A Crowdsourcing-based Approach for Speech Corpus Transcription  
Case of Arabic Algerian Dialects

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Abstract

In this paper we describe a corpus annotation project based on crowdsourcing technique that performs orthographic transcription of KALAM’DZ corpus (Bougrine et al., 2017c). This latter is a speech corpus dedicated to Arabic Algerian dialectal varieties. The recourse to crowdsourcing solution is deployed to avoid time and cost consuming solutions that involves experts. Since Arabic dialects have no standard orthographic, we have fixed some guidelines that helps crowd to get more normalized transcriptions. We have performed experiments on a sample of 10% of KALAM’DZ corpus, totaling 8.75 hours. The quality control of the output transcription is ensured within three stages: Pre-qualification of crowd, online filtering and in lab validation and revision. A baseline resource is used to evaluate both first stages. It consists on 5% of the targeted dataset transcribed by well trained transcribers. Our results confirm that the crowdsourcing solution is an effective approach for speech dialect transcription when we deal with under-resourced dialects. Before the validation of the well trained transcribers the accuracy of transcriptions reached 74.38. In addition, we present a set of best practices for crowdsourcing speech corpus transcription.

1 Introduction

The transcription task is the process of language representation in written form. The source can either be speech or a text in another writing system. Transcribed Speech Corpora are crucial for both developing and evaluating NLP systems such speech recognition. Such corpora have to respond to NLP communities expectations and allow to be exploited in machine learning based solutions.

For many languages, the state of the art of NLP systems have achieved accurate mature situation thanks to large and well designed corpora. On the other extreme, there are few corpora for Arabic (Surowiecki, 2004). Moreover, very few attempts have been considered for Algerian Arabic dialect (Mansour, 2013). Recently, KALAM’DZ corpus (Bougrine et al., 2017c) has been developed to cover the Arabic dialectal varieties of Algeria. This corpus is collected using web-based sources. Despite its important size, about more than 104 hours, very few annotations are available. In fact, only dialect and speaker annotations are provided. In this paper, we investigated a crowdsourcing-based approach to transcribe its speeches. Transcribing dialectal speeches is a very challenging task as dialects have no linguistic rules and a recourse to experts transcription is time and cost consuming.

The rest of this paper is organized as follows. In the next section, we review some related work that have dealt with speech corpus transcription for Arabic. In Section 3, we give brief glance to Algerian dialects linguistic properties. In Section 4 we describe the target corpus KALAM’DZ. Section 5 is dedicated to our crowdsourcing solution, in which we explain the designed crowdsourcing project and the deployed quality control strategy. A list of best practices based on these crowdsourcing experiments is compiled in Section 6.

2 Related Work

The existing speech corpora annotated by orthographic transcripts, could be classified into two major groups: Pre-transcribed and Post-transcribed speech corpus. In fact, pre-transcribed speech datasets are mostly collected by recording audio files directly from a set of text files prepared to be uttered by various speakers. While, post-transcribed corpora represent speech datasets collected from Internet or by recording sponta-
neous/random conversations. Thus, the second category requires a transcription process.

Regarding transcribing approaches, we can classify them according to the used method into two categories: manual and semi-automatic transcription. This latter way is usually used to transcribe a non-colloquial language such as English, French or Modern Standard Arabic (MSA). The transcription process is achieved into two passes. By the first pass, an Automatic Speech Recognition (ASR) is used in order to generate a rough transcription that is manually reviewed in the second pass. On the other hand, manual transcription, is divided according to the transcriber level into two classes: experts or non-expert (crowd).

In this literature review, we focus on transcribed Arabic Speech corpora and their related transcription process. Let us note that the major Arabic dialects corpora are available through the Linguistic Data Consortium (LDC) as well as European Language Resources Association (ELRA) catalogues. Table 1 summarizes the reviewed transcribed speech corpora.

A-SpeechDB ¹ is an MSA speech database suited for training acoustic models. The transcriptions are automatically generated. In addition, each transcribed sentence is augmented by a manually revised version (2005). NetDC² (Network of Data Centers) (Choukri et al., 2004), is an Arabic broadcast news speech corpus. It is dedicated to the Modern Standard Arabic from the Middle East region. The corpus is transcribed manually using Transcriber³ software (Barras et al., 1998).

As regards LDC Catalogue, we can review Fisher Levantine Arabic⁴ and CallHome⁵ Egyptian Arabic projects. Fisher Levantine Arabic corpus contains a collection of 2000 telephone calls of 9400 speakers from the Northern, Southern and Bedwi dialects of Levantine Arabic (Maamouri et al., 2004). The transcription was done by experts using Arabic Multi-Dialectal Transcription Tool (AMADAT). Besides, the colloquial corpus called CallHome Egyptian Arabic is transcribed manually by Gadalla et al. (1997).

