ABSTRACT

Blind navigation systems are made to help those who are visually impaired find their way through strange places. To inform users about their surroundings, these systems often combine a variety of technologies, including GPS, audio cues, and tactile input. A blind navigation system's main objective is to promote the freedom and mobility of people who are blind or visually impaired, enabling them to move about unfamiliar situations more confidently and easily. The main elements and functions of a blind navigation system would be described in an abstract. These elements would probably include a way to locate the user, like GPS, a way to educate the user of their surroundings, such aural cues or tactile feedback, and a way to update and maintain the system's map of the environment. The system would also have a way of figuring out the user's destination and telling them how to get there. This could involve verbal, physical, or a combination of both instructions. The device would also have a way of informing the user of landmarks or impediments that they should avoid. The system would also have a way to keep its map of the surrounding area up to date and accurate. This would enable the system to account for alterations to the user's destination as well as alterations to the surroundings, such as the appearance of new obstacles or landmarks. This would enable the system to give the user accurate and current information, even in environments that change.

INTRODUCTION

Visual power is essential since it will enable us to locate and distinguish our surroundings. Orientation or way-finding is the term used for this operation. Additionally, we can escape obstacles thanks to this power (Mobility). Approximately 2.2 billion individuals worldwide have vision impairments, and that number is expected to quadruple by 2050. Many persons lack the aforementioned abilities and thus require some tools in order to navigate and address their visual issues. Visual difficulties do not prevent people from navigating because they may do so on their own using their gadgets. Additionally, individuals may complete the aforementioned tasks with the aid of their recollections and vocal descriptions.The key is to develop reliable navigation systems that can forecast the user's journey, alert them to potential hazards, and work both indoors and outdoors. We should respond to three inquiries in order to create navigation systems: Where is the individual? (Also called the localization issue.) What is the person's intended location? (Recognizing the goal). How was he going to get there? Wayfinding, route following, and obstacle identification are all included in the final question. Designing navigation systems is difficult because of many obstacles, including a lack of preview, a lack of familiarity with the environment, and restricted access to positional data. To solve the aforementioned problems, researchers are working on developing technological systems. Over the past few decades, experts have suggested some safe and efficient alternatives to offer safety.

Blind navigation systems are made to help those who are visually impaired find their way through strange places. To give non-visual information about the surroundings, such as location, barriers, and directions, these systems make use of a variety of sensors and technology. The adoption of such devices can significantly increase the independence and mobility of people who are blind, enabling them to travel with more confidence and ease. The usage of these devices can also give visually impaired people a sense of comfort and safety because they can be warned of potential threats in the area.In order to give the user real-time information, a typical blind navigation system may include technologies like GPS, ultrasonic sensors, and haptic feedback devices. Additionally, the system can include an intuitive, simple-to-use user interface and offer precise directions to the required place. Additionally, the system needs to be adaptable in terms of the kinds of feedback it may deliver, including tactile, aural, or a combination of both. In summary, the goal of a blind navigation system is to enable visually impaired people to move more easily and independently in unfamiliar environments.

LITERATURE SURVEY

Data Structures for Landmark-based Navigation of Blind Pedestrians is the research paper we used to refer and understand our project better. This paper was taken from the website:- ResearchGate

This paper helped us understand the importance of this topic and help us build a Blind Navigation System designed to assist individuals who are visually impaired in navigating unfamiliar environment. This was possible using data Structures with teaching and the guidance of our mentor and professor Dr. Sowmya BJ who taught us the much needed base for this project.

This project using graphs for the maps and a star search for navigation. Where A* search helps us to find the shortest and the closed route from the current location to the destination. This will give out a route which will be read out to the user with the help of a transmitter in their ears. This will tell them approximate steps to take. And the camera in their glass will detect any obstacles which comes in the user's way. The user is also provided with a stick which has motion sensor which detects any kind of movement ahead of the user, which will also have GPS that will help their loved ones to track their location. This was our approach to the research paper which was published in the 2014

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OBJECTIVES

One of a blind navigation system's primary goals is to:

- To give blind people non-visual information about their surroundings, such as location, hazards, and directions.

