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An Approach towards eco smart houses for limited mobility in Egypt

Wael Kamel, Ph.D.[1]; Gihan Mosaad, Ph.D.[2]; Nermine Hany , Ph.D.[3]and Sarah Samadisy[4]

1. Department of Construction and Building Engineering, Arab Academy for Science Technology and Maritime Transport, Alexandria, Egypt.
2. Department of Architectural Engineering and Environmental Design , Arab Academy for Science Technology and Maritime Transport, Alexandria, Egypt.
3. Department o f Architectural Engineering and Environmental Design, Arab Academy for Science Technology and Maritime Transport, Alexandria, Egypt.
4. Architectural Engineering and Environmental Design Arab Academy for Science Technology and Maritime Transport, Alexandria, Egypt.

الملخص العربى :

أصبحت الظروف المعيشية للمعوقين ، بما في ذلك الخدمات المنزلية وتوفير الرعاية الصحية في المنزل ، موضوعًا ساخنًا في جميع أنحاء العالم مع شيخوخة السكان والتكاليف الاجتماعية المتزايدة للرعاية الصحية. يعد تصميم المنازل الإيكولوجية الذكية للأشخاص ذوي الإعاقة نهجًا عمليًا وفعالًا يهدف إلى معالجة هذا الموقف والتعامل معه. يوفر السكن الذكي دعمًا للحياة المستقلة للأشخاص ذوي الإعاقة من خلال تطبيق ودمج التقنيات المتقدمة في المنزل. الهدف هو توفير مجموعة كاملة من الخدمات لتلبية الاحتياجات الفردية والمتنوعة. تتم معالجة قضايا الاستدامة في التصميم والتطوير والبناء وكذلك في تقديم الخدمات. تبحث هذه الورقة في النمذجة المفاهيمية للمنزل الذكي للبيئة للمعوقين الذين يعيشون بشكل مستقل فيما يتعلق بالاحتياجات والطلبات المتوقعة للأشخاص المعوقين. بدلاً من التركيز على التقنيات المختلفة المعنية ، وكيفية تفاعلها مع بعضها البعض. نظرًا لأن التركيز الرئيسي على استكشاف احتياجات الأشخاص المعاقين كقاعدة لتصميم المستويات المختلفة لنظام خدمة الرعاية في المنزل الذكي للبيئة. تهدف هذه الورقة إلى تقديم الأفكار والاقتراحات التي لا يمكن أن تكون مفيدة فقط لمنشئ المنزل الذكي ولكن أيضًا تأخذ في الاعتبار احتياجات المستخدمين ومسألة التكاليف ، وهي جوانب مهمة للحلول المستدامة. تم تصميم نموذج مقترح لمنزل ذكي بيئي يتضمن تقنيات متكاملة لدعم وتقديم خدمة رعاية للمعاقين. . ويخلص إلى أن النموذج المفاهيمى كان داعمًا في محاولة فهم ومعالجة تعقيد تصميم منزل ذكي بيئي للعيش المستقل للمعوقين ، وأنه قدم أيضًا دعمًا للتواصل مع المعوقين بشأن احتياجاتهم ومتطلباتهم ورعايتهم. التوقعات المتعلقة ببيئات المعيشة الداعمة المعززة بالتكنولوجيا. كما تشير المقابلات والمسوحات بين المعوقين ، على الرغم من محدودية نطاقها ، إلى أن الأشخاص المعاقين الذين يعيشون في مصر يميلون إلى الاهتمام بحلول المنازل الذكية الإيكولوجية والتصميم المتكامل للتقنيات التي يمكن أن تلبي متطلبات الاحتياجات الأساسية للمعوقين.

Abstract:

Living conditions for disabled people, including household services and healthcare provision in the home, have become a hot topic worldwide with the aging of the population and the rising societal costs for healthcare. Design of Eco-Smart Homes for the disabled people is a practical and efficient approach that aims to address and deal with this situation. Intelligent housing offers support for independent living for disabled people through the application and integration of advanced technologies in the home. The aim is to provide a full range of services to meet diverse and individual needs. Sustainability issues are addressed in design, development and building as well as in service provision. This paper investigates the conceptual modelling of the eco-smart home for disabled people independent living in relation to the perceived needs and requests of the disabled people. Rather than focusing on the various technologies involved, and how they interact with each other. As the main focus is on exploring the needs of the disabled people as a base for designing the different levels of the care service system in the eco-smart home. This paper aims to provide ideas and suggestions that can not only be of use for the Intelligent House Builder but also take into account the needs of users and the question of costs, which are important aspects of sustainable solutions. An exemplar of an eco-smart home is designed in which includes integrated technologies to support and provide care service for the disabled. As well as a developed comprehensive system-of-systems model and a care service-level model which we have mapped on to the system-of-systems model. It is conclude that the conceptual model was supportive in trying to understand and address the complexity of designing an eco-smart home for independent living for the disabled people, and that it also provided support for communication with disabled people about their care needs, requirements and expectations about technology-enhanced supportive living environments .Also the interviews and survey among disabled people, though limited in scope, indicate that disabled people living in Egypt are inclined to be interested in eco-smart home solutions and integrated design of technologies that can satisfy the primary needs of the disabled people.

