Friendy: A Deep Learning based Framework for Assisting in Young Autistic Children Psychotherapy Interventions

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Original scientific article

***Abstract*—The management of children with autism is a complex and challenging task due to the symptoms related to the disorder that affect their cognitive and behavioral functioning. This makes it difficult for them to process information and adapt to new situations, leading to non-cooperative tendencies during therapy sessions, which can slow down their progress. To support professionals and enhance the therapy experience for these children, a deep learning and contextual chatbot technology based framework, named "Friendy," has been proposed and implemented. The results of its performance testing show a high accuracy rate of 80.5% and the experimentation with independent professionals demonstrate its promising potential for scalability and integration into future therapy processes. The framework provides a valuable solution to the difficulties encountered in the management of children with autism, offering an innovative and effective approach to their care.**

***Index Terms*—Human-Machine Interaction, System Design, Autism care, Computer Aided Psychotherapy, Affective Computing.**

I. Introduction

Autism or Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that occurs early in an individual's life and can be detected and diagnosed as early as 18 months of age according to [1][2]. Despite the scientific advances, efforts and human and material investments devoted to the treatment of autism, it is unfortunately not possible to cure it [3]. Nevertheless, there are various methods and follow-up programs that have been shown to be effective in supporting people with autism from an early age in order to reduce the symptoms associated with the disorder and prevent them from worsening [4][5]. These methods consist of programs containing therapeutic interventions such as cognitive and behavioural therapies, coaching and training for parents of children with autism. Medication is sometimes integrated in cases of severe autism [6]. Because autism is a spectrum containing several syndromes and often associated with other disorders, it affects individuals to different degrees, making each child with autism a unique case. Finding a general method of support becomes challenging, which is why there are several methods that work well for some children and not for others. Fortunately, these methods are constantly evolving over time and innovative approaches are continuously proposed and tested. Children with autism process information differently from normal children and therefore have difficulties in understanding how the world around them works. This leads to difficulties in communicating, forming social relationships, expressing thoughts, etc [7]. The aim of supporting people with autism is to help them overcome these problems as best as possible in order to provide them with greater independence and an adequate quality of life. The earlier we intervene for the child, the better the results we can expect. In this article, the authors focus on the problems of non-cooperation of autistic children during therapy sessions, which may be due to either stress or anxiety [8] [9]. Lack of cooperation is a major obstacle as it has a negative impact on the quality of therapy sessions which can slow down their progress or even cause a deterioration in the results obtained [10] [11].

In this paper, the authors propose a new approach to address the above problem. This approach consists in integrating a textually interactive therapeutic companion in order to help therapists manage the frequent agitation of autistic children that is often difficult to control and that inhibits their progress. This approach concluded with the deployment of an entire framework offering different services and encompassing different functionalities which will be described further in this paper. This paper is organised as follows: after the current introduction section, we move on to a reviewing of the literature and scientific work related to our study. Next, we explain the motivations behind the proposed solution. Afterwards, we present the architecture of the 'Friendy' framework and describe the modules that constitute it and the functionalities provided by these modules. In the Experimentation section, we first proceed to substantiate our choice of neural network architecture and present the results in terms of performance. Then we present the methodology and the process of experimentation involving independent experts in child psychiatry and autistic children during therapy sessions. Finally, we end this paper with a conclusion and perspectives.

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II. Related Works

After conducting a thorough review of the available literature, it has been observed that there are three distinct groups

TABLE I. RELATED WORKS

Tool	Year	Category	Description	Outcomes
ASDTests	2018	Screening	Multilingual mobile application using 4 Screening questionnaires (AQ-Adult-10, AQ-Adolescent-10, AQ-Child-10, and Q-CHAT-10), based on the evaluation function of the screening questionnaires the App predicts whether the user is at risk of being autistic or not	The app was used to collect data for future Machine Learning models
Autispec	2016	Screening	Adult Autism Screening mobile application based on the AQ questionnaire	Predict whether a person is at risk of being autistic or not
Autism Test	2015	Screening	a mobile application using a 20-item questionnaire about thoughts, feelings and behaviours	detect autistic tendencies that an individual may have developed
ASDetect	2016	Screening	A mobile application dedicated to autism screening for children aged 11 to 30 months with 3 types of questionnaires depending on the child's age	The application accuracy performance is up to 81%
AutismAI	2018	Screening	A machine learning based autism screening application using database collected from ASDTests app	Reported accuracy is 97.75%
[12]	2018	Diagnosis	Deep Neural Network model to predict autism and discover brain areas responsible of autism symptoms using Brain Imagery of the ABIDE dataset	The resulted model outperformed previous models by reaching 70% accuracy
[13]	2021	Treatment	A scalable framework allowing the dynamic creation of pedagogical activities dedicated to aid child healthcare professionals in therapy interventions for autistic children	child care Professionals reported positive feedbacks about general and specific features of the framework
irobiQ and Caro	2017	Treatment	Using the irobiQ human-machine interface to test whether the robot-assisted intervention system can be used for social skills training for children with autism.	Children with autism respond positively.
NAO	2018	Treatment	Using the NAO robot to improve social skills by using a bimodal technique combining voice and gestures.	Children with autism have shown rapid changes in their communication behaviour.
KILIRO	2017	Treatment	design and development of a robot whose behavior is inspired by perrots and indirect teaching to help autistic children improve their social skills	The participants showed attraction and joy in interacting with the robot.
BEAR	2017	Treatment	Help children with autism express their thoughts.	The children's interest was awakened by the robot bear.

