A Prototype of FIG Surveying Education Portal

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ABSTRACT

FIG's Commission II has long been active in developing a Surveying Education Database (SEDB) for world-wide educational data in the field. The database is available on the web and it includes generic information about the degrees offered, list of courses, contact information and the like. In recent years it has been observed that the major obstacle is keeping the data up-to-date.

Combining the efforts to solve this problem and adding a functionality to find information on distance education, this paper presents a prototype of a new WWW portal for surveying education. The portal's main task is to find information on Surveying Education and visualize it in a partly graphical output, without having to maintain a specific-purpose database.

There are two major concerns in such a project: the method for finding the necessary information ***(data acquisition/mining)*** and the method for visualizing this information ***(information visualization)***.

To acquire the data, in this implementation we will present you a ***specific-purpose search engine*** that is programmed to look for information in defined web sites. That way, eventually if any update is needed, it will be the list of mentioned web sites. These sites are updated for the course information for local students, therefore, it doesn't require a special attention for our purpose. We would be utilizing the existing data.

To visualize the information, we tried to *map* the curricula of the studied fields by designing a graphic which suits the purpose of this work. Eventually we are interested in developing this to a *self organizing map*. Currently, this graphic shows some extract from the main and sub fields of Surveying Education and presents a primitive hierarchy between them.

As the search engine finds our specified keywords in the specified web sites, it will light up the relevant *surveying morpheme(s)* which are represented in the initial graphic. Each morpheme then is linked to the sites that indexes the relevant set of keywords, and user is allowed to "dig deeper".

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1. INTRODUCTION

1.1 History

The work presented in this paper is a part of on-going efforts for enhancing the communication in the surveying education world. It is inspired by the sincere efforts in the near past and the acknowledged need for the information exchange today and tomorrow.

International Federation of Surveyors, FIG (mentioned only as FIG hereafter), has its educational commission (Professional Education, FIG Commission II) since the beginning. Commission has been active on several issues, and formed several working groups.(Current working groups are: WG 2.1 - Management skills, professional competencies and CPD policies, WG 2.2 - Virtual academy - distance learning, WG 2.3 - University curricula - content competencies, trends and assessments, WG 2.4 - Surveying students).

Their work resulted into a number of publications carrying valuable discussions as well as an online database that was planned to serve all surveying educators and students to find information on what is taught where and how to get in touch with these institutions. The implementation of this database project have been evolved through years and is called Surveying Education Database (SEDB, hereafter).

SEDB is available at FIG's main website at: http://www.fig.net/figtree/sedb/index.htm,
and currently contains information on more than 200 institutes and almost 400 surveying courses in more than 60 countries. The database also provides the home for the FIG Discussion Groups for dialogue between FIG's academic members and other academics with the purpose to develop a Virtual Academy [1].

Today, in its best shape, unfortunately SEDB is not up-to-date. Keeping the database alive has been each individual university's responsibility. The earlier "submit-your-data" (by fax or letter) principle was changed to "fill-in-online" as of February 2000, but it did not solve the problem. The lack of a "correspondent", a real person who would be responsible for the updates in each of these 200 institutions in more than 60 countries, will probably never be overcome. Therefore, an alternative method is being searched here, where the dedicated database updates will not be needed but we can reach the information we are looking for anyway.

1.2 Content of the work

We made a portal where we implemented a *specific-purpose search engine*. It is a dedicated search engine which looks for certain information (pre-defined keywords) on the certain websites (web sites of the relevant departments), and visualizes it in a certain way (gives an indication of what education is available by lighting up the proper *surveying morpheme*).

You will be introduced to the terminology and each of these steps as you read this paper. At the end, if the method proves effective and if the response from the audience is positive, we will develop the idea with the feedback from the experienced professionals of this field. Then this portal may replace SEDB. Keep in mind that as the time of this writing, the prototype is not even introduced to the audience and the discussion is not yet matured.

The advantage of using the local web-sites is obvious: they are being *updated* for the local teachers' and students' own use. Therefore it will not require any particular attention for our use.

1.3. Target Group

Ideally the target group includes anyone who would look for information on Surveying Education. This could be those who are working as educators, to follow the world-wide developments in the field, could be students/researchers who are looking for an exchange institute, or professionals who would like to find out if there is anything the nearest university can offer them to update their knowledge. It may also be those who are interested in distance education, so they can visit the relevant sites and figure out if there is any remote courses offered.

