A Conversational Agent for Mobile Assisted Language Learning

CPIAbot as a tool for learning Italian as a second language

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Abstract — **Learning the language of the host country is one of the most important aspects of social inclusion for adult migrants. Within the migrant population in Italy, it is possible to find a high heterogeneity of language profiles, which differ in level of competence and degree of literacy. This phenomenon is reflected in the composition of the classrooms of the Provincial Centers for Adult Education (CPIA), educational institutions that offer courses of Italian as a second language to adult migrants. To meet the needs identified in a preliminary survey in two CPIAs, a conversational technology was developed: CPIAbot. The system is a multimodal and multi-level chatbot, whose ecosystem is Telegram, to support both the communicative teaching in the classroom and the autonomous learning of CPIA students. For the implementation of the designed innovations, embedded in the technology, an ad-hoc system was developed, integrating a dialog-manager (NaifJs), capable of managing multi-turn dialogues, and other different solutions for the communication with external services, aimed to the management of multi-channel interactions. The contribution, therefore, will describe the technological solutions adopted, insisting on their link with the linguistic needs that have emerged from the context.**

Keywords-Multimodal/voice chatbot; Conversational Agent; Task-oriented dialog manager; Mixed-initiative bot; Conversational AI; Teachers/Students mobile platform; Social inclusion for adult migrants; Italian L2 Learning; Adult Literacy.

I. INTRODUCTION

The social inclusion of migrants poses the problem of learning the language of the countries of arrival (or transit), since language is the main means of interaction with the host society. In Italy, in particular, the migrant population has very different linguistic and social profiles, including low educated adults [1]. This phenomenon poses important challenges to the Provincial Centres for Adult Education (CPIA), the institutions in charge of offering language courses [2]-[4], where the heterogeneity of linguistic profiles is reflected in the composition of their classrooms. Within the class groups, in fact, it is possible to find students with different linguistic backgrounds [5], levels of competence and, in different situations, people that suffer social isolation and do not speak Italian outside the language class [6]. Moreover, a preliminary survey in two Ligurian CPIAs showed that, in line with the provisions of the Common European Framework of Reference (CEFR), the teachers' teaching is oriented towards a communicative approach and the topics addressed, as well as the activities proposed, are relevant to the experiences lived by students outside the classroom.

In order to respond to the needs expressed by the context of reference, embracing the Mobile Assisted Language Learning (MALL) approach [7]-[9], the idea was born to develop an educational technology, CPIAbot, which can support teachers during the lessons and students in their autonomous learning, blurring the classroom boundaries. The conversational technology described below, therefore, aims to constitute a support tool that, promoting interaction based on natural language, can be a bridge between different educational scenarios.

The importance of research on tools that support language learning through mobile devices, as pointed out by Kukulska-Hulme [10], lies in the possibilities of exploiting the ubiquity of such devices to explore new teaching options for groups of people with high mobility. Specifically, conversational interfaces have, today, the possibility to establish themselves within MALL technologies both thanks to the learners' confidence with online text and voice, synchronous and asynchronous, conversations, and thanks to the development of speech recognition technologies and the growing computing power and ubiquity of mobile technologies.

On the other hand, the relaying of conversational technologies, especially if expressly oriented to language learning, requires interdisciplinary work and a wide range of skills. Similarly, the operational development or system integration of each component of the instrument requires specific study to ensure sufficient quality in the user experience and in the didactic value of the technology. This has been particularly evident in the development of CPIAbot, as it aims to reach an audience that is heterogeneous in terms of literacy levels and language skills. On the other hand, the limitations and challenges of the described experience,

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highlighted within the contribution, may constitute future strands of research.

This contribution, therefore, aims to describe a conversational technology, developed ex novo and expressly designed for the language learning of adult immigrants, highlighting the relationship between the needs of the specific context of reference and the technological solutions implemented.

The global research question is: *What effectiveness can a chatbot have in replicating/supporting the action of a CPIA teacher inside and outside the classroom in L2 pre-A1 teaching?*

In Section 2, a state of the art of MALL tools developed for Italian as a L2 will be presented. In Section 3, the innovativeness of CPIAbot will be described, focusing on the shift from the Graphic User Interface (GUI) to the Conversational User Interface/Vocal User Interface (CUI/VUI). In Section 4, the adherence of the chatbot characteristics with the context one will be addressed, detailed widespread in Section 5. In Section 6, a reflection on some technical and UX issues will be explained, while in Section 7 the teachers' feedback will be detailed. Finally, in Section 8, preliminary conclusions are presented.

II. EDUCATIONAL APPs FOR IMMIGRANTS AND REFUGEES IN ITALY

In Italy, it is possible to find interesting examples of apps specifically designed for immigrants and refugees, even with low language skills, that share some common elements.

