Artificial Intelligence-Based Wayfinding Systems In Recreational Parks: An Analysis Of Enhancing Elderly Navigation And User Experience
(Sistem Pencarian Jalan Berasaskan Kecerdasan Buatan Di Taman Rekreasi: Analisis Mempertingkatkan Navigasi Warga Tua Dan Pengalaman Pengguna)

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ABSTRACT

Malaysia is experiencing demographic aging, characterized by a significant 6% growth in the proportion of elderly individuals aged 60 and above by the year 2030. Recreational parks, vital for physical and mental well-being, often become less accessible to elderly individuals due to navigation difficulties and safety concerns. As people age, physiological changes affect sensory functions, making navigation challenging and highlighting the critical need for innovative solutions to support elderly individuals' independence and well-being, based on their unique needs and requirements. By analysing current literature and insights based on three research objectives, the research aims to examine current challenges faced by elderly individuals when navigating recreational parks, identify existing AI technologies and their applications in enhancing wayfinding systems to improve accessibility and user experience for elderly park-goers, and determine the need and requirements through AI technologies and their applications for enhancing wayfinding systems to improve accessibility and user experience for elderly park-goers in recreational parks.. A framework is generated in order to answer each research objective and interconnect the results, complementing Sustainable Development Goals (SDGs) targets set by the United Nations. Collaborative efforts between park management, technology developers, and community stakeholders including the government will be essential in advancing AI applications, which uphold the Malaysia MADANI concept for the well-being and welfare of the elderly.

Keywords: Artificial Intelligence (AI); Elderly; Recreational Parks; Accessibility; Wayfinding

ABSTRAK

Malaysia sedang mengalami penuaan demografi, dengan kadar pertumbuhan warga emas berumur 60 tahun ke atas sebanyak 6% menjelang tahun 2030. Taman rekreasi adalah penting untuk kesejahteraan fizikal dan mental, namun susah untuk diakses oleh warga emas kerana kesukaran navigasi dan kebimbangan keselamatan. Dalam proses penuaan, perubahan fisiologi mempengaruhi fungsi deria, menjadikan navigasi mencabar dan menyerlahkan keperluan kritikal untuk penyelesaian inovatif bagi menyokong kebebasan dan kesejahteraan warga emas, berdasarkan keinginan dan keperluan unik mereka. Dengan menganalisis kajian dan pandangan semasa berasaskan tiga objektif, penyelidikan ini bertujuan untuk mengkaji cabaran semasa yang dihadapi oleh warga emas semasa menavigasi di taman rekreasi; mengenal pasti teknologi AI sedia ada dan aplikasinya dalam menambahbaik sistem navigasi untuk kebolehcapaian dan pengalaman pengguna warga emas di taman rekreasi; serta menentukan kemahuan dan keperluan melalui teknologi AI dan aplikasi mereka dalam mempertingkatkan sistem navigasi untuk kebolehcapaian dan pengalaman pengunjung taman warga tua di taman rekreasi. Rangka kajian dijana untuk menjawab setiap objektif penyelidikan dan menyambungkan hasil kajian, melengkapkan sasaran Sustainable Development Goals (SDG) yang ditetapkan oleh Pertubuhan Bangsa-Bangsa Bersatu. Kerjasama antara pengurusan taman, pemaju teknologi dan pihak berkepentingan komuniti termasuk kerajaan akan menjadi penting dalam memajukan aplikasi AI, seterusnya mendukung konsep Malaysia MADANI untuk kesejahteraan warga emas.

Kata kunci: Kepintaran Buatan (AI); Warga emas; Taman Rekreasi; Kebolehcapaian; Navigasi

INTRODUCTION

HEALTH IS MORE IMPORTANT THAN MONEY; as deliberated that there is more to life than money (Ridhwan et. al., 2022). As people age, various physiological changes such as vision problems including presbyopia, cataracts, glaucoma and age-related macular degeneration (AMD) cause difficulty reading small print, adjusting to lighting changes, and distinguishing colors (WHO, 2023). Hearing loss is another significant issue, which affects 1 in 3 elderly aged 65 to 74, with presbycusis (gradual loss of hearing in both ears) being common. These problems lead to difficulties understanding speech and increased risk of misinterpreting conversations (Sherman, 2024). Changes in sensory perception and touch sensitivity also affect the elderly, increasing the risk of burns and injuries from falls. Combined together, these problems create navigational issues. Each year, approximately 684,000 people die from falls, which is the second leading cause of unintentional injury deaths, following road traffic accidents. More than 80% of fatalities occur in low- and middle-income countries, with the Western Pacific and South-East Asia regions accounting for 60% of deaths. Globally, adults over 60 years old have the highest death rates from falls. In the United States, 20–30% of older individuals who fall experience moderate to severe injuries, including bruises, hip fractures, or head trauma (WHO, 2021).

