Tactile ground surface indicators in public places

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Introduction

Visual information is essential in traffic: traffic *lights* tell us when to cross the street. Zebra crossings signalise *visually* street sections where car drivers have to pay special attention to pedestrians. Children are taught to *look* to the left and to the right before crossing the street. Motorists are aware of the problems and hazards occurring by darkness, rain, snow or fog when range of *sight* is decreased. A lot of accident avoidance deals with the issue to *see* and to be *seen*, e.g., the failure of motorists to detect and recognise motorcycles in traffic was regarded as the predominating cause of motorcycle accidents [1].

Blind and visually impaired people have to manage their way through a world of traffic which was mainly created for people with full eyesight. According to statistics compiled by the National Center for Health Statistics of the US Centers for Disease Control and Prevention, as summarised by the American Foundation for the Blind, in 1996, there were approximately 1.3 million legally blind people in the United States. 5.5 million elderly individuals are regarded as blind or visually impaired [2]. As others, these individuals benefit from a barrier free architecture.

The idea of barrier free architecture is to provide a structure which enables everyone independently of his/her physical and mental condition to enter buildings, to move within them, and to use technical devices or other devices of daily life (as rest rooms or ticket machines) without major restrictions. Nowadays in western countries, the exclusion of handicapped people from everyday life's activity is prohibited, e.g., in the US by the 'Americans with Disabilities Act' (ADA) [3] or in Germany by the 'Equality Law of Disabled Persons' ('*Behindertengleichstellungsgesetz*') [4]. These rights were also brought up in a United Nations resolution (56/168) [5]. Two aspects of barrier free architecture should be differentiated: one is the elimination of barriers, the second is the compensation of handicaps by appropriate designing and implementation of technical devices. Tactile floor indicators are thought to compensate the loss or impairment of vision by the provision of complementary haptic information.

Tactile floor indicators

Tactile floor indicators can be used for providing directional guidance or as warning signals for potential hazards at specified locations as, e.g., at road crossings or at platform edges. When using canes, tactile information by using canes is complemented by auditory feedback. The tactile information can also be obtained more directly by contrasts in the texture underfoot. In addition, tactile floor indicators might contain strong visual contrasts in order to provide (warning and orientation) information to people with residual and full vision. Such an implementation of different modes (pictorial, verbal, tactile) for a redundant presentation of essential information is recommended by the principles of Universal Design [6].

The usage of a long cane for scanning the ground in front is described as the most common mobility aid for visually impaired pedestrians [3, 7]. By using a cane, visually impaired people are able to locate potential obstructions, provided that the obstacle is continuous to the ground or provides some form of tapping rail within 15 cm of the ground [8]. Canes also help to detect distinct changes in the surface material (e.g., from asphalt to grass) and changes in the level (e.g., steps). The principal cane technique in uncontrolled and/or unfamiliar environments is the touch technique where the cane arcs from side to side and touches points outside both shoulders [3]. An increasing number of people use a long cane with a roller tip which maintains contact to the ground. Maintaining contact to the ground facilitates the detection of distinct changes in the pavement structure.

In 2000 only 10 of 16 European countries had national guidelines for the installation of floor indicators [7]. There is a strong case to harmonise the guidelines, both within the European Community (*CEN EN 15209*) and worldwide (*ISO 23599*). However, for the current moment, inconsistencies between the guidelines of different countries have to be stated and, as a consequence, installed tactile floor indicators might differ between countries, but unfortunately there are inconsistencies within single countries and even within towns. The successful use of tactile floor indicators depends crucially on visually impaired pedestrians understanding the different meanings assigned to these indicators and being aware of the presence of such facilities [8]. A simple and intuitive structure of floor indicators, as another principle of Universal Design [6], facilitates their usability.

Floor indicators as warning system

Any sudden change in the ground level, as steps and platform edges, as well as moving vehicles represent fundamental hazards for visually impaired people, resulting in stumbling, falling, collisions, and, far too often, injuries. In order to prevent accidents of visually impaired pedestrians, the European Conference of Ministers of Transport recommended that warning surfaces should be used at pedestrians crossings, edges of rail (and other traffic) platforms, and to warn of other hazards, as steps and level crossings [9]. In order to fulfil their function as warning signals, these floor indicators should be readily distinguishable one from another [9]. In the UK and countries like Australia tactile floor indicators mostly consist of a series of truncated domes. These blister surfaces might also differ from their surroundings by colour and material. A height of 5 mm was found to be sufficient for the majority of blind people to detect the surface change [10]. Increasing the height would increase the perceptibility but would increase the risk of stumbling, and, therefore, conflicts with safety regulations: For example, in Germany the maximum height is limited to 4 mm by rules of accident prevention (*UVV VBG1*) [11].

The perceptibility and safety issues as physical characteristics of floor indicators do not represent the sole criteria for evaluating their functionality. Both the single tactile floor element and a tactile warning system, consisting of various elements, are part of a complex environment with a variety of possible hazards. The correct interpretation of warning elements is of crucial importance, as different kinds of hazard require a different behaviour of visually impaired subject. For example, crossing a cycle track usually requires a down slowing and increased attention, while crossing a street requires a stop before the curb stone and awaiting acoustic signals from the traffic or from acoustic devices at the traffic lights, signalling a continuation of the walk.

The interpretation of different kinds of hazards can be facilitated by using different kinds of tactile floor indicators, but, given that the tactile quality of the ground surface in public space is generally very varying, the options for a semiotic system of tactile warning elements are somewhat limited. As it is true for other kinds of semiotic systems, the correct interpretation of tactile warning elements depends also crucially on the abilities of the visually impaired subject. The individual need of tactile information depends on the (subjectively experienced) complexity of the place; handling of more complex places requires more information. Colour coding can be helpful for subjects with residual vision, but tactile floor indicators as warning elements have to fulfil