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Homes' Interior Design in the COVID-19 Era (Functions & Needs – Case Study: Egypt)

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Abstract- Living in an era full of rapid changes and different needs, requires taking fast actions towards satisfying them. One of these changes is COVID-19 pandemic and its mutants, where the world wakes up on the necessity of staying at home for very long intervals of time. But were homes ready for receiving their occupants for that long? Actually, lately most houses were designed as a stage in their users' life, neglecting a lot of their needs. Calls have been risen to create more sustainable interiors in order to conserve resources, such as; energy, water and raw materials. Thus, nowadays, designers' role, in a post-COVID-19 era, is to create sustainable interiors that welcome their users for long intervals of times, in addition to fulfilling their needs and keeping any negative impacts at a minimum while being economically sound. Therefore, this paper will discuss the sustainability of human's life in their homes. This will be achieved throughout studying home space planning and design, and illustrating the new functions and needs relative to the COVID-19 era, with the suitable guidelines. These functions will be validated throughout conducting a survey for the Egyptian society.

Keywords: Indoor Homes' Quality – COVID-19 Design Requirements – Sustainability – Egyptian Society – Home Space Planning and Design.

I. INTRODUCTION

Covid-19 pandemic dictated that people stay for a long time in their homes. Going out and changing the scenery became a luxury most humans cannot afford any longer to preserve their lives. Thus, being quarantined for weeks, turned homes to be places where all household members perform all of their activities; they work, study, socialize, exercise, relax and eat in it, where living for 24 hours daily in the house, for some time, never happened before [1, 2].

Although houses became the only option for people to spend their time and perform various activities, which illustrates the significance of interior spaces for the users' quality of life, it is still not obvious how this will change the future of homes [1, 3]. Since it remains unclear how the pandemic era will progress and what impacts there will be in the future, even when people fully resume their normal routines [4, 5]. However, current researches indicate that residential spaces aren't returning to their pre-pandemic states in the near future, if ever [6]. What is certain is that people re-evaluated their lives and the way they live [1].

In this period of confusion, architects and interior designers have a huge role in bringing new scope to houses throughout recognizing the changing needs for a pandemic era in their designs [7, 1]. Actually, with most people being forced to work from home and shifting their focus towards the concept of nesting, some believe that the best work done in the homes' interior will happen in the next couple of years. Many of the ideas and standards overlooked for years by clients will become major issues that must be fixed and dealt with now [4,

5]. Since clients will finally understand the value of a good architect and interior design, where it is not just about making luxurious or pretty stuff, but it also must involve their quality of life, and bringing wellness and sustainability to their homes [2]. Moreover, the economical state for most people was greatly affected by COVID-19, thus they need homes that spend less to decrease the financial burden they suffer. Hence, the question now evolves about the nature of the needs or the functions dictated by the pandemic and if originally homes' design satisfies them.

II. RESEARCH OBJECTIVES & METHODOLOGY

Since the pandemic started, the researches related to COVID-19 have been substantially increasing, however, less than 1% of them addressed the built environment in general or the buildings and their interior specifically [3]. And since interior spaces can support human lives [8], the research strives to explore the concept of sustainability in the domain of interior design to achieve human needs, wellbeing, and the continuity of his life in an era full of pandemics. The paper explored the horizon of residential spaces and home design, putting in consideration that every industry and field has been affected by the corona virus pandemic [5]. Hence, it discusses the new needs or spaces required in houses to enhance the human living experience in the era of Covid-19 with all its implications. Therefore, the research observed and explored whether the lockdown that happened over the whole world starting from China to Italy, would on the long run change the way people live in their homes [2]. This will be analyzed in the Egyptian society throughout conducting a questionnaire.

Over a period of two years of observation and by using the inductive analytical approach, the study established its ground bases and findings regarding the occupants' new needs and functions in relation to Interior design of the houses in the domain of COVID-19 and various aspects. Additionally, the research used the qualitative approach by conducting a survey throughout an online questionnaire in order to validate the research findings. The questionnaire was distributed at a specific time during the two years (January 2022), to be after the deadly peak of the COVID-19 time, to prevent getting an unreal answers and false needs due to the state of panic and fear caused by the pandemic. However, it was not distributed so far away, so that people did not forget what they needed and required.

III. HOME SPACE PLANNING & DESIGN

Interior design is a dynamic and ongoing growing discipline, and in theory, space planning and design must consider all the functions required, therefore, creative planning should be a must [8, 9]. Putting in consideration, that home spaces must

also induce warmth, safety, and well-being, in addition to creating a positive environment [9]. Thus, space planning and design implies preparing and organizing home spaces to become more usable and functional. It will also include new innovations for the functions and spaces relevant to the various need required [3]. Architects and interior designers' role now is to not only help people to enjoy their residential spaces, but also to satisfy their new needs especially since they are spending more of their days inside of it [10].

A. Functions & Needs

One of the main alterations happened during the COVID-19 pandemic is how people come to use their houses, whether it is for living, working or schooling. People had to adapt their spaces to sustain all of these functions within one house, in compliance with the new life requirements [1, 3]. For example, the reception area and the living room which became more and more the heart of the house, since they became grand

central with multifunction required from them. Prior to COVID-19, they were used mainly for socializing, eating, relaxing and studying [5]. Now they are also required to satisfy exercising, home schooling and working from home, while many persons perform at the same time as a main and not secondary function. The most common new functions and needs that were observed and analyzed, during and post to COVID-19 pandemic, in spite of people different expectations and needs from their homes, are stated in Table 1 [6]. Table 1 also illustrated the debate presented to demonstrate their necessity and how they can be achieved throughout using some strategies in space planning and design.

