Computer system for accessibility diagnostics on buildings

New information technologies applied to accessibility diagnostics on existing or projected buildings and premises

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Keywords: Accessibility, universal design, databases

Introduction

The present paper is in line with the scope of research in the application of new information technologies to architectural design. Specifically, those applied to stating the accessibility conditions of existing building and premises for disabled persons.
The aim of this paper is to present the conceptual model and methodology to develop a computer system which will allow a designer to determine the accessibility conditions of any public building or premises or during the planning stage of a project.

The need of this research

Accessibility for persons with some kind of disability is a crucial element that needs to be taken into account in the design of buildings and premises, both new and going through restoration works.
Since the Declaration on the Rights of Disabled Persons [1] of 1975 up to nowadays, international laws have tried to achieve the removal of architectonic barriers to provide the same rights to all citizens regardless their individual capacities. After the Convention on the Rights of Persons with Disabilities [2] of 2006, many countries initiated actions that will define the evolution guidelines of the accessible design in the next decades. As an example, ADA Standards for Accessible Design [3] was recently published in the United States of America. In Europe, the passing of a European accessibility law is foreseen by the end of 2012 [4]. Last year the DB-SUA, a regulation on accessibility [5], of compulsory enforcement in the whole

country and which foresees the obligation to adapt all the existing buildings by 2019, was passed in Spain.
However, both designers and technical staff endure many difficulties when adapting existing buildings. According to a survey completed by the ACCEPLAN on architects [6], more than 44% of them consider that there are problems in the regulation implementation when completing renovation and restoration works.
Those are the reasons why it is necessary to provide technical staff with the right tools to help developing his work in the research and diagnostics of accessibility problems in the building environment.

Methodology

The prerequisites defining the accessibility of a space are mainly functional requirements including from geometrical elements, such as minimum stride width, to conditions of the materials, such as slip-resistance, signalling or mechanical and physical help devices, such as handrails or induction loop facilities. Thus, the main characteristics of accessibility requirements are, no doubt, their broad number and heterogeneity.
In order to design a software system architecture which allows defining the accessibility level of a building, it was necessary to establish a methodology which makes possible to break down a complex item, as a building can be, in several simple items, to analyze them individually and, subsequently, to add them back in order to determine the result. In other words, the conditions of a complex item are based on the ordered aggregation of the conditions of each composing item.
The following steps have been followed:

1. Determining which conditions define the accessibility of a building

Basically, four conditions must be met to ensure the right accessibility level of a building: the ability to access all areas, the usage for what it was intended and to ensure that it is safe, e.g., **accessibility**, **usability** and **safety**. The fourth condition is that this prerequisites are met for all persons, regardless their capabilities, e.g., **universality**.

2. Defining which items a building has to be broken down in for analytical purposes

Two groups have been classified: simple items and complex items. Thus, a three-level structure has been established: a building is made up of different complex items, and these items are made up of simple items.

1st tier	**2nd tier**	**3rd tier**
▪ Premises	▪ Access ▪ Accommodation ▪ Lift ▪ Toilets ▪ Customer service ▪ Kitchen ▪ Dining room ▪ Bathroom ▪ Horizontal itinerary ▪ Vertical itinerary ▪ Rooms ▪ Security ▪ Signaling ▪ Information ▪ …….	▪ Doors ▪ Corridor ▪ Dislevelment ▪ Pavements ▪ Ramp ▪ Furniture ▪ Furniture ▪ Stairs ▪ Handrail ▪ Guardrail ▪ Glass items ▪ ILavatory ▪ Lightning ▪ Washbasin ▪ Shower ▪ Bathtub ▪ Locker room ▪ Parking ▪ Platform lift ▪ ……..
There can only be one register per premises	*Each first tier item can have several second tier associated elements*	*Each second tier element can have one or several third tier associated elements*

Example:
A building can have several horizontal itineraries; accessibility of each itinerary will be defined based on the aggregation of accessibility of third tier elements which compound it: corridors, doors, dislevelments, pavements, lightning, signalling...

3. Determining which requirements are to be examined for each item

Requirements will vary depending on the nature of each item. As a general rule, they can be: geometric parameters, conditions of materials or existence of a specific element.
Moreover, these requirements are further classified based on related disability type: movement, visual, hearing or affecting the security of a user.

Example:

Item	**Requirements**	**Affected disability type**
Corridor	Min. free width	Movement
	Min. width of punctual narrowing	Movement
	Max. slanting in the forward direction	Movement
	Max. minimum height of overhanging	Security
	Min. width of overhanging	Security
	Minimum lighting	Visual
	Signaling	Visual

4. Establishing a benchmark

Once that requirements to be examined are defined, it is necessary to determine which acceptance/rejection values will be used.

As one of the accessibility requirements is universality, regulations and specialised manuals of different countries have been analysed in order to establish as uniform as possible comparison parameters.
These benchmarks allow establishing the accessibility level of each item. Three levels have been established:

- Ideal conditions: those which allow using the item for the intended purposes by any person in a convenient way.
- Essential conditions: those which even if not ideal, allow the use of an item partially or with the help of others.
- Not accessible: those items which do not meet the essential conditions necessary cannot be used by persons with some kind of disability or may mean a risk, so they must be properly signalled.

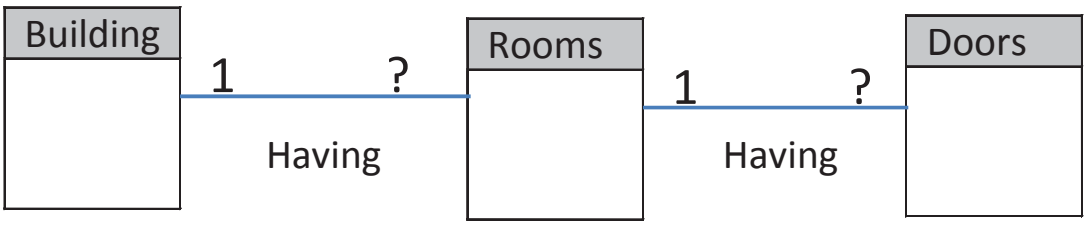
Example:

Item	**Requirement**	**Ideal conditions**	**Essential conditions**	**Not accessible**
6 m long ramp	Maximum slanting in the forward direction	< 8%	< 12%	>12%

5. Defining the information system

Based on the need to work with large amounts and diversity of data, it is necessary to define an **information system**. For conceptual design the UML (*Unified Modelling Language)* is used, as it is a universal graphic language, where **entities** will be each of the items the building has been divided in; **attributes** will be the requirements of each item which are to be analysed; and **relations** will always range from one to several depending on spatial distribution of the building.

Example:



6. Logical design of the system

A relational model is used to develop the logical design, where each of the items the building has been broken down in will be a **table**, requirements of each item to be analysed will be **columns** and existing relations among items will be defined via **keys**, where each third level item is assigned to a second level item, and each second level item is assigned to a building.

7º. Selecting the physical medium to handle data

Software tool to handle information will be a Database Management System. In this research paper the specific system to be used is not determined, as the objective is to define the conceptual and logical design so, eventually, the person developing the physical design can choose the ideal software based on specific needs.

Conclusion

The methodology employed in this research can be used as a foundation to develop other computer tools to set the characteristics of buildings, premises or environments, as long as they meet a set of requirements, whether functional, safety-related, health-related, etc.

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