Most of the software designed for learning Italian as L2 from mobile devices is free of charge. A second feature that these apps have in common is the fact that they are made in collaboration with local realities, which offer language courses to adult immigrants. Finally, in accordance with the m-Learning principles [11], mobile apps for Italian as a second language allow users to access multimedia contents every time and everywhere and are oriented to the personalization of learning.

An example is "Presente" [12], realized by CPIA Bologna and Regione Emilia-Romagna, whose main characteristic is to have, in addition to communicative exercises focused on listening and reading, a database of useful sentences organized in daily life situations. Similarly, the exercises in "Ataya" app [13], focused on the four skills (read, speak, listen, write), are divided into domains related to daily life. "Fare parole" [14], instead, is an app oriented to the graphemic and metaphonetic competence and provides exercises with a binary feedback focused on listening and writing.

A peculiar example is "Q-CPIApp" [15], built on the Learning App platform by the teacher of Lodi's CPIA, in order to provide the students exercises available on their smartphones. The activations are focused on grammar and lexicon and are organized in levels.

All the described apps are characterized for intuitive interfaces and ease of use that allows the learner's autonomous exercise, with short and engaging interactions, within the classroom and outside it.

The limitations are related to the binary feedback provided within the exercises, the weak relation between the interaction and the user's context, the lack of the students' interaction tracking (beyond the single session) and the lack of systems for vocal input management.

It is possible to find some of these elements in brand new apps recently developed.

"LinguaCuisine" [16], for instance, is an app aimed to teach Italian to adult immigrants providing cooking recipes. The main innovation is that the user can upload personal content that will personalize the learning experience.

Another peculiar example is "Studiare Migrando", realized thanks to the collaboration between the Scuola di Lingua Italiana per Stranieri (ItaStra) of the University of Palermo and the Institute for Educational Technology (CNR). The focus of the app is language learning for adult students that are attending compulsory school in CPIAs. It is based on a truly e-Learning environment aimed to support students with high mobility (often due to external factors) [17].

A brand new app, "Mondly", presents innovative and disruptive elements. The first innovation that distinguishes it from the previous app is the automated tracking of the user. An algorithm, indeed, tracks errors in order to present the failed attempt items during the same exercise or in another one. Mondly, in addition, embeds a chatbot that allows students to practice language within authentic situations. It is important to notice that users can insert even vocal input while training with the chatbot. Mondly is a "freemium" app and, in the free version, users can explore different resources/units, but just one dialog for lexical domain [18].

CPIAbot, as detailed below, stresses the margin of innovation in different ways:

- It provides a conversational and multimodal interface,
- It supports student to access resources or services with single simple commands, while they are experiencing a learning scenario (formal or informal),
- It offers adaptive feedbacks and different multi-turn dialogues
- It allows teachers to easily assign exercises and to monitor their students' interaction with the chatbot.

In brief, the contribution of CPIAbot to the MALL approach is double. On one side, the conversational interface promotes interactions in L2 in the whole User Experience, to access resources and services or to explore multi-turn dialogues. On the other side, CPIAbot represents a system that supports hybrid learning environments that actively engages students and teachers: the former can easily interact with information useful in the context they're experiencing or can explore autonomously automated exercises and the latter can assign assessment and monitor the students in their bot usage.

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It is important to notice that CPIAbot differs from other systems, like Duolingo and Babbel [19], focused on a completely informal autonomous learning.

The relation between the chatbot use and the learning path designed by the teacher is deep, since the teacher's mediation in the use of any resource for learning is fundamental for the low-educated adult learners and, in general, for the students with low level of competence.

III. A LANGUAGE-FIRST TOOL FOR LANGUAGE LEARNING

The main innovation of CPIAbot is the language-first user interface paradigm, also called Conversational UI (CUI) /Voice UI (VUI) [20], which involves interactions based on natural language. This is a completely different and innovative approach, compared to the typical one of mobile apps on smartphones, where the user navigates a decision tree through menus, touching buttons on a visual layout (the usual web GUI). The choice to adopt a CUI/VUI paradigm derives from two preliminary considerations. On one hand, with the spread of the conversational paradigm within everyday systems and devices requires the research on educational technologies to relate to these interfaces. On the other hand, while in GUI based language apps the target language is used on the exit point of interaction, when a specific exercise starts, within the CUI systems, the language is the entry point of the interaction with the tool.

Our linguistic-based interface is therefore a challenge on which we expect important feedback in the experimentation phase with students.

