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Learning Teaching Training Activity (LTTA)

Intellectual Output 3 - Evaluation Reports regarding Efficiency, Effectiveness and User Acceptance of TRUSTID in Three Case Studies at Higher Education Institutions across Europe

Dr. Argyris Constantinides, University of Cyprus

Intellectual Output 3 (IO3)

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

- *Lead:* University of Cyprus
- *Participating Partners:*
  - University of Patras
  - Cognitive UX GmbH
  - University of Coimbra ISR

- *Output type:* Studies / analysis – Data collection / analysis
- *Media:* Dataset, Publications

IO3 – Key Objectives

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- 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

IO3 - Tasks and Task Leaders

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- Task 3.1: Design of Experimental Evaluation Methodology
  - *Lead:* University of Patras
  - *Participating:* University of Cyprus, Cognitive UX GmbH, University of Coimbra
- Task 3.2: Formative Evaluation Report
  - *Lead:* University of Cyprus
  - *Participating:* University of Patras, Cognitive UX GmbH, University of Coimbra
- Task 3.3: Summative Evaluation Report
  - *Lead:* University of Cyprus
  - *Participating:* University of Patras, Cognitive UX GmbH, University of Coimbra

Task 3.1: Design of Experimental Evaluation Methodology

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- Design the overall experimental methodology to be followed throughout the course of the project
- Ecological validity (design a study that approximates the real-life contexts)
  - Design a series of user studies in which real users will be performing 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

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

Task 3.3: Summative Evaluation Report

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- We will conduct the final evaluation aiming to evaluate usability and user acceptance of the proposed platform
- Various metrics will be measured, which will focus on capturing qualitatively and/or quantitatively the user's perceived usability and security, likeability and user acceptance
- The measurements will be 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, eye trackers)

User Study Scenarios for Proof of Concept 2

Aims of the Evaluation

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We conducted a user study 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

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Type of study

- Studies are 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

- Invite participants 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

- Ask participants to subscribe to the PoC2 user evaluation study
  - Read information about the method of study, planned dates, etc.
  - Provide email so that we can communicate during the PoC2 study period

Study Design 2/2

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Evaluation Phase

- **Step 1:** Participants download and install the implemented applications (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)
    - Integration of the new version of face-based identification which uses GRPC
    - Management of Examinations and LMS integration
      - Moodle integration - fetch students' information and automatically enroll to TRUSTID
      - Instructors upload .csv with students' information exported from other LMS
      - Add/Update examination to the TRUSTID system
- **Step 4:** Conduct semi-structured interviews and focus groups to receive feedback from the participants about their experience with the TRUSTID solution

Study Registration

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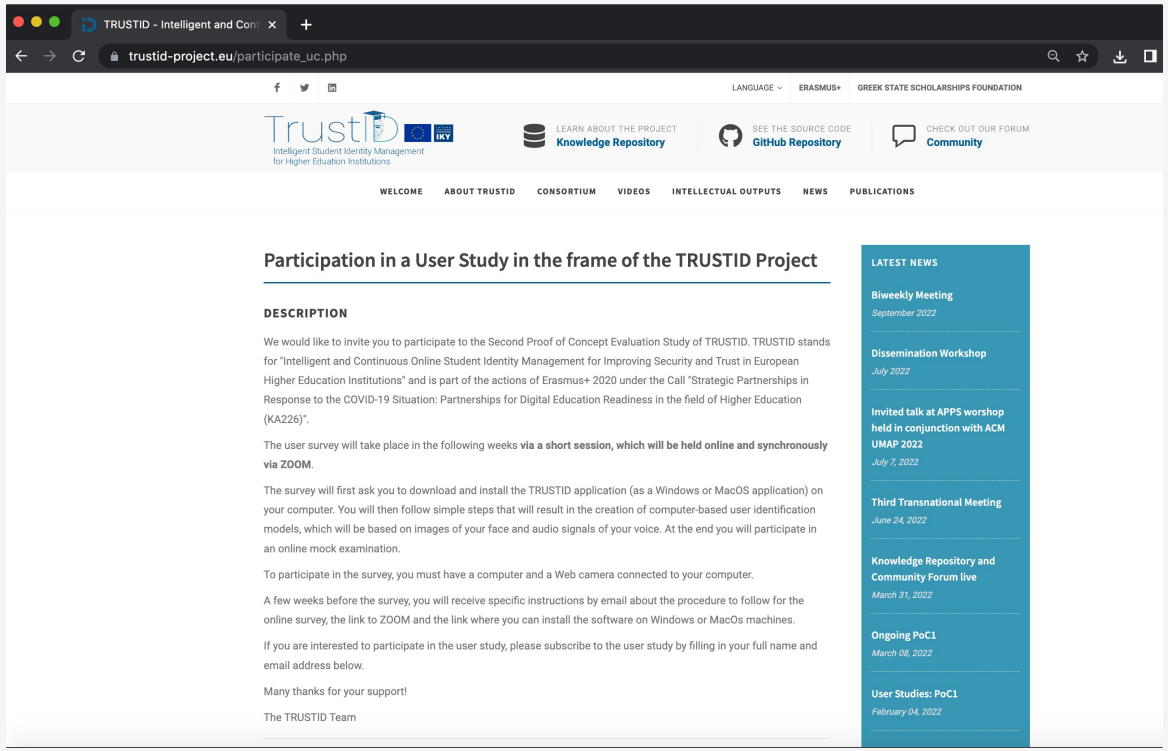