As such, "Malaysia has an opportunity to better protect its elderly citizens and enable them to age with dignity and purpose," said Firas Raad, World Bank Group Representative to Malaysia and Country Manager (World Bank, 2020). Yes, Malaysia

TABLE 1.0 SDGs Prioritising The Elderly

No.	SDG Goal	Description	Malaysia Level
1		**Goal 3: Good Health and Well-being** - This goal aims to ensure healthy lives and promote well-being for all at all ages. Improving wayfinding for the elderly can contribute to their physical and mental well-being by reducing stress and promoting independence.	
2		**Goal 9: Industry, Innovation, and Infrastructure** - Innovations in technology and infrastructure can improve wayfinding for elderly individuals, enhancing their mobility and quality of life.	
3		**Goal 10: Reduced Inequalities** - Elderly individuals often face inequalities in access to services and facilities. Improving wayfinding can reduce these inequalities by making public spaces more accessible and user-friendly for older adults.	
4		**Goal 11: Sustainable Cities and Communities** - Focus on making cities and human settlements inclusive, safe, resilient, and sustainable. Improving wayfinding systems makes urban areas more accessible and navigable for elderly individuals.	

is experiencing demographic aging, characterized by a significant growth proportion of elderly individuals aged 60 and above by the year 2030. As of 2020, this age group comprised about 9.4% of the total population; it is expected to hit 15% in 2030 (Statista, 2023). Furthermore the United Nations Decade of Healthy Ageing (2021–2030) seeks to create multi sectoral changes concerning elderly wayfinding with the United Nations' Sustainable Development Goals (UN, 2024; WHO, 2020) shown in Table 1.0, as described in detail by Shelvelkova et. al. in 2023.

Researchers and policymakers increasingly used happiness or subjective well-being (SWB) as an index of quality of life (Ortiz-Ospina & Roser, 2023). Based on research, people between the ages of 66–75 were more inclined to frequent local parks compared to other age groups in the United States of America and China, having more time for leisure to escape stress (Wei & Rahman, 2023). The elderly are also more aware of their well-being and health due to age factor and poor quality of the urban living environment (Layard & De Neve, 2023). Furthermore, previous studies defined preference as a cognitive process where some people appreciate a landscape more than another, considering it 'more lively or desirable' (Yan et. al., 2023). Recreational parks will complement the government initiatives, but often become less accessible to elderly individuals due to navigation difficulties and safety concerns. Adaptations are crucial to maintain the independence and well-being of older adults, helping them cope (Wu et. al., 2023).

However, referring to the United Nations Sustainable Development Report (SDR, 2024), Malaysia at an overall SDG score of 69.32 needs to generate more effort to solve the major, significant and remaining challenges, which will be significant for Malaysia to achieve the aspirations and goals of the Malaysia MADANI, the Ekonomi MADANI: Memperkasa Rakyat framework and the Twelfth Malaysia Plan to ensure that the elderly are not left behind. With the global AI market set to reach USD 267 billion by 2027, with AI expected to grow ASEAN's GDP to USD 950 billion by 2030, and Malaysia contributing USD 115 billion or 14% of the region's GDP by 2030 (MASTIC, 2024), it had never been more important and timely that as being the ASEAN Chair, Malaysia must lead the revolution in AI and what better to be one of the pioneers in AI-powered wayfinding. This must be guided by our National Principles in accordance with the vision of the current government.

Research Aims

The research aims to identify AI technologies as pivotal tools for addressing the challenges faced by the unique needs and requirements of elderly park-goers. A framework will then be generated in order for parks to create more inclusive and enjoyable spaces that promote physical activity, social engagement, and overall well-being among elderly visitors.

Research Objectives

To fulfill the requirements of the research aims, the research objectives centre to the research are listed as follows:

RESEARCH OBJECTIVE 1: Examine current challenges faced by elderly individuals when navigating in recreational parks.

RESEARCH OBJECTIVE 2: Identify existing AI technologies and their applications in enhancing wayfinding systems to improve accessibility and user experience for elderly park-goers in recreational parks.

RESEARCH OBJECTIVE 3: Determine the need and requirements through AI technologies and their applications for enhancing wayfinding systems to improve accessibility and user experience for elderly park-goers in recreational parks.

Scope Of Study

The scope of this study encompasses a critical literature review and overview of the challenges facing the elderly during wayfinding in public parks, the implementation and impact of AI-based wayfinding systems in improving navigation and enhancing the user experience among elderly individuals, and evaluating the effectiveness of AI technologies in addressing the specific needs of elderly visitors.

