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A PERSONAL AUGMENTED REALITY DICTIONARY

Jean-Pierre Lomaliza and Hanhoon Park
Department of Electronic Engineering, Pukyong National University, Busan, South Korea
E-Mail: hanhoon_park@pknu.ac.kr

ABSTRACT

This paper proposes a personal dictionary based on augmented reality where the user has the opportunity to create and handle his/her own customized dictionary. In addition, users have the opportunity to share their dictionaries and download dictionaries handled by other users stored in the cloud. The main concern of this paper is about assisting researchers to understand well scientific/technical articles or papers they are reading. A system/application implemented on a smart phone with the Android OS is provided to snap the text using the smart phone camera and extract the inquiring word from the camera image. In case the extracted word has matching records in the existing dictionary stored in local database, a list of definitions is proposed. And definitions in the list are sorted based on the vote index algorithm proposed in this paper. In case the word does not match with any record, the user has the choice either to add new definition, tags and field in which that word is defined; or to perform search in Google. The proposed system/application appear to be a very helpful and handy assistant that will help researchers to have less struggling to understand scientific/technical articles or papers they are reading.

Keywords: augmented reality, education system, and personal dictionary.

INTRODUCTION

Augmented reality (AR) technology has been steadily studied and progressed for about two decades [5, 6]. However, its introduction for the use of common people has been getting big interest after the emergence of high-technology devices such as smart phones or glasses where users can enjoy immersive experiences through AR applications. This paper is also concerned with developing an AR application on Android platform [1].

A number of studies [3, 7, 8] have shown that AR might not be seen only as an amusement tool for users but also a very powerful tool in education by reducing learning complexity and showing practical virtual objects that will help students in their learning process. Hence in this paper, we propose an AR application that can be classified into the education field.

There have been a number of AR applications or researches that have been developed to improve the conventional education system [3], but most of them have been focused on elementary or high-school student level. To the best of our knowledge, there is no AR-based application or system that has been developed to help researchers to understand well scientific/technical articles or papers written by others. For university researcher and students, understanding other researcher's publication is a very important step to have the possibility of innovating and creating new theories based on previous researches. Therefore, the application proposed in this paper targets on university researchers and students of all levels, from undergraduate students to doctoral students with the goal to achieve the following objectives:

- Give researchers a handy AR tool that will ease their understanding of scientific/technical articles or papers written by others.
- Give researchers opportunity to handle their personal dictionary and share them with other researchers.
- Allow older generation of researchers to bequeath their dictionaries as legacy to younger generations.

The remaining part of this paper is organized as follows: First other applications having similarity to ours will be introduced in the Section 2. Second, the proposed method and results will be discussed in the Section 3, and then conclusions and future researches will be subject of Section 4.

PREVIOUS SIMILAR APPLICATOIN

From the need of users to have personal dictionary where they can write definition of words in the easiest way they understand them, many android applications that achieve this goal have been implemented and published in the Google Play store [9]. Application called "My Own Dictionary", which is published in Google Play store, is an example of the need of people to have their personal dictionary application. It proposed a simple interface where users can handle personal dictionary in many different languages. Currently the application has over 100 thousands of downloads and having a rating of 4.7 in the Google Play store.

In other hand, several applications have been developed for android OS to extract text from images using image processing libraries such OpenCV [2] and Tesseract OCR [4]. Examples are "Text Fairy" or "OCR Instantly Free". Both have over 100 thousands downloads in Google Play store and good ratings from users. This shows in the other hand that users need these kinds of handy systems where they can extract text from image or videos without having to type anything in the keyboard. Thus our application comes with handy and easy features that will aim to satisfy users as it will be introduced in the following sections.

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PROPOSED APPLICATION

The proposed application comes with the following features:

- Merge the two existing features mentioned in the previous section into one application which means an interface where users browse words in their personal dictionary by snapping them with a camera.
- Share and download dictionaries through cloud systems.

Used libraries

To get image frames from the smart phone's camera, the OpenCV library [2] was used for a good FPS (Frame per Second) variation between 12 and 15. In this way, we can extract each frame in fraction of second and analyse them in a wanted region of the image. Then, the Tesseract OCR library [4] was used to extract inquiring text in a captured image.

