DE-ENIGMA

Playfully Empowering Autistic Children

THE PROJECT

The DE-ENIGMA project, funded by Horizon 2020 (the European Union’s Framework Programme for Research and Innovation), aims to create and evaluate the effectiveness of robot-based technology, developed to support autistic children in their learning. The main goal is to realise robot-assisted therapy solutions specifically for children on the autism spectrum. Leading to effective therapies more tailor-made for individual children than previously available.

The technology will allow for interaction between children with autism and robots that is:
- context-sensitive (caters for the specific need of the child in the local culture);
- child-sensitive (automatic understanding of children’s facial, gestural, vocal and verbal cues);
- real-world-sensitive (robust and naturalistic).

DE-ENIGMA answers a number of long-standing questions in research on autism which may speed up the adoption of technologies in education and health by:
- testing whether autistic children’s ability to learn socio-emotional (facial, bodily, vocal) skills within a direct-instruction programme is better during a robot-led than a therapist-led interaction, when performed in unconstrained recording conditions and when using all three modalities (face, body, voice);
- conducting a gold-standard randomised controlled trial to test the efficacy of a direct-instruction versus an implicit learning approach within a robot-led interaction;
- examining for the first time the effects of culture by conducting fine-grained analyses on autistic children’s recognition and expression of emotion expressions (via face, body, voice) in Western/ Northern European (UK) and Eastern/ Southern European (Serbian) contexts and by examining whether culture moderates autistic children’s ability to learn socio-emotional skills during robot-led versus therapist-led interactions.

The consortium is a partnership made up for various entities: university research departments in the field of computer science and psychology, non-governmental organisations focusing on autism and a company working in the field of robotics. The project will run until August 2019. DE-ENIGMA ensures through its commercial partner (IDM) that the knowledge and know-how accruing from the DE-ENIGMA endeavors is transferred to the number of potential public-private interested parties.

TECHNOLOGY & METHODOLOGY

DE-ENIGMA achieves target goals through five work packages (WPs):

![Fig. 1: Pilot Chart (Interactions between DE-ENIGMA components/WPs)](image)

The key to DE-ENIGMA approach in development of target technology -> incremental iterative work plan:

- technology and system are repeatedly evaluated and refined;
- feedback from children and the therapists involved in the study on potential failure points is received early enough;
- incompatibilities in design of components are prevented from going undetected until it is too late.

![Fig. 2: Incremental, iterative work plan of the DE-ENIGMA project](image)

STUDY DESIGN

- Recording of audio and 2D and 3D Kinect-based dynamic facial and bodily behaviour of 130+ children with autism of English and Serbian cultural background (approx. 65 subjects per culture).
- Children (5-12 years old) will be involved in therapist-based teaching (no robot) and robot-based teaching (using Wizard of Oz setting).
- Teaching perception, expression, understanding, and social imagination related to 4 affective states: surprise (high arousal), happiness (positive valence), anger (negative valence, high arousal), and sadness (negative valence, low arousal).
- Direct-instruction strategies (i.e. directly teaching emotional displays) during the following six phases (10-15 minutes long):
  - Surprise
  - Happiness
  - Anger
  - Sadness

EXPERIMENTAL SETTING ON SITE IN SERBIA

Recording rooms and Equipment: Robot room (Testing room 1):
- 4 microphones
- One analog high-performance space diversity wireless receiver (AKG U4K).
- One analog high-performance wireless body-pack transmitter (AKG PT4).
- One audio interface (M-Audio M-Track Quad Interface).
- 6 webcams (5 webcams + 1 on the chest of the robot).
- 1 Microsoft Kinect One
- 1 keypad
- 1 desktop and 1 laptop
- ![](image)

Recording rooms and Equipment: Robot room (Testing room 2):
- Audio configuration identical to the one adopted for the robot room.
- 4 microphones
- 1 Microsoft Kinect One
- 1 desktop and 1 laptop

![DE-ENIGMA Database Recording so far on: 6 weeks of recordings in Serbia/Belgrade; 42 participants (21 boys, 5 girls) - 5-12 years old (23 in robot sessions, 19 in therapist sessions); 14/12 children randomly assigned to robot-/therapist-led sessions; Pre-testing: background and parent questionnaire, Vineland adaptive behavior scale; Post-testing: SRS, SDQ and CARS2-QPC scale (mid-to-moderate vs severe autism).](image)

NEXT STEPS

- Processing of the collected audio-visual data (feature extraction and model design)
- Database recording in UK/London
- Integration of the developed models with Zeno
- Evaluation and dissemination of the developed DE-ENIGMA technology

The European Commission support for the production of this poster does not constitute an endorsement of the contents which reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

UNIVERSITY OF TWENTE.

Imperial College London

UNIVERSITÄT PASSAU

Institute of Education

Autism Europe

Autism Serbia

UdMIND