Keywords

Independent living, smart home, eco-smart home, integrative system design, service design, homecare, limited mobility , user needs, sensor motion .

Introduction

With the world's population increasing dramatically, solving the issue of living and care provision for d has disabled people has become an urgent topic. Each and every one of us can expect to become disabled. Everyone needs to be taken care of in their disability, no matter how powerful, rich or famous they are. As eco-smart home is an essential issue for sustainable

development. As part of the on-going development of the social high-tech era, smart home services will become an inevitable trend. Eco-smart homes provide a new environment for humans; based on technology that has been designed and developed to be ecologically sound and sustainable as the base for the smart home system Smart residential housing can enhance security, support reasonable resource consumption, provide a wide range of services for residents, and form a virtuous circulatory system. Smart homes aim to minimize the defects and weaknesses of the ordinary house. The reason to choose this topic for the paper is that to contribute in improving the possibility for disabled people to improve the quality and style of life.

The eco-smart home is equipped with technology that through various applications provides support and service for inhabitants, supports and encourages independence and the maintenance of good health. The complexity of the multitude of technologies involved in the eco-smart home is however a big challenge. For example, computer networks act as a bridge for house-based cabling, integrated configurations of various functions within the building subsystems, the realization of communication systems, automated systems, embedded sensor systems and building-integrated management of a variety of devices. Besides this, there are air conditioning systems, water and sewage management, power distribution systems, lighting systems, elevators, fire alarm systems, security systems, and access control systems.

The rapidly populating is a worldwide issue of concern, yet design of the eco-smart home needs to take in to consideration appropriate design solutions for different contexts and cultures in different parts of the world. By comparing Chinese and European social environments, we can begin to perceive important distinctions and differences. Almost all disabled people are taken care of by other human that they can depend and rely on their needs on them. The sense of family responsibility is very strong. In Europe, although this may vary between different countries and different environments, people are generally more independent, and the relationship between people does not seem to be as close as in China. Disabled people in Sweden seem to prefer living independently in their own homes rather than living together with their family or other people. Based on these observed Swedish and possibly mainly Northern European social conditions, we chose to study smart homes for independent living as a possible way to meet the unique needs of the disabled people.

This paper discusses the design of eco-smart homes for disabled as a way to provide a comfortable living environment in which they can enjoy their later years. Through a literature review, an overview gained about the current state-of-the art of smart home technologies, and also learned something about usability issues in this context.

The aim of this paper is to provide a conceptual model ,which can support further innovation, design and development bringing various products and services of relevance in this context together for the purpose of improving their interoperability, adaptability and usability, with the disabled users. Actual, varying needs as a central and driving concern. If the intended results are achieved, we believe this could contribute to better usability as well as lower

construction and management costs of eco-smart home systems, greatly improving the available intelligent solutions and their adaptability to individual needs and requirements, and thus their usefulness for elderly people. Thus, the smart home exemplar should be of interest for multiple stakeholders in this area who are concerned about implementing and managing eco-smart living solutions for all, and especially for disabled people in an aging population.

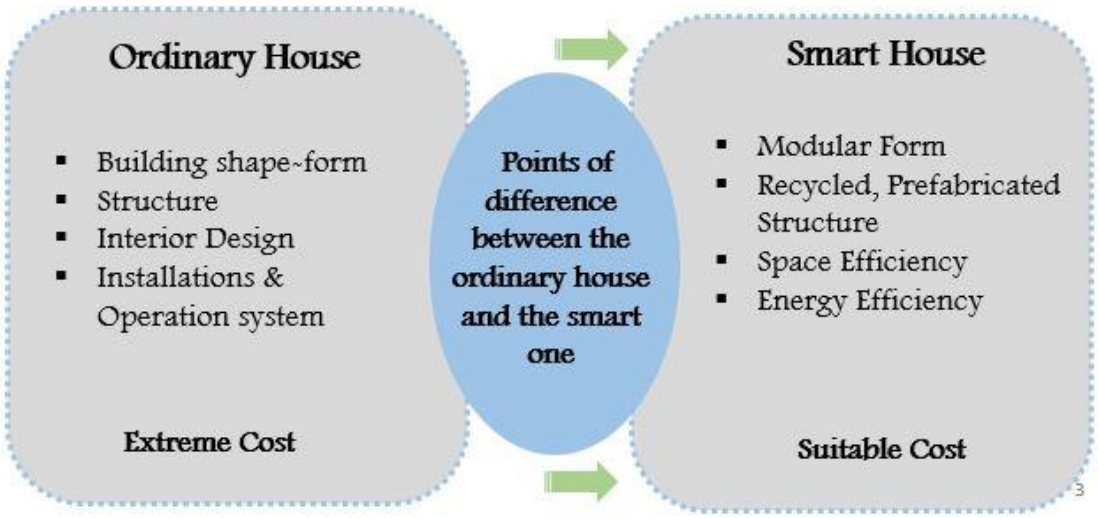


Figure 1: Points of difference between the ordinary house and the smart one. (By researcher)
Provide a conceptual model of an Eco- smart house with a full range of services to meet diverse and individual needs of limited mobility people in order to minimize the defects or weaknesses of the ordinary house and reach the maximum energy savings.