Application architecture

The proposed application is composed of three parts: manual phase, dictionary manager, and snapping scene.

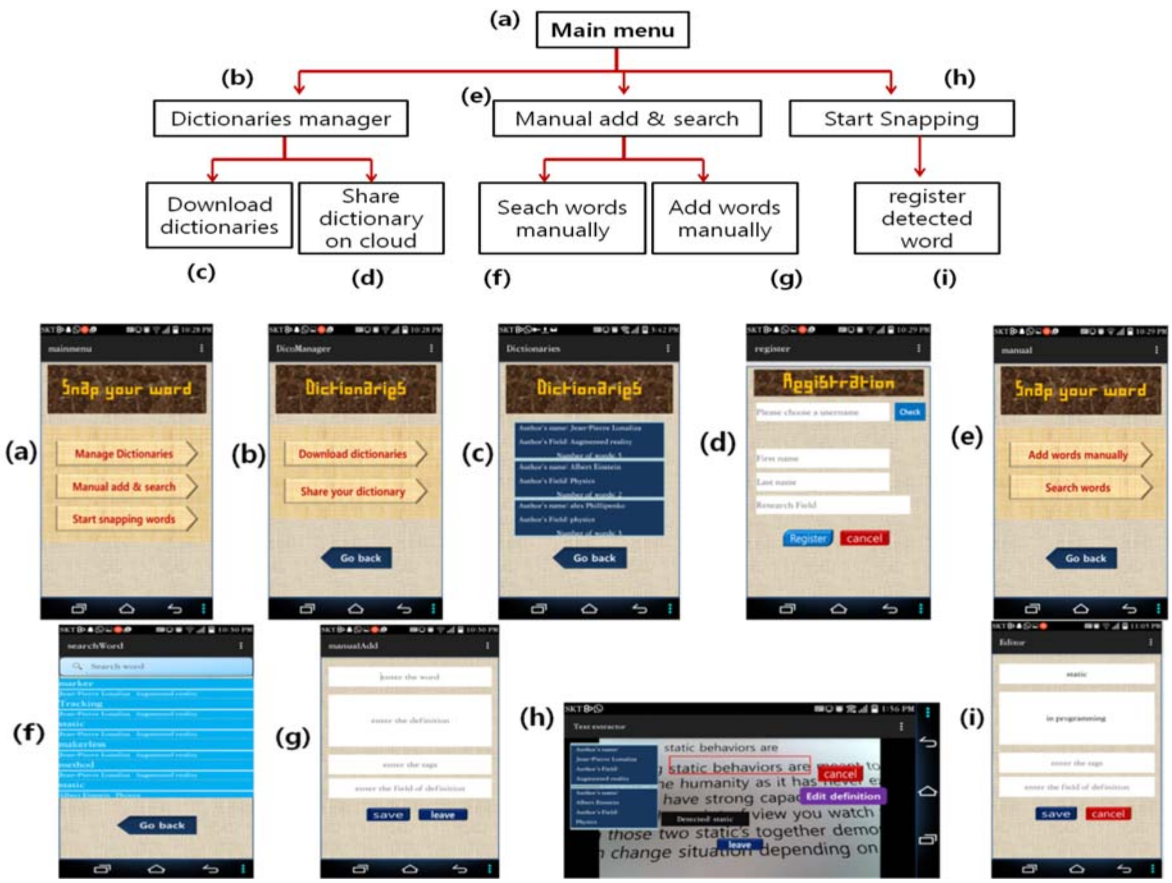

Figure-1. Architecture of the proposed application. each letter from (a) to (i) in the flowchart has a matching image showing the activity capture.

