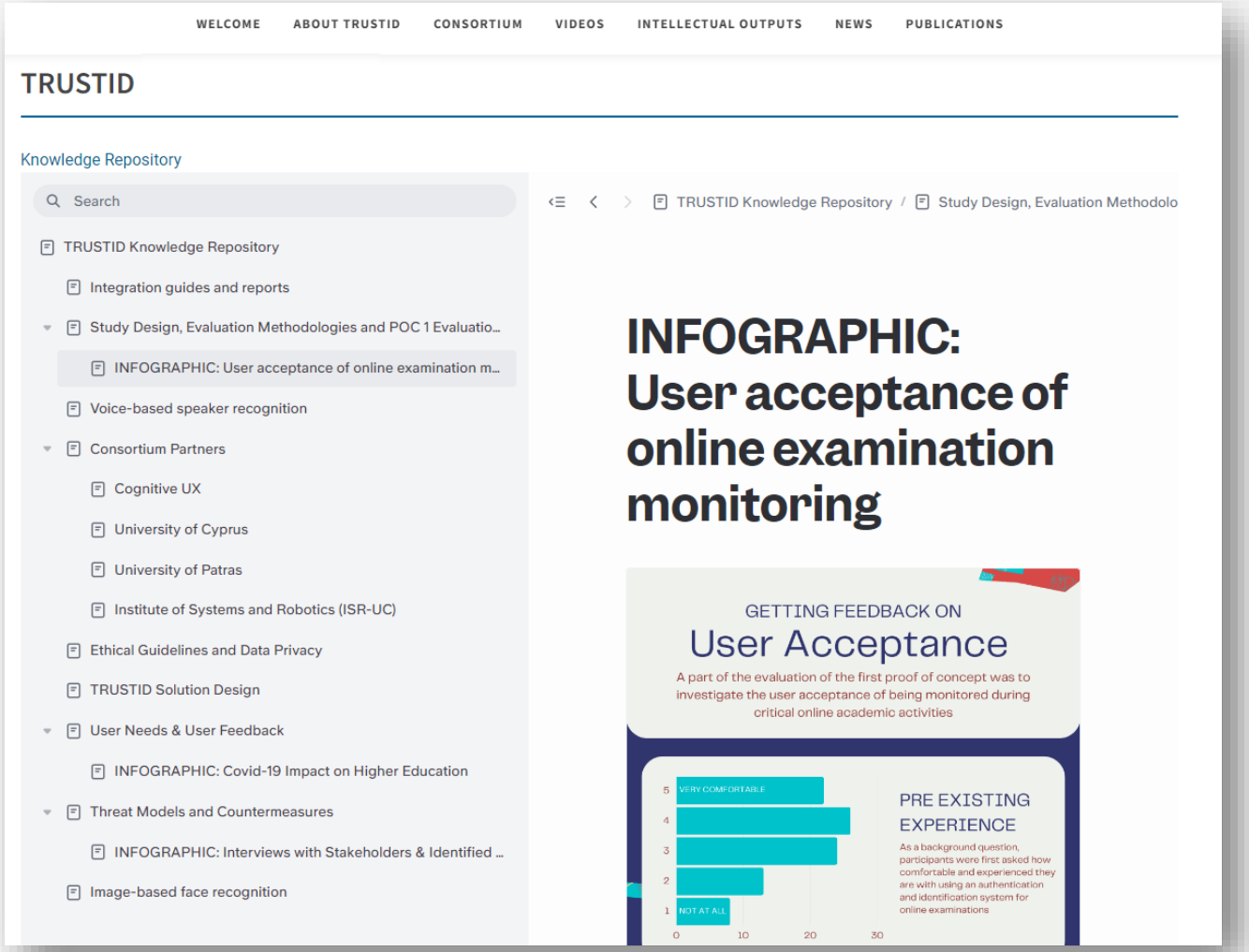
T4.2: Best Practice Guides – Actions Done in Stage 2