Saudi Accented Arabic Voice Bank (SAAVB) is dedicated to Saudi Arabic dialect. It is a very rich corpus in terms of its speech sound content and speaker diversity within the Saudi Arabia (Alghamdi et al., 2008). The transcription was done manually by experts using their own transcription interface.

Zribi et al. (2015) have built a Spoken Tunisian Arabic Corpus (STAC). It is transcribed manually by experts using Praat⁶ tool (Boersma and Van Heuven, 2001). The transcription was done respect to OTTA an Orthographic Transcription of Tunisian dialect (Zribi et al., 2013).

Almeman et al. (2013) have built a Multi-Dialect Arabic Speech Parallel Corpus (MD-ASPC) pre-transcribed MSA, Gulf, Egypt, Levantine, 32 hours.

NetDC (2004) Manual transcription by experts MSA Using Transcriber tool (1998), 22 hours of broadcast news speech.

Fisher (2004) Manual transcription by experts Levantine Arabic 250 hours of telephone conversations, Using AMADAT tool.

CallHome (1997) Manual transcription by experts Egyptian Arabic Dialect 120 telephone conversations.

SAAVB (2008) Manual transcription by experts Saudi Dialect 96 hours distributed among 60 947 files.

STAC (2015) Manual transcription by experts Tunisian Dialect 5 hours, Using Praat tool (2001).

MD-ASPC (2013) Pre-transcribed MSA, Gulf, Egypt, Levantine 32 hours.

Aljazeera Corpus (2015) Manual transcription using crowdsourcing Egyptian, Levantine, Gulf, Magrebi Using CrowdFlower.

Alg-Daridjah (2016) Manually transcribed Arabic Algerian dialects 4h30mn, 6213 utterances.

MGB-2 (2016) Manually transcribed MSA, Egyptian, Levantine, Gulf, Magrebi 1200 hours, 70% of the speech is MSA, and the rest is in different Dialectal Arabic.

MGB-3 (2017) Manually transcribed Egyptian dialectal Arabic 16 hours extracted from 80 YouTube videos.

Table 1: Details on Corpora Transcription Approaches

¹Code product: ELRA catalogue ELRA-S0315.
²Code product: ELRA catalogue ELRA-S0157.
³www.transcriber.com
⁴LDC Catalogue No. LDC2007T04
⁵LDC Catalogue No. LDC97T19
⁶www.praat.org
ASPC). It contains written MSA prompts translated to dialects and then recorded. This one is an illustration of pre-transcribed speech corpora.

Wray et al. (2015) have transcribed a speech dataset collected from programs uploaded to Aljazeeras website. The transcription is performed by a crowdsourcing technique through the CrowdFlower platform.

Bougrine et al. (2016) have build an Arabic speech corpus for Algerian dialects, by recording 109 native speakers from 17 different provinces. The transcription was done manually by authors. The Arabic Multi-Genre Broadcast (MGB-2) Challenge used recorded programs from 10 years of Aljazeera Arabic TV channel (Ali et al., 2016; Khurana and Ali, 2016). These programs were manually captioned on their Arabic website with no timing information (Ali et al., 2016). Thus, an alignment was required for the manual captioning in order to produce speech segments for training speech recognition (Khurana and Ali, 2016). Furthermore, the Arabic MGB-3 Challenge (Ali et al., 2017), unlike Arabic MGB-2 Challenge, emphasizes dialectal Arabic using a multi-genre collection of Egyptian YouTube videos. The speech transcription was done manually using Transcriber tool, without a strict guidelines for standardizing DA orthography.

We observed that most reviewed transcribed corpora did not use crowdsourcing for speech transcription. Plus, Algerian Dialect has not received any attention.

3 Algerian Dialects

Algeria is a large country, administratively divided into 48 provinces. Its first official language is Modern Standard Arabic (MSA). However, Algerian dialects are widely the predominant means of communication.

Algerian Arabic dialects resulted from two Arabization processes due to the expansion of Islam in the 7th and 11th centuries, which lead to the appropriation of the Arabic language by the Berber population. According to both Arabization processes, Algerian Arabic dialects can be divided into two major groups: Pre-Hilali and Bedouin dialect. Both dialects are different by many linguistic features (Gibb et al., 1986; Caubet, 2000). Bougrine et al. (2017b) give a preliminary version of an hierarchy structure for Arabic Algerian dialects (Figure 1).

Algerian dialect is considered among the most complex Arabic dialects with a lot of linguistic phenomena. For the current purpose, let us focus on some lexical, morphological and syntactic properties. Algerian DA vocabulary is mostly issued from MSA with many phonological alteration and many borrowed words from other languages, such as Turkish, French, Italian, and Spanish due to the deep colonization. In addition, code switching is omnipresent especially from French (Harrat et al., 2016; Saadane and Habash, 2015; Bougrine et al., 2017c).