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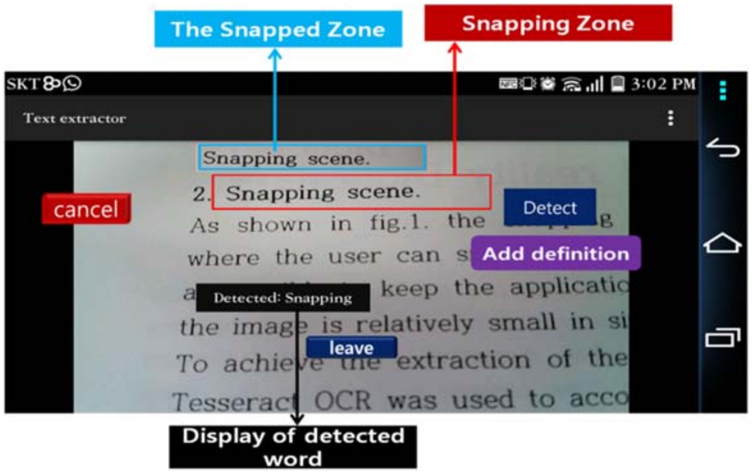

Figure-2. The snapping scene. The red rectangle is where the inquiring word has to be placed before pushing "Detect" button to snap the image. When the user presses "Detect" button, the snapped image is shown as preview in the blue rectangle. At last, the extracted (or detected) word is shown in the black text view.

- **Manual phase:** Users have the possibility to add manually words to their personal dictionaries and search manually existing words (see Figure-1-(e), (f) and (g)).
- **Dictionary manager:** Users have the possibility to share their personal dictionaries to other users through the cloud, and also download other user's dictionaries shared in the cloud (see Figure-1-(b), (c) and (d)).

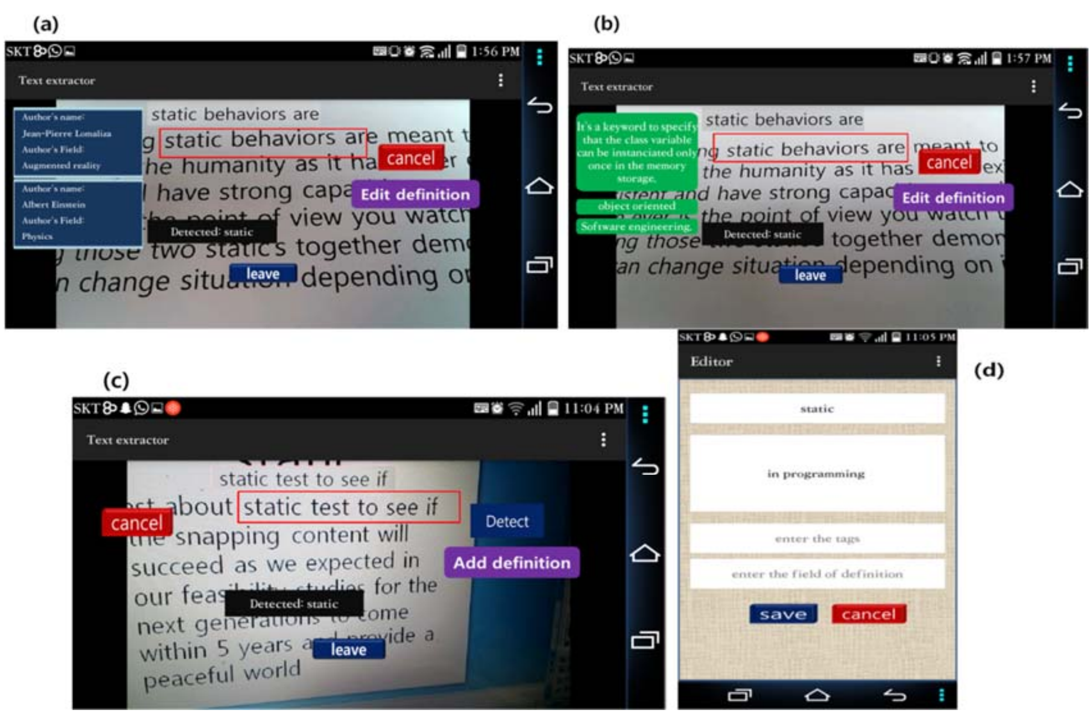

Figure-3. Possible scenarios in the snapping scene. (a) The detected word, "static", exists in the local database and has two different authors. (b) After the user selected one of two authors, the definition, tags and field are shown in green boxes. (c) The detected word does not exist in database, and the application proposes to add definition for the word. (d) The form to add new definition when the user pushes "add definition" at (c).

