Towards Personalised, Synthesis-based Content in Irish (Gaelic) Language Education

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Abstract

We present a web-based TTS facility, which will eventually provide for the major dialects of Irish. It, along with an ancillary toolkit of language resources, is increasingly being exploited in diverse teaching/learning environments. Further synthesis-based interactive educational platforms are described which are geared to specific learning tasks. These educational applications facilitate a degree of personalisation and can be adapted to the needs and proficiency levels of different types of learners. They further enable learner autonomy. It is emphasised that speech technology applications, such as those illustrated here, may have a particular impact in addressing many of the particular challenges that face teachers/learners of a minority language, such as Irish.

Index Terms: TTS, speech synthesis, language learning, Irish, personalisation, Gaelic.

1. Introduction

Synthesis and speech technology offer new possibilities for personalisation of educational content, adapting it to the individual learner in a way that can motivate learners and promote learner-centred pedagogy in the classroom and beyond. These technologies have a potentially major impact in the teaching/learning of minority and lesser-used languages, helping to address challenges that would not be immediately obvious from the major language perspective.

In this paper we outline the pedagogically oriented developments we are currently working on, in tandem with TTS development for Irish dialects. We focus primarily on two aspects. Firstly, there is the direct use by diverse cohorts of learners and teachers of the web-based TTS facility and of the linked language resource tools. Secondly, through a collaboration of research groups at Trinity College Dublin, educational games are being developed and adapted to be used with Irish synthesis. These latter platforms focus on specifically targeted learning goals. For illustrations, see www.abair.ie/slatedemo.

2. Challenges of minority language pedagogy

Irish, a Celtic language, closely related to Scottish Gaelic, and more distantly to Welsh and Breton is spoken as a community language in the Gaeltacht regions of the West of Ireland (see Figure 1). Irish is an endangered minority language: native speaker numbers in the Gaeltacht are steadily declining. According to the 2006 census [1], only 85,076 of a population of 4.2 million in the Republic of Ireland, indicated that they used Irish on a daily basis outside of the school system. However, though endangered, the situation of Irish is in some respects unusual in that it enjoys recognition as an official language both in Ireland and (since 2007) in the EU, and it is afforded certain State protections. It is taught as a required subject in all primary and second level schools in the Republic of Ireland and it is also taught as an elective subject in Northern Ireland. Outside of Ireland, there are considerable numbers of adult learners, particularly in the US and Britain, and lively online communities of Irish language learners.

Figure 1: *Irish-speaking Gaeltacht areas, in green [2]*.

Effective teaching of Irish presents numerous challenges. The language proficiency of different cohorts of learners varies a great deal. Outside of the Gaeltacht regions, a growth in Irish language medium schools over the past twenty years has brought a new vibrancy to non-Gaeltacht, Irish speaking networks. Nonetheless, English is the mother tongue and the medium of education for the vast majority of learners, who mostly have very limited access to native speaker models of the language. In these mainstream schools, learners are often further alienated by the teaching materials. These have, not surprisingly, tended to draw heavily on rural, West of Ireland literature and on themes of times gone by, and as such, do not resonate with their modern, more globalised environment.

Irish language pedagogy confronts many further challenges, which are rather typical for minority languages. There is no single spoken standard variety, but rather three main dialects, differentiated in terms of intonation/rhythm, syntax and lexicon. The sound system is complex: learners have to acquire a sound system which has roughly twice the consonantal inventory of English. In keeping with an ancient literary tradition, the orthographic system is archaic, with letter to sound mappings which are complex, opaque and very different from English. Consequently, achieving basic literacy skills is a major learning task. There is generally a dearth of language resources: for example there are no dialect specific pronunciation dictionaries.

3.   Multi-dialect synthesis & language tools

In recent years the Phonetics & Speech Laboratory at Trinity College has been developing TTS for Irish [3]. Given the lack of available language resources, much of this work has involved putting in place pronunciation dictionaries, letter to sound rules, annotated corpora etc. From the outset, a long term multi-dialect system was envisaged. In light of this, the development has, where possible, taken the form of *global* and *local*, modules. For example, the letter-to-sound rules operate first at a global level to generate the transformations that capture what is common to all three dialects. Subsequently, the local rules transform the output of the global rule module, to generate the dialect specific phonetic strings.