- enabling those who are blind to navigate with more ease and confidence will increase their freedom and mobility.

- to make visually impaired people feel comfortable and secure by warning them about potential environmental hazards.

- to give precise directions on how to travel to a particular spot.

- to give users a variety of feedback options, such as aural, tactile, or a combination of both, to choose from.

- should have a user interface that is simple and intuitive so that people who are blind can easily comprehend and use the system.

- to be durable, trustworthy, and cost-effective.

- being easily transportable and adaptable to different locations

- to be able to work in various languages in order to be accessible to everyone who is blind.

- should be compatible with voice recognition, braille displays, and other assistive devices like screen readers.

- Overall, the objective is to give visually impaired people the equipment they need to safely and independently explore new situations.

ABSTRACT DATA TYPE

An abstract data type (ADT) is a mathematical representation of a data structure that specifies a set of operations that can be carried out on the data but not the specifics of how those operations are carried out in practise. It is possible to model a blind navigation system using an ADT.

ADT BlindNavigation

Objects: x,y coordinates latitude and longitude of type float
Functions:
Float Initialize(x,y): This operation would be used to set up the navigation system, including defining the starting location, the destination, and any obstacles or landmarks that need to be avoided.

Float Move(x,y): This operation would be used to move the user from one location (x,y)to another(x1,y1). It would take into account the user's current location, the destination, and any obstacles or landmarks that need to be avoided.

Float Get Location(x,y): This operation would be used to determine the user's current location. It would return the coordinates(x,y) of the user's current location.

Float Get Obstacles(x,y): This operation would be used to get the location of any obstacles or landmarks and alert the user to avoid them and return true and the coordinates if there is an obstacle else false and next location coordinates

Float Get Destination(x,y): This operation would be used to get the location of the destination that the user is trying to reach and return(x,y)

Float Update Map: This operation would be used to update the navigation system's map with new information, such as the location of obstacles or landmarks, or changes in the user's destination and return the new destination(x,y).

An ADT for a blind navigation system would provide a clear and consistent way of modeling the system, without specifying how the operations are implemented. This allows for flexibility in the implementation of the system, as different algorithms and data structures can be used to implement the operations, depending on the specific requirements of the application.

ADT A* SEARCH

OBJECTS:
OpenSet,ClosedSet, Node, Map
FUNCTIONS:
heuristic(x, y, goalX, goalY): A function that calculates the estimated cost to reach the goal from a given node (x, y). This function is often called the "heuristic function" and can be implemented using a variety of techniques such as Manhattan distance or Euclidean distance.

a_star(startX, startY, goalX, goalY): The main A* search function that takes the starting coordinates and goal coordinates as input, and returns a path from the start to the goal, if it exists. It utilizes the OpenSet, ClosedSet and Node objects, as well as the heuristic function.

getLowestFScoreNode(): A function that retrieves the node in the OpenSet with the lowest f score.

add(node): A function that adds a node to the OpenSet or ClosedSet.
remove(node): A function that removes a node from the OpenSet or ClosedSet.
contains(node): A function that checks if a node is in the OpenSet or ClosedSet.
IsEmpty(): A function that checks if the OpenSet or ClosedSet is empty.
etNode(node): A function that retrieves a node from the OpenSet or ClosedSet.

ADT Binary Tree

objects: a finite set of nodes either empty or consisting of a root node, left Binary_Tree, and right Binary_Tree.
functions:
for all bt, bt1, bt2 BinTree, item element

Bintree Create()::=	creates an empty binary tree
Boolean IsEmpty(bt)::=	if (bt==empty binary tree) return TRUE else return FALSE
BinTree MakeBT(bt1, item, bt2)::=	return a binary tree whose left subtree is bt1, whose right subtree is bt2, and whose root node contains the data item
Bintree Lchild(bt)::=	if (IsEmpty(bt)) return error else return the left subtree of bt
element Data(bt)::=	if (IsEmpty(bt)) return error else return the data in the root node of bt
Bintree Rchild(bt)::=	if (IsEmpty(bt)) return error else return the right subtree of b

DESIGN

In order to make a blind navigation system usable and effective for people with visual impairments, it is important to take into account a number of important factors. These consist of:

Interface For Users: The user interface needs to be straightforward, easy to use, and as accessible as possible. The system must be able to convey information via touch or audible feedback. The use of auditory cues, voice prompts, and/or haptic feedback can be used to accomplish this.