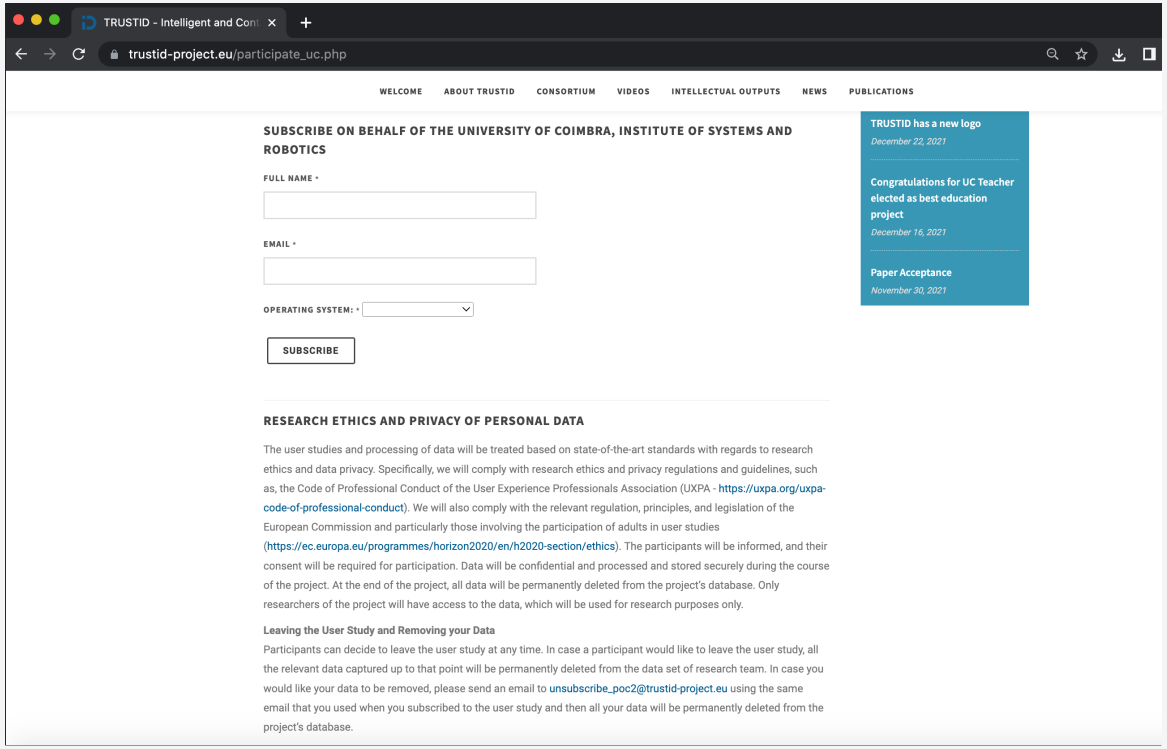

Scenario 1 – Student Biometrics Enrollment

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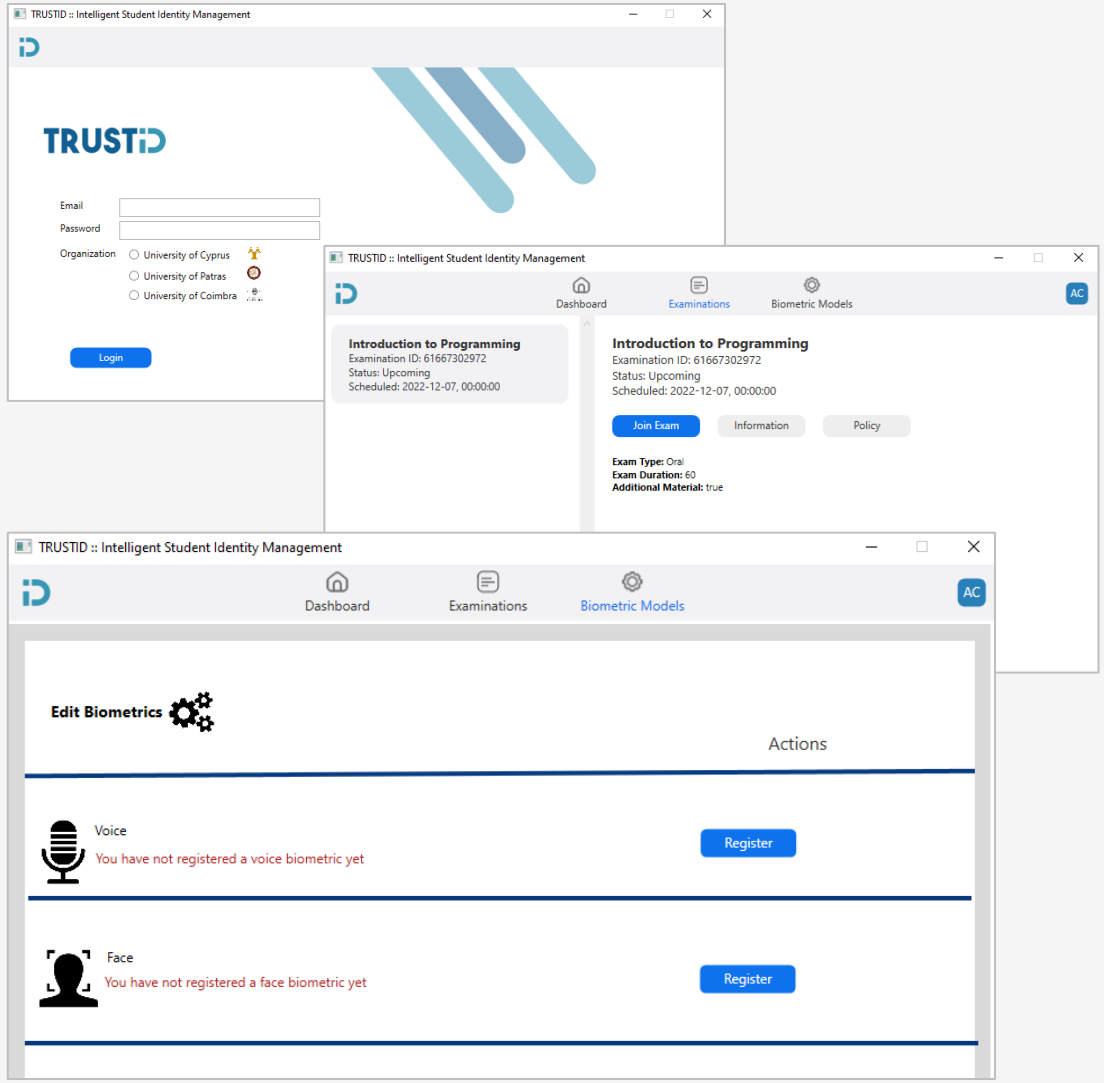
- Once the students log in to the system with their credentials, they will select their examination through the TRUSTID dashboard

