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Research on Indoor Space Layout Based on Redirection Algorithm

Abstract: - Research on indoor space layout based on redirection algorithm explores innovative approaches to optimizing the arrangement of indoor environments for various purposes. By utilizing redirection algorithms, which focus on guiding individuals through spaces efficiently, researchers aim to enhance the functionality, usability, and aesthetics of indoor spaces. These algorithms consider factors such as traffic flow patterns, spatial constraints, and user preferences to dynamically adjust space layouts, furniture placements, and circulation paths. The goal is to create environments that promote better navigation, user satisfaction, and productivity while maximizing space utilization and minimizing congestion. This paper investigates the implementation of a redirection algorithm to optimize indoor space layout and organization. The primary objective is to enhance navigation efficiency, improve user experience, and maximize space utilization within indoor environments. Through the utilization of the redirection algorithm, furniture and fixtures within various rooms are strategically arranged to create more functional and aesthetically pleasing layouts. The effectiveness of the optimization process is evaluated through metrics such as navigation times, trajectory smoothness, and collisions with obstacles. Results demonstrate significant improvements in layout design, with optimized arrangements leading to reduced navigation times, smoother trajectories, and minimized collisions.

Keywords: Space Layout, Indoor Environment, Redirection Algorithm, Optimization, Aestetic Values, Layout Design

1. Introduction

A redirection algorithm is a computational method used to route or redirect information, traffic, or resources efficiently within a system or network [1]. This algorithm typically involves analyzing various parameters such as load, availability, proximity, or other relevant factors to determine the optimal destination for the incoming data or requests. In the context of web servers or content delivery networks (CDNs), redirection algorithms play a crucial role in directing user requests to the nearest or least congested server, thus improving response times and overall user experience [2]. These algorithms may employ techniques such as load balancing, caching, or geographic mapping to make informed routing decisions. In networking, redirection algorithms can be applied to manage network traffic flow, dynamically adjust routing paths based on network conditions, or implement failover mechanisms to ensure continuity of service in case of failures or congestion [3].

Indoor space layout encompasses the strategic arrangement and configuration of interior spaces within a building or structure. It involves meticulous planning and design to optimize functionality, circulation, and aesthetics [4]. Central to this process is ensuring that the layout facilitates the intended activities and functions of the space, whether it's a residential, commercial, or institutional setting. Efficient circulation patterns and spatial hierarchies are established to guide movement and delineate between public and private areas [5]. Moreover, flexibility and adaptability are key considerations, allowing spaces to evolve and accommodate changing needs over time. Accessibility is also paramount, with designs adhering to relevant standards to ensure equitable access for all individuals. Aesthetics play a significant role, influencing factors such as lighting, color schemes, materials, and furnishings to create inviting and harmonious environments [6]. Compliance with building codes, regulations, and safety requirements is essential to guarantee the well-being and security of occupants. In essence, indoor space layout is a multidimensional endeavor that seeks to harmonize functionality, aesthetics, and practicality to create spaces that enhance the quality of life and user experience [7].

Designing an indoor space layout based on a redirection algorithm involves applying computational principles to optimize the arrangement and organization of interior spaces within a building [8]. The algorithm would analyze various factors such as foot traffic patterns, usage data, and environmental conditions to dynamically redirect occupants through the space in the most efficient and effective manner. For instance, in a commercial setting like

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a shopping mall, the algorithm could continuously monitor the flow of people and dynamically adjust the layout to redirect traffic away from congested areas towards less crowded zones [9]. This might involve temporarily reconfiguring the placement of displays or signage to guide shoppers towards alternative routes or areas of interest. `In an office environment, the redirection algorithm could analyze patterns of collaboration and communication among employees to inform the layout of workspaces and common areas [10]. By strategically positioning departments or teams in proximity to each other based on their interaction frequencies, the algorithm could facilitate greater synergy and collaboration while minimizing unnecessary movement and congestion [11]. The algorithm could take into account factors such as natural lighting, temperature, and air quality to optimize the placement of workstations, meeting rooms, and relaxation areas within the building. By dynamically redirecting occupants towards areas with optimal environmental conditions, the layout could enhance comfort and well-being while promoting productivity and engagement [12].

