



**IM-TWIN: from Intrinsic Motivations  
to Transitional Wearable INtelligent  
companions for autism spectrum disorder**  
*a European funded project*

***Exploitation Plan 3***  
**Deliverable 5.2**



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Consortium: Consiglio Nazionale delle Ricerche (ITA),  
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Interdisciplinaires (FRA), Università degli Studi di Roma  
La Sapienza (ITA), Plux-Wireless Biosignals S.A. (PRT).

## Deliverable data

|                                 |                                       |
|---------------------------------|---------------------------------------|
| <b>Work Package:</b>            | 5 Exploitation of IM-TWIN System      |
| <b>Work Package leader:</b>     | CNR-ISTC                              |
| <b>Deliverable beneficiary:</b> | CNR-ISTC                              |
| <b>Dissemination level:</b>     | Public                                |
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| <b>Type:</b>                    | Report                                |
| <b>Authors:</b>                 | V. Sperati, P. Gamboa, G. Baldassarre |

## Acronyms of partners

|             |  |
|-------------|--|
| CNR-ISTC    | Consiglio Nazionale delle Ricerche,<br>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 a final overview of the *Exploitation Plan*, a strategy initially drafted in the project proposal and then updated in the deliverable [D5.1 “Exploitation plan 2”](#)<sup>1</sup>, which aims to exploit the IM-TWIN results which are closer to a potential commercialisation (mainly the the *Senorised T-Shirt* by PLUX, and the *TWC interactive toys* by CNR-ISTC), within and after the project lifetime. In detail, the actions taken include:

- diffusion of project results to other interested users (mainly neurodevelopmental therapists and researchers, but also companies interested to co-develop the potential products) and their inclusion in the use and testing of the developed technology;
- refinement of IPR strategy and for the potential products, namely those technological outcomes which are closer to a market exploitation;
- overview of potential market and explorative surveys about potential early adopters;
- feasibility study for potential commercialisation of project results including – for the TWC devices – the possibility of founding a CNR spin-off company.
- strategy to sustain additional Research & Development activities, including the participation in further national and EU funding opportunities (e.g. new [European Innovation Council](#) calls).

It's worth mentioning that a whole work package of the project – the WP5 “*Exploitation of IM-TWIN system*” – was dedicated to the mentioned actions. This WP, led by the coordinator CNR-ISTC, was supported by the CNR *Technology Transfer Office* (TTO), and by the CNR subcontractor *Quantum Leap - Infinity Edge* company, a company expert in IPR analysis and management, market analysis, and business model planning.

To avoid weighing down the deliverable, the current document reports the updated list of taken actions for the exploitation, and leaves aside some general information about the project overall goals (including the rescheduling of some activities and accepted deviations), and descriptions about technical boards and subcontractors, described in detail in the previous deliverable D5.1 “*Exploitation Plan 2*”.

## 2. Exploitation actions implemented

In the following subsections we report all the actions that were implemented, and all materials that were produced to promote the exploitation of the project results.

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<sup>1</sup> <https://im-twin.eu/deliverables/>

## 2.1 Deliverables belonging to WP5

This subsection presents the list of the 13 deliverables produced in the WP5.

### D5.3 “IM-TWIN system booklet 1” (CNR, report, public, M3, 31 Jan 2021).

The first [IM-TWIN system Booklet](#) is a “CALL TO ACTION” which describes the general aims and objectives of the IM-TWIN project, in order to promote the possible involvement of stakeholders in the implementation of the exploitation activities.

The booklet was edited at the beginning of the project activities with a very extensive approach, including all the potential stakeholders identified at the time of the proposal in order to promote through targeted messages (see Table 1) their possible involvement in the implementation of the exploitation activities.



| Stakeholder category  | Need Addressed   |
|---|--|
| ASD Therapy Centers   | Improve the efficiency of therapy and the quality of life of children diagnosed with ASD with personalised tools for stress detection  |
| Health, Social, Educational Services  | Evaluate IM-TWIN research findings on emotion-detection in the framework of neurodevelopment surveillance protocols ( <b>screening programs in primary care for early diagnosis</b> ).   |
| Research Bodies   | <b>Integrated dataset usable for research on ASD</b> , built on a highly interdisciplinary integration of the last advances in signal processing, cognitive sciences, artificial intelligence, autonomous robotics   |
| Digital health/ Autonomous Robotics, Socially Assistive Robotics Industries | New solutions thanks to the IM-TWIN platform (wearable sensors and software) of <b>integrated data acquisition for socio-emotional detection and adaptive interaction</b> , that can be used for a wide range of clinical applications, at lab/clinical environment or at home (for remote monitoring scenarios) |
| ASD Industry  | Research program specifically aimed to collect experimental evidence on the beneficial use of the IM-TWIN system as a basis to monitor ( <b>early detect</b> ) <b>ASD and to improve the efficacy of child-customized therapies</b> .  |
| Intelligent Toy Industry  | Transitional Wearable Companion as a new class of interactive/adaptive toys to <b>develop emotional and social intelligence</b> , along with the pleasure of making new discoveries (curiosity and exploration) combining developmental psychology soft robotics and AI.   |

