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Indoor Navigation

Implementation and Possibilities

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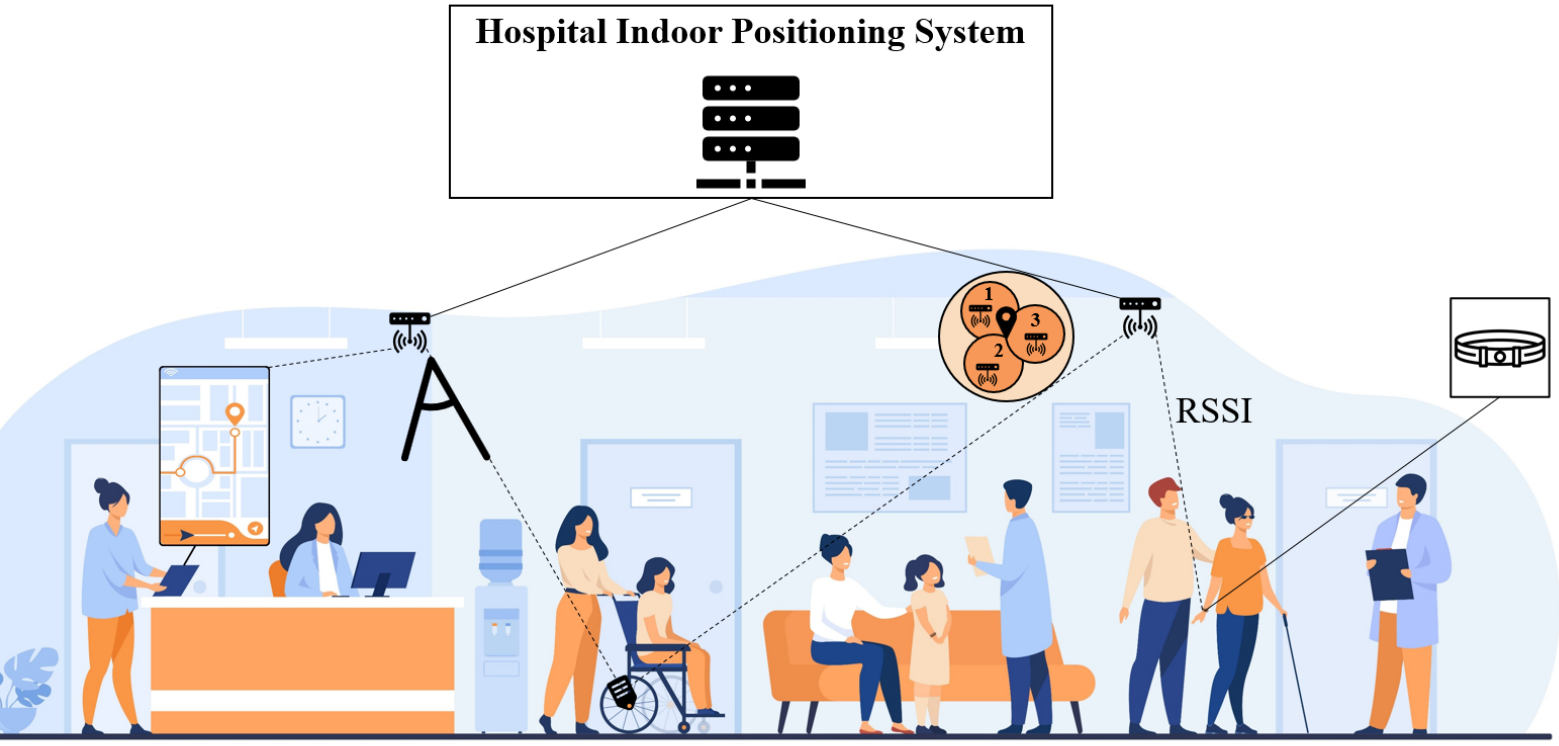

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Who hasn‘t experienced it: In the traffic of a big city, drivers, cyclists, or pedestrians quickly lose their orientation. To solve this, outdoor navigation systems based on the global positioning system (GPS) are a solution and offer the user the possibility of the best possible navigation to the destination. However, orientation can also be problematic in large buildings, e.g., hospitals, shopping malls, or university complexes. In addition to outdoor navigation, indoor navigation and positioning systems have been available for a few years. These systems can be used to find the right destination even in corridors, stairwells, and floors. The destination does not have to be static but can also show the paths to tagged objects that are mobile in buildings. To perform indoor positioning, there are a variety of technologies that have emerged within the last few years. Examples to make a positioning are, among others, W-LAN, Bluetooth low energy, ultrasound, and infrared, which are linked with a mathematical algorithm.