Now it became obvious that what users request in their homes, in an era of pandemics, are related directly to internal environmental quality, comfort and wellbeing. This in itself is one crucial aim of sustainability, beside the new domain of sustaining one's life in itself. Since satisfying the requested needs and functions means people won't go out when they must not to satisfy the missing factors in their houses.

Table 1. The new Functions & Needs developed in home design due to COVID-19 pandemic [1, 2, 4, 5, 6, 7, 10, 11, 12].

| Function/ Need Required | It's Necessity | Space Planning & Design Requirements / Solutions |
|--|--|--|
| 1. Working (Office) & Home-Schooling Area (Studying Area) | <p>COVID-19 pandemic emphasized the importance of providing a workspace within the house. Due to the quarantine, everyone has been forced to work from home. Thus, having a working area is no longer the luxury of the privileged few, even if people are back to working from offices or workspace. It needs to be comfortable and inviting to work in, rather than using the spare bedroom, dining room table or kitchen bench. This means a return to real home offices will reappear rather than the temporary corners if there is enough space, or designing permanent solutions if there is not enough space.</p> <p>As for home schooling or studying, in the beginning some believed that it won't be a long-term concern, as working from home will, and over the past two years that was proved to be relatively true. However, home schooling needs almost the same requirements as for working areas, putting in consideration the different age generic for the users.</p> | <ul style="list-style-type: none"> • It requires a space far from social areas in order to decrease the distractions and to be more productive. • It must be separated from the rest of the house, if possible, in order to psychologically differentiate between the working hours and relaxing at home hours. • It must resolve noise issues and be aesthetically pleasant to be suitable for video calls and maximize efficiency. • It needs good lighting and efficient storage. • Architects must use creative, smart and satisfactory solutions & locations for workspaces to squeeze them in, whenever there is no much space. • Pocket doors can be used to separate spaces. • Soundproofing solutions could be used. • Thus, it is not fit in an open-plan space even if cleverly furnished. |
| 2. Quarantine Area | <p>When a member in the household gets infected by COVID-19 or its mutants, he must be quarantined away from the family. Thus, he needs a separate space with all the facilities, which includes at least a separate bedroom and a bathroom. It is much similar to the concept of a visitor's area/room in designing.</p> | <ul style="list-style-type: none"> • There must be a designated area within the apartment separated from the rest of the house. • Space design must use non-mixed circulation. • Smart solutions & furnishing could be used. |
| 3. Exercising, Relaxing & Doing Nothing (Niksen) | <p>Niksen means "doing nothing" in Dutch. After the lockdown periods, people realized that sometimes doing nothing at all is the best thing to do. It allows them to come back healthier and more productive. Additionally, with no gyms available, people needed spaces where they can conduct their daily workouts with ease.</p> | <ul style="list-style-type: none"> • It requires creating sanctuary-like spaces inside the home; for example, designing small reading and relaxing corners. • It means creating a space that can be sufficient to exercise. • Smart solutions & furnishing could be used. |
| 4. Psychological Requirements | <p>Throughout observation, three main psychological needs were found to be the most required by home users.</p> <p>Privacy: Getting quarantined with all the household members, made the concept of privacy to be much more evaluated, especially with large family with kids. For example, people will need a space to cook without disturbing the other households' members or a separate entrance where they can isolate things before bringing them inside the house.</p> <p>Aesthetics & Space psychology: They became crucial to provide a sense of calm, organization and positivity, in order to support and elevate people mental and physical wellbeing, especially with long periods of quarantine.</p> <p>Private Outdoor Spaces (Sound & Sight): Not being able to go outdoors, created the urgent need to have outdoor spaces inside the houses while maintaining the sense of privacy. Especially since,</p> | <ul style="list-style-type: none"> • Using closed scheme home layout is preferred to the open plans, where there is one space that includes the kitchen, reception, dining and living area with without privacy. • The design materials and color schemes must be greatly considered with lots of natural light. • Space design, colors, and fabrics can create various feelings that help in maintaining the users' psychological health and sense of comfort inside his home. Feelings such as happiness, comfort, warmth, safety, romance, excitement and pride. • Social and family gathering spaces should be open to garden spaces, to integrate the external and internal spaces. • Smart solutions could be used. • In small area apartments small terrace can be devoted to spend some time outdoors. It can also be achieved |

| | | |
|----------------------------|--|--|
| | having an outdoor view reduces eye strain and stress and can provide the link with the outdoor world all human psychologically requires. | throughout using windows, to provide natural views and connectivity with outdoor environment. |
| 5. Greenery | After being quarantined inside a flat, for long periods, there is the need for greenery or having a small garden inside the house. It is a proven methodology in reducing stress and improving internal air quality. Not only that but also studies conducted by Texas A&M indicates that the presence of greenery and plants can improve concentration and memory retention. Furthermore, growing what you may eat can be a concept worth adopting for the indoor/outdoor gardening in the coming days. It is believed that Biophilia will become a real necessity, instead of being just a trend. | <ul style="list-style-type: none"> Using smart design and solutions to incorporate greeneries inside the houses. Vertical gardens can be used. Providing small indoor areas for gardening, equipped with artificial light, air circulation and water could be provided. |
| 6. Healthier Spaces | After the COVID-19 period, most people developed an interest in personal and home hygiene and sanitization. Many alternatives became available and can be used individually or together. For example, many hands touch the doorknobs or the lighting buttons, which made the vocal control a real solution to avoid touching and contamination. In addition, people who live alone can use it when they feel sick and cannot get help. As for the bathroom sanitization control specially, this crisis emphasized the importance of smart technology that are not available still in all countries. Another example is online shopping which has been accelerated due to the pandemic and consequently home deliveries. This necessitates a dedicated home entrance space for package drop-off and sanitation. Also, storage spaces are needed for storing things such as pantries. Finally, if there is a shutdown, using solar panels and geothermal are great solutions to provide electricity, heating and water supply and being fully sustainable. | <ul style="list-style-type: none"> Various solutions can be used, such as: Using smart homes and vocal control systems to avoid contacting certain surfaces. Using air purifiers and indoor air quality monitoring. Using new filtration systems for both the air and the water. Using germ-resistant materials for flooring and surfaces. Using auto-cleaning technologies integrated inside the furniture (wardrobes and kitchen cabinets). Using easily cleaned fabrics for the furniture and rugs. Using Ultraviolet lamps to kill bacteria and viruses. Using smart toilets that are available in Japan and automatic cleaning faucets that are used in public restrooms. Providing entrance space and storage areas. |

