

DEVELOPMENT OF MOBILE APPLICATION FOR GATED AND GUARDED COMMUNITY MANAGEMENT

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ABSTRACT:

This study focuses on the development of mobile application for complaints in gated and guarded housing areas. This community area is equipped with fences and controlled by the guard. This community is managed by an organization that has been paid to manage the assets, facilities and security in the residential areas. Currently, the existing complaint management medium is by using text messages and WhatsApp. Due to this, it is difficult for the management to review the complaints and this makes the process of managing complaints time consuming. Furthermore, the residents are not well-informed of the current status of the complaints. This application development involves the use of cross platforms for Android and iOS. The application uses location based services (LBS) to find out the complaint address of the user. The data sent are stored in an integrated database with the developed application. This application is tested on site to study its effectiveness. Based on the survey, the results showed that the application is useful in managing resident complaints.

1. INTRODUCTION

1.1 Overview of Gated and Guarded (G&G) Community

The concept of gated and guarded community is a popular new modern housing concept in Malaysia. A 'Gated and Guarded Community' in Malaysia generally refers to a residential community with secured, gated and guarded surroundings. It can be a building such as a condominium or cluster of houses which is surrounded by a wall or fence on a perimeter, with access being limited and controlled with certain security measures such as 24 hours guards, patrol and closed-circuit television system (CCTV) (Mutalib et al., 2012). In Malaysia for example The Mines, Tropicana and Kajang Country Height residential areas, besides the security, the communities were provided with extra facilities such as recreational areas, golf courses and club house (Shamsudin, 2016).

The demand for gated and guarded housing concept is arising in the housing industry. Having a house is a key necessity in life. Now, most buyers are more sensitive in choosing housing environment that has security elements such as gated community or guarded neighbourhood. Other than that, buyers also prioritize on freedom zone, where residents are free to use the facilities provided in the neighbourhood

1.2 G&G Community Complaint Management

G&G communities are equipped with physical security measures such as security guards, CCTV or central monitoring system and 24-hour patrol system. They also have Privatization of public spaces, private roads are closed to general traffic and private amenities. All the facilities are being managed by one organization that is hired by the community itself. Residents pay an amount of money to the management to handle all of the amenities. In Malaysia, a complaint can be made using web-based services or using mobile device. The local authority uses e-complaint system that enable public to address their problems

through web browser. However nowadays, the use of smartphone are more than just a call. People can use smartphone function for communication channels like WhatsApp and social media to address their daily problem.

In recent years, the use of mobile devices has showed a rapid growth and its function has increased greatly in order to perform more tasks. These devices also provide users with applications, which can help users with their daily activities such as searching for point of interest and direction, car navigation and helping in searching for lost device.

1.3 Mobile Application for Complaint Management

There are some mobile apps that have been developed in order to solve the gated communities issue not only for management of resources but also in different issue. For example in India, "MyGate" is a mobile-based security solution for gated communities, was launched in 2019 and is now used by more than 160 000 users in Bengaluru (Bhat, 2018). This app enable users to notify whenever someone visits their home, like how a security guard would call up the house through an intercom system.

Other than that, "i-Neighbour" is a mobile application developed to support a cloud based and automated Visitor Management System for high rise and gated-guarded residential neighbourhoods. "i-Neighbour" allows residents, visitors and management personnel to access and use the features of i-Neighbour solution straight from their mobile devices (FingerTec, 2016). These two existing apps focuses more on managing the complaint without integrating the element of geospatial in the apps. Location-based services (LBS) use the positioning capabilities of wireless applications and collect information about the users' current geographical location. LBS can give the reports' geo-location information. These modern technologies (i.e. GIS) are used to improve the daily management either for individual or large organization. Other

applications can be seen in Izham et.al. 2011, Azri et.al. 2015 and Mohd et.al 2016.