of scientific studies focused on the development of specialized tools for the care of individuals with autism. The first group include studies that aim at screening young children who might be susceptible to develop autistic traits. The studies found are mainly mobile applications using different techniques like 'ASDTests' [14][15], 'Autispec' [16] as well as 'Autism Test' [17] which are based on mature, scientifically validated questionnaires such as the AQ-10 [18] and the Q-CHAT [19]. Other applications are oriented towards artificial intelligence, in particular Machine Learning, to predict autism in children, such as 'ASDetect' [20][21] and 'AutismAI' [22][23] with respective accuracy rates of 81% and 97.75%. The second group of studies aims to assist in the in-depth diagnosis of autistic traits in individuals with autism or co-morbid autism disorders, as in the study by [12] in which a deep neural network was implemented on a large database of brain images in order to identify brain areas responsible for differentiating between several autistic disorders. The third category of tools is for the treatment or monitoring of children with autism. In the study by Trevisan et al [13] which focuses on developing a framework for educational activities to support professionals during cognitive therapy for children with autism. The tool, created using modular and dynamic templates, can also be used for normal children by other education professionals.. Other studies consist of using interactive robots to interact with autistic children in therapy sessions as summarised in the work of Ramirez et al [24], such as irobiQ and Caro [25], NAO [26] and KILIRO [27][28] which aim to help the child develop social skills. The BEAR robot in the study by [29] aims instead to help the autistic child to express his or her thoughts. We summarise the studies cited in this section in Table 1.

III. MOTIVATIONS AND PHILOSOPHY BEHIND FRIENDY

Care and monitoring programs for children with autism usually include therapy sessions containing supervised, dedicated and child-oriented educational activities. The aim of these sessions is to enable children with autism to develop social skills and improve their ability to communicate with others. Since each autistic child is considered a unique case, the expected results differ from one child to another, but the main obstacle to therapy sessions remains the non-cooperation of the autistic subjects. It is difficult to treat an autistic child without provoking a stressful or anxious reaction within the child, and it is also significantly difficult to gain the child's trust, despite the efforts and pedagogical means used in these processes. Therefore, the proposed framework aims to increase children cooperation level during therapy sessions through exchange, interaction, attractiveness and awareness of the autistic child. Based on [30] [31], We support the claim that children with autism show less distrust and more attraction towards technology and are considerably comfortable with it. In this context, a framework containing an intelligent contextual chatbot based on deep learning has been modelled and implemented. The main objective of this chatbot named ‘Friendy’ is to act as a therapy companion and assists professionals by helping the child to understand his/her situation and surroundings through a textual interface. Our aim is to encourage children to open up, feel more comfortable and gain confidence during therapy sessions. A wide range of contexts has been covered. Indeed, ‘Friendy’ is a contextual chatbot, however the context in this case is not a single topic such as autism, but a wide range of topics around the interests and concerns an autistic child may have. ‘Friendy’ will therefore be expected to discuss a variety of areas and subjects that may be of interest to the child in question. as mentioned in the section on related works, almost all of the solutions proposed in the context of companions for children with autism are physical solutions in the form of robots, which is a considerable advantage as a robot certainly can provide the impression of being real, but it also creates a disadvantage in terms of scalability, deliverability, availability of the solution and its ease of use for the general public, not to mention the high cost of production and improvement for this type of solution. ‘Friendy’ on the other hand is a cross-platform virtual companion that can be launched and supported in almost all systems, making it a mainstream tool with an ensured maintainability thanks to its modular architecture.

IV. Modelling Decisions and Implementation

‘Friendy’ is a cross-platform framework designed to assist therapists in intervention sessions for autistic youth. As presented in the general architecture of the framework (see Figure 4). ‘Friendy’ is divided into several complementary modules, each of which is responsible for the execution of functionality with a common goal. This allows the separation of different tasks and functionalities by applying the principles of aspect-oriented modelling, in order to have flexibility in the deployment and expansion of the system without suffering from intra/inter-modular dependencies. The framework is composed of 5 main complementary modules that we present in the following.

