

Factors Driving Wayfinding Efficiency Among Hajj Pilgrims: An Empirical Study at the Al Mashaaer Al Mugaddassah Metro (MMM) Station, Muzdalifah

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Abstract: The guiding devices are designed to aid pilgrims in navigation and provide directions to ensure safety and comfort during Hajj. Nonetheless, the existing methods are incapable of directing individuals from varied backgrounds to MMM rail station in Muzdalifah. This is particularly difficult given that over one million pilgrims annually journeyed on foot from Arafah to Muzdalifah to Mina between 2010 and 2023. This research aimed to examine the factors influencing the performance of navigation systems at the MMM train station in Muzdalifah, with the objective of enhancing these systems according to user preferences. A specific group of 485 pilgrims was chosen for a survey, and 271 valid replies were analysed. The data analysis employed SPSS version 25 to rank variables. The findings revealed that the quality of symbol and icon design, the alignment of design elements, and the presentation of information were the four aspects affecting the efficacy of wayfinding systems at the MMM train station in Muzdalifah. These studies highlighted how many aspects of wayfinding provide users with identifying signals or essential warning information. It was proposed to utilise familiar features, such as symbols, icons, and numerals, that accommodate languages for navigational assistance. Furthermore, it is prudent to include design elements with clear meanings on wayfinding signage to obviate the necessity for external aid.

Keywords Wayfinding, Signage, Pilgrims, Almashaaer Al Mugaddassah metro, Muzdalifah (MMM)

1. INTRODUCTION

Live camera depicts substantial throngs of pilgrims and the flags they follow at train stations and one of the gates during Hajj 2019. Figure 1 delineates the circumstances surrounding the stations during Hajj. In this analysis, it is observed that for every 50 pilgrims, there is one guide, which corresponds to the cabin capacity on the train. They depart collectively from the station, leaving in nearly linked clusters. If a pilgrim falls ill and seeks medical attention, or is delayed for any reason—such as using the lavatory, hydrating, or pausing for a photograph with a celebrity—resulting in separation from the group, the likelihood of becoming lost increases significantly, contributing to crowding issues. Overcrowding constitutes the foremost challenge for designers, engineers, and governments due to its potential effects and ensuing issues [1].



Figure 1 Live footage is an example of large crowds of pilgrims and the flags they follow at train stations and at one of the entrances as well from Hajj 2019

Figure 2 Description of the situation under the stations in Moreover, Arafat Plain, near Mecca, plays a role during Hajj. It is where pilgrims assemble on the day of Dhu al Hijjah to carry out one of Hajj's significant rites: standing at Arafat. This significant event symbolizes a period of rejuvenation, prayer and seeking forgiveness as pilgrims engage in contemplation while standing on the grounds of Arafat. The logistical aspects and timing intricacies of the Hajj pilgrimage highlight the detailed planning needed to accommodate the millions of pilgrims who gather in Mecca during this season. The specific timings of rituals like the stoning ritual in Mina, the act of sacrifice during Eid al Adha and the symbolic Sa'i between Safa and Marwah are all parts of the Hajj journey that emphasize the significance of particular locations and moments in this pilgrimage. Overall, Hajj worship holds value for Muslims deeply intertwined with specific sites, spatial arrangements and temporal sequences. These elements not only direct the path of the pilgrim but also strengthen their spiritual bond with divinity, nurturing a sense of unity, devotion and piety among believers MMM train station was set up to help pilgrims during the Hajj pilgrimage by providing comfortable transportation [3]. This metro service is known for being the way to travel with stops in Mina, Muzdalifah and Arafah, as shown in Figure 3. There are two platforms, one on the left and one on the right. The platforms are separated by a set of tracks. People are standing on both platforms, waiting for trains. There are more than 300,000 pilgrims who use these stations each year, as depicted in Figure 4. Signs were put up around the train stations to guide pilgrims effectively. Wayfinding is crucial for directing people to spaces, warning them about dangers and giving safety instructions [4]. It includes a signage system with dynamic displays, symbols and spatial features designed for safety, comfort and accessibility standards. Additionally, it helps enhance the area's appeal while fulfilling its purpose [5]. Wayfinding, as described by [6], is, about helping people navigate spaces by using social and physical cues to find their way around.