IV. CPIABOT: FUNCTIONAL ASPECTS OF EDUCATIONAL ACTIVITIES

The adherence of the tool to the characteristics of the specific context required a design and development effort, aimed at matching particular requirements:

- Accessibility (CPIA students must be able to use CPIAbot from their own devices)
- Ergonomics (a multimodal and multi-level chatbot to support learning in heterogeneous classes)
- Adherence to the teaching approach (interaction in natural language and possibility to use CPIAbot as a support for communicative activities)
- Hybridization of learning spaces (possibility of CPIAbot to act as a link between the classroom lesson and the individual learning of the extra-school).

Compliance with each of the listed parameters involved the use of specific applications or the development of ad hoc software, as none of the (mobile) apps already available was able to meet the functional specifications required by the project [21].

The result, CPIAbot, is a conversational server application on cloud, developed in NodeJs programming environment, which interfaces to Telegram servers through the Telegram Bot API [22].

The CPIAbot's software architecture is schematized in Figure 1.

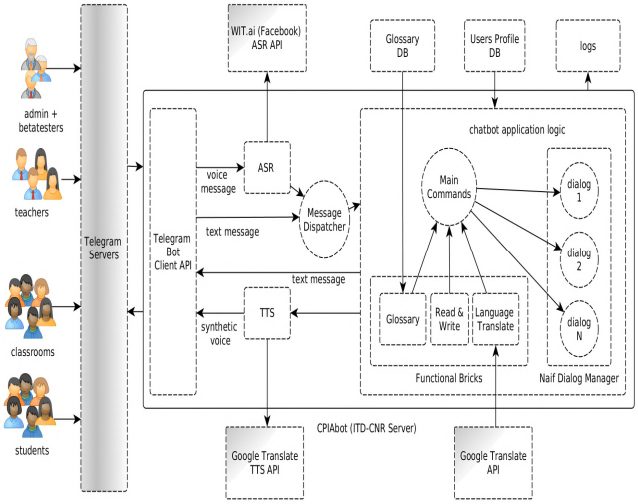

Figure 1. Architecture of CPIAbot

The illustrated architecture is the structure on which the technological solutions presented in the following paragraphs have been implemented.

V. CPIABOT: TECHNOLOGICAL FRAMEWORK

The technological solutions, conceived and developed for each of the parameters indicated in the previous paragraph, are illustrated below.

A. *Accessibility: The choice of Telegram instant messaging app as the chabot channel*

In order to facilitate the access to the developed system for the CPIA's students, it was decided to develop a chatbot within the instant messaging app Telegram.

Downstream of an analysis of the best communication channel for the development of a conversational application, Telegram was found to have more features suitable to the conceived technology with respect to the other apps analyzed: Google Assistant voice assistants, Amazon Alexa (especially through smart-speaker voice interfaces) and WhatsApp. Therefore, the most suitable platform for the development of the application turned out to be Telegram for different reasons.

Costs saving: Telegram app is a free software whose client-side code is open-source; it does not require the purchase of dedicated hardware and the Telegram application can be installed on any personal computer, already available in the classroom, or on smartphones in the possession of students. In the case of Amazon or Google voice assistants, instead, it is necessary to purchase expensive hardware devices, with a cost linear with the number of classes in which to use the devices themselves.

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Low System Requirements: Telegram is a lightweight app that can also be installed on mobile devices with older Android/iOS operating systems.

Feasibility: Whatsapp is the most used mobile chat messaging app in Italy, that is why it would be the preferred channel for the development of chatbots, but they are here feasible only through the Whatsapp for Business platform, now available in private beta. In addition, the APIs of the business platform allow the exchange of text messages (SMS-like) but do not allow to manage multimedia content such as audio, images and video.

B. *Ergonomics: A multimodal and multi-level chatbot for heterogeneous classes*

To face the heterogeneity of the CPIA's classrooms, CPIAbot has been conceived and developed as a multimodal and multi-level chatbot. CPIAbot can be defined as a multimodal chatbot, as the interface allows users to interact through different channels. Using multimedia content in the paratext facilitates the decoding of the written text and makes the system easy to use, even for low-educated adult learners.

Three elements characterize the multimodal interface of CPIAbot: written interaction, oral interaction, and multimedia contents.

Written interaction: Telegram allows for written interaction with the chatbot, otherwise impossible with a Google and Amazon conversational application; especially cantered on the use of smart speakers (it is partially possible even when using assistants via smartphone)

Oral interaction: In CPIAbot the student can interact either by typing through the keyboard or by speaking, through a voice message or a video message. The audio recording is processed by a speech recognition platform, which converts the user's voice into text. For the speech recognition task we used the Facebook/WIT.ai API service, one of the few available free of charge for the Italian language.

Multimedia contents: The processing of the user request produces a response to the user which can be textual, vocal or an integrated multimedia content; for example, an image (also with subtitles), a video, an audio recording or an animation.

The answers to the user are translated into speech with a synthetic voice, thanks to the use of a Text To Speech platform. The synthetic voice in Italian language used is that provided by the Google Translate Speech cloud platform.

