Towards a Portal and Search Engine to Facilitate Academic and Research Collaboration in Engineering and Education

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ABSTRACT

International academic and research collaborations are of great importance at this time but currently it is not easy to search and find researchers in the engineering field in Latin America and the Caribbean. Some countries in this region, such as Colombia, have published online the curriculum vitae of its researchers and classify research group according to their productivity, but the information is in Spanish and other countries in the region do not offer the same information. Many universities in the region do not publish the names and emails of their professors. Scholar and citation databases exist but only list publications written in English. Many scholars in Latin America and the Caribbean publish in other languages, such as Spanish or Portuguese. There is a need for a creation of a portal and search engine to find Who's Who in Engineering Education in the Americas to facilitate searching for possible collaborators for future research proposals or exchanges. The Latin American and Caribbean Consortium of Engineering Institutions (LACCEI) proposes to develop such a portal with a database of universities and researchers built on top of an object-oriented architecture and include publications in English, Spanish, Portuguese and French indexed by LACCEI to accomplish their objectives of the cooperation and partnerships among member institutions in the areas of engineering education, research, and technology advancement. Here we present the some aspects of the architecture that allows someone to narrow down searches geographical or by engineering discipline.

Keywords: Academic collaboration, international collaboration, research collaboration, database, search engine

1. THE NEED FOR AN ACADEMIC AND RESEARCH COLLABORATION SEARCH ENGINE

In this day and age, it is critical for the international competitiveness of the Americas to collaborate in research and academically with the rest of the world and increase the international visibility of its scholars and universities. Those researchers that publish in English are visible in many scholar databases and citation indexes but how can one find a researcher that is publishing in other languages? Some countries in this region, such as Colombia, have published online the curriculum vitae of their researchers and classify research group according to their productivity, but the information is in Spanish and other countries in the region do not offer the same information. Many universities in the region do not publish the names and emails of their professors, so it is hard to locate, contact and collaborate with them. Scholar and citation databases exist but only list publications written in

English. Many scholars in Latin America and the Caribbean publish in other languages, such as Spanish or Portuguese.

The Latin American and Caribbean Consortium of Engineering Institutions (LACCEI) intends to develop a search engine to facilitate locating and contacting possible partners for academic and research collaborations through a Who's Who in Engineering Education, a search engine and database with information of professors, researchers and universities in Latin America, the Caribbean and other parts of the world interested in collaborating with this region. It currently has more than 3000 authors in the database that have published within LACCEI and lists their publications. It is expanding this search engine and making it available online. We present here some aspects of the object-oriented architecture of the search engine. We use the Unified Modeling Language (UML) to express the structure and relationships. When completed the goal of the LACCEI portal is to have a complete system where any person could find the information related to Engineering Education and the network of people working in this field, particularly in Latin America and the Caribbean, and at some point in another countries.

1.1. LACCEI's MISSION AND MOTIVATION

LACCEI is a non-profit organization with the mission to develop partnerships among academia, industry, government and private organizations. It aims to serve as an opportunity to explore new collaborations and strengthen existing relationships. The goals and objectives of LACCEI include the cooperation and partnerships among member institutions in the areas of engineering education, research, and technology advancement. It gives emphasis, among other areas, on faculty and student exchange, innovation of engineering education, laboratory development and sharing of resources, faculty development, industry internship, cooperative programs and career development, joint training and research programs, and solicitation of funds, [LAC]. Many organizations are asking LACCEI for information on individual and Engineering institutions in the region because of the difficulty in locating such information. The Global Engineering Dean's Council asked LACCEI to identify all the Engineering Deans in the region, likewise program directors from the National Science Foundation have asked LACCEI to identify possible academic and research collaborators and active research laboratories in the region to promote internal collaborative research proposals with universities from Latin America and the Caribbean.

1.2. BACKGROUND AND RELATED WORK

The current scholar databases primarily index publications written in English. There are a few that index the Engineering field in Spanish. Moreover there are some sites that offer some information about universities in the region but do not provide for the type of search this project requires. A search of the web resulted in the following listings, databases or search engines:

- **Altillo**: It is a web site that search all the universities in South America listing the university, general email, phone number, URL physical addresses, and include for some the degrees they offer [ALT].

