MobiliSIG: Development of a Geospatial assistive technology for navigation of people with motor disabilities

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Long abstract

Social participation of persons with disabilities represents a challenging problem for Canadian and international societies. According to Health Canada, over 3,300,000 Canadians report some level of disability that poses a unique problem to their health [1]. Recent data published by Statistics Canada reveal that the proportion of people with a disability aged 15 or more, has increased from 14.6% in 2001 to 16.6% in 2006 [2]. This number is in constant increase due the effectiveness of biomedical interventions as well as the aging population. In Quebec province, among the people with motor disabilities, there are more than 125 000 users of wheelchair (200,000 in Canada) including 32 000 who travel with a manual wheelchair [3]. Moreover, aging population increasingly uses scooters to move for their daily activities. For a large majority of these people, the ability to move independently is essential for their daily activities and their efficient engagement in their social roles (e.g. work, go to school, go to the market, participate in community life, etc.) [4]. However, the mobility of these persons is significantly constrained by their disabilities as well as divers obstacles in urban environments where they perform their daily activities.

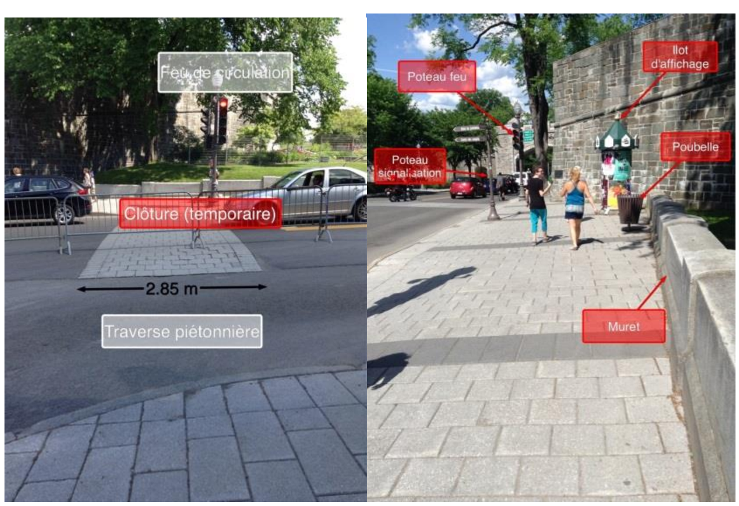

Figure 1. Examples of obstacles and facilitators in urban area[19]

According to the Disability Creation Process DCP («Processus de Production du Handicap» PPH) [5] (figure 1), the quality of social participation of people with disabilities is the result of interactions between their personal factors (identity, and physical and mental abilities) and the physical and social environments in which they live. Such interactions are very complex, because, firstly, the profiles of persons that use wheelchairs or scooters are very heterogeneous (physical characteristics, the nature of the disability, experience, etc.). Secondly, the environment in which these individuals perform their daily activities is full of barriers (e.g. stairs, sidewalk edges, narrow doors, architectural barriers) which strongly constrain their mobility.