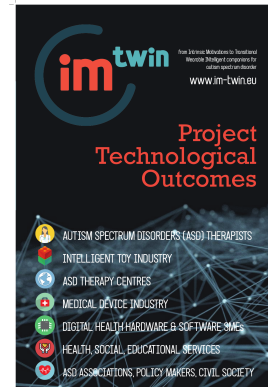
**Table 1: IM-TWIN Stakeholders categories and Needs Addressed.**

#### **D5.4 “IM-TWIN system booklet 2” (CNR, report, public, M22, 31 Aug 2023)**

The [second IM-TWIN system booklet](#) is more focused on the technological results potentially closer to a market exploitation, and is called “*Project Technological Outcomes*”. In detail, the booklet describes the 3 components of the IM-TWIN system: 1) the *Transitional Wearable Companion - TWC* toys; 2) the *Sensorised T-Shirt*, including the fCWT algorithm for data processing 3) the *Eye Contact Detector* tool.

The booklet was edited at the end of the project activities, to provide the reader with an effective overview of the developed technologies and their actual use with ASD and neurotypical children.

With reference to the stakeholders category in Table 1, the booklet is more focused and mainly addressed to ASD therapy centres and research bodies.



#### **D5.7 “Identification of target groups and relevant stakeholders 1” (CNR, report, confidential, M6, 30 Apr)**

The deliverable describes a list of potential stakeholders (rehabilitation and research centres, associations involved in ASD intervention, companies developing technology for kids with special needs), potential targets for the dissemination of the project outcomes.

#### **D5.8 “Identification of target groups and relevant stakeholders 2” (CNR, report, confidential, M27, 31 Jan)**

This deliverable describes those stakeholders with which CNR signed / is going to sign formal agreements to share and test the technological outputs of the IM-TWIN project. Currently, formal agreements have been signed with 5 Italian associations / research institutes<sup>2</sup>, which are active in the early intervention of ASD and other comparable Neurodevelopmental Disorders (NDD).

To date (November 2023), CNR is currently preparing the ethical documents, mandatory to use the project experimental outputs at the locations of the selected stakeholders.

#### **D5.5 “End-user engagement questionnaire 1” (CNR, confidential report, M21, July 2022)**

This deliverable reports the outcome of the first questionnaire (in Italian), addressed to potential Italian early adopters (such as neurodevelopmental therapists and researchers), about the propensity to use / purchase the *Panda PlusMe* interactive toy as a support tool for ASD early intervention. The online questionnaire was sent to 120 mail addresses (all belonging to individuals), and was compiled by 17 participants.

#### **D5.6 “End-user engagement questionnaire 2” (CNR, confidential report, M32, June 2023)**

This deliverable reports the outcome of the second questionnaire (in English), addressed to international potential early adopters (such as neurodevelopmental therapists and researchers), about the propensity to use / purchase the IM-TWIN system components (*Panda PlusMe* toy, *Sensorised T-Shirt*, *Eye Contact Detector* tool), as support tools for ASD early intervention. The online questionnaire was sent to 69 mail addresses (29 individuals and 40 associations supporting ASD intervention in the USA), and was compiled by 24 participants.

<sup>2</sup> The list is reported in the confidential deliverable D5.8.

**D5.11 “SWOT analysis, addressable-markets analysis” (CNR + Quantum Leap, confidential report, M28, February 2023)**

This deliverable provides a first market and SWOT analysis for the components of the IM-TWIN system.

**D5.12 “Country-based exploitation questionnaire and stakeholder interviews” (CNR, confidential report, M30, April 2023)**

This deliverable reports the result of a paper questionnaire about the IM-TWIN system components, filled out by the Italian audience who attended the event “*Workshop on new technologies and neurodevelopmental disorders*”<sup>3</sup>, described in the deliverable D6.8 “*Workshop for therapists and rehabilitation centres 1*”. The questionnaire was filled at the end of the event, after the presentation of the IM-TWIN system.

**D5.9 “IPR analysis and strategy 1” (CNR + Quantum leap, confidential report, M15, Jan 2022)**

This deliverable provides a first analysis of the IPR management and strategy (e.g. through trademark, patent, trade secret, copyright, industrial design, utility model) concerning the project technological outcomes. It also includes preliminary patent landscapes for wearable devices and smart toys.

**D5.10 “IPR analysis and strategy 2” (CNR + Quantum leap, confidential report, M33, July 2023)**

This deliverable provides an update of the IPR management, given in the previous deliverable 5.9.

