CAT-SL: Deploying Machine Learning & Computer Vision for Sign Language teaching

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About CAT-SL

- According to the European Union of Deaf, more than 750.000 deaf SL users live in EU, while only 12.000 interpreters are registered.

- In Greece and Portugal more than 60% of the deaf children have extremely limited reading and writing skills.

- Therefore, the educators need to receive appropriate training in Sign Languages, the native languages of the Deaf, so that they are able to communicate with them and to teach them how to develop linguistically.

- However, it is hard for Higher Education Institutes to find and employ experts in Sign Language. Therefore, any educators are not adequately trained to face the challenges of communicating with deaf children in the classroom.

About CAT-SL

- **CAT-SL** (Computer Assisted Teaching of Sign Languages using Computer Vision and Machine Learning) was a 3-year project co-funded by the Erasmus+ programme of the European Union, started in 2020 and it involved 5 partners across Europe.

- CAT-SL manages to give appropriate training in sign languages to teachers, to communicate effectively with their students.

CAT-SL Partners

- **Coordinator**: University of Patras, Greece

- **Partner**: Insituto Superior de Engenharia do Porto, Portugal

- **Partner**: Hellenic Mediterranean University, Crete, Greece

- **Partner**: Cyprus University of Technology , Limassol, Cyprus

- **Partner**: Royal Dutch Kentalis, Netherlands

CAT-SL Objectives

- To develop an innovative and affordable system/service for interactive SL teaching for students, based on computer-vision, machine-learning, linguistic technology, and avatars.

- To set up the CAT-SL infrastructure in four Higher Education Institutes (one for every partner), and one primary education one, based on open standards.

- To develop curricula and guides for teaching SL using the CAT-SL system for at least two multilingual courses, in Greece, Cyprus, Portugal and Netherlands.

- To actively disseminate the project results through the promotion of workshops with stakeholders in the EU to raise awareness on the main challenges faced by the Deaf.

CAT-SL Target groups

- The students at Special Education university departments, aiming to learn how to use and teach SLs to deaf children.

- The primary school pupils who aim to learn how to use the SLs.

- The course administrators, who may be university professors teaching SLs in Special Education departments, as well as educators in public or private organizations involved in SL teaching or Deaf education.

- The teachers, who may be university professors or educators, as in the previous case.

- The system administrators, who will be able to set up and maintain the system.

CAT-SL Outputs

Intellectual Output 1

A research study was developed which extensively analyzes the:

- **requirements to incorporate specific teaching curricula** based on practices followed in the four participating countries and at EU level.

- **requirements on capturing user body motion and level of detail** (e.g., hand/body/head motion, facial expressions etc.). The morphological, syntactic and semantic rules of the SLs will be extensively considered and encoded.

- **requirements on how to display feedback to the users**, e.g., how should the avatar visualize the body motion, how should it highlight errors, how should it evaluate the students.

- **incorporation of serious games** to offer a more playful environment, especially for the younger users.

- **investigation of the challenges in the above process** as well the challenges for the teacher - student communication.

CAT-SL Outputs

Intellectual Output 2

- The CAT-SL Automated Sign Language Teaching System for European SLs was developed here.

- A server-based learning service was developed. The development was based on the analysis given in O1.

- One-by-one the user requirements were mapped to design requirements. Afterwards, the design requirements were mapped to software modules which were then integrated into a system to offer an educational service for learning SLs.

- The user is able to access the service by using only a webcam.

CAT-SL Outputs

Intellectual Output 3

- The Sign Language Learning Curricula was developed here.

- Interactive material was developed that covers two SL courses in three different languages: Greek (including Cypriot dialect), Portuguese and Dutch.

- The development was based on the analysis given in O1.