Choosing a Location: Using a combination of GPS, Wi-Fi, and Bluetooth technologies, the system should be able to precisely pinpoint the user's location. Real-time location data for the user should also be accessible through the system.

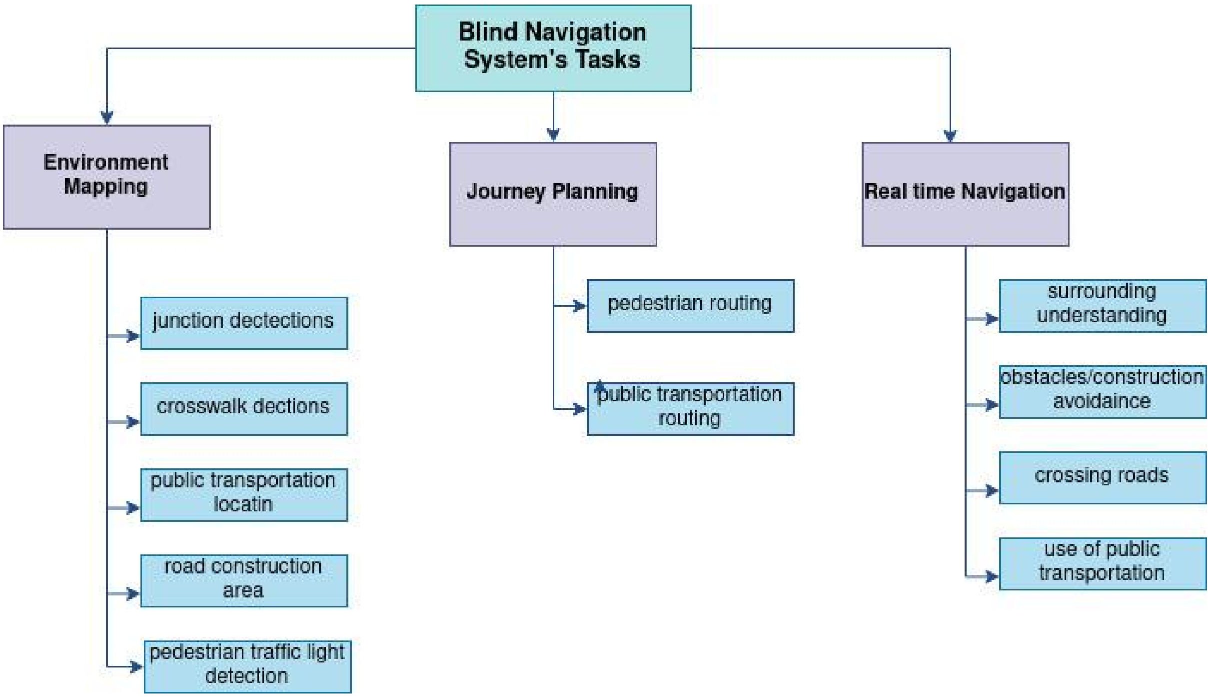
Planning a route and a map: The system must include a map of the surrounding area and be able to tell the user which route is the most efficient for getting to their desired location. Additionally, the system should be able to consider the user's current location, the destination, and any landmarks or impediments that need to be avoided.

Detecting obstructions: Any obstructions or landmarks in the user's path, such as stairs, curbs, or other dangers, should be detectable by the system, and it should be able to warn the user of them. The employment of sensors, cameras, or other technology can be used to accomplish this.

Data management: The system must be able to save and modify information about the surrounding area, such as the locations of hazards and landmarks as well as changes to the user's intended destination. The user should have easy access to this information, and it should be maintained current.

Power management: The system needs to be made of energy-efficient materials and have long-lasting batteries. Additionally, the system should be able to tell the user of the battery level and offer options for charging the device.

Security and privacy: The system ought to be built with the user's privacy in mind, and it shouldn't gather or keep any personal data without that user's permission. The system must be built with security against hacking and other harmful assaults in mind.