**D5.2 “Exploitation plan 3” (CNR, report, M35, Sep 2023)**

The current document.

**D5.14 “Draft business plan” (CNR + Quantum Leap, confidential report, M24, October 2022)**

This deliverable presents a preliminary study to evaluate the creation of a startup company, for the commercialisation of some of the IM-TWIN components.

**D5.13 “Feasibility study and business model” (CNR + Quantum Leap, M36, October 2023)**

This deliverable completes the study presented in the previous deliverable D5.14.

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<sup>3</sup> [https://im-twin.eu/news/#Workshop\\_4\\_February](https://im-twin.eu/news/#Workshop_4_February)

## 2.2. Participation in EIC services

To support the development of new competences necessary for managing the whole process of exploitation of the project results, ISTC-CNR and PLUX members were involved and completed the following EIC services:

- **[EIC Pathfinder Bootcamp](#)**: (16-19 February 2021) dr. Baldassarre (from CNR-ISTC) took part in the bootcamp and gave a pitch about the *Plusme* interactive toy and the IM-TWIN system.
- **[EIC Women Leadership Programme](#)**: (October 2021 - March 2022) dr. Ozcan (CNR-ISTC) was selected as one of the “50 women in science in EU” for the service, which provided 24 hours of coaching and mentorship addressed to prepare women in science to start their own business.
- **[Horizon Results Booster](#)**: (May - October 2022) dr. Sperati (and informally dr. Ozcan and dr. Schembri, all from CNR-ISTC) took part in the *Horizon Results Booster*, service 1 “*Portfolio Dissemination, and Exploitation Strategy PDES*”, module C “*Assisting projects to improve their existing exploitation strategy*”. The PDES service concerned the *PlusMe* toy, and was formally done within the related European project *PlusMe*<sup>4</sup>, but it also covered some aspects of IM-TWIN project.
- **[Horizon Results Booster](#)**: (April-June 2023) dr. Schembri (CNR-ISTC) took part in the *Horizon Results Booster*, service 2 “*Business Plan Development*”. Since the module required, as a prerequisite, the draft of a business plan, the new deliverable D5.14 “*Draft of a business plan*”, not planned in the original proposal, was added in the amendment AMD-952095-7.
- **[EIC Programme Managers](#)**: (March-December 2023) dr. Rita Cristovão (PLUX CEO) took part in the *EIC Programme Managers*. The programme offered a 24 hours coaching, finalised to better define the commercialisation of the sensorised T-Shirt, taking into account the regulatory pathways for medical devices.

## 2.3 Scientific Publications

All publications produced in IM-TWIN are available at the project webpage

<https://im-twin.eu/publications/>

- **(2021) X-8: an experimental interactive toy to support turn-taking games in children with Autism Spectrum Disorders**  
B. Özcan, V. Sperati, F. Giocondo, G. Baldassarre, extended abstract presented at 23rd

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<sup>4</sup> [www.plusme-h2020.eu](http://www.plusme-h2020.eu)



*International Conference on Human Computer Interaction, HCI International 2021*; published in Stephanidis C., Antona M., Ntoa S. (eds), *HCI International 2021 - Posters. HCII 2021. Communications in Computer and Information Science*, pp 233-239, vol 1419, Springer, Cham, DOI: [10.1007/978-3-030-78635-9\\_32](https://doi.org/10.1007/978-3-030-78635-9_32)