A. Roles and Users Management Module

In this module, the primary goal is to provide different perspectives on the system, thereby facilitating the creation of tailored privileges and access controls. The system’s design enables the adjustment of access levels based on the type and context of its use, providing a flexible and customizable solution. To illustrate the roles and privileges, Table 2 presents a comprehensive list of roles and their respective privileges, while Figure 2 displays the relationships between these roles. By offering this level of detail, this module provides the necessary information to implement access controls and ensure the secure and effective use of the system.

B. Training Module

The training module allows the creation and training of different deep neural network structures using a given data set. All parameters required for training are configurable (such as the type of network, number of layers and samples, etc.). The architecture of the training module is shown in Figure 3. The trained model is considered as the core processing unit of the framework, as any response produced by the framework is a direct result of applying the trained model to the user’s input during the interaction with the chatbot. The deep neural network structure, performance evaluation and the dataset will be displayed and discussed further in this paper.

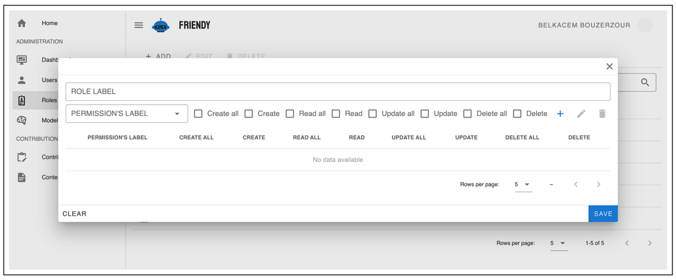


Fig. 1. Roles’ Management Implementation

TABLE II. User’s Roles and Permissions

Role	Privilege
Admin	Full framework access. Machine Learning models training and versions management. Users, roles and dataset management.
Simple User	Chatbot interaction and and personal data access.
Contributor	Create and add contributions
Manager	Accept, reject, modify contributions