- The user is able to access the material by connecting to the CAT-SL platform based on Moodle. The learning curricula includes theoretical background and practical exercises in the form of serious games. Lessons consist of concepts, types of words or signs, such alphabet and numbers, signs (People, Objects, Places, etc.), communication scenarios (greetings, friendly conversation, hotel, train station, doctor, bank etc.).
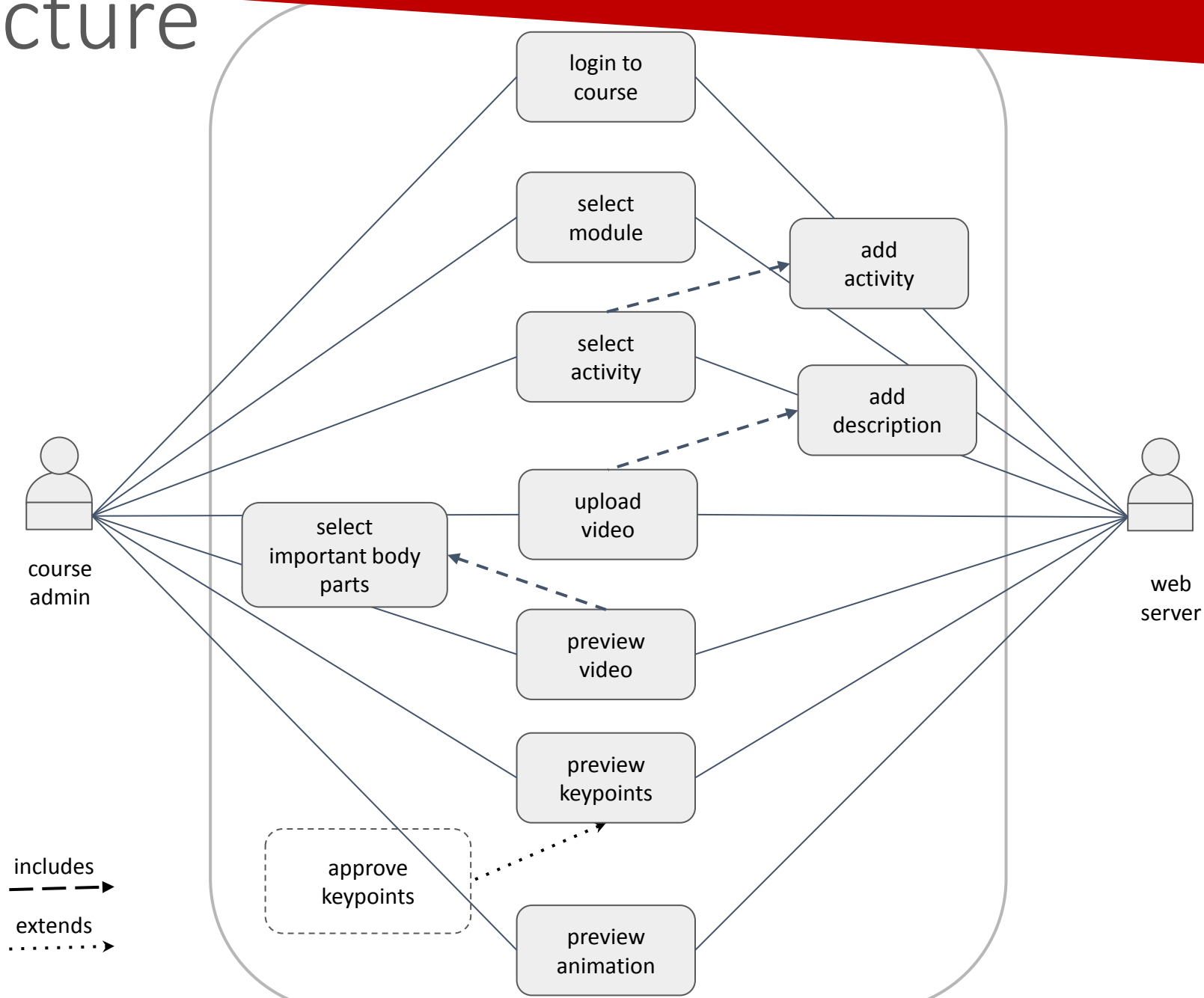
CAT-SL Outputs