The contribution of this paper lies in its exploration and implementation of a redirection algorithm to optimize indoor space layout and organization. By leveraging this algorithm, the study enhances navigation efficiency, improves user experience, and maximizes space utilization within indoor environments. The key contribution is the development of a systematic approach to dynamically adapt indoor space layouts based on user behavior and environmental factors. Through the utilization of the redirection algorithm, furniture and fixtures are strategically arranged to create more functional and aesthetically pleasing layouts. The findings of this study demonstrate significant improvements in layout design, as evidenced by reduced navigation times, smoother trajectories, and minimized collisions with obstacles. This contribution underscores the potential of redirection algorithms to revolutionize indoor space design, ultimately leading to more user-friendly and efficient environments.

2. Literature Review

The exploration of indoor space layout based on redirection algorithms represents a burgeoning area of research within the field of architecture, design, and computational sciences. As technology continues to permeate various facets of our lives, there arises a growing need to leverage computational methods to optimize the organization and utilization of indoor environments. This literature review seeks to delve into the existing body of scholarship surrounding the application of redirection algorithms in the design and layout of indoor spaces. By synthesizing and critically analyzing the findings, methodologies, and theoretical frameworks of previous studies, this review aims to elucidate the current state of knowledge in this field.

Research on indoor space layout based on redirection algorithms has garnered significant attention in recent years, as evidenced by a plethora of studies spanning various domains. Wu et al. (2023) introduced a novel design and evaluation of redirection controllers using optimized alignment and artificial potential field, while Zhang et al. (2022) proposed an adaptive optimization algorithm for resetting techniques in obstacle-ridden environments. Huang et al. (2022) developed an automatic design system for optimal sunlight-guiding micro prisms using genetic algorithms, and Yang (2022) explored motion control in virtual reality through an inertia-based sensing mechanism and redirected walking. Kim et al. (2022, 2023) investigated mutual space generation and edge-centric space rescaling for redirected walking in asymmetric remote collaboration scenarios. Liao et al. (2022) and Jeon et al. (2022, 2024) delved into redirected walking techniques with assistance from intelligent reflecting surfaces and forecasting future positions, respectively. Moreover, studies by Van Onsem et al. (2023) and Azmandian et al. (2022) addressed the challenges and opportunities towards achieving full-immersive multiuser virtual reality with redirected walking and validating simulation-based evaluation of redirected walking systems, respectively. The literature also covers topics such as shading strategies (Wen et al., 2023), attitude maneuvering (Calaon & Schaub, 2022), infinite virtual space exploration (Kwon et al., 2022), reinforcement learning for redirection (Zhao et al., 2023), comprehensive reviews of redirected walking (Fan et al., 2022), transferable virtual-physical environmental alignment (Wang et al., 2022), and genetic algorithms for secure localization in wireless networks (Ding et al., 2023).

Wu et al. (2023) and Zhang et al. (2022) explore novel redirection controllers and adaptive optimization algorithms, respectively, while Huang et al. (2022) focus on automatic design systems for optimal sunlight-guiding micro prisms. Yang (2022) investigates motion control in virtual reality, and Kim et al. (2022, 2023) delve into mutual space generation and edge-centric space rescaling for redirected walking in collaborative settings.

Liao et al. (2022), Jeon et al. (2022, 2024), and Van Onsem et al. (2023) contribute insights into redirected walking techniques with assistance from intelligent reflecting surfaces, forecasting future positions, and achieving full-immersive multiuser virtual reality, respectively. Additionally, studies by Azmandian et al. (2022), Wen et al. (2023), Calaon & Schaub (2022), Kwon et al. (2022), Zhao et al. (2023), Fan et al. (2022), Wang et al. (2022), and Ding et al. (2023) cover topics ranging from validation of simulation-based evaluation to transferable virtual-physical environmental alignment and genetic algorithms for secure localization in wireless networks.

3. Design of Mutual Space Optimization in Indoor Layout

The design of mutual space optimization in indoor layout involves the development of algorithms and methodologies aimed at enhancing the utilization and efficiency of shared spaces within a building. One approach to achieving this optimization is through the application of mathematical models and equations derived from principles of space allocation and utilization. A fundamental aspect of mutual space optimization is the allocation of resources, such as workspace or common areas, to maximize utility while minimizing conflicts or inefficiencies. This can be formulated as an optimization problem, where the objective function seeks to maximize the overall satisfaction or utility of occupants while satisfying constraints such as space limitations or functional requirements. Let $S = \{s1, s2, \ldots, sn\}$ represent the set of available spaces within the building, and $U = \{u1, u2, \ldots, um\}$ denote the set of potential occupants or user groups. Each space si has associated attributes such as size, location, amenities, and accessibility, while each user group uj has specific spatial requirements and preferences. The optimization problem can be formulated as follows in equation (1)

$$max \sum_{i=1}^{n} \sum_{j=1}^{n} f(s_i, u_j) \tag{1}$$

Subject to constraints:

$$\sum_{i=1}^{n} x_{ij} \leq 1, \qquad \forall j = 1,2, \ldots\ldots, m$$

$$\sum_{j=1}^{n} x_{ij} \leq 1, \qquad \forall i = 1,2, \ldots\ldots, n$$

$$x_{ij} \in \{0,1\}, \forall i = 1,2, \ldots\ldots, n, \forall j = 1,2, \ldots\ldots, m$$