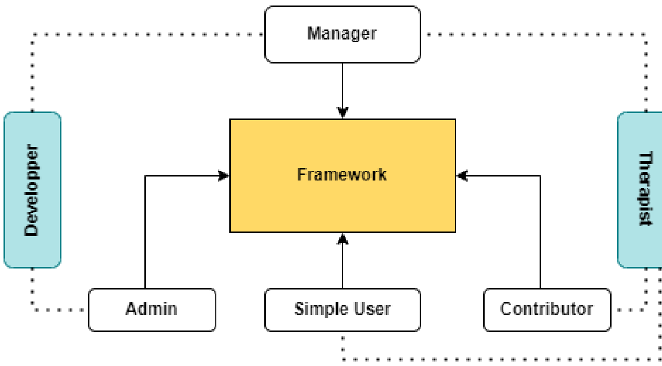


Fig. 2. Roles and relations

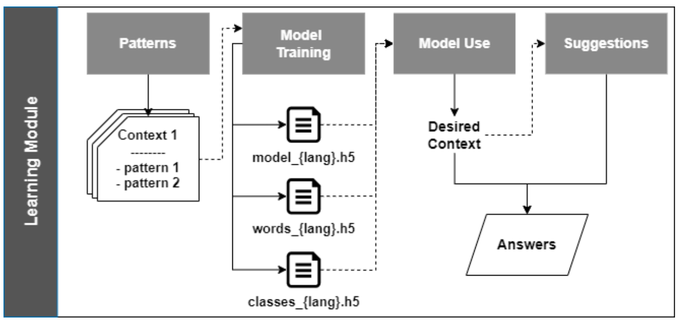


Fig. 3. Training Module Architecture

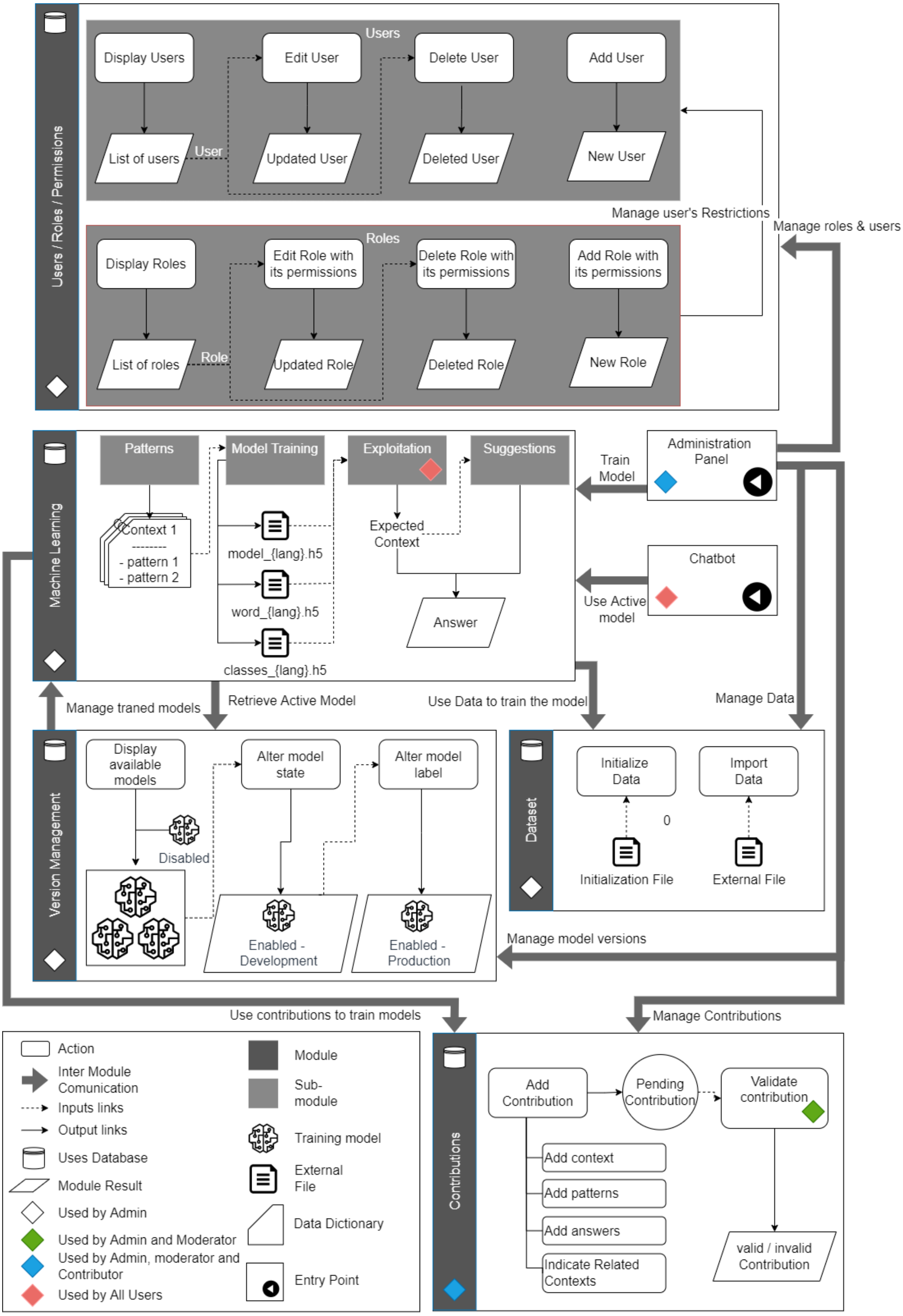


Fig. 4. The System 5-Modules General Architecture

C. Version Management Module

The versioning module allows the tracking and updating of different versions of the trained neural networks. This allows a separation between the version presented to different users in real time (called production version) and the versions under test (called development version). A created model is initially in an inactive state, once activated, the model transitions to the development state, where its performance is evaluated. If the model is judged to be superior to the current deep neural network, the framework gives it the permission to be upgraded to the production state to replace the current model and be available to other users. Figure 5 is a state machine that illustrates the different phases a neural network in the framework can go through.

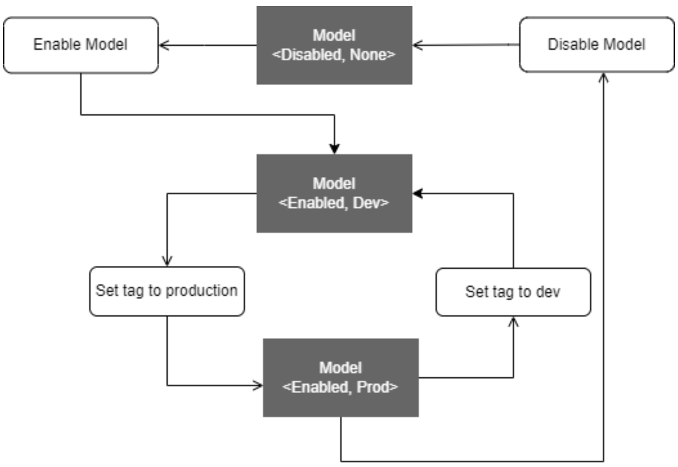
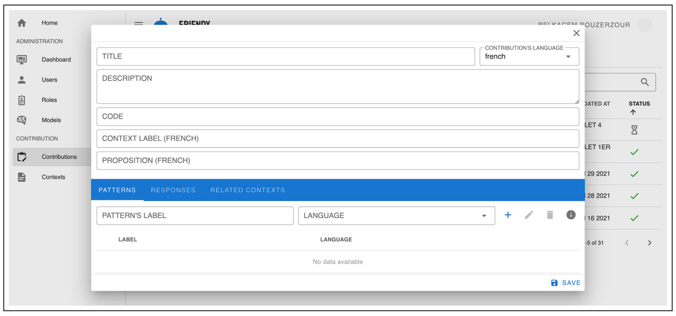
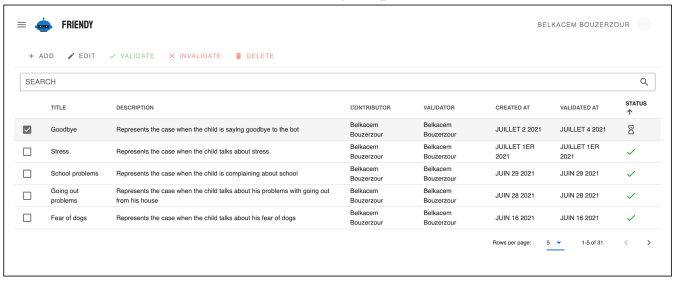