The multimedia interaction concerns not just contents in output (to the user), CPIAbot architecture, indeed, is built to allow users to upload images and video files, besides audio and text. By example, CPIAbot can process an image submitted by a learner, trying to understand the content of the picture and triggering a dialog (future development). Telegram allows the use of many types of multimedia contents (audio, images and video), which is not possible through Alexa and Google smart speakers (Amazon Echo/Google Home). It would indeed be possible just with smart display devices (Amazon Echo Show or Google Nest) but the high cost per device remains an issue.

CPIAbot, on the other hand, can be defined as a multi-level chatbot, since the outputs of the system, as well as the channel with which they are transmitted to the user, can be differentiated according to the level assigned to the user by your teacher. This is expected to be an important feature in the integration of CPIAbot within multi-level classrooms, supporting the personalization of content and activities, with the aim of reducing the workload of the teacher.

C. *Timing Management: output pauses and input silence*

Another peculiar element of CPIAbot, that could support the personalization of learning activities within heterogeneous classrooms, is the timing management. The management of timings in the interaction with users is an element of differentiation of CPIAbot, compared to other reactive-only chatbots (operating just in pull mode): the chatbot, for each message issued, can be programmed to insert pauses (of an arbitrary number of seconds, depending on the student's learning level) to allow the learner to have sufficient time to read or listen to the content provided by the chatbot.

It is also possible to concatenate multiple timeouts in sequence, engaging the student to continue the conversation or forcing him to end the dialog.

D. *Adherence to the didactic approach*

The adherence between the characteristics of CPIAbot and the communicative approach, to which teachers' teaching is oriented, emerges on two levels.

On one hand, in fact, the language-first paradigm of the chatbot orients the student to interact with the system in the target language, even using very simple expressions, instead of continuing the interaction through menu navigation (as described in the previous paragraph).

On the other hand, CPIAbot's resources allow the student both to have support for their communicative needs and to measure themselves in simulated dialogs, pushing them to exercise their communicative competence in everyday situations (even if simulated).

That is why CPIAbot provides two types of interactions: short "user initiative" interactions and dialogs with "bot initiative" interactions. In the first mode, the student, like other users, can invoke single function (here defined as *user requests*), useful to support both teaching activities and the use of L2 in daily life, by students. It is the user, therefore, who guides the conversation. In the second mode, the student activates a multi-turn *dialogue*, which proposes a lexico-grammar or a communicative task. In this case, the conversation is controlled by the chatbot, which proposes different conversation turns, prompts and content depending on the stimuli entered by the user. By virtue of the

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coexistence of these two human-bot interaction modalities (reactive and proactive), it is possible to define CPIAbot as a “mixed initiative” chatbot.

The request message that the user sends to the bot is processed by a sentence processing procedure (the *main state* dispatcher) that matches the natural language sentence, expressed by the user, with available user requests or dialogs.

a) User requests

The application provides primitive functions to support the understanding and the production of the Italian language. These primitive functions are always available to the student; these are single-turn sequences (where there is no specific dialogue context, i.e. there is no "conversational state").

Below, we offer a brief overview of the functions implemented (all the examples of invocations of functions are translated into English to facilitate the reader's understanding)

Write (Scrivi), displays the written text corresponding to the speech that the user has sent to the bot with voice message or video message. The function enables read-write skills, facilitating sound/sign association. Example:

```
write supermarket
```

Read (Leggi), activate the playback, through the available synthetic voice, of a text written by the user with the keyboard. This function also enables read-write skills, facilitating sound/sign association. Example:

```
read supermarket
```

***Syllable* (*Sillaba*)**, similar to writing, but breaks down a word or phrase into its constituent syllables. The function facilitates the sound/sign association with division into syllables. Example:

```
syllable salt
```

Spell (Compita); scan one-word letter by letter. This function can be invoked either verbally or in writing and in the latter case, it is indicated, for each letter, whether it is written in upper or lower case. Example:

```
spell tomatoes
```

Translate (Traduci), allows users to translate from the Italian language to one of the 104 languages available on Google Translate or, vice versa, from a foreign language to the Italian language. The interlanguage translation can be used in the understanding of terms/phrases in a text, or for translation from source language to target language to support oral production. Example:

```
translate in German good morning
```

Word (Parola): A simplified glossary was created that provides static (photos) and animated (gifs and videos) multimedia material. The lexical database collects the terms indicated in the Syllabus [23] for the domains "work" and "purchases" chosen for the bot experimentation phase. The CPIAbot glossary currently contains about 500 glosses, inserted in 24 semantic fields (groups). The glossary is a subset of the total list of glosses that the Syllabus proposes for the Pre-A1 level (~900 terms) and A1 level (~1000 terms). Each term has an associated data structure, in which the following attributes are stored: description, usage examples, multimedia content (an image, or video or animation), audio recording, grammar notes, category and group, language level. The attribute "description", in particular, is co-constructed incrementally by CPIA teachers through a collection of simplified definitions of glosses (suitable for Pre-A1 and A1 level learners), provided in crowd-sourcing mode.