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



Scenario 1 – Student Biometrics Enrollment (Face)

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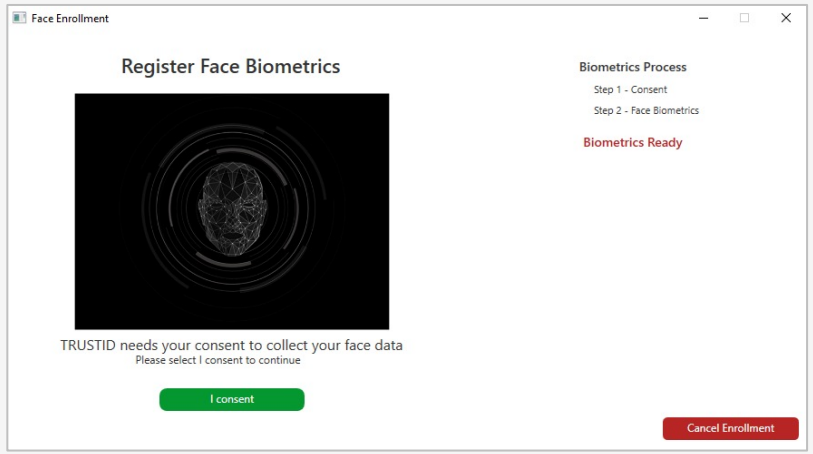
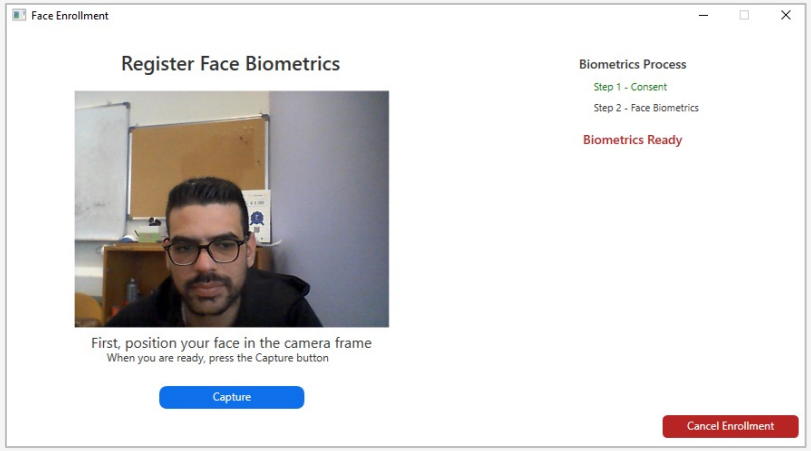
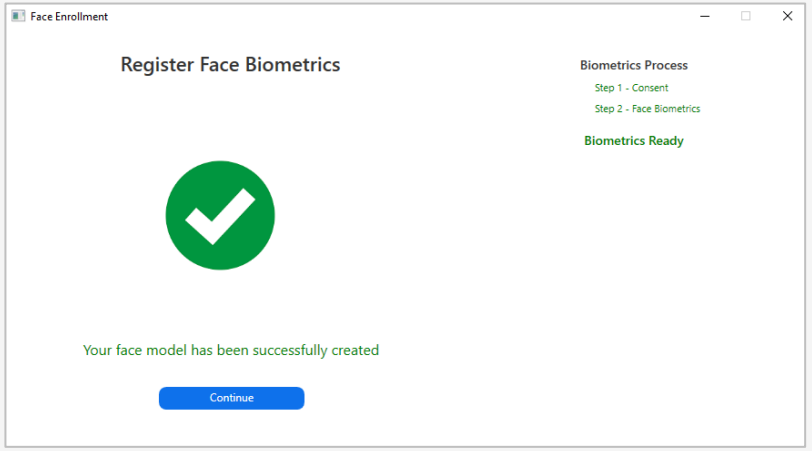
- The TRUSTID app captures student's face data and generates the face model