Egyptian code and policies for disabled people upon site layout

Egypt's disabled population is a considerable minority whose rights and livelihood were ignored by the last regime, and whose future lies in the hope that some attention might be brought to its concerns and needs after the Revolution. So far, the early signs have been positive. For the first time in decades, Egyptian politicians are beginning to integrate people with disabilities into their political platforms. This has partly resulted from the large number of people who became disabled as a result of injuries suffered during the Revolution, attracting more media attention to the problem.

The issue of disability in Egypt is multifaceted, affecting the disabled population itself, as well as other segments of society. For example, children are often forced to leave school and find work in cases where the head of the household becomes disabled. Workers' compensation rights are limited, and often not enforced. Disability also remains culturally stigmatized in Egypt. Rather than encouraging people with disabilities to become active members of society, cultural norms have often led to families hiding their disabled members and caring for them at home. Some Egyptian parents view their offspring's disability as a form of divine punishment while others fear it may have a negative social impact on their

other children. The effects of marginalization have also extended to public and private schools, where admissions standards often cause children with disabilities to be rejected, that's why they really need a high attention from the society as to establish special neighborhoods with special facilities and needs that they could give them the opportunity to live in it with a good quality of life and take their human rights as any other normal humans, for example in state sponsored schools created for children with disabilities, the education provided is weak and few families can afford the extra costs for tutoring and teaching aids.

The Egyptian counterpart to the ADA is the Rehabilitation of Disabled Persons Law, passed in 1975. This law gives people with disabilities access to vocational training and employment, but does not outlaw discrimination altogether. The government policy for employing disabled Egyptians is based on a quota system (5%) for companies with more than 50 employees. According to most sources, however, this quota is not enforced, and companies will often have disabled persons on their payroll to meet the quota without actually employing these individuals. While there are many existing non-profit organizations focused on people with disabilities, they approach the issue as one of charity, rather than one of integration and employment. (Country profile of Egypt ,2002)

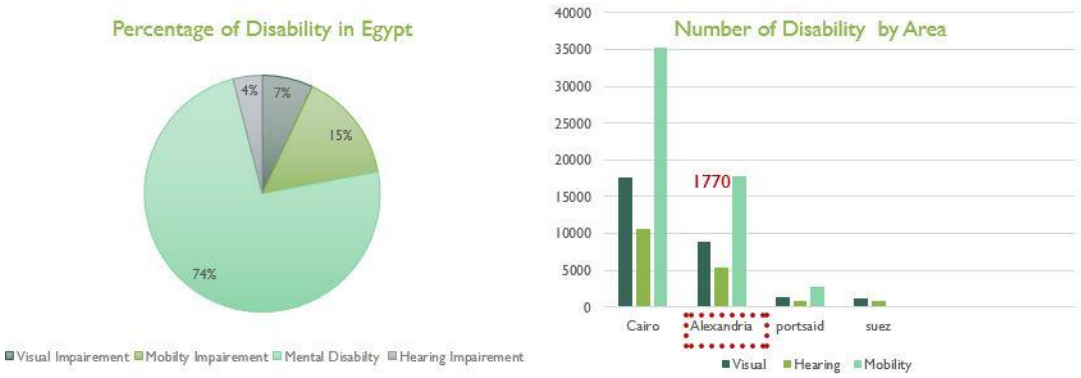


Figure 2: Percentage and number of disabilities in Egypt according to the statistics of the national authority. (Country profile of Egypt ,2002)

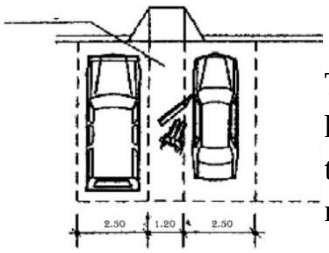
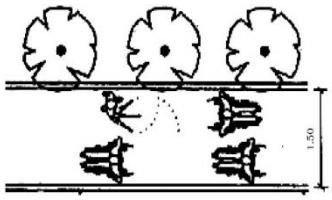
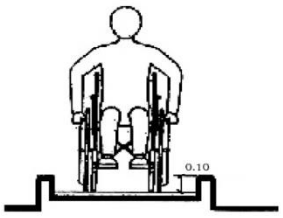
The percentage of mobility impaired is considered 15% is nearly is the highest percentage of disability after the percentage of the mental disability, and the number of limited mobility people in Alexandria is nearly about 17000.