When invoked, the function returns a multimedia output, and the word insert as parameter of the user request, is displayed with a picture, a gif or a short video, accompanied by a synthetic entry describing it together with a sequence of short sentences.

The glossary can also be queried with semantic filters with respect to categories and groups of words and/or grammar rules, thanks to the ***Give me words*** user request. The function has been designed primarily for use by the teacher in the classroom. Example:

```
give me six words in category work, singular
```

b) Multi-turn Dialogs

Besides, the peculiar feature of CPIAbot is the contextual multi-turn dialogues (we call it just *dialogs*), which perform lexical and grammar exercises (repetitive tasks) and real scene simulation dialogues.

Repetitive task dialogs

Listen and repeat - Practice the pronunciation of words, with repeated exercises. The student listens to a word extracted randomly from the glossary and reproduced in a synthetic voice, then has to repeat it. The student can select words from the entire glossary or from different groups of words in the glossary, divided by level of pronunciation difficulty (these levels have been defined in collaboration with the CPIA teachers).

Read and repeat - Practice the sound/sign association through repeated exercises. Like the previous exercise, but instead of listening to the sound of a word, the student must read an entry from the glossary presented in writing.

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Listen and write - Practice the sound/sign association, through repeated exercises. The student listens to a word and then has to write it on the keyboard.

Guess the word - Supports vocabulary acquisition with image-word association. The learner must guess which word corresponds to the picture selected randomly by the chatbot. The exercise can draw on all the words in the glossary or one of the 24 groups defined in the Syllabus.

Simulated dialogs

The dialogs consider the authenticity of the communicative situations proposed, also in reference to the social practices of the students. The conversations, therefore, are based on the daily life of the learners in Italy and calibrated to their communicative needs. The dialog "Let's shop" is an example: in this dialog, the learner is called to assist a fictitious character in choosing the place where to buy food. After a short contextualization, in which the fictitious character illustrates the task (shopping) to the user, the chatbot proposes some short questions about the place where the student prefers to accompany the protagonist to buy what he needs. At the end of the dialogue, the chatbot asks the user to identify, between two images, the one representing the chosen place.

All the structures of CPIAbot's dialogs have elements in common. The dialog flow is constructed to provide adaptive feedback to the student, allowing them to access resources/contents that support the interaction if the user's input does not reach a predetermined level of correctness or does not contain the necessary information to proceed with the conversation.

The teacher, therefore, can integrate the dialogs with the chatbot within the design of the learning unit, aimed at pursuing the objectives identified.

Since all of the dialog types described require the ability of the conversational system to maintain the context in the different turns of the conversation, to realize such multi-turn task-completion dialogs, a special dialog manager, called *NaifJs*, has been developed in ITD-CNR.

c) *A dialog manager for task-completion dialogs*

NaifJs is a dialog manager that implements dialogue management with a Finite State Machine (FSM), released as open source (Git: https://github.com/solyarisoftware/naifjs), where each *input state* is a node of "understanding" and local processing of input sequence patterns, and where each *output state* is a node of content production with some backend elaboration and messaging to user. Each dialog is activated programmatically with the setting of an initial state that performs some kind of logic (L, in Figure 2), presents a message to the user and can store contextual memory variables (M). The output message to the user can be a textual description of a scene, a voice message, an image or audio/video content, followed by a question (prompt) to the student.

NaifJS supply to in JavaScript developers a simple DSL (Domain Specific Language) that allows to program stateful dialogs using simple function statements, as shown in Figure 2, to manage dialog flow life-cycle (`start`, `end`), to change state (`goOut`, `goIn`), to match an input pattern (`match`), to output contents (`say`, `tts`), to manage timeouts callbacks, to manage dialog memory (`setvar`, `getvar`).

In the dialog flow, the output state typically activates a subsequent state (input state), in which the dialog manager analyzes the user's response (a sentence in Italian language) and performs a contextual interpretation based on a Pattern-Matching (PM). The dialog manager is agnostic with respect to the Natural Language Understanding (NLU) mechanism and for simplicity and efficiency; the parsing has been implemented with the use of regular expressions.

In the case of a positive pattern match, the input processing node performs some processing and a response is given to the user (textual, with synthetic voice or other multimedia audio/video content).

The current state can evolve into a new state or might not change (loopback), based on a dialog flow programmed by the designer. The dialog flow finally ends, according to the application logic and the dialog ends.