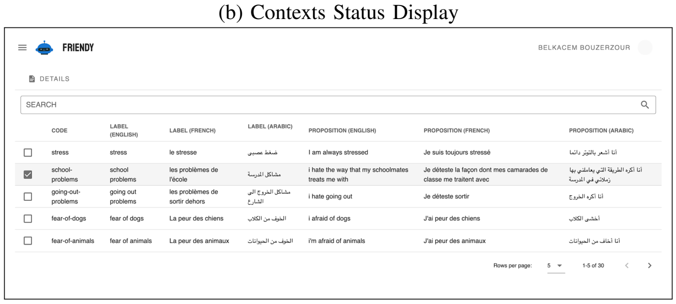
Fig. 5. Neural Network Model Lifecycle



(a) Context adding Implementation



(b) Contexts Status Display



(c) Contexts Display

Fig. 6. Contribution management module implementation

D. Contribution Management Module

A contribution is a context/pattern pair, where the context is a topic of discussion and the pattern is a text that a user may have entered while interacting with the framework and that may refer to or identify a context. To this are added the templates that the framework may have as responses to the identified context. The database of contexts is based on community collaboration, the community is composed of experts such as child psychiatrists, psychologists, educators, sociologists and pedagogues. The contribution management module provides the means for these individuals to enhance the dataset (see figure 6.a). To ensure the consistency of the data, the contribution management module provides the administrator with the ability to view, accept, reject or modify the different contributions submitted by collaborators, as shown in Figures 6.b and 6.c.

E. External Data Management Module

The contribution management module is a critical component of the platform, offering the ability to continually expand and enhance the dataset through the integration of new contexts and patterns. However, for users who have an existing dataset, the external data management module offers a streamlined method for importing this data directly into the platform. The requirement for compatibility during the learning process necessitates that the imported dataset follows the format specified by the model. This ensures that the data can be effectively utilized during the machine learning process.

V. Experimental Protocol

The proposed experimental protocol includes a performance testing portion of the proposed model in which we present the experimental setup and accuracy results obtained. This will be followed by a preliminary study to test our approach by involving volunteer practitioners in the field who will play a role in setting up the experiment plan, making decisions and providing a preliminary judgement based on the observations made during the experiment.

A. Neural Net Performance Testing

1) Architectural Settings: After consulting best practices and examining different comparisons of deep neural network topologies in terms of performance, compatibility and constraints imposed by the type of data in hand [32][33], our choice rapidly settled on the use of a dense layer topology. Table 3 presents a comparison of the 3 Considered topologies that are commonly used according to [34], i. e: Dense Layer, Long Short Term Memory (LSTM) and the Gated Recurrent Unit (GRU) topology. The choice retained remains an initial approach for the purpose of experimentation and could undoubtedly mature into a more appropriate architecture as the study and the proposed dataset evolve.

TABLE III. NEURAL NETWORKS ARCHITECTURE COMPARISON

	LSTM	GRU	Dense Layers
Pre-Processing	Non Compatible	Non Compatible	Compatible
Execution time	Important (Depends on data size and structure)	Important (Depends on data size and structure)	Important (Depends on data size and structure)
Data Quantity	Requires a large amount of data	Requires a large amount of data	suitable for small datasets
Complexity and configuration	Complex	Complex	Simple (in our case)

The neural network model that achieved the highest performance is composed of 5 layers; 3 hidden layers implementing the ReLu function composed respectively of (512, 512 and 256 nodes), and an output layer implementing the softmax function composed of 150 nodes which is the actual number of context classes. ReLu and Softmax functions are defined as follows:

$$Relu_0 = max(x, 0) = \left\{ \begin{array}{ccc} x & if & x > 0 \\ 0 & if & x \leq 0 \end{array} \right\} \tag{1}$$

$$Softmax(x)_j = \frac{e^{x^T w_i}}{\sum_{i=0}^{m} e^{x^T w_i}} \tag{2}$$

Where *w* is the weight vector of the connection between the neural network layer and the softmax layer and *m* is the output size of the softmax layer. Finally, to prevent overfitting, dropout nodes had been added to the first 2 hidden layers. Figure 7 displays the final structure of the deep neural network.

