UNIVERSITY OF NAIROBI

FACULTY OF ARCHITECTURE AND ENGINEERING

DEPARTMENT OF THE ART AND DESIGN

BDS 604: MASTER THESIS/PROJECT

**DESIGNING NAVIGABLE INTERIOR SPACES IN AFFORDABLE HOUSING FOR THE VISUALLY IMPAIRED IN KENYA.**

**By:** SHARON JOHNSON – B51/41329/2021.

**Supervisor:** Dr. Michael Munene

**Co-Supervisor:** Ms. Joyce Akach.

Proposal submitted in partial fulfillment of the requirement for the Master of Art in Design submitted to the Department of Art and Design, University of Nairobi.

2nd JUNE, 2023.

DECLARATION.

This thesis is my original work and has not been presented to any other examination body.

**SHARON JOHNSON  B51 / 41329 / 2021**

Sign:................................. Date:... 15ᵗʰ/8/23 .

**Declaration by Supervisor**

This thesis has been submitted for examination with my approval as a University of Nairobi Supervisor

**Dr. Munene Michael**  Senior Lecturer, School of the Arts and Design

Sign................................. Date... 15. 08. 2023

**Declaration by Co-Supervisor**

This thesis has been submitted for examination with my approval as a University of Nairobi Co-Supervisor

**MS. Joyce Akach** lecturer  School of the Arts and Design

sign................................. Date.... 15/8/2023

# ACKNOWLEDGEMENTS.

# DEDICATION.

To God, parents, siblings, able supervisors, and all those who embraced me, in this journey of advancing my knowledge, for all your feedback and sharing, and sacrifices. I say we made it.

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Rp- retinitis pigmentosa.

V.I visually impaired

# ABSTRACT.

**Background:** Universal Design is a guideline that makes all designs usable by all people to the greatest extent possible without need for adaptation, a tool that the government of Kenya chose not to implore when designing the affordable housing units for the sighted population and left out the visually impaired. **Problem:** Affordable housing is an initiative that was brought for by the previous jubilee government to offer accommodations to all Kenyans at an affordable cost of living. Although Affordable housing in Kenya right now is built for the sighted population. Inclusivity in their designs does not measure up to the universal design principles hence visually impaired persons cannot access, navigate or experience the privilege of affordable housing in Kenya.

**Objective:** This paper seeks to assess the navigability of the housing units, establish the challenges face by a visually impaired person in the space and propose principle elements for designing navigable interior spaces for them. **Design:** The paper has used qualitative and quantitative methods to collect the necessary data for the research.

**Setting:** The study was carried out in Ngara. **Subject:** The paper studies the visually impaired person and their navigation in the affordable housing unit environment . **Results:** The research results revealed that the affordable housing units where not designed to accommodate the needs of a visually impaired person hence the need for the government to consult the universal design guidelines when designing for all.. **Conclusion:** This paper concluded that when designing for all, then all stakeholders should be present from the initial stages of the design conception. Also involving expert with knowledge of matters like universal design is key for successful designs.

# CHAPTER 1.0 INTRODUCTION

## 1.0 Introduction .

Universal design is the process of making an environment that is as open, clear, and useable as possible for everyone, regardless of their age, size, skill level, or disability. When constructing an environment (or any buildings, products, or services in it), the needs of every person who intends to use it should be taken into account. This is not a special necessity that just helps a tiny fraction of the population. It is a requirement for quality design. When a space is functional, practical, reachable, and enjoyable to use, everyone benefits. By considering all users' unique needs and abilities throughout the design process, universal design creates products, services, and environments that meet peoples' needs. Simply put, universal design is good design.

## 1.1 Background to The Study.

As much as Kenya is trying to evolve to inclusive design it has still failed in the front of universally designed homes which cater for the visually impaired. The previous jubilee government had set a goal of building over 500,000 units of affordable housing by the time their second term was over which they did not accomplish. Since 2017, only 2613 units have been constructed with another 3480 underway, which are being built at a cost of 6.9 billion shillings. Unfortunately, the government did not take the Universal Design principles into consideration when designing the affordable housing units for the visually impaired person.

Navigation in indoor environments is highly challenging for the visually impaired, particularly in new environments. Several solutions have been proposed to deal with this challenge. Visually impaired people prefer the process of perceiving objects through touch, so to make their accessibility and navigation easier and more familiar makes their work easier. Compared with persons with sight, visually impaired people suffer from not only limited accessibility to public buildings but also poor experience of these buildings. This special group has attracted more and more attention from the designers who endeavor to make them live an easier life. Compared to sighted people, Visually Impaired have to rely more on their haptic and auditory perception. These two senses are thus the main interest of designers to crack the daily problems of the visually impaired.

This study examines how the senses are used in the built environment and how sighted designers might improve the experience of a visually impaired person in a building that provides affordable accommodation. People who are visually impaired use a variety of aural, tactile, olfactory, and kinesthetic senses to determine location and orientation. As important components of the built environment that serve as essential markers and messages for people who are blind or visually impaired, textures, acoustics, and fragrances should be included in interior design on purpose. The study explores how interior designers have included these features and makes recommendations for how to successfully incorporate them into future inclusive designs.in affordable housing sector.

Visual impairment knows no limit, a framework would be a tool best for inclusivity of the whole population, a solution that best serve diversity. A framework would be; a design map that informs on the best possible way to design the interior spaces of these housing units, for accessibility and inclusion, which drums up universal design.

**1.2 Problem Statement**

Affordable housing is an initiative that was brought for by the previous jubilee government to offer accommodations to all Kenyans at an affordable cost of living. Although Affordable housing in Kenya right now is built for the sighted population. Inclusivity in their designs does not measure up to the universal design principles hence visually impaired persons cannot access, navigate or experience the privilege of affordable housing in Kenya.

**1.3 Research Objectives**

- To assess navigable interior spaces of the affordable houses through the application of an access audit tool, universal design.
- To establish challenges and problems that a visually impaired person faces in navigating an interior space.
- To propose the principle elements of designing navigable interior space for the visually impaired in alignment with the universal design principles.

**1.4 Research Questions**

- How is the access audit tool, universal design, applicable in accessing navigable interior spaces in affordable housing units?
- What are the challenges and problems that a visually impaired person encounters while navigating an interior space?
- What are the principle elements to consider while designing a navigable interior space for a visually impaired person that also meets the universal design principles?

**1.5 Justification of The Study**

The main goal of this research is to advance our understanding of how to design in a way that can be supported by knowledge of the context, experience, and expectations of those who would be impacted by the design of Kenya's affordable housing units. To improve the accessibility of residential spaces for visually impaired people in this context means finding ways to support the development of design actions that can improve their perception and understanding of space, increase their likelihood of orienting themselves and making independent decisions, and allow them to move freely and enjoy the space to its fullest.

**1.6 Significance of The Study.**

According to research, even though those who are blind or visually impaired are missing one of the five senses—vision—and are unable to see the world like others, they can still interact with their environment by using other senses. Their emotional requirements and comfort should also be taken into consideration, in addition to adhering to the universal design principles and standards that are required for a suitable design according to their particular form of knowledge and perception of the world. Designers must adopt a new perspective on the needs of the blind and visually impaired, develop a suitable perspective on their issues, and present their work in a way that allows for their daily activities to coexist with others so that all users can enjoy their residential spaces without assistance. Therefore, improving the quality of interior space design will require an understanding of and analysis of specific behaviors of the blind and visually impaired as well as their requirements and memories.

## 1.7 Geographical Scope.

The affordable housing units have been built in different areas of Kenya but this research will study and focus on affordable housing located at Ngara park road.
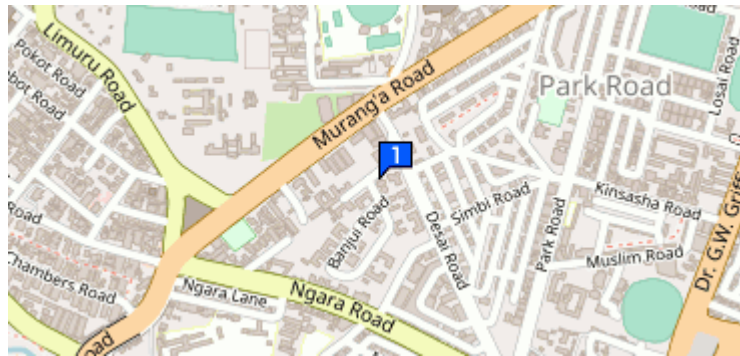


**Figure 1; Map of the Ngara park road affordable housing units.**(source; google maps 2023.)

## 1.8 Limitation of the study.

This study recognizes the exitance of law and regulations set for people with disabilities, policies that if were to be upheld design would be much accessible and easy. Even so, Kenyans with disabilities face daily obstacles that hinder them from fully participating in society, despite having one of the most progressive and rights-based constitutions in the world. Public structures continue to routinely deny equitable access to people with impairments.

During the research, the issue of *lack of awareness* with regard Universal Design came up strongly from the informants. Design professionals and architects also had a good level of awareness although in some cases there was little knowledge about specific design features or best practice guidelines. *Lack of communication* between the important stakeholders when the designing process was in its initial stages. Also informant were very reluctant to participate in the data collection phase which led to some of them pulling out. Accessibility of the study area was also a challenge, it being a residential environment and the residents wanting their privacy maintained.

## 2.0 LITERATURE REVIEW

### 2.1 Introduction

"Housing plays a central role in the social life of people and is a fundamental physiological need required for human survival," McLeod, 2018. "Communities and nations that are properly housed generally enjoy better living standards and prosperity. Shelter, like food and clothing, is one of man's basic rights, and making sure that all citizens are decently housed is a commendable goal," Nzau, 2018. The International Covenant on Economic, Social and Cultural Rights of 1966, the Istanbul Declaration and Habitat Agenda of 1996, and the Declaration on Cities and Other Human Settlements of 2001 are just a few of the international documents that include the right to housing (Republic of Kenya, 2004). The Kenyan Constitution has other references to the right to housing. Every person has the right to basic standards of sanitation and accessible, suitable housing, according to Article 43 (1b) of the Constitution. But how then is a visually impaired person supposed to exercise his/her right to own a house provided by the government under the big for agenda, if those houses are not designed to include them?

### 2.2 Affordable Housing Policy

The big four agenda that was put forth by the jubilee government back in 2017 had an affordable housing initiative included in it. The target was to build 500,000 units by 2022 in order to create homes for Kenyans. Housing is a basic need that provides a sense of safety, a place of relaxation which promotes good health for others housing gives them a recognition of ownership and peace of mind. According to the world bank, 50,000 units have been constructed against a margin of 250,000 units a year leaving a huge deficit of housing units to be delivered. Housing conditions defer in different regions of the country, 60% of human beings live in poor housing conditions in the slum regions in Kenya with poor infrastructure, water, and a well-sanitized environment. On a 100% scale margin, 30% is the recommended threshold expenditure for monthly living, beyond this means that one is drawing from the other basic needs budget making it unbearable to survive. Wealth distribution is one of the major factors that affect the affordability of a home which has led developers to concentrate more on creating homes for middle and upper-class citizens forgetting the lower-class society. If the lower-class person is not considered a major player in the housing

ring, do you think a visually impaired person has a fighting chance, hence the inequality in our Kenyan society.

The current measure of inequality in Kenya is at 0.48 according to the Gini-Coefficient where 0 is equality and 1 is complete inequality. As of 2017, the world bank stated that the demand for high-middle income housing was at 2% and 15% while for lower income was at 48% hence the launch of the affordable housing program to rethink the failing plan in the housing sector. However, since the launch, not all persons were accounted for while finding a solution to the housing problem. For instance the affordable housing units in Kibera, the government thought that leaving the ground floor units of every building for the disabled was a solution that incorporated them into the project. This was just a bandage on a deep wound. If the government had a plan that catered to this community, then a long-term solution would be underway.

One of the most stressful life-changing experiences we go through is moving into a new house. It can also be dangerous and confusing for people with vision impairment who are moving away from their parents' house for the first time, in addition to being extremely joyful and causing worry. Most significantly, it necessitates meticulous thought and planning. There may be a need for support before, during, and after the relocation in order to cope with the difficulties of moving to a new house and location. The government acknowledges that ownership of land, housing, and property is a fundamental human right for people with disabilities as a way of attaining their security, self-reliance, and livelihood on an equal footing with others. This is done through the National Disability Policy, which was reviewed in 2016. Eliminating obstacles that prevent people with disabilities from purchasing and owning land, housing, and property is one of the key interventions the government lists in the policy. Another is ensuring that at least five percent of accessible homes are reserved for people with disabilities.

**2.3 Accessibility in Housing Design.**
Being accessible means that a person with a disability has the same opportunity to learn, engage, and use services as a person without a disability, in a way that is similarly efficient, equally integrated, and that is reasonably simple to use. The information must be fully, equally, and independently accessible to people with disabilities in the same way that it is to people without disabilities. It is nevertheless necessary to guarantee equal access to the educational advantages

and opportunities provided by the technology as well as equal treatment when using it, even though this may not lead to the same ease of use as that of those without impairments.

Avoiding the need for house renovations by adding accessible design elements when building new homes may be a superior strategy for attaining housing accessibility. The majority of research to date on accessible design elements has evaluated total housing accessibility, with an emphasis on the drawbacks of inaccessible housing. This research have demonstrated that insufficiently accessible dwelling designs can limit the functional independence and performance of elderly individuals and those with impairments in both daily routines and employment roles. Additionally, home accessibility issues as a whole may have detrimental effects on health, including lowered mental health and a lower quality of life in terms of health. Although useful, there is a dearth of study examining the precise architectural elements required to increase accessibility in housing.

**2.4 Universal Design.**
The following seven concepts serve as the foundation for universally well-designed products and environments: Fair use (the design is practical and marketable to individuals with a range of skills); flexible in usage (the design takes a variety of personal preferences and talents into account); Simple and intuitive (Use of the design is simple to understand regardless of the user's experience, knowledge, linguistic proficiency, or present level of focus; Tolerance for Error (The design reduces hazards and negative repercussions of accidents); Perceptible Information (The design communicates important information to the user efficiently regardless of their sensory capacities); Low Physical Effort, Size and Space for Approach and Use (appropriate space is supplied to enable comfortable and effective use for everyone regardless of physical and sensory ability), and Low Physical Effort, Efficiency with Minimal Effort are all features of the design.

