



NTT DATA

AI and design: a human-centered methodology in practice

**How a collaborative approach
can help to create ethical
technological solutions**

Adriano Manfrè, Corinne Schillizzi, Claudia Lunini

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“Every child or adult with autism has unique characteristics and needs, hence there is “no one fits all” approach to autism treatment. When a teacher is replaced, it’s difficult for them to manage.”

Paola Golzi

Associazione Nazionale
Genitori soggetti autistici



Introduction

Autism Spectrum Disorder (ASD) is a developmental disorder affecting social interactions, communication and behavior that generally appears in the first years of life. According to the World Health Organization, it is estimated that worldwide one in 160 children has an ASD, and epidemiological studies conducted over the past 50 years suggest that the prevalence of ASD appears to be increasing globally. Nevertheless, ASD manifestation varies a lot from an individual to another, making it difficult to fully understand and define it even on a scientific level and, as a result, to provide treatment tools and methodologies that are suitable for different patients.

One of the common challenges for people with ASD is to **communicate effectively** with their caregivers and all the people around them. Selecting the right communication methods and tools is crucial for caregivers in order to avoid children's potential crises and educate them to independency. Such methods and tools deeply depend on the person, so they have to be customized according to the abilities of the subject with ASD and to the specific circumstance of interaction. Taking into consideration all these aspects can be challenging for a person, and technologies can come in handy.

Among all technologies, **Artificial Intelligence** (AI) is definitely the best fit thanks to its capability to **learn**

and adapt, which is the reason why it is becoming one of the leading emerging technologies to help to address the main challenges, even in social contexts.

However, often AI solutions tend to be developed based on the available data, while it would be also necessary to implement them bearing in mind their ethical and social impact. For instance, in a sensitive domain such as the ASD, it is important to consider first the ethical and social outcomes of such a solution by leveraging on a collaborative approach between teams of multiple and heterogeneous parties, in order to access and analyze disparate point of views.

AIDA (Artificial Intelligence Design for Autism) project is a good example to demonstrate how a collaborative approach between different capabilities can give rise to a solution of value, with **a strong social and ethical impact**. This collaboration allowed us to create a solution **starting from humans' needs**, focusing on the understanding of their perspectives through design research and a collaborative process between the two competencies of AI and Design.

In this paper, we will see how the AI process supported by a strong ethical approach, as in the case of AIDA project, can deliver new applications that keep in mind the United Nations Sustainable Development Goals (SDGs) to support people and their needs.



AIDA: Artificial Intelligence Design for Autism

AIDA is a non-profit research project born within NTT DATA to help people with Autism Spectrum Disorder and their caregivers to communicate effectively suggesting the most suitable tools and methodologies to adopt. AIDA has the purpose of creating an AI solution that bases its foundations on users' needs. The AIDA project is born to provide meaningful insights into a sensitive domain like ASD, bringing humanity and society to the center of the process.

Unlike the classic AI projects, where data constitutes the starting point, AIDA started from the needs of the final users and transformed those needs into knowledge that the AI algorithms could learn. Understanding the needs of the final users required considering all the actors involved: parents, educators, and therapists. The various perspectives came from different points of view, in accordance with the role played by the persons and their particular sensitivity in measuring situations. The extensive stakeholders' involvement was pivotal to enable the team to analyze the autism topic from different perspectives, and collecting a considerable number of insights about the current experience of multiple actors.

The complex and sensitive application domain required the introduction of a central ethical focus in all the steps of the process, starting from the data collection. AIDA project, in fact, aims in particular at reducing ethical AI-related risks. Because of its sensitive domain, a design error may result in a difficult and delicate situation for the child involved; hence, the creation of a robust, reliable and explainable solution has been the focal point that guided the process.