2) Dataset Overview: In view of the specificity of the problem, we were not able to find datasets in the literature that deal with the same problem or that are closely related to it. We therefore opted for the construction of our own dataset which will constitute the basic vocabulary of the different chatbots. For this we set up several sessions including practitioners for a conceptual brainstorming which will bring out the most recurrent and common contexts amongst the autistic children based on practitioners' observations during the cognitive and behavioural therapy sessions. The main challenge was to list a large number of contexts, then to compose different sentence patterns that would trigger the latter and finally to imagine different responses to those entries. In other words, the aim was to imagine different conversation scenarios that would be interesting to the autistic children and that would in some way attract their attention. The current dataset contains 150 contexts, each containing at least 2 patterns. Figure 8 gives an overview of the first 33 contexts ordered by numbers of available patterns.

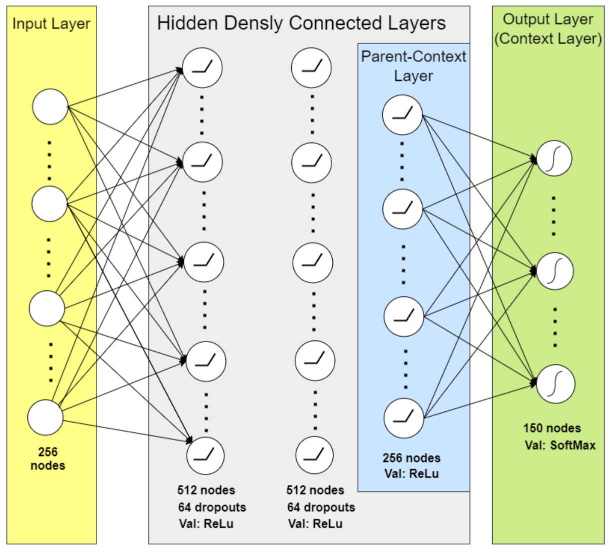


Fig. 7. Model's Architecture

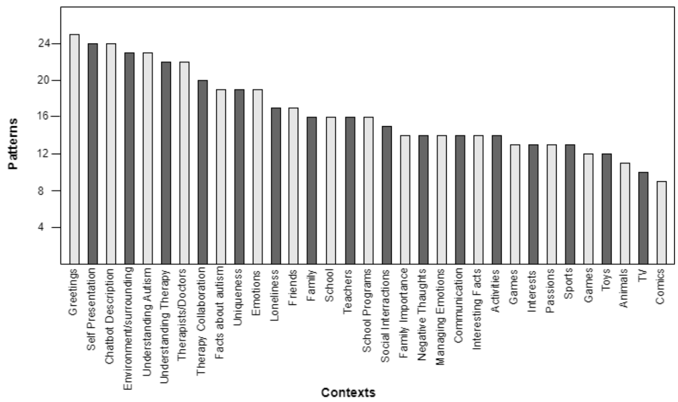


Fig. 8. Contexts' Overview

3) Performance Testing: the training set-up came with the following features: CPU Rayzen 5300, RAM 32gb, GPU NVIDIA GEFORCE GTX 1660ti. The dataset was divided into two parts: 70% for training and 30% for validation. A training run is conducted over 750 epochs followed by a validation phase. Runs are repeated 10 times by shuffling the content of the dataset distribution to ensure fair randomness. The accuracy score obtained is therefore the mean accuracy of the 10 runs. accuracy of 97% has been achieved after 350 epochs on the training data and an accuracy of 80.5% has been achieved for the validation data after 100 epochs as shown in the accuracy graph in Figure 9.

B. Therapy Experimentation

1) Methodology and Population: The framework was tested in therapy sessions in collaboration with independent professionals including small groups of autistic children hand picked by practitioners. Observations on the different reactions

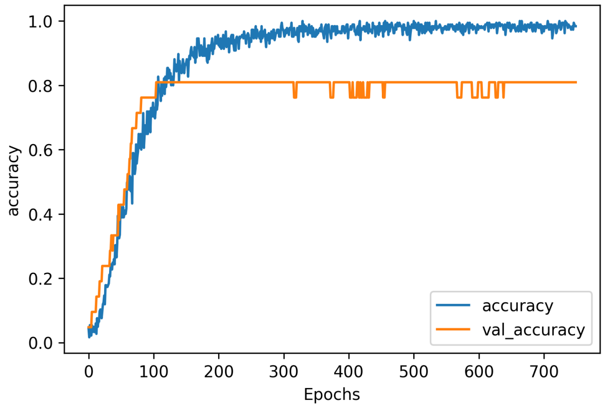


Fig. 9. Model's training and validation accuracy

of the children before, during and after the interaction with the chatbot were made and the opinions of the professionals towards the framework based on previously prepared and oriented questions were collected. Table 4 summarises the collaborators profiles.