B. Interior Space Design Methodology and Strategies Guidelines

Home space design must express and support the culture, experience, and the changing needs of its users. Architects' and designers' role is to meet these requirements while maintaining the greater good [13]. They must consider the users' mindset as they do aesthetics and function. Each client has his own set of space requirements achieved throughout a good space planning, and his own sense of aesthetics achieved throughout applying correctly the space psychology [12, 1]. Designing homes for people to relax in will never change, however a few considerations must be taken into account now such as social distancing, people boredom from staying at homes and the slower life rate [10]. As demonstrated in table 1, a lot of the new needs and functions required due to the COVID-19 pandemic at the residential spaces, have many sustainable and smart solutions imbedded in them. The methodology guideline to follow for the process of space design in the era of pandemics was required. It simply involves three aspects, and they are:

- **Function & Needs:** Design while respecting new and old functions and needs for the occupants, environment and local society.

- **Problem Solving:** Being innovative & creative and going smart.

- **Sustainability:** Improving indoor environmental quality to sustain human health; physical and psychological.

As for the space planning strategies that can be used in a COVID-19 era, they involve [1, 6]:

- Creating resilient smart spaces that can contain multifunction, while preserving privacy; such as a guest's bedroom that can turn into an office or rooms with alcoves or walk-in closets that can be home offices [1, 6].

- Breaking down the space into separated zones, for function, privacy and quarantine.

- Creating appropriate storage areas/spaces where everything can be left in and to not pack up every day [1].

- Using Modular free standing or built-in furniture that can be easily adapted and flexible [1].

- Noise control and creating mutable spaces throughout the material used, using acoustical techniques and insulation systems in walls, floors and ceiling. Also using convex shapes in space design to diffuse and prevent the sound waves.

Finally, it became mandatory that interior designers and architects stand up for the challenges and develop an adequate, innovative and effective designs and solutions, throughout redesigning to fulfill the users changing needs [3].

IV. EQUIPMENT, SYSTEMS, & FURNITURE

COVID-19 changed how people live and where they spend extra time at their homes. In this new era, the way the houses are built and their contents are subject to change [10]. The pandemic made the idea of using smart equipment and systems in the residential buildings more and more feasible since they have more health and safety features which provides a peace of mind, as demonstrated before mentioned. They allow users to control their homes from outside with zero contact [1]. It can also achieve multi- tasks functions that are requested in the above-mentioned part. This includes the

movable and fixed furniture and the smart solutions used to create smart, dynamic and/or livable spaces in regard to the fourth dimension; time. Table 2 will illustrate some of the smart equipment, systems and furniture that can be used in home interior design.

V. SUSTAINABLE GOALS & ECONOMIC VALUE

Now, the question becomes if going green can help in achieving the above-mentioned needs. Firstly, it must be understood that creating sustainable interiors theoretically means [15]; Increasing indoor quality, decreasing energy and water use in buildings, minimizing waste and maximizing reuse, and creating proper acoustical and visual environment. Additionally, it creates resilient spaces while keeping the environment green in consideration to the building's whole life-cycle stages. Therefore, the right application of the sustainability goals in the interior of homes can greatly achieve the above-mentioned needs, since they deal with the same elements.

As aforementioned, COVID-19 pandemic illustrated the need for the sustainable goals in houses' design. Other goals of sustainability were also perceived, such as; going for recycling, upcycling, and reuse of materials which became more tempting due to the economical degradation [16, 5]. Also, the goal where less is more and local is better become more applicable. People learned to live with less, where they shop every 10 days for food, creating a stronger sense of community and more awareness towards the environment. Furthermore, demand on local products increased, since governments needed to salvage their economics, and people began to understand they are more sustainable than imported materials [2].

Unfortunately, coronavirus created the fear from an economic stand-still [4]. Yet at the same time, spending shifted towards utility, comfort and safety. Residential interior design will go towards high-quality and multipurpose furnishings that will increase its economic value and stand the tests of time and use [6].

VI. THE EGYPTIAN SOCIETY; SURVEYING USERS' FEEDBACK

A survey was conducted to support the paper findings and analyses throughout conducting an electronic questionnaire. The research focused on assessing Egypt's middle and higher classes. According to central agency for public mobilization and statistics [17], Egypt current population is around 103,380,228, in May 2022, where around 43,000,000 are considered children under 18 years old. And around 38% of the population is the middle and higher classes. That means that the available sample study is around 22,944,486 people. And the study will take only residence of Cairo and Giza; the major two cities in Egypt. Where Cairo is with around 10,128,409 million people and Giza is around 9,366,745 million people with total of 19,495,154 million people, with around 18.86% of Egypt's overall population. This makes the maximum study sample is around 4,327,330 people [16]. The research studied around 1 for every 42,000 persons with a total of 104 people. Each one represents the needs for a different family of averagely 3 persons, which gives us a total of around 312 persons with ratio 1: 14,000. This sample however is still for just getting a view about the study deductions being on the right track for the Egyptians' needs [18].

A. Study Sample Basic Information

Table 3 will demonstrate the study sample basic information analyses and classification. It is shown that there is a healthy variation between the options of the target group [18].