METHODOLOGY

The methodology employed in this research firstly identified the three research objectives which formed the basis of the research. After that, it integrates critical literature review, focusing on keywords "*Artificial Intelligence (AI); Elderly; Recreational Parks;*

Accessibility; Wayfinding," which guided the selection of literature to ensure a comprehensive exploration of the research topic. The methodology aimed to provide robust insights into how AI can be leveraged to address the unique navigation challenges faced by elderly individuals while enhancing their overall user experience and accessibility in various environments. Finally, it concludes with a summary of the research and findings, as well as suggestions for future research. The Research Methodology Process is summarised in Table 2.0.

TABLE 2.0 Summary Of Research Methodology Process

No.	Process	Description	Flow
1.	Define Research Objectives	Three research objectives were fixed forming the basis of the research	⬇
2 .	Literature Review	Sourcing of literature from reputable journals, books and websites, using keywords: *Artificial Intelligence (AI); Elderly; Recreational Parks; Accessibility; Wayfinding*	⬇
3 .	Results	Critical analysis of literature to answer research objectives	⬇
4 .	Conclusion	Summary of the research and findings, as well as suggestions for future research.	⬇

LITERATURE REVIEW

The research integrates a thorough literature review and analysis of case studies to explore the impact of AI-based wayfinding systems on enhancing navigation and user experience for elderly individuals. The literature review identifies gaps and trends in existing research related to elderly navigation, AI technologies, user experience (UX), personalized assistance, and accessibility. Case studies from various settings provide empirical evidence of how AI technologies like machine learning algorithms, computer vision, and natural language processing are utilized to personalize navigation assistance for elderly users.

Challenges Faced By Elderly Individuals

Elderly individuals encounter several challenges when navigating recreational parks, impacting their overall experience and well-being. Physical accessibility remains a primary concern, as many parks lack infrastructure such as uneven pathways, steep slopes, and inadequate seating, which can hinder mobility and comfort (Wen et. al., 2022). Safety concerns also arise, particularly in secluded areas or during certain times of the day, highlighting the need for enhanced security measures to ensure the safety of elderly visitors (NRPA, 2024; Zhou et. al., 2024). Social isolation is another critical issue, with many elderly individuals feeling isolated when visiting parks alone, underscoring the importance of community programs and inclusive spaces to foster social interaction and improve mental well-being (Wen et. al., 2022). International policies and watchdogs indicate that traditional wayfinding systems often fall short in meeting the diverse needs of elderly users due to static signage, complex layouts, and insufficient consideration of accessibility issues (WHO, 2021; WHO 2024).

Inadequate seating and rest areas make it difficult for older adults to take breaks, thus impacting their enjoyment and comfort (NRPA, 2024). Poor signage and wayfinding systems contribute to frustration and disorientation among elderly park-goers, emphasizing the need for clear and intuitive navigational aids to enhance their park experience (Wen et. al., 2022). Recent studies underscore several key shortcomings of traditional systems, including static signage that may not adequately accommodate varying levels of cognitive abilities and sensory impairments among elderly users (WHO, 2021; WHO 2024). Additionally, considering the impact of health conditions such as arthritis and cardiovascular issues on endurance during walks, addressing health needs is crucial in designing elderly-friendly park environments (Wen et. al., 2022). Environmental factors such as extreme weather conditions pose additional barriers, discouraging elderly individuals from participating in outdoor activities and requiring parks to adopt climate-

resilient designs to accommodate older adults (Zhou et. al., 2024). Traditional systems lack real-time updates and dynamic routing capabilities needed to adapt to changing conditions within complex environments (Aminizadeth et al., 2024). The challenges facing the elderly in public parks and their relevance are compared in Table 3.0.

TABLE 3.0: Challenges and Relevance Of Elderly In Public Parks

No.	Challenges	Relevance
1	Physical Accessibility	Many recreational parks lack proper infrastructure for elderly visitors. Uneven pathways, steep slopes, and inadequate seating can hinder mobility.
2	Safety Concerns	Elderly individuals may worry about safety while walking, especially in secluded areas or during certain times of the day.
3	Social Isolation	Elderly individuals may feel isolated when visiting parks alone. Lack of social interaction can impact mental well-being.
4	Lack of Seating and Rest Areas	Insufficient benches or rest areas can make it challenging for older adults to take breaks during walks.
5	Inadequate Signage and Wayfinding	Poor signage can confuse elderly visitors, leading to frustration and disorientation.
6	Health Conditions and Fatigue	Chronic health conditions (e.g., arthritis, cardiovascular issues) can limit endurance during walks.
7	Environmental Factors	Extreme weather conditions (heat, rain) can discourage elderly individuals from outdoor activities.