- **(2021) Link between topographic memory and the combined presentation of ADHD (ADHD-C): a pilot study**  
N. Faedda, C. Guarilia, L. Piccardi, G. Natalucci, S. Rossetti, V. Baglioni, D. Alunni Fegatelli, M. Romani, M. Vigliante, V. Guidetti, *Frontiers in Psychiatry* 12:647243, DOI: [10.3389/fpsy.2021.647243](https://doi.org/10.3389/fpsy.2021.647243)
- **(2022) The fast Continuous Wavelet Transformation (fCWT) for real-time, high-quality, and noise-resistant time-frequency analysis**  
Arts, L.P.A. and van den Broek, E.L. *Nature Computational Science*, 2(1), 47–58. DOI: <https://doi.org/10.1038/s43588-021-00183-z>
- **(2022) A Novel System with a Smart Toy Responding to Child's Facial Expressions: Potential Use in Early Treatment of Autism Spectrum Disorders**  
Montedori, F., Mattei, F.R., Özcan, B., Schembri, M., Sperati, V., Baldassarre, G., in: Stephanidis, C., Antona, M., Ntoa, S., Salvendy, G. (eds) *HCI International 2022 – Late Breaking Posters. HCII 2022. Communications in Computer and Information Science*, vol 1654. Springer, Cham. [https://doi.org/10.1007/978-3-031-19679-9\\_24](https://doi.org/10.1007/978-3-031-19679-9_24)
- **(2022) Leveraging curiosity to encourage social interactions in children with Autism Spectrum Disorder: preliminary results using the interactive toy PlusMe**  
F. F. Giocondo, N. Faedda, G. Cavalli, V. Sperati, B. Özcan, F. Giovannone, C. Sogos, V. Guidetti, G. Baldassarre (2022) Extended Abstract presented at the *International Conference of Human-Computer Interaction CHI 2022* (New Orleans, LA, April 30, May 5 2022); published in *CHI EA '22, Extended Abstract of the 2022 CHI Conference on Human Factors in Computing Systems*, Article No. 273, pages 1-7, DOI: [10.1145/3491101.3519716](https://doi.org/10.1145/3491101.3519716)
- **(2022) Interactive soft toys to support social engagement through sensory-motor plays in early intervention of kids with special needs**  
B. Özcan, V. Sperati, F. Giocondo, M. Schembri, G. Baldassarre, Proceedings of the conference ACM [Interaction Design and Children, IDC '22](https://doi.org/10.1145/3501712.3535274) (Braga, Portugal, June 27-30 2022), section "Demo & Art Track", pages 625-628, DOI: [10.1145/3501712.3535274](https://doi.org/10.1145/3501712.3535274)
- **(2022) Multi-sensory Wearable Bio-feedback Pillow to Enhance Genuine Feeling of Intimate Connection**  
B. Özcan, V. Sperati, F. Giocondo, M. Schembri, G. Baldassarre, Proceedings of the [17th International Conference on Tangible, Embedded, and Embodied Interaction – TEI 2023](https://doi.org/10.1145/3569009.3573114) (Warsaw, 26 February-1 March), *Late Breaking Work*, Article No. 44, Pages 1–6 DOI: [10.1145/3569009.3573114](https://doi.org/10.1145/3569009.3573114)

- **(2023) Supporting turn-taking activities: a pilot study using a smart toy with children with a diagnosis of neurodevelopmental disorders**  
F. Giocondo, N. Faedda, G. Cavalli, M. Schembri, F. Montedori, F. Giovannone, C. Sogos, V., Guidetti, V. Sperati\*, B. Özcan\*, G. Baldassarre\*, Proceedings of the 22nd ACM conference [Interaction Design and Children, IDC '23](#) (Chicago, Illinois, USA, June 19-23 2023), section "Work in Progress", pages 464-469  
DOI: <https://doi.org/10.1145/3585088.3593863>
- **(2023) Biosignal Quality Control in Real-World Intelligent Environments**  
L. P.A. Arts, E. van den Broek (2023)  
Workshop proceedings of the 19th International Conference on Intelligent Environments (IE2023), pages 24-33  
DOI: [10.3233/AISE230006](https://doi.org/10.3233/AISE230006)
- **(2023) Platform and Hardware Independent Reliable Signal Processing**  
L. P.A. Arts, E. van den Broek  
Workshop proceedings of the 19th International Conference on Intelligent Environments (IE2023), pages 14-23  
DOI: [10.3233/AISE230005](https://doi.org/10.3233/AISE230005)
- **(2023) Speech Emotion Recognition using Deep Convolutional Neural Networks improved by the fast Continuous Wavelet Transform**  
van Zwol, B.E., Langezaal, M.A., Arts, L.P.A., Gatt, A., and van den Broek, E.L.  
Workshop Proceedings of the 19th International Conference on Intelligent Environments (IE2023), p. 63–72.  
DOI: <https://www.doi.org/10.3233/AISE230012>
- **(2023) Towards Continuous Monitoring of Well-Being**  
Meijer, A.L., Arts, L.P.A., Gomez, R., and van den Broek, E.L.  
Workshop Proceedings of the 19th International Conference on Intelligent Environments (IE2023), p. 196–205.  
DOI: <https://www.doi.org/10.3233/AISE230032>
- **(2023) Electrodermal activity: Continuous monitor of well-being**  
Meijer, A.L., Arts, L.P.A., Gomez, R., and van den Broek, E.L.  
Journal of Smart Cities and Society, 2(4) [in press]



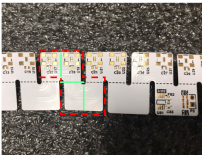
## 2.4 Dissemination material

Next materials, produced to support the project dissemination and exploitation (including free software, web and Android apps, manuals, brochures), are freely available at the project web pages <https://im-twin.eu/hardware-and-software/> and <https://im-twin.eu/press-kit/>:

- **Code repositories and web app for implementing and run the algorithm “fast Continuous Wavelet Transformation (fCWT)”**, by UU
  - Code on GitHub repository: <https://github.com/fastlib/fCWT>
  - Code on Ocean repository: <https://doi.org/10.24433/CO.8389373.v1>
  - fCWT web app: <https://fcwt.app/>
- **Code repository for the “BLE Android Plugin”, a plugin necessary to enable the bluetooth communication on Godot<sup>5</sup> based Android app**, by CNR-ISTC.
  - Code on GitHub repository <https://github.com/IM-TWIN/BLE-Android-Plugin>
- [Sensorised T-shirt user manual](#), by PLUX.
- [TWC user manual](#), by CNR-ISTC.
- [TWC App android \(apk file\)](#), by CNR-ISTC.