- **Universi**a: It is the largest Spanish and Portuguese speaking network of universities. Sponsored by Santander Bank, Universia is made up of 1,242 partner universities from Spain, Portugal and 20 Latin American countries (Andorra, Argentina, Bolivia, Brasil, Chile, Colombia, Costa Rica, Ecuador, Dominican Republic, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru, Puerto Rico, Uruguay and Venezuela) representing 15.3 million university professors and students. It is separated in It allows searching for a university by geographical location, type of degree (Diploma, BS, Masters, Doctorate, MBA, Advanced Technician), Teaching Modality (Distance, Online, Lecture, Hybrid), Fields (Agriculture; Arts and Humanities; Health Sciences; Exact, Physical and Natural Sciences; Social Sciences; Education, Engineering & Technology). For each institution it shows, the type (Public/Private), Date of Founding, URL, general email, telephone, physical address, Number of Students, Number of professors, degrees offered, campuses, and the President or Rector of the University [UNI].

- **Universidades24**: It is a web site that focuses on Venezuelan universities and degrees they offer. One can search by region, area of interest (Basic Sciences, Social Sciences, Health Sciences, Education Sciences, Military Sciences and Arts, Agricultural and Ocean Sciences, Humanities and Arts, and Engineering,

Architecture & Technology), and type of information (Education, Scholarchips, Jobs, University News, and Rankings) [UNIV]. For each university, they list their address, campuses, telephone, fax, e-mail, URL, academic schedule, application deadlines and requirements, degrees offered.

- **CEPS**: It is a web site run by the Consejo de la Enseñanza Privada Superior that only list the universities in Guatemala and some information of each one [CEP]. For each university it lists the telephone, URL, founding date, campuses, faculties, degrees, and names the authorities with contact information for some.

- **COLCIENCIAS**: The Departamento Administrativo de Ciencia, Tecnología e Innovación, known as Colciencias, is a Colombian Government Agency that supports fundamental and applied research in Colombia. They have a complete database of universities and institutions of Science, Technology and Innovation across Colombia. Their intent is to be the motor in innovation, sustainability, equity and competitively in the country and around the globe. It depends on the Education Ministery, the Government organization that manages the data and also matches their database with the Departamento Administrativo Nacional de Estadistica (DANE) and the Instituto Colombiano de Crédito Educativo y Estudios Técnicos en el Exterior (ICETEX). COLCIENCIAS is another government agency that is directly responsible for managing the resources allocated from the national budget for Science Technology [COL]. Each researcher that applies or work for a project funded by Colciencias needs to register in CvLAC, the Curriculum Vitae for Science and Technology [CVL] in part of the Plataforma ScienTI which has developed a database of Groups working with Scientific Research, Technical Development and Innovation (GrupLAC), individuals participating in the groups, and a Model for Ranking the Group [SCI].

- **Google Scholar**: It is a freely accessible web search engine that indexes the full text of scholarly literature across an array of publishing formats and disciplines. Released in beta in November 2004, the Google Scholar index includes most peer-reviewed online journals of Europe and America's largest scholarly publishers, plus scholarly books and other non-peer reviewed journals. It is similar in function to the freely available **Scirus**, from **Elsevier**, **CiteSeerX**, and **getCITED**. It is also similar to the subscription-based tools, Elsevier's **Scopus** and **Thomson ISI's Web of Science**. They allow one to search scholarly literature, explore related works, citations, authors, publications, locate the complete document through your library or on the web, and allows an author to create a public author profile [GOO].