Figure 2: Description of the situation under the stations in Hajj

However, existing navigation systems are struggling to assist groups of pilgrims from racial and ethnic backgrounds. Feedback from pilgrims and social media indicates that these systems lack consistency and universal appeal [7]. These shortcomings have led to instances where pilgrims get lost and separated from their families. Several researchers have highlighted the importance of incorporating valuable end users' considerations into the design of navigation systems [8]. Research on navigation systems during the Hajj pilgrimage has mainly concentrated on guiding pedestrians through crowded areas[7].

However, there is a gap when it comes to the Al Mashaaer Al Mugaddassah metro train station with a large number of pilgrims, more than 1,000,000 annually from 2010 to 2023, making the journey on foot from Arafah to Muzdalifah to Mina. This information is sourced from **Table 1** [9] [10]. In line with Saudi Arabia's Vision 2030 and the government's dedication to providing services for pilgrims, this research aims to pinpoint the factors that impact the effectiveness of wayfinding systems at the Al Mashaaer Al Mugaddassah metro train station and enhance these systems according to user preferences.

The research kicks off by examining the literature on the factors that affect wayfinding system efficiency. Will then delve into discussing the research methodology and outcomes. The conclusion will summarize the research results. Put forth suggestions for enhancing the wayfinding systems.

The pilgrim lacks of personal freedom for the pilgrim and the ability to move between stations and accommodations comfortably and go to the bathroom or elevators alone, as he follows a guide and has limited freedom to act and set out uniquely, far from following the gro Figure 3: Pilgrims flow every 50 pilgrims follow a guide



Figure 3: Pilgrims flow every 50 pilgrims follow a guide

2. MATERIALS AND METHODS

However, existing navigation systems are struggling to assist groups of pilgrims from racial and ethnic backgrounds. Feedback from pilgrims and social media indicates that these systems lack consistency and universal appeal [7]. leading to instances where pilgrims get lost, separated from their groups or families, or even involved in accidents with vehicles[11].To address these challenges effectively, a navigation system must give signals to users when they've reached their desired destination. Alrabiah and Dong (2021) highlight the importance of incorporating considerations into the design of navigation systems.

Research on navigation systems during the Hajj pilgrimage has mainly concentrated on guiding pedestrians through crowded areas [7]. However, there is a gap when it comes to the Al Mashaaer Al Mugaddassah metro train station with the large number of pilgrims, more than 1,000,000 annually from 2010 to 2023, making the journey on foot from Arafah to Muzdalifah to Mina. This information is sourced from Table 1[12]. In line with Saudi Arabia's Vision 2030 and the government's dedication to providing services for pilgrims, this research aims to pinpoint the factors that impact the effectiveness of wayfinding systems at the MMM train station and enhance these systems according to user preferences.

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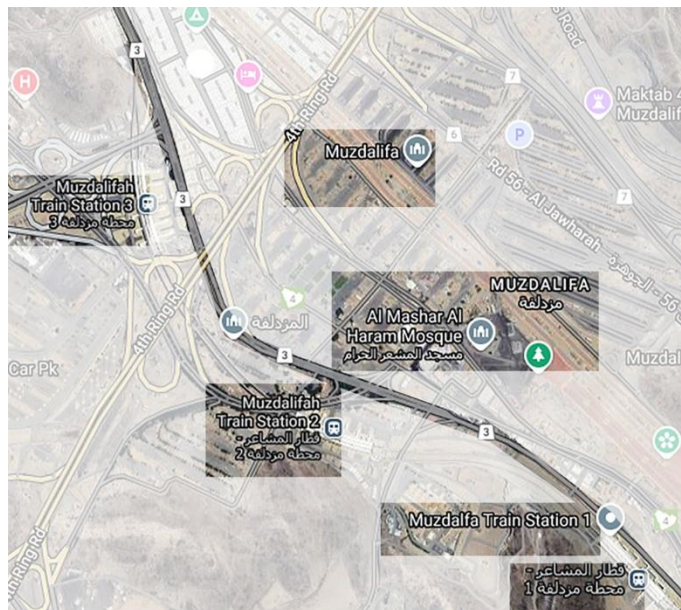


Figure 4 MMM train station with 3 stations each in Muzdalifah.