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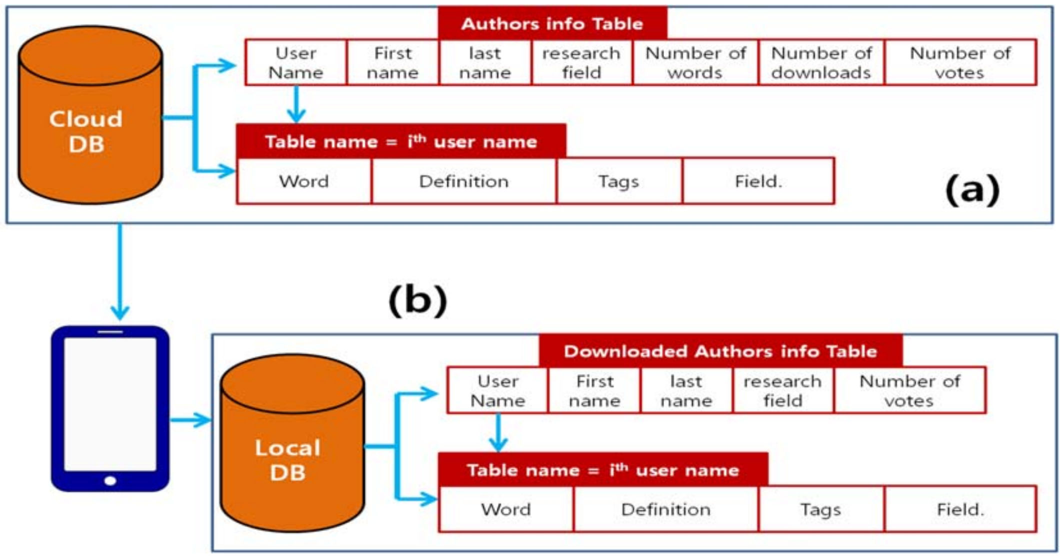

Figure-4. Data management flow. (a) Tables in the cloud, the first is "Authors info table" contains all authors (who shared their dictionaries) information, and *i* (= number of authors) other tables associated to user name field in the first table. (b) Tables in a local smart phone, having same management system as the one in the cloud.

- **Snapping scene:** The snapping scene as shown in Figure-2 and -3, is where everything happens. At first user has to place the wanted word in the red rectangle in the screen and start detecting by pushing the "detect" button. And then, the application will try to extract text from the captured piece of image, and then will query the extracted text in the local database. In case the application finds matches in the database, it displays list of matches by showing author names and their research fields so that the user might select the desired author's definition. And then the definition, tags, and field will be displayed. In the other hand, if there is no match found in the database, the application will propose to the user either to add new definition for the word or search online using Google search as shown in Figure-1-(h), (i).

Database management

As shown in Figure-4, the database management is handled in two levels: cloud level and local level.

- **Cloud level:** There are two types of tables. The first and main table is the "Authors info" table; it has information of all authors that uploaded their dictionaries in the cloud. The second one is that is associated to each author. In other words, each author has a table having his user name as table name. The table has information of all words with definitions, tags, and fields.
- **Local level:** Same as the cloud level, the database has a main table that has information of all authors from which the user downloaded dictionaries, although the fields of the table are slightly different from those in the cloud level. And, there are tables associated to each author.

Vote index

Our application provides basic features for sharing and downloading dictionaries of other authors or researchers (see Figure-3). But, to make our application further customize and dynamically changing to the direction of users' needs, we introduced voting index which has the same concept as most of search algorithms used by big websites such as Google.

The voting index combine the number of words the author has written, the number of download, and the number of times that users selected their definition in the snapping scene.

- Number of words: this is added to the voting index to encourage users to add more words in their personal dictionaries.
- Number of downloads: If an author is a good writer or handle dictionary having good descriptions, users will prefer to download more contents of this author.
- Number of selections: As users spend much time in our application trying out other authors' definitions, they will get the habit to select definitions from the author that is good at writing.