The approach

“While some AI technology is intended to operate autonomously, one of the most useful types of AI-augmented intelligence (also known as intelligence amplification, or IA) - uses machine learning and predictive analytics of data sets not to replace human intelligence, but to enhance it.”¹

The complex application domain, the multiple fields covered by the project, and the need of creating an ethical solution led us to explore a **cross research methodology** by applying a **human-centered approach** to the design of an AI system. To do so, we established a collaborative design process among three teams working together: AI Experts, UX/Service Designers, and field stakeholders. This collaboration led to the necessity of defining a tailored approach to research and resulted in establishing the NTT DATA Artificial Intelligence and Design Methodology.

This methodology has the objective to generate a compliant strategy that cares about Data and AI algorithms and enable organizations to make a social impact. It is founded on a human-centered approach that leverages the European Union’s Ethics guidelines for trustworthy AI: Ethics, Lawfulness, and Robustness. Moreover, it takes into consideration social aspects such as sustainability and society well-being, promoting solution than solve social issues. Furthermore, it aims at building AI solutions that follow the Responsible AI principles: Fairness, Reliability and Explainability.

The methodology consists of a series of guidelines defining the general approach to follow for an effective collaboration between people of the different teams and areas involved. It also collects a set of selected **tools and activities** necessary to generate impactful AI services and products that combine the best of AI, Design, and Business expertise.²

Following the defined methodology, we started with the active participation of the stakeholders in order to get valuable insights. This phase of user research took a long and slow journey to assimilate enough knowledge about the context and its peculiar characteristics. Hence, the ASD experts were involved in gathering and analyzing research findings, and finally, the results were shared with AI experts with the aim of re-iterating the research activities in order to obtain a more reliable AI model design.

Building AI solutions that follow the Responsible AI principles: Fairness, Reliability and Explainability.

¹ <https://digitalreality.ieee.org/publications/what-is-augmented-intelligence>

² <https://medium.com/tangity/using-qualitative-research-to-structure-an-unbiased-ai-dataset-1012b1e24262>.

The challenges

The main purpose of AIDA is to help children in the Spectrum by providing an ethic and reliable AI solution that uses Data & AI Algorithms following a compliant.

Leveraging AI, one of the main challenge concerned the **data collection**: what kind of data could be of interest for building the solution, how to collect the information in accordance with privacy regulation, and how to structure it.

What data should be collected?

In order to understand what kind of information could be useful, we had to focus on the final users' needs. Through user research activities, like interviews, participant observation and workshops with autism experts and caregivers, we were able to identify the key aspects to focus on, both regarding the children specific characteristic and the communication tools and methods. During this phase, we deeply realized the complexity of this domain and the innumerable features that need to be considered when facing a delicate field like the ASD.

How to collect data in a structured way?

We had to define a suitable and robust data structure in order to build a knowledge base for feeding the AI algorithms. This required the definition of the characteristics to be considered, the nature of each characteristic (whether it is numeric information or text to be analyzed or something representing a category), and its role in the design of the AI solution.

How to avoid biases?

Another important aspect that we had to face in defining this strategy was how to avoid biases when collecting data. In fact, collecting information from multiple stakeholders could easily bring bias, since the human perspective deeply depends on the peculiar role played by the specific people with respect to the child and their sensitivity in analyzing and evaluating a particular situation involving the child.

How to bring ethics into practice?

Once realized what kind of information was needed, and how to collect it, the further challenge was defining a strategy to collect data in a way that complies with ethical principles and GDPR regulation and minimizes the exposure of personal information.

**Help children
in the Spectrum
by providing an
ethic and reliable
AI solution.**

Our solution: Diary App for data collection and information sharing

The Diary App

The Diary App is the tool created to collect data, useful for both users and AIDA team. Indeed, it enables caregivers to share information about the child, his/her preferences, communication manners, activities and tools, and, on the other hand, it enables the team to collect the data needed to let the Artificial Intelligence engine learn. Having this double purpose, **it needed to be designed according to both Design and AI perspectives**. From the user point of view, the main requirement was the possibility to easily share information about the child and keep track of the child progresses over time. From the AI point of view, the app needed to enable the collection of structured data in order to have it almost ready to use by the learning engine.