Nonetheless, the existing wayfinding technologies are incapable of autonomously directing the multitude of pilgrims from diverse racial and ethnic origins. This assertion was founded on numerous testimonies from pilgrims and social media platforms indicating that the existing findings exhibit inconsistency and lack universality [7]. This has resulted in multiple incidences of pilgrims becoming lost or separated from their groups or families, and, on rare occasions, being struck by automobiles. Consequently, an effective navigation system must furnish users with the requisite indications to ascertain their arrival at the intended destination. In [13, 14] asserted that acknowledging the cultural variables in wayfinding design can facilitate a unified approach to addressing the issue. Consequently, research pertaining to navigation systems during Hajj was analysed. Recent studies have consistently associated navigation with pedestrians in congested environments [7]. Nevertheless, the analysis of prior studies revealed a deficiency at the MMM train station, especially considering that over 1,000,000 pilgrims were recorded annually from 2010 to 2023 during Hajj, traversing on foot from Arafah to Muzdalifah to Mina, as illustrated in Table 1[15]; Argaam Report, 2023. This study aimed to identify the key factors affecting the efficiency of wayfinding systems at the MMM train station, in order to enhance these systems according to user preferences, thereby supporting the efforts of King Salman Bin Abdulaziz's government to provide optimal services to pilgrims through Saudi Arabia Vision 2030.

This study initially discusses findings from pertinent literature regarding aspects that affect the efficacy of wayfinding systems. The research technique is succeeded by discussions of the findings. The concluding part encapsulates the conclusions drawn from the research findings and offers recommendations.

Table 1. Transported several pilgrims through Metro Train Stations from 2010–2023.

No	Hajj season	Numbers of pilgrims (m/n)	Numbers of pilgrims per ticket sales at metro train stations+000	Numbers of pilgrims travelling by foot In In the thousand
1	1431H 2010	2.79	175,	2,615,
2	1432H 2011	2.93	375,	2,555,
3	1433H 2012	3.16	570,	2,590,
4	1434H 2013	1.98	370,	1,610,
5	1435H 2014	2.09	370,	1,716,
6	1436H 2015	1.95	374,	1,576,
7	1437H 2016	1.86	311,	1,549,
8	1438H 2017	2.35	360,	1,990,
9	1439 H 2018	2.37	360,	2,010,
10	1440 H 2019	2.49	358,	2,132,

11	1444H 2023	1.85	330,	1,520,
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Source: [16]

3. LITERATURE REVIEW

Wayfinding plays a crucial role in ensuring smooth navigation, particularly in high-density environments such as transportation hubs. For Hajj pilgrims, effective wayfinding is essential due to the massive crowds, time constraints, and diverse backgrounds of travellers. The Al-Mashaaer Al-Mugaddassah Metro Train Station in Muzdalifah is a key transit point during Hajj, facilitating the movement of millions of pilgrims, as depicted in Figure 5. However, despite existing wayfinding measures, challenges such as overcrowding, unclear signage, and language barriers persist. Addressing these challenges requires a deeper understanding of the factors influencing wayfinding efficiency and the potential strategies for improvement [5].

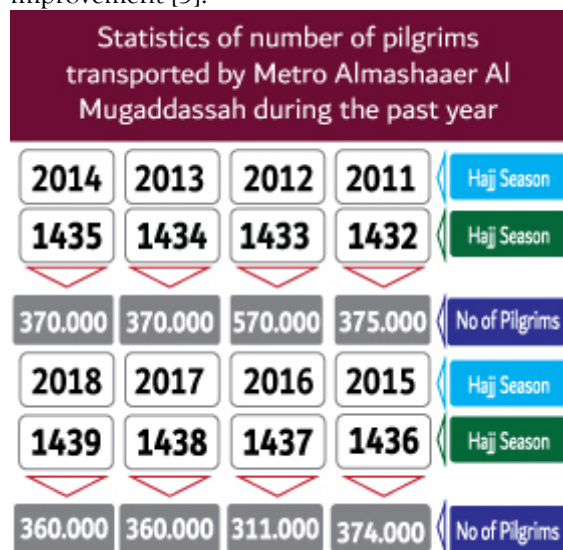


Figure 5 MMM train station and the total number of pilgrims conveyed from 2011-2018