The Ngara park road affordable houses among the other affordable housing projects fail to meet the universal design requirements since how they are designed is not easily interpretable and navigable to a person with visual impairment. Navigation is the most important part of independent living and if this is not achieved the visually impaired person using the space will have a problem understanding the environment around him/her and this could lead down the hazardous and accident lane quicker as opposed to safety and comfort that a home brings. These housing units have been designed for the sighted population ignoring the fact that all designs should speak for themselves, be usable by all diversities, and be accessible to all persons. Auditing this particular

housing space, for one the walls have the same texture and a smooth paint finish which for a visually impaired person will make it hard to tell the rooms apart. The elevator is good for moving from one floor to the next but an alternative voice recognition type of elevator would be the best suited for every person. The building lacks signage and a mapped layout of the whole environment that can be read(in braille) by a visually impaired person for proper direction. Lack of use of the Tactile material which is best when it comes to drawing a defined path on the floor that makes it easier to guide the white cane and easily maneuverable. Tactile material can also be used on the staircase steps to act as both an indicator to the next step and also as a preventive for wet floor accidents due to its texture. Lighting is the most essential part of any design because it illuminates and brings the design to life while enhancing the visibility of everything, in this case, the buildings have insufficient lighting in so many places including the stairway.

Universal designs are supposed to make the product and its environment usable by all people, to the greatest extent possible, without the need for adaptation or a specialized design which the Ngara park road housing units are failing to achieve these principles.

**2.4.1 Universal Design In Affordable Housing.**

In the last ten years, the emphasis was broadened to wider issues of social inclusion. A newer definition is more relevant to all citizens without ignoring people with disabilities. It states that Universal Design is, **"*a process that enables and empowers a diverse population by improving human performance, health and wellness, and social participation*"** (Steinfeld and Maisel, 2012). The possibility of improving a wide range of people's quality of life grows with universal design. By giving those with disabilities a level playing field, it also lessens stigma. The design community has not embraced Universal Design as widely as some other contemporary design initiatives (such as sustainability and historic preservation). The impression that Universal Design is a design for people with disabilities continues to be one obstacle to adoption. The expected issues, namely; can be solved by building inexpensive housing units that adhere to universal design principles and goals.

**Aging in Place:** Most people desire to stay in their current homes as they get older. In addition to many social and financial advantages, aging in place supports factors that contribute to successful aging, such as life satisfaction, health, and self-esteem. According to a 2021 AARP study, three-

quarters of those 50 and older want to remain in their current homes or communities as long as possible, compared to around half of people in the 18 to 49 age group. 34% of older respondents understand they might need to make physical alterations to their home in order to stay there.

People need housing designs that can be adjusted to a wider range of health issues than traditional designs allow if they want to age in place in their own houses. A crucial component of design for aging in place is to persuade builders of housing to incorporate Universal Design elements.

**Sustainability:** In order to comply with accessibility requirements, sustainable items used in buildings must be made operable by persons with limited function. However, they must also be usable by the general public in order to be practical. They frequently cause usability problems for end users because of their novelty. This may lead to the product being replaced and even to the abandonment of the sustainability objective. Through the use of universal design, innovative sustainable products can be more widely accepted.

**Social Justice:** Designers with a social conscience are concerned about the fact that good design, like many other things in society, is a luxury that many people cannot buy. Because design for diversity ultimately cares about social justice for everyone, it can focus on any civil rights issue, despite its initial concentration on disability rights. Access to housing, education, healthcare, transportation, and other resources in society for all those groups who have been denied full participation should therefore be a priority for Universal Design. Designing for low-income minority populations, which frequently have higher rates of impairment than the mainstream population, is a situation where universal design is particularly relevant.

Having housing that is universally accessible doesn't increase prices; rather, it only raises the design standard to accommodate all diversity and use building materials that address current and future emergent issues. In contrast to later redesigning and having to modify the space to fit the user, having a building created completely prepared to the change in the human physical factor is prioritized higher in the design business.

**2.5 Visual Impairment.**

"There are many different causes of visual impairment including cataracts, glaucoma, corneal scarring (from a variety of causes), age-related macular degeneration and diabetic retinopathy," Foster & Resnikoff, 2005. "The main causes of blindness and low vision globally is reported to be a result of uncorrected refractive errors (myopia, hyperopia, or astigmatism), cataract, and glaucoma," (Pascolini & Mariotti, 2010). "The estimated number of people who are visually impaired in the world is 285 million, 39 million are blind and 246 million have low vision, 65 % of these people are visually impaired and 82% of all blind are 50 years and older," (Pascolini & Mariotti, 2010). According to KNSPWD (2009), the population of persons with visual impairment in Kenya is 331, 594 consisting of 177,811 (female) and 153,783 (male).

Allocating ground-floor houses is not a solution anymore the government has to put in measures that will last a lifetime. These solutions include a well universally designed affordable housing unit that is favorable to persons with visual impairment and those who might develop it in the future not forgetting low vision caused by aging among other arising problems. Cost shouldn't be an issue with a budget of 5 billion set aside for the project. For a progressive nation, we are building our country backward, if only the government would look at solutions for arising problems before they do we would be ahead in development rather than stagnating; in this case, involving a designer who fully incorporated all users into the affordable housing unit plan would have been a step in the right direction to make the homes accessible and navigable for the sighted population and the visually impaired as well.

**2.5.1 Different types of Visual Impairments.**

There are five categories of visual impairment that affect the functioning of the eye, not including total blindness;

 **Visual Acuity (Clarity).**

Visual acuity is the term used to describe how clear or keen one's vision is. In general, it depends on how well the retina of the eye works and how the brain interprets what it sees. 20/20 (6/6 in metric) is the standard for testing distant visual acuity. Glasses, contacts, or surgery can be used to

treat certain vision problems, but not all. As a result, some people will always have fuzzy vision due to low visual acuity.

**Light Sensitivity.**

Numerous people with impaired eyesight experience photophobia, or an abnormally high sensitivity to light. Bright light hurts the eyes and gives people headaches and makes it difficult or impossible to see. Some people find it unpleasant and difficult to read computer screens at regular brightness when the background is light. A darker color for the backdrop is required.

**Contrast Sensitivity.**

The capacity to discriminate between bright and dark portions of images, such as to read writing on a backdrop, is known as contrast sensitivity. Brightness is the basis for contrast. Colors that appear to be highly distinct from one another (such red, blue, and green) may have similar brightness and not offer enough contrast.

**Field of Vision.**

The range from which a person's eye may get visual information when looking directly ahead is known as the field of vision, sometimes known as the visual field. A person's field of vision is typically 180 degrees from left to right and 150 degrees up and down, with the middle 5 degrees and middle 20 degrees being the best for seeing color and having the sharpest eyesight, respectively. The phrase "field loss" is used to characterize people with a smaller field of vision.

Following is a list of different categories for visual field loss:

• Central field loss: The central portion of a person's field of vision is diminished or nonexistent.

• Peripheral field loss: This condition, sometimes known as "tunnel vision," limits vision to the center of the visual field.

• Other field loss: People may experience scattered spots of vision obliteration, a ring of field loss, field loss in either their left or right eye, or other field loss.

Examples of simulated visual field loss:



**Fig. 2.2 Example of central field loss.** (Source  w3c.org ,2016).
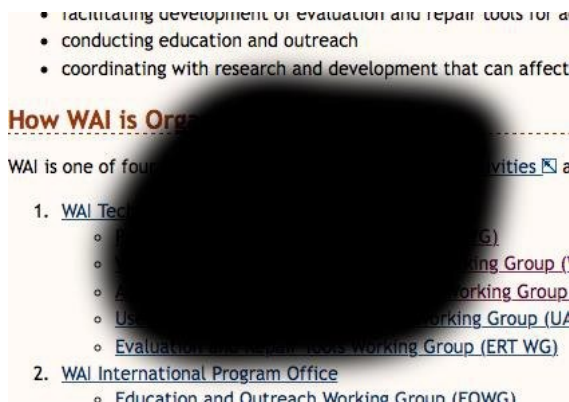


**Fig. 2.3 Example of peripheral field loss.** (Source; w3c.org ,2016).
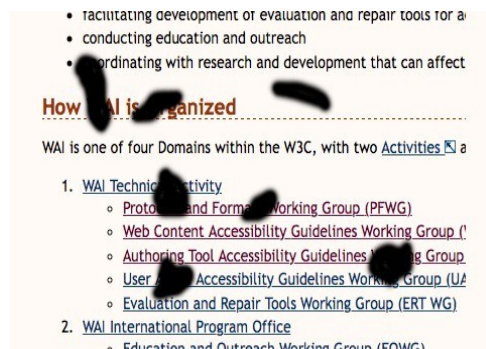


**Fig.2.4 Example of other field loss.** (Source; w3c.org ,2016).

**Color Vision.**

Some people are unable to see some colors at all or only partially due to deficiencies in their eyes' cone receptors, which are responsible for seeing color. Even though most color-blind individuals

can see the majority of colors, this condition is typically referred to as "color blindness". Rarely does someone have no perception of color at all. One in 200 women and one in twelve men (7%) suffer from color vision issues worldwide.

Simulated examples of color blindness:
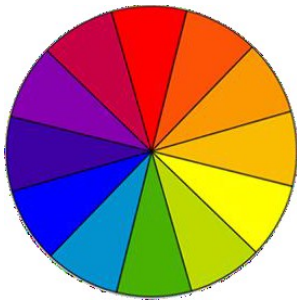


**Fig.2. 5 Full color perception blindness**
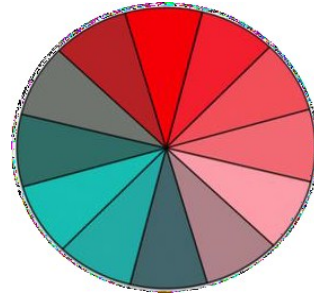


**Fig. 2.6  Red-green color**
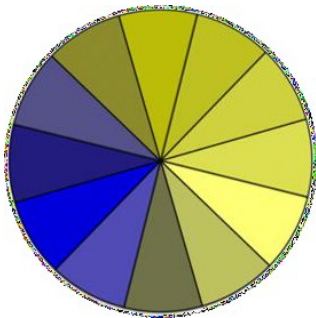


**Fig. 2.7  Blue-yellow color blindness** (rare)
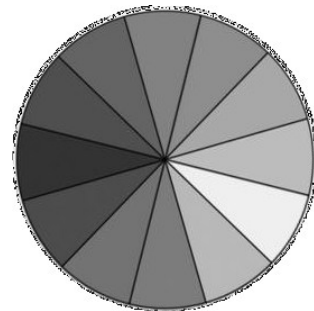


**Fig. 2.8 No color perception**

**2.5.2Examples of diagnosed eye conditions.**

**Keratoconus.**

Keratoconus is a disease that causes, the cornea, the transparent, dome-shaped front of your eye, gradually becomes thinner and bulges outward into a cone shape. Vision is distorted by a cornea with a cone shape, which can also make one more sensitive to glare and light. Usually, both eyes are affected by keratoconus. One eye may be more affected than the other, though. People usually start to have symptoms between their late teens and 30. The situation could deteriorate gradually for ten years or more. One might be able to use glasses or soft contact lenses to treat visual issues in the early stages of keratoconus. Later, ones might need to have stiff, gas permeable contacts or other kinds of lenses, such scleral lenses, installed. If things worsen, one might require a corneal transplant.



Healthy cornea vs keratoconus

Healthy cornea

Keratoconus cornea
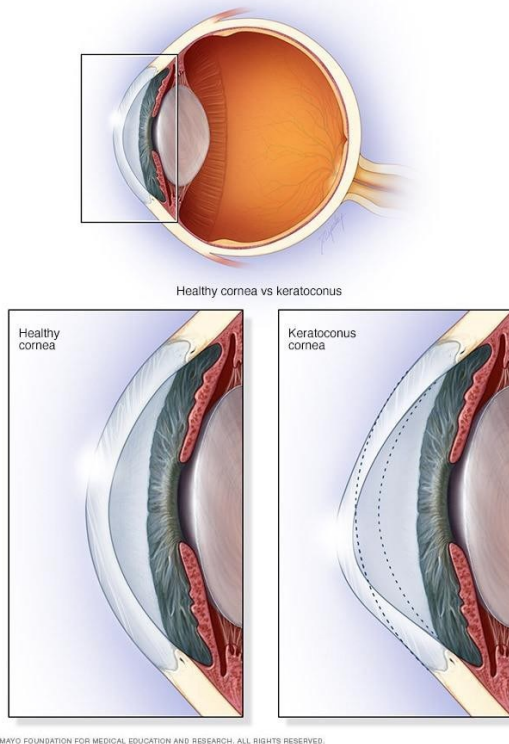
**Fig 2.9; Keratoconus affected eye.** (Source: Mayo clinic.org)

**Retinitis Pigmentosa.**

Retinitis pigmentosa (RP) is a condition that affects the retina, the layer of tissue at the back of the eye that is sensitive to light. RP causes the retinal cells to gradually deteriorate over time, resulting

in visual loss.RP is a hereditary condition that affects people from birth. Most people eventually lose the majority of their vision, and symptoms typically begin in childhood.

RP has no treatment options. But persons with RP can make the most of their vision with the help of visual aids and rehabilitation (training) programs.

Additionally, RP impairs peripheral (side) vision, making it difficult to see out of the corners of your eyes. Your field of vision gradually gets smaller until all you have is some central vision (also known as tunnel vision).Some RP sufferers experience vision loss more quickly than others. Most RP sufferers eventually lose both their side and their center vision.

The following are other signs of RP:

 • Sensitivity to strong light.

• A decline in color vision.

**Retinitis Pigmentosa**

**Normal anatomy**

Pupil

Cone
Rod

Lens

Optic
nerve

Retina

**Retinitis pigmentosa**

Deteriorating
retina

Cleveland
Clinic
©2023
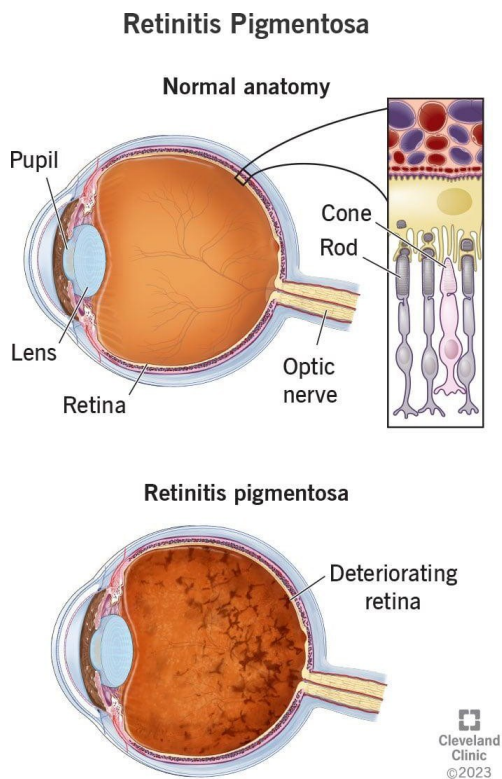
**Fig 2.10: Retinitis Pigmentosa affected eye.** (Source: Cleveland clinic,2023).