Scenario 1 – Student Biometrics Enrollment (Voice)

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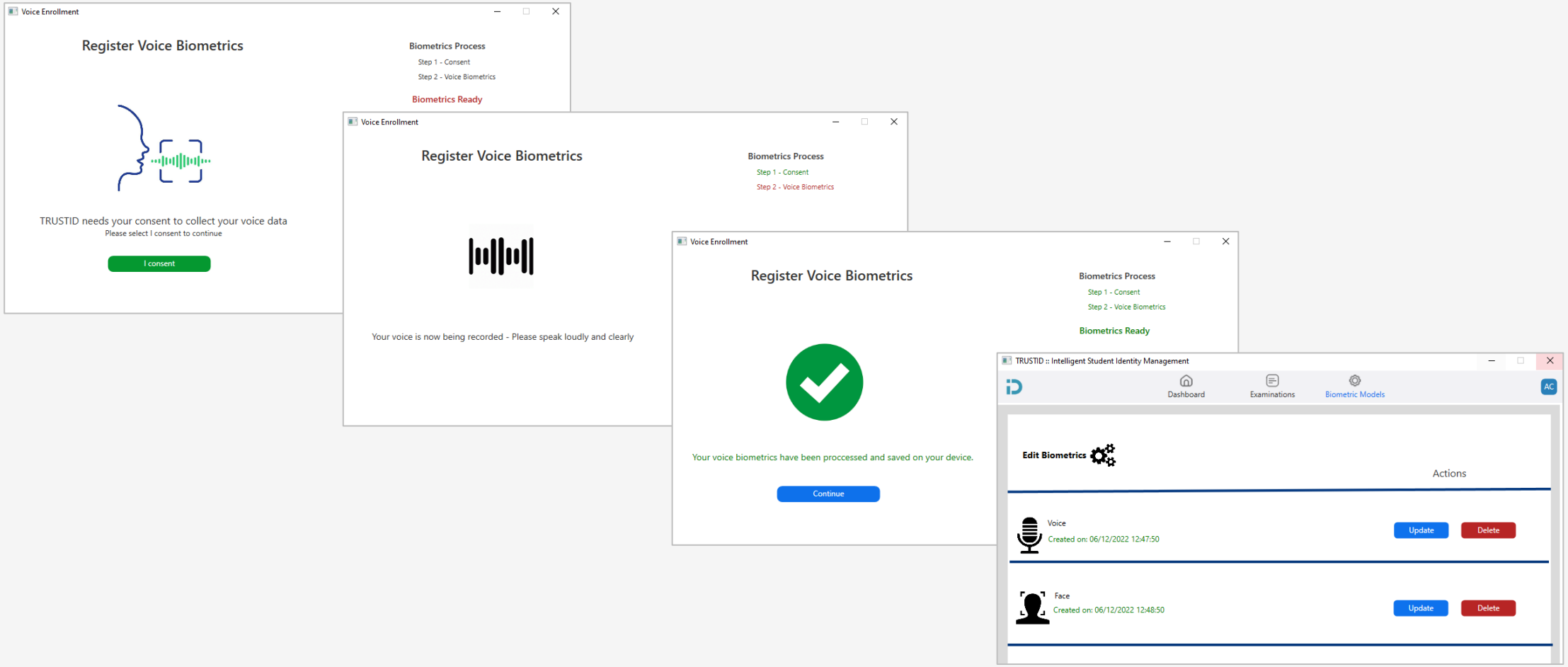
- The TRUSTID app captures student's voice data and generates the voice model



Scenario 2 – Student Identity Verification

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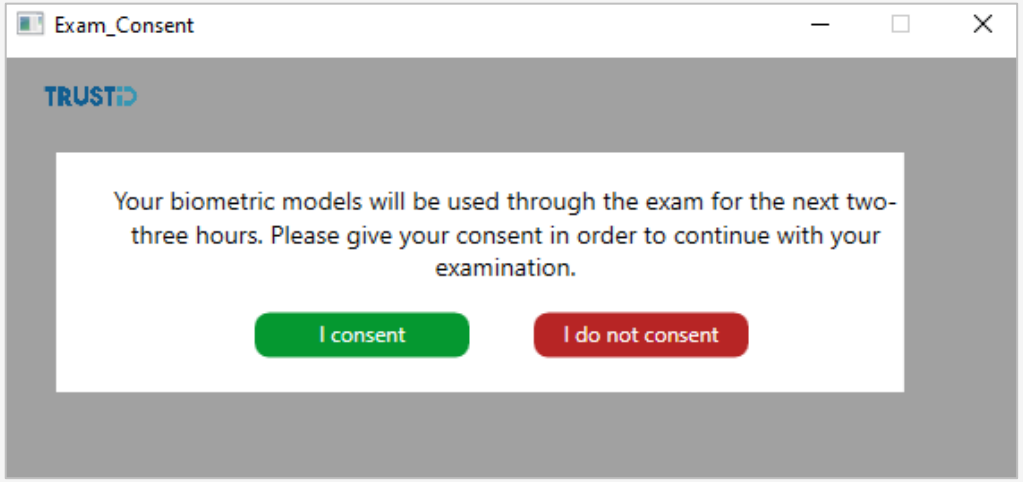
- Before initiating the examination, the student will provide their consent to use their biometric models, and they will then go through the identity verification step in which they will be identified through the implemented face- and voice-based identification mechanisms