## 2.5 IPR results

This subsection reports the current status of IPR results:

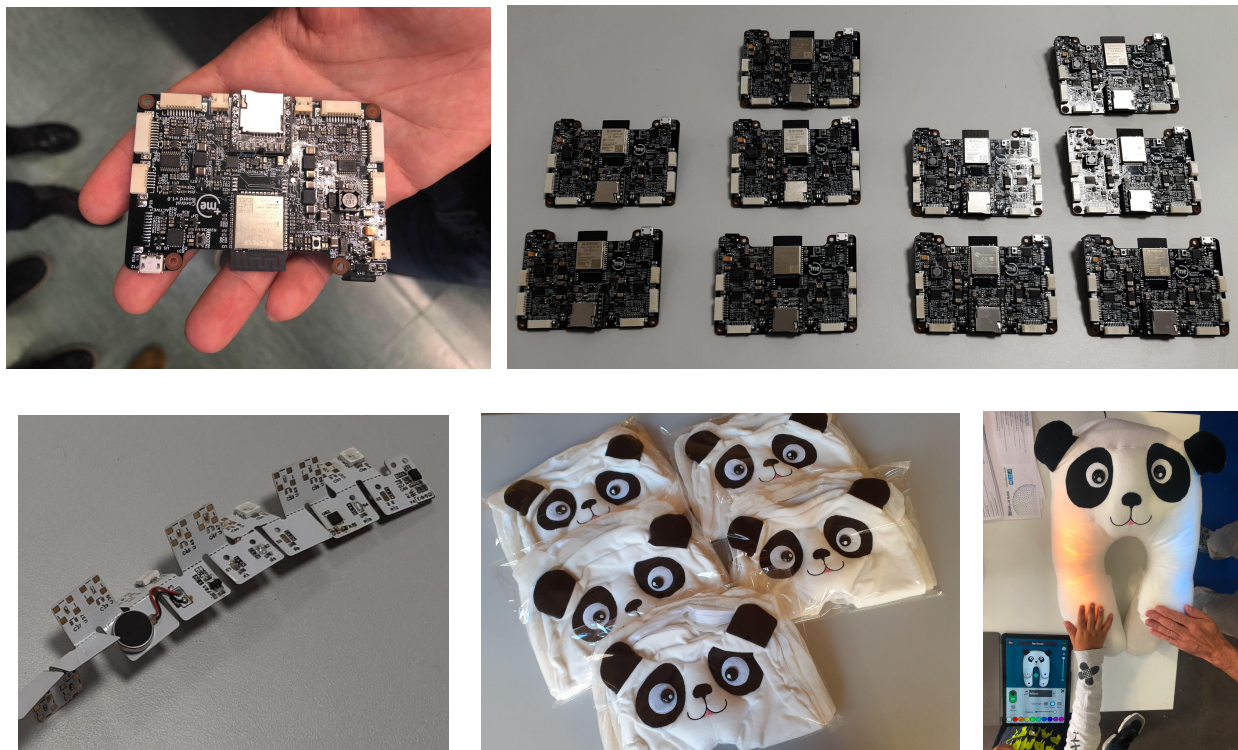
- **Trade mark “PlusMe”**. Figurative mark associated with the TWC *PlusMe* toy. Trade mark data: filing number 018509222; filing date: 06/07/2021; Nice class: 9,10,42,44; Owner: CNR; EUIPO link: <https://euipo.europa.eu/eSearch/#basic/1+1+1+1/018509222> 
- **Design of “X-8 Octopus”**. Design associated with the TWC *Octopus X-8* toy. Design associated data: filing number 009076284-0001; filing date: 01/07/2022; Owner: CNR; EUIPO link: <https://euipo.europa.eu/eSearch/#details/designs/009076284-0001> 
- **Patent for the “IM-TWIN system core”**. Request for patent for the system composed by the components “PlusMe toy + sensorised device + camera glasses”. The application was filed on date 21/06/2022, but the first research report resulted in some objections raised by the EU evaluator. On date 24/10/2023 a rebuttal was filed and is awaiting the EU evaluator’s response.
- **Patent for flexible electronic design**. Request for patent for design of flexible electronics, used in the *PlusMe* toy. The Application was presented on date 08/08/2023 for Italy, and is awaiting the EU evaluator’s response. 

<sup>5</sup> The *Godot* engine (<https://godotengine.org/>) was used to develop the TWC Android app.

