IM-TWIN: from Intrinsic Motivations to Transitional Wearable INtelligent companions for autism spectrum disorder

a European funded project

IM-TWIN production

Deliverable 3.7

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Deliverable data

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Acronyms of partners

CNR-ISTC	Consiglio Nazionale delle Ricerche, Istituto di Scienze e Tecnologie della Cognizione (Italy)
UU	Universiteit Utrecht (The Netherlands)
CRI	Centre de Recherches Interdisciplinaires (France)
LA SAPIENZA	Università degli Studi di Roma La Sapienza (Italy)
PLUX	Plux - Wireless Biosignals S.A. (Portugal)

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1. Overview of the deliverable

This deliverable provides details about the current status (May 2023) of the IM-TWIN system.

2. IM-TWIN system components

To date (May 2023), several components both hardware and software (respectively HW and SW) of the IM-TWIN system have been produced and are now in testing phase. In Table 1, for each component, we report the current status, the reference deliverable (if any) and additional notes about the development.

Table 1: IM-TWIN components status

Component ID (HW / SW)	Status	Reference deliverable	Notes
1) Panda PlusMe device (HW & SW)	- Produced 25 copies; - Released the Android App	- D3.5 “PlusMe production 1” - D3.6 “PlusMe production 2”	- Component planned in the original system - Samples in use in Italy and France -User manual available in the project website[1] - Videos available in the project website[2]
2) Octopus X-8 device (HW & SW)	- Produced 3 copies; - Released the Android App	- D2.1 “Processing of physiological signals, visual info, and PlusMe interaction, first version, (Section 4)”	- Additional component, not planned in the original system, but supporting the development of relevant system features - component designed on the suggestion of therapists, to support *turn-taking* activities - Samples in use in Italy - Videos available in the project website[3]

[1] https://im-twin.eu/hardware-and-software/#manuals
[2] https://im-twin.eu/video/#Plusme
[3] https://im-twin.eu/video/#x8_functional_features

3) Sensorised t-shirt (HW & SW)	- Produced 30 copies	- D1.3 “Physiological wearable sensors”	- Component planned in the original system - Samples in use in France[4] - User manual available in the project website[5] - Videos available in the project website[6]
4) Camera glasses (HW & SW)	- Produced 1 copy	- D2.1 “Processing of physiological signals, visual info, and PlusMe interaction, first version” - D3.3 “PlusMe AI-augmented behaviour and IM-TWIN 1”	- Additional component, not planned in the original system, but supporting the development of relevant system features - component designed on the suggestion of therapists, to detect *eye-contact* behaviour - Sample in use in Italy - In evaluation the production of additional copies - Videos available in the project website[7]
5) Signal Quality Indicator (SW)	- Software released	- D2.1 “Processing of physiological signals, visual info, and PlusMe interaction, first version”	- Additional components, not planned in the original system, but supporting the development of relevant system features. - component designed to help therapists in using the sensorised t-shirt (see component 3) - Software in use in France

[4] For use in Italy, the Consortium is waiting for the authorisation from the Italian Ministry of Health, which evaluated the tool as a medical device.
[5] https://im-twin.eu/hardware-and-software/#manuals
[6] https://im-twin.eu/video/#sensorised_tshirt
[7] https://im-twin.eu/video/#eye_contact_detector

6) Affective Status Indicator (SW)	- Software in development	- D3.1 "Affect and emotional classification" - D3.2 "Personalised affect classification and feedback" (due at May 2023) - D2.2 "Processing of physiological signals, visual information, and PlusMe interaction: last version" (due at July 2023)	- Component planned in the original system - A dedicated dataset (namely, the physiological data collected by the sensorised t-shirts, during the experimental activities with children) is required to train the software to categorise the affective status. The data collection is currently ongoing in France (see component 3).
7) "fast Continuous Wavelet Transformation fCWT" algorithm (SW)	- Software released	- D2.1 "Processing of physiological signals, visual info, and PlusMe interaction, first version"	- Additional component, not planned in the original system, but supporting the development of relevant system features - component designed to pre-process the physiological signals and separate meaningful patterns from background noise - Source code freely available in the project website[8]

3. Conclusions or Future Developments

To date (May 2023), the IM-TWIN system is partially developed. Several HW/SW components, as individual tools, proved to be reliable and aroused the interest of potential users involved in ASD treatment (in particular neurodevelopmental therapists), who envisaged a concrete usage of the produced technology in real therapy scenarios. In particular *PlusMe*, *Octopus-X8* and *Camera Glasses* (respectively the components 1,2,and 4) were produced with success, and are already being used by therapists, who provided positive feedback; the sensorised t-shirt (component 3) has been produced as planned and is now under test, in particular to be employed for the next *Affective Status Indicator* (component 6); the *Signal Quality Indicator* (component 5) is very important to collect quality data during experiments and use; finally, the fCWT algorithm (component 7) had a relevant impact in the scientific community, as outperforming the performance of existing algorithms in the context of physiological signal data processing.

The main system feature – namely the ability to categorise the ASD child's effective state in real time during the therapy session, to provide a relevant feedback to the therapist – relies on the integration of the all technologies described in Table 1; this step requires still a critical task,

[8] https://im-twin.eu/hardware-and-software/

currently ongoing, namely the collection of a proper database of physiological signals from ASD children (see components 6 in Table 1). This ‘core’ feature will be developed and analysed in the next deliverables, which will better denote the state of development of the IM-TWIN system:

- D3.2 “Personalized affect classification and feedback” (due at May 2023);
- D2.2 “Processing of physiological signals, visual information, and PlusMe interaction: last version” (due at Jul 2023);
- D3.4 “PlusMe AI-augmented behaviour, and IM-TWIN 2” (due at July 2023);
- D4.2 “Empirical validation: IM-TWIN” (due in October 2023).