**Photophobia.**

Eye discomfort in strong light is known as photophobia. Light can enter the eye through the cornea. The iris of the eye changes form as light enters it by either expanding and allowing more light to enter or contracting and allowing less light to enter to modify the size of the pupil.
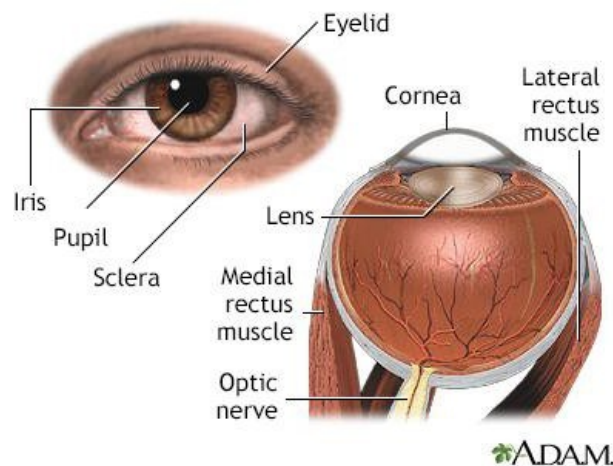


**Fig 2.11: Photophobia affected eye.**(Source; Mount Sinai.org)

**Presbyopia.**

Presbyopia is the impairment of one's ability to perceive small print or up-close objects. A frequent disorder that gradually worsens over the course of a lifetime is presbyopia. It's possible that until you're 35 or 40 years old, nothing will change. People with presbyopia usually hold their books at arm's length. There are certain persons who get headaches or "tired eyes" while reading or performing other close chores. Reading glasses or multifocal (bifocal) lenses can improve your vision if you have presbyopia.
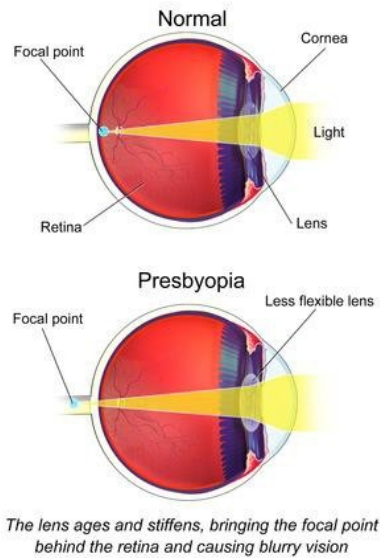
**Fig 2.12: Presbyopia affected eye.**(Source; Wikipedia 2023)

**Myopia.**

Many people have a condition called myopia that makes near items appear clear and far away objects appear blurry. It occurs when light rays are improperly bent (refracted) as a result of the shape of the eye or particular features of the eye. Although light should focus on the retina at the back of the eye, it is instead focused in front of the retina.
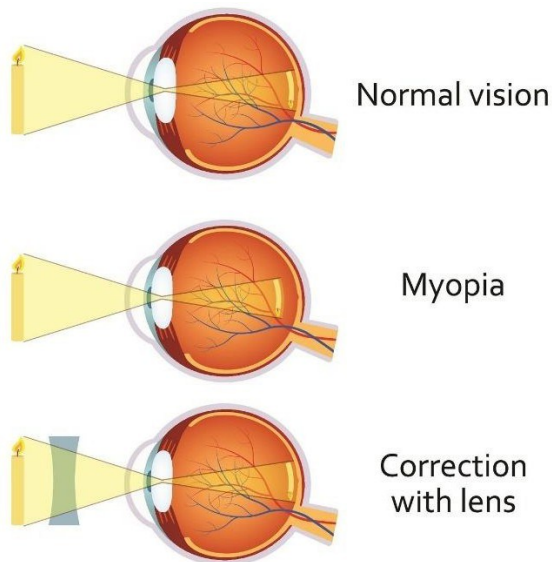


**Fig 2.13.Myopia affected eye.**(Source; Kraft Eye Institute,2022)

**Hypermetropia.**

An eyesight problem known as hypermetropia makes it impossible for light rays to focus on the retina but rather behind it. The short eye length is the primary contributor to this problem. People with hypermetropia can only focus on distant things, relying on accommodation, which is the ciliary muscle's contraction of the lens, to focus.
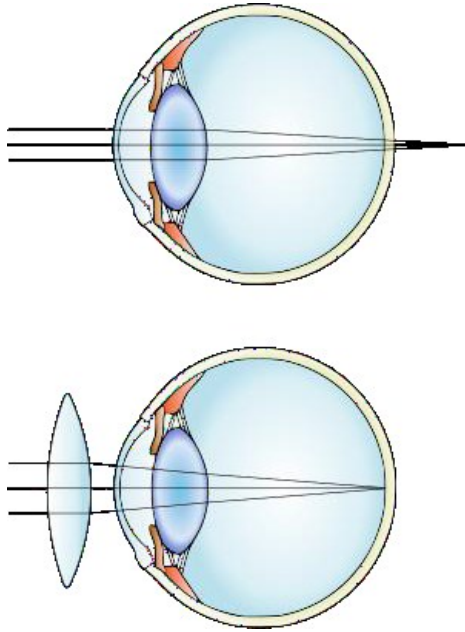


**Fig 2.14: Hypermetropia affected eye.**(Source Wikipedia,2023)

**Cataracts.**

Cataracts are hazy spots that form in the front of the eye's lens. The lens of the eye is typically transparent, much like a camera lens. Vision becomes hazy as a result of cataracts, which prevent light from freely passing through the lens to the retina at the rear of the eye. Cataracts often develop gradually and do not cause pain, redness, or tearing in the eye. Some don't grow and don't affect vision. If they enlarge or thicken and significantly impair vision, surgery is nearly always an option.
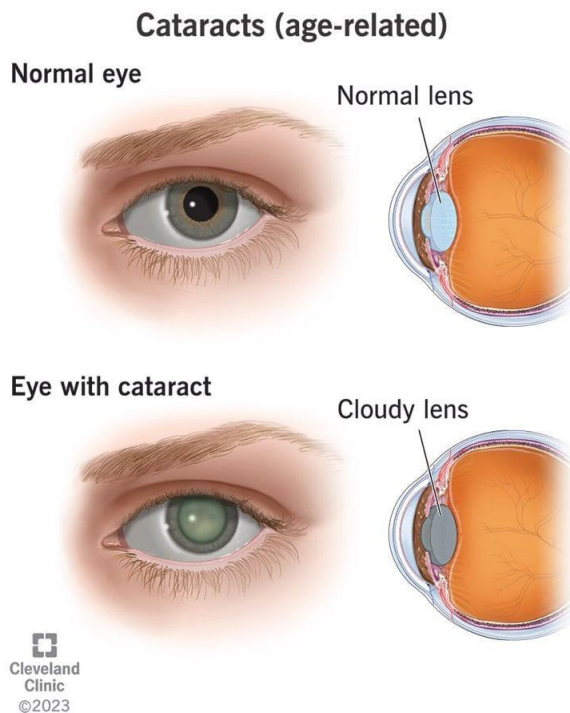
**Fig 2.15: cataract affected eye.** (Source; Cleveland clinic,2023).

**2.6 Universal design: use of tactile material .**

Tactile maps:

Different kinds of tactile maps can be used for communication, for studying geography, or even for developing navigational abilities in specific locations. These goods can be grouped into:

• Travel Maps. This current information includes things like roads, buildings, obstacles, stairs, elevators in cities, and telephones.

• Topographic maps. These offer the itinerary to the blind and are highly simplified, leaving out extraneous information.

• Maps for orientation. These have less specific information than Mobility maps, such as transportation systems, retail establishments, recreational locations, etc.

• General Reference Maps, such as a country's physical or political map.

• Thematic Maps. This gives detailed information about the population, the climate, etc. Usually, blind people use these things before they travel to a new location.

The Mobility Instructors may typically teach the visually impaired the itinerary as per the agreed protocol, and then support them as they attempt to follow the real route. According to studies, people who are blind or visually handicapped prefer to use these devices at home to learn the route before taking it. Once they have learned, they require a guide to show them the proper path. It should be highlighted that past research have demonstrated the value of these kinds of gadgets in assisting visually impaired people with mobility, spatial orientation, and autonomy. The difference between tactile scale-models and tactile maps must also be made. While tactile maps display the information embedded in symbolic elements like points, lines, and surfaces, tactile scale models represent real information in a volumetric manner.

Recognizing that people with visual impairments are a diverse group and that comprehension of haptic reading techniques is essential for comprehending these kinds of gadgets is vital. This information enables users to recognize the information provided in a tactile product, especially in realistic circumstances, more precisely and effectively. Second, the distinctions between congenital and noncongenitally blindness influence the ability to get familiar with certain reading methods and the capacity of accessing visual memory, both of which are required to comprehend graphical norms. If the information had been assimilated well, all of these criteria would determine the user's ability to decipher the tactile-graphic information and acquire accurate understanding of the environment.

**2.6.1 Indoor navigation technology on the rise.**

"Understanding the needs of Persons with visual impairments population and discovering new ways to provide life-long support can reduce financial burdens, improve quality of life, and support independence. For the majority of Persons with visual impairments , a main challenge involves difficulties with independent navigation," (Gharpure et al., 2004). " One component of navigation is wayfinding, defined as the planning and decision-making component of navigation," (Dalton et al., 2019). "When navigating indoor environments, Persons with visual impairments experience unique difficulties because it is harder for them to identify and avoid environmental obstacles," (Cattaneo & Vecchi, 2011). In indoor settings, navigational aids for people with visual

impairments are not always practical (voice GPS systems, for instance, lack access to the structure of indoor environments).

Technologies should be improved to support both the users' desires and the known obstacles to indoor navigation. Thus, the development of technologies to support people with visual impairments in wayfinding can benefit from an awareness of their needs, obstacles to this task, existing solution options, and preferences. Robots, for example, can aid people who need help navigating buildings and have visual impairments.

Robots have the ability to complement existing technologies for navigating in a beneficial way and fill in any gaps that may exist. For instance, unlike other commonly used technologies, robots can move about on their own, enabling the robot to both physically lead users and support sensors to map the users' environment for them, reducing the cognitive strain. People who are visually impaired typically need to recall their environment. Additionally, if necessary, robots can carry out manipulation duties (such as moving a trip hazard or picking up a dropped object).

"The most used tools are white canes (which provide limited information about the user's environment), followed by guide dogs (which are uncommon and expensive), and tactile maps ," (Jeamwatthanachai et al., 2019). "Technologies in wayfinding for Persons with visual impairments have attracted numerous research interests and efforts with some approaches being based on smartphones and wearable devices such as smart glasses," Wilson et al., 2007; Cheraghi, 2017; Zhang & Ye, 2017; Zhao et al., 2020. "However, these devices have two major problems. First, smartphones and wearable devices cannot move and explore the surrounding environments independently of the user. Second, use of Bluetooth beacons for localization can be expensive and labor intensive. In addition, due to the size of the wearable devices, some methods are confined to using Global Positioning System (GPS) for localization," Cheraghi, 2017, "which are inaccurate or unavailable in indoor environments," (Wilson et al., 2007). "Wayfinding assistance robots solve the lack of mobility problem and provide a larger payload for the installations of better hardware devices," Xiao et al., 2021; Kulyukin & Gharpure, 2008; Nanavati et al., 2019. "User studies show that wayfinding robots are preferred by Persons with visual impairments over traditional aids such as a white cane," Tobita et al., 2017.

Well Kenya has yet to adapt fully to the technology best for navigating the current indoor terrain. Technology is advancing quicker than expected and as such new milestones are being conquered, hence its relevance is key in assisting the navigation of Persons with visual impairments. Designer have yet to consider technology as an additive to universal design and integrate it to wayfinding systems in order to give a full residential independence to the Persons with visual impairments in their space with no much worry of adapting it as the life and age. Technology is the future of wayfinding.

**2.7 Problems and Challenges That Visually Impaired Persons Face in New Spaces.**

There are many problems that visually impaired persons encounter in unfamiliar spaces that make it hard for them to navigate freely and enjoy the environment some of them include:

- Inability to tell if a floor is wet or if there are clothes in the pathways because a white cane cannot detect such things hence it could cause a lot of unintended accidents.
- The training and acquisition of guide dogs are quite expensive, in order for the dog to be familiar with the new environment it has to undergo particular training to making efficient as a guide.
- Visually impaired persons use distance estimation when getting more acquainted with both familiar and unfamiliar spaces i.e. counting steps. Imaging trying to mentally count steps in a noisy environment, it makes it extremely hard to concentrate.
- Lack of sighted guides: these guides help with the familiarization of the space before the use of sense and feeling. For example a well-descriptive map of the layout of the space in braille as well, a few landmarks among others to help with self-navigation.
- Obstacles and barriers; an undefined path can cause a lot of accidents because the visually impaired person has to hit a lot of things losing their balance in order to create a path. It is therefore inadvisable to have things like mounted furniture or objects.


**2.8 Conclusion**

Developing the best standard design to practice means engagement and consultations should take place between technical experts, blindness service providers, blindness consumer organizations,

and the user to center the design best fit for everyone. As a designer, universal design principles are a tool for change in solving a problem in its early stages if not preventing it and the government ought to acknowledge the important role we play in the success of creating a functional design.

**CONCEPTUAL FRAMEWORK**

Identification of the product.(A.H)

User data.

Analysis of the user requirement.

Qualitative research.

Product design. Implementation phase.

UD guidelines

Access audit tool.