Co-funded by the Erasmus+ Programme of the European Union

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*



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

Co-funded by the Erasmus+ Programme of the European Union

TRUSTID Project Brochures

What is TRUSTID

User Recruitment

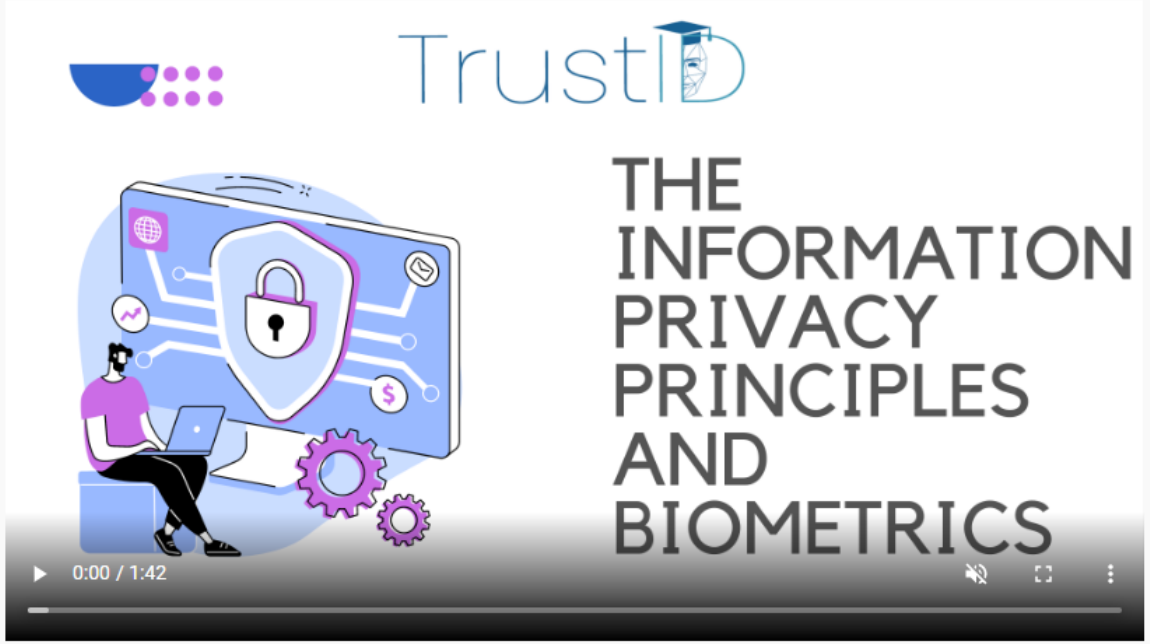
T4.2: Best Practice Guides – Actions Done in Stage 2

Co-funded by the
Erasmus+ Programme
of the European Union

Best Practice Videos

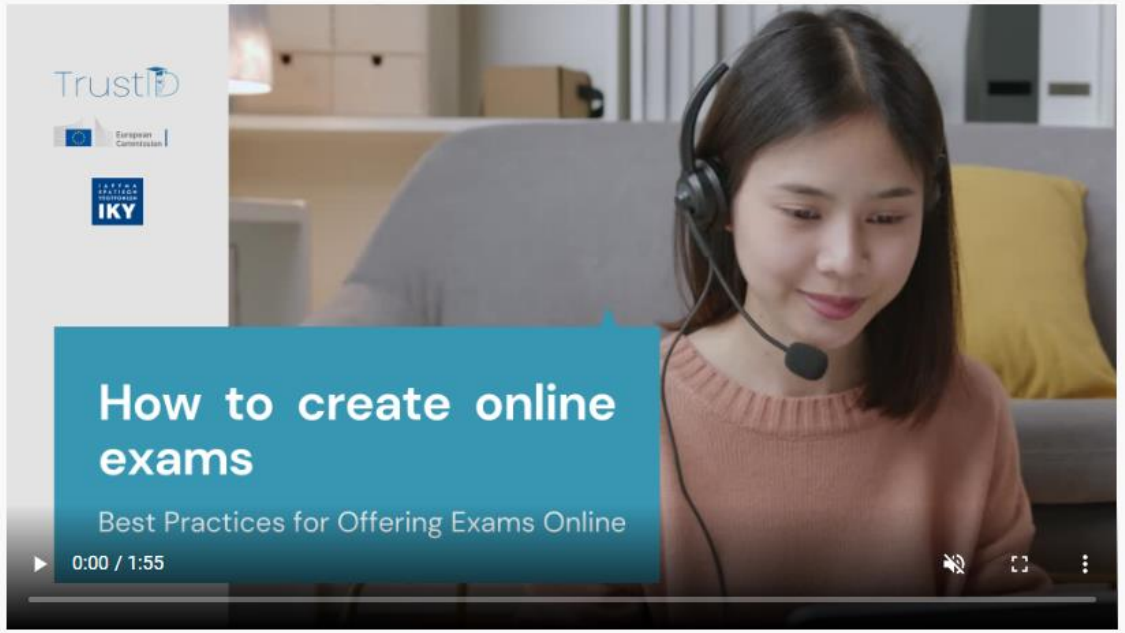
The Information Privacy Principles and Biometrics