Collecting data about the child and the context

In order to define what data to collect, we analyzed the research insights through the **input/output table**. This table represents a tool designed to help the design and AI team collaborate to formalize the desired solution outputs and consequently the inputs needed to obtain such outputs. To do so, the group first brainstormed about the outputs and then took a step back to understand which data we had to collect to feed the AI model.



10 Our solution: Diary App for data collection and information sharing

INPUTS	OUTPUTS
Child's preferences	Best communication methods
Known/new situation for the child	Best tool and methods
Crisis/non crisis state	Calming sounds
In case of crisis, what the child is doing	How to manage sounds
Know/unknow people	How to manage temperature
Child's kind of communication	How to protect them being hurt
Caregivers' kind of communication	How to structure environment
Sounds	Kind of communication (verbal/not verbal)
Environment	Example of preferred things
Communication effectiveness	Example of preferred activities
Used tool	

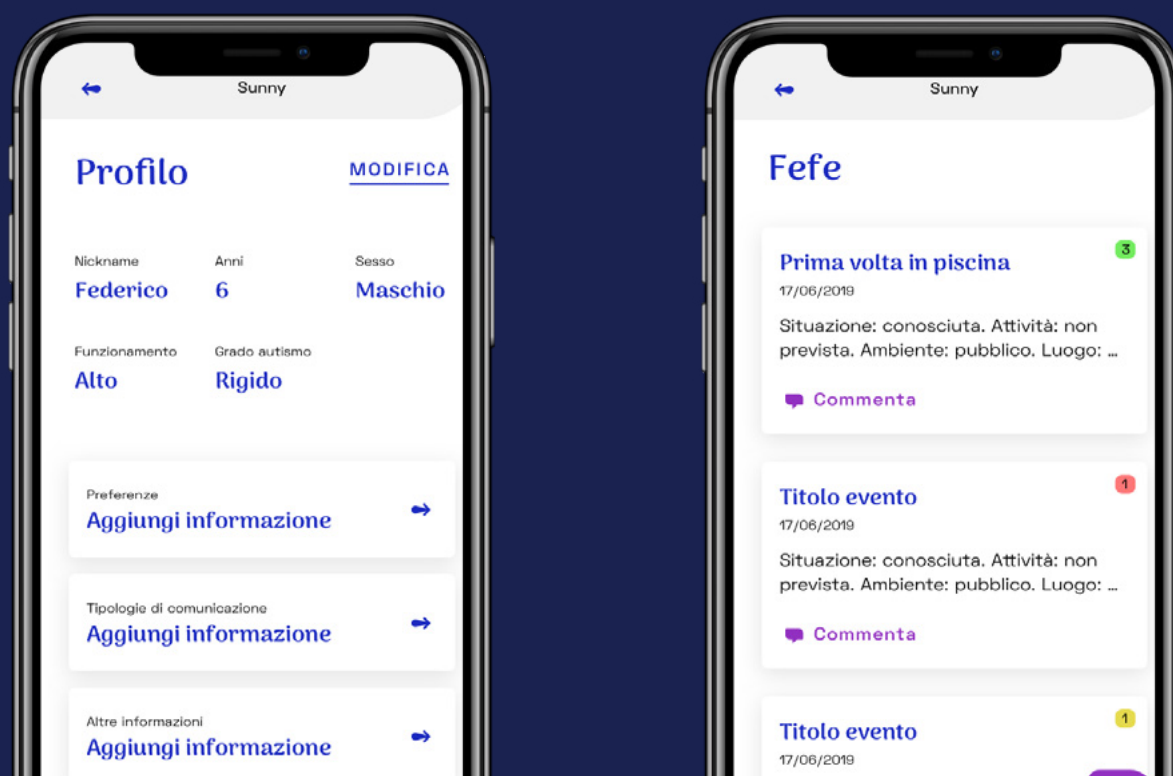
Since the final scope of AIDA is to help caregivers suggesting them the most proper method or tool to communicate with the child in a certain circumstance, the AI engine needs to analyze structured data that covers all these aspects: child characteristics, available tools or methods, circumstance related information.