Evaluation | requirements.
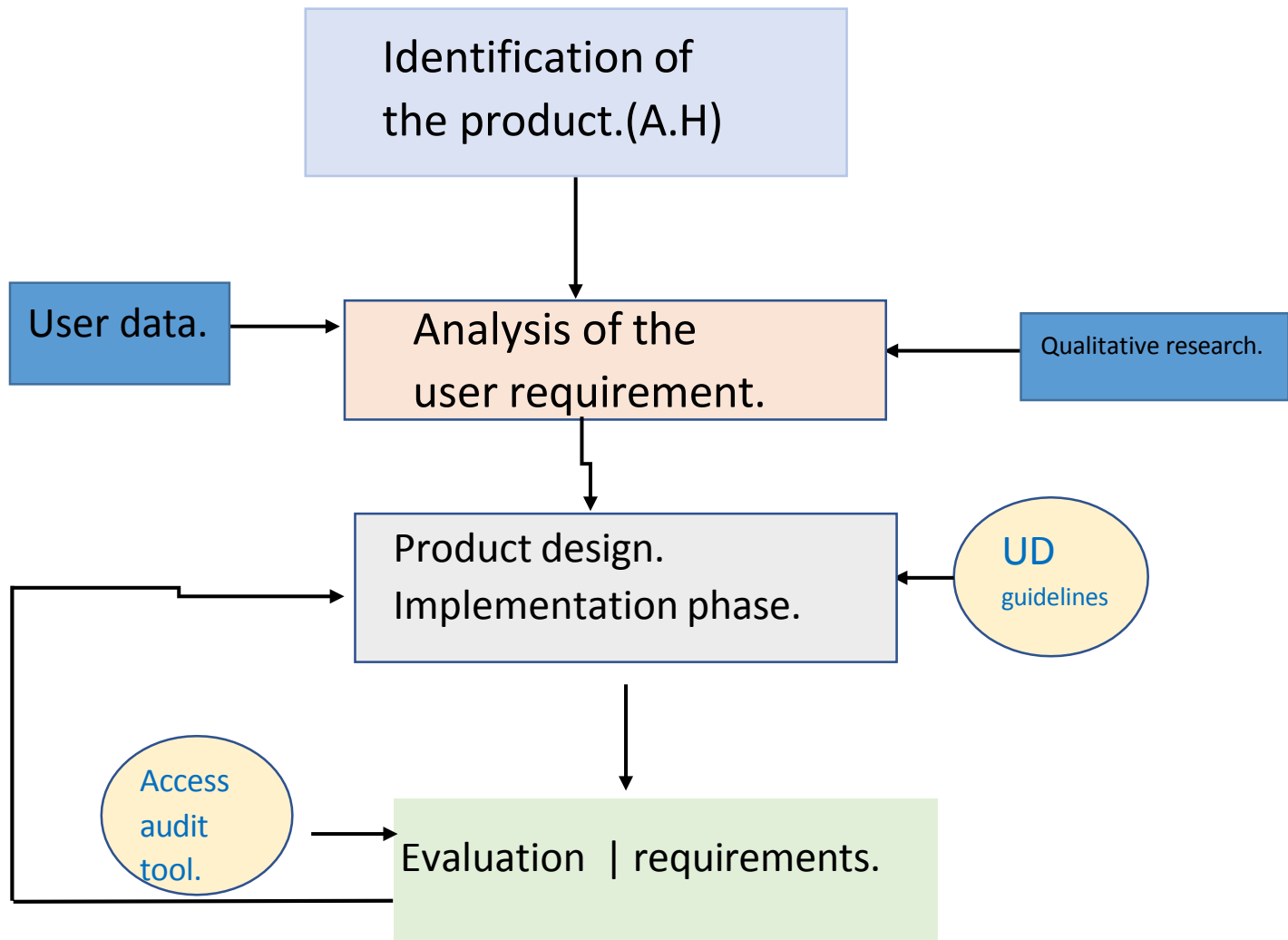
**CHAPTER 3: RESEARCH METHODOLOGY.**

**3.0 INTRODUCTION.**

The research design, demographic, sample, sampling technique, study region, and data collection techniques are all covered in this chapter.

**3.1 Research Approach.**

The goal of the research design is to give the study an adequate structure. The choice to be made about the research approach, which decides how pertinent data for this study will be gathered, is a very important decision of the process; nonetheless, the research design process contains numerous interrelated options. An descriptive research design will be used for this investigation. This research strategy combines qualitative and quantitative methods to offer a helpful description of a subject for which there is scant to no relevant data. The aim of descriptive research is to accurately describe a studied problem. To Creswell (2000), " the descriptive method of research is used to gather information about the present existing condition. Mugenda and Mugenda (2003) argue that, " descriptive research design determines and reports the way things are." "Cross-sectional surveys are primarily used to gather information concerning individuals' opinions, beliefs, perceptions, or practices," (Creswell, 2008).

**3.2 The Study Area**

 The research focus is on affordable housing units in Ngara. The government of Nairobi has allocated the first group of affordable housing apartments at the Park Road affordable housing project. This has happened since the first batch of the 488 finished units, which have already undergone inspection and been turned over to the government, was made available to the public. Apartments with one bedroom cost Sh1 million, those with two bedrooms cost Sh2 million, and those with three bedrooms cost Sh3 million. Depending on the unit they select, interested parties are required to deposit 12.5 percent of the total cost. A cash payment or a mortgage may be chosen by the interested parties as their preferred means of financing the outstanding debt.

The new flats have a range of social amenities in addition to parking, rooftop gardens, a jogging track, solar water heaters, lifts, a perimeter wall and security gate, a retail and commercial center, and a safe children's playground. A prospective buyer must register on the Boma Yangu internet portal, according to Mr. Hinga, the minister of housing and urban development, in order to purchase a unit at Park Road. Candidates must be Kenyan citizens who can prove they have the financial means to make ethical and responsible purchases.

## 3.3 Population Frame and Sampling Size.

Mugenda and Mugenda (2003) "define a population as an entire group of individuals, events, or objects with some observable characteristics." The target population, which is further divided into the target population and accessible population, is the entire group of people or things to which the researcher wishes to generalize the study findings in this research. This includes a small number of people in the community of the visually impaired as well as people who currently occupy affordable housing units. The accessible population is the section of the population to whom the researcher has acceptable access; it may only apply to a particular region, state, city, county, or institution. It may also be a subset of the target population. The chief architect of the affordable housing project on Ngara Park Road, a designer with extensive experience in universal design, is the accessible population for this study.

Every member of the population must be identified in order for them to have an equal chance of being chosen as a subject (element), hence the sample size is a list of all the population elements from which the sample is drawn. The sample size of the study is an estimated 20 occupants living currently in the affordable housing units,7 members of the visually impaired community, the head architect of the ngara park road affordable housing project, and 1 designer who is well vast in universal design and 5 other designers, 6 interior design students.

## 3.4 Sampling Method

Orodho and Kombo (2003) "define sampling as the procedure a researcher uses to gather people, places, or things to study." This study adopted simple random sampling where every element (member) of the population has a probability greater than) of being selected for the sample, to obtain the number of occupants as well as visually impaired persons to administer questionnaires

to and purposive sampling to obtain information from the head architect of the Ngara park road affordable housing project,6 interior designers,6 interior design students.

### 3.5. Data Collection Methods.

Data collection is the process of compiling information from all relevant sources in order to respond to the research question, test the hypothesis, and evaluate the outcomes. Different data collection strategies can be categorized using secondary and primary ways of data acquisition.

### 3.5.1 Secondary Data Collection Methods.

Secondary data is information that has already been published in publications such as books, newspapers, magazines, journals, web portals, etc. There is a variety of information available from these sites. It is essential to use the correct set of criteria when selecting the secondary data to be included in the study in order to increase the levels of research validity and reliability.

### 3.5.2 Primary Data Collection Methods

The term "primary data" describes information that has never been preserved before. The findings of your initial investigation serve as your principal data. More time and effort may be required for primary data collecting and analysis than for secondary data research. There are two categories of methods for gathering both quantitative and qualitative primary data. The adoption of quantitative data collection techniques is encouraged by this study. Numerous mathematical computations are used as the foundation for quantitative data collection techniques. Quantitative information is gathered and analyzed using closed-ended questionnaires and other methods. Quantitative methods can be used more rapidly and inexpensively than qualitative methods. Additionally, because quantitative procedures are highly standardized, outcomes may be easily compared.

### 3.5.2.1 Questionnaires

According to Hannusheck (2007), "questionnaires will be used for this study because they are much more efficient in that they permit the collection of data from a much larger sample." According to Mulusa (1990), "questionnaires allow respondents to give frank answers to sensitive questions if they are not required to disclose their identity."

**3.5.2.2 Interview**

According to Gill et al., (2008), "a semi-structured interview is an interview that has several key questions which help to define the areas to be explored, but also allows the researcher the flexibility to pursue an idea in response in more detail; this is a medium between structured and unstructured interviews." This study does use semi-structured interviews to capture the facts, views, and opinions of the head architect of the ngara park road affordable housing project.

**3.5.2.3 Observations**

This method implies the collection of information by way of the investigator's observation, without interviewing the respondents. According to Marshall and Rossman (1989), " defines observation is the systematic description of events, behaviors, and artifacts in the social setting chosen for study." According to Cohen, et al. (2000), "Observations may enable researchers to see things that are taken for granted by participants. The researcher thus takes a personal outlook of the housing units to pick up on things overlooked by the occupants."

**3.6 Data Analysis and Presentation**

Research data analysis, according to LeCompte and Schensul, is a procedure used by researchers to turn data into a narrative and then analyze it to gain new knowledge. It makes logical that the data analysis process aids in breaking up enormous amounts of data into smaller pieces.

The data collected in this study will be analyzed using the different methods of analysis and represented in tables pie charts and graphs respectively.

**3.7 Ethical Consideration**

Due to the sensitive nature of the respondents, disability research more than any other sort of research always necessitates ethical attention. Accordingly, the researcher considered a number of measures to maintain ethical issues in all stages of the study. The measures were; Gaining Formal Permission and Confidentiality.

**3.8 Expected Results**

For the foreseeable future, the government of Kenya will adopt this guiding framework to build inclusive homes that solve even a possible development of a visual impairment that will be accessible and navigable to all persons regardless of their adversity.

**CHAPTER 4; FINDINGS.**

**4.1 Introduction.**

This chapter gives knowledge of the researchers' findings from two perspectives:

I.   Findings from the questionnaires and interview guides that were administered to various sets of target populations in order to better understand the issue at hand and how best to improve an environment to better suit a visually impaired person.

II.  Universal design access audit tool for analysis of the affordable housing unit's environment in regards to accessibility and navigation for the visually impaired person.

**4.2 Findings from Respondents.**

This section presents data and information collected from various respondents as per the questionnaires and interview guides. The respondents' pool consisted of; interior designers, interior design students, persons with visual impairment, and the lead architect of the boma yangu affordable housing project.

**4.2.1  Information from residing visually impaired residents of the affordable housing units.**

The researcher sort to establish a sample of the whole population(the visually impaired persons) as a representation, from the most affected visually to the least affected, just to understand how they perceive the environment, and their experiences with the navigation of it since they first acquired the property and how they best adapted to it and whether it was designed to accommodate their needs.

The general number of interviewed persons is 7, all with different visual impairments as indicated in the table below.

| NO. | GENDER. | ONSET VISUAL IMPAREMENT. | DURATION OF THE VISUAL IMPAIRMENT. | ENVIRONMENT. | TYPE OF VISUAL IMPAIRMENT |
|---|---|---|---|---|---|
| V.I 1 | Female. | 2018. | 5 years. | Lives alone. | Retinitis pigmentosa. |
| V.I 2 | Male. | 1989. | 34 years. | Married with three kids. | Myopia . |
| V.1 3 | Male. | 2005. | 18years. | Lives with his parents. | Keratoconus. |
| V.I 4 | Female. | 1967. | 56 years. | Married with one kid and a nanny. | Hypermetropia. |
| V.1 5 | Male. | 2007. | 16 years. | Lives alone. | Photophobia. |
| V.I 6 | Female. | 1949. | 74years. | Lives with the daughter. | Presbyopia. |
| V.I 7 | Male. | 1996. | 27 years. | Lives alone. | Cataracts. |

**Table 1; Information about each visually impaired respondent.** *(Authors construct, 2023).*

**4.2.1.1 Access to the main entrance.**

According to the respondents the access to the main entrance; 60% could access it easily both at night and during the day from the day they moved in. For the remaining 40% said that access to the main entrance was quite a challenge for them, especially during the night.
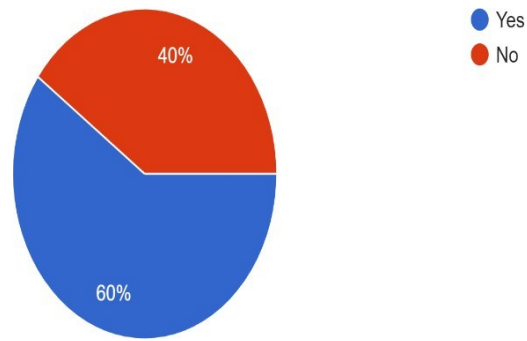
**Figure 4.16 Level of accessibility of the main entrance.** *(Authors construct, 2023).*

### 4.2.1.2 Accessibility and Navigation of the indoor spaces.

| No . | Accessibility and navigation. | Length of adjustment. | Adaptations. |
|------|------|------|------|
| V.I 1 | Not Easily . | 8 months. | Remodeled the wall textures, kitchen, and lighting fixtures. |
| V.I 2 | Not Easily. | 1 year. | Remodeled the wall finishes, color of the paint used, and floor finish for the living room to wood and lighting. |
| V.I 3 | Easily. | 3months. | Remodeled the wall  textures |
| V.I 4 | Easily. | Fit right in. | Added different floor furnishes for different rooms. |
| V.I 5 | Not Easily. | Still adjusting. | Painted different rooms with different colors and adjusted the lighting fixtures to suit the sight. |
| V.I 6 | Not Easily. | Still adjusting with assistance. | Minimal furniture installation for a clear path flow. |
| V.I 7 | Easily. | 2 weeks. | Non . |

**Table 4.2 ease in accessibility and navigation of the indoor spaces and the length of adjustment and adaptations.** *(Authors construct, 2023).*

For most of the visually impaired participants, they had to adjust their environment to better suit themselves in order to easily maneuver and feel comfortable in their homes

**Figure 4.17 Level of ease in navigating the space.** *(Authors construct, 2023).*
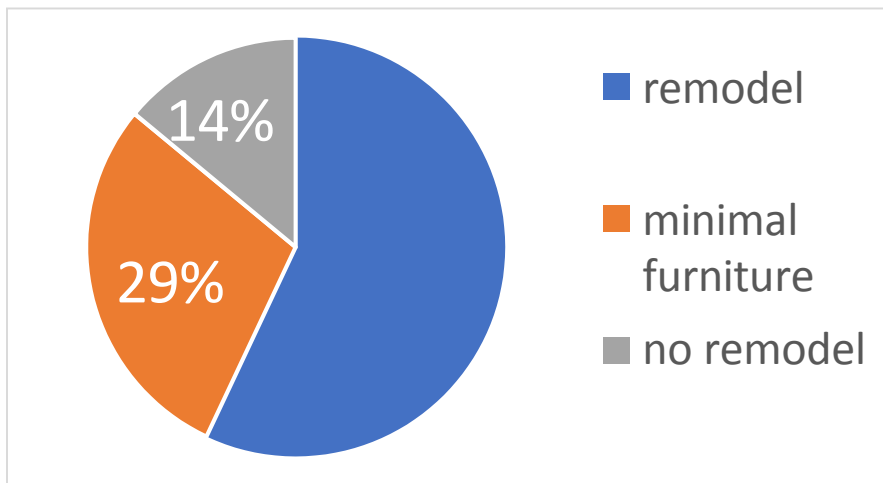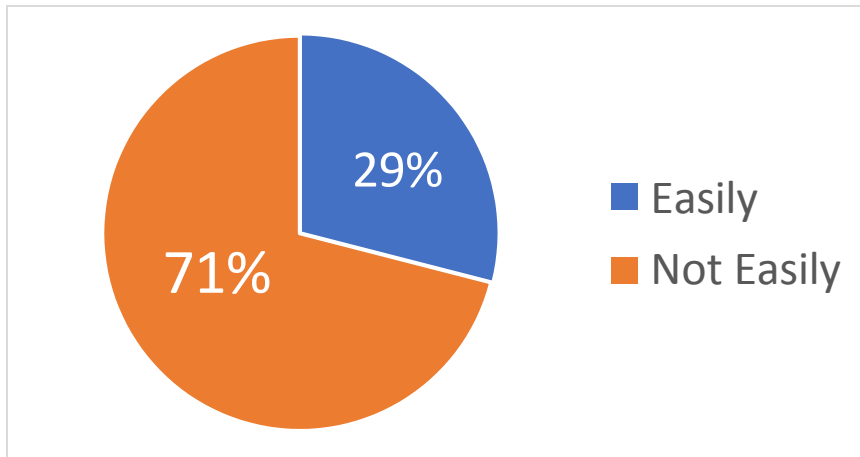