Intellectual Output 4

- The teaching guide for the CAT-SL Automated Sign Language Teaching System was developed here. The guide is available in four languages (English, Greek, Dutch, Portuguese) and is a document also referring to videos.
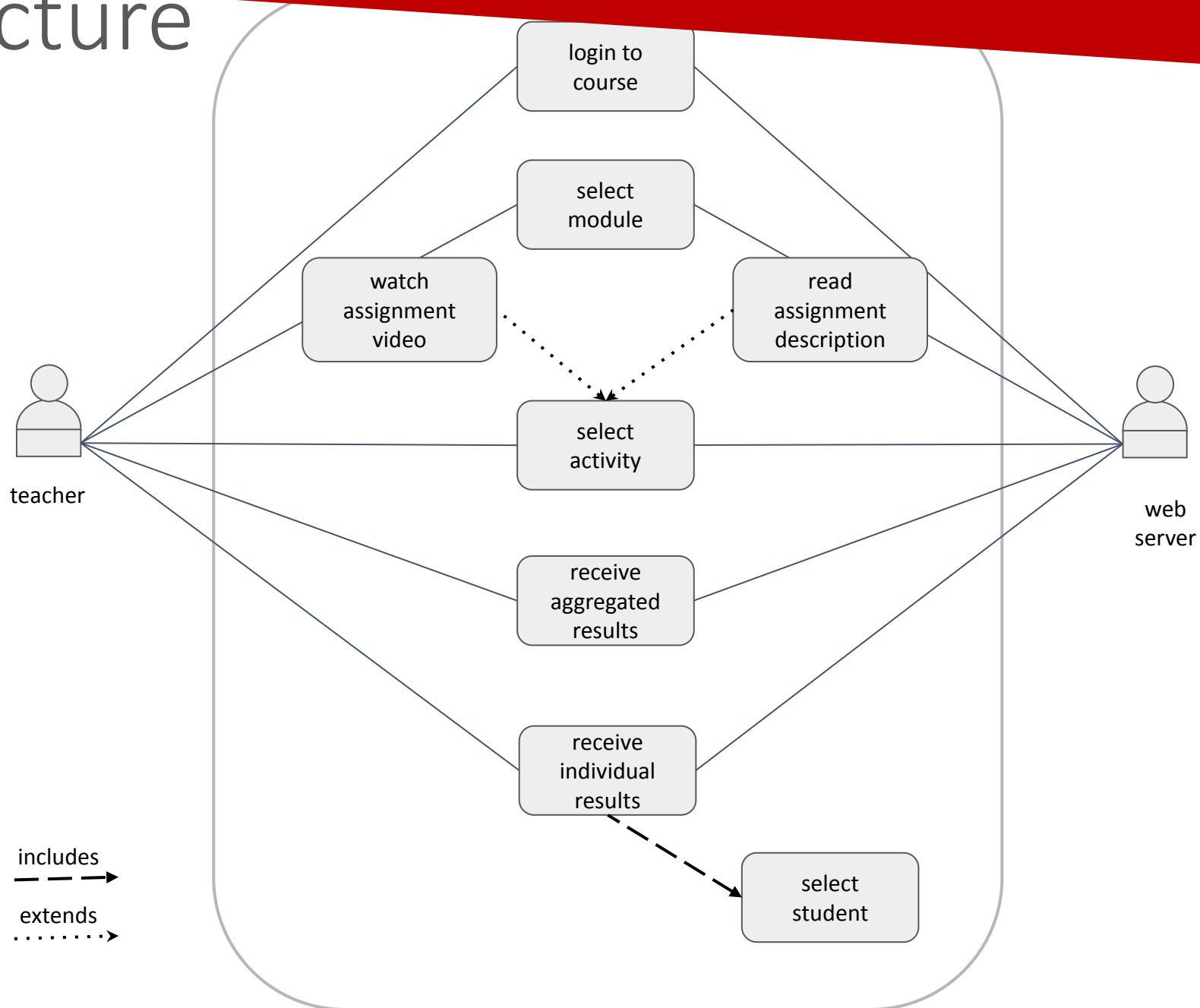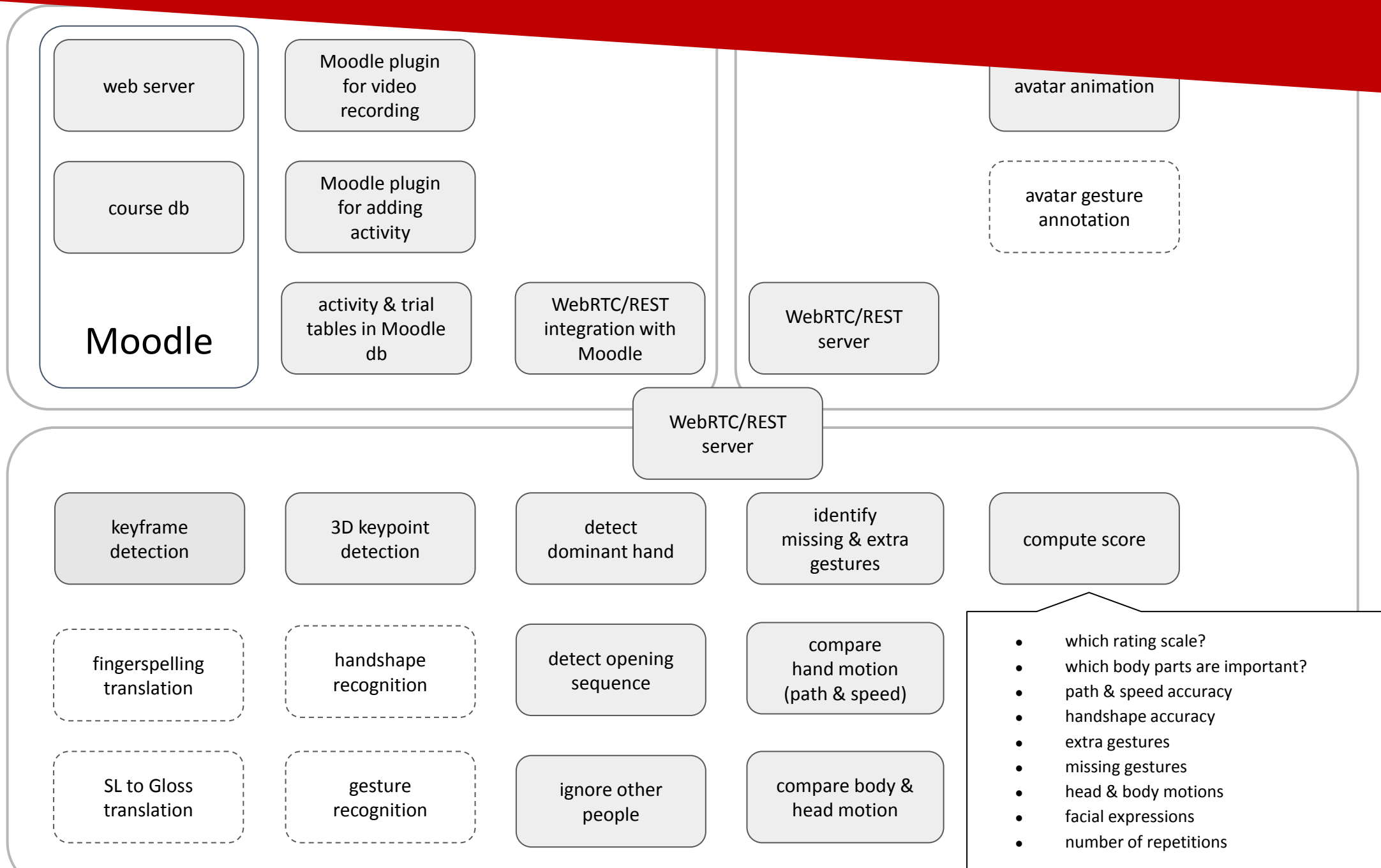
Architecture

Course Administrator

Architecture

Functional Requirements

Moodle

- web server
- course db
- Moodle plugin for video recording
- Moodle plugin for adding activity
- activity & trial tables in Moodle db
- WebRTC/REST integration with Moodle
- WebRTC/REST server
- avatar animation
- avatar gesture annotation

WebRTC/REST server

- keyframe detection
- fingerspelling translation
- SL to Gloss translation
- 3D keypoint detection
- handshape recognition
- gesture recognition
- detect dominant hand
- detect opening sequence
- ignore other people
- identify missing & extra gestures
- compare hand motion (path & speed)
- compare body & head motion
- compute score
  - which rating scale?
  - which body parts are important?
  - path & speed accuracy
  - handshape accuracy
  - extra gestures
  - missing gestures
  - head & body motions
  - facial expressions
  - number of repetitions

CAT-SL System

CAT-SL

More information can be found on:

➢The project's website http://cat-sl.eu/

➢The projects Moodle that hosts the courses and the CAT-SL system : https://cat-sl.hmu.gr/

➢The website for practicing to SL https://catsl.eelvex.net/

Thank you!