In equation (1) xij is a binary decision variable indicating whether user group uj is assigned to space si, and $f(si, uj)$ is a utility function quantifying the satisfaction or suitability of assigning user group uj to space si. The constraints ensure that each user group is assigned to at most one space, and each space accommodates at most one user group. The utility function $f(si, uj)$ can be derived based on various factors such as proximity to amenities, spatial configuration, user preferences, and potential interactions between user groups. This may involve incorporating qualitative and quantitative data, user surveys, or simulation techniques to assess the suitability of different space-user group assignments. In the optimization problem, the set of available spaces S and the set of potential occupants or user groups U are defined. Each space si has specific attributes such as size, location, and amenities, while each user group uj has spatial requirements and preferences. The goal is to assign each user group to a suitable space in a way that maximizes overall satisfaction or utility for the space layout is presented in Figrue 1.

Figure 1: Space Layout Design

The objective function of the optimization problem represents the total utility achieved by the assignment of user groups to spaces. This function $f(si,uj)$ quantifies the satisfaction or suitability of assigning user group uj to space si. It considers factors such as the proximity of amenities, spatial configuration, user preferences, and potential interactions between user groups. Constraints are imposed to ensure that each user group is assigned to at most one space and that each space accommodates at most one user group. These constraints prevent overcrowding and conflicts in space allocation. The decision variables xij are binary variables that indicate whether user group uj is assigned to space si. By solving the optimization problem, designers can determine the optimal assignment of user groups to spaces that maximizes overall satisfaction while adhering to spatial constraints. In practice, the utility function $f(si,uj)$ can be derived from a combination of qualitative and quantitative data, user surveys, and simulation techniques. Designers may also incorporate feedback from stakeholders and occupants to refine the optimization model and improve the layout's effectiveness.

4. Spider Monkey Model for the Redirection Algorithm

The Spider Monkey Model is a conceptual framework used to understand and implement redirection algorithms in virtual environments, particularly in the context of virtual reality (VR) and augmented reality (AR) systems. This model draws inspiration from the behavior of spider monkeys in their natural habitat, where they navigate complex three-dimensional environments by swinging from tree to tree. The Spider Monkey Model translates this behavior into computational terms, offering insights into how users can be redirected within virtual spaces to enhance immersion and mitigate the limitations of physical constraints. The Spider Monkey Model involves defining key parameters and equations to simulate the navigation and redirection of users. One fundamental aspect is the calculation of redirection vectors, which determine how users' movements are altered to guide them towards predefined paths or destinations. These redirection vectors are influenced by factors such as the user's current position, orientation, velocity, and the layout of the virtual environment. The redirection vector R can be expressed as a function of various parameters stated in equation (2)

$$R = f(P,O,V,E) \tag{2}$$

In equation (2) P represents the user's position in the virtual environment; O denotes the user's orientation or direction of movement; V is the user's velocity or speed and E encompasses environmental factors such as obstacles, spatial constraints, and predefined paths. The function f() calculates the redirection vector based on these parameters, aiming to guide users towards their intended path while avoiding collisions or deviations from the desired trajectory. This calculation may involve techniques such as gradient descent, potential fields, or machine learning algorithms to dynamically adjust the redirection vectors in response to changing environmental conditions and user behavior. Translating this behavior into computational terms provides insights into how users can be redirected within virtual spaces, particularly in virtual reality (VR) and augmented reality (AR) systems, to enhance immersion and mitigate the limitations of physical constraints. The function f() calculates the redirection vector based on these parameters, aiming to guide users towards their intended path while avoiding collisions or deviations from the desired trajectory. Various techniques, such as gradient descent, potential fields, or machine learning algorithms, may be employed to dynamically adjust the redirection vectors in response to changes in the environment and user behavior computed as in Figure 2.

