The Use of UAV in Housing Renovation Identification: A Case Study at Taman Manis 2

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Abstract. Housing industry in Malaysia is growing rapidly due to the increase in population and the arising of economic level of Malaysian people. Most residential houses are built according to the standard residential design that may lead to house renovation by the buyers after purchasing the house. A method of using Unmanned Aerial Vehicle (UAV) monitoring was used to obtain information of the renovated houses directly on-site at Taman Manis 2, Parit Raja, Batu Pahat. Through comparison of image captured by the UAV with the original house plans, we found out that a total of 160 units out of 336 units of houses undergo a renovation process. Surprisingly, 41 units have been renovated illegally which has 40% to 96% of renovation rate. The acquired data were analyzed and can be concluded that the method of using UAVs to obtain information is highly recommended. The study is expected to help Municipal Council to detect improper & illegal renovation by the residents in a residential area.

1. Introduction

The housing sector in the city is growing rapidly in line with supply and demand of the population. However, development based profit has contributed to the deterioration of the quality of life. Nowadays, the housing sector has been neglected an important component of empowerment that is more prosperous and perfect in enhancing the quality of life of residents in the city. That is the need of the comfort of space inside and outside the house, in addition to basic facilities and infrastructure, as well as the convenience of residents and neighbourhood relations is emphasized. This will improve the quality of life, especially in the city [1]. In Malaysia, there are a variety of housing types ranging from town homes to bungalow. The types of houses are distinguished by the size, materials and house prices.

The passage of time and the pace of technological development is moving so fast that cause some changes in design, materials and prices for housing. With this, existing house renovation should be made to provide comfort and suitability in terms of design and materials used. Increasing number of the family members is also one of the reason for house renovation. More family members, more space needed to provide comfort to each one of them. However, the main function of a house remains as a shelter [1].

Unauthorized construction is one of the main issues of Department of Building in all Municipal Council where this have contributes to the relatively difficult situation between the residents and the
officers. The officers from local municipal normally need to conduct a routine check-up at area under the municipality to identified illegal house or building renovation. This conventional practice was time consuming and less efficient. Among the main reasons of why the unauthorized construction is rampant was due to house owners lack of knowledge in obtaining approval requirements, as well as, repel the wrong perception about the delays and difficult to get approval from the Council. There are also cases where house owners do not know where and with whom to deal to get accurate information about the house renovation proper standard procedure. In addition, there is also misinformation conveyed by third parties or building contractors to house owners who underlying causes of unauthorized renovation in order for them to speed up the process of house renovation and get paid.

2. Literature Review
There are various methods that can be used in carrying out the UAV applications, especially for the military as well as engineering. The application not only can give an advantage to humans, especially in terms of security but also be used as research, monitoring the work of landslides, floods and mapping boundaries.

Based on the literature, the use of UAVs can assist humans in performing certain jobs, such as jobs that needs high accuracy, high risk, and require a lot of energy or work that demands constant monitoring. In addition it can be used in places that are difficult to reach or dangerous to humans [2].

In general, there are some type of UAV are available in the market and each UAV categorized according to the duration of the flight (endurance), speed, height and weight loading capabilities like Micro UAVs that have designs based on a glider plane can only carry a small camera and lightweight. Although Micro UAV can fly above 10,000 feet, for the purpose of taking aerial images, the optimal level of image quality that is used is between 800 feet to 1,200 feet and the image resolution from 6 cm to 15 cm per pixel. Figure 1 shows Draganflyer X6 is an example of such a system with 1 kg of tri-rotor platform able to increase the payload of 500g to a height of 2,400 m up to 20 minutes of low-flying [3].

Renovation or remodeling is the process to repair either a commercial or residential building. To establish a basic human need, the changes must be new or better condition than before. Thus, according to the study H. Ahmad et al., (2011) on the meaning of “escape of inmates” to the renovation of houses in Malaysia. The objective of the study is to identify improper modifications to UBBL 1984 for residential buildings / houses after obtaining the Certificate of Completion and Compliance (CCC). In this study, the modern house refers to medium / low cost houses as residential buildings / houses. House type (medium-cost houses / low) was chosen because both sides connection layout of the building (between the two parties wall) and set a very minimum on the back. However, the area or position plays a vital role in determining the purchase of a house. Changes occur when the house does not meet the condition of the house owner's taste. This led to a widening expansion space kitchen to the backyard to the maximum extra space available [4].
3. Methodology
Materials and methods are explained here. The tools involved is Quadcopter UAV Type Bug V2 to obtain aerial images are then processed using the Agisoft application that are available in FKAAS computer laboratory. While the installation of Topcon GPS is used to getting the coordinates of the Ground Control Points (GCP). The collection of data through site was made of the observations in order to obtain the types of houses in-situ. The study was conducted in Taman Manis 2, Parit Raja, Johor.