Although the initial dataset does not cover the entire field, this pilot application tries to offer something to all of those above directly or indirectly. The concentration on the design is to make the life of the end-user easier by making an initial classification for her/him.

1.4. The terms used in this paper

Some of the terms we use here require some explaining. First of all, we took the liberty to be inventive about using the word "morpheme", see the explanation below. The others included in this section are used across several fields covering serious research areas (especially in neural networks). These facts may lead to a potential confusion. We may have utilized the latter arguably, but as an attempt to clear it up, here you will find some explanations.

Search-engine: A remotely accessible program that lets you do keyword searches for information on the Internet. There are several types of search engine; the search may cover titles of documents, URLs, headers, or the full text. [2]

Morpheme: A meaningful linguistic unit consisting of a word, such as *man,* or a word element, such as *-ed* in *walked,* that cannot be divided into smaller meaningful parts.[3]

In this paper, we use the term ***"surveying morphemes"*** for expressing the terms that probably have the common meaning to all surveyors. These are not the keywords, they are more like basic words that can act like the parents of the keywords, they are the roots. We assume that the root words (morphemes) are rather exact and stable, but their "children" (keywords) are not.

Data mining: Analysis of data in a database using tools which look for trends or anomalies without knowledge of the meaning of the data. Data mining was invented by IBM who hold some related patents. Data mining may well be done on a data warehouse. ShowCase STRATEGY (http://www.showcasecorp.com/) is an example of a data mining tool. [2]

Although some may argue that web pages are not to be considered a database, it is a form of it. The "Free online dictionary of computing" also includes "hypertext" as the second entry for the definition of database. [2].

We use the term counting on the fact that we are dealing with data that is not well-structured, and we try to use a non-standard method to understand it.

Self-Organizing Maps (SOM): The SOM is an algorithm used to visualize and interpret large high-dimensional data sets. Typical applications are visualization of process states or financial results by representing the central dependencies within the data on the map. [4]

SOM is one of the important Neural Network types. We are not utilizing anything of a SOM in this prototype. But for the later developments it can well be utilized, therefore we would like to include the idea in this paper for further discussion.

Information Visualization: The process of forming a mental model of data, thereby supporting insight into that data. [5]

Like the two last terms, data mining and SOM, this is also a term employed in neural networks research, as well as other fields of science. Our use of the term corresponds very well with the short description above.

2. DATA ACQUISITION

2.1 Defining the domains and keywords

As this was going to be a specific-purpose search engine, it had to do the searching in the pre-defined web-sites. The domains are, at the end, going to be all the institutions that give education on topics related to surveying, if they have a website. This prototype includes the 48 "academic members" of FIG which have websites submitted to FIG. [6]

These institutions are listed on the web site in a pull-down menu, and user is able to chose from the list.

Figure 1a and 1b in the following pages will show the interface before and after a search is performed.