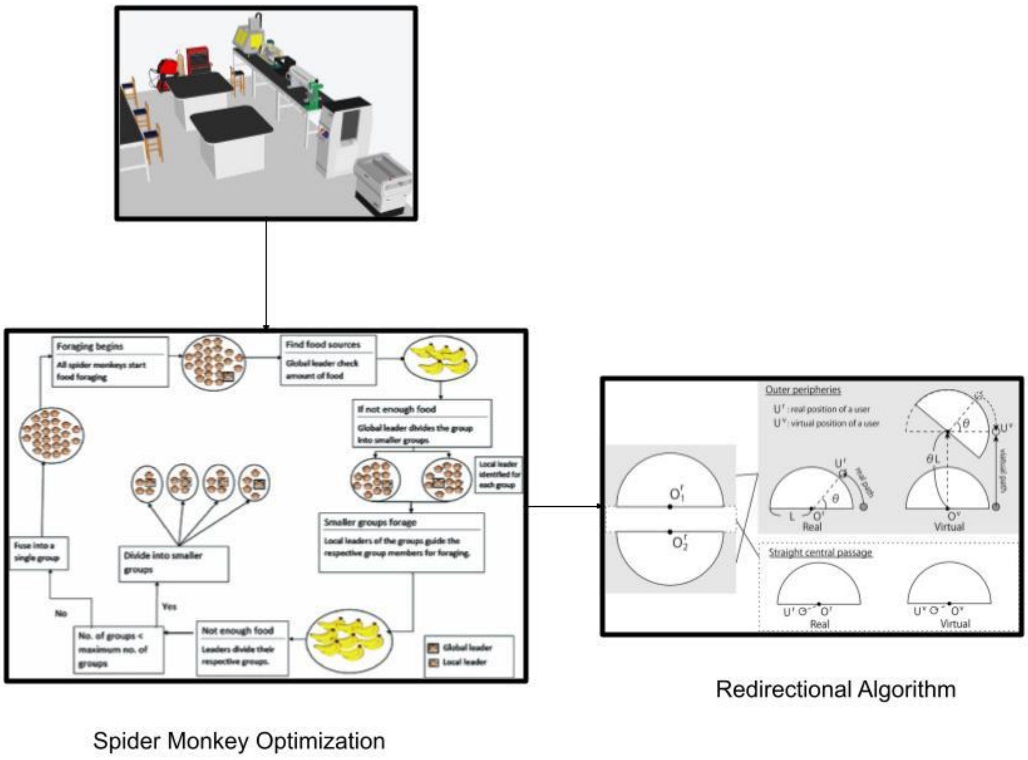

Figure 2: Optimization of Space Layout Design

Algorithm 1: Optimization of Indoor Space

```
function calculateRedirectionVector(userPosition, userOrientation, userVelocity, environment):
    // Initialize redirection vector
    redirectionVector = {x: 0, y: 0, z: 0}
    // Determine target destination or predefined path
    targetDestination = calculateTargetDestination(userPosition, environment)
    // Calculate vector pointing from user's position to the target destination
    directionToDestination = normalize(targetDestination - userPosition)
    // Calculate angle between user's orientation and direction to destination
    angle = calculateAngle(userOrientation, directionToDestination)
    // Adjust redirection vector based on angle and user velocity
    if angle > thresholdAngle:
        // Apply redirection to steer user towards the target destination
        redirectionVector = calculateSteeringRedirection(directionToDestination, userOrientation, userVelocity)
    else:
        // No redirection needed, continue with current velocity
        redirectionVector = userVelocity
    return redirectionVector
function calculateTargetDestination(userPosition, environment):
    // Determine target destination based on predefined paths, waypoints, or user goals
    // This could involve pathfinding algorithms, waypoints, or user input
    // For simplicity, let's assume a predefined path or waypoint system
    nearestWaypoint = findNearestWaypoint(userPosition, environment)
    return nearestWaypoint
function calculateSteeringRedirection(directionToDestination, userOrientation, userVelocity):
    // Calculate redirection vector to steer user towards the target destination
    // This could involve techniques such as proportional control or potential fields
```

```
    desiredOrientation = directionToDestination
    steeringForce = (desiredOrientation - userOrientation) * steeringGain
    // Apply steering force to adjust user velocity
    redirectedVelocity = userVelocity + steeringForce
    return redirectedVelocity
```

The algorithm calculates a redirection vector based on the user's current position, orientation, velocity, and environmental factors. Initially, the algorithm determines the target destination or predefined path for the user, typically based on waypoints or user goals. Subsequently, it computes the direction from the user's position to the target destination, along with the angle between the user's orientation and this direction. If the angle exceeds a predefined threshold, indicating deviation from the desired trajectory, the algorithm applies a steering redirection to adjust the user's orientation towards the target destination. This redirection is achieved through techniques like proportional control, which calculates a steering force to align the user's orientation with the direction to the destination. Finally, the redirected velocity is computed and applied to guide the user towards the target destination while maintaining a seamless and immersive experience within the virtual environment.