For what concerns children's characteristics, the interviews and the medical literature about ASD, suggested the features to be taken into account. Few personal information was considered, as the age and the gender of the child. Moreover, we considered two specific features related to the ASD, namely, the functioning level, which is the intellectual or language impairments that ranges between Low and High functioning, and the cognitive flexibility that is the ability to shift to different thoughts or actions depending on situational demands that ranges between Rigid and Flexible. In fact, according to the medical literature, these features allow defining a very first clustering that can help to address an initial set of tools and methods suitable for each cluster. Since AIDA aims at giving more customized suggestion, more detailed information needed to be collected regarding how a specific tool/method was used in a certain situation and their impact. According

to these needs, we designed the **two main functionalities of the Diary App**: the creation of a child profile, and the creation and sharing of Stories about his daily life and routine.

The child **profile** is a collection of the child's personal information that will enable the AI to classify children needs. The profile is composed of the above-mentioned basic information like the child's age and gender and the ASD-related information of the functional level and cognitive flexibility. Exploiting such information, it is possible to determine four initial classes in which children on the Spectrum can be divided. Such classes will be enriched by other information about the child's general preferences and the child's communication preferences collected through stories.

The **Story** functionality, indeed, offers users the possibility to create and share an event concerning the child. In particular, using this functionality, the user can tell in detail how a certain situation has evolved, providing information on the context of the event, on the child's reaction, on the tools and methodologies adopted to handle such situation, and on the result obtained using the selected tool.



Use the app to structure the data

By considering the necessity of the AI algorithm to leverage data as structured as possible, the insertion of a Story in the application was designed **as a guided process** composed of several steps in which the user is asked specific questions. In fact, the creation of a story is designed to enable the AI engine to find patterns between a situation, a communication manner and the child reaction. In the first step, the user is asked to describe the circumstance from a set of predefined aspects that may affect child behavior. Secondly, the user provides information about the child's reaction and the tools or activities used in that situation. Finally, the user provides information about the efficacy of the communication (tool/activity) used. This final question is very useful from an AI perspective since it allows the system to understand which combinations of situation-tools are winning and which failed, providing labels to those combinations.

Avoiding bias providing role access in the app

As anticipated, another challenge was related to the biases that each stakeholder (caregivers) could bring according to his/her background and experience with the child. In order to avoid introducing human biases into the data, in the early stages of the project, the group analyzed the aspects that could carry such biases. Once we identified such aspects, we were able to **formalize them and define a strategy to avoid biases**, thus designing the app accordingly. In particular, this means that we needed to understand the caregiver's role for the child, and how that role could influence his/her judgment. This allowed us to assign weights to users' feedbacks accordingly. To achieve this, it was necessary to provide the role choice (therapist, educator, parents, teachers) during the registration phase on the App.

12 Our solution: Diary App for data collection and information sharing

Focus on privacy and security from the very first steps

Privacy and security were crucial to us from the design phase. We have made every effort to ensure that the solution guarantees the principles of security and protection from unauthorized access, to strengthen data traceability, and to develop the proper means and policy for collecting, storing, using, and providing personal information.

For example, **to safeguard the privacy of the children**, the use of nicknames was envisaged from the first design phase of the application. Moreover, **only people selected and invited by the parents can access** the child's profile. We are including all the data security requirements in the analysis phase, before the actual production, so that all data utilized will not be attributable to the child.

