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Planning the Path and Avoidance Obstacles for Visually Impaired/Blind People

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Abstract: *This paper suggests a navigation structure for visually impaired/blind people using A star algorithm. The proposed structure is consisted of two parts. In the first part planning the path and in the second part avoiding obstacles. The aim is to guidevisually impaired/blind people from a required location to a desired location. Two tests are run in each part and modeled in C sharp language and MATLABprogram. Simulation results show good performance for the proposed scheme that the visually impaired/blind people reach the desired location successfully without error. In conclusion, A star path finding algorithm using C sharp language was a valid and reliable method to guide the visually impaired / blind people from a required location to a desired location in indoor environment with or without obstacles.*

Keywords: *Planning the path, avoidance obstacles, visually impaired/blind people, A star algorithm, path finding, and indoor navigation.*

I. Introduction

In the difficult context of day to day life of visually impaired/blind persons, the white cane still represents the most popular tool used for obstacle detection, provided that the encountered locations have been visited before and memorized. In an unfamiliar setting, they completely depend on other humans to reach the desired destination [1].Sentient computing is the proposition that applications can be made more responsive and useful by observing and reacting to the physical world. It is particularly attractive in a world of mobile users and ubiquitous computers [2].Blind and visually impaired people have different important daily needs including navigation. Navigation and way finding is crucial for the blind population, as for any other. Visually impaired people in new environments may feel totally disoriented or isolated. These people can easily end up in dangerous and confusing situations as they move in unknown places. Pressing navigation-related problems blind people face include determining one's position, heading or moving direction, and the detection of close objects (most probably mobility barriers) [3].

Visually impaired people rely on different tools and skills to navigate. They usually rely on their white canes, seeing-eye-dogs and other skills acquired over time to aid their navigation. Visually impaired people, that are able to perceive sounds, tend to learn how to identify audible landmarks. In general, people supplement their loss of sight by becoming better with other senses, even smell [4].

Cognitive mapping skills are flexible enough to adapt to the sensory loss. Even people who are blind from birth can deal with spatial concepts and can find their way through different spaces [3].

Many technologies have been developed to assist blind users with different navigation needs. This includes avoiding obstacles like laser canes and other handheld devices that transmit laser or ultrasound beams to detect objects ahead of the user and give audio or vibration feedback that varies according to how close the objects are [5, 6].In indoor navigation, we need two things, positioning system and suitable path finding algorithm so research into indoor positioning systems has identified some possible technologies, but none of these has been developed and distributed to consumers [7].

Guerrero et al., (2012) [8] demonstrated an indoor navigation system for the visually impaired. They reported that a navigation in indoor environments was highly challenging for the severely visually impaired, particularly in spaces visited for the first time. Several solutions have been proposed to deal with this challenge. Kim and Chang (2013) [9] presented high-resolution touch floor system using particle swarm optimization neural network. A touch floor system, based on force sensitive resistors, capable of identifying user position and motion with high resolution, was proposed in this paper. Sun et al. (2014) [10] presented a new wearable computer called eButton. The concepts of its design and electronic implementation were described. Zhang et al. (2014) [11] described an indoor positioning algorithm for mobile objects based on track smoothing. A new indoor positioning algorithm was proposed for mobile objects based on track smoothing. Abou Haidar and Roger Achkar (2014)[12] proposed smart walker. Elderlies, blind or visually impaired people recur to a cane as a traditional ambulation aid.

In this paper, planning the path part and avoiding obstacles part using A star algorithm is presented for a visually impaired/blind people operating in two runs in each part using C sharp and MATLAB program.

II. Path Finding Algorithms

Path finding in the basic definition is moving an object from its initial position to the final location. Path Finding Algorithms (PFA) are used in many different application areas such as: -Games and Virtual Tours, Robot Motion and Navigation, Driverless Vehicles, Transportation Networks, and Human Navigation. Path finding algorithms have many usage areas. These algorithms are useful in the field of roboticsbecause they can be used to guide a robot around difficult terrain without human intervention [13].

There are many algorithms that are commonly known and used, ranging from simplex to complex, in order to be able to solve the path finding problem. There also exist some algorithms that plan the whole path before moving anywhere. Best-first algorithm expands nodes based on a heuristic estimate of the cost to the goal. Nodes, which are estimated to give the best cost, are expanded first. The most commonly used algorithm is A* algorithm, which is a combination of the Dijkstra algorithm and the best-first algorithm [14].