To date TTS has been developed for the Donegal dialect of the North (female voice, unit selection synthesis) and for the Connemara dialect of the West (male voice, unit selection and HTS synthesis). Work has begun on the Kerry dialect of the South (female voice, unit selection and HTS synthesis).

Figure 2: *The www.abair.ie webpage provides public access to Irish TTS and ancillary language resources.*

The Donegal TTS facility, along with a number of the underpinning language resources have been made available on a webpage www.abair.ie, illustrated in Figure 2 (*abair* is the Irish word for *say)*. The top page provides a box where text (up to 300 characters) can be typed or pasted in, synthesised, played and saved as an mp3 or wav file. Linked pages give access to a number of our language resources. A phonetisation module gives direct access to the output of the letter-to-sound rules. This allows the user, for any text input, to view the phonetic output string. Part-of-speech tagging is also provided, as is a tokenisation module. The latter allows, among other things, access to the complex rules for the expansion of numerals in Irish.

These facilities have been provided as "raw" resources to educationalists. They have generated considerable interest among learners and teachers: our research group is frequently invited to present the *abair* facility to Irish language teaching organisations, North and South. Following specific feedback and requests, further teaching-related features have been added. A browser add-on allows the user, when using on-line electronic texts (e.g., online newspapers) to link to the *abair* synthesis to listen to words or phrases the user has highlighted. A further facility allows the user to synthesise extended passages, as the 300 character limit on the main web facility was limiting, especially for teachers who wanted to prepare classroom materials in advance of class.

There has been intense interest from parents and teachers of children with a visual impairment. For the visually im-

paired, synthesis and screenreading for electronic text are an essential requirement to access materials in any language. To date these learners could only access such Irish materials through an English TTS system, which produces (to the untrained ear) an entirely unintelligible speech output. These children have often been encouraged to opt out of learning Irish, or have struggled against enormous odds. For those attending Irish language medium schools, in and outside of the Gaeltacht regions, the situation has been particularly acute. In response to requests from parents and teachers, a screen-reading facility has been provided, using the open source NVDA facility [4] along with the Connemara HTS voice. For the first time visually impaired learners now have the means to participate fully in the study of Irish and to pursue their education in Irish-medium schools.

The basic web-based TTS system was made available less than two years ago, and the additional facilities (such as the screen-reading facility) less than a year ago. They are far form perfect, and are being refined on an ongoing basis. The Connemara voice is ready for public release, and will appear on the *abair* webpage in the near future.

Despite their rather recent release, and despite the fact that we have not made any particular attempt to advertise their existence, indications are that these facilities are already being widely used. According to Google Statistics, there were slightly under 30,000 hits in the past year. These include 15,019 hits from USA, 8,753 from Ireland and 5,183 from the UK. There is a considerable volume of enthusiastic email feedback from learners of all levels and ages, and from around the globe. Most widely commented on is the fact that learners, no matter where, can now for the first time readily hear how written words and phrases are pronounced. Given the complex and opaque mappings from Irish orthography to sound, and the fact that the majority of learners do not have access to native speakers of the language, simply being able to pronounce text has removed a major roadblock in the learning process.

Feedback from teachers and learners continuously draws attention to the fact that *abair* enables more effective autonomous learning outside the classroom. Parents, unsure of their command of Irish pronunciation, have also commented that, for the first time, they feel empowered to assist their younger children with homework. From the feedback it is also clear that the *abair* facility enables uses that are adapted to the proficiency and needs of the individual. Teachers increasingly report that it is being used to enhance reading, writing and auditory comprehension skills in the classroom, and beyond.

More surprisingly, the *abair* facility appears also to have generated considerable interest within the Irish-speaking Gaeltacht areas. One second level school in the Kerry Gaeltacht is planning a support scheme where the synthetic output of *abair* will be used to support literacy training among Irish speaking pupils.