B. Functions and Needs Analysis

COVID-19 illustrated the need for some specific spaces and elements inside the houses. This part will assess their current availability and their importance during and post to that period of time. Table (4) presents an analysis for the availability of the suggested functions and needs in the home interiors and the need for them during and after the COVID-19 pandemic [18].

Table 2. Equipment, systems, & furniture used in interior home design [1,14]

| Equipment / Systems | Function / Economical Effect | Environmental Effect/ Sanitization |
|----------------------------------|---|--|
| Automated Hand Sanitizers | It can be used instead of ordinary hand washing and drying. | They have more Sanitization Effect They provide no contact |
| C-bus and Google | It can be used to switch various home systems on and off without being at the house. | They conserve energy and water They provide no contact |
| Sensors / Phones | It can be used to activate lighting and cooling and heating systems that can be monitored throughout mobile phones. | They conserve energy and water They provide no contact |
| Smart Toilets | They use sensory systems to automatically interact with the user. They can provide nightlights, so users don't need to turn on another light when using the toilet. Although they use electricity, some versions have energy-saving modes to decrease their energy consumption. | They enhance hygiene, since no contact is needed when using them. They can lower the water use by sensing the needed exact amount of water to flush the toilet. The water and air dryer appliances remove the need for using toilet paper. |
| Smart Furniture | Most of the smart furniture is developed to achieve multi-task functions and preserve space and resources, which is critically needed in the COVID era, to sustain its new required functions in homes. | They can conserve space and resources. They can achieve multi-tasks functions and needs. Sanitization depends on their material. |

Table 3. Study Sample Basic Information Classification

| | Percentage / Options | | | | | | |
|--------------------------|----------------------------------|---|---------------------------------|---|--|--|------------|
| | Nationality | 100% | Egyptians | | | | |
| Residence | 99% | In Egypt | | | | | |
| Gender | 42.3% | Male | 57.7% | Female | | | |
| Marital State | 36.5% | Single | 63.5% | Married | | | |
| Age Range | 0% | 18-24 | 52.9% | 25-40 | 47.1% | Over 40 | |
| Working Status | 1% | Student | 94.2% | Working | | 4.8% | Unemployed |
| Accommodation Type /Area | 14.4% | 59.6% | 13.5% | 3.8% | 4.8% | 3.8% | |
| | Flat (under 120 m ²) | Flat (120 m ² – 200 m ²) | Flat (over 200 m ²) | Twin House/ Villa (under 250 m ²) | Twin House/ Villa (250 m ² – 400 m ²) | Twin House/ Villa (over 400 m ²) | |

Table 4. An analysis for the availability of the suggested functions and needs in the home interiors and the need for them during and after the COVID-19 pandemic

| Space/ Element | Availability at Your Current Accommodation | | | Was it required during the COVID-19 quarantine period? | | | Is it still needed now after two years? | | |
|--------------------------------------|--|-------------------|----------------|--|-------------|----------------|---|----------|----------------|
| | Yes, Available | No, Not Available | To Some Extent | Yes (During) | No (During) | To Some Extent | Yes (Now) | No (Now) | To Some Extent |
| Office Room / Zone | 32.7% | 43.3% | 24% | 65.4% | 22.1% | 12.5% | 71.2% | 11.5% | 17.3% |
| Home Schooling / Studying Zone | 44.2% | 35.6% | 20.2% | 70.2% | 20.2% | 9.6% | 67.3% | 22.1% | 10.6% |
| Quarantine Area | 29.8% | 57.75% | 12.5% | 60.6% | 27.9% | 11.5% | 44.2% | 33.7% | 22.1% |
| Exercising, Relaxing & Doing Nothing | 32.7% | 46.2% | 21.2% | 55.8% | 24% | 20.2% | 56.7% | 22.1% | 21.2% |
| Greenery | 49% | 42.3% | 8.7% | 62.5% | 20.2% | 17.3% | 74% | 14.4% | 11.5% |
| Healthier Spaces | 26% | 53.8% | 20.2% | 56.7% | 27.9% | 15.4% | 62.5% | 19.2% | 18.3% |
| Psychological Requirements | | | | | | | | | |
| Privacy | 57.7% | 17.3% | 25% | 71.2% | 13.5% | 15.4% | 77.9% | 6.7% | 15.4% |
| Aesthetics & Space Psychology | 35.6% | 32.7% | 31.7% | 63.5% | 17.3% | 19.2% | 67.3% | 15.4% | 17.3% |
| Private Outdoor Spaces | 46.2% | 42.3% | 11.5% | 66.3% | 25% | 8.7% | 71.2% | 18.3% | 10.6% |