A* is one of the many search algorithms that takes an input, evaluates a number of possible paths and returns a solution. In computer science, A* (as "A star") is a computer algorithm that is widely used in pathfinding and graph traversal, the process of plotting an efficiently traversable path between points, called nodes [15].

III. System Design Navigation

Provided that the visually impaired/blind people (users) has traversed the path, our navigational system should determine a user's location, find the best path to a destination, and give meaningful instructions along that path.While attempting to navigate an already constructed map, the system must track its belief about the visually impaired/blind people current location on that map. Figure 1 shows in indoor navigation system.

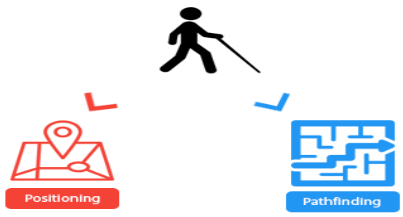


Figure 1: In indoor navigation system.

IV. Overall System Navigation

In the case of a visually impaired/blind people, the navigation intelligence and local path planning is provided by the person. Hence, our proposal focuses on the planning the path and the obstacles detection system to assist visually impaired/blind people as shown in the Figure 2 below.

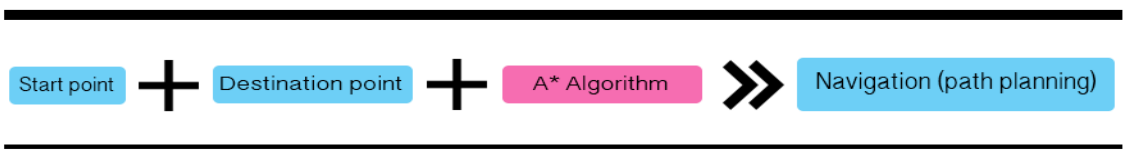


Figure 2: The structure of planning the path of visually impaired/blind people

In the same concept our proposed system of visually impaired/blind people when the environment or indoor navigation contains several obstacles, our structure is shown in Figure 3 below.

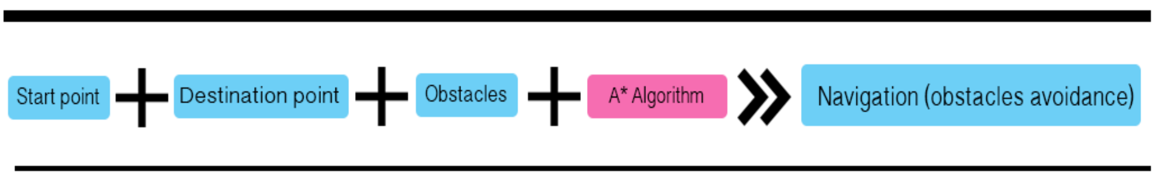


Figure 3: The structure of avoiding the obstacles of visually impaired/blind people

1.1 Planned path results and discussion

Increasing sources of sensor measurements and prior knowledge have become available for indoor localization on smartphones. How to effectively utilize these sources for enhancing localization accuracy is an important yet challenging problem. In this section, we present planning the path of visually impaired/blind

people localization algorithm that exploits various sources of information. Specifically, we also introduce the concept of A star algorithm to indicate the area where the visually impaired/blind people is in an indoor map.
In run 1 where the visually impaired/blind people is moved from start position (2,3) to goal position (20,10), and in run 2 where the visually impaired/blind people is moved from start position (3,13) to goal position (22,1) the results are shown in Figures 4 a, b and Figures 5 a, b respectively.