- **LinkedIn**: It is a generalized cite that shows the person and their connections such as: Friends, companies, groups, current job, previous jobs, and personal information. It is the world's largest professional network with 200 million members in 200 countries and territories. Its mission is to connect the world's professionals [LIN]. Linked in allows one to search by a partial name, a geographical location, company, keywords, school attended, groups joined. It shows the how many degrees the contact is removed for the person searching, for example YOU is the person, a 1st degree contact is directly connected, a 2nd degree contact is connected to a person directly connected to you, a 3rd degree contact is two connections removed from you. It allows the person to note their location, current title, and affiliations, previous affiliations, and education.

1.3. THE MODEL

The goal of this project is to make researchers and scholars and their work visible to others interested in collaborating academically or in research to promote international collaboration. In order to do that, the request is to find people in a specific engineering or related field, located in a particular region, discover research labs and groups, what they are publishing and be able to communicate with them. The main purpose as described before, is to design and create a database where one person can find or do an online search for a peer in Latin America or even if it is not from Latin America, to locate someone who may be interested in being a collaborator or volunteer in a project. After the peer is found, the idea is to connect to explore collaborating in projects, faculty and student exchanges and sharing information and resources.

This project will consider a database design for LACCEI that uses the Object Oriented Modeling (OOM) with the Unified Modeling Language (UML) to express complex interrelationships. This design will contain a broad and integrated schema for academicians and researchers in Engineering and related fields, beginning with the 3000 individuals that have a LACCEI publication, displaying their public information and allowing them to add links to additional information.

The startup point with the design and search is the geographical area that will make the link to all the countries, states or regions within the country, and then to all the institutions. Initially LACCEI will populate the detailed information provided by their more than 150 member institutions, and provide basic information to other Engineering institutions. Figure 1 shows the structure and relationships between the Institution and other classes that permit to narrow down the search by drilling down through the geographical area (America, South America, North America, Central America, Europe, Oceania, Asia-MiddleEast, Caribbean, Africa) in Geoarea through its composition relation. The class Country stores de ISO 2 character standard country abbreviation, the countries name, flag, and telephone country code. Not shown are the Subregion of a country, called State for the USA, and varies in name depending on the country. Each institution has a latitude and longitude that allows pin-pointing its location on a Google map. The use of the attribute InstType allows the database to classify them as Government, Industry, Academic, and Organization. The Institution is allowed to be searched or listed by its formal name, abbreviation, or nickname. Also the schema captures the complex structure of an educational system, such as University of California System, and its campuses and sub-campuses through the composition relation.
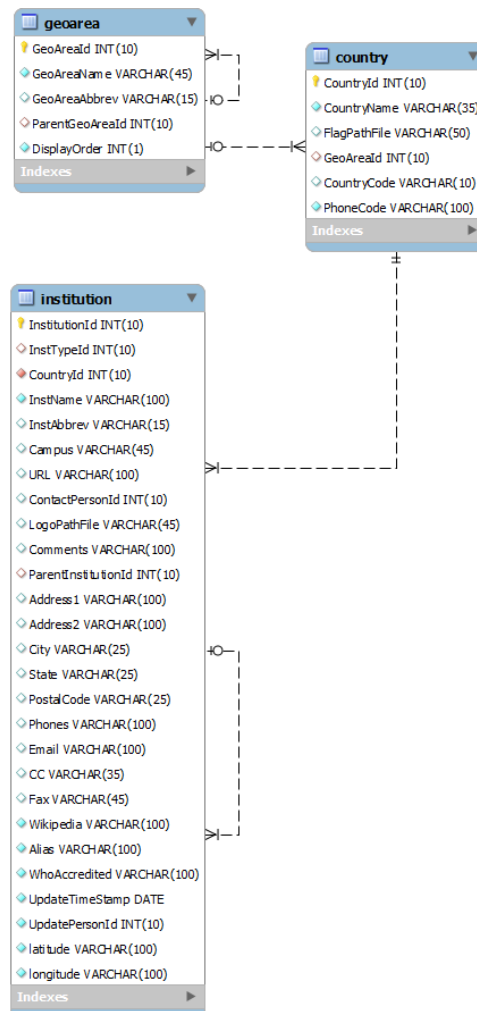