The single greatest complaint to date concerns the fact that only a single (northern) dialect is publicly available on the *abair* webpage. This is soon to be at least partially remedied, as the western dialect is due to be released in the near future, and the southern variety should follow. Further personalisation of the synthetic voices is a more distant goal, which we are working on in parallel research projects. Eventually we envisage not only a variety of basic synthetic voices in each dialect (male, female, child) but also user fine tuning of voices (more on this below).

Although intended as a "raw" resource toolkit, pilot projects are planned, to explore how *abair* can be exploited most effectively in Irish language education. We are involved in the initiative mentioned above, to harness these facilities for literacy training for Irish speaking children in the Gaeltacht. Out-

side of the Gaeltacht, pilot projects are also in train, in collaboration with primary and second level teachers, from English- and Irish-medium schools, to maximise the effectiveness of the system, and to ensure that future developments are sensitive to learner needs. As our facility grows, with a greater diversity of synthetic voices in the various dialects, so too will the range of language resources we can provide on the web, e.g., dialect specific pronunciation lexica. It is also intended that the *abair* webpage be used as a forum for community based development and sharing of language learning/teaching resources, and eventually, a repository for synthesis-based educational materials.

4. TTS-based language learning platforms

The Irish synthetic voices, a female Donegal (northern) voice and a male Connemara (western) voice, have also been used to explore the use of customised platforms with specific language learning objectives.

4.1. Interactive game: the Language Trap

The first platform is an interactive game, developed for use in second level Irish language classrooms, in collaboration with the Knowledge and Data Engineering Group, TCD, who designed the concept and graphics, in the first instance for a game directed at learners of German in Ireland [5].

Figure 3: *Screen illustration of interactive language learning game Language Trap, adapted for Irish.*

This game is in the form of an interactive guided dialogue that allows students to progress through a virtual world (a hotel and its surrounds) with the task of conversing with various characters that form part of the game. The dialogue involves the user selecting phrases from a menu of possible options shown on the screen (see Figure 3), which are spoken with synthetic output from the *abair* facility. The specific scenario developed for the Irish game involves a search by the principal character for the missing half of his/her winning Lotto ticket. One must interrogate the characters encountered without revealing one's true purpose, for fear of being double-crossed. The learner has the task of finding the character who holds the other half-ticket, by following hints and directions given by other characters as the game progresses.

The game features linguistic adaptivity. The language level of the game adapts to the user's language level: as the user chooses more complex structures, the options on offer become accordingly more complex. Performance feedback and motivational support are provided through a particular companion character in the game, who, when requested, will tell you that your selections are excellent, good, poor, etc. Meta-cognitive hints on how well you are doing appear as thought bubbles linked to your main character [5]. The duration of the game is about 15 minutes, varying a little depending on the level of difficulty at one plays the game.

Various forms of personalisation are incorporated into this game. Learners can select their main character by gender or by dialect (male character with Connemara Irish or female character with Donegal Irish). We are currently limited to these two synthetic voices: in order to provide for the more extended cast required for the game, we have for the moment carried out rather crude voice adaptations, involving speed and pitch manipulations only. However, we are currently engaged in parallel research which will hopefully yield not only a wider selection of basic voices (e.g. children's voices, more dialects) but also sophisticated voice source manipulations that will permit further fine-tuning of individual voices to provide a much greater level of personalisation [6]. We envisage at a future point being able to go some way towards investing our voices with personality traits in a way that might also be culture-sensitive, in a way that draws on findings from cross-cultural studies of voice quality [7].

The game in its present form is now being piloted in second level schools, targeting 16-18 year old students preparing for their final second-level (pre-university) assessment. Evaluation will be based on pre and post assessments of competence in the targeted skill (acquisition of vocabulary and of idiomatic phrases). Qualitative feedback will also be elicited from learners and teachers on the success or otherwise in increasing (i) language competence, (ii) motivation, and (iii) comfort with listening to Irish of different dialect sources.

4.2. Virtual characters for listening comprehension

The *abair* facility has also been exploited to provide a platform for educational materials geared at the development of listening comprehension skills. This platform is based on a virtual reality scene developed as part of the Metropolis Project at the Graphics, Vision and Visualisation Group, TCD. The user moves around the Front Square of Trinity College, mingling with the crowd, and may eavesdrop on ongoing conversations among groups of students (the groups are of three characters).