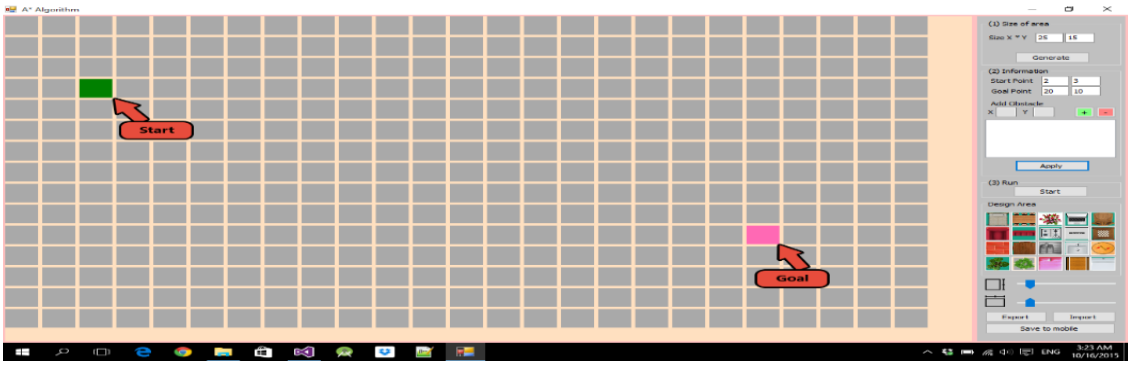


Figure 4 a: Indication of start and goal position of run 1

Figure 4 b: Visually impaired/blind people path planning using A star algorithm of run 1

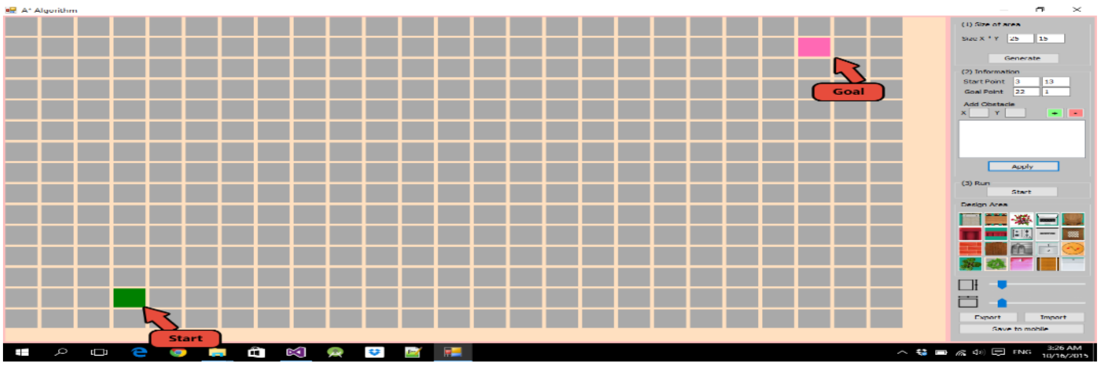
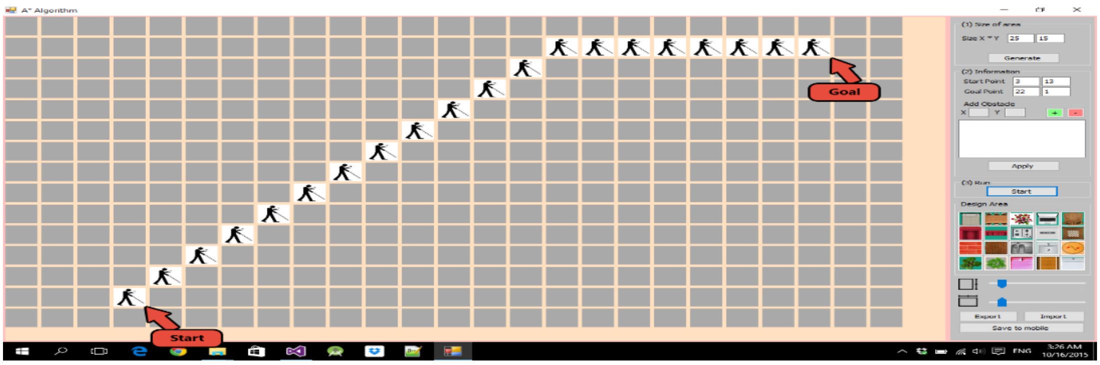


Figure 5 a: Indication of start and goal position of run 2



5 b: Visually impaired/blind people path planning using A star algorithm of run 2

The evaluation of path points are done in distance unit using Matlab as shown in Figure 6, 7 for run 1 and run 2 respectively.

