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Proposing Robotic Foldable Houses for a Half-Day Urban Lifestyle

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ABSTRACT

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Keywords: Robotic Folded House; Half-Day Lifestyle; Sustainability; Urban Design

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PROPOSING ROBOTIC FOLDABLE HOUSES FOR A HALF-DAY URBAN LIFESTYLE

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Abstract

With the increasing cost living in the downtown, the issues from misdistribution of the accommodation and the work places for office workers become worse and worse. Linking together them can not only ease urban traffic congestion but also save much time for the office workers. By utilizing the vacant time of some public areas, this study proposes the robotic foldable houses for a half-day urban lifestyle. Based on the grounded theory, this study has outlined benefits from application of robotic foldable houses. Meantime, this study also sets the design requirements for the sample units by analyzing the characters. Finally, this study concludes with the good performance of the proposed units in sustainability, efficiency and effectiveness.

Keywords: *Robotic Folded House, Half-Day Lifestyle, Sustainability, Urban Design*

1. Introduction

Buildings have long been associated with unmovable and unfordable stereotypes. However, with the acceleration of city developing and population harvesting, the cost of living in downtown has been incessantly rising and the land use in the city central has been pushed to the edge of sacristy [1]. In addition, the narrow space and overpopulation in the downtown have resulted in the increasing travelling time and distance from one zone to another. Therefore, meeting the needs of metropolitans is perhaps the urgent application of a foldable building that can be quickly linked together the accommodation and the ephemeral communities. As a matter of fact, the central areas that are subjected to publicity such as squares, pedestrian zones, plazas, and so on, are normally fully utilized during the daytime but vacant at night. This fact highlights the possibility of operating such spaces as living environments during nighttime. This study proposes a new adaptable living lifestyle, the half-day

urban lifestyle, for metropolitans to accommodate arability. The theory is based on designing robotic foldable residential units to achieve spatial utilization as well as to contribute efficient lifestyle. The proposed units can be folded at daytime enabling normal business activities and erected automatically during nighttime when the business closed [2].

From the geospatial development point of view, the robotic foldable house is undoubtedly favoring the urban developing concept of mobility, foldability and flexibility. It is highlighted most that this type of building can not only be manufactured and placed in position quickly but can also perform its ability to fold and unfold automatically during its needs without making it cost too much. Moreover, by utilizing its advanced features, this type of building is so versatile that also can be used a mobile working station to cope with urgent circumstances such as urgent aids, earthquake rescuing and so on [3].

As the application of robotic foldable houses becomes popular to the public area design, the transformation from publicity into privacy and from normal business function to residential dwelling function is crucial. The building itself will be making no influence to the public activities in the daytime and maintain its accommodability to achieve this novel urban lifestyle in the nighttime. The proposed areas should be capable for accommodating a certain number of houses and making no influence to the existing commercial environment [4].

2. Research Methods

This study follows grounded principles to review relevant technologies in order to validate the proposed concept. Adaptable means of approaching this idea is determined using current knowledge of prefabricated houses and content analysis. The majority determinants from this approach can be revealed as followings.

1. The proposed area should be investigated in order to fulfill the architectural design requirements for the dimension of the houses which should be ensuring user-friendly and cost-effective. The architectural appearance of the whole units shall be well dedicated and integrated with the neighboring physical environment and bio-environment, in which, the foldable units aimed to create not only a novel living lifestyle but an adaptable scenic view within the neighborhood as well.
2. The environment of the neighbors such as the fabric of the buildings, the height, the orientation and other elements will be taken into account when approaching architectural and structural design for the sample units, to ensure architectural harmony within the neighborhood. The fabric design for the proposed units is crucial to achieve indoor thermal comfort that prompts living condition when the house is occupied. The orientation of the house is an important parameter that associates with illumination, taking advantage of valuable natural sunlight source as much as possible for solar power plant during the daytime. Meantime, carefully chose the area that could possibly be shaded by the erected structures.
3. The environment assessment should be taken into account during the processes of both pre-construction and post-construction. The commercial activities in daytime are much more important in this zone. Therefore, the proposed units will do no interruptions to the business activities. In response to that, the proposed units shall be in a better form that “hide” underground without making deterrent for people to access the main commercial building or plaza. Meantime, the feasibility investigation must be carried out to assess potential advantages and disadvantages. After construction, it is also a necessity to inspect whether there is a potential adverse impact on business activities.
4. The interior design of the sample units is vital to achieved better living environment. The parameters for the inner walls, the ventilation systems, and the interior facilities will be taken into consideration as the appearance of which is of favorable to be compelling to fit the surroundings.
5. Safety issues should be considered for designing the houses. The safety issues are more likely to occur during the nighttime. As the houses are designed for the night use, the safety cannot be emphasized more. Thus, a detailed design for the doors and windows toward a safer and cozy living environment should be involved.
6. Relevant robotic technologies and Building Information Modelling (BIM) techniques should be integrated for the proposition of the sample units. The 3D visualization is of great help to