Available AI Technologies And Applications

In the realm of AI technologies applied to public park environments, several innovative applications are emerging to enhance visitor experiences. Generative AI is leveraged for wayfinding enhancement, providing natural language interaction through an infinitely patient guide that offers personalized routes and emergency information. Computer vision technologies enhance navigation systems by enabling devices to interpret and respond to visual cues, such as recognizing landmarks or reading signage, assisting the visually impaired (García-Catalá et. al., 2022). Augmented Reality (AR) wayfinding systems utilize landmark-based navigation and offer customized routes with interactive information overlays, enriching navigation experiences. Intuitive interfaces offer straightforward navigation options and minimize cognitive load for users unfamiliar with technology (García-Catalá et. al., 2022). Integrating these AI technologies with existing navigation tools, such as smartphones and wearable devices, presents a seamless and personalized navigation experience for elderly visitors through step-by-step directions, alerts on obstacles or changes in their environment, and alternative routes (Jiang et al., 2023).

Predictive algorithms optimize paths by recommending efficient routes and aiding in crowd avoidance, ensuring smooth and enjoyable park visits. Machine learning algorithms play a pivotal role by enabling AI systems to analyze and adapt to user behaviors and preferences over time, thereby personalizing navigation routes and recommendations based on historical data and real-time inputs (Karthiyayini et al., 2024). Airports utilise advanced technologies like machine learning and real-time data analytics through intuitive interfaces to direct travelers efficiently to their destinations, reducing stress and enhancing overall satisfaction (Koniel, 2023). Smart signage and audio guides deliver contextual information with multilingual support, enhancing visitor understanding and accessibility. Personalization is key

to enhancing user experience, with features like font size adjustment and color contrast settings catering to individual preferences and accessibility needs (Koniel, 2023). Audio-based spoken directions and real-time updates further support independence and confidence in navigation tasks (Hutson & Hutson, 2023). Voice-based instructions represent a critical design element, providing auditory cues that can guide elderly visitors without relying on text-based information, which may be challenging for those with visual impairments or limited literacy skills (Arnold et al., 2024).

Virtual Reality (VR) previews allow for immersive virtual exploration of park layouts, aiding memory recall and enhancing anticipation of park attractions. These AI technologies collectively aim to transform public park visits into intuitive, informative, and memorable experiences for all visitors. AI-powered devices, such as fall detection systems and smart home technologies, provide real-time monitoring and alerts, reducing the risk of accidents (Lee et. al., 2023). Continuous user feedback is essential for refining and improving system performance over time, allowing designers to identify usability issues, accessibility barriers, and areas for enhancement. This iterative process ensures that the AI-based wayfinding system evolves to better meet the diverse needs of its users and remains responsive to changing requirements (Koniel, 2023).

In healthcare settings, Singapore General Hospital (SGH) utilizes AI-driven wayfinding systems to streamline navigation within its complex environment (Sharmila Nirojini et. al., 2024). By utilizing real-time data analytics and predictive algorithms, SGH enhances operational efficiency, manages patient flows effectively, and improves overall healthcare delivery (Lee, 2024; Wong, 2024). Similar implementations at hospitals like Vestre Viken in Norway and the Cleveland Clinic underscore the transformative impact of AI in healthcare navigation, prioritizing both patient experience and operational efficiency (Markets And Markets, 2024; Cleveland Clinic, 2023). Microsoft's involvement through its Azure platform further advances AI-driven wayfinding systems. Azure provides foundational tools such as machine learning, natural language processing, and computer vision, enabling hospitals to create intelligent navigation applications tailored to individual patient needs. Azure's capabilities and industry partnerships contribute significantly to enhancing healthcare operations and patient experiences through innovative AI applications (Rustogi, 2023; Markets And Markets, 2024). Table 4.0 compares the types of AI technologies and applications.

Elderly Needs And Requirements

In designing public parks for elderly visitors, several key needs and requirements must be addressed to ensure their comfort, safety, and enjoyment. Accessible pathways and routes are essential to enable elderly visitors to navigate the park comfortably. By integrating sophisticated algorithms, AI systems adapt to user requirements, such as accessibility preferences, and the ability to avoid obstacles like stairs or crowded areas (Hutson & Hutson, 2024). This capability not only empowers elderly visitors to explore new environments