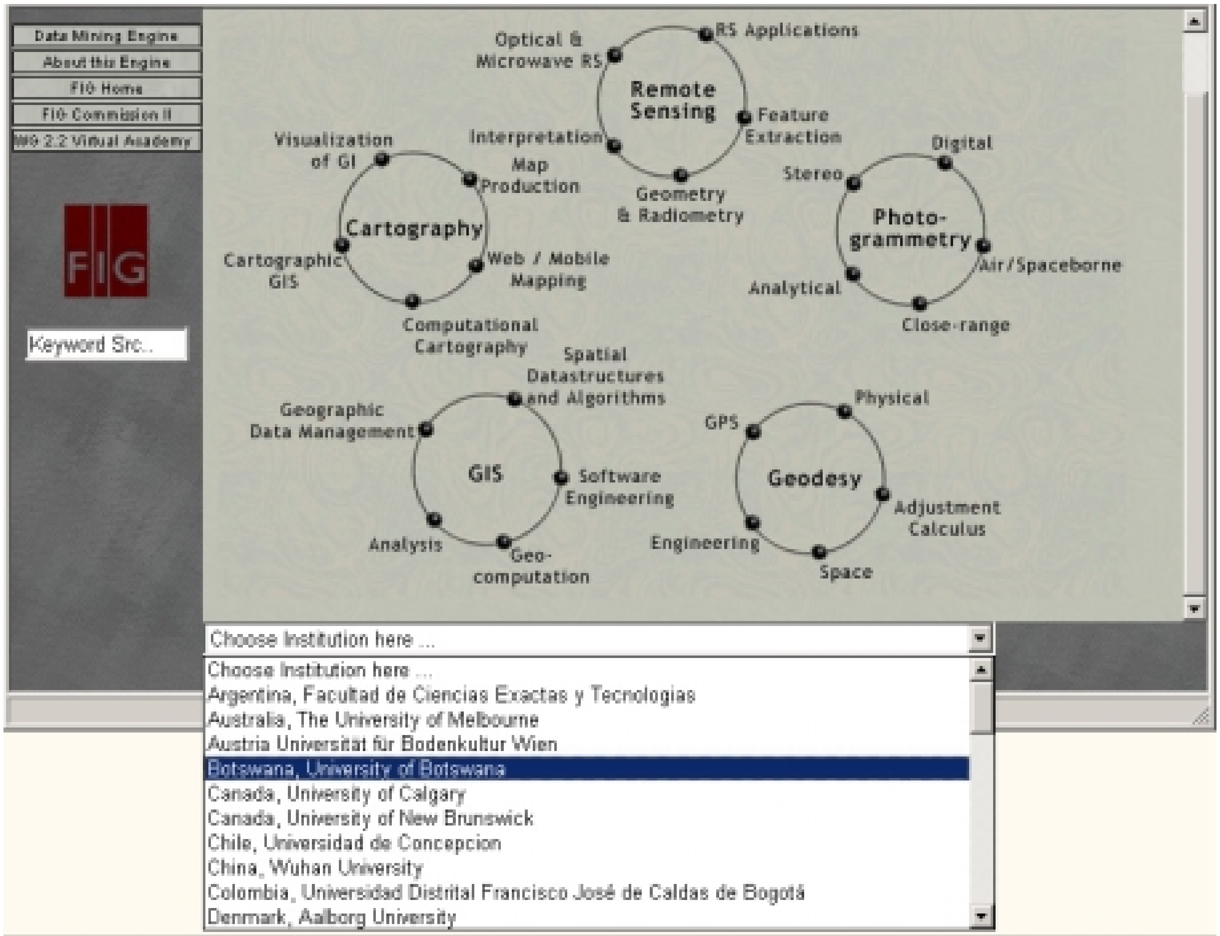


Figure 1a. A sample that shows the search interfaces ***before*** the search is performed. On the left, the keyword search area, on the bottom the pull-down menu that shows the universities can be seen.

The portal has a free keyword search available for individual searches and if the user chooses to do her/his search with that, s/he will get a listing of the "hits".

If the user chooses an institution from the pull-down menu, then s/he will trigger the search engine to go to the relevant sites for that department/institution, run a search for pre-defined keywords. This process is invisible to the end user. The program goes to search the defined domain for a set of keywords, each set represented by a morpheme, and presents the initial results by "lighting up" the circles when the category exists. A screen shot of a sample "results" page can be seen in following pages.

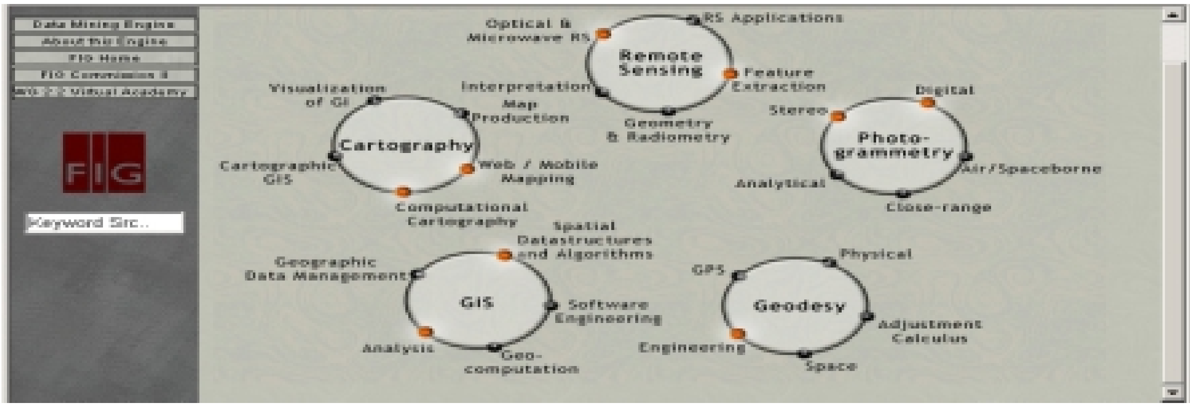


Figure 1b. A sample that shows the interface ***after*** the search is performed. All parent morphemes are lit up, this means they are all found in the searched pages. The child-morphemes also are lit-up and change color when they are found.

