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A Review on Wayfinding Information System (WIS) in Complex Environment

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Abstract

Wayfinding systems function as a concept intended to assist people in finding their way from a point to a final destination efficiently and as quickly as possible while also making the journey a pleasant experience. Although the concept appears to be simplistic, planning a wayfinding system is a challenging task particularly in complex environments. This paper attempts to explain the prime concept and the function of wayfinding information systems (WIS) focusing on a complex environment based on an extensive review of literature. The purpose of WIS is not only to provide an efficient navigation map but also to create a pleasant and less stressful atmosphere especially to exhausting travelers. Consideration for simplicity and ease of navigation is essentially the prime goal in planning and designing a practical WIS especially in complex environments.

Keywords: Wayfinding, Wayfinding Information System (WIS), Complex Environment, Environment Cues

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1.0 Introduction

The goal of a wayfinding system is to assist people traveling from a point to an intended destination swiftly while experiencing space in a physical environment. Environmental cues play a significant role in providing a successful wayfinding information system (WIS) comprising items such as signs, maps, landmarks, site layout and structure of an environment. In addition, verbal cues are also categorized as parts of WIS that become necessary in complex settings such as in metropolitan centres, hospitals, educational campuses, and transportation systems (Baskaya, Wilson, & Özcan, 2004). Therefore, travellers need visual clues such as maps, instructions, and symbols to assist them achieving their objectives in increasingly complicated architectural environments. In stressful settings, effective wayfinding systems contribute to a feeling of well-being, security, and safety (Wan & Krishnamurti, 2008). It is therefore crucial that WIS shall provide clear and simple-to-follow directions conveniently (Lynch & Dunham, 1960) whilst avoiding confusion which may lead to a situation of "getting lost" (Carlson, Hölscher, Shipley, & Conroy Dalton, 2010).

Several authors (e.g. Arthur & Passini, 1992, Haq & Zimring, 2003, Baskaya et al., 2004) insist that it is most likely that poorly designed wayfinding system was the reason for people to getting lost their way rather than naivety on the part of the users. They assert that if a user is unable to find their way, it will be due to a poorly designed WIS that failed to provide a clear guide to people.

Over the years, technology in wayfinding has evolved, and the most recent of navigational aids is global positioning systems (GPS). A study by Fewings (2001) in Farr et al. (2016), found that people have effectively used a variety of navigational aids, including compass, maps, the stars, and sextants, to ease their wayfinding.

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2.0 Complex Environment

The term "complex environment" is used as a navigational terminology that refers to an environment in which spaces are not clearly delineated for navigational purposes. These are environments with ambiguous and difficult-to-interpret navigational, spatial and geometric cues (Stankiewicz & Kalia, 2007). Included in this context are public spaces, city centres, hospitals and educational institutions settings that fit this description (indoors and outdoors) of a complex environment. Navigating through these complex environments can be confusing, and may cause anxiety and frustration (Iftikhar, Shah, & Luximon, 2020; Chang, 2013). In addition, Mandel (2010) found that disoriented individuals who find themselves lost from wayfinding might feel frustrated, anxious, self-blame and unwise. In such a situation, he can be in a state of anger and resentful towards the environment.

Wayfinding involves information systems that help people understand and experience space in a physical setting. It is crucial to develop ways to ease their wayfinding especially in complex environments, such as urban centres, hospitals, educational campuses and transportation facilities. In complex architectural surroundings, people require visual cues such as maps, instructions and symbols to help them reach the intended destination point. It is arguable that an effective WIS adds to a sense of well-being, security and safety in stressful environments.

Allen (1999) identified three actions involved in wayfinding, namely; "commute", "explore", and "quest". Whereas "commute" refers to traveling between two known locations where efficiency is the determining factor for success; "explore", refers to the traveller's uncertainty and unfamiliarity within the environment. The traveller's existing environmental knowledge, the number and value of new routes and destinations are essential in determining a success criterion. The third type of action is the "quest", which requires the traveller to go from one known location to an unknown one. This task requires knowledge of the destination through verbal description or a map.