TABLE IV. PROFESSIONALS' PROFILES

Professionals	profession	experience in child cognitive and behavioural therapy	previous use of computerised tools
P1	Child-Psychiatrist	7 years	Yes
P2	Child-Psychiatrist	7 years	No
P3	Child-Psychiatrist	4 years	No
P4	Child-Psychiatrist	3 years	Yes
P5	Pediatrician	2 years	Yes

To each professional is assigned a group of autistic children chosen from their therapy patient list. To ensure the safety and feasibility of the experiment, some criteria must be taken into account before forming the groups of children, these criteria include: age, autistic symptoms' severity, therapy maturity, absence or non-significant development delay and parent consent. table 5 details the participants population by groups.

TABLE V. POPULATION OVERVIEW

Groups	Population (Boys/Girls)	Age
G1	7 (5/2)	10 to 13
G2	5 (4/1)	9 to 12
G3	8 (5/3)	10 to 13
G4	8 (6/2)	10 to 14
G5	7 (5/2)	9 to 11

The process of the therapy session starts in a relatively usual way for each patient. Afterward the child will be invited to interact with the chatbot by introducing it as a virtual therapy companion. The aim is to have a reasonably proper and partially guided exchange via the framework interface (as displayed in figure 10) between the child and the chatbot in order to observe the child's behaviour towards the chatbot.

2) Children Related Observations: The observations were based on 2 main aspects. The first being the degree of cooperation at particular times during the therapy session and the alignment with the expected dialog scenario. The second aspect focused on capturing emotions based on facial expressions and body language. Table 6 resumes the observations made.

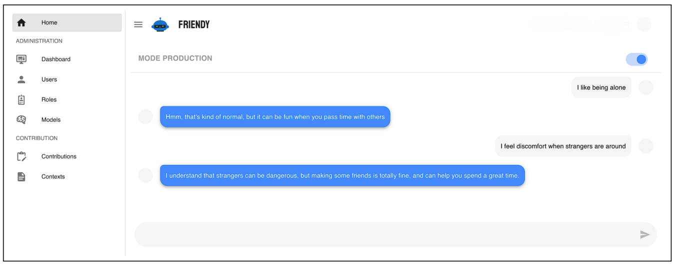


Fig. 10. Chatbot Dialog Interface

TABLE VI. CHILDREN'S SESSION OBSERVATIONS

Aspect	Subaspect	Observation
Cooperation	Introducing Phase	19 children were cooperative in which 7 expressed excitement, curiosity and impatience toward interacting with friendy. 13 children were cooperative after therapists and assistants encouragement and cheering. 3 children* refused interacting with the chatbot.
	Interaction Phase	10 out of 32 children were relatively independent when interacting with the chatbot. 14 out of the remaining 22 children needed slight guidance and suggestions. Finally, the remaining 8 needed extensive explanation with multiple gestures and suggestions.
	Separation Phase	24 out of 32 children were cooperative. The remaining 8 required more persuasion and pedagogical manoeuvring by the therapists to separate them from 'Friendy'.
	Scenario Alignment	18 out of 32 children were easily influenced by therapists to follow the lines of the interaction scenario, 9 children needed to be put back in track 2 to 4 times. The remaining 5 needed to be put back in track more then 5 times.
Emotions	Excitement	7 children showed excitement perceptible by their body language movements
	Surprise	20 children expressed varying degrees of surprise at the introduction and interaction with Friendy.
	Content and Happiness	27 out of 32 children expressed content and happiness distingueshed by laughs and smiles up to 8 times per session
	Embarrassment	16 children expressed embarrassment when the topic of discussion revolved around their relation with school, teachers and therapists.
	Sadness and Anger	15 children expressed sadness in which 6 showed shades of anger when separating them from Friendy.

*The 3 children were not included in the rest of the observations.

3) Therapists General Feedback: Professionals were invited to evaluate the framework in different aspects and give feedback for future improvements. Their feedback was collected through a questionnaire inspired from the study of [13] and divided into two parts as displayed in figure 11. For the numerical part of the questionnaire, the scores given are considered to be favourable to the framework as shown in Figure 12.

For the part concerning the direct questions, the answers from Q.B1 to Q.B6 have been grouped in table 7. The answers were mostly favourable towards the framework, the professionals are willing to consider introducing the tool gradually in some interventions depending on certain conditions.

Evaluation Questionnaire

Numerical Assessement (1-10)

Q.A1. From 1 to 10, How would you rank our Framework (considering 1 as bad and 10 as Great)
Q.A2. From 1 to 10, How would you evaluate your experience with the Framework (considering 1 as bad and 10 as Great)
Q.A3. From 1 to 10, How would you evaluate the Ergonomy (ease of use, intuitiveness and attractiveness) of the Framework (considering 1 as bad and10 as Great)
Q.A4. From 1 to 10, How would you evaluate the chatbot dialogue performance (considering 1 as bad and 10 as Great), what would you suggest to improve it ?