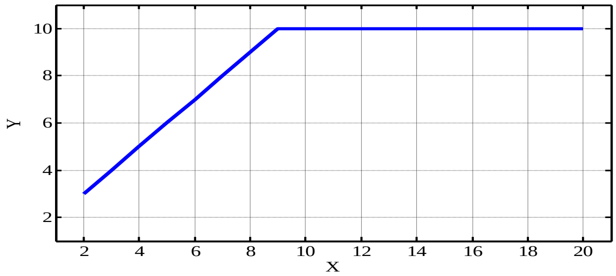


Figure 6: The evaluation of path points of run 1

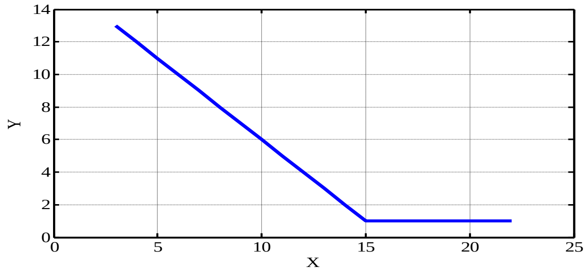


Figure 7: The evaluation of path points of run 2

1.2 Avoiding Obstacles Results and Discussion

In this section, we present avoiding obstacles of visually impaired/blind people localization algorithm that exploits various sources of information. Specifically, we also introduce the concept of A star algorithm to indicate the area where the visually impaired/blind people is in an indoor map.

In run 1 where the visually impaired/blind people is moved from start position (1,7) to goal position (20,3), and in run 2 where the visually impaired/blind people is moved from start position (6,4) to goal position (19,12) the results are shown in Figures 8 a, b below Figure 9 a, b respectively.

Figure 8 a: Indication of start and goal position of run 1

Figure 8 b: Visually impaired/blind people obstacles avoidance using A star algorithm of run 1

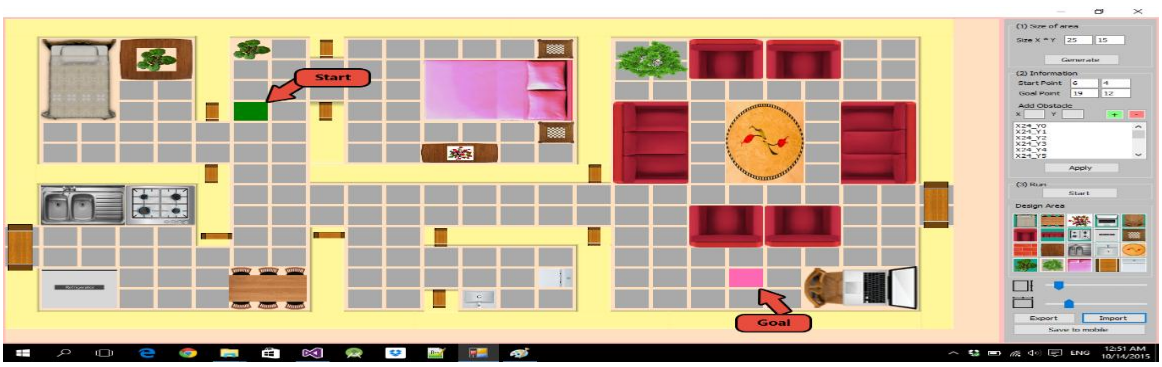


Figure 9 a: Indication of start and goal position of run 2

Figure 9 b: Visually impaired/blind people obstacles avoidance using A star algorithm of run 2

The evaluation of path points are done in distance unit using Matlab as shown in Figure 10, 11 for run 1 and run 2 respectively.

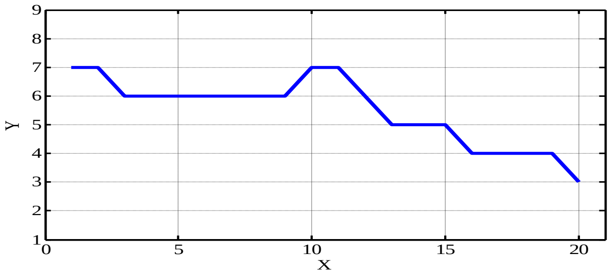


Figure 10: The evaluation of path points of run 1

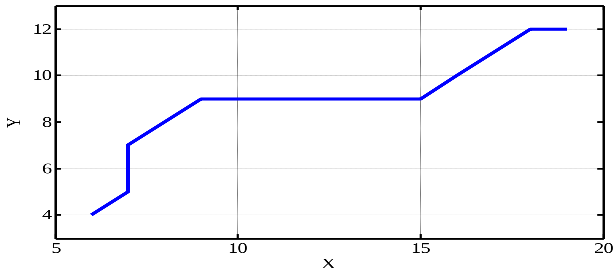


Figure 11: The evaluation of path points of run 2

V. Conclusion

A star path finding algorithm using C sharp language guided the visually impaired / blind people from a required location to a desired location in indoor environment with or without obstacles. This method was valid and reliable.

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