

**Ph.D. in Information Technology  
Thesis Defense**

**February 6<sup>th</sup>, 2025  
at 10:00 am**

**Sala Conferenze Emilio Gatti – building 20**

**Diego MORRA – XXXVII Cycle**

**Leveraging Accessible Design Toolkits and AI for the inclusivity of Individuals with Intellectual Disabilities in IoT Programming**

Supervisor: Prof. Maristella Matera

**Abstract:**

This thesis investigates the design of accessible toolkits aimed to engage people with intellectual disabilities (ID) in ideating and personalizing Internet of Things (IoT) technologies. My research lies at the intersection between technology, inclusion, and user empowerment, focusing on designing tangible user interfaces (TUIs) and collaborative methods that enhance the engagement and autonomy of people with ID.

The context of this research is rooted in the increasing importance of digital literacy and technology accessibility in contemporary society. Individuals with ID are often excluded from the digital transformation due to the complexity of technology and the need for appropriate educational tools. The development of IoT technologies has the potential to significantly improve the quality of life for individuals with ID by enabling them to control and personalize their environment. However, the complexity of these technologies presents a barrier. This thesis aims to bridge this gap by developing toolkits that simplify the creation and personalization of IoT devices for users with ID.

The primary contributions include designing and validating two innovative toolkits, IoTgoID and MakeNodes, which combine physical and digital elements to facilitate the understanding and creation of smart devices by ID users. IoTgoID is a modular toolkit that allows users to create IoT devices through simple, intuitive interactions with tangible components. MakeNodes extends this concept by providing a more flexible platform that integrates various sensors and actuators, enabling users to build customized IoT solutions. Through extensive user studies and iterative design processes, this thesis demonstrated how these toolkits can positively impact the well-being and social inclusion of individuals with ID. Engaging end-users in the process of making these toolkits empowers them to take control of their environment, fostering a sense of accomplishment and self-efficacy.

In addition, this thesis investigates how large language models (LLMs), such as GPT-4, can enhance coding accessibility for individuals with ID by generating code from natural language prompts. This approach aims to lower coding barriers, enabling greater participation in technology creation and leveraging AI to enhance the inclusivity of people with ID in IoT programming.

The findings of this thesis underscore the importance of user-centered design and the potential of AI-based tools to democratize access to technology. By focusing on the needs and abilities of ID users, the research contributes to developing more inclusive and empowering technologies. The

main outcomes of this thesis consist of design guidelines and recommendations for people with ID inclusion in the technology process, emphasizing the need for continued collaboration between stakeholders, researchers, and communities of people with disability to create tools that enhance the participation and agency of individuals with ID in the modern digital era.

## **PhD Committee**

Prof. Nicoletta Di Blas, **Politecnico di Milano**

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