Large-scale religious gatherings, such as Hajj, present unique navigation difficulties, particularly in transit hubs where space is limited, and movement must be efficient. Research indicates that high congestion levels cause delays, stress, and safety hazards, making effective navigation crucial [4]. The images of overcrowded metro platforms and footbridges, as seen in Figure 6 highlight the pressing need for efficient crowd control mechanisms.

Studies show that poor crowd management leads to disorganized movement patterns, further slowing down wayfinding efficiency [5]. Implementing intelligent routing mechanisms and real-time crowd monitoring can mitigate such issues by optimizing pedestrian flow and reducing bottlenecks.

Traditional wayfinding systems, including static signage and directional indicators, are the most commonly used navigation aids in public spaces. However, research on transit environments suggests that static signs alone are insufficient in dynamic, high-pressure situations [17-21]. The placement, visibility, and clarity of signage significantly affect a pilgrim's ability to navigate effectively. Figure 7 depicts an example of unclear signage in a crowded metro station, illustrating how poor visibility and placement can hinder movement. To enhance signage effectiveness, experts recommend using highly visible text, universally understood symbols, and strategic placement along natural movement paths [19].

Hajj attracts millions of pilgrims from diverse linguistic backgrounds, many of whom may struggle to interpret Arabic or English signage. In some instances, where signage fails to accommodate multilingual travelers, leading to confusion and delays. Studies emphasize that multilingual digital assistance and culturally appropriate visual cues can significantly improve comprehension and usability in such multilingual contexts [3]. To address this, digital wayfinding applications with real-time translation and audio guidance have been proposed [13]. These solutions can bridge communication gaps, ensuring that pilgrims receive accurate and accessible navigation assistance in their native languages.



Figure 6: Metro Trains and Crowds at the Station



Figure 7: Crowded Metro Platform with Pilgrims in Ihram



Figure 8: An example of unclear signage in a crowded metro station



Figure 9 signage fails to accommodate multilingual travellers.

Research highlights the increasing role of technology-driven solutions in improving wayfinding efficiency in high-density environments [11]. Mobile applications providing personalized navigation routes, real-time crowd updates, and AI-powered recommendations have been explored as potential solutions. Figure 9 illustrates an example of a digital navigation interface being used in a high-density transit station. Furthermore, the use of wearable technology, such as smart wristbands with built-in navigation features, has been proposed to assist pilgrims in navigating the metro system without relying solely on static signs or mobile networks [11]

Pilgrimage sites experience extreme peaks in foot traffic, necessitating a system that not only directs individuals but also optimizes overall crowd movement. The images in Figure 10 show dense pedestrian traffic along structured walkways and waiting areas, demonstrating the urgent need for well-planned pedestrian routes and movement strategies. By studying human behaviour and implementing intelligent routing mechanisms, planners can reduce bottlenecks, improve safety protocols, and enhance mobility across the MMM network. Real-time monitoring systems can track pedestrian flow, allowing for data-driven decision-making in crowd management [10].



Figure 10. The following image shows the layout of the waiting areas before entering the corridors and boarding the train.

Understanding the key factors influencing wayfinding efficiency is critical for designing effective navigation systems, particularly in high-density environments like the MMM Train Station. Poor wayfinding can lead to delays, anxiety, and even safety risks in crowded transit areas. By identifying the most influential factors such as signage clarity, strategic station layout, multilingual support, and real-time digital assistance stakeholders can develop more user-friendly and adaptive wayfinding solutions. The integration of both physical and digital interventions not only enhances efficiency but also improves the

overall experience for pilgrims, ensuring their journey remains smooth and stress-free despite the challenges posed by extreme crowd density and language diversity. Figure 8 and Figure 9 depict smart navigation tools and real-time data monitoring being implemented in large-scale transit systems. Future enhancements should focus on integrating smart navigation tools with real-time data to enhance accessibility and ease of movement at the MMM Train Station in Muzdalifah. By addressing these critical factors, the wayfinding experience for Hajj pilgrims can be significantly improved, contributing to a safer and more organized pilgrimage journey [5].