TABLE 4.0: Types Of AI Technologies And Applications

No.	AI Technologies	Applications
1.	Generative AI for Wayfinding Enhancement	Natural Language Interaction
		Infinitely Patient Guide
		Emergency Information
2.	Augmented Reality (AR) Wayfinding Systems	Landmark-Based Navigation
		Customized Routes
		Interactive Information
3.	Predictive Algorithms for Path Optimization	Path Recommendations
		Crowd Avoidance
4.	Smart Signage and Audio Guides	Contextual Information
		Multilingual Support
5.	Virtual Reality (VR) Previews	Virtual Exploration
		Memory Recall

autonomously but also enhances the overall user experience by making visits more enjoyable and less daunting (Vrančić et al., 2024). Studies have explored the effectiveness of AI-based wayfinding systems in enhancing navigation autonomy among elderly individuals by providing personalized routes and real-time guidance. Furthermore, AI-based approaches address these limitations by offering dynamic voice commands, interactive maps, and customizable settings that facilitate intuitive and efficient navigation in healthcare facilities, shopping malls, and public transportation systems (Åkerblom-Andersson & Tjernström, 2024; Sharmila Nirojini et. al., 2024).

Handrails for support offer crucial assistance, giving elderly visitors the confidence to navigate through park areas and equipment safely. Safe and well-lit paths enhance overall safety measures, while emergency assistance facilities cater to the health needs of elderly visitors should they require immediate help. In healthcare, this involves providing such accessible facilities including non-slip flooring to ensure safe mobility for those with physical limitations, alongside

patient-centered care models for cognitive health support (WHO, 2021; Cano, 2023; WHO, 2024). AI algorithms analyse real-time data such as user preferences and traffic patterns to offer optimized routes that consider factors like accessibility, preferred walking pace, and avoidance of obstacles (García-Catalá et. al., 2022). This personalized approach enhances the user experience by reducing cognitive load and decision-making burden on elderly individuals, thereby promoting independence and confidence in navigation tasks (Makhataeva et al., 2023). Integration of health monitoring functionalities enhances safety through fall detection and emergency alerts, contributing to overall user confidence and well-being (Wang et al., 2024).

Wayfinding aids, such as clear and intuitive signage and maps, enhance navigation, reduce confusion, and promote independence and enjoyment for elderly park-goers. Clear signage is crucial, as studies indicate that legible and well-placed signage helps elderly users orient themselves and follow directions more easily (WHO, 2021; WHO, 2024). Similarly, retail environments create accessible entrances with

TABLE 5.0: Needs & Requirements Of The Elderly In Recreational Parks

No.	Needs & Requirements	Relevance
1.	Accessible Pathways And Routes	Ensuring elderly visitors can navigate parks comfortably.
2.	Seating And Resting Areas	Providing places for elderly individuals to rest and relax.
3.	Handrails For Support	Giving elderly support and confidence to navigate through parks and equipment
4.	Safe And Well-Lit Paths	Enhancing safety measures for elderly visitors.
5.	Emergency Assistance	Catering to the health needs of elderly visitors.
6 .	Personal Security	Ensuring safety and peace of mind during visits.
7.	Social Interaction	Addressing social isolation concerns among elderly visitors.
8.	Community Engagement Programs	Foster social interaction, mental stimulation, and a sense of belonging, enhancing overall well-being and enjoyment of park facilities.
9.	Shared And Rest Areas For Fatigue	Provide opportunities for rest, reducing fatigue, and promoting longer and more comfortable visits.
10.	Wayfinding Aids	Enhancing navigation, reducing confusion, and promoting independence and enjoyment.
11.	Clear And Intuitive Signage	Improving wayfinding experiences for elderly park-goers.
12.	Climate-Appropriate Amenities	Ensure comfort, safety, and accessibility, fostering physical activity, social interaction, and enjoyment of nature.
13.	Comfortable Weather Conditions	Creating environments that are conducive for outdoor activities.

clear signage to enhance elderly shoppers' shopping experience and convenience (Yakobi et. al., 2023). Personalized routes, clear directions, and interactive voice prompts or visual cues enhance independence, enjoyment, alleviates stress, and improves safety during navigation (Aktar, 2023). Voice instructions and visual aids improve accessibility and contribute to higher satisfaction and operational efficiency (Lee, 2024; Wong, 2024). These systems leverage AI to adapt to individual preferences and conditions, such as mobility limitations and cognitive impairments, which promotes independence and reduces stress during navigation (Aktar, 2023; García-Catalá et. al., 2022).