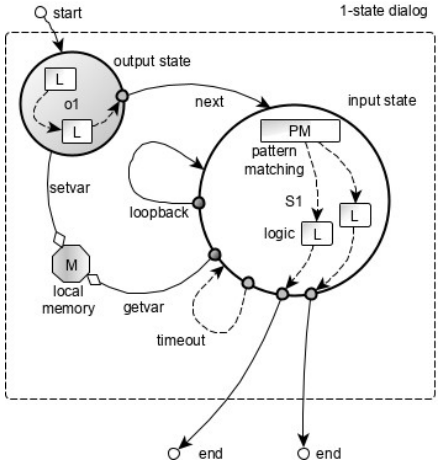

Figure 2. Naifjs dialog manager. Dialog with a single input state (on the left). 2-states dialog (on the right).

To complete a specific task (as a language exercise), the multi-turn conversation is implemented as a network of micro-dialogues, called *dialog units* (Figure 3), each containing a graph of nodes that allow conversation flows in a specific domain. These dialog units are concatenated modules, which can receive input parameters. Each dialog unit has a short-term memory: temporary variables with local visibility to the unit itself.

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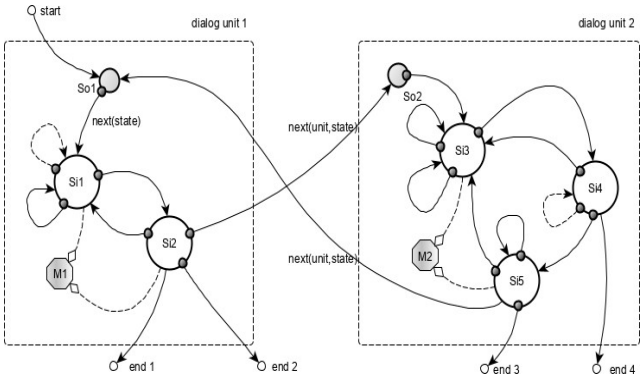

Figure 3. Multi-state (5 states) and multi-unit (2 units) dialog example with Naifjs dialog manager.

E. Hybridization of the learning environment

The hybridization of the learning environment of Italian L2 is a process that intersects two dimensions. On the one hand, the hybridization of learning is guided by the teacher, within the classes, for instance on the aspects of L2 that students may have encountered incidentally in the extra-school time (words, expressions, syntactic constructions, etc.) [24]. On the other hand, in an inverse process, the teacher attempts to extend the didactic action beyond the lesson hours, proposing to the students structured activities to be carried out autonomously, even at lower levels [25]. In this, CPIAbot can act as a mediator able to facilitate remote communication between the teacher and his students or allowing the teacher's monitoring of his students' interaction with the system.

The prerequisite that enables such processes is the User Unique Identification (UUID). In Telegram, in fact, registered users can be easily and uniquely identified. This allows, through profiling mechanisms, to customize the experience for each student, as well as enable the monitoring of interactions and their analysis. The univocal identification of the speaker is instead a problem in interactions with Google and Amazon devices, with which there is, to date, no mature technology available to identify the voice print of the individual speaker in front of the smart speaker, positioned for example in the classroom, where the number of students can be high and may vary over time.

In CPIAbot, therefore, the UUID potentialities are exploited to allow the creation of different account types: (1) student accounts, to be used by students inside and outside the classroom; (2) teacher accounts, to be used by teachers outside the classroom; (3) classroom accounts, to be used in the classroom by a teacher and his students. Each one of these account type can perform peculiar actions in the system:

Students' usage: the conversational agent is designed for personal use inside and outside the classroom with access via smartphone.

Teachers' usage: the cloud-based database and logging system allow the bot to keep information about student activities both outside the classroom and within the class group. For in-classroom activities, the conversational agent can act as a teacher's assistant in the classroom during lessons. Through the class account (each classroom has his unique account), the teacher can use all the features of the bot on the classroom personal computer, often connected to an Interactive Whiteboard (IWB), to propose exercises and games to be done in groups or as individual exercises to be done later "at home".

With the CPIAbot push mode (see below), teachers can send notifications messages and messages containing activable exercises to single students and/or virtual classrooms.

A teacher, interacting with CPIAbot through simple commands, can create virtual classrooms naming these with a personal chosen *classname* (e.g. *3C*) and the teacher can group students in the specified classroom with simple command messages to the agent.