2.2 Search Algorithm

The search algorithm is roughly as follows:

0. Make a set of institutions: $A_i=\{a_i\}$ (variable)
   a. Make a list of web sites as a subset of institutions (one or more www addresses for each institution): $a_i=\{Aa_i\}$

1. Make a set of morphemes $B_i=\{b_i\}$ (variable)
   b. Make a list of keywords as a subset of morphemes (one or more keywords for each morpheme) $b_i=\{Bb_i\}$

2. Make a set of graphics (image files) for each morpheme: $G_i=\{g_i\}$
   2.1. Make a set of lit-up graphics (same image files, different color) for each morpheme: $G_k=\{g_k\}$

3. Allow user to select from the list A_i.

4. If a_i is selected, take b_i and $Bb_{i,}$ search all Aa_i

5. Write the results for a_i to $R_i=\{r_i\}$, where r_i is the web sites hit.
   5.1. If no hits returned, give message “no results found for a_i”, go back to step 3
   5.1. If any result is returned, replace $g_i \rightarrow g_k$
      5.1.1. Link R_i to g_k

3. INFORMATION VISUALIZATION

As we do not know much about the data on the other end during the whole process, what do we do with the results when we get them carries an important role for interpreting the data. In this stage, the interpretation of the results may be left to the viewer without any categorization as most traditional search engines do. Alternatively the results may be categorized to help the viewer to have a faster reach to the information. Here we implement both approaches, and the latter one with a visual interface, with a “model”.

If there’s a particular question in mind -- in this case “what kind of surveying education /research that institution has?” would be it – then one could visualize the information in a more “visual” fashion. The viewer, then, would be able to have an overview of her/his computer-generated answer by looking at a visual “categorized” result instead of a list.

Why visual?

“Maps provide connections between ideas and concepts.”[7]

Why are we trying to build a visual model, would not the “list” just work? Sure it would, but the modern trends in design are not after “barely functional” works. As humankind learns more and more about her/his own brain, designs are also seeking to meet the optimum for human perception, to give the message in the most efficient and quick way.

As we are building a visual model within this work, it is supposed to help the viewer’s brain to build initial patterns. That would then, bring the interpretation of the results faster and would give an overview, a frame, the big picture of the information.

3.1. Extracting the morphemes out of the Surveying Curricula

What does surveying education cover? What must it cover?

The answers to these questions vary regionally – it may not be even country-based. It may depend on the availability of resources (i.e. human resources, technological resources), or the needs of the region (i.e. urban vs. rural), or the relative availability of education and market needs (i.e. if a lower education exists for educating operators, there may not be much demand for engineers).

Plus this relative facts, it is under an ongoing change, and that is for the better, of course.

The curricula studies and publications have been very valuable for the information exchange and the development of the surveying education in an international level. And they gave a good basis for this search too.

We needed to define some structure of curricula which was simple enough not to “lose touch” with the viewer, but yet does not leave the important elements for the sake of simplicity. We ended up drawing a tree: trunk, 1st , 2nd, 3rd, 4th degree branches, and then, leaves.