From the design perspective, the app is designed by considering the best practices for a GDPR compliant application that makes the user knowledgeable about the data he/she is going to provide and how it will be used. Users must actively opt-in to have their data collected, stored and used. Considering the field, we are caring even more about the user awareness of what is doing to make a properly informed decision when they move forward.

We spent effort to make it **easy to withdraw** consent at any time to guarantee users this right, providing withdraw in the setting section, easily accessible.

We are also caring about transparency on the entire use of data by explaining the goal of participation on the welcome page. Each aspect is communicated in simple way, avoiding technical word that could be misleading for the user.

Finally, we are defining data access limits also within the company, in order to minimize data exposure.



Benefits arising from the approach

The approach followed brought several benefits in the collaboration and in the definition of a solution that really focuses on users' needs. Particularly, the collaboration allowed us to analyze such needs and translating them into something concrete and usable, namely the data. In fact, considering just this primary phase of data collection through the Diary App, we can see an interesting outcome. As we mentioned at the beginning, ASD varies a lot from an individual to another, making it difficult to fully understand the condition and defining general treatments. This is partially due to the absence of a wide and comprehensive knowledge base, which make it difficult to explore this field. By collecting data through the application, we are building a dataset that not only is necessary for AIDA's purpose, but could also provide **valuable insights** for medical research in this domain.



Collecting data through the app, we are building a dataset necessary for AIDA's purpose.

AIDA Future Evolutions

The Diary App represents the very **first step** toward the construction of the entire **AI system** made by different components. Once the dataset will contain enough data, we will have patterns of situation-tools on which to start the analysis and the building of the AI model. If we look at the entire AIDA project, as we have conceived it, data coming from the Diary App will be enriched using wearable sensors monitoring children biometrics features. These further steps will combine children reaction to specific biometrics feature, with the goal of having even more insights to deeply understand ADS from several points of view and improve the model suggestions not only to help caregivers in solving already existing crisis, but also **preventing** such **crisis** by finding patterns that occur in the early stages of a child crisis.

Solving and preventing crisis by finding patterns that occur in the early stages of a child crisis.



A close-up photograph of a child's feet wearing blue denim jeans, sitting on a blue textured carpet. Several wooden alphabet blocks are scattered around the feet. One block prominently shows the letter 'N' in green, another shows 'M' in red, and another shows 'E' in red. The scene is brightly lit, suggesting an indoor setting.

Conclusion

Our experience within the AIDA project allowed us to experience firsthand the benefits of a **collaborative and ethical approach**. Bringing together different competencies in fact has been the key that led us to ideate an AI product starting from the real needs of the final users and to build a dataset containing the most suitable information to achieve the best results to satisfy such needs. This will result in a positive impact on people's lives. We strongly believe that this effort spent in the designing phase of the AI solution can make a difference. By bringing humanity and society at the center of our process from the very beginning, it is possible to consider all the requirements needed to design AI solutions that ensure the three characteristics of trustworthy AI - ethical, lawful, and robust - according to the EU guidelines. The positive impact is made by design to enhance human intelligence rather than operate independently.

For what concerns AIDA future evolutions, partnerships are essential to make the project grow. We aim to start a wide collaboration involving hospital and associations in different nations and cultures in order to spread our solution and enrich the knowledge base.

**The positive impact
is made by design
to enhance human
intelligence rather than
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Key Takeaway

1 AIDA is a non-profit research project to help people with Autism Spectrum Disorder and their caregivers to communicate effectively.

2 The project was developed with attention to ethical aspects, by applying a human-centered approach to the design of an AI system.

3 The main challenges concerned data collection and its structure, avoiding biases, guaranteeing privacy, and putting ethics into practice.

4 This solution, created focusing on users' needs, will be able also to collect valuable insights for future medical research.



Adriano Manfrè

AI Team Leader

NTT DATA



Corinne Schillizzi

Sr. UX & Service Designer

Tangity



Claudia Lunini

Data Scientist

NTT DATA

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