3.2. Universal design

Given the growing prevalence of the term "universal design," it is essential to understand its fundamental nature. Experts Dr. Arvid E. Osterberg and Donna J. Kain assert that universal design seeks to accommodate all individuals, irrespective of their skills. Some may perceive universal design as applicable solely to individuals with cognitive impairments. Moreover, it encompasses those who encounter challenges but are not explicitly classified as disabled or elderly. First-time travellers in unfamiliar locations may have difficulties in navigation due to practical obstacles.

In essence, universal design seeks to benefit everyone by addressing challenges people encounter in their lives. The Universal Design Center at North Carolina State University defines design as creating products and environments that can be used by everyone regardless of age, ability or situation without the need for adjustments. This definition was put forward by Connell et al. The concept of design aims to enhance comfort and safety while ensuring that information and physical spaces are accessible to all individuals[20]. When developing a wayfinding system, it's crucial to address accessibility issues. Although not all universal design practices are legally required, the United States has accessibility laws like the Americans with Disabilities Act (ADA) standards, especially concerning sign design for those with impairments. SEG (Society for Environmental Graphic Design) is an organization dedicated to design and offers detailed interpretations of ADA requirements. The "Principles of universal design" were established in 1977 by professionals at North Carolina State University including architects, product designers, engineers and researchers, in design.

According to Levine in 2003 [21], following these seven principles results in a design approach that's inclusive and enhances usability for everyone. Connell et al. in 1997 outlined the principles that ensure designs are usable for all individuals[20]:

- 1) Equitable usage: The design should be useful and accessible to individuals with skills, offering the methods of use to all users.
- 2) Adaptability to users' pace: The design should be flexible enough to accommodate preferences and skills, allowing users to customize their experience.
- 3) Intuitive use: The design should be easy to understand the user's background, knowledge, language proficiency or current level of attention due to its simplicity and intuitiveness.
- 4) Clear information presentation: The design should effectively convey information to the user irrespective of conditions or the user's sensory abilities by utilizing various media such as graphics, text and tactile methods for redundant information delivery.

Furthermore, it works well with methods and technologies commonly used by people with impairments.

- 5) Error tolerance: The design minimizes the chances of mistakes and negative consequences that could occur from intended actions. It provides warnings about faults and potential dangers.
- 6) Minimal physical strain: The design enables comfortable use with fatigue, requiring minimal effort.
- 7) Size and space accessibility: The design considers the user's body size, posture and movement for approach reach, manipulation and utilization of the accessory.

4. RESEARCH METHODOLOGY

The research technique establishes the structure and approach for the study. It entails recognising and preparing to tackle the research problem, which acts as a framework for investigations [22]. The approach employed during the research process from inception to conclusion is referred to as the technique. Methodology is defined as a framework that links research methods to results, directing the selection and application of methodologies. Research technique entails the methodical collecting, analysis, and interpretation of data to derive solutions to issues. The focus is on the analytical approach or procedure utilised, encompassing the study methods for collecting tourists, the data collection procedures implemented, and the interpretation and analysis of the gathered data.

Following the analysis of the discovered difficulty, the construction of the research problem statement, together with the study's goal and objectives, was undertaken in the adoption of a research framework. The research hypotheses developed from the literature review will guide the methodology to fulfil the study's objectives. The research methodology would include the research process option [23, 24].

4.1 Research approach

In literature, as referenced in [25], the research methodology is often used interchangeably with the research process and research technique. The scientific approach involves a 'research process that encompasses stages from conclusions to data collection, analysis and interpretation.' There are three research methods: quantitative, qualitative approach and hybrid technique.