Each student part of (virtual) classroom *3C* just has to click buttons inside the received message to activate the corresponding dialogs.

a) Report

Furthermore, teachers can remotely monitor students' chatbot usage and obtain information on the exercises done by an individual learner, or statistical information on the progress of the specified class, just using simple commands in natural language. Teachers can also get a report specifying a period of days/months from now. Example: report for the last week activities of the classroom 3c; report for the last 2 days' interactions of the student Giorgio Robino.

```
classroom 3C report 1 week
student Giorgio Robino report 2 days
```

b) Pull and push messaging

CPIAbot mainly performs a reactive interaction (*pull mode*): the chatbot is always listening to a user request, which is typed on the keyboard of the device, smartphone, tablet or personal computer. The programmer, for example in relation to the student's language level, processes by the conversational agent, which responds immediately, or at a configurable time, to the user's request in a similar way to a man-to-man conversation.

A proactive interaction (*push mode*) is also developed in CPIAbot, thanks to a Telegram feature (currently not available on Google and Amazon smart speakers) which contacts the user in a deferred time (sending a *notification* after the end of a dialogue session). In the push mode, the chatbot can send unsolicited notifications or start new conversations with the student (triggered by a backend logic or *human-in-the loop* teachers messaging). In this scenario, the student receives notifications on his or her device, in which the agent proposes diverse activities to the student, such as an exercise, a topic conversation, aimed at achieving one of the training objectives.

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Among other uses, push activable messages, along with the report function, helped teachers to fully-remotely interact with students during the COVID lockdown period, caused by COVID pandemic, allowing them to propose and monitor distance activities even with the lower educated students.

VI. TECHNICAL ISSUES, USER INTERFACE (UI) AND USER EXPERIENCE (UX) OPEN POINTS

The implementation of the functions and dialogues designed traveled in parallel with the preliminary tests within PreA1-A1 level courses of the two CPIA involved. These preliminary tests revealed critical points concerning the use of the chatbot by learners with low levels of competence in L2.

A. Speech recognition

The Automatic Speech Recognition (ASR) Facebook/WIT.ai technology platform, integrated via cloud API into CPIAbot, has an excellent level of understanding of speech input from Italian-speaking beta-testers. In tests carried out so far with a set of 20 beta-testers, adults speaking Italian fluently, the Single Word Error Rate (SWER) was less than 7%. Testing with foreign learners, the speech recognition system performances degrade a bit, revealing a higher WER in case of incorrect pronunciation. Another general open point in speech recognition is *syllables recognition*. The used ASR is not able to recognize single syllables, part of Italian language dictionary. This is a common issue all available ASR in the market have. Following this limitation, CPIAbot current version is not able to correct learner syllables pronunciation.

B. Push to talk and push to listen buttons

The voice interaction using the Telegram app is enabled by a *push-to-talk*: the student has to press a recording button of the message to be sent, at the same time he has to speak keeping the button pressed and releasing it until you speak, ending the message. Similarly, to hear the voice response of the bot, the user must press a button to activate the playback of the bot response (*push-to-listen*). In comparison to a smart speaker *wake-word* / *continuous mode* UX usual by example with Google Home smart speakers ("*Hey google, what's time is it?*"), the push-to-talk / push-to-listen interaction modality is a bit unnatural and is a friction element with poorly literate (computer literate) learners. This is a telegram UI limit, not a CPIAbot limit, nevertheless this kind of interaction requiring the user to explicitly press a button to talk and listen, is interesting from a linguistic/educational perspective because it forces the learner to be very focused on the voice interaction sequences, when chatting with the virtual assistant.

C. Language-first for lower-educated adults

After a first experimentation without any button, we introduced a disambiguation menu to simplify usage. Users can now interact with the bot just speaking or writing any word or any sentence; the bot reply with a short list of options, suggesting buttons that activate related contextual user request, as ***write***, ***read***, ***translate***, as shown in Figure 4.