These three actions are most apparent to a person in finding places he might want to visit. Difficulties occur when one is "getting lost" in the process of "getting there" resulting in an uneasy feeling of anxiety, panic, loss of confidence, and vulnerability when this happens. Chang (2013) has observed that tourists experiencing anxiety in unfamiliar destinations use several wayfinding strategies. He found that persons differ in strategising preferences, in finding his way to unfamiliar destinations. With reference to other previous studies, Chang added that a traveller's perceived difficulties in wayfinding experience, anxiety, and wayfinding strategy preference affect wayfinding performance. In any case, a wayfinding aid is necessary to overcome difficulties faced by visitors in certain premises.

2.1 Wayfinding Information System (WIS)

The term "wayfinding" is closely associated with maps, street numbers, directional signs, etc (Lynch, 1960). Accordingly, Lynch described wayfinding as "...the process of creating a mental image of one's surroundings via perception and memory and the consistent use and organization of sensory cues from the external environment". Lynch's images on environment setting consists of five major elements, namely; paths, landmarks, regions, edges, and nodes, form the fundamental components of cognitive maps which had been referred to and supported by Appleyard (1969) on its applicability.

As Muhlhausen (2006) has described, navigation does not merely rely on the presence of signage; it also involves perception, spatial knowledge, information elaboration, memory, and problem-solving process. Muhlhausen also points out the distinction between wayfinding and signage, in support to Lynch's use of maps, street numbers, and directional signs contributed significantly to this limited perspective of wayfinding. In the same vein, Malcolm, Groen, and Baker (2016), that wayfinding entails assessing the context of one's surroundings and making sense of spatial characteristics. These situations need an understanding of the environment's relative locations as well as its potential destinations.

According to Waters & Winter (2011), studies on navigational information are mostly emphasizing wayfinding aids to promote navigator independence among users, particularly in urban environments. Data have shown that users need to find their way efficiently particularly in increasing complexity of the architectural environment. Thus, optimizing automated wayfinding design is required (Huang et al., 2018). In addition, Khan (2019) has suggested the necessity to analyze the trend to discover the variables contributing to users' navigation experience in a complex environment. In this regard, Huang and his colleagues highlighted that we could effectively direct people to their destinations by generating automated wayfinding designs. It may also assist the designer in visualizing the accessibility of a destination from various points of view and correcting any "blind zones" with extra signposts as necessary.

A study by Waters and Winter (2011) involved a wayfinding test by using the Santa Barbara Sense of Direction (SBSOD) scale to analyze the experience of successful navigation among users. This study highlighted the sense of direction in the user as they went about finding their way to their desired destination. In support, Khan (2019) had the need to study the current spatial layout and wayfinding condition and identify the variables that influence the users' experience when trying to find their way through a complex environment. Several authors have found that these are often the limiting factor in wayfinding. Another way to look at the problem is to consider the sense of direction of the user. Consequently, Waters and Winter (2011) proposed an improved wayfinding aid to overcome the issue of ineffective wayfinding information by analyzing the score from the SBOSD test which measure users' sense of direction (Condon et al., 2015; Hegarty, Richardson, Montello, Lovelace, & Subbiah, 2002), a self-assessed psychometric test designed in 2002. The score is based on the sense of direction of a user. However, according to Huang et al. (2018), three problems remain with this issue; firstly, the

interplay between signs and human navigation, and secondly, the many possible navigation scenarios that can make the manual design process overwhelming and non-trivial.

Creating a WIS design for a typical layout can be a demanding task as well as time consuming. Often, inadequate information contributes to the difficulties in developing high quality navigational information. As Khan (2019) has said, the challenges that arise make it more difficult for a user to find their way to the desired location, which may impact their physical and mental health due to confusion.