Considering the nature of this study, a quantitative approach will be adopted. According to [26] quantitative research approach involves describing phenomena in terms by mathematically analyzing collected data using structured statistical methods. Quantitative science assumes that observable and measurable evidence forms the universe. It seeks to categorize issues into categories, across various subjects. [27, 28]. Scholars contend that a quantitative approach establishes relationships between variables to test hypotheses. Variables are operationalized into measures for evaluation using tools.

Quantitative methods involve collecting data, processing it numerically and assessing it. In this approach, variables are considered the focus of the study, hypothesized and then examined through data collection.

In the realm of research approaches and levels, different philosophies guide strategies and methods. These include positivism, with experiments focusing on aspects like individuals in a sectional manner using questionnaires. Another approach involves field surveys in settings through interviews or case studies with an emphasis. Interpretive methods like grounded theory explore group dynamics over time with experiments or ethnographic studies using mixed-method approaches for observations or archival analysis of data. Research design serves as a blueprint for conducting studies. It aims to structure the analysis so that variables are identified and interactions between them are clear. Research methodology acts as a strategy for researchers to manage data collection, evaluation and interpretation processes. It sets the foundation for how data is gathered and analyzed to yield insights.

4.2 Research Strategy

This study employed a qualitative methodology prior to doing a quantitative analysis. The qualitative data of the study were derived from a literature analysis and encompassed nine criteria affecting the efficacy of wayfinding systems, which have been analysed by prior researchers and utilised to develop a structured questionnaire. The survey comprises two segments. Section A comprises the respondents' demographics, including age, gender, primary language, secondary language, and the frequency of Hajj participation. In section B, participants were instructed to rank the elements affecting the efficiency of the wayfinding systems at the MMM train station in Muzdalifah using a five-point Likert scale from 1 to 5, with 1 denoting "insignificant" and 5 denoting "very significant."

4.3 Exemplary Structures

A selective sample of 485 pilgrims was chosen for the survey. This is corroborated by [29], who asserted that more reliable data can be obtained from valid respondents. A total of 485 questionnaires were distributed, with 394 returning completed. This indicates an 81.23 percent response rate from the total distributed questionnaires. Out of the 394 returned surveys, 125 were discarded from the study due to inaccurate completion, including numerous missing data and repeated responses. A total of 269 valid questionnaires were utilised for subsequent analysis, resulting in a response rate of 55.46 percent. This was deemed sufficient for analysis according to the claim by [30] that a 30 percent response rate is suitable for survey research. The finalised questionnaires were subsequently encoded into SPSS version 25. 4.4. Cronbach's alpha reliability assessment.

The Cronbach's alpha coefficient test was employed to assess the instrument's reliability. A measure is deemed credible if the Cronbach's alpha coefficient is 0.70 or above [30]. In this study, the Cronbach's alpha coefficient values for the construct exceeded 0.7, indicating that both the construct and its variables exhibited strong reliability in measuring the same latent trait and scale.

5.0 RESULTS AND DISCUSSION

A cross-tabulation of respondents' ages and their frequency of Hajj participation, as illustrated in Table 2, reveals that 113 (42.01%) respondents with Hajj experience ranging from 1 to 4 times were aged

between 1 and 20 years. 123 responders, constituting 45.73%, with Hajj experience ranging from 1 to 4 or more, were aged between 21 and 40. In contrast, 33 responders (12.27%) with same Hajj experience were aged 41 or older. In all, 87.74% of responders with Hajj experience ranging from 1 to 4 or more were aged between 1 and 40 years. This indicates the data's dependability, implying that it was gathered from appropriate respondent categories.

Table 2. Cross tabulation between the ages of the respondents and the number of times they had performed Hajj.