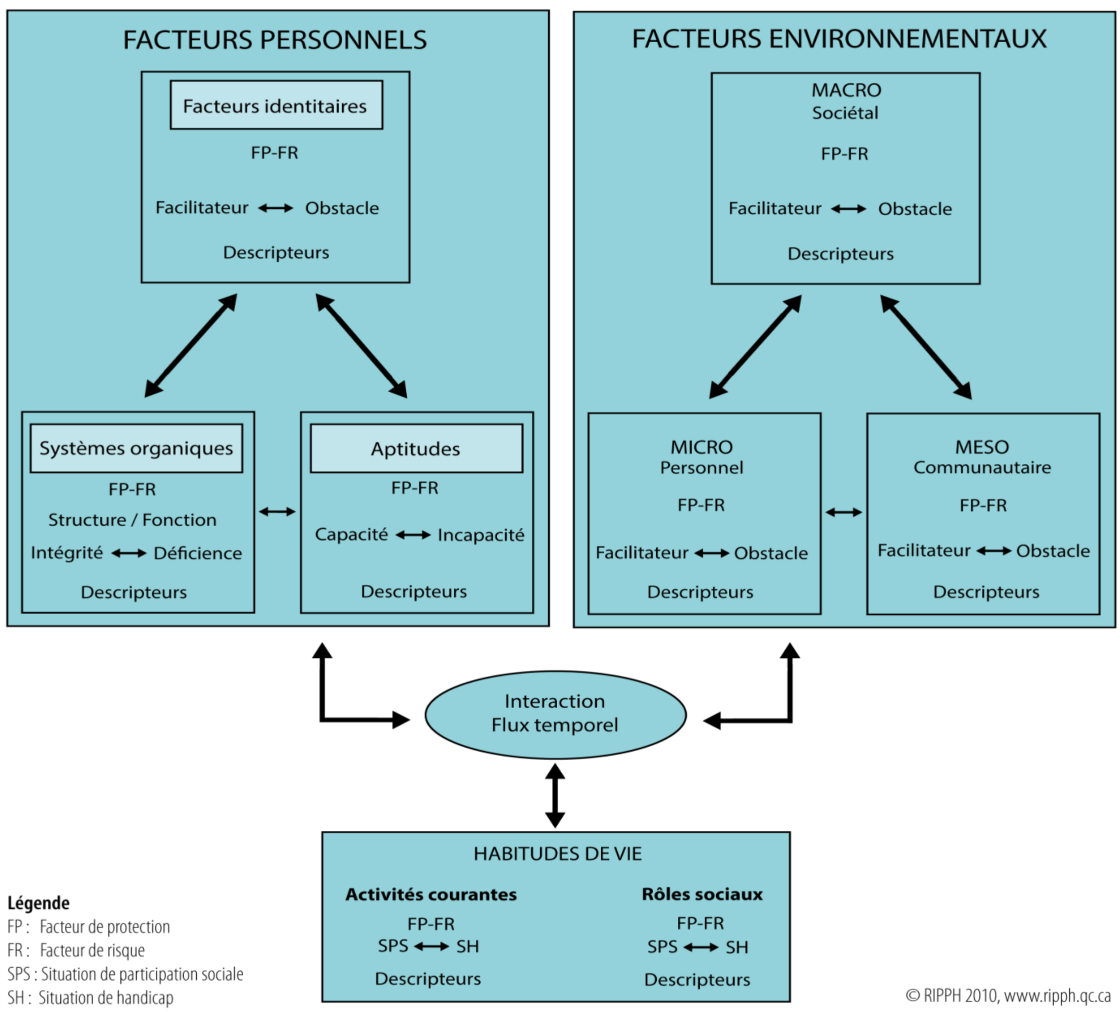

Figure 1. Disability Creation Process DCP according [5]

Recent advances in geospatial and wireless communication technologies (Geographic Information Systems (GIS), Global Positioning Systems (GPS), Internet, mobile and wireless communication technologies) offer a great opportunity for the development of new assistive solutions to help persons with disabilities in their displacement and hence to improve their security, health and social participation [6,7,8]. In particular, these technologies provide a variety of features that allow these individuals to overcome diverse obstacles which reduce their mobility and contribute to their social exclusion [8]. However, despite the increasing availability of assistive technologies for navigation and mobility of general public, their potential is poorly exploited for people with motor disabilities [9, 10, 11, 12, 13]. In fact, for individuals moving with wheelchairs or scooters, we notice that: 1) the existing solutions do not consider adequately their personal and the environmental factors in the estimation of accessibility information as suggested in DCP model [5], 2) the existing tools fail to provide near-real-time information about accessibility of the environment, 3) the communication interfaces are not well adapted to the heterogeneity and severity of the impairment [13, 14].