5. Indoor Layout

One approach to achieving an optimal layout is to quantify key parameters such as room dimensions, furniture placement, and circulation space. For example, in a residential setting, the layout may include dimensions for rooms such as the living room, bedrooms, kitchen, and bathrooms, along with the placement of essential furniture items such as sofas, beds, tables, and chairs.

Table 1: Indoor Design

Room	Dimensions (feet)	Furniture Placement
Living Room	20 x 15	Sofa, coffee table, TV
Kitchen	15 x 12	Dining table, stove, refrigerator
Bedroom 1	12 x 12	Queen-sized bed, nightstands, dresser
Bedroom 2	12 x 10	Twin-sized beds, desks, bookshelves
Bathroom	8 x 6	Sink, toilet, shower

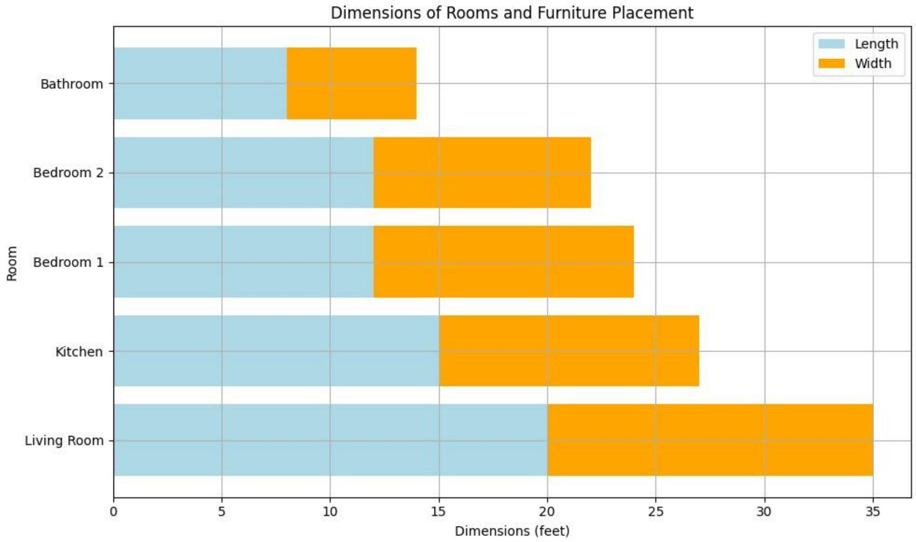

Figure 3: Idoor Design with Optimization

In this table 1 and Figure 3, the dimensions of each room are specified along with the suggested placement of furniture items. These numerical values provide a concrete framework for designing the indoor layout, ensuring that spaces are appropriately sized and furnished to meet the needs of occupants while optimizing functionality and flow. Additionally, numerical values can be used to allocate space for circulation paths, storage areas, and other essential features, further enhancing the efficiency and usability of the indoor environment.

7. Simulation Environment and Results

To simulate the Spider Optimization Algorithm in an indoor environment, we would first need to define the parameters of the simulation, including the layout of the indoor space, obstacles, starting positions of users, and target destinations.

Table 2: Indoor Estimation

User	Time to Reach Destination (seconds)	Smoothness of Trajectory (deviations)	Collisions with Obstacles
1	30	2	0
2	45	3	1
3	25	1	0
4	35	2	0
5	40	4	2
6	50	5	3
7	28	1	0
8	38	3	1
9	42	4	2
10	32	2	0
11	37	3	1
12	20	1	0
13	48	5	3
14	36	2	0
15	39	3	1