Direct Questions

Q B1. Have you noticed improvement in intention expressing compared to usual sessions ?
Q B2. Have you notice improvement in children's cooperation level ?
Q B3. Did the children express more emotions than usual ?
Q B4. Do you think our framework will help unlocking children communication skills ?
Q B5. Do you consider including our framework in your future interventions ?
Q B6. Would you consider becoming a collaborator to improve our dataset ?
Q B7. what weaknesses have you noticed in our framework
Q B8. what functionalities or extentions do you propose for further improvement ?

Fig. 11. Therapist's Evaluation Questionnaire

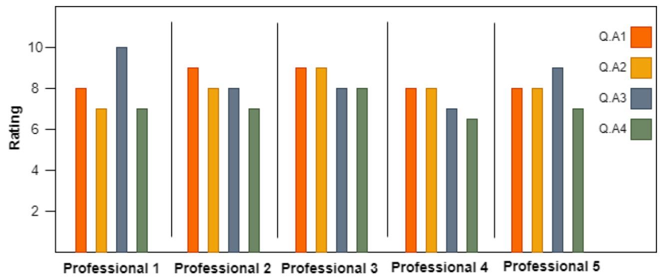


Fig. 12. Therapist's Numerical Assessment responses

Regarding Q.B7, therapists noted that the chatbot requires more flexibility, which may be the case if the context base is increased. Another point highlighted by therapists 2 and 3 is the absence of vocal interactions, a point that is already taken into consideration for the next releases of the framework. Professional 1 found it difficult to add contributions without being guided and suggested to break the process into steps.

TABLE VII. PROFESSIONAL'S DIRECT QUESTIONS ANSWER

	Q.B1	Q.B2	Q.B3	Q.B4	Q.B5	Q.B6
P1	Agree	Agree	Agree	Yes, at a certain degree	Undecided	yes
P2	Agree	Agree	Agree	yes	yes	yes
P3	Agree	Agree	Agree	yes	yes	yes
P4	Slightly Agree	Agree	Slightly Agree	Yes, at a certain degree	yes	yes
P5	Slightly Agree	Agree	Agree	yes, if improved	Undecided	yes

The experiment was concluded by inviting the participants to provide constructive feedback on how to improve Friendy via the Question B8. Several suggestions were made, and a selection of those that seemed most relevant is presented. Professional 1 and 5 mentioned giving friendy the means to initiate pedagogical activities in the form of mini-games incorporated into the tool, these mini-games can be educational, communication-oriented, etc. One of the experts mentioned personifying Friendy, giving it a form and animations such as body movements and facial expressions. The same expert added, we quote, 'it would even be interesting to let the child forge his own companion character and personalise it as he/she wishes'.

VI. PERSPECTIVES

To the best of our knowledge, and judging by our approach and angle of addressing the problem of non-cooperativeness in children during psychotherapy; our paper stands as a pilot study opening the way to many questions and many possibilities for improvement that will certainly be addressed in our future studies, our perspectives include but are not limited to the following:

- The pursuit of benchmarking, taking into account and integrating other topologies such as LSTM, GRU and hybrid models from the state of the art by proposing a comprehensive comparative study that would validate the most efficient model.
- An in-depth study centred on the dataset whose aim is to investigate and improve its internal structure and move from a simple context/pattern model to a complete model offering more coherent semantics and better mapping between contexts to ensure a smoother and flexible discussion thread.
- Adding new modalities of interaction with the chatbot, notably voice commands. This will allow a faster and more efficient interraction during therapy, taking into account that the chatbot will also have a voice of its own.
- Creating different datasets with different vocabularies to result into many chatbot personalities. Then, putting these chatbots into a comparative study to have insightful data on which ones would be suitable depending on the autistic children population.

VII. CONCLUSION AND PERSPECTIVES

the Friendy framework has shown promising potential as a virtual companion for children with autism during therapeutic interventions. The results of the validation tests and evaluations conducted in therapy sessions highlight the effectiveness of the system in bonding with the children and improving their cooperation during therapy. This framework represents a step forward in the integration of technology in therapy and has the potential to significantly enhance the therapeutic experience for children with autism. However, the challenge of increasing the conversational base of Friendy remains, and it requires the collaboration of the child psychology expert community to obtain quality data for the system's database. In conclusion, the Friendy framework has great potential to make a positive impact in the field of therapy for children with autism and its development and improvement will be an ongoing process.

ACKNOWLEDGMENT

We propose in this article a contextual chatbot based framework that can help during therapy sessions for autistic children. The system has been thought from a general point of view, but certainly cannot be used for all autistic children

like severe cases of autism or cases with other co morbid disorders like developmental delay. Young children with very limited autonomy are to be considered but should be assisted and accompanied by a tutor or professional when using the tool. We would like to remind that Friendy has been designed as a virtual companion, but is not in any way developed to generate addictive tendencies.

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