2.2 Objective and method of study

This study seeks to explore further topics on wayfinding by reviewing classics as well as the most recent literature at the initial stage. At this stage, the study focuses on the types of wayfinding layout design that comprises effective visualization (visuospatial) process. It is important for the designers to apply in their layout design based on a correct "blind zone" and additional signs (Huang et al., 2017). In addition, Khan (2019) suggested that focusing on wayfinding information that has a close relationship with the overall wayfinding experience may eventually help the users avoid unwanted situations while finding their destination and provide better accessibility to the users' destination.

Figure 1 shows a list of Wayfinding Design Parameters as identified by several authors (Azman, 2019). Previous research tended to use these parameters in developing WIS as reference to assist architects and designers in their work. Wayfinding Performance Assessment (WPA) concerning Universal Design Environment Assessment (UDEA) and Wayfinding Environment Assessment (WEA) were used in this study to evaluate the performance of the user.

Informational Wayfinding		
No.	Wayfinding Design Parameter	Source
i)	You-are-here (YAH) map	Darken & Peterson, (2002); D. Levine, (2003)
ii)	Information Counter	Mahlhausen, (2006)
iii)	Information handouts	Levine, Marchon and Hanley, (1984); Nelson-Shulman, (1983-84); Wright, Hull, & Lickorish (1979)
iv)	Identification Signage	Guiliani, (2001); Society for Environmental Graphic Design, (1993), Pollet & Haskel, (1979)
v)	Directional Signage	Guiliani, (2001)
vi)	Regulatory Signage	Guiliani, (2001)
vii)	Location of Signage and Cues	Carpman, Grant, and Simmons, (1985); Guiliani, (2001)
viii)	Font Size & Type	Malaysian Standard MS1184:2004 Universal Design and Accessibility in the built Environment – Code of Practice (Second Revision), 2014
ix)	Use of Pictogram, Typography and Colour as Signage	Hashim, Alkabi and Bharwani, (2014); Lee and Kline, (2011); Foster, (2001); Gakapoulus, (2009)
x)	Use of Simple Informational maps with minimum text	
xi)	Clear Identity Sign of Entry and Exit	J. Carpman (1995)

Fig. 1: Wayfinding Design Parameters
(Source: Azman, 2019)

3.0 Wayfinding Aids and Design Elements

The critical components of wayfinding aids play a significant role in providing a good navigation experience to users. In order to create a wayfinding system for the ease of users, it is essential to keep simplicity and ease of travel in mind. Certain design concepts to consider are consistency in appearance, location, uniqueness, simplicity, standardized imagery, reassurance regarding the current path, and separation from other aspects of the environment.

According to Soh & Smith-Jackson (2004), map design, individual differences, and environmental signals in an outdoor recreational area all impact wayfinding performance in an outdoor recreational area. In the public domain, some of the key components that have been investigated and studied include an application that uses simplified pictograph symbols for wayfinding in a complex environment that is helpful for users to navigate (Sivaji, Radjo, Amin, & Hashim, 2015). A standardized signage system in a complex environment may also

help to expedite the navigation process (Rousek & Hallbeck, 2011). As pointed out by Vilar, Rebelo, & Noriega, (2018), information dispersion during a crisis would increase when the amount of contact and visual information increases.

To identify issues on the wayfinding of complex environment design flaws, Rousek and Hallbeck (2011) conducted an investigation, emphasizing several design elements involving signage, paths, target sites, lighting, and flooring. This investigation has resulted in enhanced wayfinding for the most highly visually impacted individuals. It is said to be able to improve wayfinding for those with normal vision via universal design. To have an efficient WIS in a complex environment, it is necessary to enhance signage design considering users who might have difficulties with visual attention while navigating (Mishler & Neider, 2017). Liben, Myers, and Christensen (2010) emphasized a need to include directional information on 'You-Are-Here' maps even though on-field predictions and self-reported wayfinding skills were successful.