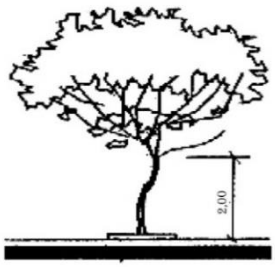
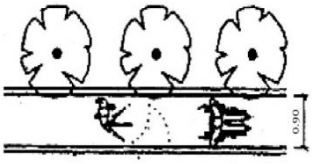
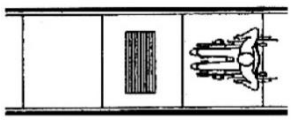
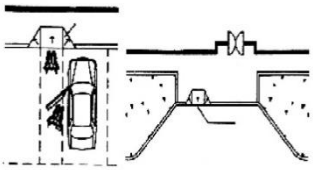
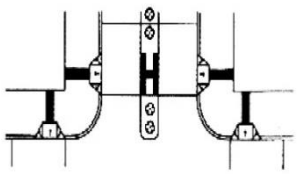
As Egypt pushes forward into a new stage, seeking democracy and social equality, the integration of people with disabilities is an issue that stands side by side with the integration of women and other marginalized sections of society. One of the first steps that should be taken toward this end is the representation of people with disabilities in the constituent assembly for Egypt's new constitution. Another major step that should be taken to effectively tackle this issue is improving the collection of statistics. Thorough statistics are necessary to understand the parameters of the disability issue, and to ensure that new laws are laid down and enforced. While some suggest that dealing with these fringe issues should come after the

"main" goals of the Revolution are met, these goals will not be satisfied without tackling all the issues collectively plaguing Egyptian society.

The Social Welfare Law 79 of 1975, and subsequent amendments, in particular, Law 25 (1977) and Law 92 (1980), are amongst those that deal specifically with disabled people's welfare rights. Their principal function is to ensure that people who acquire impairment through work related injured or diseases receive appropriate compensation and pensions.

Table 1: Design Consideration for disabled specially for the (handicapped) in site.(Egyptian international construction code ,2002)

Design Consideration in the Egyptian Code	
	The Minimum Distance for a pedestrian handicapped human path in the garage has to be (1.20) meter not less than as well as minimum distance for the car stop has to be not less than (2.5) meters.
	For double Handicapped passage the Minimum width has to be not less than (1.5) meter to take minimum 2 meters handicapped persons in one lane.
	If there is grass on the sides of the path a border has to be done with a height which is not less than (0.10) on both sides of the bath.

	If the site is planted the height of the stem of the tree should not exceeds (2.0) meters as to facilitate the circulation along the site as well as for the handicapped to move around it.
	For a single handicapped path, it shouldn't be design with a width less than (0.60) meter as to facilitate the movement of the wheel chair.
	If there is any floor drain along the path it should be put in the middle of it and covered with a mark.
	At the beginning of the path a ramp should be done a width in a range from (0.90) meter to (1.20) meter with a percentage of sloping not less than (12:1) .
	At the Intersection of pedestrian streets for handicapped, it should begin the path with a ramp of sloping not less than (12:1) at the beginning of the four intersections.

Egyptian Code upon the building Design and its consideration.

Usually the average person needs to be 60 cm of the movement, but in the case of the movement with the help of any tool setting calls for a person to show ranges from 70 cm in the case of the use of regular stick. 75 cm in the case of the use of at least two stick 90 cm in the case of the use of a crutch. 90 cm in the case of using a stick with a three-legged.

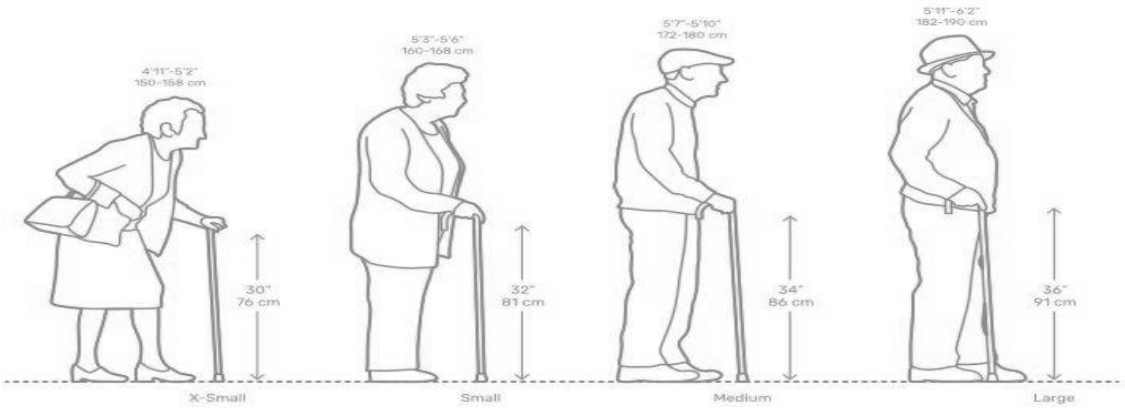


Figure 3: Dimensions of a person with a walking helping sticks or assistive canes. (Egyptian building construction code,2002)

The solution to help the disabled to easily navigate divided types of wheelchairs into three types:

1. World record type, should someone else pay the chair and does not pay a disabled chair himself, and found in hospitals, airports and other public buildings. It is not the purpose of going out into the street
2. World record type, who is on the patient to pay the chair himself by moving the rear wheel chair.
3. Wheel chairs linear induction motor which is very convenient for patients or the elderly and those who do not find the physical ability to move the chair.