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

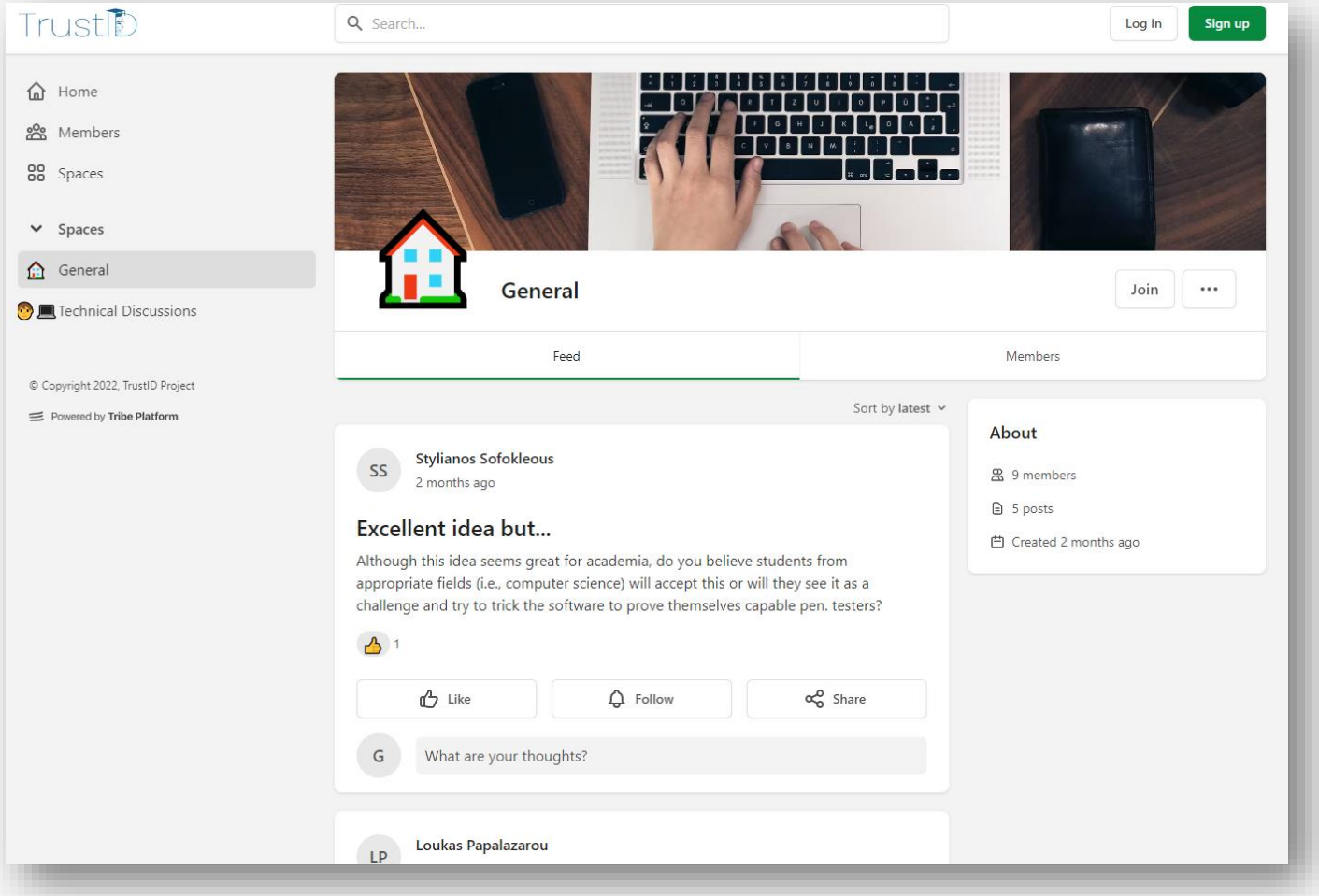
Co-funded by the Erasmus+ Programme of the European Union

TRUSTID Community Forum v2

Embedded in the TRUSTID website

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

tribe.