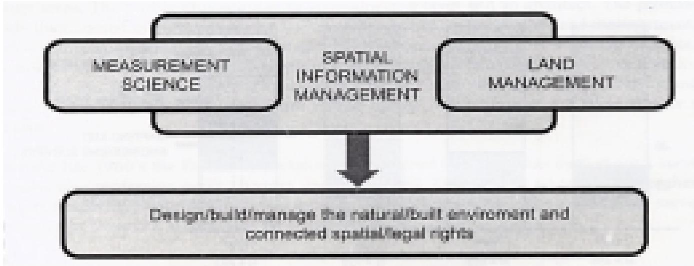
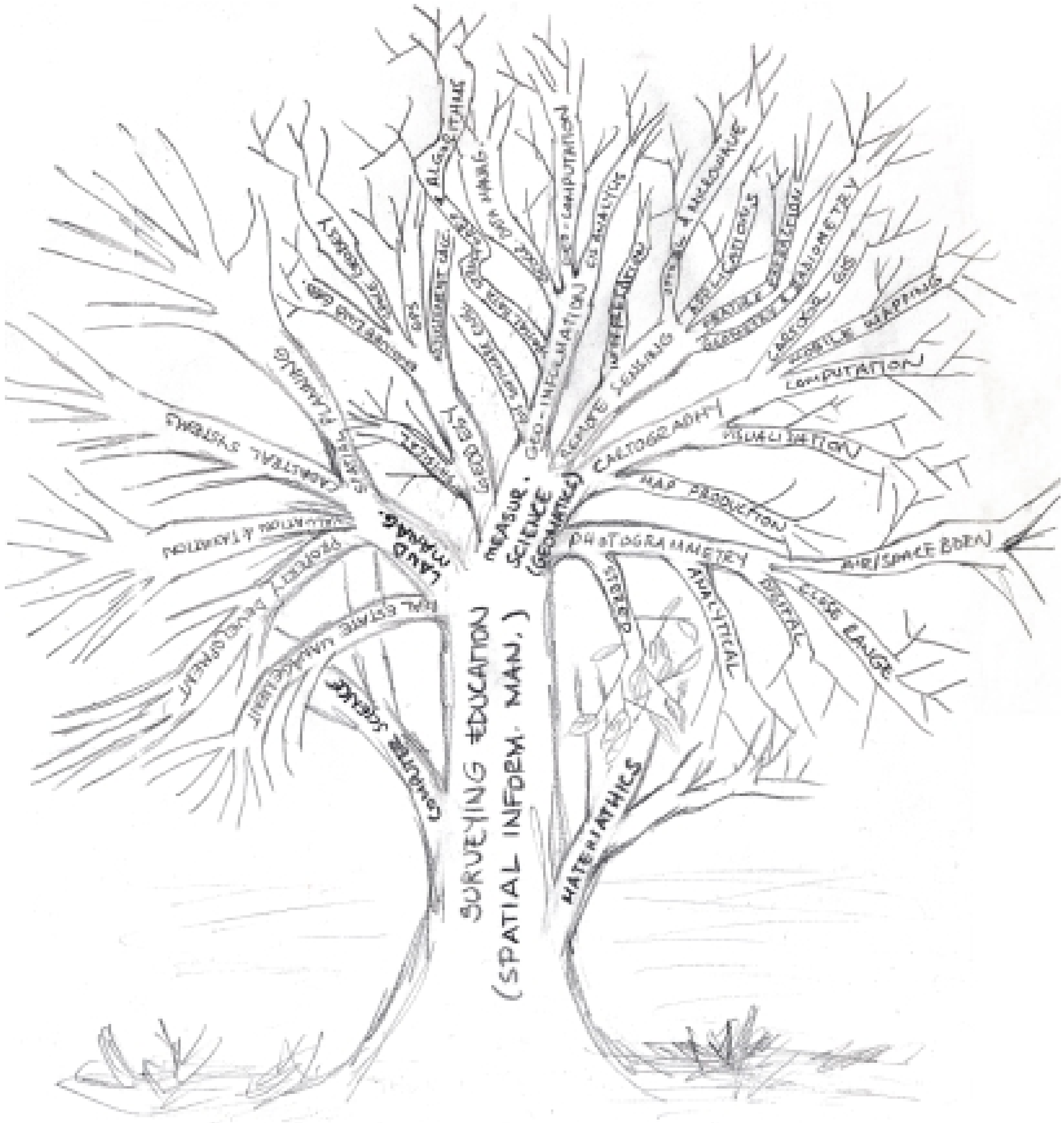


Figure 2: FIG's foresight of future educational profile. [8]

The figure above gives an idea of the most fundamental categorical approach. Then the categories may grow into very fine details.



drawn by: *arzu* ☺

Figure 3: A hand-drawn sketch of the efforts to categorize the curricula contents. The "leaves" are the keywords behind the morphemes, which are not represented in this picture.

Within this project, we called those appear in the interface as "morphemes" and those which are searched automatically with a background process as "keywords" (see a list of them in the website [17]).

3.1.1. Morphemes and keywords in this prototype

The prototype will focus on the measurement sciences/geomatics. The land management and its sub-branches will eventually follow.