Figure 1. Relation between Geoarea- Country -Institution

The persons in the database, represented in Figure 2, are associated to Institution through the classes Employee, Student, Alumni, or Member (in the case of where the institution is an organization. The Person class stores the given names under `PersonName` and their last names under `PersonLastName` to allow for complex and multiple names. It allows for storing their image, contact information, languages. The `PersonEmail` and `PersonPhone` allow multiple emails and telephone numbers to be attached to a person, to designate if it is their primary email, and whether to display it (i.e., make it public). All contact information defaults to private. The type designates whether the email is position dependent, work, personal, or cc (i.e., to be copied to this email). The phone type allows to annotate whether it is their work unit phone (e.g., department), or direct, home, mobile, fax, etc.
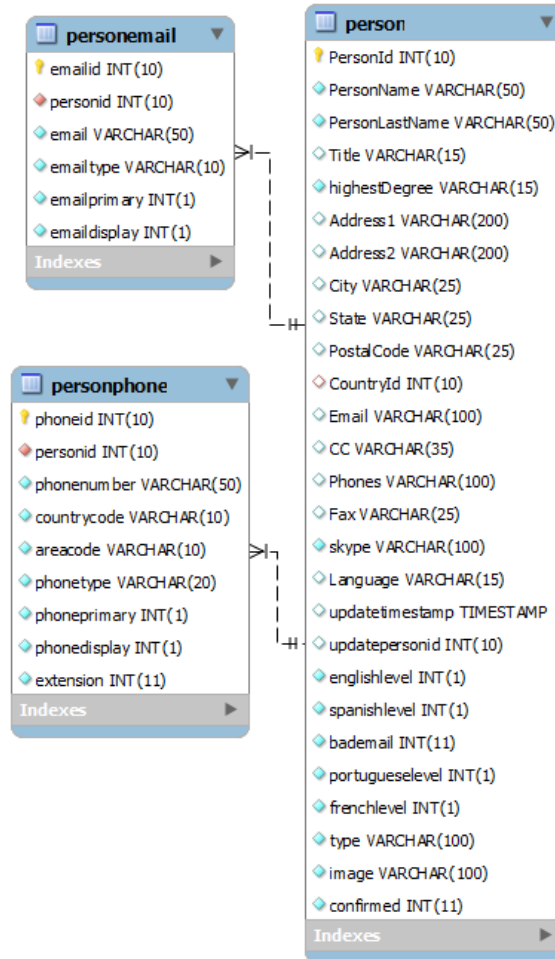
personemail
- emailid INT(10)
- personid INT(10)
- email VARCHAR(50)
- emailtype VARCHAR(10)
- emailprimary INT(1)
- emaildisplay INT(1)
- Indexes

personphone
- phoneid INT(10)
- personid INT(10)
- phonenumber VARCHAR(50)
- countrycode VARCHAR(10)
- areacode VARCHAR(10)
- phonetype VARCHAR(20)
- phoneprimary INT(1)
- phonedisplay INT(1)
- extension INT(11)
- Indexes

person
- PersonId INT(10)
- PersonName VARCHAR(50)
- PersonLastName VARCHAR(50)
- Title VARCHAR(15)
- highestDegree VARCHAR(15)
- Address1 VARCHAR(200)
- Address2 VARCHAR(200)
- City VARCHAR(25)
- State VARCHAR(25)
- PostalCode VARCHAR(25)
- CountryId INT(10)
- Email VARCHAR(100)
- CC VARCHAR(35)
- Phones VARCHAR(100)
- Fax VARCHAR(25)
- skype VARCHAR(100)
- Language VARCHAR(15)
- updatetimestamp TIMESTAMP
- updatepersonid INT(10)
- englishlevel INT(1)
- spanishlevel INT(1)
- bademail INT(11)
- portugueselevel INT(1)
- frenchlevel INT(1)
- type VARCHAR(100)
- image VARCHAR(100)
- confirmed INT(11)
- Indexes

Figure 2. Person information

All LACCEI publications have been included in the database and linked to their author, permitting the person's publication to be shown in their detail, other publications and information can be added by the person to their profile through providing a URL web link to additional information. Each publication is classified by the track under which it was submitted to a conference or publication, allowing the database of publications to be searched by field. We plan to add keyword searches in the future. The LACCEI publications are published with ISBN number and available free online. They are being indexed additionally by Google Scholar, LATINDEX, Caribbean Search, Fuente Académica Premier de EBSCO Publishing, INSPEC by IET, Publindex in Colombia,

and more indexing is being currently submitted [LAC]. This indexing and the LACCEI search engine will provide more visibility to the researchers.

