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State-of-art analysis of the technology used for indoor navigation.

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Abstract

This technical report provides a basic information about the technological development envisaged for indoor orientation systems with multi-modal interaction.

Keywords

technical report, State-of-art, analysis, technology, indoor navigation.

1 Analysis

The recent trend of mapping indoor spaces and allowing visitors of large buildings to use mobile applications to orient and navigate has been picked up by many big players like Google or Apple which are slowly allowing users to navigate using their native applications. Many private companies (infsoft, Esri, IndoorAtlas, InsiderNavigation, etc.) are specializing in various types of technologies (BLE, WiFi, geomagnetic technology, etc.) enabling indoor navigation. Support of users with visual impairments is being solved by leveraging different types of technologies [1, 2, 3]. The solutions mainly use handheld devices (smartphones) whereas the aim of this project is also to use alternative approaches (interactive kiosk) to aid orientation and allow navigation in public buildings.

Accessibility of self-service kiosks is required by law for example in the US (section 508 Rehabilitation Act) and through European Unions' Directive 2016/2012 and technically by EN 301549. Adaptation of output includes voice feedback for ticket machines [4], voice input, or gesture-only input [5]. Kiosks showing maps have previously not been made accessible to blind people and require adaptation of the contents to meet the user's needs [6].

Besides the audio output, the Audio UI should allow the user to control over the interaction. Conversational agents [7] show a row of issues needed to be tackled when designing the audio UI, like grounding, repetition, undo, etc. Verbal description of the route can be a highly efficient way of navigation especially when the description is enriched by landmarks [8]. The basic interaction technique is based on providing information upon pressing buttons related to particular terminal functions [9].

Indoor localization cannot utilize GPS. Dead reckoning through measuring footsteps has a considerable error rate [10]. Localization based on fingerprints of WiFi access points has been tested successfully for example in Frankfurt airport with blind people [11]. However, this approach is generally not feasible as access points adapt their signal's strength. Bluetooth (BT) beacons have been utilized to allow localization of blind pedestrians in buildings and for a generation of routing information [12, 13]. The problem is the high number of beacons needed and their maintenance . A possible solution to this problem can be the approach described by [14], where the BT beacons are placed only at the decision points.

To address the needs and preferences of diverse users, for instance in a public building, numerous self-adaptive UIs have been developed; recently also by using techniques from the field of artificial intelligence [15]. Adapting UIs in the public space to individual requirements can be realized by remote-controlled interfaces as it was demonstrated for ATMs [16] or for bus display [17]. An architecture for the personalization of UIs, which allows one to take your settings from one device to another, was developed in the Cloud4All project and by GPII [18]. Another example is a method for context-sensitive automatic generation of UIs described in [19].

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