**Figure 4.18 Level of adaptation of the environment to suit the visually impaired person.** *(Authors construct, 2023).*

**4.2.1.3 Importance of Signage in the Accessibility and Navigation of the Environment.**

The respondents had mixed feelings concerning signage. Most of them felt strongly that signage would play a big role in the direction, a different percentage felt that it was just as important as

other guiding factors whereas a smaller percentage rendered signage not important in their daily navigation and accessibility of their environment.
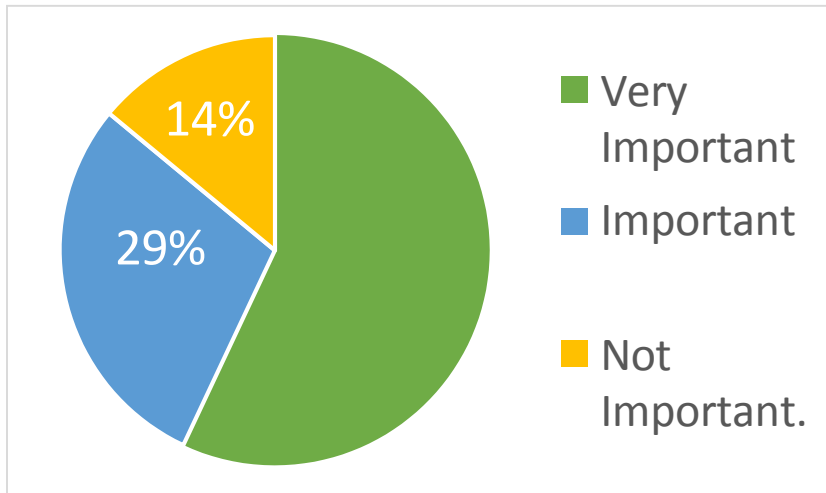


**Figure 4.19 Level of importance of signage in navigation and accessibility.** *(Authors construct, 2023).*

### 4.2.1.5 Voice recognition elevators.

The researcher discovered that the respondent majorly prefer voice recognition elevators compared to the normal elevators for various reasons angled at the same outcome. The respondent who didn't think the voice recognition elevator had a role in their navigation had already adapted to the currently installed elevators. The final set of respondents require assistance in using the elevators.
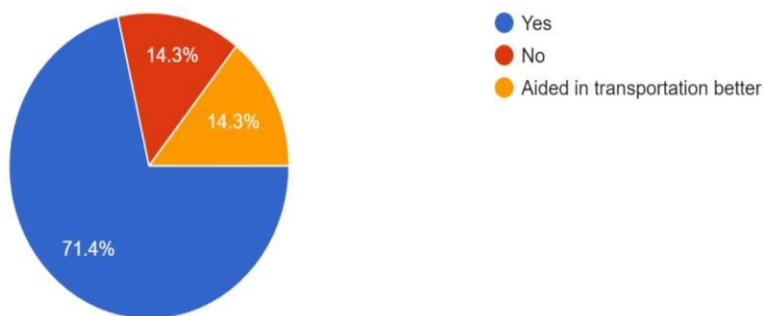


**Figure 4.20 Importance of voice recognition elevators in navigation.** *(Authors construct, 2023).*

**4.2.1.6 Textures and good lighting.**

Textures have great importance in aiding the navigation of a visually impaired person combined with great lighting set just right to the preferable ambiance of the user making it easier for the user to navigate their space. For this reason, the respondents had different opinions on different lighting fixtures and tall textures and how both have aided the navigation of the environment or not aided at all.
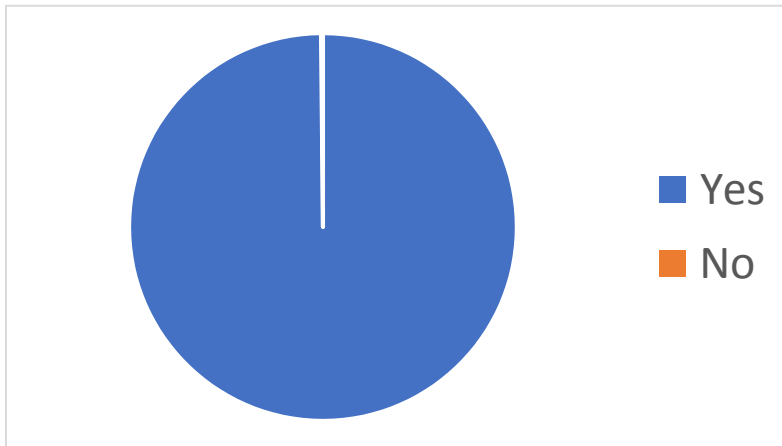


**Figure 4.21 Level of importance of textures and good lighting.** *(Authors construct, 2023).*

**4.2.1.7 Tools suited to inform while navigating and accessing the environment.**

| No | Navigation Tools. |
|---|---|
| V.I 1 | Signage (esp. when cleaning to indicate wet floors). |
| V.I 2 | Signage and maps. |
| V.I 3 | Signage. (esp. making of trenches and bumps) |
| V.I 4 | Signage and maps. |
| V.1 5 | Proper lighting more at night. |
| V.1 6 | No tools necessary. |
| V.I 7 | Improve surface paintings, trench marking, and road markings as well. |

**Table 4.3 Accessibility and navigation tools.** *(Authors construct, 2023).*

The higher side of respondents had a common opinion on proper signage within the environment of the affordable housing units, which as the researcher also observed is lacking on a large scale. V.I 5 informed the researcher that the street lights are solar powered, which has its advantages but their concern was when the lights go on the light up strongly but as the night moves along the power dims making it hard to see. V.I 7 & V.I 3 informed the researcher that they have slipped into the trenches on the road a couple of times both while walking and driving and insist on proper road feature markings.

**4.2.2 Information from Practicing interior designers.**

Interior designers had a part to play in this research as they shed light on a few things that the original designers\creators of the Boma Yangu affordable housing missed. The researcher managed to administer questionnaires to seven interior designers and managed to get six responses back.

| No | Area of Specialization | Years in Practice. |
|----|------------------------|--------------------|
| 1 | Interior fittings | 4 years. |
| 2 | Interior design | 15 years. |
| 3 | Design | 7 years. |
| 4 | Inclusive design | 16years. |
| 5 | UD expert | 9 years. |
| 6 | Interior architecture | 2years. |

**Table 4.4  Area of specialization of different designer and years in practice.** *(Authors construct, 2023).*

**4.2.2.1 Focal points while designing for the visually impaired.**

In response to the question of the focal points to focus on while designing for the visually impaired, it was unanimous that each and every designer should consult and communicate with the visually impaired person because the environment they are creating is theirs. Hence understanding the user

is best compared to personal opinions. Below is a table of other focal points the different designers responded to be important to the design process.

| No | Area of specialization | Focal point. |
|----|------------------------|--------------|
| 1 | Interior fittings. | Wall and floor finishes. |
| 2 | Interior design. | Human Anatomy. |
| 3 | Design. | Traffic flow, lighting both natural and artificial, abrasion in terms of surfaces. |
| 4 | Inclusive design. | Pathways and wayfinding. |
| 5 | UD expert. | Universal design principals. |
| 6 | Interior architecture. | The flow of objects/architecture. Their sense of touch he uses to identify items. |

**Table 4.5 Different focal points when designing for the visually impaired.** *(Authors construct, 2023).*
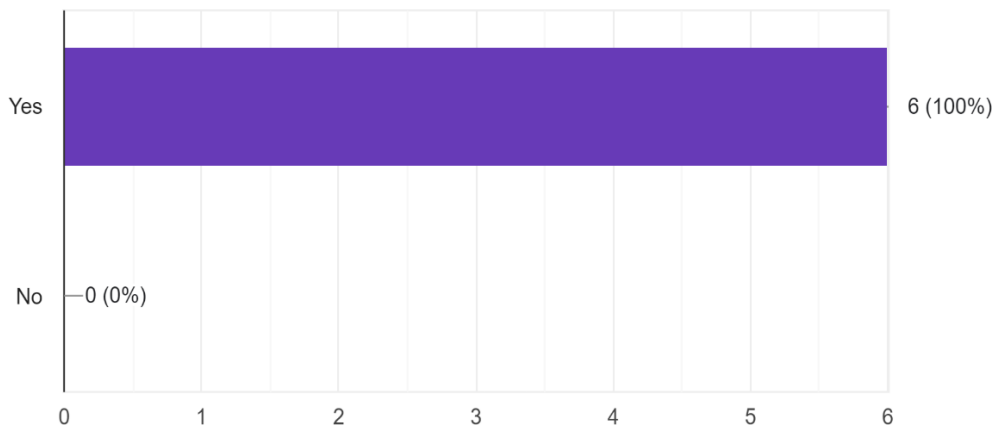


**Chart 4.1 Suitability of communicating with the visually impaired while designing for them.** *(Authors construct, 2023).*

### 4.2.2.2 Finishings and Furnishings.

In response to the question of whether visual impairment dictates finishing and furnishes to be used, the respondents all agreed, and proceeded to give reasons why.



**Chart 4.2 Visual impairment dictates finishings and furnishing materials to be used.** *(Authors construct, 2023).*

Reasons given:

- The furnishes and finishes are more functional than aesthetical.
- They give more understanding of their space to aid in their basic everyday activities.
- Some of the visually impaired can perceive light hence understanding what light appeals to them is important.
- A designer should maximize scented items and tactile materials since Visually impaired persons use their sense of touch to perceive their environment.
- Avoid clutter and sharp objects to prevent injuries.

### 4.2.2.3 Universally designing a space vs renovating which is cheaper.

In the response to this particular question of universally designing universally versus renovating which is cheaper, a larger percentage said it is cheaper only one respondent said they don't know.
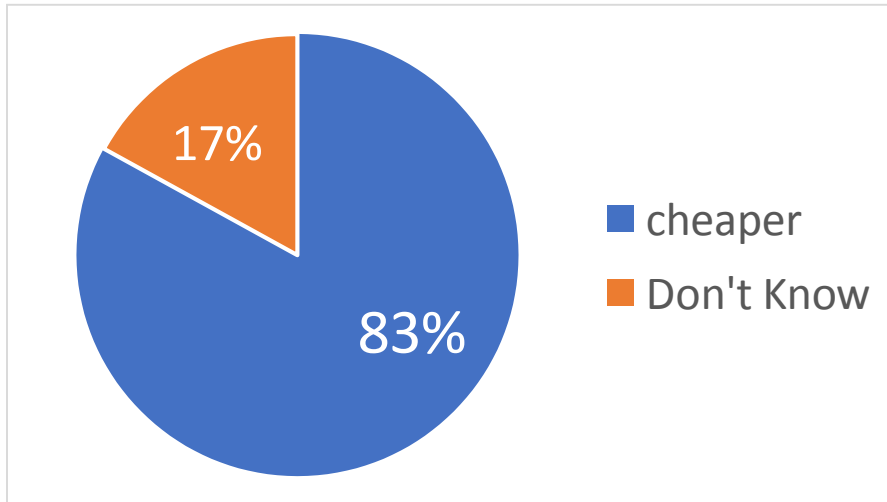


**Figure 4.22 Universally designing a space vs renovating which is cheaper.** *(Authors construct, 2023).*

**4.2.2.4 Tools that make a space navigable for a visually impaired person.**

The different designers responded differently to this question and below is a table with the different responses on what tools they thought is necessary to aid a visually impaired person navigate their environment.

| No | Area of specialization | Tools for navigation for a V.I |
|----|------------------------|-------------------------------|
| 1 | Interior fittings | Use of directional and warning tactile indicators, and braille on lifts and entrances. Use of smooth and obstacle-free pathways. |
| 2 | Interior design | Clear paths, and minimal reorganization to avoid distorting the image of the clear path formed in the memory |
| 3 | design | Well-lit spaces with a great harmony of bolder color schemes |
| 4 | Inclusive design | Proper labeling and indications of different facilities as well as paths. |
| 5 | UD expert | Material finishes and wayfinding. |
| 6 | Interior architecture | The furniture arrangement plans eliminate safety hazards. |

**Table 4.6 Tools for navigation for a visually impaired person.** *(Authors construct, 2023).*

### 4.2.3 Information from interior design students.

The researcher wanted to find out whether the design student are well equipped with knowledge that would help them in cases where they have to design for the differently abled(in this case the visually impaired).Out of seven questionaries administered the researcher received six responses in return.