In this way, the vote index will be used to sort list proposed in the snapping scene where many definitions from many authors might point in the same word.

Performance analysis of text extraction

The usability of the proposed application greatly depends on the performance of text extraction. Thus, we present the results of analysing the performance of text extraction in the proposed application. For experiments, we used the smart phone (PANTECH VEGA RACER 3 IM-A85OL, having 2 GB RAM, a screen resolution of 720

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x 1280 pixels (~277 PPI pixel density), and a rear camera of 13 MP).

The test was done using A4 papers printed out with MS PowerPoint's font size of from 8 to 12 pt. And snapping was freely taken to guarantee the objectivity of our analysis.

As shown in Table-1 and Figure-5, with only 1.166 attempts on average before getting the right extraction, it is shown that users can get correct extraction in 85.71% of cases, and almost 100% of correct extraction for characters bigger than 8 pt. But in the other hand, with the average detection time of 5.66 seconds, the system might be slower for users who have faster keyboard typing skills. Therefore, the reduction of extracting time will be subject of future studies.

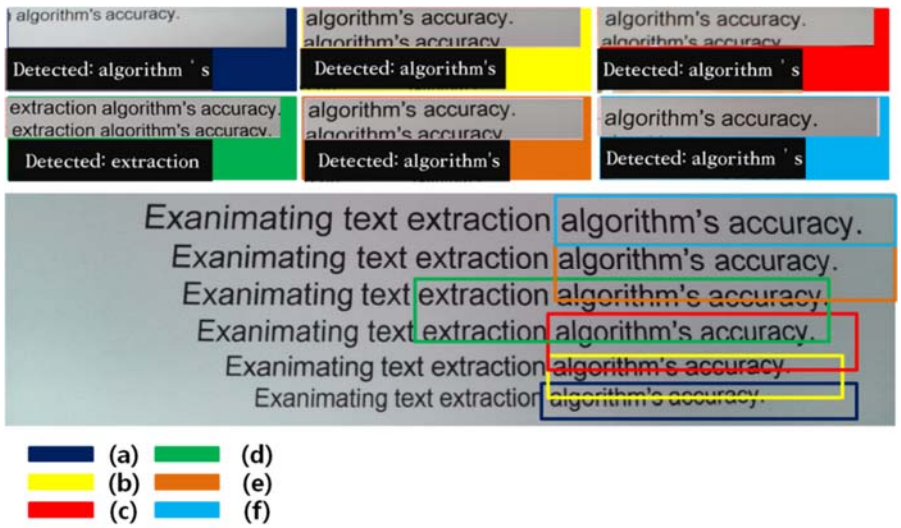

Figure-5. An example of text extraction experiments for different MS PowerPoint's font sizes: (a) 8, (b) 9, (c) 10, (d) 10.5, (e) 11, and (f) 12 pt.

Table-1. Trials and time for successful text extraction.

Font Size [pt]	**Trials**	**Time** [sec]
8	~ 2	~ 10
9	~ 1	~ 5
10	~ 1	~ 4
10.5	~ 1	~ 5
11	~ 1	~ 5
12	~ 1	~ 5

CONCLUSION AND FUTURE WORKS

In this paper we proposed a personal AR dictionary application which had educational purpose and targeted on university researchers and students. With the proposed application, the users could have the opportunity to create and handle their personal dictionaries. In addition, they had the advantages of downloading dictionaries from other users and also share their dictionaries to other users in the cloud. Therefore, the users could read and understand much more easily scientific/technical articles or papers from other researchers. This was a great contribution in that the proposed application showed how AR could bring a big improvement into the conventional education system.

In Section 3.5, we could know that the text extraction process by the Tesseract OCR library was sensitive to the resolution, luminosity, and other image properties, and also sensitive to properties of the smart phone used (e.g., quality of camera used). As a result, it took quite long to extract correctly the inquiring word. Therefore, our future work will aim to enhance the detection algorithm.

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