The first phase of this project is to design and create the infrastructure of the database, link all the institutions including their main campus and other campuses to the country and geographical area, and in the case of USA institutions the state will be part of the link. In the future the purpose is to do the search in every nation by state, province, region or departments which will vary depending on the country. After the institutions are setup correctly with the most important information, the next step is the link between institutions and persons and their personal information or institutional information with the link to employee added. The primary key for the internal search and updating of the information by the individual is the email of the person. This will be used as the login in the LACCEI web page that will permit editing of one´s personal information. This makes it easy to communicate to all past authors and registrants to verify and update their information but complicates matters when a person changes position or university if the email on file is one for the position, e.g. dean@university.edu, but we are working on a portal to make the transition easy and to keep the information updated by the university as well as the individual. LACCEI will encourage individuals to use their personal email to avoid frequent changes to their login information.

Moreover it is important to consider in the design the complexity of the institutions, because some universities will have n campuses and those campuses will have sub-campuses. One example of this complexity is the Tecnológico de Monterrey which has many campuses and they in turn have more sub-campuses, sometimes called sedes or units that will vary with each institution, because there is not a single definition or notation of campuses, as is the same problem in the institutions units and departments, areas, divisions. Additionally, more and more, institutions have campuses in other countries, adding to the complexity of the schema. Moreover, similarly as described is the complexity of the design of the structure for college, schools, departments, offices and all the structural classification of the institutions which vary depending of the country and the institution by itself. The goal after the institutions and the departments are setup correctly and the person has the important information updated is to link the person as employee in such institution. We have designed for the future to also link student and alumni, so that in the future a university can track its alumni who are researching.