## 2.6 Panda PlusMe: next steps for exploitation

With the deliverables D3.5 and D3.6 “PlusMe production 1 and 2”, CNR produced 25 samples of the TWC toy *Panda PlusMe* (see fig. 1). In order to promote the exploitation of these devices, CNR finalised / is finalising formal agreements with potential early adopters (mainly institutes for intervention with ASD children and comparable neurodevelopmental disorders) who showed interest in using *PlusMe* for activities with children. The list of early adopters is provided in the confidential deliverable D5.8 “*Identification of target groups and relevant stakeholders 2*” (see previous section 2.1 “Deliverables belonging to WP5”).

It is worth mentioning that currently the TWCs (*Panda PlusMe* and *Octopus X-8*) are integrated with new software/hardware features: the *data collection software* and the *Eye Contact Detector*. These tools, described in detail in the section 3 and 4 of the deliverable [D2.2 “Processing of physiological signals, visual information and PlusMe interaction, second version”](#), increase the device ability to collect behavioural data<sup>6</sup>. Such technical improvement enhances the user’s interest in the product, as confirmed by interviews and surveys<sup>7</sup>. This direction of development goes toward the creation of a *platform*, where the TWC toys are used both to support therapy and as a tool for monitoring the children’s behaviour through data collection and analysis.

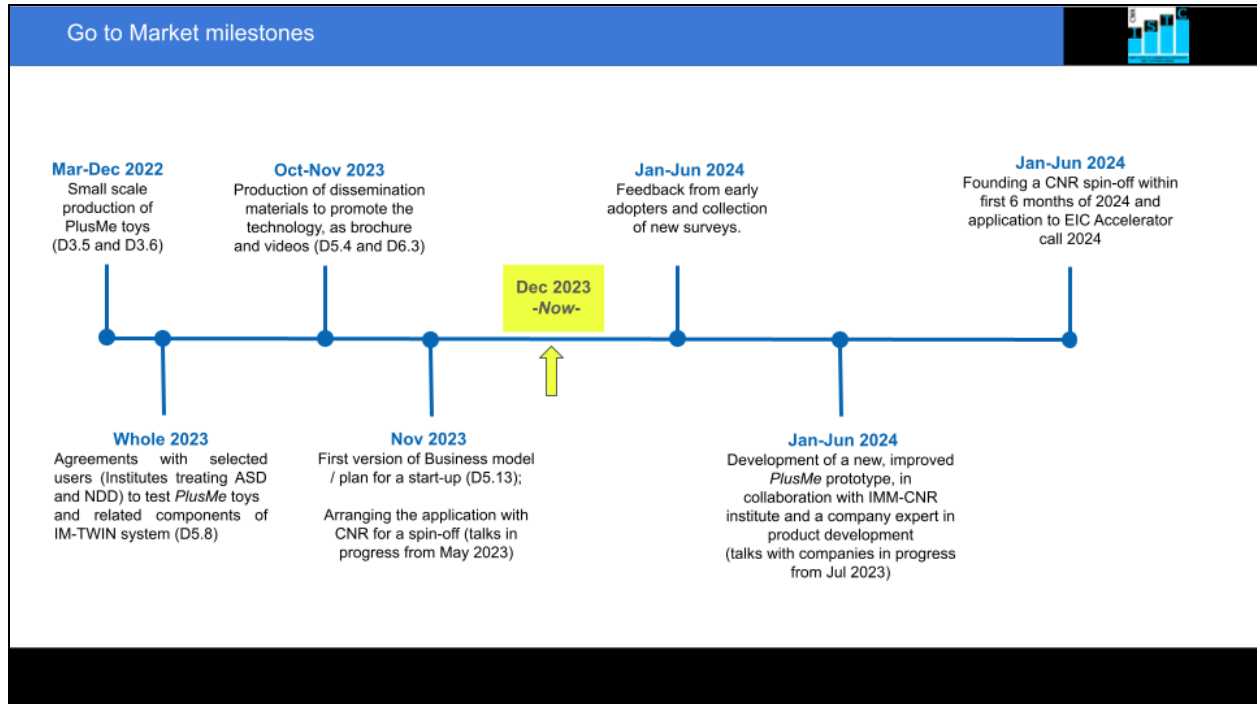


**Figure 1:** the inner electronics of *Panda PlusMe*, realised for a small scale production of the toy.

<sup>6</sup> See also videos at links [https://im-twin.eu/video/#eye\\_contact\\_detector](https://im-twin.eu/video/#eye_contact_detector) and [https://im-twin.eu/video/#x8\\_functional\\_features](https://im-twin.eu/video/#x8_functional_features)

<sup>7</sup> See the 2 confidential deliverables “*End user engagement questionnaire*”.