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Conzept

At the core of indoor navigation - similar to outdoor navigation - is the need for users to reach a destination optimally. From a technical point of view, indoor navigation systems are more like positioning systems, as they can perform other important tasks for people and companies in addition to navigation. Such a system can be used to find important objects in a building, such as respirators in hospitals. For this purpose, these devices are provided with so-called tags, which represent a receiver for the indoor positioning signal. These can be tags (similar to Apple‘s „Airtag“ product) or stickers, for example, which can be used for inventory simultaneously. Concerning mathematical positioning within a building, various methods are available. Often, the so-called trilateration is used for this purpose, which requires three or more reference points for position determination. For this purpose, routers are usually used, e.g., for W-LAN positioning, and the signal strength of the W-LAN is measured. The position in the room is then determined from the ratio of the signal strength to the distance of the router for at least three different positions.

Procedure for an implementation

Several activities are necessary to implement an indoor navigation system in, e.g., manufacturing companies, hospitals, or airports.
First, needs have to be analyzed. For this, various stakeholders should be integrated in a participatory manner. In particular, the developers and implementers of the system should be

represented in addition to the potential users. In this step, it is important to determine the functions and characteristics of the positioning system, as these may vary depending on the application field. One example is radiation in hospitals (e.g., due to radiology), which significantly affects the quality of the positioning system and must be considered during development. On the user side, it is interesting for the development of new indoor navigation systems to see to what extent potential users would tend to use such a system. To investigate this, various methods from social sciences or psychology are available that aim to explain a certain behavior. These refer to different factors that significantly influence an intended use of an indoor navigation system. Examples of such factors can be the personal attitude towards an indoor navigation system, i.e., whether someone would like to use it and finds it useful. Furthermore, normative beliefs and perceived norms of the potential user are interesting, i.e., whether someone would tend to use such a system, as far as this individual gets it recommended by another individual who is important to her/him in this context. Concerning hospitals, this could be someone‘s family or best friends, for example.

Second, the first step‘s technical conditions and potential functions are to be determined and evaluated with the help of a cost-benefit analysis. The technologies are to be evaluated in particular against the technical conditions of the implementation context. For example, with a prevailing W-LAN that can be used for indoor navigation, acquiring an additional system, e.g., BLE-based indoor navigation, does not appear to make sense. Current research shows that indoor navigation systems should be evaluated primarily in terms of accuracy, availability, precision and cost. A cost-benefit analysis should be performed in close coordination between developer and implementer to avoid unnecessary costs.

Possibilities of indoor navigation

There will be many use cases for indoor navigation and positioning systems in the future. Current research is, for example, related to tracking people, such as Alzheimer‘s patients in hospitals and predicting their position. They do so, as they use certain clusters based on a continuous measurement of positions in combination with machine learning. For such clusters, hospitals are divided into specific areas to make predictions of possible positions as accurately as possible. Furthermore, indoor positioning methods are beneficial in production contexts. For example, the locations of (intermediate) products on production lines can be represented. Likewise, warehouses can be optimized concerning the handling, e.g., in the food industry, where such systems contain

pallet information on shipping and best-before dates. Shopping malls and retailers also offer a variety of advanced functions that can be linked to an indoor navigation system, such as processing shopping lists. In this case, indoor navigation systems provide the optimal shopping route so that a shopping mall or supermarket tour is as efficient as possible. Furthermore, such a system can be used to display discount promotions offered by retailers to increase the benefits for customers on the one hand and sales for retailers on the other.

Conclusion

Following the success of outdoor navigation systems, indoor navigation and positioning processes are on the rise. In this regard, such systems are of interest to developers and implementers, as well as to users, in that they serve to assist us in everyday navigation-related tasks. Moreover, current research on indoor navigation and positioning shows that we will encounter such systems more frequently in our everyday lives in the future, with relative certainty.

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