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

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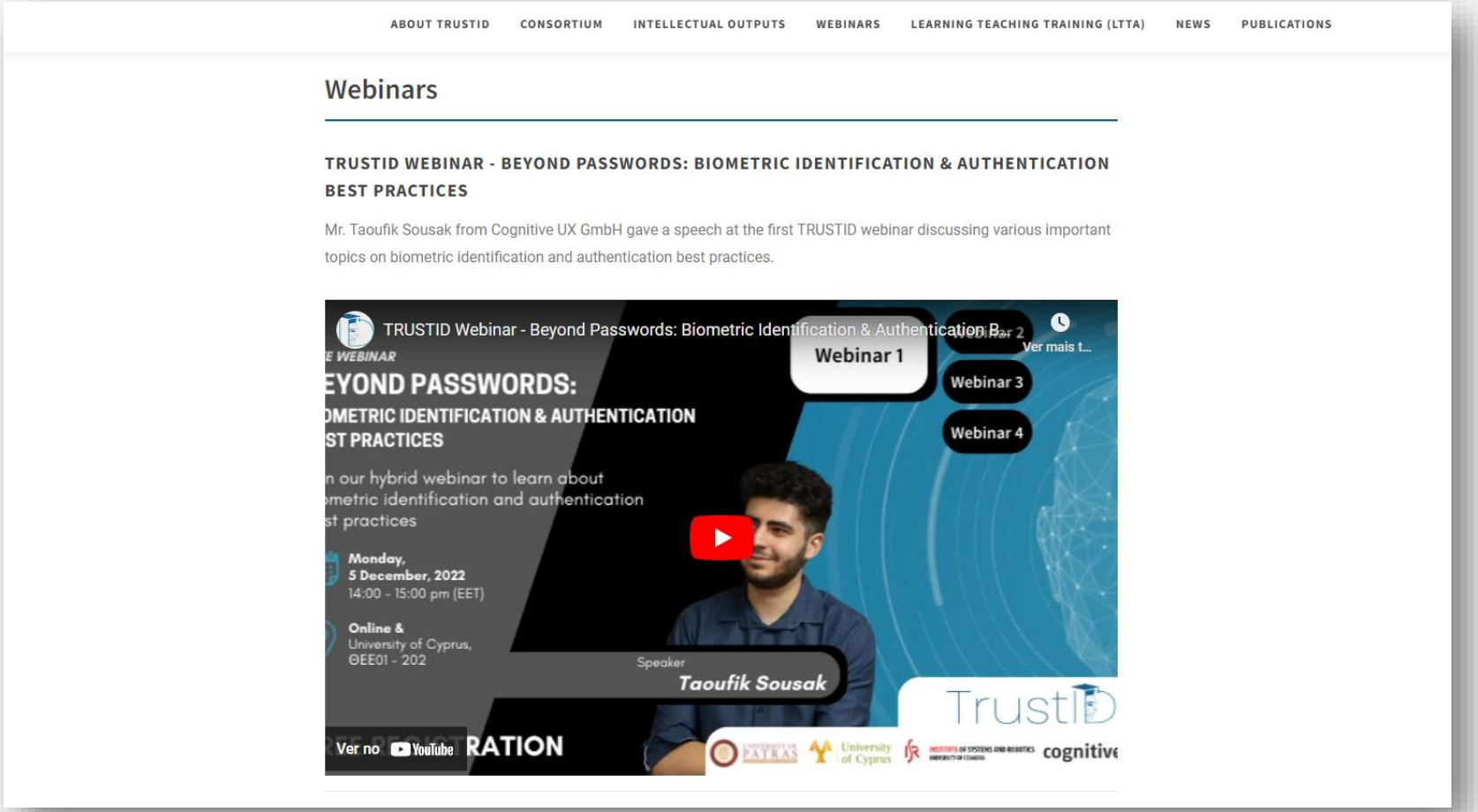
Webinars Webpage