Scenario 2 – Student Identity Verification (Face)

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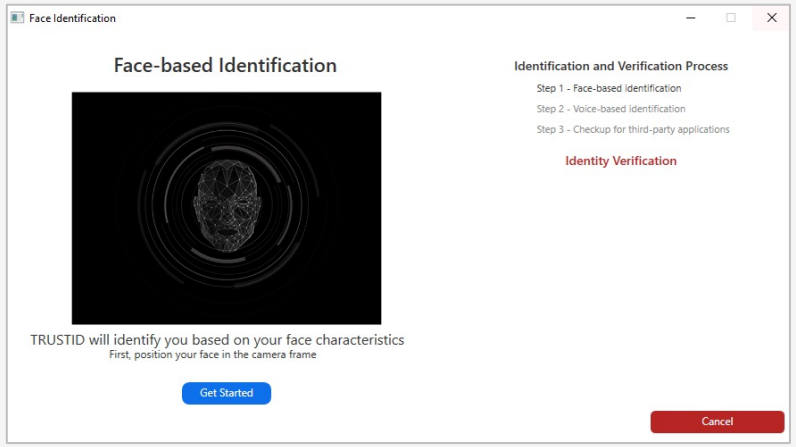
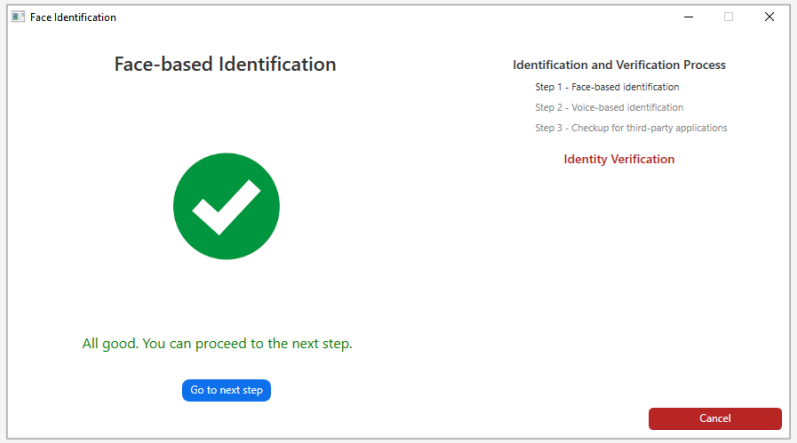
- Students will be requested to misuse the system, e.g., use impersonation, in which another person will sit in front of the camera to verify their identity





Scenario 2 – Student Identity Verification (Voice)

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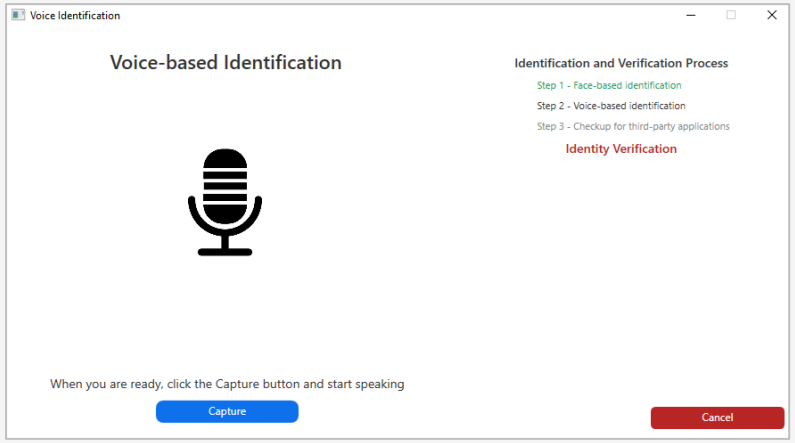
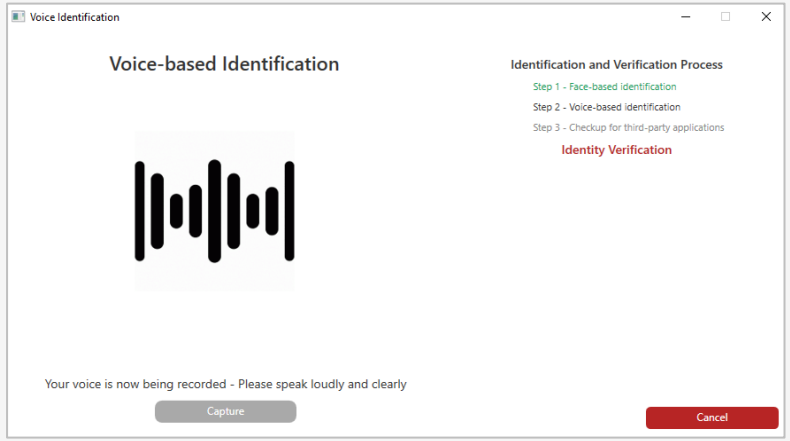
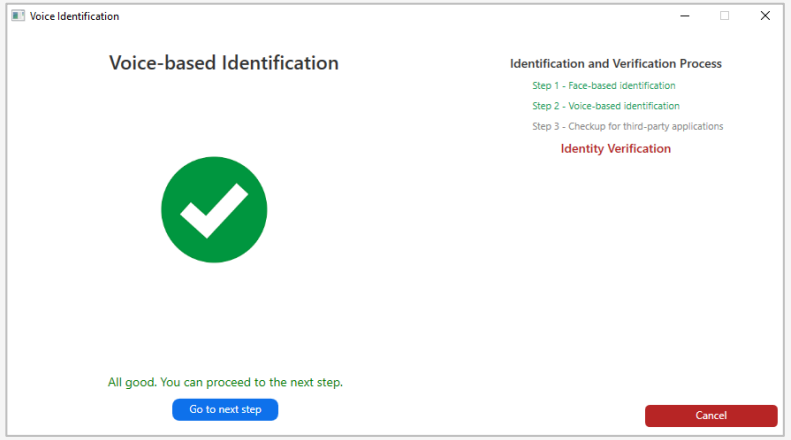
- Students will be requested to misuse the system, e.g., use impersonation, in which another person will speak to the microphone to verify their identity