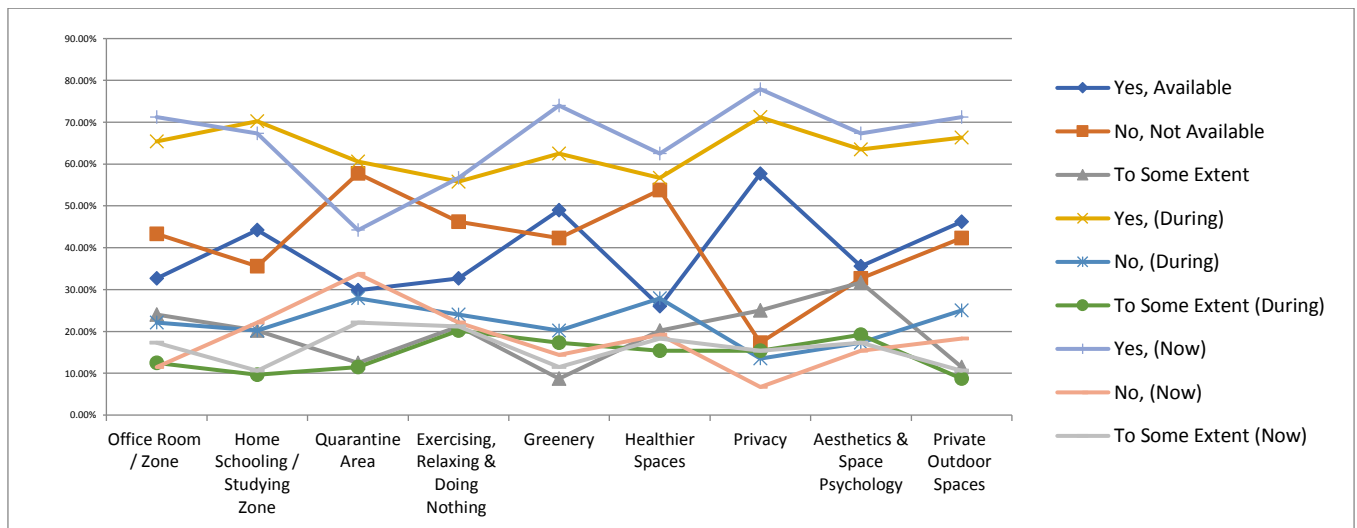


Figure 1. Chart illustrates the variations for the availability and the need (during and after the corona virus) for the suggested functions & needs, as demonstrated by the study sample

After reviewing the results some very minor inconsistencies were observed, which could be further studied in another research, however they don't affect the results found. It was observed, as demonstrated in figure 1, that less than 50% of the study sample have these spaces or needs in their current accommodation with a ratio of 26% to 49%, with the

exclusion of privacy with 57.7%. It was also demonstrated that the questionnaire results were consistent with the research analytical findings, where only less than 30% saw that these functions and needs were not needed during the COVID-19 and surprisingly with only 4% increase for after the COVID-19 ended by two years to reach only 34%. This clearly

showed the awareness that people as users have, that in this era of pandemics, some things will be needed long after their direct insinuation. It can be also due to the type of the study sample selected. Additionally, it set the road in a way to the changing in needs that the Egyptian society might need in their houses.

Additionally, table 5 supplied a detailed analysis for the importance of the suggested functions and needs in the home

interiors during and after the COVID-19 pandemic. It was the answer of the study sample when was asked to arrange the needs required, according to their importance to them during and after the COVID-19 period [18].

As clearly demonstrated in table 5 and figure 2, most of the percentage of the study sample lies between the options; 2 – important to some extent, 3 – very important, and 4 – Essential.

Table 5. A detailed analysis for the importance of the suggested functions and needs in the home interiors during and after the COVID-19 pandemic

| Space/ Element | Arrange these functions & needs according to their importance | | | | | | | | | |
|--|---|-------------------|------------------------------|--------------------|---------------|--------------------------|-------------------|------------------------------|--------------------|---------------|
| | During COVID-19 quarantine period? | | | | | Now | | | | |
| | 0 - not important at all | 1 - not important | 2 - important to some extent | 3 - very important | 4 - Essential | 0 - not important at all | 1 - not important | 2 - important to some extent | 3 - very important | 4 - Essential |
| Office Room / Zone | 6.73% | 2.88% | 27.88% | 32.69% | 29.81% | 6.73% | 6.73% | 41.35% | 22.12% | 23.08% |
| Home Schooling / Studying Zone | 7.69% | 3.85% | 26.92% | 38.46% | 23.08% | 9.62% | 12.50% | 32.69% | 28.85% | 16.35% |
| Quarantine Area | 7.69% | 15.38% | 27.88% | 21.15% | 27.88% | 13.46% | 22.12% | 26.92% | 19.23% | 18.27% |
| Exercising, Relaxing & Doing Nothing | 3.85% | 9.62% | 45.19% | 25.96% | 15.38% | 2.88% | 14.42% | 37.50% | 29.81% | 15.38% |
| Psychological Requirements: Privacy | 3.85% | 8.65% | 45.19% | 26.92% | 15.38% | 4.81% | 9.62% | 41.35% | 32.69% | 11.54% |
| Psychological Requirements: Aesthetics & Space Psychology | 3.85% | 9.62% | 50.96% | 26.92% | 8.65% | 1.92% | 16.35% | 38.46% | 32.69% | 10.58% |
| Psychological Requirements: Private Outdoor Spaces (Sound & Sight) | 2.88% | 16.35% | 37.50% | 32.69% | 10.58% | 4.81% | 20.19% | 29.81% | 31.73% | 13.46% |
| Greenery | 0.96% | 11.54% | 37.50% | 30.77% | 19.23% | 2.88% | 11.54% | 35.58% | 33.65% | 16.35% |
| Healthier Spaces | 0.00% | 10.58% | 44.23% | 24.04% | 21.15% | 0.00% | 14.42% | 41.35% | 25.00% | 19.23% |