In order to make a blind navigation system acceptable and effective for people with visual impairments, a combination of technology and user-centered design principles are used in its creation. The system must be easy to use, accurate, and flexible to change to meet the needs of the user and the environment.

ALGORITHM

BLIND NAVIGATION ALGORITHM

Create a class or struct for a node with the information specified in Step 1:

Vertex/node identifier

The coordinates x and y (if the graph is a map)

The calculated total distance via this node between the source and the destination ($f = g + h$)

Actual separation between the source and this node (g)

The envisioned separation between this node and the destination (h)

Pointers to the preceding node, enabling us to retrace the path

Organize the open list into a priority queue that is sorted by the projected total distance (f) between each node.

STEP 2: Develop a function that uses the Manhattan or Euclidean distances to estimate the travel time (h) between a given node and a specified destination.

Initialize the source node and add it to the open list with the parameters $f = g = 0$ and h = the calculated travel time.

While there are items on the open list:

Select from the open list the node with the lowest f value.

Make a note of it being closed

STEP 3: Verify that this node is the destination; if it is, retrace the path and send it back.

For each node close by:

Skip it if it's on the closed list.

If it isn't already on the list, add it using the formula $f = g + h$, where g represents the distance from the source to this node and h represents the anticipated distance from this node to the destination.

Check to see if the current g value is lower than the previous one if it is already in the open list; if so, update the f, g, and h values as well as the pointer to the prior node.

A* SEARCH ALGORITHM

1.Create a closed set to hold nodes that have already been reviewed and an open set to hold nodes that need to be evaluated.

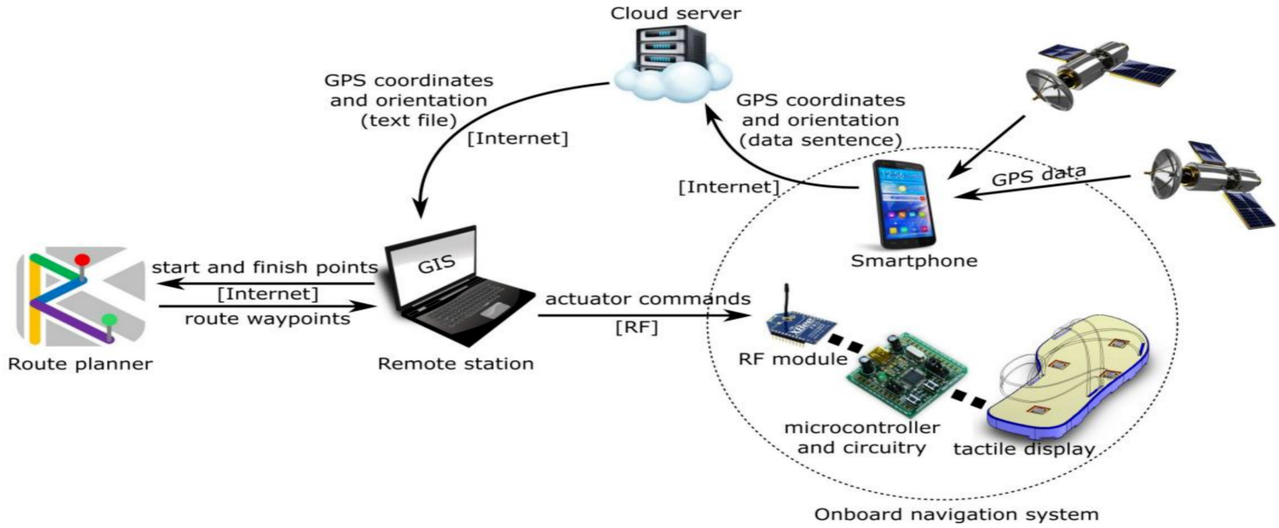
2.Add the beginning node to the open set in step two.
The open set is not empty in step three.
a. Select the node from the open set with the lowest f score (cost plus heuristic).
3.Return the path if the current node is the objective.
c. Add the present node to the closed set and take it out of the open set.
d. Say the following for each of the node's neighbours:

Ignore the neighbour if it is in the closed set, out of bounds, or an obstruction.
Determine the expense and heuristic for the neighbour.
4.Include the neighbour in the open set if it is not already there or if it has a lower

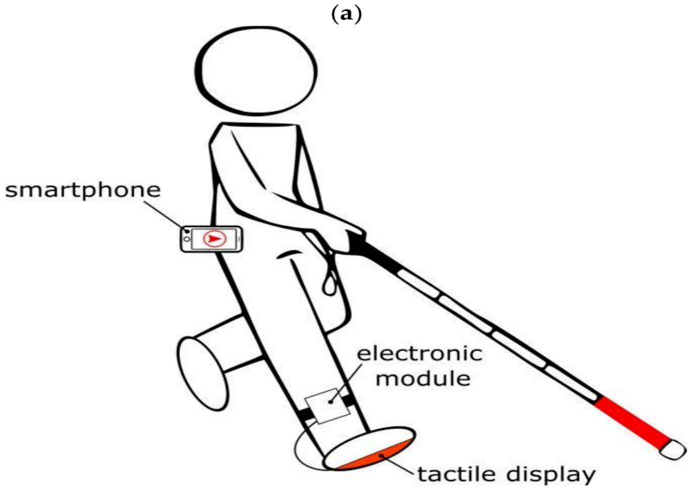
RESULT AND DISCUSSION

An A* algorithm can produce some excellent outcomes for a blind navigation system. The algorithm can produce a path that is both secure and effective (shortest possible path) (avoiding obstacles). This can give blind people more confidence and independence when navigating new situations. User studies are one method of assessing the outcomes of a blind navigation system. These studies may involve having blind people use the system in actual situations while gathering information on things like the amount of time it takes to get somewhere, how accurate the path is, and how satisfied the user is with the system.

A blind navigation system is a tool used to guide blind people through new situations. These systems may consist of a mix of hardware and software, such as a smartphone app, a cane with sensors, or both. The pathfinding algorithm, which creates a safe and effective route from the user's current location to their destination, is one of the essential elements of a blind navigation system. This project uses a star search for navigation and graphs for the maps. Whereas A* search assists us in locating the direct and fastest route between our current position and our destination. With the aid of a transmitter placed in the user's ears, this will provide a route that will be read aloud to them.This will outline the general measures they should take. Additionally, any obstructions that are in the user's path will be detected by the camera in their glass. Popular algorithms utilised in these systems include A* search. The A* algorithm is a heuristic search method that chooses the optimum path by combining the cost of reaching a node (g score) and the expected cost of getting to the objective (h score). This technique, which may take into consideration barriers and other constraints like the existence of stairs or changes in elevation, can be particularly useful for pathfinding in a blind navigation system.