Scenario 2 – Student Identity Verification (Checkup Forbidden Applications)

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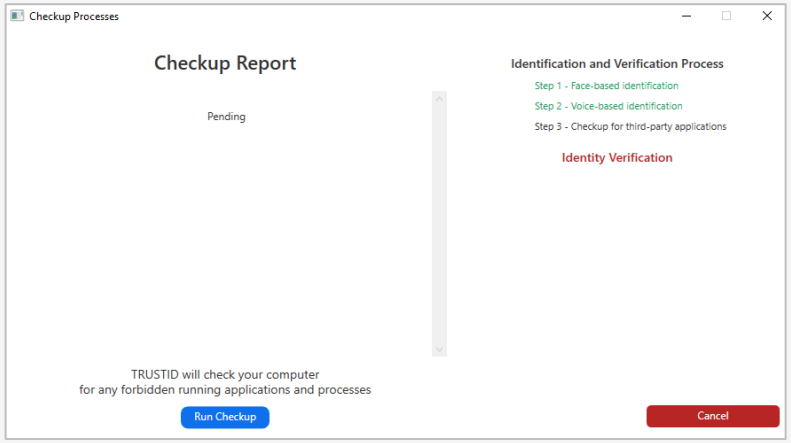
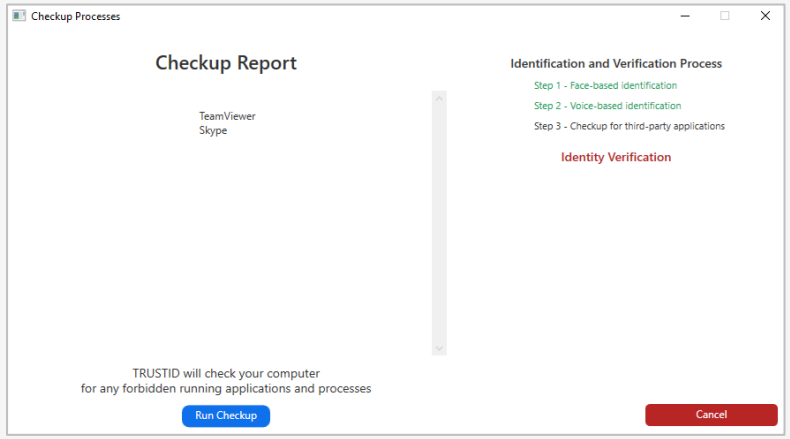
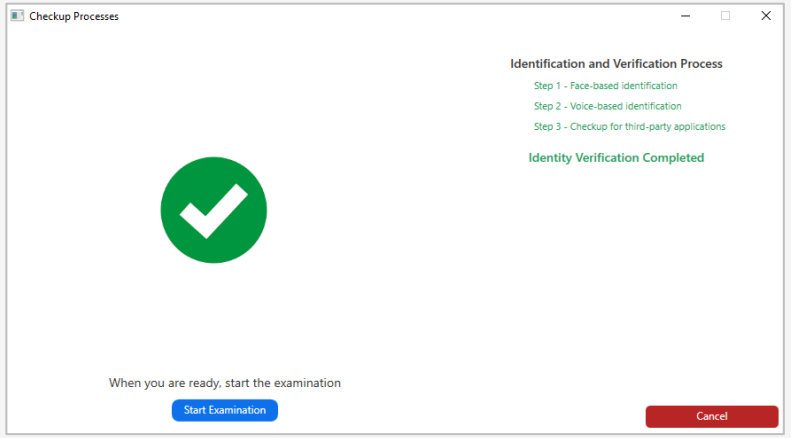
- Students will be requested to misuse the system, e.g., use communication/collaboration tools prior to joining the examination