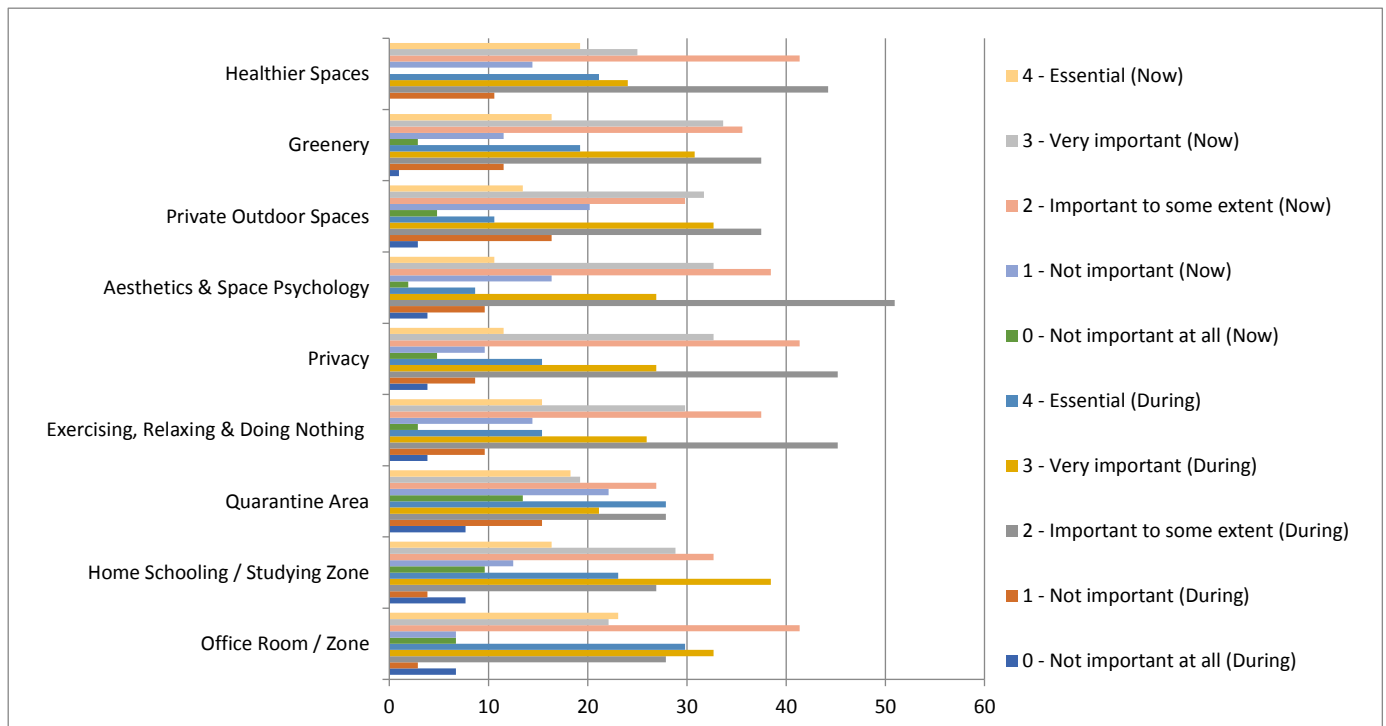


Figure 2. Chart illustrates the variations for the importance for the suggested functions & needs, during and after the corona virus, as demonstrated by the study sample

As for table 6 and figure 3, they are an analysis for the importance of the suggested functions and needs in the home interiors after the COVID-19 pandemic in correlation to each other, using two weighting systems. The main system is the single ranking analyses (Mean). It was used where 9 was the best, and 1 was the lowest, in relation to the exact calculated points for every function and need that were redistributed accordingly.

It was no surprise that the office room or zone was the most important function needed in the two weighing systems. However, and as shown in figure 4, it was very astonishing

that aesthetics and space psychology, in spite of their importance, got the lowest place in the ranking analyses and the sixth in the other, which require further analysis [18].

The other secondary analysis (Highest) was by illustrating the percentage of every category in relation to the participants answers along the 9 different numbers for weighting their importance. It is also the bases for calculating the single rank analysis. Of course, this method is not for ranking, but it illustrates another side of the participant answers. However, office space and home schooling maintained their importance.

Table 6. An analysis for the importance of the suggested functions and needs in the home interiors after the COVID-19 pandemic in correlation to each other (single ranking and percentages)

| Single Ranking Analysis | Functions & Needs | Arrange the functions and needs according to their importance to you now in order and don't repeat the numbers. (Where number 9 is the most important and 1 is the least important in relative to each other) | | | | | | | | |
|-------------------------|--------------------------------------|--|--------|--------|--------|--------|--------|--------|--------|--------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 9 (614 Points) | Office Room / Zone | 15.38% | 5.77% | 9.62% | 7.69% | 1.92% | 1.92% | 8.65% | 19.23% | 29.81% |
| 8 (547 Points) | Home Schooling / Studying Zone | 9.62% | 22.12% | 6.73% | 3.85% | 2.88% | 5.77% | 14.42% | 25.00% | 9.62% |
| 7 (532 Points) | Greenery | 12.50% | 17.31% | 7.69% | 4.81% | 8.65% | 6.73% | 13.46% | 15.38% | 13.46% |
| 6 (527 Points) | Exercising, Relaxing & Doing Nothing | 2.88% | 8.65% | 11.54% | 15.38% | 13.46% | 26.92% | 10.58% | 7.69% | 2.88% |
| 5 (507 Points) | Quarantine Area | 20.19% | 6.73% | 13.46% | 6.73% | 7.69% | 3.85% | 18.27% | 10.58% | 12.50% |
| 4 (502 Points) | Privacy | 3.85% | 7.69% | 12.50% | 15.38% | 33.65% | 11.54% | 3.85% | 3.85% | 7.69% |
| 3 (492 Points) | Healthier Spaces | 23.08% | 10.58% | 7.69% | 9.62% | 4.81% | 9.62% | 7.69% | 10.58% | 16.35% |
| 2 (481 Points) | Private Outdoor Spaces | 6.73% | 11.54% | 23.08% | 12.50% | 6.73% | 12.50% | 16.35% | 4.81% | 5.77% |
| 1 (478 Points) | Aesthetics & Space Psychology | 5.77% | 9.62% | 7.69% | 24.04% | 20.19% | 21.15% | 6.73% | 2.88% | 1.92% |