An additional complication forecasted in the search is the use of the word "Dean", it is used in some universities to designate who is in charge of all Engineering disciplines, in others it is called Director, or Rector, or Vicerrector (if it is a polytechnic or technological institution). But in Latin America and the Caribbean some Department Chairs are called Heads or even Deans, even though they are in charge of just one department offering degrees of Engineering. Additionally we have come across Directors and Coordinators of a particular Engineering degree. We have abstracted all these complications by allowing the user or university to specify the position by whatever it is called. Each LACCEI institution will identify who is the representative of all Engineering disciplines in their institution, and we will designate that person as the LACCEI Dean, likewise the person responsible for the individual disciplines as LACCEI Chairs.
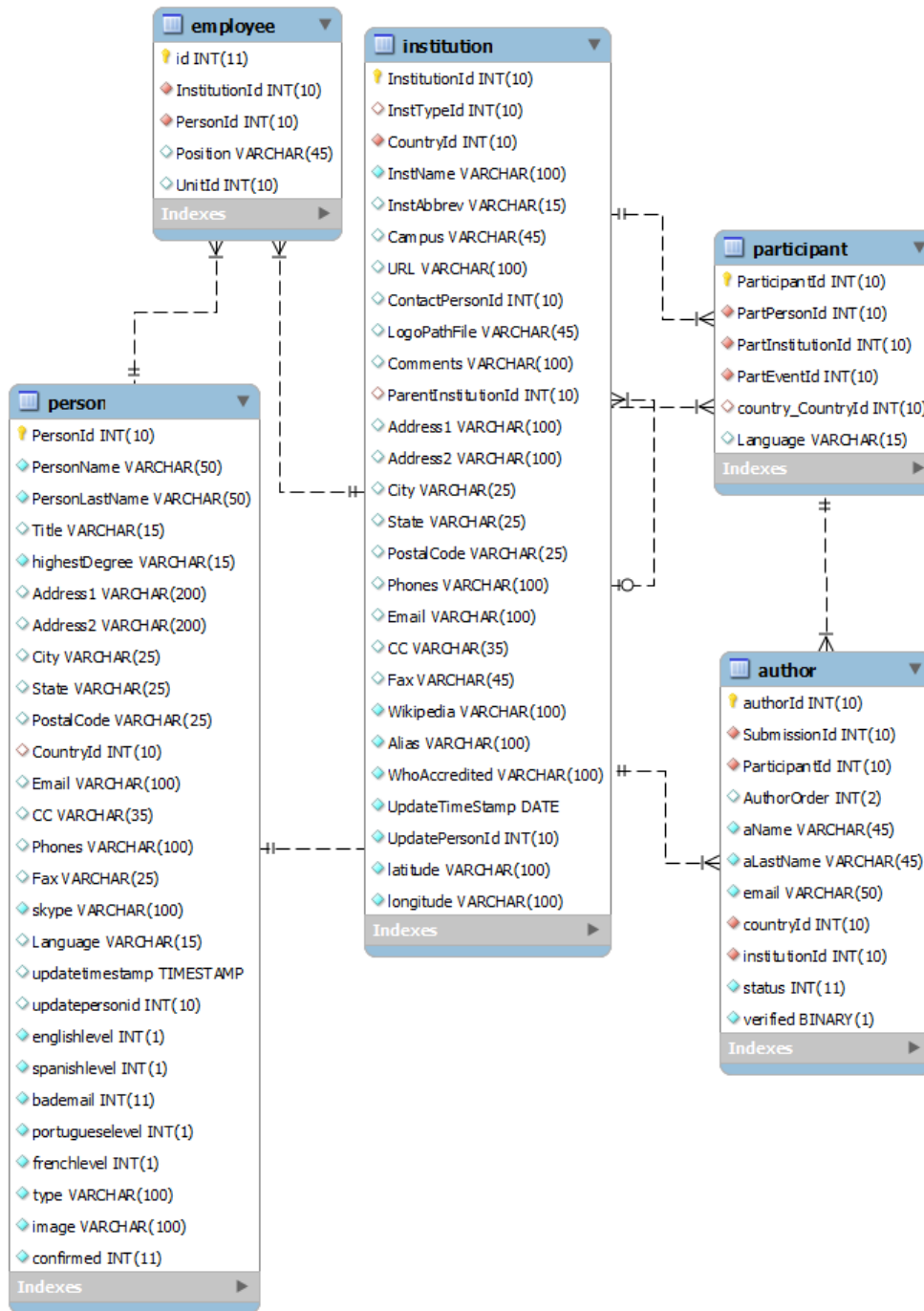
Figure 3. Relation between institutions with persons

Figure 3 shows the structure and the link between person, participant of the conferences and author of papers and journals. Afterwards, at some point, the degree obtained from the person, the academic position, the areas of research, study and interest will have to be added to the design in case if somebody wants to contact the leader of a group or any field. Therefore, when a person will want to know their information containing personal, institutional, publishing and areas of research, study and interest, they will have to log in into Who's Who in the LACCEI website to update or search all the information. Consequently to accomplish this future phases a plan of dissemination will have to be considered and some other aspects to design the proper way to link institutions, person and other important structures in LACCEI's database.

2. CONCLUSIONS

This model will be used in the development of a portal and search engine by Latin American and Caribbean Consortium of Engineering Institutions (LACCEI) to create and give public access to Who's Who in Engineering Education that will provide entrance to the database with information of professors, researchers and universities interested in collaborating and their related work in designated disciplines. The design and development of the proposed search engine of the LACCEI database will benefit any person who needs to search for collaborators. The LACCEI database currently contains information on 3000 registrants and authors and their publications within LACCEI. LACCEI intends to honor the privacy of individuals by allowing them to keep their contact information private, yet allowing the visibility of their research and their university and research groups to be increased to foster international collaboration.

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