Scenario 3 – Continuous Student Identification

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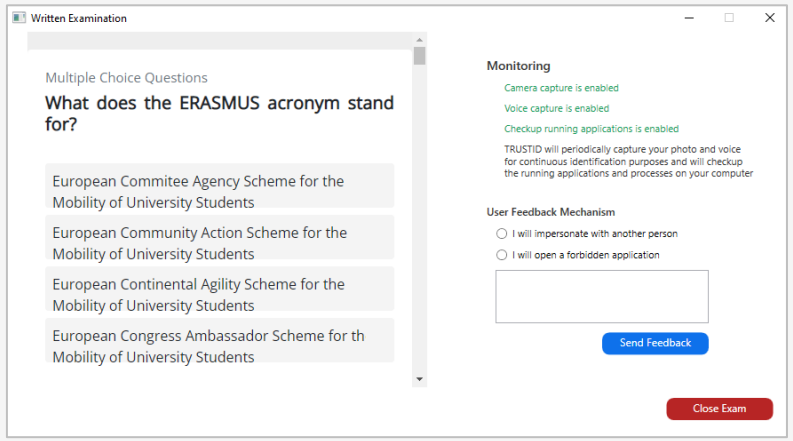
- The system will continuously identify the students through the continuous face- and voice-based identification mechanism
  - Students will be requested to misuse the system, e.g., use impersonation, in which another person will sit in front of the camera or will speak to the microphone to verify their identity



Scenario 4 – Monitoring the Student's Computing Device

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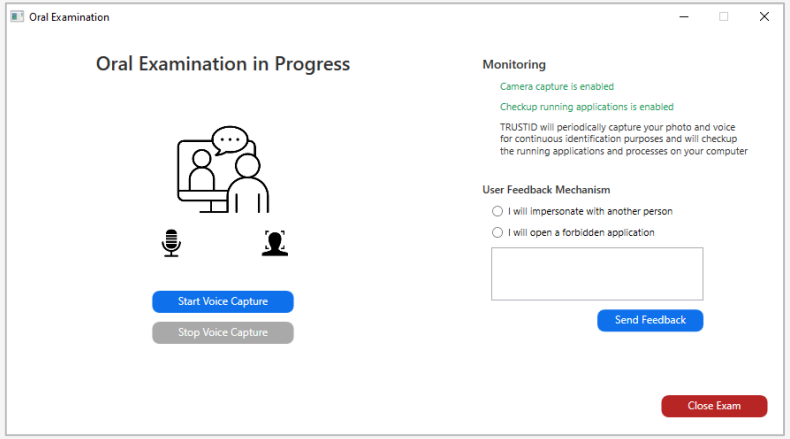
- Monitoring the students' computing device's running applications and processes
  - Students will be asked to misuse the system, e.g., by asking them to open communication/collaboration tools during the examination session



Scenario 5 – Examination Management for Instructors

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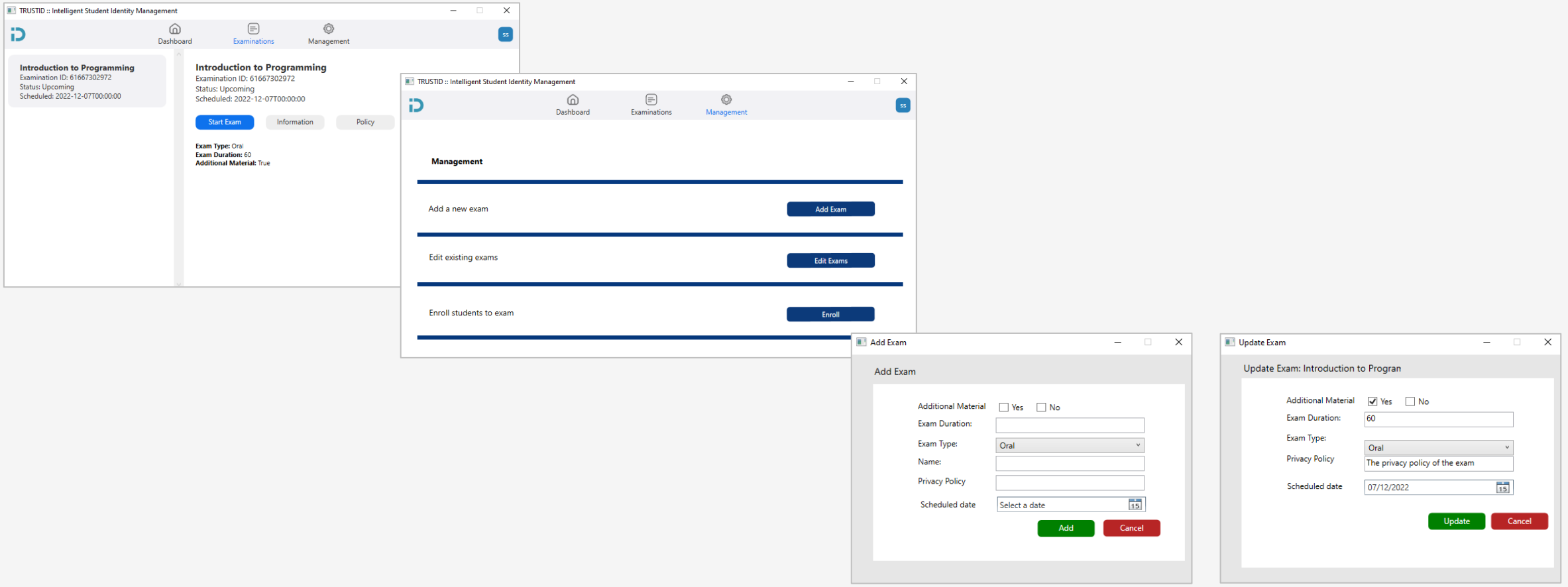
- Add/Update examination