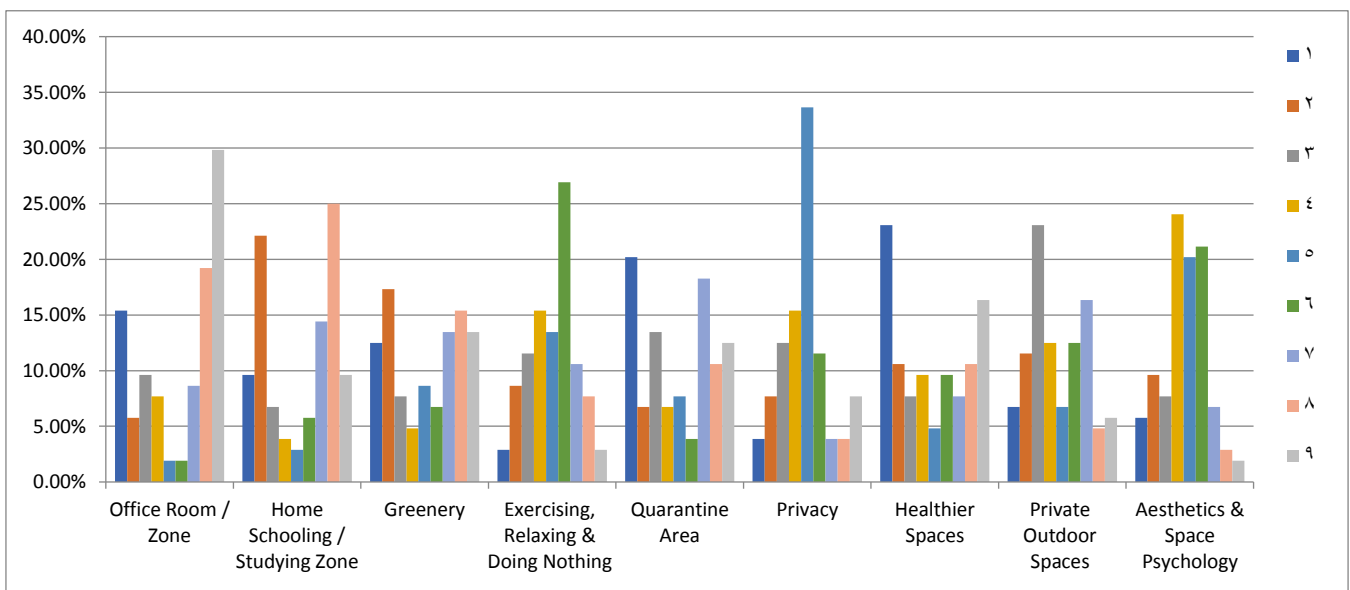


Figure 3. Chart illustrates the variations for the importance for the suggested functions & needs, during and after the corona virus, as demonstrated by the study sample

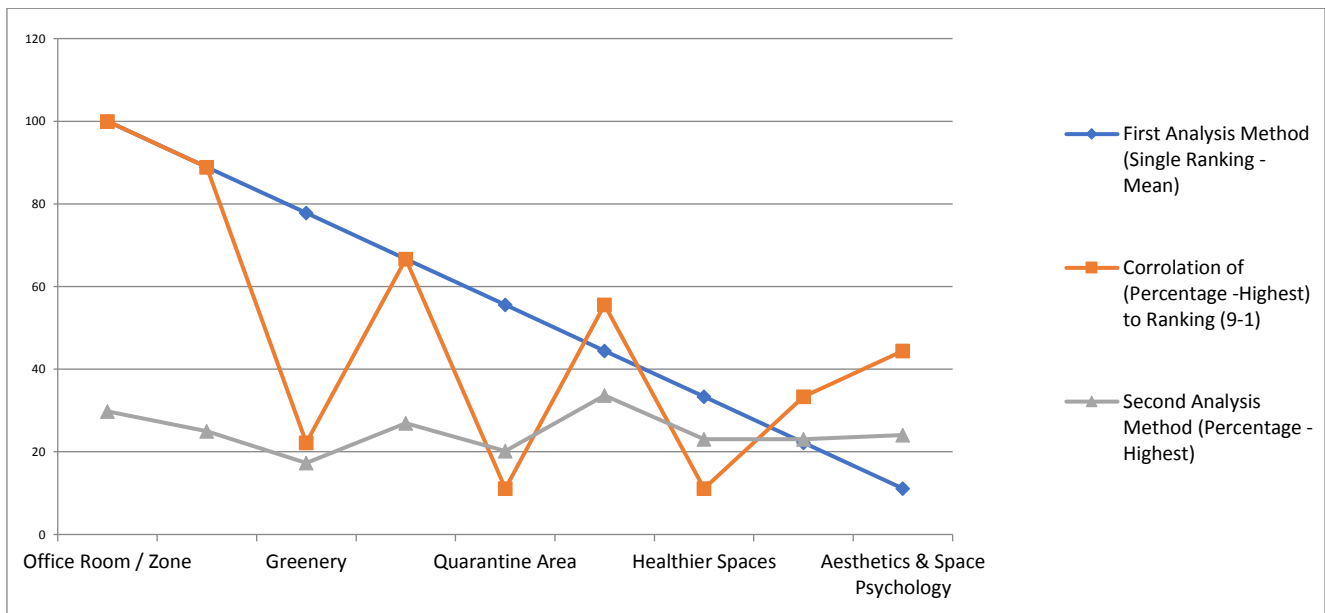


Figure 4. Chart illustrates the correlation between the analysis methods, as demonstrated by the study sample, using the two methods of assessment

C. Additional Functions and Needs Analysis

Some additional functions and needs were demonstrated by the study sample with less weighting to the overall study sample. They include having; a water feature such as a pool, a small kitchenette in the quarantine area, a privacy room, a dedicated playing area for children, a dedicated gymnasium area, and a changing room near the entrance for better sanitization and hygiene before entering. They also include having; an outdoor box for delivery item to not make any connection with delivery men while quarantined or a supply receiving area, a space for practicing hobbies such as music, drawing, crafts making, etc., and a storage near the kitchen. It was also suggested by the sample that it would be better to have the quarantine area beside the entrance [18].