the construction, operation and maintenance of the sample units. BIM technologies are applied to ensure the buildings is well tuned.

3. Analysis & Results

- a. The application of the proposed system is expected to diminish the research problem through the potential development of various advantages namely; formation of affordable robotic temporary housing, minimization of urban/suburban commutes/traffic congestion, decreasing environmental pollutions, and so on.
- b. The proposed foldable units are expected to be hidden underground during daytime and erected only during the night to prevent negative impacts on daily routine urban lifestyles during the daytime.
- c. The proposed foldable units are expected to be able to be erected automatically and close down for adjustable time settings to cater hassle-free implementation/automation.
- d. The folded houses are expected to be self-sustained.
- e. The proposed foldable units are expected to be straightforwardly mass-producible.

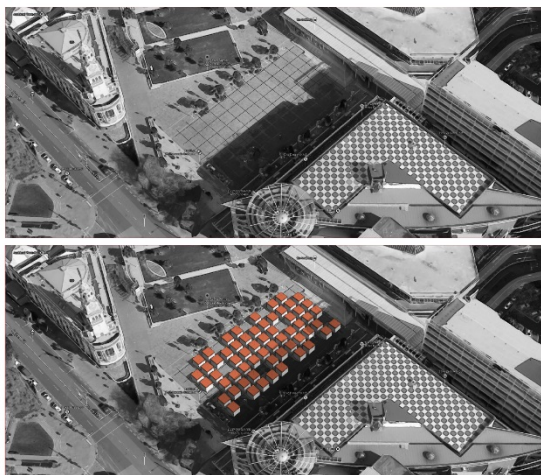


Figure 1 Robotic foldable houses (daytime/nighttime)

4. Discussion & Conclusion

Various advantages can be perceived as the result of applying the proposed system.

- a. The buildings will be made from green materials that can be recycled, biodegraded, or reused in other circumstances.
- b. The building is structural efficient and architectural aesthetic.
- c. The building is affordable and adaptable, providing indoor thermal comfort and safety. However, widespread application of the proposed units must be thoroughly investigated as an integrated part of urban nightscapes to minimize its potential social challenges.

The application of robotic foldable houses is sustainable because it not only has the potential to achieve the effectiveness of land use in the city center, but also delivers a half-way lifestyle for those who willing to adapt the easy way of accommodation without spending too much time on travelling and feel secured during occupancy. This application aimed at utilizing the land use in the urban area, absorbing the pressure from the metropolitans who stressed on accommodations and providing as much convenient living lifestyle as possible. The erected houses can be versatile in multiple applications in the future, and it can also be repositioned and environmentally friendly. The role of the robotic foldable houses is a prompted means to improve the efficiency, quality and environmental performance of downtown house use.

References

- [1] Manley., D.A.S.K. (2016), *Adoption of prefabricated housing—the role of country context*. Sustainable Cities and Society. 22: p. 126-135.
- [2] Setyowati, E. (2014), *Eco-building Material of Styrofoam Waste and Sugar Industry Fly-ash based on Nano-*

technology. Procedia Environmental Sciences. **20**: p. 245-253.

[3] Jaillon, L. and C.S. Poon (2014), *Life cycle design and prefabrication in buildings: A review and case studies in Hong Kong*. Automation in Construction. **39**: p. 195-202.

[4] Steinhardt, D.A. and K. Manley (2016), *Adoption of prefabricated housing—the role of country context*. Sustainable Cities and Society. **22**: p. 126-135.