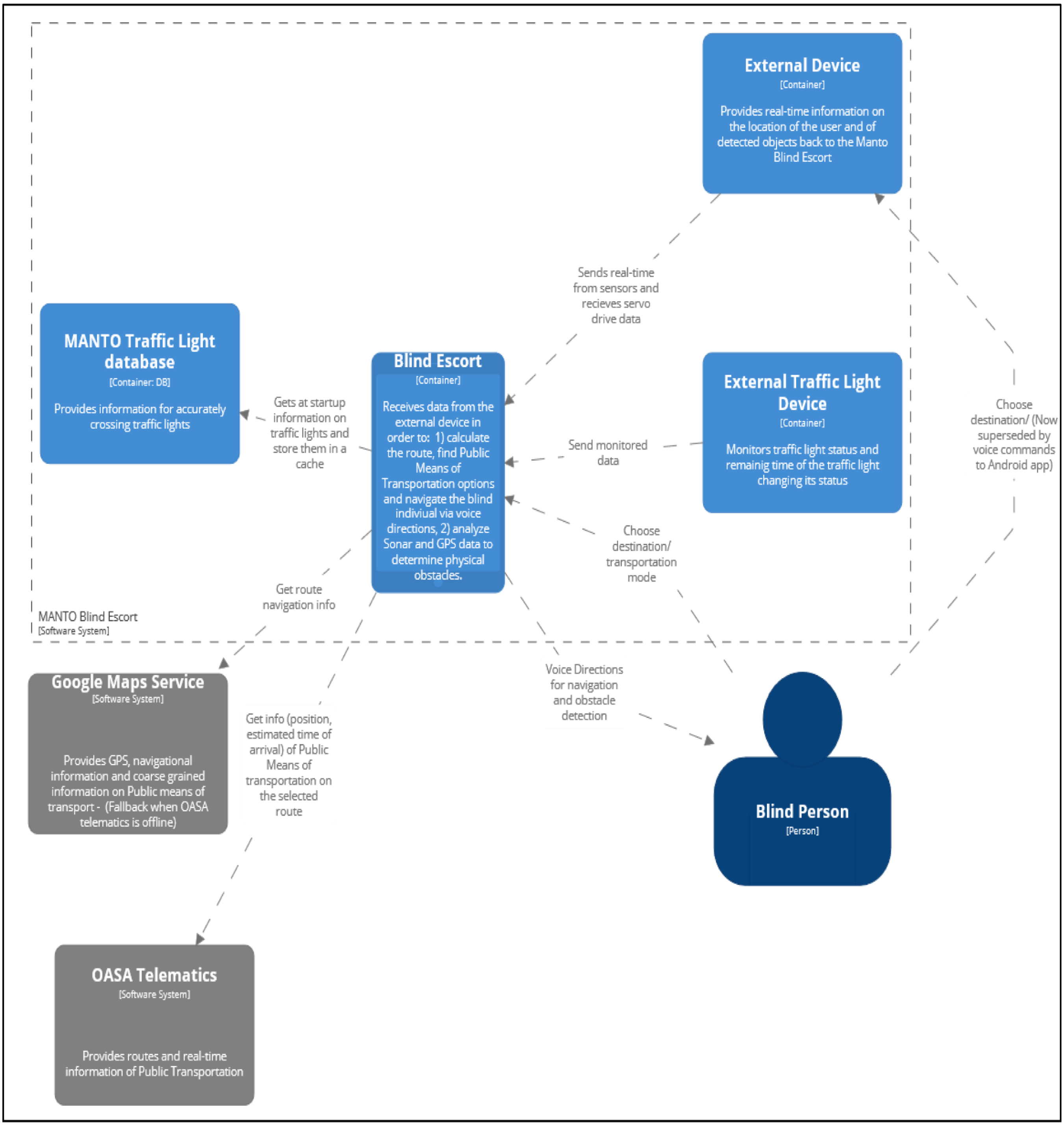
(a)



(b)

However, there are several restrictions when employing the A* algorithm for blind navigation. Its reliance on a map or environment model is one of its main drawbacks. The algorithm might not function as effectively in a poorly specified or dynamic context. Additionally, additional elements that are crucial for blind people, including the existence of stairs or elevation changes, might not be taken into account by the algorithm.

Its computationally expensive nature and potential for slowness in big environments are additional drawbacks. When the user has to navigate immediately, this can be a problem because it can be unsafe to wait for the algorithm to complete.



Researchers have suggested a number of A* algorithm extensions and changes to get around these restrictions. The Rapidly-exploring Random Tree (RRT) algorithm is a well-liked example of an extension that creates a random path across the environment and then utilises the A* algorithm to optimise it. This can account for additional aspects like elevation changes and be faster than the A* algorithm by itself.

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CONCLUSION

In conclusion, many data structures, including graphs, trees, quadtrees, and grid-based data structures, can be used to create a blind navigation system. The application's specific needs, such as the size of the map and the quantity of queries required, will determine the data structure to be used. The developed data structure should be able to give the information required for the blind person to navigate the environment quickly and accurately. The shortest path between two sites, for instance, can be provided by the system using a graph data structure and the A* algorithm, while the hierarchical relationship between various locations can be provided by the system using a tree data structure.It is vital to keep in mind that a full navigation system for blind persons consists of many different parts, and the effectiveness of the system as a whole depends on elements like precise localization and object identification.

Finally, to make sure the system is accommodating their needs and is simple to use in everyday situations, it is crucial to undertake user testing and obtain feedback from blind people.