5 parent-morphemes for Geomatics, each of them have 5 child-morphemes. Then each of the child-morpheme has keywords associated with itself, not visible to the viewer, but the search program uses them in the background. A list of these keywords can be found in the website [17].

To find out what "morphemes" would represent the "geomatics" education, there were several meetings and the version we currently are using is presented below.

Geomatics -- Parent morphemes:

Photogrammetry, Geodesy, Cartography, Remote Sensing, GIS

Child morphemes:

1. Photogrammetry -- *1.1. Stereo-photogrammetry, 1.2. Analytical Photogrammetry, 1.3. Digital Photogrammetry, 1.4. Close-range Photogrammetry, 1.5. Airborne/Spaceborne Photogrammetry*

2. Geodesy -- *2.1. Physical Geodesy, 2.2. Engineering Geodesy, 2.3. Space Geodesy, 2.4. GPS, 2.5 Adjustment Calculus*

3. Cartography -- *3.1. Map Production, 3.2. Visualization of GI, 3.3. Computational Cartography, 3.4. Web Mapping / Mobile Mapping, 3.5. Cartographic GIS*

4. Remote Sensing -- *4.1. Geometry & Radiometry, 4.2. Feature Extraction, 4.3. RS Applications, 4.4. Optical and Microwave RS, 4.5. Interpretation*

5. GIS -- *5.1. GIS Analysis, 5.2. Geo-computation, 5.3. Geographic Data Management, 5.4. Spatial Data Structures and Algorithms, 5.5. GIS Software Engineering*

The list above can be seen in *Figure 1a* as a model. In this prototype we also worked on several designs, but unfortunately, because of the lack of space in the paper, we cannot include the alternative designs here.

4. CONCLUSIONS

This portal prototype may develop as a very useful tool for the surveying community and may *replace*, or *used along with* the SEDB. However young is the method and data model immature, we believe it gives an impression of what is to come.

FIG Commission 2 members would yet continue discussing these tools and ideas for information exchange between the higher educational institutes of Surveying Science. With their feedback and yours, dear reader, the portal will grow to cover all we need to know about Surveying Education.

4.1. Future

First the usability of the interface will be tested. The functionality of the model will be judged by utilizing the visitor-feedbacks (the portal has a poll). Once the method is established, the task is to complete the dataset.

As the dataset is completed, the morphemes and keywords and interface would ideally be in different (multiple) languages, and the results would indicate what language is the found course, material or information. Some additional searches might be enabled for educational jobs, grants, post-graduate or post-doctorate positions etc.

The interface would be extended to cover more information about course material search based on the file types, sizes etc. for distance education.

Self Organizing Maps?

The method, the information visualization, the visual data mining, everything we touched in this prototype but did not do in the sense a neural networks application would do, needs to be studied and considered. The relationships between our so-called morphemes may be designed in a (WEB)SOM [4] if the nature of the development demands it. The neural network research laboratory of our university (HUT) has a strong involvement in this area and several good examples of SOMs. Their website is listed in the references here as number [4].

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BIOGRAPHICAL NOTES

Arzu Çöltekin is born in 1973, in Turkey. She took her BSc. (1989-1995) and MSc. degrees (1995-1997) in Surveying Engineering in Yıldız Technical University (YTU), Istanbul, Turkey. In 1997, she was admitted at Helsinki University of Technology (HUT) as a PhD student, and in 1998, she started to work as a teaching assistant in the same university.

She currently has 2 national and 6 international publications on topics related to photogrammetry, GIS, 3D modeling, virtual reality and surveying education, and 2 others are accepted including this one.

Her earlier work experience includes 3 months as a summer trainee in a local municipality planning department (summer 1990 Istanbul), 5 years (first 3 years part-time, during the studies) work in a private engineering company producing maps for cadastral, planning and architectural uses (1990-1995, Istanbul), 2 months as a summer trainee in Technical University of Delft (Summer 1994, Netherlands), 1 year teaching/research assistance inYTU, and 4 years in HUT.

A member of Finnish Surveyor's Association MIL, Turkish Chamber of Surveyors HKMO, IEEE student member, FIG Commission 2, ISPRS Commission WG V/2, currently (January 2002), Arzu Çöltekin is a PhD student and a teaching assistant in Helsinki University of Technology, Finland.