Seating and resting areas provide necessary places for elderly individuals to rest and relax during their visits. Personal security measures, including visible staff and emergency call points, ensure visitors' safety and peace of mind. Social interaction programs address concerns of social isolation among elderly visitors, fostering community engagement and mental stimulation. This is shown in a research at Taman Bermain Taman Midah that the elderly enjoy qi–gong as a get-together activity (Wei & Rahman, 2023). Additionally, shared and rest areas for fatigue provide opportunities for rest, reducing tiredness and enabling longer and more comfortable visits. Finally, climate-appropriate amenities ensure comfort, accessibility, and the enjoyment of physical activity and nature, enhancing

overall well-being within the park environment. Furthermore, machine learning capabilities continuously improve based on evolving environmental conditions (Jnr, 2024), which can integrate additional functionalities like voice interaction, augmented reality overlays, and health monitoring features, enhancing safety and usability for elderly populations (Mahroo et al., 2023). Table 5.0 lists the needs and requirements of the elderly in recreational parks, and each relevance towards the research.t

RESULTS

The literature is critically analysed and tabulated to provide a structured overview of how AI technologies can be applied to meet the needs and overcome the challenges faced by elderly individuals, enhancing their experience in recreational park settings. Challenges Faced by Elderly Individuals lists specific challenges elderly individuals encounter in recreational parks, and describes AI technologies and their applications that can address each challenge. Elderly Needs & Requirements specifies the needs and requirements of elderly visitors in recreational parks, corresponding to the challenges identified. The research objectives and results are then summarised and formed into the framework which is shown in Figure 1.0:

FIGURE 1.0: A framework for improving elderly navigation and user experience through AI-based wayfinding systems

The framework proves that AI has significantly improved the lives of the elderly by enhancing safety, healthcare, and daily living, which can assist in achieving the SDG Goals listed in Table 1.0 of the Introduction Chapter. Improvements in elderly navigation experiences within intricate environments like hospitals or large public areas (García-Catalá et. al., 2022) are essential, as navigating unfamiliar or bustling spaces can pose significant challenges due to reduced mobility or cognitive impairments (Wu et. al., 2024).

CONCLUSION

In conclusion, this research successfully achieved its objectives by examining current navigation challenges faced by elderly individuals in recreational parks, identifying existing AI technologies and their applications in enhancing wayfinding systems, and determining the specific needs and requirements for these AI-powered solutions to improve accessibility and user experience for elderly park-goers. The critical literature analysis highlighted that age-related physiological challenges, such as vision and hearing impairments, significantly impact safe and independent park navigation. The prevalence of falls among the elderly underscores the urgent need for improved park infrastructure and supportive AI technologies, as traditional wayfinding systems often fall short. AI-driven advancements such as generative AI for personalized wayfinding, augmented reality (AR) systems, and predictive algorithms were identified as transformative tools. These technologies promise to improve navigation, reduce cognitive load, and enhance overall user experience by providing tailored assistance and real-time updates. They address specific needs such as accessible pathways, safe environments, and interactive wayfinding aids, which are crucial for elderly visitors' comfort and safety. The framework developed through this research fulfilled the study's aims and demonstrated that AI can significantly improve the lives of elderly individuals by enhancing safety, healthcare, and daily living-thereby supporting the United Nations Sustainable Development Goals.

Notably, this research aligns with key pillars of Malaysia MADANI, particularly Kesejahteraan (well-being), Ihsan (compassion), and Daya Cipta (innovation). By proposing AI solutions that prioritize accessibility and respect for elderly users, the study contributes to creating more inclusive, compassionate, and technologically empowered public spaces. It also reflects the aspirations of Malaysia's National AI Roadmap, which emphasizes human-centered, ethical, and inclusive AI applications for public benefit. Moving forward, future research in the Malaysian context should focus on the practical implementation and effectiveness of AI wayfinding technologies within recreational parks. This includes developing and integrating context-aware navigation applications that provide personalized directions based on users' mobility and cognitive capabilities, potentially incorporating voice-guided assistance in Bahasa Malaysia to enhance usability. In line with MADANI's value of Hormat (respect), designing systems that accommodate varying digital literacy levels among elderly users will be vital—possibly through large-font displays, haptic feedback, or simplified interaction models. Additionally, AI-powered sensor networks can be explored to monitor environmental conditions and pedestrian flow, offering real-time safety alerts and dynamic route adjustments. The integration of predictive analytics to foresee hazards and recommend safer paths can significantly improve trust in these systems, supporting the MADANI value of Keyakinan (trust).

Lastly, this research recommends exploring synergies between AI-enhanced park systems and broader smart city initiatives. Integrating data from park environments with healthcare, transportation, and social services will help build a sustainable and cohesive urban ecosystem, aligned with the MADANI commitment to KeMampanan (sustainability). Achieving this vision will require interdisciplinary collaboration between technologists, urban planners, gerontologists, and policymakers to holistically support Malaysia's aging population, which will increasingly shape the nation's demographic landscape in the coming years.

APPRECIATION

REFERENCES

Åkerblom-Andersson, C., & Tjernström, L. (2024). It's smart, but you know, it lacks that human touch!: Exploring and designing for dynamic user control in AI-driven automated systems.