Scenario 6 – LMS Integration

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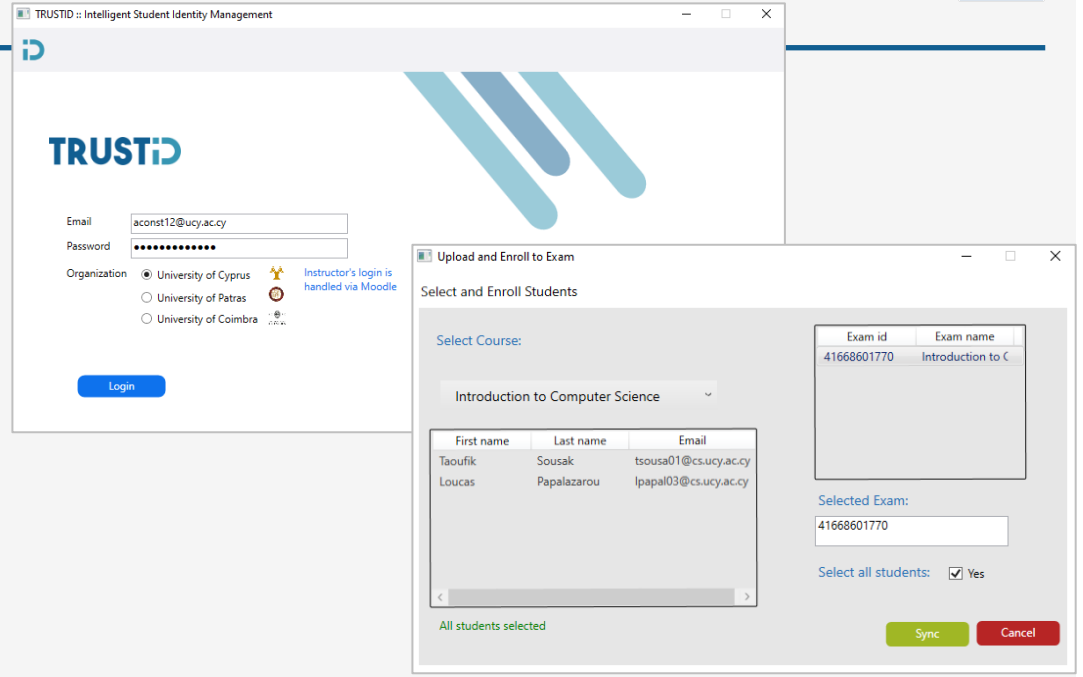
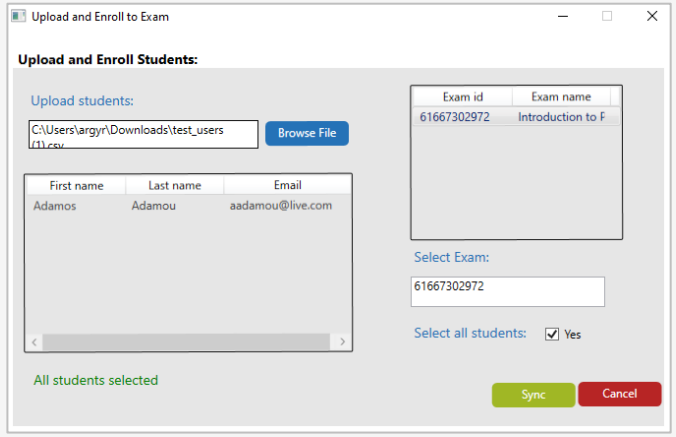
- Moodle integration
  - Fetch students' information and automatically enroll to TRUSTID



- 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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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%

Questionnaire Results

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Question	Disagree	Moderate	Agree
Overall, how simple and clean is the TRUSTID software's user interface?	3	10	89
Overall, how intuitive to navigate is the TRUSTID software's user interface?	2	11	89
Overall, what's your opinion on the way features and information in the TRUSTID software are laid out?	5	10	87
Overall, how secure do you find the face identification process?	9	22	71
Overall, how secure do you find the voice identification process?	12	23	67
Overall, do you like the idea to be identified with face-based biometric identification during an online examination?	21	20	61
Overall, do you like the idea to be identified with voice-based biometric identification during an online examination?	26	24	52

Key Findings

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What worked well in PoC2:

- The System Usability Score was calculated to be 78, which is a high score (Any score above 68 would be considered above average[1]).
- Face enrollment.
- 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. Relevant quotes:

"The voice registration wasn't successful the first few times" ~ P6

"The voice registration did not work, I had to change my default microphone input in windows for it to work" ~ P7

"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" ~ P14

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

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TrustID

Thank you!

Dr. Argyris Constantinides, University of Cyprus

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