### 4.2.3.1 Focal points when designing for a visually impaired person.

In response to the question of which are the focal points to focus on when designing for a visually impaired person below are the responses from the different students.

| No | Focal points when designing for a V.I |
|---|---|
| Student 1. | Declutter the space. |
| Student 2. | Surfaces textures. |
| Student 3. | Space should be friendly . |
| Student 4. | Acoustics, finishing materials, and lighting of the space. |
| Student 5. | Furniture plan. |
| Student 6. | Wall textures and floor finishes. |

**Table 4.7 Focal points when designing for a visually impaired person.** *(Authors construct, 2023).*

**4.2.3.2 Inclusion of visually impaired persons when designing for them.**

The researcher asked the students whether communication with the visually impaired as stakeholders in a project that would benefit them is important and the students 67% said yes and 33% said no. The 33% gave a follow-up reason as to why they said no and according to them, the visually impaired person will not know what is needed in the building.
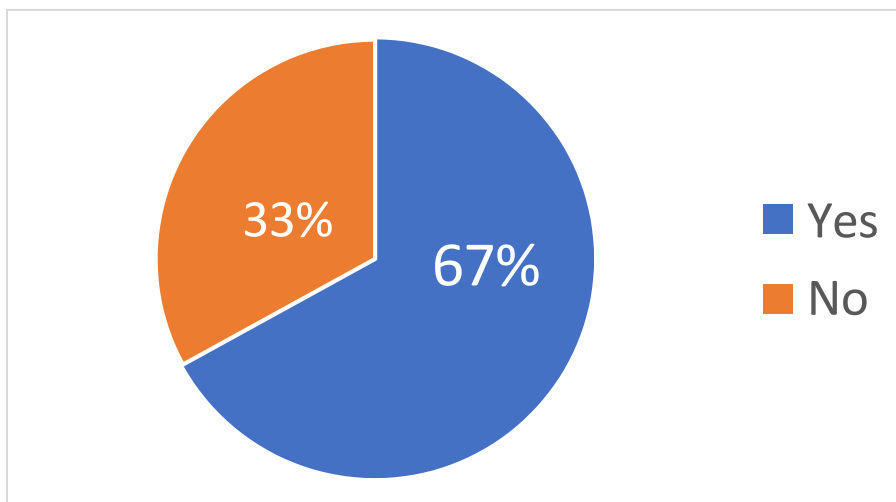


**Figure 4.23 Communicating with visually impaired persons when designing for them.** *(Authors construct, 2023).*

**4.2.3.3 Furnishings and Finishes.**

In response to the question of whether visual impairment dictates finishing and furnishes to be used, the respondents all agreed, and proceeded to give reasons why.
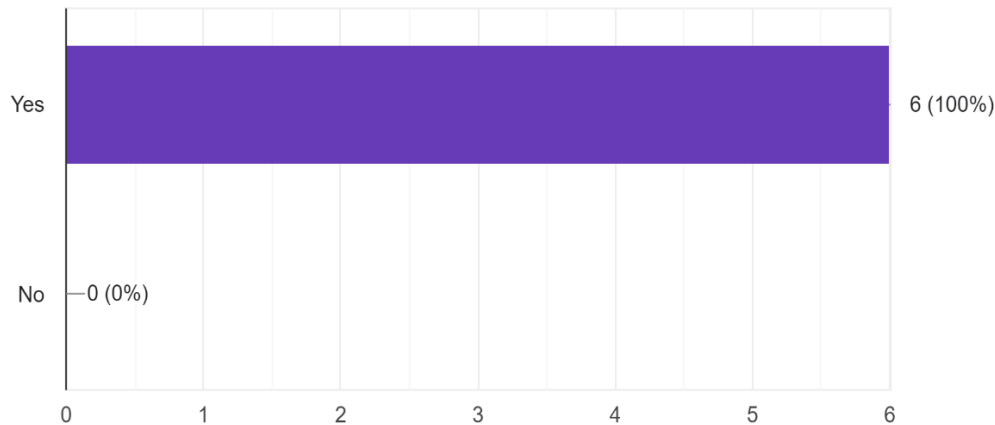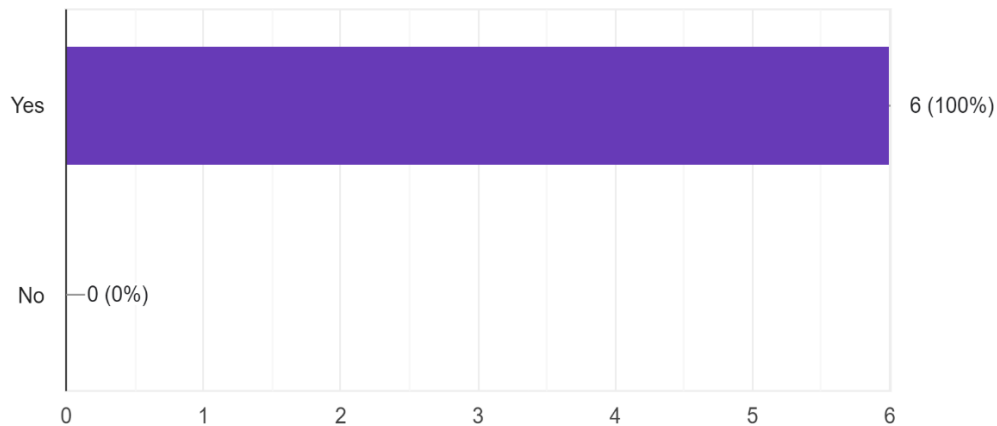


**Chart 4.3 Visual impairment dictates finishings and furnishing materials to be used.** *(Authors construct, 2023).*

Reasons given to the researcher;

- Three students said that finishings and furnishes can be used as landmarks for directing and redirecting the visually impaired person.
- The tactile material as a finish on floors could be used to direct and guide movement.
- They can be designed to suit their needs.
- They make the space more navigable and definitive design that makes the space more efficient eliminating hazardous outcomes.

**4.2.3.4 Navigation Tools.**

In response to the question of what the major tools of navigation for a visually impaired person were below are the responses given:

| No | Navigation tools. |
|---|---|
| Student 1 | Braille and walking stick. |
| Student 2 | Handrails. |
| Student 3 | Braille, zoom text fusion screen reader. |
| Student 4 | Furniture plan. |
| Student 5 | Textured surfaces, color variation, uncluttered space, signage. |
| Student 6 | Wall textures and floor finishes. |

**Table 4.8 Navigation tools.** *(Authors construct, 2023).*

## 4.2.5 Challenges encountered in navigating the interior spaces in the affordable housing unit's environment.

As for the challenges that people with visual had encountered when they relocated to the affordable housing units at ngara park rd. the informants stated the following:

- *When I first moved to my apartment everything was white the houses, and corridors, which was so much for my eyes to take in. So I had to repaint a few of my walls to clearly demarcated which room was which. The current elevator that we are using is quite okay but I don't think that it would cost the government that much to install a voice recognition one, it would help a lot because sometimes the eyesight is failing and that would tell me which floor am at because I alighted at the wrong floor a couple of times. The labeling of the building also has been a big challenge, they should have indicated for example; BLOCK D- houses 100- 219, which would make it easy for direction purposes.* (Hastings, resident 2023).

- *My perception of light is different from the rest of the population, my biggest challenge was the reinstallation of proper lighting in my space and adapting to the ones that light up the corridors leading up to my unit* (Ann, resident 2023).

- *The roads are a big challenge, especially the trenches that pass in the middle of the road they are not clearly marked. I have stumbled in them a couple of times and when cleaning goes on since wastewater goes through them slipping is another obstacle waiting.* (Resident 2023).
- *The street lights are solar powered so when the night is young they are so bright but it does not take long enough for them to power down making it hard to see.* (Resident 2023).
- *Cleaning is okay but the people cleaning should clearly indicate that the floor is wet, also the house labels put all the way up the door trim should have been placed at eye level and had a braille interpretation.* (Resident 2023).
- *The houses are too many per floor and association with the next-door neighbor is close to a 0.1% chance of speaking to them, so if by any chance your lenses fail you, you are on your own if there is no family around to help.* (Resident 2023)

The above challenges according to the informant have not been addressed since they don't know where to channel them.

### 4.3  The Affordable Housing Units Navigation Audit Findings.

All the areas of interest from the navigation access audits are reported in this section. The responses apart from the interviews and questionnaires administered, the research was also dependent on select affordable housing units' access audits and observation. The researcher visited the housing units several times in order to observe and get the proper feedback needed.

**Labels.**

The researcher found out that the labels in the building are not efficient as they favor the sighted population. Entrances to the particular housing blocks are not labeled except for the general flat label that says BLOCK A, BLOCK D. The lift also is not labeled. generally, the researcher observed that a lot of spaces needed labeling and labels that have braille as well, because the existing ones do not have.

**Figure 4.24 & 4.25 The existing labels on the trim of the door and elevator.**(Source: Researcher, 2023)

**Wall Textures.**

The researcher observed that all the rooms to each unit had a white paint finish throughout the rooms .Which for a visually impaired who can perceive light and color is a problem. Also Textures mostly speak to the sense of touch, therefore designing with a visually impaired person in mind different wall textures should be different for the separate room as opposed to one.
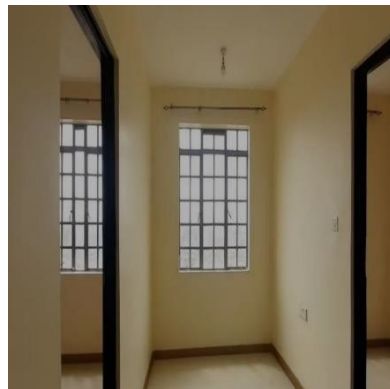


**Figure 4.26 Wall finish of a unit before occupancy.** (Source: Researcher, 2023)

**Staircase.**

The staircase image is an inaccessible staircase because it lacks clear visual contrasts on the staircase, feet-censored lighting on each step, and tactile material fitting that's hard, slip-resistant, and easily detectable by a white cane. The lighting is also terrible at night. The researcher also observed that guard rail at the edge of the wall in image c is also a danger as someone can easily lose balance and fall over. The handrails also do not have the braille provision.
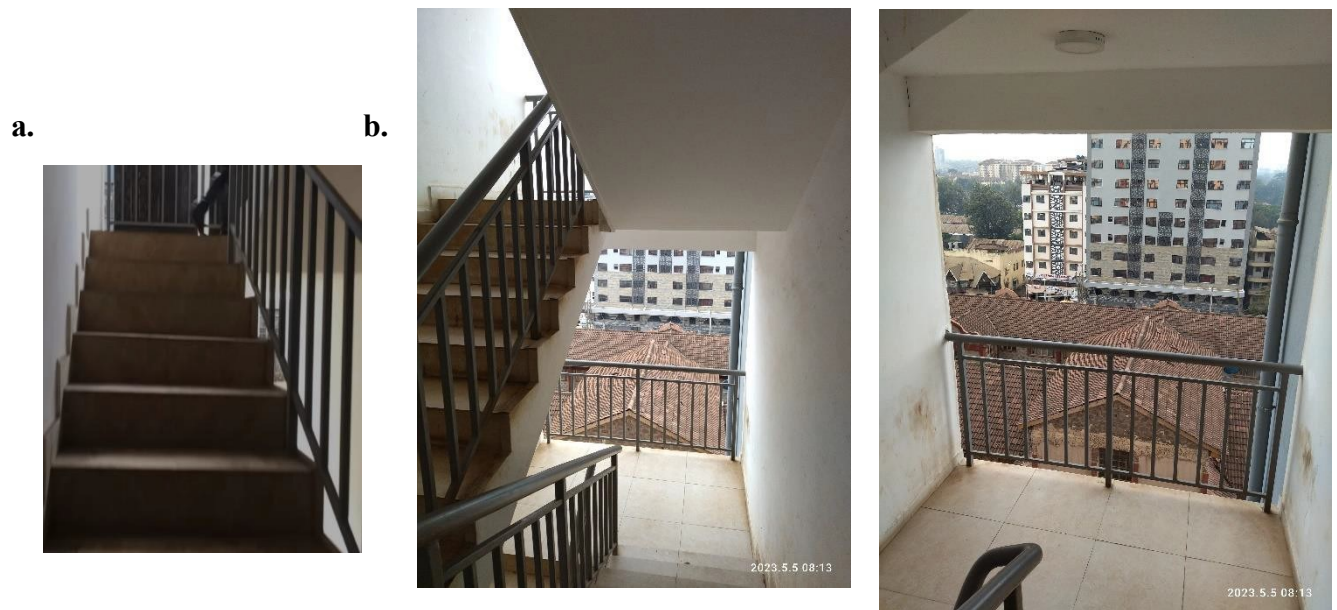


**Figure 4.27 Staircase images both during the day( image b&c) and at night (image a). (**Source; Researcher, 2023**)**

**Elevator.**

Lift is the easiest mode of transportation in a building with many floors, the existing one lacks a voice recognition software which is beneficial for all diversities. The researcher also observed that there was no label indicating that it is a lift. Moreover the floor number on the dial pad are translated to braille.

**Figure 4.28 the lift inside and outside.(**Source; Researcher, 2023**).**

**Floors.**

Having same floor material for all room is economical but at a disadvantage to a visually impaired person.



**Figure 4.29 Floors. (**Source; Researcher, 2023**)**

**Bathrooms.**

The researcher observed that the toilets lacked contrast in texture and color which is important, the toilet seat that is in the existing model and toilet is one color. The bathroom floors are also the same texture which for a visually impaired person makes it hard to use the facility efficiently.

**Figure 4.30 Bathroom (**Source; Researcher, 2023**).**

**Lighting.**

The researcher established that the lighting along the staircase is terrible at night and dark at ground floor level during the day as well. The street lights are powered by solar panels which is a good green energy but the solar charge doesn't last all night long making the light dimmer and dimmer.



**Figure 4.31 Street light solar powered. (**Source; Researcher, 2023**)**

**Trench .**

**Figure 4.32 Trench in the middle of the road within the environment of the housing facility. (**Source; Researcher, 2023**)**

The researcher found out there are shallow trenches along and central to the road that carries out dirty water from the building. Also that some of the visually impaired residents have been victims of sprained ankles from the trenches, especially at night.

**NOTE:** The researcher ask the lead architect the most important question of all ; whether during the conception stages of designing the affordable housing units, an interior designer was present and a representative of the visually impaired community, he said NO, they were not present.

## 4.4 Conclusion.

Developing the best standard design to practice means engagement and consultations should take place between technical experts, blindness service providers, blindness consumer organizations, and the user to center the design best fit for everyone. As a designer, universal design principles are a tool for change in solving a problem in its early stages if not preventing it and the government ought to acknowledge the important role we play in the success of creating a functional design.

Students are the future generation of designers that are supposed to be equipped fully with an understanding of universal design as well as inclusive designs. These principles will enable them to become better designers in tomorrow's nation. Interior designers in the market also need to gather more information on universal design knowledge to better improve their skills.

The suggestions in the recommendation section are a road map/skeleton to better understand how to design for a visually impaired person but the best solution is communication with the client.

## CHAPTER 5; DISCUSSION AND SYNTHESIS.

### 5.1 Introduction.

The purpose of this study was to better understand how best to design a navigable interior space and environment for a visually impaired person with reference to universal design principles and how to implement them. The study findings highlighted challenges that they encounter in their environment at the Ngara park Road affordable housing units, what they wish their environment would have, and as per the data collected, there is a lot that needs to be implemented as far as universal design is concerned. "Diversity is about all of us and about us having to figure out how to walk through this world together," Jacqueline Woodson (2023) "and Our ability to reach unity in diversity will be the beauty and the test of our civilization,".~ Mahatma Gandhi. The research purposed to meet the following objectives;

- To assess navigable interior spaces of the affordable houses through the application of an access audit tool, universal design.
- To establish challenges and problems that a visually impaired person faces in navigating an interior space.
- To determine principal elements of designing navigable interior space for the visually impaired in alignment with the universal design principles.