Hajj experience	Age of the respondents						Total	%
	1–20	%	21–40	%	41 and above	%		
1	10	8.85	19	15.45	8	24.24	37	13.76
2	41	36.28	42	34.15	12	36.36	95	35.32
3	33	29.20	33	26.83	6	18.18	72	26.77
4 and above	29	25.66	29	23.58	7	21.21	65	24.16
Total	113	42.01	123	45.73	33	12.27	269	100

5.1 Results of mean analysis

The data was analysed using the mean analysis function of SPSS version 25. The effectiveness of each parameter was evaluated based on the importance of weighting and the proposed efficiency of each variable. The mean values in Table 3 reveal that symbols and icons, with a mean of 2.25, ranked first; design quality, with a mean of 2.10, ranked second; alignment of design elements, with a mean of 2.02, ranked third; information display, with a mean of 1.99, ranked fourth; and font size, with a mean of 1.81, ranked fifth. Font choices, with a mean of 1.61, were ranked sixth; colour harmony, with a mean of 1.42, was ranked seventh; sign position, with a mean of 1.19, was ranked eighth; and colour contrast, with a mean of 1.00, was ranked ninth. The data demonstrate that the mean values ranged from 1.0 to 2.25.

Table 3. Average values and rankings of pilgrims' replies about the aspects affecting the efficiency of wayfinding systems at the MMM train station in Muzdalifah.

Factors	N	Minimum	Maximum	Mean	Std. deviation	Ranking
Symbols and icons	269	1.00	3.00	2.25	0.87420	1st
Design quality	269	1.00	3.00	2.10	0.88327	2nd
Alignment of design elements	269	1.00	3.00	2.02	0.91200	3rd
Information display	269	1.00	3.00	1.99	0.89356	4th
Font size	269	1.00	3.00	1.81	0.86807	5th
Font choices	269	1.00	3.00	1.61	0.84251	6th
Colour harmony	269	1.00	3.00	1.42	0.66267	7th
Sign position	269	1.00	3.00	1.19	0.53234	8th
Colour contrast	269	1.00	1.00	1.00	0.00000	9th
Valid N (listwise)	269			1.89		
Average mean						

For this reason, the average mean was computed in order to objectively examine the agreement in important rankings among the pilgrims. This was done in order to develop a consensus on the ranking

of all aspects that affect the efficiency of wayfinding systems at the MMM rail station in [31], has made a recommendation that is consistent with this. When it comes to the average mean, the cut-off values for interpretation are as follows: "insignificant" (which is below the typical mean) and "highly significant" (which is above the average mean). According to this view, the results that were classified as "insignificant" should be discarded since they do not accurately reflect the opinions of the people who participated in the survey. The findings that were calculated at a "highly significant level" indicate that the respondents placed a greater emphasis on a certain variable.

6.0 CONCLUSION

The results indicate the four primary aspects affecting the efficiency of wayfinding systems at the M M M rail station in Muzdalifah, highlighting the elements that furnish users with directional, identifying, or cautionary information. This reinforces the notion that a navigation system should cater to a heterogeneous population by directing them through the same environment via analogous communication methods. It was advised that universally recognised elements, such as symbols, icons, and numerals that facilitate multilingual communication, be employed in wayfinding systems. Furthermore, design elements must possess clear and unambiguous meanings that may be comprehended independently for effective wayfinding.

The findings have necessitated the identification of solutions that counteract issues affecting the efficiency of wayfinding systems. This study can produce methods to enhance the efficiency of wayfinding systems in the MMM (Al-Mashaaer Al-Mugaddassah metro) train station.

Author contributions: Mohd Hisyam Rasidi (M.H.R.) and Khalid Ahmed M. Alghamdi (K.A.M.A.) contributed to the conceptualizations and methodology of the study. Yahya M. Nabhan (Y.M.N.) and Abdullah F. Suruje (A.F.S.) were responsible for software development. Validation was performed by K.A.M.A., M.H.R., Hossam Mahmoud E. Elwardanu (H.M.E.), and Mohammad Jamil Filfilan (M.J.F.). Y.M.N. conducted the formal analysis, while A.F.S. carried out the investigation. Resources were provided by K.A.M.A. and M.H.R. Data curation was managed by Y.M.N. and A.F.S. The original draft was prepared by H.M.E. and A.F.S., with review and editing by K.A.M.A. and M.H.R. Visualization was handled by Y.M.N. and A.F.S. Supervision and project administration were undertaken by Y.M.N. and A.F.S. Covering the costs of grammar, spelling and review by M.J.F. and H.M.E. All authors have read and agreed to the published version of the manuscript.

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