4.0 Discussion

Understanding a person's sense of direction is fundamental in wayfinding experience in a complex environment. A successful WIS is primarily dependent on the legibility of the complex environment, which is also an indicator of the efficiency of the functional layout of the environment. The physical characteristics of the environment, as discussed here, are the most important variables in determining whether or not an environment is legible. Suppose the users readily see the physical characteristics of the environment. In that case, they will be able to construct a cognitive image in their minds and make the required decisions to navigate their way through it. A study has discovered that to understand the relationship between the sense of direction and wayfinding performance, wayfinding information is a helpful tool since it offers all the important environmental understandings of the surrounding environment. As a result, this study aims to comprehend the concept of wayfinding, the factors that influence wayfinding performance in a complex environment, and the role of WIS in the field of wayfinding relationship between sense of direction and wayfinding performance.

In general, wayfinding is the process of determining and following a route between an origin and a destination (Golledge, 1999). According to Lynch (1960), wayfinding is based on "consistent use and organization of definite sensory clues from the external environment." Lynch's work provided the foundation for wayfinding research. He explained that as people navigate in an environment, they constantly attempt to build an image of that environment in their minds using the structure and characteristics of physical objects in that environment to assist them in orienting themselves.

Wayfinding is a dynamic phenomenon. There are four categories of theories linked to human wayfinding. The four types of theories that explain the four aspects of wayfinding are; (1) theories of spatial cognition, (2) theories of perception, (3) theories of mental representation, and (4) theories of spatial knowledge development. Since wayfinding is fundamentally a cognitive/problem-solving phenomenon, it will lead to more concrete and impactful design decisions to consider the technical underpinnings of wayfinding (Jamshidi & Pati, 2020).

When designing a navigation system, it is critical to include spatial knowledge and spatial ability and visuospatial skills and capabilities. When administering a psychometric test to its subjects, the most frequent method is to combine two distinct tests with a wayfinding task: the SBSOD (Santa Barbara Sense of Direction) score and the CRT (Card Rotation Test) or the MRT (Mental Rotation Test). (Dong et al., 2018; Ishikawa & Zhou, 2020; Wei, Anson, Resnick, & Agrawal, 2020) Sometimes, the testing included the simulation of an augmented reality map task, which was also implemented (Lorenz, Thierbach, Baur, & Kolbe, 2013, Gardony, Martis, Taylor, & Brunyé, 2021).

For navigational purposes, it is essential to put these skills to use throughout the mapping process. In addition, before any wayfinding information can be created or produced, the psychometric score of the user's sense of direction must be taken into consideration. Many researchers have implemented tests and tasks for their subjects to measure spatial ability and record their whereabouts during wayfinding. When navigating, it is critical to put these abilities to use in the mapping process.

5.0 Conclusion and Recommendations

To improve user wayfinding efficacy and navigation experiences, it is necessary to examine the criteria of wayfinding factors that influence user's performance, activities, and wayfinding tasks. When working with complex environments, signage, circulation, visual accessibility, and building design must all be addressed. These elements ought to provide a hassle-free and pleasant experience when navigating. Environmental cues play a significant role in obtaining successful wayfinding. Effective WIS contributes to a feeling of well-being, security, and safety.

Public spaces, city centers, hospitals, and educational institutions are examples of settings that meet the definition of a complex environment which include both indoor and outdoor areas. When navigating through these complex environments, it is easy to get disoriented, leading to feelings of stress and anger.

Wayfinding entails assessing the context of one's surroundings and making sense of spatial characteristics. It also involves perception, spatial knowledge, information elaboration, memory, and problem-solving process. WIS designs can effectively direct people to their destinations. It may also assist the designer in visualizing the accessibility of a destination from various points of view.

The result provides some valuable insights into the process of developing a wayfinding plan for a typical layout, which is a time-consuming job. Inadequate information may be a contributing element to the problems faced in the development of navigational guidance. As Khan (2019) aptly stated, inadequacy of WIS may result in difficulty to find a way to the intended destination.

The prime features of a good WIS shall be simplicity and ease of navigation. In order to have a good WIS in a complex environment, it is necessary to improve wayfinding information so that it is comprised of design principles for general users as well as people with visual

impairments. The information obtained so far, will be used as the basis for a proposal of an advanced WIS model in complex settings and environment which will be carried out in the following stage of this study.

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