### 5.2 Application of an access audit tool ,Universal Design.

The first objective was *To assess navigable interior spaces of affordable houses through the application of an access audit tool, universal design.* The findings highlighted in the previous chapter, clearly sets a precedent for the value of design with intent, in communication with the

person whom the design is for, and most important education reinforcement on universal design. Universal Design has evolved. Designing environments usable by all people, to the greatest extent possible, without the need for adaptation or specialized design is the best approach to properly designing for visually impaired persons.

The foundation of universal design is the idea that the physical environment, communication, and products should be used by as many people as possible. The idea of universal design is well known, but the specific design requirements of people who are blind or partially sighted have not always been completely taken into account or incorporated into the built environment. Designing an indoor navigation system for a blind or vision-impaired user is a very difficult task, but it is one that should be taken on. The challenge is in properly comprehending and respecting the specialness of the diverse needs of the visually impaired community in their environment. Even while all humans share the same external environment, a person with limited or no vision will see that environment very differently than we do. A new strategy in research and design techniques including the disabled is strongly motivated by the philosophy of Universal Design.

Participants are shielded from hazards including street crossings, severe weather, and construction when they are travelling indoors. However, navigating indoors has unique difficulties. Designing for those who are blind or visually impaired is a challenge since, in a normal spatial perception process, visual information "predominates" over information from the other senses because we are more "aware" of it. We can still be attentive to our sentiments and experiences even though we are not conscious of them. These additional non-visual sources of information, despite being "forgotten," considerably advance our understanding of spatial relationships.

The research has informed so much of what was ignored when designing the affordable units which if the inclusion of a person who is visually impaired had been taken into account some of the this below would have been visible in the design:

• The establishment of two information centers near the main entrances, which will provide all users with written, audible, and tactile information on parking activities as well as information about the physical layout of the apartments and their surroundings, with specific information for those who are blind or visually impaired.

• The development of a distinctive route design framework that divides the hierarchy of the paths into three groups: primary, peripheral, and secondary (distinguished by their contrasting colors, textures, sounds, and size).

- The creation of local points for orientation – information totems situated along the paths marking the position of centers of interest, providing tactile maps and specific detailed description about each place (sound information).

- Colour contrast; "Use of colour to provide better contrast may make a positive difference in the home environment of the people with visual impairment and the majority of guidelines and checklists include colour contrast as an important modification for people with visual impairment," (Percival, 2007) which may aid mobility (Bright, 1997).

- "Clear path flows/ furniture flow to avoid fear of accidents especially for the elderly. This perception (fear for accidents) may be justified as studies have shown that there is a positive association between home accidents and visual impairment especially in older people," (Evci et al., 2006; Wood et al., 2011). "In addition, when an older person has an accident, the consequences are more serious than for younger adults," (Dessypris et al., 2009) "such as injuries to the head, hip fractures and death" (Morley, 2007). "Visual impairment is a risk factor for falls," (Lord et al., 2006) "by impacting on the ability to see the edge of steps and misjudging the depth of the walking surface and perhaps by modulating posture and gait."

"Visual impairment is set to increase further due to conditions contributing to sight loss such as obesity and diabetes," (Cardwell et al., 2007). " Additionally, environmental changes can reduce the impact of visual impairment and current demographic trends will implicate future design of the built environment," (Stuen & Faye, 2003). "The World Health Organisation (2012), promotes age-friendly physical environments and encourages inclusive design enabling people to remain at home for longer," (Barnes et al., 2011). Ageing in place is defined as continuing to live "in the community with some level of independence rather than in residential care" (Wiles et al., 2011, p. 1). "Policy Makers however still tend to use the social model in a limited way focusing primarily on the needs of physically impaired people," (Morris, 2001).

### 5.2.1 Design features and visual impairment.
"Accepted design features that are beneficial to visually impaired people include appropriate use of lighting, logical building layouts, level thresholds, colour contrast between adjacent surfaces and matt finishes," (Goodman, 2008). "Quality of lighting conditions has an impact on both the

ability of visually impaired people to carry out tasks and their quality of life," (Brunnstrom, Sorensen, Alsterstad and Sjostrand, 2004). "Sight loss guidelines therefore recommend consistent levels of artificial lighting and maximum use of natural light," (Barker et al., 1995; Goodman, 2008; RNIB and Thomas Pocklington Trust, 2012). "It is also recommended that to avoid an institutional feel, features that favour visually impaired people should be inconspicuous and not instantly obvious to sighted people," (Goodman, 2008).

"All entrances should be illuminated. However, the lighting needs of individual people will vary due to different ranges of sight, medical conditions and one's age. Hence adjustability of light levels is recommended for various tasks," (Goodman, 2008). "Glare too needs to be considered as it can have a negative impact on people with a variety of conditions including cataracts, retinitis pigmentosa and glaucoma," (Goodman, 2008; Green et al, 2002 and Wu, 2011). By employing the proper shade equipment in conjunction with matt-finished sinks, doors, and door knobs, glare can be avoided. People with poor vision may be able to differentiate one element from another by using contrast-enhancing colors. People who are blind or visually impaired can-do jobs and distinguish between different rooms or spaces with the use of tactile items. Surface contrast can help restrooms have fewer safety hazards. By having a front door that is a different color from one of the nearby homes, for example, color contrast can help with wayfinding outside the home.

**Analysis of the recommended design features for visual impairment friendly spaces.**

Designing a space for a visually impaired person means thinking outside the box but with universal design, it makes it easier to design a space that well accommodates them as well as the sighted population. There are a few recommendations given below on how best to improve the challenges listed in the findings:

**Labels And Maps.**

A properly labeled building is efficient as opposed to the existing labeling that only favors the sighted population. Labels that include the visually impaired and are placed within arm's reach instead of close to the ceiling are navigation friendly and universal. They offer proper information for proper navigation.
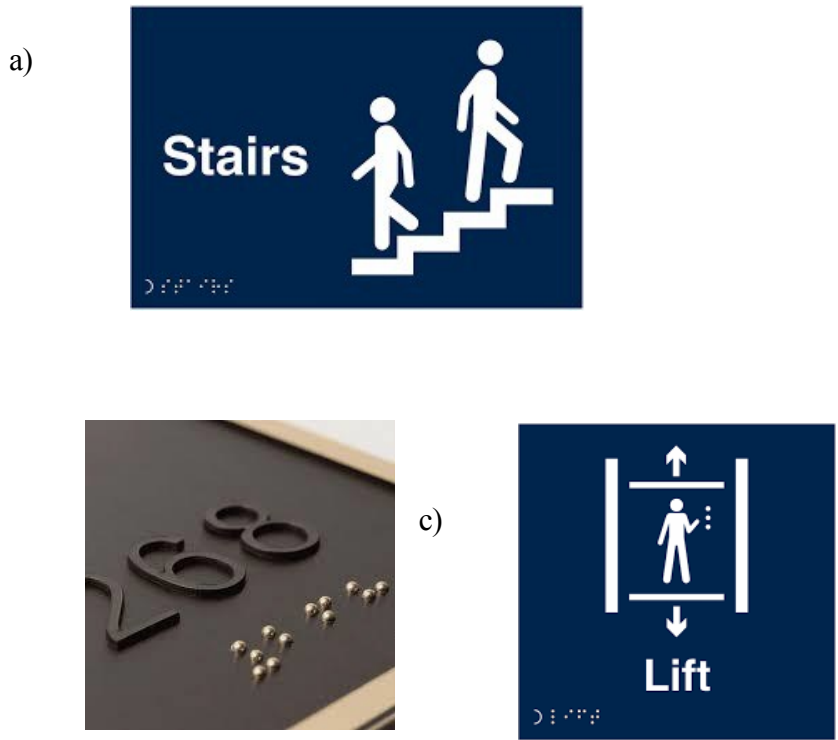
**Figure 5.33  Different labels a; staircase, b; house number c; lift.**

Maps tend to offer sort of a preview layout of the environment and also give insights on the specifics. For visually impaired persons, it is a very key part of their navigation system as it gives them a sense of familiarity with the ground they are about to venture into. Therefore maps are a must-have piece of design.

**Figure 5.34  Braille Maps.**

**Textures.**

Textures mostly speak to the sense of touch, when designing with a visually impaired person in mind different wall textures help them tell different rooms apart as opposed to the same wall finish throughout all rooms. It is also a design plus to have different finishes for better aesthetics.



**Figure 5. 35 Wall textures.**

**Staircase.**

To achieve an accessible staircase create clear visual contrasts on the staircase like the yellow strip lines on the first image to show the next step, two use of feet censored lighting on each step a second option is the use of tactile material that's hard, slip-resistant and easily detectable by a white cane shown in the third option. Lastly, braille handrails are the icing on the cake, the braille engraving would contain information like step numbers, and next floor level beneficial to the visually impaired person.

**Figure 5.36  Different features on different Staircases.**

**Elevator.**

Lift is the easiest mode of transportation in a building with many floors, one with voice recognition



is beneficial for all diversities.

**Figure 5.37 Voice recognition elevator.**

**Floors.**

Having the same floor material for all rooms is economical but at a disadvantage for to a visually impaired person. Different materials on the floor tell the rooms apart, adding tactile material also maps out a path to be followed.
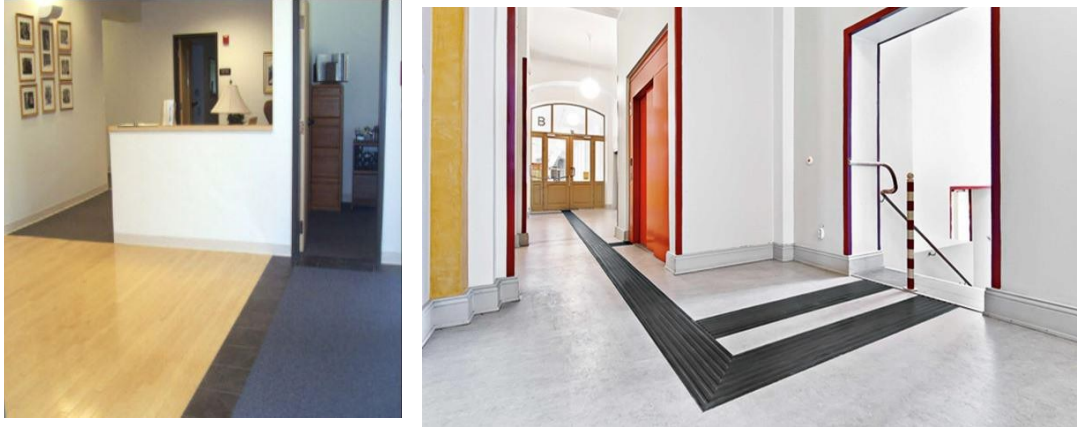


**Figure 5.37 display of different floor materials for different rooms and tactile path in black second photo.**

**Bathrooms.**

The contrast in texture and color is important in the sense that it gives a clear difference in things like the wall and the floor. When installing a toilet set it is advisable that the seat have a darker color than the toilet bowl which makes it easier to see and tell i.e. the second proposed image. For easier navigation use dark textured, non-slip floor tiles to create a walkway like the first proposed image with a clear underfoot one can tell if they have ventured off course. To declutter a bathroom avoid rags and mats for clear paths and prevent trip hazards. Also, avoid chrome fittings or any reflective surface instead use matte effect or non-shiny surfaces.

**Figure 5.39 Ideal bathrooms.**

**Lighting.**

A room should have even illumination from good lighting, with no shadows or dark spots. This is crucial for lowering the danger of trips and falls while moving around the house. Make sure there is adequate illumination provided around staircases and steps, as these areas have a higher risk of injury from falls.

To prevent shifting between well-lit and darker and poorly-lit sections, brightness levels should be consistent throughout the home. The eyes need some time to adjust, which is why. The amount of brightness required might also change from day to day for many persons who are blind. Dimmer switches can be a terrific technique to quickly change the brightness and lighting levels to suit the situation.

**a) b) c) d)**

**Figure 5.40 a) screw fitting bulb b) bayonet c)LED bulb d) LED dimmer switch. (**Source; iStock 2018)

**5.3 Visual impairment Challenges and problems while navigating interior spaces.**

The second objective of the study was *to establish the challenges and problems that visually impaired people face while navigating an interior space.* Visual impairments are of different levels and each person perceives the world differently from the other person. This study has enabled the discovery of different challenges that each respondent during the data collection phase expressed to have faced as they adapted to living in the affordable units. Designing structures and interior and exterior spaces that go beyond simply meeting legal criteria and that are distinctively universal from a conceptual, functional, spatial, and material standpoint is the challenge. Designers may offer solutions that can be quantified and performed normatively because the situations related to the demands of people with movement impairments are frequently measurable. Normative criteria are also based on data on people with vision impairments, however these are more insufficient.

It takes innovative reading and navigation techniques to learn a visual language that, for instance, enables the blind and visually handicapped to make their way through indoor and outdoor spaces. The difficulties that visually impaired people face when navigating freely and taking in their surroundings involve a variety of issues, some of which are listed below:

- The white cane cannot detect some slippery floor hazards, especially a wet floor or objects that make the floor more slippery when dropped on the floor, for example, fabric, such things hence it could cause a lot of unintended accidents. This has also affected a few of the visually impaired person with visual aid, who expressed the need for a sign that indicates if the floors are wet.
- Lighting sufficiency. This study also discovered that light is crucial and advantageous to the partially sighted. While navigating inside structures, people have historically used light as a tool to assist them sense distance and orientation. However, in some places, too strong light that shines directly into the eyes might temporarily impair vision. In some other cases the glare of the light is set differently due to the condition of the user.

- Visually impaired persons use distance estimation when getting more acquainted with both familiar and unfamiliar spaces i.e. counting steps. Imaging trying to mentally count steps in a noisy environment, it makes it extremely hard to concentrate.

- Lack of sighted guides: these guides help with the familiarization of the space before the use of sense and feeling. For example a well-descriptive map of the layout of the space in braille as well, a few landmarks among others to help with self-navigation.

- Obstacles and barriers; Obstacles and barriers are a daily struggle for many who have vision impairment. A lot of accidents can be caused by being struck by barriers that can make them lose their body balance and orientation, which is crucial for traversing an unclear path. This is because the visually impaired person must strike several objects while losing their balance in order to establish a path. Therefore, having mounted furniture or objects is not a good idea.

- Well labeled environment. Labels are the gold mines of communication for the visually impaired and they provide a majority of the direction needed for a visually impaired person to find their way in their environment. Translation of the label to braille is also important something the study showed lacked in the affordable housing units, the place of the labels in an accessible position.

- Lack of textured floors and walls. Textures speak to the sense of touch which is the most used sense by the visually impaired community. The different arrangements tend to communicate more in the differentiation sense and tell places apart.

