# GuideDroid: Low Cost Indoor Navigation Assistant for the Visually Impaired

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# Abstract

This paper presents an innovative, low cost indoor navigation system for the visually impaired which takes advantage of the emerging communication technology Near Field Communication (NFC). The main idea is to orient users by NFC enabled mobile phones that gathers the current position from NFC tags and tells user the way to follow to reach her desired destination possibly using intermediate checkpoints. The system also provides a collision detection mechanism that warns user for near obstacles.

Since it was implemented on Android and behaves like a guide dog, we named it GuideDroid.

# Problem statement

Among the many challenges faced by the visually challenged persons are the constraints of independent mobility and navigation in an unfamiliar indoor environment. Finding the location and path to some desired location including public utilities inside the building can be an arduous task. Besides, constant changes in the workplace and on the street offer collision risks much higher than the familiar environment for the visually impaired.

GPS based navigation that is now getting widely used is not feasible in an indoor environment due the weakness of satellite signal. Variety of technologies is tested and new designs are generated for indoor navigation in order to circumvent the lack of excellence.

The existing solutions for indoor navigation systems typically require the use of expensive and heavy sensors, or equipping rooms and hallways with radio-frequency technologies such as Bluetooth, Ultra Wide Band (UWB), Wi-Fi or RFID which are used to determine the user's location.

Although several attempts have been made at making such indoor navigation systems, none of them have found wide acceptance.

# Our solution

~~Through the extensive use of sensors and location features existing in smartphones and other mobile devices, assist people with visual disabilities and / or hearing in tasks such as locomotion, identification of places and services available, and the location and orientation courses.~~

**Design principles**

* Uniformity of the geographic location model (latitude/longitude) to enable integration with existing outdoor navigation systems and its mechanisms.
* Cheap and off-the-shelf components.
* No changes in buildings infrastructure (no wireless network needed).
* Should be useful for both visually impaired or not.
* The user should not be obligated to start the navigation by some initial point; she should be able to start at any point when she feels lost, thus avoiding unnecessary help for well know paths.

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**System design**

nnnnn

Since it is necessary to maintain the same location model (latitude/longitude) widely used in outdoor navigation and indoor GPS signal is insufficient to obtain such information, how to solve the issue?

Our solution is to spread strategically NFC tags in the buildings, providing their precisely calculated coordinates and thus serving as landmarks for orientation (waypoints) in the same way as an open environment (outdoor). This is the main aspect of this innovative solution.

**How it works**

... turn-by-turn instructions between waypoints.

Vamos considerar o caso do usuário precisando chegar a uma determinada sala em um prédio que desconheça. Esse prédio está representado na figura 1.

Let us consider the case where the user needs to reach a particular room in a building unknown. This building is represented in figure 1.

Ao chegar à porta do prédio, o usuário aproxima seu telefone do cartaz que contém a tag NFC junto à porta. A detecção da URL especial que inicia por “guidedroid://” dispara a aplicação GuideDroid que então identifica o prédio e faz download do arquivo XML que o descreve. A aplicação também pergunta ao usuário qual a sala destino, apresentando uma lista com os nomes das salas existentes no prédio.

At the door of the building, the user approaches your phone poster containing the NFC tag at the door. Detection of special URL that starts with "guidedroid :/ /" triggers GuideDroid application that identifies the building and then downloads the XML file that describes it. The application also asks the user which room destination, presenting a list with the names of existing rooms in the building.

Uma vez escolhido o destino, a aplicação calcula o percurso usando o algoritmo de Dijkstra e pede ao usuário que rotacione o celular no sentido horizontal (ver figura 2) para determinar a orientação magnética do primeiro trecho do percurso.

Once chosen the destination, the application calculates the route using Dijkstra's algorithm and asks the user to rotate the phone horizontally (see Figure 2) to determine the magnetic orientation of the first stretch of the route.

Quando a orientação magnética é encontrada, o celular vibra e anuncia a distância que o usuário deve prosseguir naquela direção. No final desse trecho, existirá nova tag NFC que corresponde ou ao destino ou a um ponto intermediário (waypoint) onde o processo se repete para determinar um novo trecho.

When the magnetic orientation is found, the phone vibrates and announces the distance the user should continue in that direction. At the end of this passage, there new or NFC tag that corresponds to the destination or an intermediate point (waypoint) where the process is repeated to determine a new section.

Exemplificando com a figura 1, vamos supor que o destino seja a sala 106. O usuário encosta o celular à tag NFC da entrada e após a inicialização necessária, a aplicação determina o menor percurso A,C,K,J,I para atingir a sala 106.

Exemplifying with Figure 1, we assume that the destination is the room 106. The user puts his phone to the NFC tag entry and after any necessary initialization, the application determines the smallest path A, C, K, J, I to reach room 106.

Então o usuário rotaciona seu celular que ao apontar para o ponto da tag C vibra e diz “siga nesta direção por 4 metros”. Quando atinge essa nova tag, o processo se repete para o trecho entre C e K e assim por diante até atingir o ponto I que representa a entrada da sala 106.

Then the user rotates their mobile phone than to point to the point the tag C vibrates and says "follow this direction by 4 feet." When it reaches this new tag, the process repeats for the section between C and K, and so on until reaching the point I represents the entrance of the room 106.

Esse processo baseado em trechos curtos pode ser entediante no início, mas não precisa ser repetido a cada vez que o usuário percorrer esse mesmo prédio. Uma vez que o usuário memorize um determinado percurso, ele só precisará da ajuda do GuideDroid quando desconhecer o percurso.

This process based on short stretches can be tedious at first, but it need not be repeated every time the user go through this same building. Once you memorize a certain way, he will only need the help of GuideDroid when ignoring the route.

Vamos imaginar que ela se encontre na sala 105 e que tenha chegado lá sem ajuda, pois já havia aprendido o percurso. Então ela deseja ir ao banheiro (F) mas desconhece esse percurso. O que ela faz é encostar o celular na tag G na porta e a aplicação irá carregar o arquivo XML desse prédio pois o arquivo em cache correspondia à outro prédio. Ela pode então escolher seu destino (F, banheiro feminino) e a aplicação irá calcular o percurso G,H,I,J,K,L até lá.

Let's imagine that it is in the room 105 and it has gotten there without help, for he had learned the route. So she wants to go to the bathroom (F) but is unaware of this route. What it does is pull the cell in G tag on the door and the application will load the XML file this building because the cached file corresponded to another building. She can then choose your destination (F, ladies) and the application will calculate the route G, H, I, J, K, L there.

Supondo-se que ela já sinta segurança ao deslocar-se por parte desse percurso (pois ela lembra do corredor até o ponto K, por exemplo), ela não precisará parar em cada ponto intermediário até chegar a um ponto conhecido (o ponto K, neste caso). Basta encostar o celular nesse ponto K, manter o destino como L (o banheiro) e a aplicação pedirá que rotacione o telefone até encontrar a direção do ponto L e anunciar “siga nesta direção por 3 metros”.

Assuming she ever feel safe to move by that route (because it resembles the corridor to the point K, for example), it does not need to stop at each waypoint until you reach a known point (the point K, in this case). Simply touch the phone at this point K, keeping the target as L (the bathroom) and the application will ask you rotate the phone to find the direction of the point L and announce "follow this direction by 3 feet."

# Evidence the solution works

# Competitive approaches

# Current status and Next steps