Comparisons of images were made once the original plan with UAV images are processed into AutoCAD and GCP were used as markers to enable the position and the area detected. Data were collected for analysis the percentage area of the house and the type of changes made onsite study. Figure 2 shows a flow chart of a survey methodology.

![Flow Chart of Survey Methodology](image)

4. Data Analysis and Discussion
The data was processed and analyzed for every area of the house, and also the identified type of addition or renovation is made by comparing both data and images of the original plan UAV is in the form of a percentage. The analysis results are presented in tables, diagrams and graphs. Out of the 336 units are available onsite review, 160 house units undergo a renovation process or additions while the 176 housing units does not have any changes from the original plan. It was found that there are 3 types of renovation made which are changes of housing area, home renovation type and the type of ineligibility.

4.1 Analysis of Changes
The percentage changes made to each household is calculated by the difference New Area (m$^2$) and Area of Origin (m$^2$).
Percent Change \% = \frac{\text{New Area (m}^2\text{)}}{\text{Base Area (m}^2\text{)} - \text{Building Area (m}^2\text{)})} \times 100\% 

Table 1 shows the percentage area of the house is done by comparing the original data with UAV images using AutoCAD. While Figure 3 shows, the number of houses in Taman Manis 2.

| Percentage Area % | 0\% | 1\%-9\% | 10\%-19\% | 20\%-29\% | 30\%-39\% | 40\%-49\% | 50\%-59\% | 60\%-69\% | 70\%-79\% | 80\%-89\% | 90\%-96\% |
|-------------------|-----|---------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Total Houses      | 176 | 11      | 52        | 24        | 32        | 11        | 8         | 7         | 7         | 3         | 5         |

![Figure 3: Total Type of House](image3)

4.2 Analysis of type of Renovation
Type of house renovation is taken through the AutoCAD analysis based on the area of the residence. The change is detected between the front of the house, backyard of the terrace house types as well as left and right for the semi-detached houses (SEMI-D), end lots and corner lot. Figure 4 shows the percentage trend of house owners to make renovation to their houses.

![Figure 4: Percentage Type of House renovation trend](image4)

4.3 Analysis of Ineligibility
Based on the type of ineligibility, terrace houses and terraced lots usually make renovations on the front and backyard of their houses. This is because the area allowed for terrace houses make additions or renovations is 10 feet from the front and back of the house as well as the corner lot. Semi-detached houses type are allowed to add up to no more than 5-feet backyard from the building and is open.
construction 10-feet side yard and front of the house [5]. Figure 5 is an example of an ineligibility of semi-detached houses and corner lot.

![Figure 5: Ineligibility Type of Semi-D houses and Lot Corner.](image)

The renovation involves an increase in levels of a loft to existing buildings. This construction requires the approval of the local authorities first before doing the work and the plans must submitted by consultants and issued by the CCC as well as building a gazebo and pergola construction of the front and outside of the house that requires a permit for the renovation or construction of PBT authorities [6]. Figure 6 shows the construction of the gazebo and pergola.

![Figure 6: Construction of the Gazebo and Pergola.](image)

5. Conclusions

The main objectives of this study was to identify residential buildings that have been renovated and changes that have been made to the original building plan by using UAV as a mean to gather information. Each household size and percentage of renovation were analyzed and compared to the original site conditions. As a result, there are half of the houses in the study area that were renovated
and can be seen from aerial view using UAVs. Clear images does facilitate the comparative work to be carried out easily.

There are 336 units of houses in Taman Manis 2 were analysed and the total of 160 (48%) units of houses made their renovation and the balance of 176 (52%) units of houses did not do any renovation to their house. For type of terraced house of 22'x70' ($143m^2$) the renovation shall not exceed $57.53m^2$ while corner lot of 62'x70' ($402m^2$) the renovation does not exceed of $122.74m^2$ and end lot of 55'x70' ($357m^2$) will not exceed $116.13m^2$. Meanwhile, Semi-D house of 35'x80' ($260m^2$) the renovation does not exceed $83.61m^2$. And low cost terrace housing 14'x70' ($91.04m^2$) renovation is not more $78.04m^2$.

It can be concluded, the percentage of the renovation of the original site in excess of 40% to 96% (41 unit houses) are considered ineligible for construction or renovation of houses. There are 6 units of Semi-D houses illegally renovated up to its setback area. An eligibility of side yard for 5 units of Semi-D houses construct until there is no space for the open construction of 10 feet. Studies can also determine the types of renovation that have always been done by the owners of the houses in Taman Manis 2, that in total of 141 units of terrace houses, Semi-D, and low cost terrace houses commonly choose to raise their backyard. With this knowledge, we know each residential area choose to raise the rear of the house is the ultimate choice and permission to raise the percentage of households also shows that almost all areas in Taman Manis 2 perform renovation allowed and not exceeding the permissible renovation rate.

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