Embedded in the TRUSTID website



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

T4.2: Best Practice Guides – Ongoing Actions

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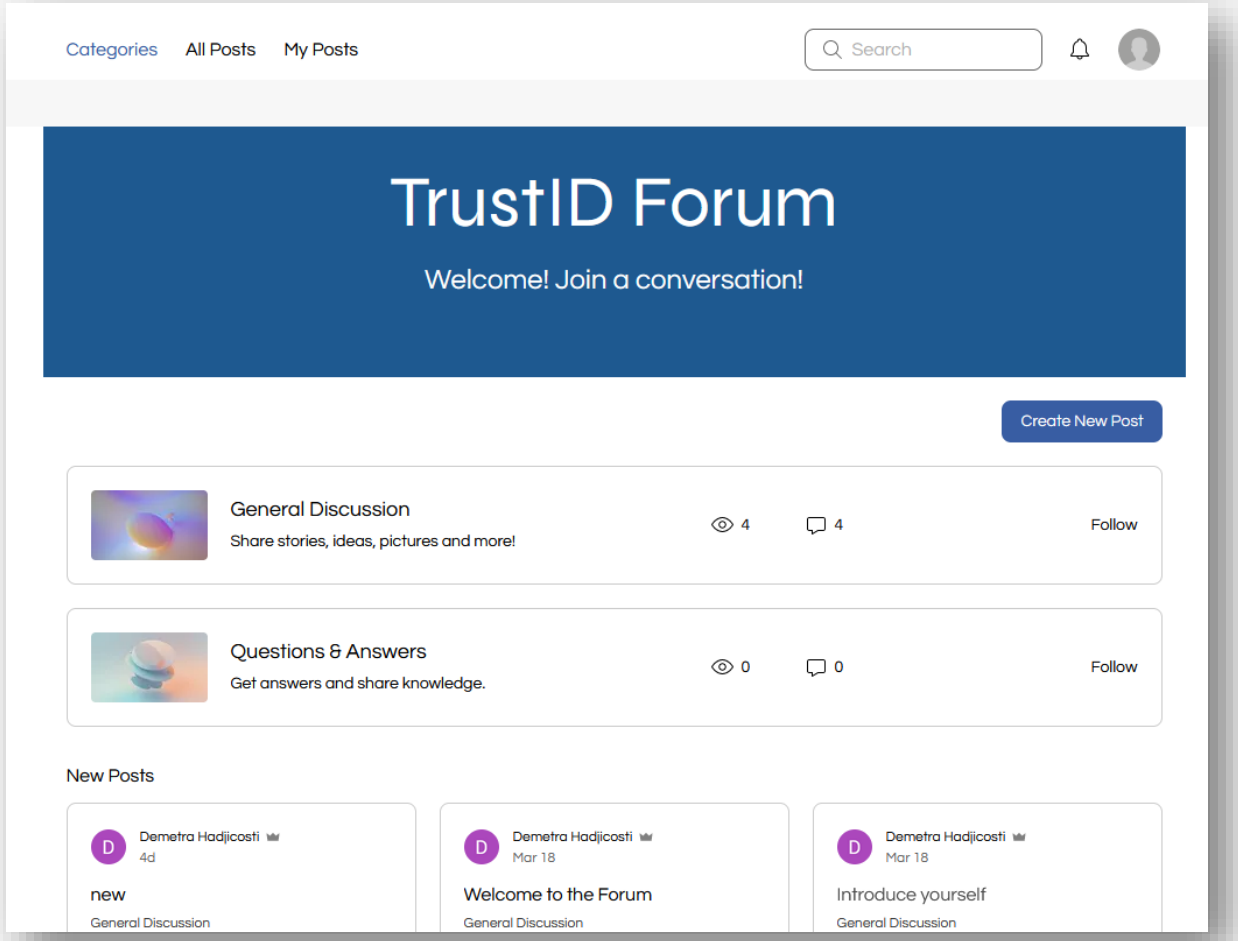
TRUSTID Community Forum v3

Embedded in the TRUSTID website: 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)