Algerian DA morphology is similar to MSA excepts for some features. Some variations make Algerian DA morphology simpler than MSA. Essentially in some aspects of inflection and inclusion system, by eliminating several clitics and rules. Whereas negation in Algerian DA, including other Arabic dialects, is more complex than MSA. It is expressed by the circum-clitic negation and surrounding the verb with all its clitics or the indirect object pronouns (Harrat et al., 2016; Saadane and Habash, 2015).

As regards Algerian DA syntax, the words order of a declarative sentence is relatively flexible and all orders are allowed. The speaker begins the phrase with what he wants to highlight (Harrat et al., 2016). But the most commonly used order is the SVO order (Subject-Verb-Object) (Souag, 2006).

For more details on Algerian linguistic features refer to Embarki (2008); Saadane and Habash (2015); Harrat et al. (2016).

4 Targeted Corpus

Few speech corpora for Algerian Dialectal varieties are available (Bougrine et al., 2016, 2017c). For this study purpose, we have chosen KALAM’DZ corpus (Bougrine et al., 2017c). KALAM’DZ is a large speech corpus dedicated to Algerian Arabic dialectal varieties (Bougrine et al., 2017c). It covers eight major Arabic dialects spoken in Algeria. This corpus is collected from web sources namely YouTube, Online Radio stations, and TV channels. The size of the corpus is about 104 hours with 4881 speakers. All annotations are extracted from the related web sources metadata which are namely the ti-
Article text
Publishing and advertising for attracting and retaining a large number of contributors is a key of success of any crowdsourcing system. We have decided to follow a simple strategy to advertise our platform. Social networks are always a good choice; we have gone with Facebook as preferable way for our targeted community.

Given that dialectal Arabic lacks a standardized orthography, we have defined an Orthographic Transcription Guideline that help to deliver a normalized transcription as much as possible. Our designed guideline is inspired from Saadane and Habash (2015) and Wray et al. (2015). In fact, we have designed some rules based on the Conventional Orthography for Dialectal Arabic (CODA) due to Habash et al. (2012) and adapted for Algerian dialect by Saadane and Habash (2015). Some other rules are added following the recommendations for crowdsourcing Arabic speech transcription due to Wray et al. (2015). This guideline is delivered through a video demonstration. Among these rules:

- The transcription is done in Arabic Script.
- To have a normalized spelling, the crowd has to transcribe colloquial words as close as possible to appropriate MSA spelling.
- In order to facilitate future potential Part-Of-Speech (POS) tagging task; foreign words, named entities, places and proper names should be transliterated in Arabic and guarded by some predefined tags. For example: [ العلم: مكان الجزائر] ([Named Entity: Place Algeria]) is used to tag that [ الجزائر] is a proper noun indicating Algeria country.
- For more uniform transcription, a given spoken form is always written the same way.
- To be more faithful when transcribing; all non-speech sounds should be transcribed. For instance music, noise, breathing, laughs, they have to use respectively the predefined tags.

Quality Control
A front-end verification process makes sure that transcribers respect the given guideline. In fact, two JavaScript functions are deployed, one function forces transcribers to type using only Arabic letters, and the second function to make sure that no spamming data are collected by disabling Copy/Paste functionality.

In order to ensure the quality control of the output transcriptions, we have acted in three stages: Transcriber Pre-qualification, Online Filtering, and WTT revision.

For the two first stages, we use an in lab transcripts as a Baseline Resource (BR) coupled with a mechanism of Transcriber Trusting. BR resource contains 256 transcribed utterances which represents 5% of the targeted sample. In brief, the mechanism works as follows. Initially, an arbitrary score of 50% is assigned to any new transcriber. This score changes every time that the transcriber has to pass a trusting control by means of transcribing a speech segment belonging to BR. In fact, his transcript is confronted to the corresponding BR one. The comparison is done by means of Levenshtein distance and similar tests.

Now, let us explain how the control quality is performed:

- Within the Pre-qualification stage, the transcriber should go through a trust test. In fact, they have to perform 5 successful transcripts. Then, he will be allowed working. Otherwise the transcriber is invited to check the guideline once again, and every transcriber has 3 attempts before suspending their account.
- Once trusted, this is not for ever, the Online Filtering stage is activated. In fact, a verification process is launched after every 5 submitted transcripts. Where the system ask the transcriber to transcribe one speech among BR. Here also users are invited to check the guideline once again, if their scores are lowered. Users with score higher than or equal to 70% will be considered as a trusted transcriber so he will be tested every 10 transcriptions instead of 5.
- In parallel, the WTT revision step is launched. It is added to get more accurate transcriptions. In fact, the well trained transcribers, mainly the authors and lab members, reviewed the transcriptions submitted by users with score less than 70%. If the task needs a bit revision they performed it. Otherwise, they list the task again. Figure 2 shows WTT interface to validate/revise transcriptions.
### 5.4 Project Data Evaluation and Aggregation