To overcome these problems MobiliSIG research team has proposed to design and develop a mobile multimodal assistive solution according to the principles of Cognitive Design. The proposed solution is meant to facilitate the mobility of persons with motor disabilities that use wheelchairs or scooters for their daily activities and hence contribute to improve their health, social integration and their quality of life. The originality of the proposed solution resides on several factors, including 1) participative design and development of a spatiotemporal accessibility information system according to the principles of Cognitive Design approach [13]. This information system should take into consideration the perception, experience, nature and severity of disability of people that use wheelchairs or scooters for their daily displacement. To achieve this goal, a Cognitive Design approach will allow the integration of the cognitive needs of these individuals at the heart of the design process, while taking into account the influence of the environment on their navigation activities [13]. 2) Design and implementation of an innovative multimodal and interactive interface for communicating detailed information on the accessibility in near real-time using mobile technologies. The communication of information will be ensured using multimodal means (visual, auditory, touch, etc.). This multimodal interface is fundamental to our proposed solution [15, 16], because it will allow users to have a more personalized and adapted interaction with the mobile assistive solution by considering their heterogeneous profiles both in terms of the severity of their incapacities and their communication methods. 3) Continuous updating of accessibility information based on the emerging approach called ‘Crowdsourcing’ or ‘Volunteered Geographic Information (VGI) system’ [17]. This promising approach involves an active participation of the users (people with motor disabilities) of the assistive solution in updating accessibility information and hence ensuring its sustainability. The assessment of the validity and quality of the information provided by the users before allowing the update of the database is an important issue that will be addressed. We propose an innovative knowledge transfer plan that integrates project partners, including Québec city authorities and the IRDPQ rehabilitation institute directly in different stages of design and implementation of the proposed solution.

The applied methodology (figure 3) integrates theories and methods from geomatics, computer sciences, cognitive sciences, health sciences and rehabilitation. More precisely, the design and development of a mobile multimodal assistive solution for people with motor disabilities, integrates the principals of highly innovative Cognitive Design approach [13] to information system development [18]. Hence, the design and implementation of the proposed assistive technology is iterative and incremental and integrates the heterogeneity of accessibility perception among people with motor disability throughout of all the project phases.

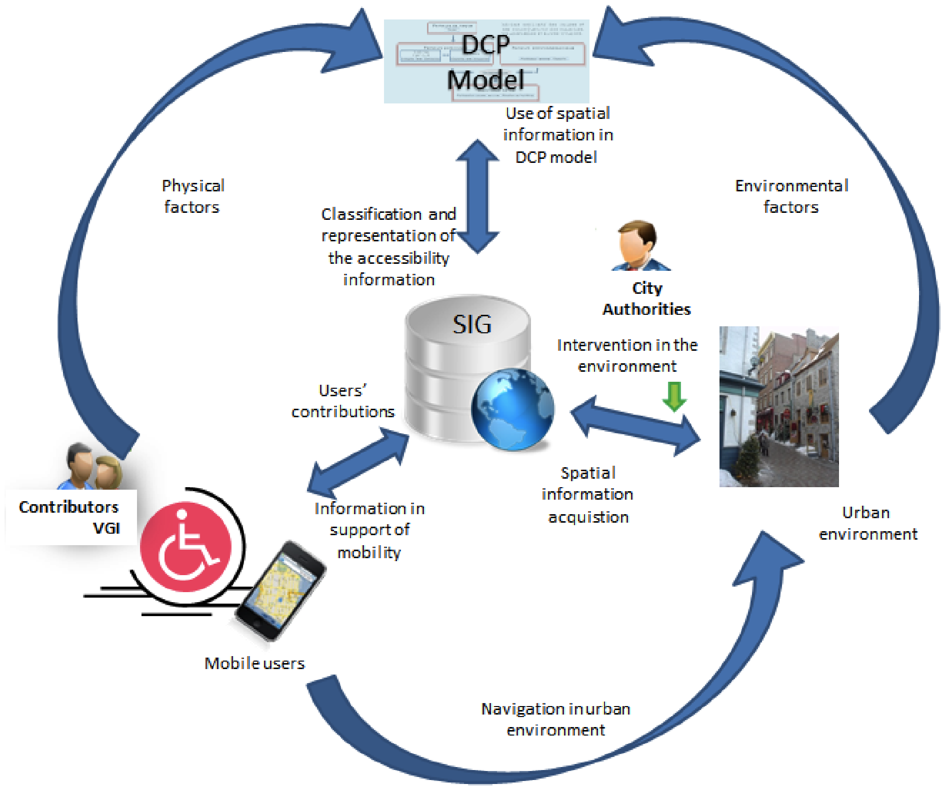

Figure 3. Overall methodology

This talk will present recent developments and achievements within MobiliSIG project. We will specifically focus on the presentation of the results obtained from an interview carried out to express the perception of the people with motor disability on the classification of obstacles and facilitators in an urban environment. We also will present challenges regarding the gap between ontologies of DCP model, Quebec city spatial database and the norms and standards for city planners. Finally, challenges and research perspectives will be presented and discussed.

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