The *TWC-platform* development will continue after the end of the project. To sustain the next R&D activities, CNR-ISTC will apply to new research calls<sup>8</sup>, and a team of researchers undertook to establish a spin-off within the first 6 months of 2024, with the goals to realise a new, improved *PlusMe* toy, to take contact with companies expert in product development, and to participate in the *EIC Accelerator* call. The indicative timeline of the mentioned steps is described in the *Go-To-Market-Milestones* diagram, which is part of the project *Transition Plan* (see fig. 2).



**Figure 2:** the “Go-To-Market Milestones” diagram. describing the next steps planned by CNR-ISTC for the TWC toy exploitation.

## 2.7 Sensorised T-shirt: next steps for exploitation

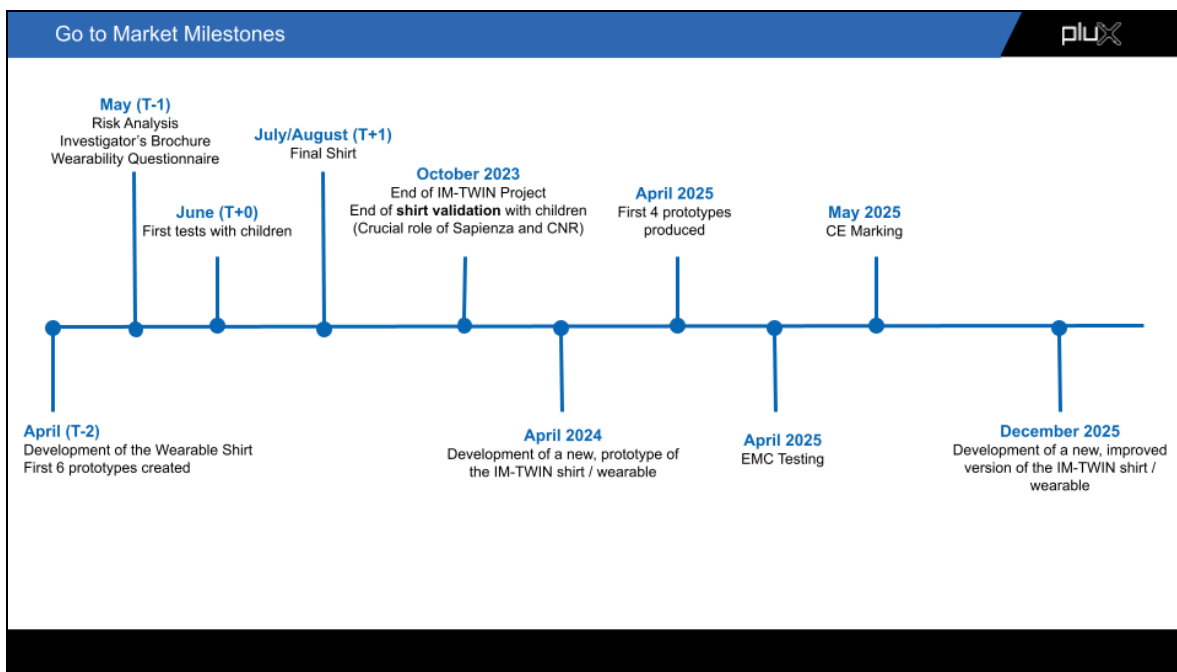
PLUX will continue the development of the sensorised T-shirt (see fig. 3) in a national project and after the end of the project, the following pathways to market will be pursued: partnership with companies that develop SW for Emotion Recognition/ Apps for Stress Management (PLUX as Hardware providers) and partner with Research Centres (working with children, or identifying emotions in adults). PLUX will develop new prototypes of the IM-TWIN shirt and go through EMC testing to obtain CE marking.

<sup>8</sup> To date (Nov 2023), the CNR-ISTC applied in 2023 to 4 calls (two not successful, two awaiting evaluation).



**Figure 3:** the T-shirt prototypes used in the experimental activities.

The indicative timeline of the mentioned steps is described in the *Go-To-Market-Milestones* diagram, which is part of the project *Transition Plan* (see figure 4).



**Figure 4:** the “Go-To-Market Milestones” diagram. describing the next steps planned by PLUX for the sensorised T-Shirt exploitation.

## 2.8 Further exploitation actions concerning TWC devices

In this subsection we report general activities, not formally directly linked to the IM-TWIN project, but which can foster the exploitation of the project outcomes:

- As part of exploitation activities, CNR-ISTC published a page dedicated to *PlusMe* toy in the [Horizon Results Platform](#), a website where the EU funded research results are described for potential stakeholders. The page is available at the following link:

<https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/horizon-results-platform/56880>

- To foster the foundation of a start-up for the potential TWC toys commercialisation, a team of researchers from CNR-ISTC, in April 2023, took part in an Italian call for financing innovative companies. The call was entitled “*Planet Fundamentals*<sup>9</sup>” and granted for the winners a pre financing of 100.000 euros and an accelerator programme. The CNR team passed the first step of selection (interview with stakeholders and pitch presentation), but was not selected for the second step (financing and access to accelerator programme). The participation, although not successful, allowed the researchers to prepare important material such as a *startup pitch presentation*, to be improved for future occasions.