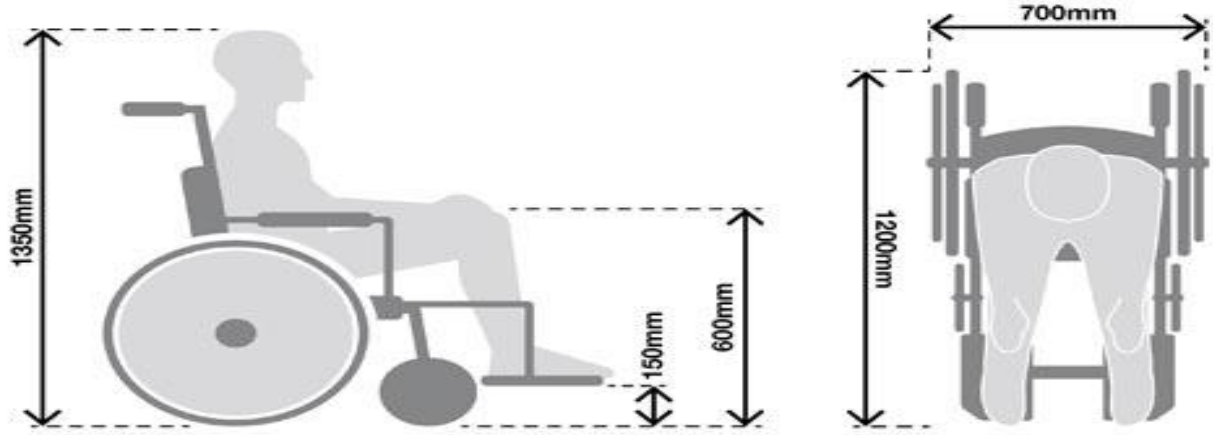


Figure 4: Dimensions of the wheel chair and the space that could be occupied in such any building. (Egyptian building construction code,2002)

Dimensions required for the movement of wheelchairs

The empty chair needs an area of 70 cm x 120 cm, while the chair with the patient area of 75 cm x 125 cm. Also, the folded chair needs 30 cm x 80 cm. The weight ranges chair according to its kind between the 12 and 25 kg, while the wheelchair linear induction motor and batteries

up to 40 or 50 kg.
The chair needs to be 90 cm regular movement forward. In the case of turning a knock on the letter L 90 cm by 120 cm after rotation.
As in the case of the chair rotation needs to different dimensions and In the case of rotation in the quarter-circle or 9 degrees a person needs to be an empty space up to 140cmx140cm..While ,the 180 degree rotation setting calls to an area of 160cmx140cm. The 180 degree rotation setting calls to an area of 160cmx140cm.
The 360 degree rotation setting calls to an empty circle diameter of 150 cm, at least. For more convenience we can have a diameter of 170 cm.

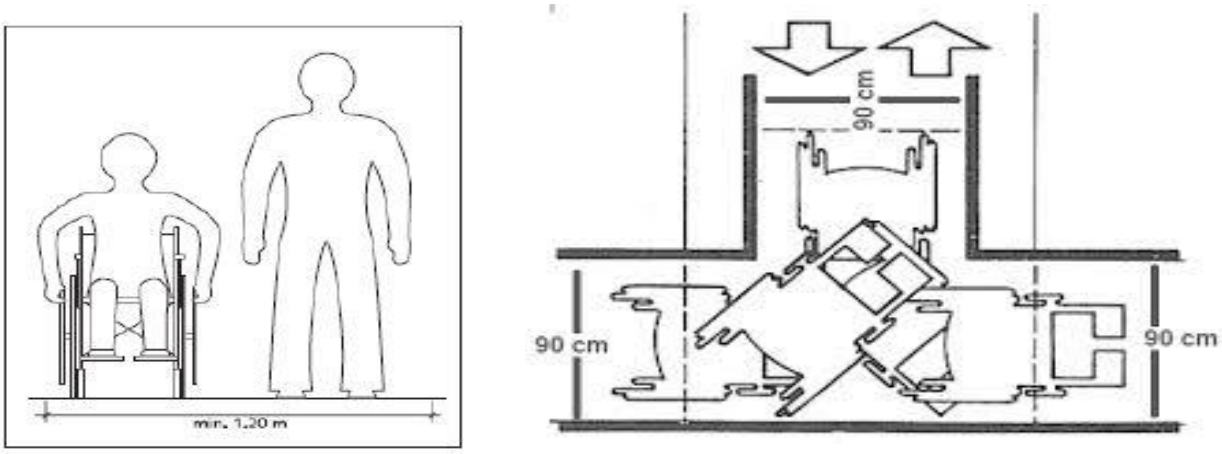


Figure 5: Space needed for the handicapped for circulation inside the building. (Egyptian building construction code,2002)

Literature review

Starting with the Roman architect Fitrov who put a link between the space and the human body passing by the architect for L' corbusier who has developed a module for gold vacuum and the ratio . The studies are all derived from the dimensions of the body from the point of view ideal has been away these standards for the basic needs of many of vacuum users.
These concepts have not changed, but starting in 1960 in northern Europe, particularly in England, Sweden has retreated human body model is ideal standards and afternoon hierarchy of the cycle of human life associated with age and special needs of each age group . Architects then began to think seriously about the division of vacuum users by age group and by Sex and by their ability to move. It was Goldsmith in his book designing for disabled publication in 1963 of first discussed this division and touched in his speech to wheelchair users.
Then in 1981 were humanitarian standards for the inclusion of children and the elderly as well as limited mobility, and thus disappeared person architectural model is ideal standards and that the hypothetical L' Corbusier .
Then in 1984, on the occasion of start racing in the project Cité des Sciences et de l'Industrie in Paris was a design considerations for people with special needs puts a premium on the disabled , children and even infants allocated to vehicles.

