# Divide and Conquer: Atomizing and Parallelizing a Task in a Mobile Crowdsourcing Platform

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## ABSTRACT

In this paper we present some conclusions about the advantages of having an efficient task formulation when a crowdsourcing platform is used. In particular we show how the task atomization and distribution can help to obtain results in an efficient way. Our proposal is based on a recursive splitting of the original task into a set of smaller and simpler tasks. As a result both more accurate and faster solutions are obtained. Our evaluation is performed on a set of ancient documents that need to be digitized.

## Categories and Subject Descriptors

H [**Information Systems**]: Crowdsourcing—*Trust, Incentive Schemes*

## Keywords

Crowdsourcing Ground Truth Generation; Mobile Crowdsourcing Platform; Document Analysis; Computer Vision

## 1. INTRODUCTION

The power of crowdsourcing is more and more evident in different disciplines [4]. Although changing tasks to this new paradigm is not enough. Having the right platform and tools is also an important factor for the efficient achievement of the tasks, as well as for exploiting the crowdsourcing working model. In the current work a new crowdsourcing mobile platform [1] is used to take advantage of the ubiquity of such devices (i.e., tablets and smartphones). In this way everybody and anywhere can contribute to a given task just with a small piece of his/her time. Also, the touch and draw capabilities of such devices are suitable for the kind of task related with segmenting words. The facts mentioned above (right platform and tools) are evident, however, it is also important to present the task in a proper way. In this sense we present our experience in a case study where the global problem is recursively atomized to increase the accuracy and at the same time obtaining the result in a faster way.

This paper is focused on handwriting ground truth generation using crowdsourcing. Most handwriting recognition approaches are learning-based systems. Therefore, they require large amounts of annotated images to train a recognition engine. For historical documents, such training data —ground truth— may not exist, or its creation may be tedious and costly, since it has to be done manually. In such a task, crowdsourcing has become very popular in the last years, because only with the massive help of volunteers, huge amounts of data can be manually labelled. In this field, it is worth to mention PixLabeler [3], the Civil War Diaries and Letters Transcription Project[2], the DEBORA project [1], to mention a few. A solution to segment words from ancient documents using a mobile-based crowdsourciong platform is discussed the current work.

## 2. CASE STUDY

### 2.1 Motivation

Search in ancient documents focused on people information is very important in historical research, including family history and genealogical research. Queries about a person and his/her connections to other people allow focusing the search to get a picture of an historical context: a person's life, an event, a location at some period of time. Furthermore, the ability to handling this information represents the key in order to build big historical social networks. Manual inference of such networks can require significant time and effort, including pooling and cross-referencing many different data sources. Some of the most famous historical social networks are the Family Search database[3], the Mormon Mi-

[1] http://www.knowxel.com

[2] http://digital.lib.uiowa.edu/cwd/transcripts.html

[3] https://www.familysearch.org/


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http://dx.doi.org/10.1145/2506364.2506371.

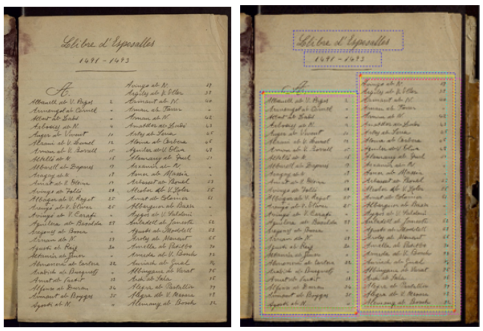

**Figure 1: Original page and first task result.**

gration database[4], or the Historic Journals[5]. The conducted experiment was focused on the Marriage Licenses Books [2] from the Archives of the Barcelona Cathedral. These books contain details of more than 500.000 unions celebrated between the 15th and 19th centuries.

## 2.2 Experiment structure and results

Previous solutions to this problem were based on a desktop platform. The software needed just a PC to be installed and allowed to segment the words from the document. Since it is not intended to be used in a crowdsourcing way there is not a tool to administrate the tasks to be done by a given user. On the contrary to that piece of software, we propose to use a crowdsourcing platform developed for mobile devices and use a recursive task atomization. The users, instead of receiving the whole page to segment the words, receive a very small and concrete task. The initial task consists in extracting the page layout. This task results in columns, see (Fig. 1). The outputs of this first task allow the platform to release a second task; splitting these columns of text into several boxes containing on average 6 lines of text to properly display the task in several devices (from 3.4" to 10.1"). In the second task, the user is asked to draw the bounding box of every single word. Later on this output is used to generate the next task. Finally, in the last task the user is asked to precisely segment the word contained in the given box (see right side of Fig.2).

[4]http://lib.byu.edu/mormonmigration
[5]http://journals.byu.edu

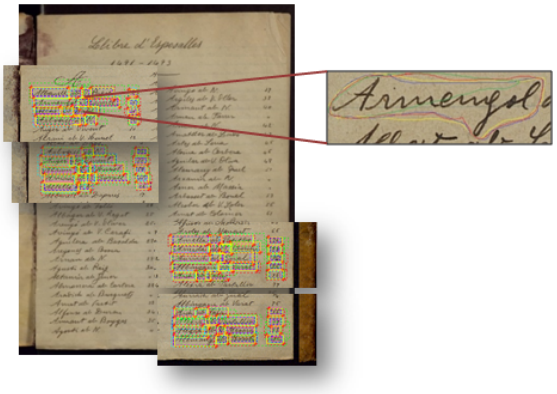

**Figure 2: Illustration of the segmentation result.**

The recursive split up strategy presented above has shown advantages with respect to initial attempts where the user received the whole page to segment the words. Firstly, the simplicity of the task allows an easier and faster fulfillment. Secondly, having the task atomized as small pieces of work, although seems to increase the amount of tasks, it allows the parallelization in the solution, and then faster results are obtained. On average, all the words from a given page were extracted in 9 minutes, while by using the software mentioned above, it required 20 minutes per page on average. No redundancy was applied in both experiments, each final word was segmented only by one user. The experiments were conducted by different persons using both platforms.

The reduction in time should be attributed to the simplification of the work done by the platform, because there is no change in the amount of data processed. In the mobile platform previous tasks are oriented to this simplification. The crowdsourcing platform have no need of zooming the image and locating the next interest point. Obviously, theses design strategies could be applied to the static platform but anyway the other improvements related directly to mobile crowdsourcing will not be achieved: ubiquity, less fatigue, work in parallel, less time to get the final solution.

# 3. CONCLUSIONS

This paper presents a new strategy to tackle a segmentation problem using a proper task formulation together with a crowdsourcing mobile platform. The right task formulation allows speed up and increase the accuracy on the results. On the other hand, the usage of a general purpose crowdsourcing platform, based on mobile devices, allows a high parallelization and reach users everywhere. Additional advantages, such as friendly user interface and accuracy in the inputs due to the usage of the touch screen interface are obtained. Finally, a higher dissemination of the tasks is obtained due to the crowdsourcing philosophy.

# 4. ACKNOWLEDGMENTS

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