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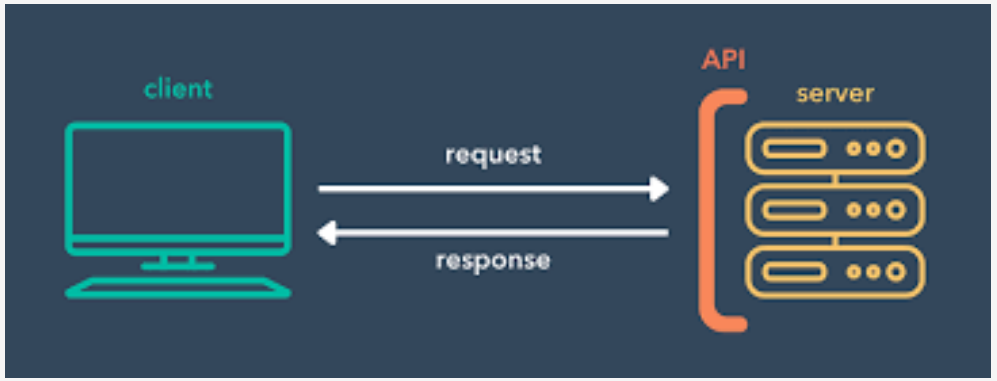
- Design **system integration guidelines** based on the developed **Application Programming Interfaces** developed as part of IO2 for exposing the intelligent continuous student identification mechanisms and user models to third-party software
- The API allows developers to subscribe and get an API key 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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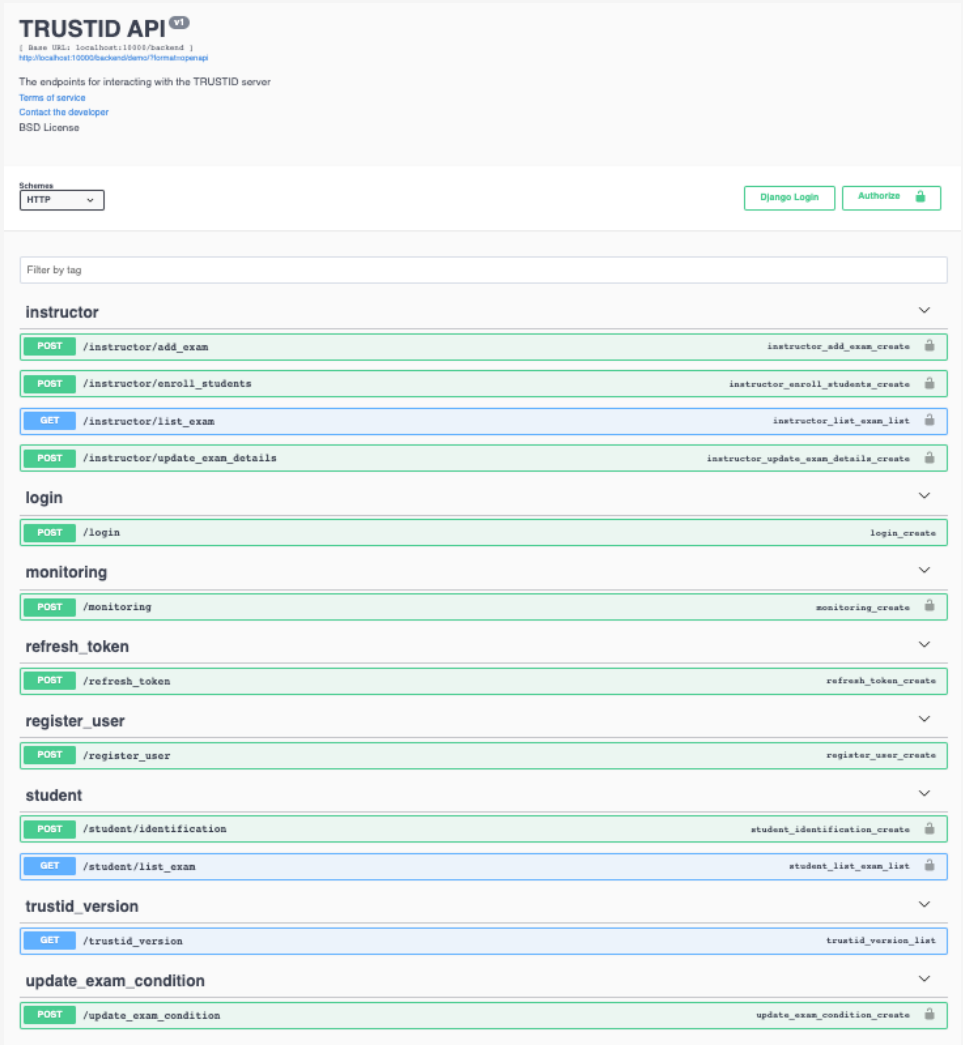