Pre-fabricated technology in a modular smart house

With the increasing demand for housing, it is very important for the government to find some alternative and useful way to meet this expanding problem. According to there are three options to meet this increasing demand. First is the used of indigenous building materials, second is the search for the improvement on the conventional method of construction as well as the design standard and lastly the used of innovative technology. Innovative technology refers to the used of newly discovered construction materials or methodology such as the Modular Housing System.

Modular house is the culmination of one type of building system. The building process starts with efficient modern factory assembly line techniques. The prefabricated components are brought to the site and erected using building block type construction. Work is never delayed by curing time or missing materials and can be completed for 30 to 45 working days. There are some residential modular buildings that are built on a steel frame (referred to as on-frame modular) that do meet local building codes and are considered modular homes. In 1960s the demands for comfort from clients side was growing and along it grew the design and functionality of modular houses as shown in Figure 6.

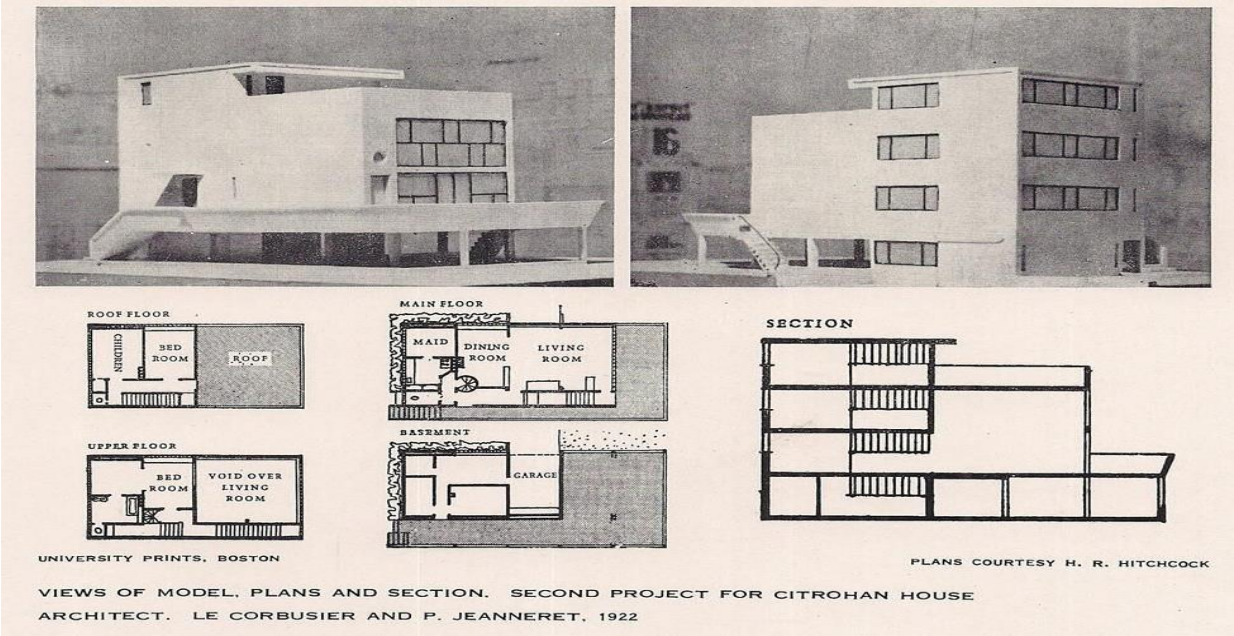


Figure 6: First Modular House in 1922 by Corbusier

Case Study

Disabled suffer of isolation as well as being UN safe in this country. They want to access their houses easily as well as to access parks, shops and to live a normal high quality of life that gives them the of feeling of being still exist.

This is a proposal for an eco-smart house which is an essential issue for sustainable development in Egypt, as a part of the ongoing development of the social high technological era, smart home service provide a new environment for humans ;based on a technological system that has been designed and developed to be ecologically sounds as well as being sustainable .

This eco smart house will be proposed and designed especially for disabled people with limited mobility as to improve the possibility for disabled people in Egypt to have a comfortable life.

The concept is based on simple modular rectangular form which could be extended by a modular unit according to their needs on the long run and the smart facilities could help the limited mobility person through the high technological system that let the house works highly efficiently as shown in figure 4.1the four stages to form a modular house with a module of three meters to let two handicapped persons rotate in any zone they need and this was chosen to facilitate movement inside.