The SPEECH2TEXT’DZ project was launched on May 2018. Contributors were invited to participate.

| Total duration       | 51 Days     |
|----------------------|-------------|
| Number of crowd      | 208         |
| Number of transcription | 5335      |
| Number of audio transcribed twice | 277        |
| Number of audio transcribed more than twice | 312        |
| Average Transcriptions per user | 25.65      |
| Guideline video views per day | 33         |
| Average Transcription time | 3min 21s  |

| Table 3: Global Statistics about the Project Execution. |
|-----------------------------------------------|

After 51 days of web application hosting, more than 208 users registered. According to Google Analytics tool and our platform administration page we have got some statistics and details regarding user participation and behaviors. Table 3 gives global statistics about the project execution. In average a time of 3min 21s is needed for one transcription. This fact, shows that the transcription task is very challenging despite that utterance size is about 6.2s in average. This is also confirmed by the fact that in average a user transcribes less than 26 speeches.

In order to ensure transcription quality, all works took less than 20 seconds are treated as malicious work and been consequently eliminated. Moreover and as explained, WTT can validate and review users transcriptions and list a task again if it is needed.

For evaluating the crowdsourcing solution, we consider the transcription quality by the crowd transcribers before the WTT revision stage. Table 4 shows the distribution of users according to their achieved scores and the related number of transcribed utterances.

Scores show that the well transcribed utterances were performed by less than 21 crowds. While the 73 transcribers reached a score between 60% and 80%.

The overall precision $Pr$ achieved is computed using the following formula:

$$Pr = \frac{\sum_{i=1}^{NT} \#Uttr_i \cdot \text{Score}_i}{N}$$

Where $N$ is the total number of transcribed utterances, $NT$ the number of transcribers, $\#Uttr_i$ and $\text{Score}_i$ are respectively, the number of transcribed utterances and the average score of a user $i$. Accordingly, we have got a precision about 74.38%, which can be considered as an acceptable result according to the challenging dialect transcription task.

Let us mention that after the WTT revision step all the transcription are considered as well transcribed according to the defined guideline.

Figure 3 illustrates a sample of transcriptions confronted to the well-trained transcribers’ ones. We have observed that the most common mistakes and errors are due to the misunderstanding of guideline or also from the fact that users ignore watching the video tutorial that demonstrates how to transcribe and use the platform. Also some users misuse the defined tags, for example instead of using the tag [تَرْدِيدَ] they used [تعجب].

| % | 55-59 | 60-69 | 70-79 | > 80 |
|---|-------|-------|-------|------|
| # Users | 33    | 81    | 39    | 34   | 21   |
| # Transcribed Utterances | 1136  | 1011  | 1186  | 936  | 1086 |

Table 4: Users Score Quality Rates and Transcriptions Distribution by Score.
6 Best Practices

Based on the experiments of this crowdsourcing-based solution and the resent results, we have dedicated some rules for a good validation of dialect transcription:

- Dialect speech transcription is a hard task, for that the size of the speech segments must be managed.
- Daily observation must be done to check the progress of completed tasks to recall new users when it needed.
- A part of quality control must be implemented on the project to avoid malicious work and get accurate result.
- The online filtering stage is very important to ensure quality control and avoid useless workload.
- The time of launching calls must be considered to get a large participation.

7 Conclusion and Future Work

For many researchers and institutions, crowdsourcing has become a popular method in NLP for lowering time and cost comparing to expert requirements. In this paper, we have investigated a paid crowdsourcing solution in order to transcribe a part of the speech utterances of KALAM’DZ corpus. We have followed two strategies to ensure the control quality of users transcriptions. First a predefined guideline is provided in order to help and train the crowd to deliver as normalized transcriptions as possible. The second control quality strategy is ensured using three control stages: Pre-qualification of transcribers, online filtering and revision step.

The results show that using crowdsourcing with a well tuned quality control mechanisms is an effective way for speech dialect transcription. In fact, the reached transcription results shows that the precision of the transcriptions is more than 74.38% according to a baseline resource.

In addition, we have determined a list of best practices for crowdsourcing-based solutions for corpus transcription.

This crowdsourcing-based solution has proved its accuracy, in an ongoing work we are enlarging the dataset to be transcribed by improving the crowd recruitment strategy.

As future work, we plan to extend the usage of crowdsourcing in order to cover further annotation and validation to KALAM’DZ corpus such start POS tagging the sentences to build a treebank-like resource.

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