D. Smart Solution Analysis

As for using smart solutions in the houses' interior, when the study sample were asked if some solutions, especially the smart ones, to achieve the above requirements and make their homes healthier, to live safely and comfortably were relatively expensive, will they agree to implement them in their homes? The majority answered that it depends on the increased cost with 63.5%, while 26.9% said yes and 9.6% said no, as shown in Figure (5). This is actually a great response when taking the economical factor in consideration and show the awareness people are having. As for when they were asked if some of the solutions were not to their preference but they are better for saving the environment and the resources, will they agree to implement them? The majority again answered that it depends on its importance to their needs with 59.6%, while 34.6% said yes and 5.8% said no as shown in Figure (5). This again is a consistence answer with the nature of interior design and its direct relation to human preferences. Finally, some of the study sample demonstrated the importance of using smart equipment to improve indoor quality such as; Air purifying equipment, etc. [18].

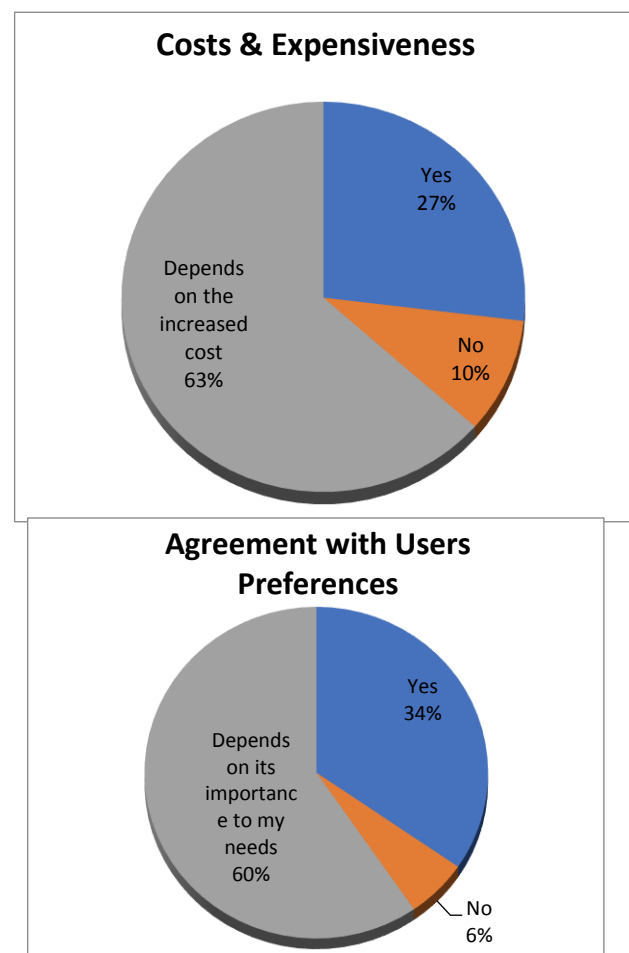


Figure 5. Charts illustrate the relevance of the costs and preferences, to the users in their selections for smart equipment or furniture, as demonstrated by the study sample

VII. CONCLUSION

The world has been living in a moment of huge changes since 2019. And, for sure, residential buildings and houses became the protagonists of this particular moment in life. The

research demonstrated how COVID-19 pandemic changed many things concerning the rules of socialization and interaction and subsequently creating a new norm in life that will last long into the future. COVID-19 changed how people lived, worked, played, stayed, and it is needless to say, it changed the way people lived in their homes as well as the way they need them to be designed. New functions and needs were developed and discussed in the research. They are Office, Home Schooling, Quarantine Area, Exercising, Relaxing & Doing Nothing zones. In addition to some Psychological Requirements such as; Privacy, Aesthetics & Space Psychology, Private Outdoor Spaces, Greenery, and Healthier Spaces. Some, might say that these are no new functions, however, what is new and was emphasized in the research is their elevated importance due to the pandemic. At last, users began to change their concepts and necessitate their availability in their homes with architects and interior designers after a long time of ignorance and considering them not crucial.

These functions and needs were also validated for the Egyptian society by conducting an electronic questionnaire to a specified study sample. This questionnaire explored and analyzed the needs and requirements for humans inside their home due to COVID-19 pandemic and its mutants, in order to feel more comfortable and have more efficient houses. And in general, the questionnaire results actually supported the analytical findings of the paper.

Additionally, it was found that going sustainable and respecting the green principles can help a lot in achieving better results in creating more comfortable homes in face of COVID-19. Furthermore, sustaining people lives must be considered as a part of the grander sustainability concept, as demonstrated by the research. Finally, the most important finding that was discovered was that the changes in the functions and needs, initiated due to COVID-19, will be needed for some time in the future. This requires that architects and interior designers must start developing new methodologies and approaches to their designs in order to satisfy the demands of the new era of COVID-19, in addition to using smart technologies and solutions.

VIII. RECOMMENDATIONS

For future studies; it is recommended for other researchers to:

- Apply the findings of the paper on a multiple real case study design.
- Conduct another grander analysis that represents no less than 1:5000-1:10,000 of the suggested study sample to further validate the results including all the Egyptian cities.
- Finally, it is also recommended to further study the space psychology of the houses and why it scored the lowest place in the opinion of the study sample in spite of its importance.

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Conflicts of Interest: The questionnaire was conducted based on voluntary participation, where only consented participants

completed the requested survey. Thus, there are no ethical issues applied to this research and no conflict of interest.

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