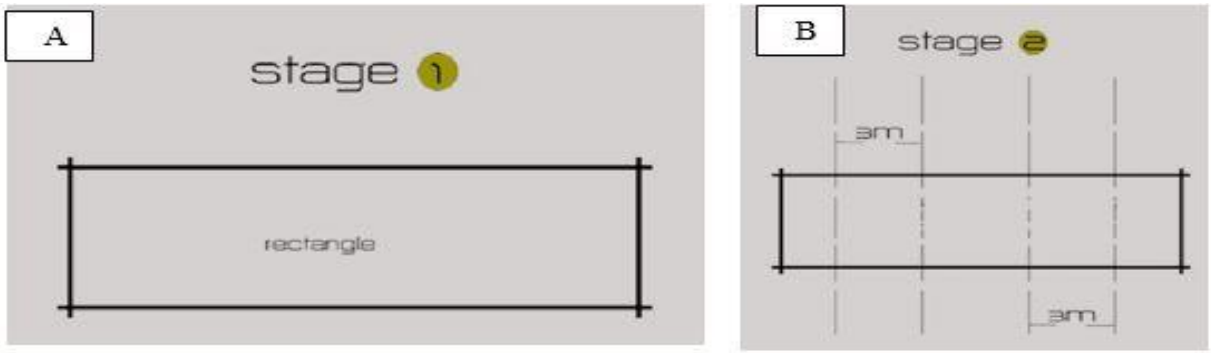


Figure 7 (A) :Simple rectangular form for the house .(By researcher)

Figure 7 (B) : Modular design based on (3m) module for the additional of extension unit .(By researcher)

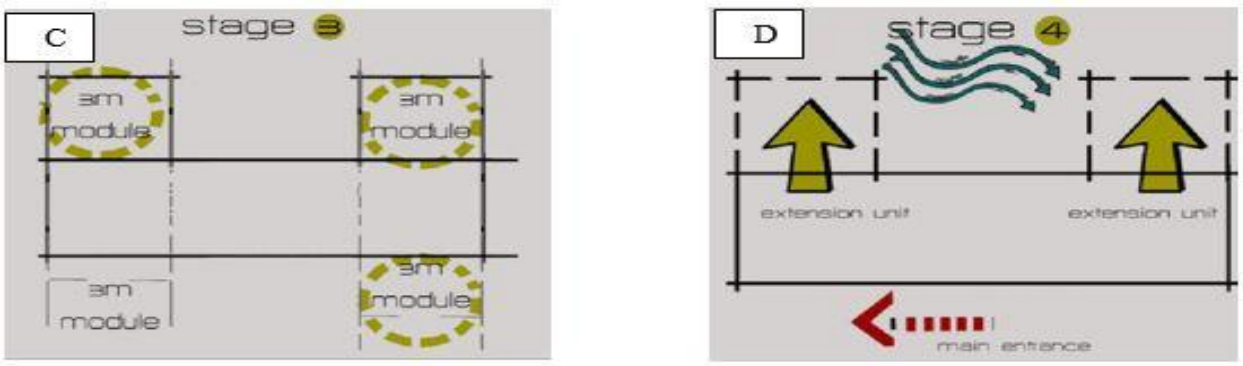


Figure 7 (C) : The extended unit could be extended to all directions according to their needs and with respecting the orientation.(By researcher)

Figure 7 (D) : The orientation and the environmental needs change the rectangular form in to a U shaped form .(By researcher)

The design of a modular plan of area 108 m^2 as shown in figure 4.2 consists of defined zones such as entrance and reception with an area of 18 m^2 ,dining and kitchen with an area of 18m^2 ,toilet with an area of 9m^2 ,master bed room with an area of 18m^2 and a pre-fabricated library with an area of 9m^2 as shown in figure 4.3,in addition to two additional zones in the extension which are the guest room and a kids room as shown in figure 8.

Figure 8: Ground floor plan (N.T.S) before extension with an area of 108 m^2.(By researcher)