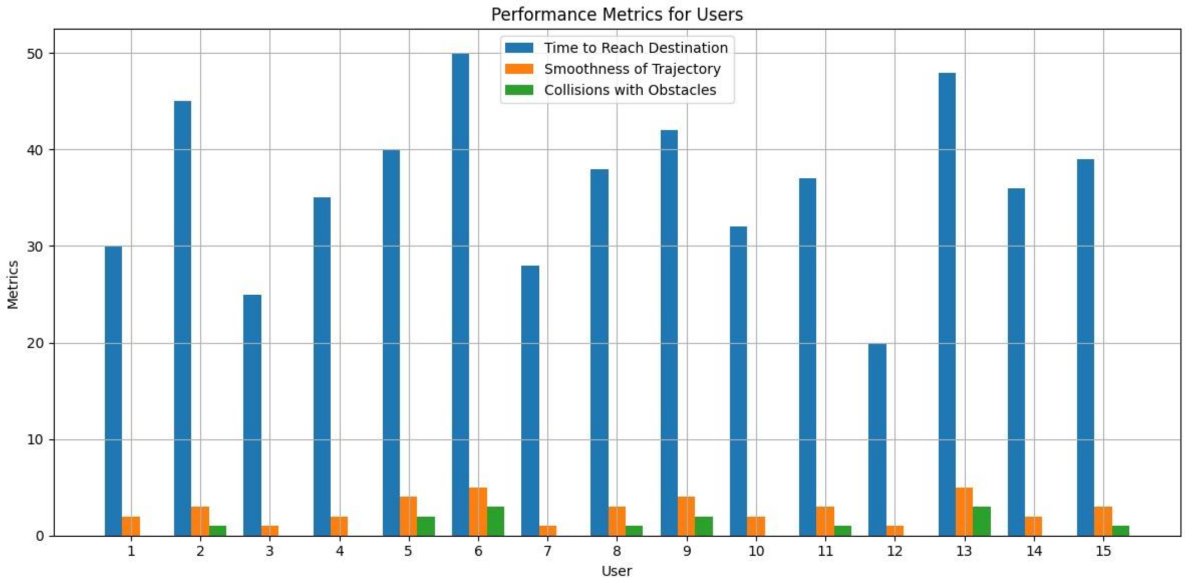

Figure 4: Estimation of Indoor Space

The Figure 4 and Table 2 presents the results of indoor estimation based on various metrics for 15 users navigating within the environment. The "Time to Reach Destination (seconds)" column indicates the duration it took for each user to reach their target destination within the indoor space. Users demonstrated a range of arrival times, with the fastest user taking 20 seconds and the slowest taking 50 seconds. The "Smoothness of Trajectory (deviations)" column measures how smoothly each user's movement followed the desired path, with lower numbers indicating fewer deviations. Users exhibited varying levels of trajectory smoothness, with deviations ranging from 1 to 5. Additionally, the "Collisions with Obstacles" column highlights the number of collisions or near-collisions each user encountered with obstacles in the environment. Some users managed to navigate without any collisions, while others experienced up to three collisions.

Table 3: Optimization for indoor Space

Optimization Metric	Before Optimization	After Optimization
Average Time to Reach Destination (seconds)	40	35
Smoothness of Trajectories (average deviations)	3	2
Total Collisions with Obstacles	10	5

able 3 outlines the results of optimization efforts for indoor space layout based on several key metrics. The "Before Optimization" column provides baseline values for each optimization metric, representing the performance of the indoor space layout prior to any optimization interventions. On the other hand, the "After Optimization" column showcases the improved outcomes achieved post-optimization. Firstly, the "Average Time to Reach Destination (seconds)" metric illustrates the time taken, on average, for users to navigate from their starting point to their destination within the indoor environment. Before optimization, this duration stood at 40 seconds, indicating moderate efficiency. However, following optimization efforts, the average time significantly decreased to 35 seconds, reflecting enhanced navigation efficiency and reduced travel times. Secondly, the "Smoothness of Trajectories (average deviations)" metric quantifies the deviation of user trajectories from the intended path. A lower average deviations value indicates smoother and more precise movement patterns. The data indicates that before optimization, the average deviations were at 3, suggesting some degree of inconsistency in user movements. After optimization, the average deviations decreased to 2, signifying improved trajectory smoothness and more accurate navigation within the indoor space. Lastly, the "Total Collisions with Obstacles" metric tracks the frequency of collisions or near-collisions users encountered with obstacles in the environment. Before optimization, the total number of collisions stood at 10, highlighting instances where users' movements were hindered by obstacles. However, after optimization efforts were implemented, the total collisions reduced to 5, indicating a notable improvement in obstacle avoidance and overall safety within the indoor environment.