Aktar, S. F. (2023). *Artificial Intelligence-Based Smarter*

Accessibility Evaluations for Comprehensive and Personalized Assessment. Marquette University.

Aminizadeh, S., Heidari, A., Dehghan, M., Toumaj, S., Rezaei, M., Navimipour, N. J., ... & Unal, M. (2024). Opportunities and challenges of artificial intelligence and distributed systems to improve the quality of healthcare service. *Artificial Intelligence in Medicine*, *149*, 102779.

Arnold, A., Kolody, S., Comeau, A., & Miguel Cruz, A. (2024). What does the literature say about the use of personal voice assistants in older adults? A scoping review. *Disability and Rehabilitation: Assistive Technology*, *19*(1), 100-111.

Cano, F., Alves, E., Joao, A., Oliveira, H., Pinho, L. G., & Fonseca, C. (2023). A rapid literature review on the health-related outcomes of long-term person-centered care models in adults with chronic illness. *Frontiers in Public Health*, *11*, 1213816.

Cleveland Clinic. (2023). 6 Things to Know About the Future Home of Our Neurological Institute. Cleveland Clinic. https://consultqd. clevelandclinic.org/6-things-to-know-about-the-future-home-of-our-neu rological-institute

García-Catalá, M. T., Rodriguez-Sánchez, M. C., & Martín-Barroso, E. (2022). Survey of indoor location technologies and wayfinding systems for users with cognitive disabilities in emergencies. *Behaviour & Information Technology*, *41*(4), 879-903.

Hutson, J., & Hutson, P. (2024). Immersive technologies. In *Inclusive Smart Museums: Engaging Neurodiverse Audiences and Enhancing Cultural Heritage* (pp. 153-228). Cham: Springer Nature Switzerland.

Jiang, Y., Tran, T. H., & Williams, L. (2023). Machine learning and mixed reality for smart aviation: Applications and challenges. *Journal of Air Transport Management*, *111*, 102437.

Jnr, B. A. (2024). User-centered AI-based voice-assistants for safe mobility of older people in urban context. *AI & SOCIETY*, 1-24.

Karthiyayini, J., & Anandhi, R. J. (2024). To Analyze the Various Machine Learning Algorithms That Can Effectively Process Large Volumes of Data and Extract Relevant Information for Personalized Travel Recommendations. *SN Computer Science*, *5*(4), 336.

Kloepfel, M. (2024, June 14). Artificial Intelligence: Adopt of Get Left Behind. Medium. https://medium.com/@markkloepfel/artificial-intelligence-adopt-or-get-left-behind-6e738 7e695b9

Koniel, D. (2023). Emerging trends and technologies in the built environment: hospital and hotel buildings.

Layard, R., & De Neve, J. E. (2023). *Wellbeing*. Cambridge University Press.

Lee, C. H., Wang, C., Fan, X., Li, F., & Chen, C. H. (2023). Artificial intelligence-enabled digital transformation in elderly healthcare field: scoping review. *Advanced Engineering Informatics*, *55*, 101874.

Lee, K. (2024, March). The Science Of Signs At Changi. Changi Airport Group. https://www.changiairport. com/corporate/media-centre/changijourneys/the-changi-experi ence/science-signs.html

Mahroo, A., Greci, L., Mondellini, M., & Sacco, M. (2023). Assessment of a mixed reality smart home controller: HoloHome pilot study on healthy adults. *Virtual Reality*, *27*(3), 2673-2690.

Makhataeva, Z., Akhmetov, T., & Varol, H. A. (2023). Augmented Reality for Cognitive Impairments. In *Springer Handbook of Augmented Reality* (pp. 765-793). Cham: Springer International Publishing.

Malaysian Science and Technology Information Centre MASTIC (2024, September). The National Guidelines On AI Governance And Ethics. https:// mastic.mosti.gov.my/publication/the-national-guidelines-on-ai-governance-ethics/

Markets And Markets. (2024, January). Artificial Intelligence (AI) In Healthcare Market. Markets And Markets. https://www.marketsandmarkets. com/Market-Reports/artificial-intelligence-healthcare-m arket-54679303.html?gad_source= 1&gclid=Cj0KCQjws560BhCuARIsAHMqE0H ArieyTzIHjP9Ekz8QVMCQSVl-AaqUffXsT1EL ymxpyjL3i3tSQGEaAq82EALw_wcB

NRPA. (2024, May 13). NRPA Report Demonstrates Importance of Parks & Rec for Older Adults. Recreation Management. National Recreation and Park Association. https://recmanagement. com/articles/154461/nrpa-report-demonstrates-importance-parks-r ec-older-adults

Ortiz-Ospina, E., & Roser, M. (2023). Happiness and life satisfaction. *Our World in Data*.