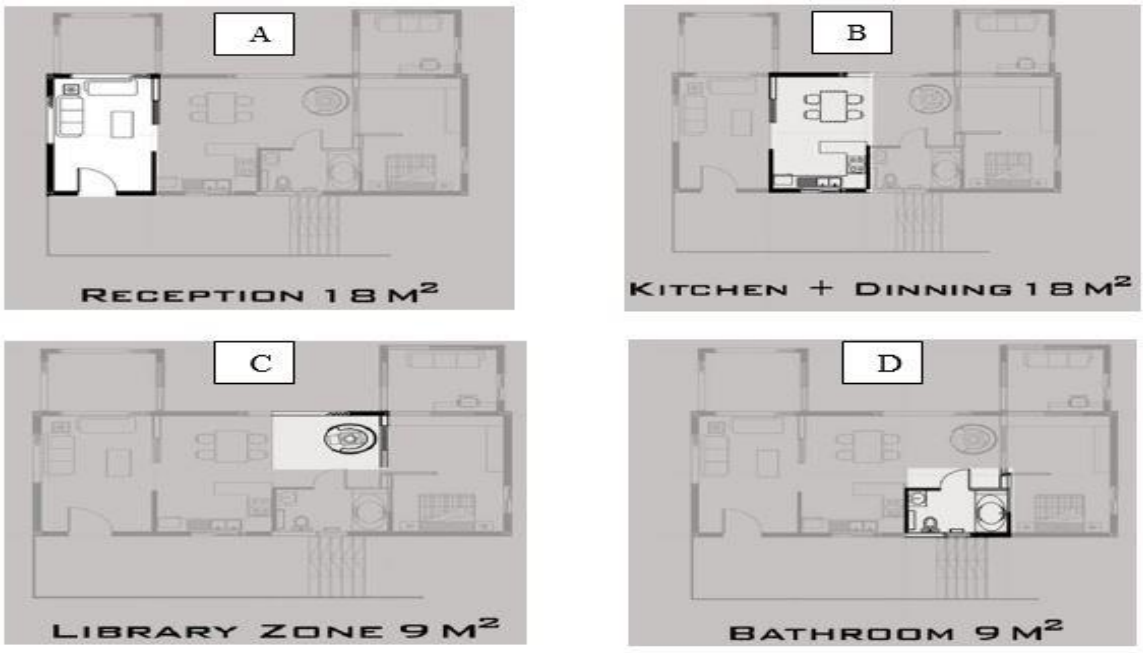


Figure 8: The area of each zone in the plan before extension. (By researcher)

Using of smart technology, environmental solutions and space saving in the unit:

Space-saving furniture designs are ubiquitous in our daily lives and workplaces. Effective space saving does not depend on downscaling, but on smart ways of collapsing a piece of furniture or making it more collapsible. Among the many space-saving mechanisms such as stacking, implosion, and folding is perhaps the most frequently observed and best practiced on furniture. Even when confined to furniture, folding can still be executed.

Figure 9: Living zone in the unit with no internal structure to facilitate the using of folded smart furniture. (By researcher)

Folded sofa which can be converted in to modern bed as well as folded table which can be extend in other forms and size.

Figure 10: Dining zone in the unit is designed to be opened to the entrance and living zones with out internal columns or partitions to facilitate movement inside the unit. (By researcher)

Folded dining table which is easy to extended if the members of the family increases and also can be folded again. Folded furniture used in such unit saves money on the long run because they are multi-function as they can be used in different spaces with different forms, they also save space to the user.

Also the implementing indoor vegetation in most of zones of the unit. And The Use of Eco-materials and LED lighting system in each zone of the unit to decrease the amount of heat released in the space, as well as large window opening to reach the maximum view and day lighting as shown in figure 11.

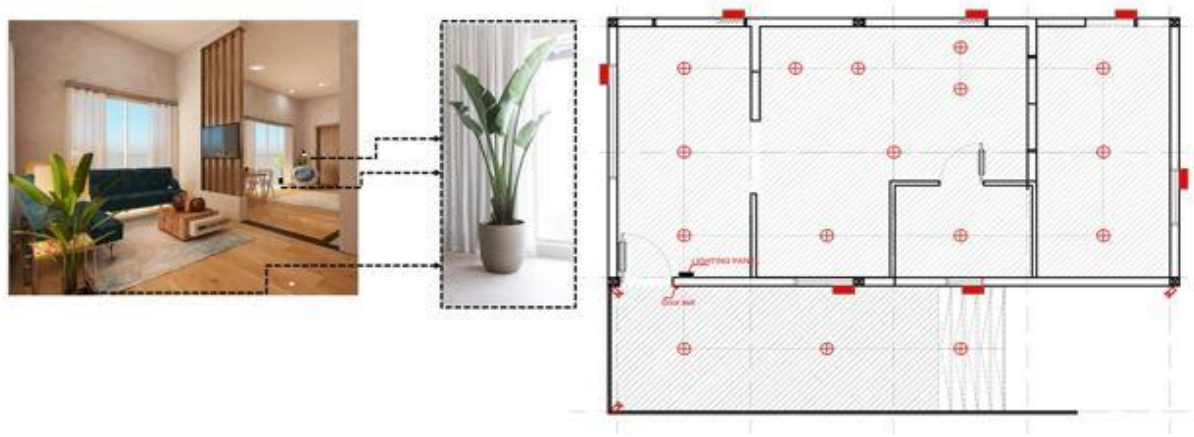


Figure 11: Smart LED lighting system and indoor vegetations have been used in each zone of the unit for saving energy and minimizing the running cost of the unit. (By researcher)

Conclusion

This paper showed that there is a high percentage of disabled people in Egypt that have a problem in finding adequate housing within the community setting as shown by figures and statistics.

Also, by studying the Egyptian Building Code, it is shown that it needs to go under modification specially for the studied housing section regarding the comparing it with the universal design standards for disability as the Egyptian building construction code didn't cover all part of design that is needed by a limited mobility person.

As the prototype presented in this paper could help in solving the problem of providing adequate housing for the disabled, provide a long awaited solution to many of them that desire to live independently by the integration of the Eco-smart systems and the universal design standards for space saving and facilitating the way of living especially for the limited mobility users with a lower cost than any ordinary house.

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