Indoor Orientation System for Visually Impaired: Example Application in a Library Building

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University libraries are indispensable resources that students frequently visit to access reliable academic and information despite the widespread use of online content. Although certain access facilities are provided, it is sometimes difficult for the visually impaired to reach their desired objectives in such important centers.

Universities, which serve as centers of information production for societies, provide ease of access to visually impaired individuals in varying degrees. A wide variety of projects developed within these facilities may prove to be beneficial. For example, special scanner systems in libraries can convert any book to pdf and audio book format very quickly.

Kastamonu University can be seen as an example of a model center that enables this type of research. It aims to assist visually impaired individuals so that they may easily reach all points of the campus without a need for help. Sighted individuals enjoy instant access to visual signage and landmarks which guide them to their destinations, even in completely unfamiliar surroundings. In contrast, visually impaired individuals learn to navigate using a variety of alternative techniques to explore their surroundings and locate their destination. In new and complex environments, this can be an extremely challenging task. Due to the abovementioned importance, the university library building was chosen as a place where the first step of a visually impaired enhanced accessibility project would be realized. This was also designed to be highly valuable for any person who might be faced with orientation challenges.

This project implemented user-friendly features which allowed for downloading the mobile application to one's phone which in turn is activated before entering the library building. When the person enters the building, the application tells him or her where he or she is. It then proceeds to update this information as the user walks within the building. In addition, the user can choose one of the points installed in the application at any time. After selecting one of the locations such as the reading room, toilet, or offices, the application starts to voice what the user should do just like a road map navigation application. It is only necessary to shake the phone in order to listen to the directive again.

The system developed during operation consists of the following four components:

1. Electronic Transmitting Network

This network consists of electronic transmitters called beacons which are placed on the wall and ceiling of the library building. The coverage areas of these devices are directly proportional to the energy they spend. The system's 100-meter diameter can be reduced to a certain extent in order to ensure optimum energy consumption. Therefore, the size of the domain is arranged to contain a

diameter of 4 meters. In this way, the battery life of several weeks is extended to 5 years. Coverage area of an electronic transmitter starts at the point where the other ends. Thus, a coordinate system is formed in a continuous polygon-shaped area.

This coordinate system is actually a digitized map of the region. In the electronic transmitter network, Edistone technology for Android-based devices and iBeacon technology for IOS-based devices are used.

2. Mobile Software

The software installed on the mobile phone entering the polygon area evaluates the signal received from the closest transmitters and sends it to the built-in program on the server. It then detects the position of the user on the map of the region installed on the system via the information returned by the calculations on the server. Information is automatically spoken about the points near the location where the user is detected.

3. Server Software

Information sent to the server by the software installed on the mobile phone is evaluated by the software on the server. Since the processing power of mobile devices is not relatively high, all the necessary mathematical operations such as triangulation algorithms and other mathematical operations are calculated on the server. The exact coordinates and direction of the phone within the digital map are calculated. This information is then transmitted to the phone.

4. Mobile Phone

The individual's phone is the device in which the mobile software is installed, communicating between server software and the user.

The application of Beacon technology in libraries provides important opportunities for the visually impaired. Since visually impaired people need a library representative when they use libraries for scientific research, this technology makes it possible to maximize accessibility while minimizing reliance upon outside help.

Thanks to this highly flexible and customizable system, new applications and similar notifications in libraries can be sent instantly to all users.

Access to the right information as well as production of knowledge is extremely important for all societies. In this context, developing a technology which can play a major role in improving the conditions for disadvantaged individuals is extremely important. Through conducting this study, it has been proven that a technological device which has become a part of daily life, can increase the quality of autonomy and self-reliance in research for visually impaired individuals who wish to use libraries.

This practice is important in terms of opening up different applications which will be developed after its implementation, using similar or more advanced technological methods.