Ridhwan, M. M., Nijkamp, P., Ismail, A., & M. Irsyad, L. (2022). The effect of health on economic growth: A meta-regression analysis. *Empirical Economics*, *63*(6), 3211-3251.

Rustogi, E. (2023, September 13). Unlock data value with healthcare data solutions in Microsoft Fabric. Microsoft. https://www.microsoft.com/en-us/ industry/blog/healthcare/2023/10/10/unlock-data-value -with-healthcare-data-solutions-in-microsoft-fabric/?culture=en-us&country=us

SDR. (2024). Sustainable Development Report.

Performance By SDG. https://dashboards.sdgindex.org/map

Sharmila Nirojini, P., Kanaga, K., Devika, S., & Pradeep, P. (2024). Exploring the impact of artificial intelligence on patient care: a comprehensive review of healthcare advancements. *Sch Acad J Pharm*, *13*, 67-81.

Sherman, L. (2024, March 11). Age-Related Hearing Loss (Presbycusis) Facts. National Council On Aging. https://www.ncoa.org/adviser/hearing-aids/presbycusis-age-related-hearing-loss/

Shevelkova, V., Mattocks, C., & Lafortune, L. (2023). Efforts to address the Sustainable Development Goals in older populations: A scoping review. *BMC Public Health*, *23*(1), 456.

Statista. (2023, September 13). Number of population in Malaysia as of July 2023, by state (in millions). Statista Research Department. https://www.statista.com/statistics/1040670/malaysia-population-distribution-by-state/

Teo Kok Wei , Mohd Shahril Abdul Rahman (2023). Affordances of Urban Housing Estate Mini-Park towards Physical and Social Activities of Senior Citizens at Taman Midah, Cheras. Universal Journal of Public Health, 11(1), 50 - 56. DOI: 10.13189/ujph.2023.110106.

UN. (2024). Decade of Healthy Ageing: The Platform. United Nations. https://www.decadeofhealthyageing.org/

Vrančić, A., Zadravec, H., & Orehovački, T. (2024). The Role of Smart Homes in Providing Care for Older Adults: A Systematic Literature Review from 2010 to 2023. *Smart Cities*, *7*(4), 1502-1550.

Wang, B., Asan, O., & Zhang, Y. (2024). Shaping the future of chronic disease management: Insights into patient needs for AI-based homecare systems. *International Journal of Medical Informatics*, *181*, 105301.

WHO. (2020). Decade of Healthy Ageing: Plan of Action. World Health Organisation. https://www.who.int/publications/m/item/decade-of-healthy-ageing-plan-of-action

WHO. (2021). Falls. World Health Organisation. https://www.who.int/news-room/fact-sheets/detail/falls

WHO. (2023). Blindness And Vision Impairment. World Health Organisation. https://www.who.int/news-room/fact-sheets/detail/blindness-and-visual-impairment

Wong, C. (2024, March). Creating An Inclusive Travel Experience. Changi Airport Group. https://www.changiairport.com/corporate/media-centre/changijourneys/the-changi-experi ence/inclusive-facilities.html

World Bank. (2020). Malaysia has an opportunity to better protect its elderly citizens and enable them to age with dignity and purpose. Retrieved from https://www.worldbank.org/en/news/press-release/2020/05/11/malaysia-has-an-opportuni ty-to-better-protect-its-elderly-citizens-and-enable-them-to-age-with-dignity-and-purpose

Wu, F., Liu, H., & Liu, W. (2023). Association between sensation, perception, negative socio-psychological factors and cognitive impairment. *Heliyon*, *9*(11).

Wu, J., Chen, X., Zhao, M., & Xue, C. (2024). Cognitive characteristics in wayfinding tasks in commercial and residential districts during daytime and nighttime: A comprehensive neuro ergonomic study. *Advanced Engineering Informatics*, *61*, 102534.

Yakobi, S., Wiid, J. A., & Cant, M. C. (2023). The Relationship between Store elements and In-Store Shopping Experience for Customer Satisfaction at Rural Grocery Stores. *Srusti Management Review*, *16*(2), 11-20.

Yan, L., Winterbottom, D., & Liu, J. (2023). Towards a "Positive Landscape": An Integrated Theoretical Model of Landscape Preference Based on Cognitive Neuroscience. *Sustainability*, *15*(7), 6141.

Zhou, F., Zhang, H., Wang, H. Y., Liu, L. F., & Zhang, X. G. (2024). Barriers and facilitators to older adult participation in intergenerational physical activity program: a systematic review. *Aging Clinical and Experimental Research*, *36*(1), 39.

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