- Lack of contrast in color. . People who are blind or visually handicapped sometimes pause to take in their surroundings or to adjust to light changes. They frequently start by attempting to establish a shift in surface area or feature at the wall or ceiling junction, which is typically the part of the room with the least amount of clutter. When moving, they focus their attention downwards, within a distance of two meters, and examine the area in front of them for contrasts between features. Color contrast is crucial for a complete perception because of this.

- Clearly marked pathways.

- Lifts. From the study conducted it is evident that persons with visual impairment prefer vice recognition elevators which aid much in navigation and they inform on the current

and proceeding destination. This helps much when the vision fails and also makes navigation easier.

**5.4 Principal elements of designing a navigable interior space for a visually impaired person, universal principles.**

The third objective of this study was *to determine the principal elements of designing navigable interior spaces for the visually impaired in alignment with universal design* principles The Universal Design Principles, The seven universal design principles gave the phrase its official definition. The guidelines were created in 1997 at the Center for Universal Design at North Carolina State University by a working group of architects, product designers, engineers, and environmental design researchers. The principles are put to use to assess current designs, direct the creative process, and inform customers and designers about the qualities of more usable places and products. Following are the guiding principles: (1) equitable usage; (2) flexibility in use; (3) straightforward and intuitive use; (4) perceptible information; (5) tolerance for error; (6) low physical effort; and (7) size and space for approach and use. The concepts are crucial for comprehending both the history of the term "universal design" and how it has been applied as a cutting-edge tactic. The interaction of people and space is essential to the practice of architecture, and the same concepts do not necessarily apply to indoor and outdoor spaces.

Architecture/Design that is created specifically for people who are blind or visually handicapped is fantastic and superior to our usual designs. This is because complex needs and considerations are carefully considered and responded to. The other senses are amplified and often serve as a person's overall navigation system when they have a particular handicap. A visually impaired individual would be able to comprehend and visualize a space in a new way thanks to their senses of touch, hearing, and smell. Given these considerations, a structure's design and concepts should be such that they appeal to all the senses and make it comfortable and easy for someone who is blind to move around it.

**Fewer barriers.**

A room with a lot of walls or other barriers can be dangerous for someone who is blind. It would be better if there were less walls and "obstacles" in the room, even if the person was used to the

layout and planning. Designing the room with alternatives to conventional walls, such as low walls, furniture pieces, or gaps inside walls, can make it more accessible.

**Wayfinding.**

Even if a visually impaired person needs navigation to help them navigate a location, it is the responsibility of an architect to develop designs that incorporate this element. You can achieve this by using various floor materials to make a pattern that directs people, by using scent to point the way, or by incorporating tactile elements to make a pathway.

**Tactile materials.**

Tactile materials, or materials that promote the sense of touch to perceive them, perform wonderfully in a building that is accessible to blind persons because a person with low vision cannot see the materials within a place. A visually impaired person's perception of an environment can be greatly impacted by different textures, such as the difference between a stone surface and a textured concrete wall. These materials and textures work together to produce a navigation system that makes it possible to distinguish between the different spaces.

**Acoustical treatments.**

For a person who relies largely on their hearing abilities—and who is visually impaired—excessive noise or loud noises might be uncomfortable. A blind person will use the noises surrounding them for navigation while navigating through space, hence treating walls and other surfaces with acoustic materials is crucial. The environment "sounds better" and is more comfortable when annoying noises like a mechanical vent or loud chattering are reduced and natural sounds like footfall or water drips are expanded.

**Braille.**

Braille, the language for the blind, is the finest approach to allow blind individuals to read a sign or even grasp a plan. To make the layout easier to understand for persons who are visually challenged, many architects have included Braille in their architectural drawings. To help their clients appreciate the changes made to her home, the architects at So & So Studio made miniature versions of the house! In order to help visually impaired persons understand how an elevator button or a fire extinguisher works, braille can also be added to signage at those locations.

**Technology.**

How has technology changed? Now, certain smart houses and appliances significantly assist those with specific disabilities. Personal assistants can aid tenants with their daily activities thanks to smart technologies. With the help of technologies, people may now adjust their thermostat's temperature and even turn on and off their lights from a single location. Using these new technologies, architects may design a system that would let a blind person modify their entire home to suit their needs.

**Fragrance or the sense of smell.**

Along with the ability to hear and feel things with the touch sense, one can also improve their sense of smell. A person can also be led through the building and given the ability to distinguish one location from another by the use of scented flowers or plants in that area. The aromatic flowers in the garden at the Center for the Blind and Visually Impaired in Mexico serve as sensory clues that aid visitors in finding their way around the building.

**Soft and natural lighting.**

Extremely bright, glaring light can strain the eyes and be annoying for those with low eyesight. It is exceedingly difficult to protect direct bright light from penetrating large glass surfaces without shielding. According to a poll, this is the primary source of difficulty for someone who is blind inside a structure. Thus, in a setting for a person who is visually impaired, dazzling lights and direct, harsh sunlight should be minimized and soft lighting with low glare should be encouraged.

**Color coding.**

Why is color coding crucial for someone who is blind?

Color vision is somewhat still possible for those with low vision. Because an aggregation of excessively bright colors in one area can be unpleasant, it is important to incorporate various tones into a room. With this in mind, color composition and contrast are crucial. Both color and brightness, which are related to how well we can detect depth and movement, can be contrasted.

## CHAPTER 6 : CONCLUSIONS AND RECOMMENDATIONS.

### 6.1 Introduction.

The aim of this research was to understand the complexities of designing for a visually impaired person, where they stand in matters navigation in the spaces afforded to them, how best the houses would have been designed and the role of universal design in these spaces. Engaging with quite a

number of participants and stakeholders in this discussion lead to a discovery of quite a lot of issues that need to be addressed in order to secure the future of the visually impaired community in housing design. Universal design is a topic discussion that needs to be pushed in design firms, and classrooms, to better create designs that are inclusive of all diversities. Ignorance is part of the problem and the thinking that disability is only defined by physical immobility which is the greatest limitation to designing for the other forms of disability.

"When designing our built environment, it is important to consider the needs of a diverse population. However, twentieth-century housing design mainly focused on able-bodied requirements," (Imrie 1998). "Architectural design standards met the needs of the "ideal" or average man and therefore atypical physique was not adequately represented," (Gilson and DePoy 2011). "As a response, lifetime homes were developed in the early 1990s by Joseph Rowntree Foundation," (Lund 2011). "They are based on the principle that homes should be accessible to everyone including older people, children and people with impairments," (Irish Council for Social Housing 2006).

"The quality of the home environment influences an occupant's mental and physical wellbeing, although not always positively," (Imrie 2004a; Iwarsson 2005; Jackson and Kochtitzky 2010; Jackson 2003; Werngren-Elgstrom et al. 2009). "Home is many things; it is a container of wellbeing, a place of security, a space where social life, leisure and recreation take place," (Bachelard 1964; Stretton 1976). "It is also part of a self-identity, built up over time around memories using many senses, including sight," (De Botton 2006; Pallasmaa 2005). "Cultural security, identity, relationships and mental capabilities are formed at home," (Lewin 2001). Heidegger (1993) maintains that "home is an integral part of the human experience because individuals engage with it in everyday life." "Therefore, taking the lived experiences of housing occupants into consideration is crucial when designing homes, especially as dissatisfaction can result if human needs or motivations behind home-making are ignored by designers," (Zavei and Jusan 2012).

Imrie (2004a) "asserts that many disabled people are not experiencing several of the concepts of an ideal home. This occurs as a result of poor floor plans alongside design conceptions that do not consider impairments." "Likewise, descriptions of "ideal homes" disregard elements of domestic life such as impairment, illness or disease," (Chapman and Hockey 1999). Gilman (2002) believes that "a home is a human institution and is therefore open to improvement." Besides, Imrie (2004a)

notes that, "whilst houses may offer elements of an ideal home at a given time, they are transient and could change when people develop impairments." It is therefore important to design homes that can accommodate the onset of impairment in order to maintain some of the concepts of an ideal home in an occupant's life. Tinker (1997) suggests that "a comprehensive evaluation of homes designed for lifetime living needs to be carried out and this should include the perspectives of their occupants."

## 6.2 Summary of the findings.

The research under the access audit tool, universal design was to investigate the condition of the affordable housing units in relation to its environment being a dependable space for the visually impaired community to live in independently without having to adapt the environment to cater for their impairments. However through the informed principles of universal design a framework guideline of how to design for the visually impaired is important and due to help in the creating process.

The main issue that emerges in the research synthesis is the importance of engaging all diversities when designing a home that will house them in a lifetime. This opens doors to communication and understanding the user fully before designing the product. The other issue is how loud universal design principles are being echoed in design, architectural firm and classrooms which is an underlying issue that if picked up then designs will not have to be adapted to fit a certain set of people but rather everyone. Visually impaired persons have a different perception of the world and while one sense is failing them the other four senses are heightened understanding their tools for navigation helps generate timeless designs that will cater to their need for life.

There is no bubble that differently abled persons live in to best include them in design is to communicate, understand their perception of living and consult universal design.

## 6.3 Conclusion.

Universal design should be embraced more from the student level all the way to the professional level. When molding the student to becoming a designer sooner they understand the value of creating products that are universal the greater the chances of inclusive accessible designs in the future. Professional interior designs who have no knowledge of universal design should go back to the drawing board and seek this knowledge for better awareness.

Visually impaired people have a wide range of need that need to be met in order for them to fully access and enjoy built environments. With proper planning and insertion of them in the initial stages of design will better the designs for them with full access. The government also need to understand that designs aren't for the sighted population only and non-disabled persons rather for the vast diversities. Also measures should be set forth when it comes to planning and construction of affordable housing units as well as other built environment for accessibility evaluation and making sure they are universally up to standard.

Another aspect that architects and interior designers should consider is the future, time factor. With the increasing rate of developing sight problems ,the designs ought to have catered for this to avoid too much adaptability but with room for adaptation.  Technology is one of the trends that is catching up to the world of design embracing it will open more doors to efficient planning and execution of deigns under the universal design umbrella.

The largest framework task is making the visually impaired person equitable when access the affordable housing units as part of the general population. This makes the feel seen, included and valued which gives them confidences and independence to live and navigate their space comfortably. Also the focal points of designing for this community should drum up more conversation to further extend more discovery on how best to design spaces that are sited and inclusive of the visually impaired community.

### 6.4 Contribution to knowledge.

The main objective of this research was to propose framework models for designing for people with visual impairments in the affordable housing set up. The proposed guidelines will give room for adaptability of future designs in the housing sector  that properly include persons with visual impairments and how to design accessible and navigable interior space with then for them as part of the general population.

### AREAS FOR FURTHER RESEARCH.

Application  of  Principle of universal design in the framework for affordable housing units

Technology advances in relation to design for the visually impaired.

| Housing features. | | | |
|---|---|---|---|
| Main . | Detail. | Characteristics. | Benefits. |
| Entrance . | Step &slope. | • Stepless entrance.<br>• Slopping walk at 1.20. | Easier to move.<br>Easier to maintain and repair. |
| | Color. | • Distinctive color | Easy identification. |
| | Label. | • Large, informative and translated to braille. | Communicate to all. |
| Bathroom. And toilet. | Space. | • Provide clear floor space.<br>• Curbless showers. | Easier movement. |
| | Handrails. | • Provide handrails. | Easy to grab and move. |
| | Handle and faucet control. | • Single lever handles. | Easy to open. |
| | Toilet . | • Different color for its seat and bowl. | Easier to see. |
| | Shiny surfaces. | • opt for a matte finish. | Avoids reflection of light. |
| Lighting . | LED lighting. | • Bulbs compatible with dimmer switches. | Easy to adjust to user preference. |
| | General lighting. | • Proper lit environment. | Easy to see. |
| Textures . | Walls and floor finishes. | • Different finishes for spaces for both.<br>• Non- slip flooring. | Easy to touch(as mode of sight).<br>Aesthetic appeal. |
| Stairs. | Handrail. | • Provide handrails with braille writing. | For barrier, to grab, and informing . |
| | Lighting. | • Provide sensered lighting. | Easy sight of each step. |
| | Contrast. | • Provide a color contrast to tell each step apart. | Easy to see. |
| | Finish | • Provide tactile or non-slip floor surface. | Avoid slipping. |
| Labels and maps, | Type | • Provide maps and labels that have a braille translate.<br>• Eye length height placement. | Wayfinding.<br><br>Ease to see and touch. |

**Table: 4.9 ; Simplified suggestion to fill in the housing design gap. (**Source; Researcher, 2023**)**

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# APPENDIX 1

**INTERVIEW/QUESTIONATIONARE FOR THE VISUALLY IMPAIRED.**

1. Is the outdoor walking path detectable by the white can and safe to access? Yes or No.

2. Can you easily access and recognize the main entrance? Yes or No.

3. How easily can you access and navigate your indoor space? And how long did it take you to adjust to it?

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4. What importance would signage have held in aiding accessibility and navigation of your environment?

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5. Would voice recognition elevators help in navigation? Yes or No.

6. What floor of the building would you prefer to live on and why? if it is a floor higher than the ground floor what would make it easier for you to access?

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   …………………………………………………………………………………………

7. Do different textures and good lighting aid in the navigation of your space? Yes or No.

8. What access tool would be better suited to inform you of your environment?

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9. What other specific provision would you propose to be added in order to improve the navigation of your environment?

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   …………………………………………………………………………………………

10. What is the name of your visual impairments and when were you diagnosed?

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**APPENDIX 2**

**INTERVIEW/QUESTIONNAIRE FOR THE LEAD ARCHITECT.**

1. When designing the building did you consider persons with visual impairment? Which groups of people were consulted and involved in the design process of the building?

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**APPENDIX 3**

**QUESTIONNAIRE FOR AN INTERIOR DESIGNER.**

1. What are the focal points when designing a space for a visually impaired person?

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   …………………………………………………………………………………………

2. Do you think communicating with a visually impaired person about their needs helps build a space best suited for them or not? Yes or No.

3. Does visual impairment dictate the materials to be used in finishing and furnishing a space if so why?

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   …………………………………………………………………………………………

4. Is designing a space universally cheaper or renovating it to suit the client's needs?

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   …………………………………………………………………………………………

5. What makes a space navigable and accessible for a visually impaired person?

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   …………………………………………………………………………………………

6. What is your area of specialization as a designer?

   …………………………………………………………………………………………
   …………………………………………………………………………………………

**APPENDIX 4**
**QUESTIONNAIRE FOR AN INTERIOR DESIGN STUDENT.**

1. What are the focal points when designing a space for a visually impaired person?

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   …………………………………………………………………………………………

2. Do you think communicating with a visually impaired person about their needs helps build a space best suited for them or not?

   …………………………………………………………………………………………

   …………………………………………………………………………………………

3. Does visual impairment dictate the materials to be used in finishing and furnishing a space if so why?

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   …………………………………………………………………………………………

4. What are the major accessibility tools suited for visually impaired person?

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