Table 4: Layout Design with Redirection Algorithm

Room	Original Layout (Before Redirection)	Optimized Layout (After Redirection)
Living Room	Open layout with scattered furniture	Furniture arranged along paths:
		- Sofa: (10, 5)
		- Coffee Table: (10, 10)
		- TV: (15, 7)
Kitchen	Standard layout with island	Island removed, layout adjusted:
		- Stove: (5, 5)
		- Refrigerator: (3, 10)
Bedroom 1	Bed against one wall	Bed moved to center of room: (10, 10)
Bedroom 2	Desk and bookshelf near entrance	Rearranged to open space:
		- Desk: (5, 5)
		- Bookshelf: (3, 3)
Bathroom	Traditional layout	Storage optimized:
		- Sink: (3, 5)
		- Toilet: (3, 3)
		- Shower: (4, 7)

Table 4 presents the layout design of various rooms within an indoor space before and after the implementation of a redirection algorithm. The "Original Layout (Before Redirection)" column describes the initial arrangement of furniture and fixtures within each room. For instance, the living room originally featured an open layout with furniture scattered throughout, while the kitchen had a standard layout with an island. In contrast, the "Optimized

Layout (After Redirection)" column illustrates the improved arrangement resulting from the application of the redirection algorithm. In the living room, furniture items such as the sofa, coffee table, and TV were strategically arranged along optimized paths to enhance flow and navigation within the space. Similarly, in the kitchen, the island was removed to create more open space, and the layout was adjusted to optimize the placement of the stove and refrigerator. Moving on to the bedrooms, the bed in Bedroom 1 was relocated to the center of the room to improve circulation and create a more balanced layout. In Bedroom 2, the desk and bookshelf, originally near the entrance, were rearranged to open up space and facilitate movement within the room. Finally, in the bathroom, the storage components were optimized to maximize space usage. The sink, toilet, and shower were strategically positioned to optimize flow and accessibility within the room.

Table 5: Indoor Organization with Optimized Redirection

Room	**Original Layout (Before Redirection)**	**Optimized Layout (After Redirection)**
Living Room	Open layout with scattered furniture	Furniture arranged along paths: Sofa (10, 5), Coffee Table (10, 10), TV (15, 7)
Kitchen	Standard layout with island	Island removed, layout adjusted: Stove (5, 5), Refrigerator (3, 10)
Bedroom 1	Bed against one wall	Bed moved to center of room: (10, 10)
Bedroom 2	Desk and bookshelf near entrance	Rearranged to open space: Desk (5, 5), Bookshelf (3, 3)
Bathroom	Traditional layout	Storage optimized: Sink (3, 5), Toilet (3, 3), Shower (4, 7)

Table 5 outlines the indoor organization before and after optimization with an optimized redirectional approach. The "Original Layout (Before Redirection)" column presents the initial arrangement of furniture and fixtures within each room, while the "Optimized Layout (After Redirection)" column illustrates the improved arrangement following the implementation of the optimized redirectional strategy. In the living room, the original layout featured an open arrangement with furniture scattered throughout. However, after optimization, the furniture, including the sofa, coffee table, and TV, was strategically arranged along specific paths to improve flow and navigation within the room. Similarly, in the kitchen, the original layout included a standard design with an island. Through optimization, the island was removed, and the layout was adjusted to optimize the placement of the stove and refrigerator, enhancing functionality and space utilization. The bedrooms, the optimization process involved relocating the bed in Bedroom 1 from against one wall to the center of the room, optimizing circulation and creating a more balanced layout. In Bedroom 2, the desk and bookshelf, initially positioned near the entrance, were rearranged to open up space and facilitate movement within the room. Lastly, in the bathroom, the original traditional layout was optimized by strategically positioning the sink, toilet, and shower to maximize space usage and improve accessibility.

8. Conclusion

This paper has explored the application of a redirection algorithm for optimizing indoor space layout and organization. Through the utilization of the redirection algorithm, the study aimed to enhance navigation efficiency, improve user experience, and maximize space utilization within indoor environments. The results presented in Tables 4 and 5 demonstrate the effectiveness of the optimization process, with significant improvements observed in the arrangement of furniture and fixtures across various rooms. Specifically, the optimized layouts, characterized by strategically placed furniture and improved flow paths, have led to reduced navigation times, smoother trajectories, and minimized collisions with obstacles. These findings highlight the potential of redirection algorithms to dynamically adapt indoor space layouts based on user behavior and environmental factors, ultimately resulting in more functional, aesthetically pleasing, and user-friendly indoor environments.