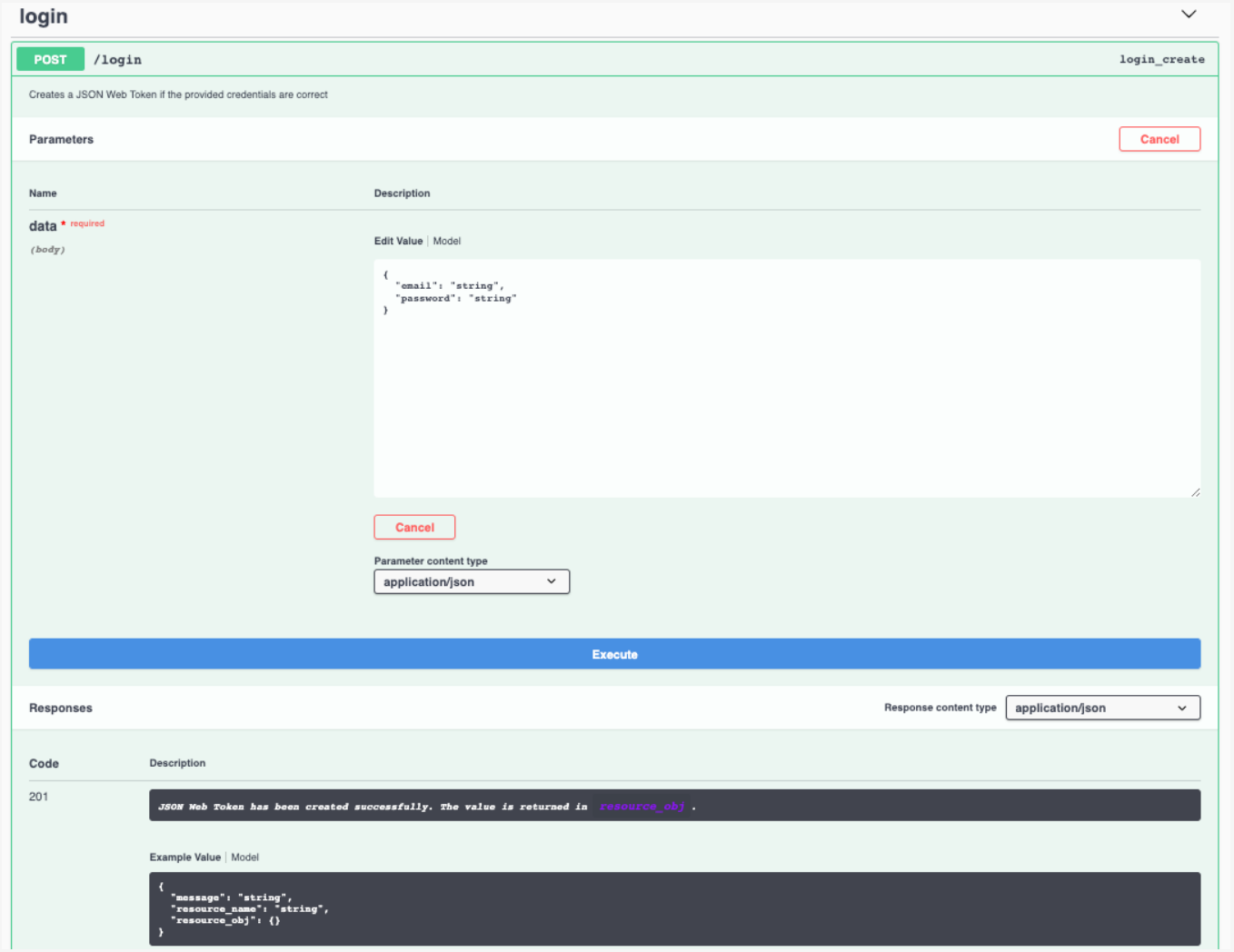

Web API – Documentation

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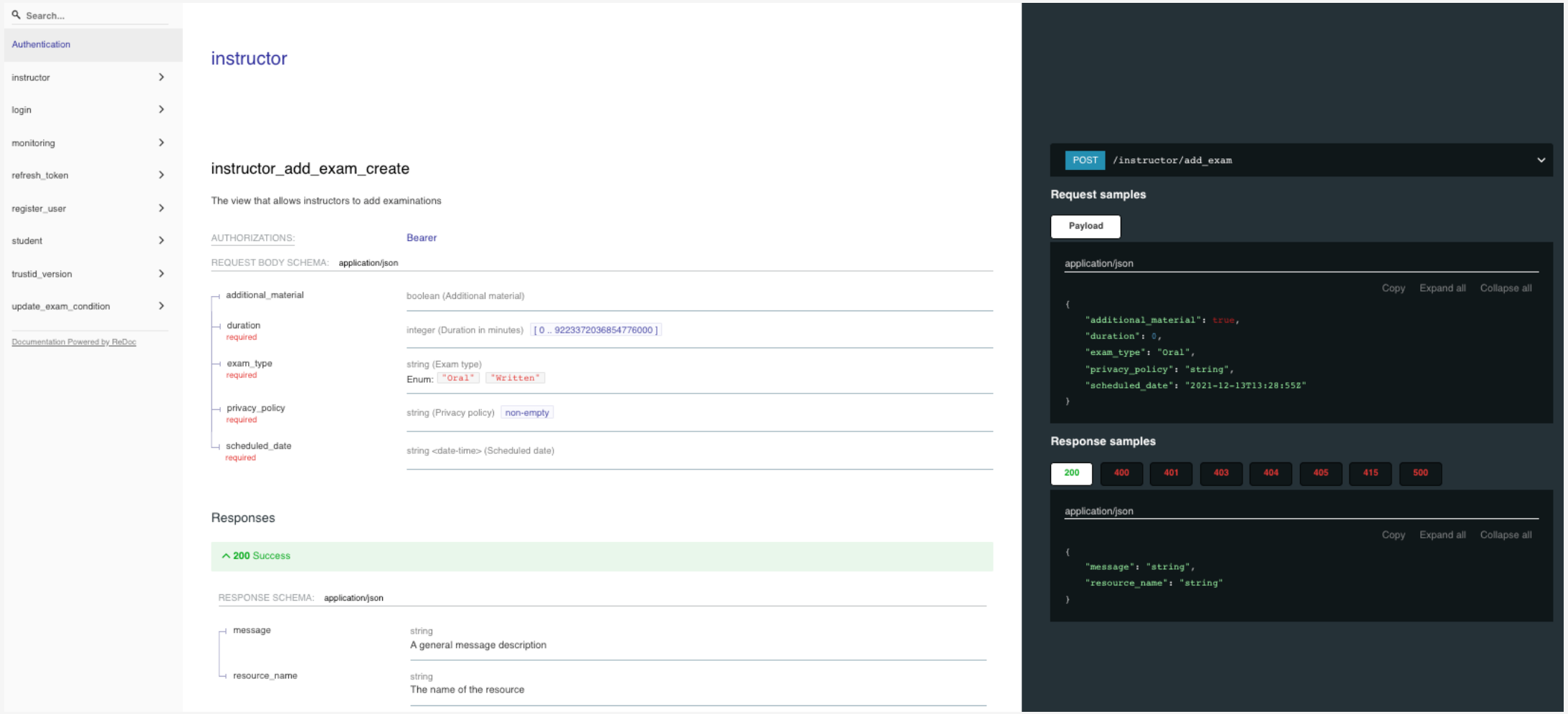

Intellectual Output 4 - Tasks and Achievements

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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

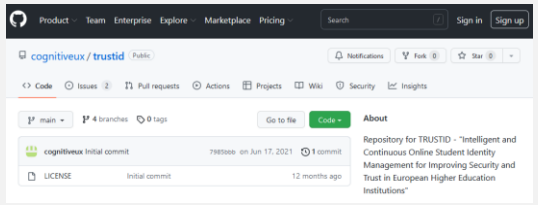
- Task 4.1: Training Webinars
- Task 4.2: Best Practice Guides
- Task 4.3: System Integration Guidelines (through an API)

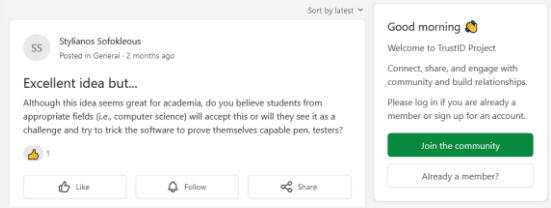
Achievements and Outputs

Deployment of Final Knowledge Repository
https://trustid-project.eu/kr.php

Deployment of Final TRUSTID Community Forum
https://trustid-project.eu/community.php

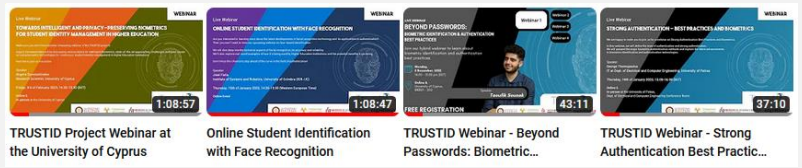
TRUSTID GitHub Open-source Code Repository
Available at: https://github.com/cognitiveux/trustid





Webinar
TRUSTID Webinar Events

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



Project Milestones (M)

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- 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

Publications

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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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TrustID

Thank you!

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