Figure 4: *Screen capture of virtual conversers [8].*

The animated characters are created using motion capture data of real conversations between actors originally conducted in English. Motion capture involves recording the movements of the joints of actors: these movements are then transposed to the animated characters in the virtual reality scene [8]. We have exploited this game-like scenario by replacing the original English dialogues with synthesised Irish dialogues, matched so that the spoken content is appropriate to the dynamics of the interactions, in terms of turn taking, gestures, etc.

The educational objective of this particular adaptation is to train listening comprehension skills. The linguistic content of each dialogue is tailored so as to contain particular vocabulary and grammatical constructs and to cover specific conversational topics. These are drawn from the Leaving Certificate (pre-university) Examination curriculum, and are pitched at an appropriate level of difficulty. Each dialogue is between three

and five minutes in duration, and has been written for a specific group of virtual conversers in the scenario. For a particular learning goal, the learner selects the appropriate conversing group and answers listening comprehension-type questions designed by the teachers either to complement classroom work or to test the aspects of language being studied at the time.

The educational content of the conversational example included in the demo (www.abair.ie/slatedemo) focuses on the use of the conditional mood, an aspect of grammar which many students of Irish find problematic. It is envisaged that prior to using the game, the teacher would have provided the typical lesson on the conditional mood. Following that, the learners would be presented with an appropriate dialogue and given a specific task. The precise task can be tailored to the proficiency level of the learner. For example, they might be given the task of identifying the mood in which specific conversational interactions/conversations are taking place, or they might be asked to identify regular and irregular verbs delivered in the conditional mood during the course of the conversation. Although not targeted here, these materials might readily be adapted to provide for autonomous learning, in contexts where a teacher is not available.

4.3. Evaluation

We are currently designing in-depth evaluations of both of these platforms, in collaboration with teachers from 10 second-level schools nationwide. The evaluations will encompass a measurement of learning outcomes based on pre- and post-testing, as well as qualitative analysis of learners' and teachers' experience with these purpose-built games. Initial rather informal pilot tests have been carried out on a group of 6 learners and 1 teacher, as a way of getting feedback and of elaborating and refining our evaluation materials.

Reactions to these pilot tests have been highly encouraging. Apart from the impact on learning, which is yet to be quantified, the pilot learners showed considerable enthusiasm for the use of these virtual scenarios/games, pointing out that these were a fun experience and that they found it 'cool' to be learning Irish through modern media. The hope is that these kinds of educational materials may increase learner motivation and may further help redress the frequent perception that the Irish language is inextricably bound with rural materials from long ago, and constrained by the boundary walls of the classroom. The use of more engaging materials may help learners see the language as a living, vibrant channel of communication.

5. Conclusions

The ways in which speech technology, such as high quality synthesis can be harnessed for educational purposes are likely to vary depending on the language and the context in which it is being acquired. Applications that might appear trivial from the perspective of the teaching of the widely spoken languages can have a major impact on the teaching/learning of minority and lesser used languages, helping to redress the particular difficulties that present themselves. For these languages, survival depends crucially on the effectiveness of their transmission, and so effective pedagogy is central to language preservation. Speech technology offers invaluable supports, and it is our hope that the approach we have adopted may be useful to other minority language groups.

Our future aim is that the *abair* facility might become a virtual resource centre for Irish language resources, whether developed by research groups or by individuals in the community. Through this, one would hope to support the autonomous learner, and to help teachers access, develop and share pedagogical materials that are maximally suited to the needs of their students. As a free, public, web-based resource, which is also accessible by mobile phone, we aim to empower learners and educationalists, wherever they might be.

Personalisation is a key requisite for the emerging technology. In the first instance, a priority is to ensure that appropriate dialect- gender- and age-appropriate synthetic voices become available. Looking to the future, an aspiration is for the synthetic voices to be tunable, to allow for an increasingly personalised, culture sensitive nuancing of our synthetic voices.

6. Acknowledgements

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