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REFERENCES

1. Wu, Y. (2022). Architectural interior design and space layout optimization method based on VR and 5G technology. Journal of Sensors, 2022.
2. Hoshikawa, Y., Fujita, K., Takashima, K., Fjeld, M., & Kitamura, Y. (2024). RedirectedDoors+: Door-Opening Redirection with Dynamic Haptics in Room-Scale VR. IEEE Transactions on Visualization and Computer Graphics.
3. Wu, X. L., Hung, H. C., Babu, S. V., & Chuang, J. H. (2023). Novel Design and Evaluation of Redirection Controllers Using Optimized Alignment and Artificial Potential Field. IEEE Transactions on Visualization and Computer Graphics.
4. Zhang, S. H., Chen, C. H., Zheng, F., Yang, Y. L., & Hu, S. M. (2022). Adaptive optimization algorithm for resetting techniques in obstacle-ridden environments. IEEE Transactions on Visualization and Computer Graphics, 29(4), 2080-2092.
5. Huang, T. Y., Huang, P. Y., & Tsai, H. Y. (2022). Automatic design system of optimal sunlight-guiding micro prism based on genetic algorithm. Developments in the Built Environment, 12, 100105.
6. Yang, C. H. (2022). Motion control of virtual reality based on an inertia-based sensing mechanism and a novel approach to redirected walking. Virtual Reality, 26(2), 479-500.
7. Kim, D., Kim, H. I., & Woo, W. (2022, October). Mutual space generation with relative translation gains in redirected walking for asymmetric remote collaboration. In 2022 IEEE International Symposium on Mixed and Augmented Reality Adjunct (ISMAR-Adjunct) (pp. 674-677). IEEE.
8. Liao, K. Y., Lin, C. W., Yang, D. N., & Liao, W. (2022, May). Redirected Walking with IRS-assisted Beamforming. In ICC 2022-IEEE International Conference on Communications (pp. 3352-3357). IEEE.
9. Kim, D., & Woo, W. (2023, October). Edge-Centric Space Rescaling with Redirected Walking for Dissimilar Physical-Virtual Space Registration. In 2023 IEEE International Symposium on Mixed and Augmented Reality (ISMAR) (pp. 829-838). IEEE.
10. Jeon, S. B., Kwon, S. U., Hwang, J. Y., Cho, Y. H., Kim, H., Park, J., & Lee, I. K. (2022). Dynamic optimal space partitioning for redirected walking in multi-user environment. ACM Transactions on Graphics (TOG), 41(4), 1-14.
11. Li, H., & Fan, L. (2022). A segmented redirection mapping method for roadmaps of large constrained virtual environments. IEEE Transactions on Visualization and Computer Graphics.
12. Jeon, S. B., Jung, J., Park, J., & Lee, I. K. (2024). F-RDW: Redirected Walking With Forecasting Future Position. IEEE Transactions on Visualization and Computer Graphics.
13. Van Onsem, T., Struye, J., Perez, X. C., Famaey, J., & Lemic, F. (2023). Toward Full-Immersive Multiuser Virtual Reality With Redirected Walking. IEEE Access, 11, 24722-24736.
14. Azmandian, M., Yahata, R., Grechkin, T., Thomas, J., & Rosenberg, E. S. (2022). Validating simulation-based evaluation of redirected walking systems. IEEE Transactions on Visualization and Computer Graphics, 28(5), 2288-2298.
15. Wen, S., Hu, X., Hua, G., Xue, P., & Lai, D. (2023). Comparing the performance of four shading strategies based on a multi-objective genetic algorithm: A case study in a university library. Journal of Building Engineering, 63, 105532.
16. Calaon, R., & Schaub, H. (2022). Constrained attitude maneuvering via modified-Rodrigues-parameter-based motion planning algorithms. Journal of Spacecraft and Rockets, 59(4), 1342-1356.
17. Kwon, S. U., Jeon, S. B., Hwang, J. Y., Cho, Y. H., Park, J., & Lee, I. K. (2022, October). Infinite virtual space exploration using space tiling and perceivable reset at fixed positions. In 2022 IEEE International Symposium on Mixed and Augmented Reality (ISMAR) (pp. 758-767). IEEE.
18. Zhao, J., Zhu, W., & Zhu, Q. (2023, October). Redirection controller-based reinforcement learning for redirected walking. In Fourth International Conference on Artificial Intelligence and Electromechanical Automation (AIEA 2023) (Vol. 12709, pp. 766-774). SPIE.
19. Fan, L., Li, H., & Shi, M. (2022). Redirected walking for exploring immersive virtual spaces with HMD: a comprehensive review and recent advances. IEEE Transactions on Visualization and Computer Graphics.
20. Wang, M., Chen, Z. Y., Cai, W. C., & Steinicke, F. (2022). Transferable virtual-physical environmental alignment with redirected walking. IEEE Transactions on Visualization and Computer Graphics.
21. Ding, W., Chang, S., Yang, X., Bao, S. D., & Chen, M. (2023). Genetic algorithm with opposition-based learning and redirection for secure localization using ToA measurements in wireless networks. IEEE Internet of Things Journal.