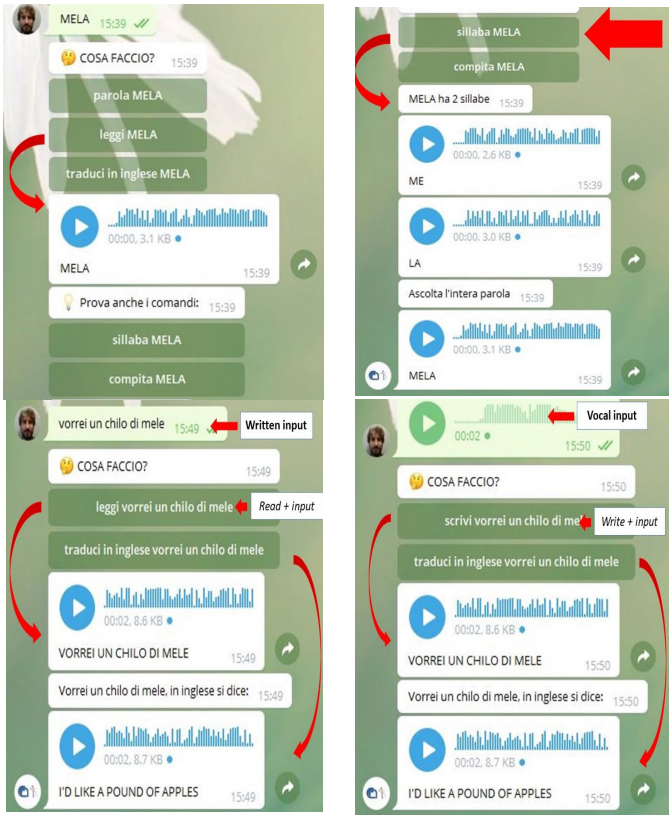

Figure 4. Examples of disambiguation menues

The final UI was successful in teachers and students' feedback, achieving a versatile and adaptable interaction, that allows a full natural language interaction for advanced users (with language level >= A1) and a simplified experience for PreA1 students (with buttons suggestions).

VII. TEACHERS FEEDBACK

The experimentation of CPIAbot within the PreA1-A1 courses of two Genoese CPIAs was planned for the spring of 2020 when, due to the COVID lock-down, all Italian educational institutions suspended their lessons. It should be noted that the distance teaching carried out by the teachers during the lock-down was an emergency solution. The teachers, therefore, sought operational solutions to meet sudden and changing needs of the context, requiring a period of adjustment to build a real design of the teaching actions. In this framework, CPIAbot was immediately used for the possibility of sending group assessments, or customized for the individual student, which can be activated without having to navigate complex learning environments and is usable from their mobile devices. In a mirror-like manner, teachers used the monitoring functions integrated in the chatbot to monitor student activities. At the

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end of the academic year, unstructured interviews were carried out with six teachers who continued to use the chatbot even during the COVID lock-down.

The final question of the interview allowed teachers to give free feedback on CPIAbot. The analysis of the answers showed that, in general terms, teachers consider the chatbot a useful tool for teaching Italian as a foreign language, while highlighting different aspects. Among the elements emerged in the teacher's answers, it is possible to find the representation of CPIAbot as a good tool for teaching vocabulary, thanks to the multimedia contents. Another element that emerged is the role of stimulus for the students, while another teacher underlined the flexibility and the portability of the tool. This came together with the grade of detail of the report about the students' activities, available within the system. Finally, another important element, elicited by different teachers was the importance of a preliminary phase where the teachers mediate the students' use of the system during classroom activities.

VIII. CONCLUSIONS

Learning Italian is one of the key steps for the integration of adult migrants arriving in or temporarily transiting through our country. Among the institutional responses to this specific linguistic need are the CPIA, which offers L2 courses aimed at achieving different levels of competence. To meet the needs of the CPIA context, CPIAbot, a conversational educational technology, has been conceived and *ad hoc* solutions have been developed, in order to tailor the characteristics of the system on the users' ones.

Accessibility to the system by students, for instance, is facilitated by the ecosystem in which we chose to develop the chatbot, i.e. telegram, an open source instant messaging app, free of charge and not requiring high system requirements to be installed on mobile devices.

The attention to the heterogeneity of the classes has been translated into the creation of a multi-modal and multi-level chatbot, to allow students with different degrees of competence (and literacy) to interact with technology. The UX, in fact, includes written and oral human-bot interaction, occasionally supported by multimedia resources, and the multi-turns dialogs are tailored to the linguistic competence of the student.

The adherence to the communicative approach, adopted by teachers and aligned with the CEFR guidelines, is implemented in the chatbot on two levels. Firstly, a conversational "language-first" technology, such as CPIAbot pushes the student to interact in natural language with the whole system. Secondly, the content and the activities proposed by the software are oriented to the communicative needs of the adult immigrant.

Finally, CPIAbot embeds features that support the hybridization of the learning spaces, because it bridges the formal and non-formal dimensions of learning. In particular, CPIAbot enables the teachers to set up, manage and monitor activities that consider the autonomous learning of the students, thanks to the UUID system and to the consequent account type differentiation (Teacher, Student, Class). This element played an important role in the (not expected) usage of CPIAbot during the COVID-lockdown period, when teachers could interact and monitor their students thanks to the features embedded in CPIAbot.

CPIAbot, therefore, is a language learning technology that tries to merge the advantage of the mobile/multi-devices oriented systems with the conversational approach. The former represents a solution that supports the expansion of a personalized learning path outside the classroom, the latter represents an interface that promotes the use of the target language as a mean to interact with the system and not only as the object of a specific exercise.

In conclusion, waiting for the implementation of the experimental phase of the project, it is possible to say that the developed technology, CPIAbot, contains within itself the prerogatives of a tool usable within the heterogeneous classrooms attended by adult students and could be integrated with a communicative oriented didactic, thanks to its peculiar architecture and interface.

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