### 3. Overview of planned future exploitation steps and conclusions

We have presented above the dissemination and exploitation activities carried out in the last reporting period. Some activities will continue after the project termination, and others are foreseen. An overview of both types of activities is as follows.

- **Transitional Wearable Companions (TWCs).** The activities to exploit the TWCs realised during the project implementation will continue after the project termination. In particular, we will employ for this purpose the 25 copies of the PlusMe and the 2 copies of the X-8. Some copies of the TWCs have been already borrowed to 5 centres different Centres for collaboration (as specified in detail in confidential deliverables). The other copies will be shared with other collaborating partners and recognition and contracting activities are already ongoing to this purpose.
- **T-Shirt.** PLUX will continue the development of the sensorised T-shirt within a national project after the end of the project, following a pathway to market involving a partnership with companies that develop SW for Emotion Recognition/ Apps for Stress Management and Research Centres (working with children, or identifying emotions in adults). PLUX will also develop new prototypes of the IM-TWIN shirt and go through EMC testing to obtain CE marking.
- **IM-TWIN system and Platform.** The TWCs will also continue to be developed as a fundamental component of the IM-TWIN system. In turn, the IM-TWIN system will become the core element of a new IM-TWIN Platform (see Section 2.6). Beyond the IM-TWIN system, the Platform will encompass tools to collect and share data on cloud, means to share instructions on the use of the IM-TWIN system components, and applications for data processing.
- **NewCo.** CNR will implement the next steps of the creation of the new company. This will be a start-up created as CNR spin-off having the legal status of “innovative company”.

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<sup>9</sup> <https://socialfare.org/planet-fundamentals/>

The mission of the start-up will be the further development and commercialisation of some components of the IM-TWIN system (mainly the TWC, the sensorised glasses, and the main software implementing the Platform).

- **New EU/national projects.** The consortium members, in isolation or sub-groups and also together with new partners, will participate in new EU projects to move forward the TRL level of the IM-TWIN system and components. As an example, to date the consortium partners have already participated in four calls with such a purpose:
  - 2 EIC Transition calls: this far the projects presented were not funded, but new attempts will be realised in the future.
  - The EU call “IHI Innovative Health Initiative”, awaiting the outcome of the evaluation.
  - The Italian “Fondazione TIM” call, awaiting the outcome of the evaluation.
- **Patents.** As discussed in Section 2.5, the project is awaiting of the outcome of 2 patent applications:
  - *Patent on the “IM-TWIN system core”.* Filed on 21/06/2022, we are awaiting the outcome of the rebuttal presented on 24/10/2023.
  - *Patent for flexible electronic design.* Filed on 08/08/2023 for Italy, we are awaiting for the evaluators’ response.
- **Experiments.** The tests of the IM-TWIN components and system will continue to be carried out, in particular within collaborations involving at least CNR and Sapienza.
- **fast Continuous Wavelet Transform (fCWT) algorithm.** UU will seek collaborations with some of the companies indicated in the “Deliverable 6.13 - B2B Meeting 2”, in particular to exploit some of the potentialities of the algorithms for multiple applications.
- **Publications.** After the great effort required by the project on the side of development, testing, and exploitation, the project partners will realise additional publications involving the IM-TWIN system/components and the outcomes of its tests.

This document provides an overview of the initiatives undertaken to capitalise on the results of IM-TWIN for exploitation purposes. The project faced challenges, including the Covid-19 pandemic, the shortage of electronic components, and difficulties obtaining Italian ethical clearance, which impeded a smooth progress of project exploitation activities. Despite these hurdles, and also thanks to an amendment resulting in a one-year extension, the project succeeded to carry out the planned exploitation activities foreseen by the Workplan, thus maximising the project’s impact.

Notably, various activities contributed significantly to advancing and integrating the multiple innovations developed by the project towards higher Technology Readiness Levels (TRL) and the market. These innovations represent novel means to study, monitor, and support the therapy of children with ASD. These technologies include the Transitional Wearable Companions (led by CNR-ISTC), the Sensorised T-Shirt (led by PLUX), the novel algorithm *fast Continuous Wavelet Transform fCWT* (led by UU), and the integrated IM-TWIN system (partially validated through tests led by Sapienza and CRI). The exploitation achievements reviewed here all underscore the robustness of the IM-TWIN concept, which relies on modular components that can be



exploited both individually and as parts of integrated systems. The potential of the IM-TWIN concept is further evidenced by planned exploitation activities planned to continue beyond the project termination.