2. RESEARCH MOTIVATION

The current method for residents to address their complaint is through email and text messaging but the challenge comes in proper management of the issue and events (Roars, 2018). Thus, the complaints tend to be unheard due to poor issue submission mechanism and strategy (Kannan, 2017).

Besides that, searching for complaints captured in emails or other directories is taking too much time (Kannan, 2017). This caused the delay in complaint data filing, retrieval and fixes as it is hard to identify the history of the complaint that had been made before. Extracting geospatial information requires dedicate procedures (i.e. Azri et. al., 2016) Furthermore, according to Mohd Soheli Deshmukh and R.Rajput (2016), inefficiency in tracking the complaint progress can cause delay in solving the issues raised by the residents.

Therefore, this research highlights three major research questions which are: 1) How mobile application and geospatial technology can be integrated to solve gated and guarded community's daily problem?, 2) How to design and develop a mobile application for on-the-site complaints in gated and guarded community? and 3) How to test the developed mobile application for on-the-site complaints in gated and guarded community?.

Based on these questions, three main objectives are formulated to achieve the aim of this research. The first objective is to study the integration of mobile application and geospatial technology in solving gated and guarded community's daily problem. Second, to design and develop a mobile application for on-the-site complaints method in gated and guarded community. The third objective is to test the developed mobile application for on-the-site complaints method in gated and guarded community. Next section discusses the mobile application development in order to achieve the three aforementioned objectives.

3. GATED AND GUARDED RESIDENT COMPLAINT MOBILE APP DEVELOPMENT

The methodology of this study involves four phases, which are the preliminary study, application development, application implementation and testing, and final phase is output and discussion. Figure 1 shows the flowchart of the research methodology.

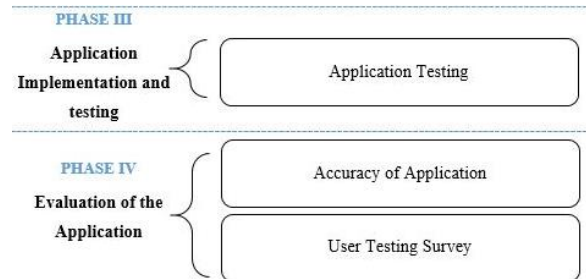
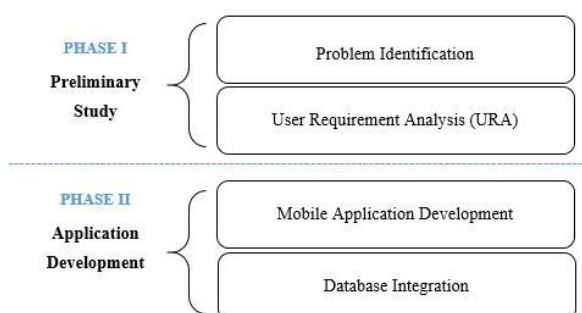


Figure 1. Mobile Application Development flowchart

3.1 Phase I: Preliminary Study

Phase 1 is a preliminary study that involves identification of the research problem regarding the issue and understand the need of user based on user requirement analysis (URA).

3.1.1 Problem Identification

This stage involves literature review to define the problem and identifying activities required to accomplish the goals. Thus, objectives and research question were being identified based on the problem identification. This is an important stage because it helps in giving a better picture of this study as well as to find out the best solution to fix the problem.

3.1.2 User Requirement Analysis (URA)

There are several methods to carry out URA which is user surveys, focus groups, scenarios and use cases and interview (Maguire and Bevan, 2002). In this research, interview method was chosen. The interview was conducted with the management of Fortune Hills through call interview. The interview session was conducted to identify the current issue and requirement of the residents in the housing area. Besides that, the category of complaints were identified. Figure 2 shows the category of complaint based on the interview session.

Road Damage	Animal Waste	Long Grass
Lamp Post Damage	Trash	Construction
Insect	Parking	Others

Figure 2. Category of complaints (source: interview session)

3.2 Phase II: Application Development

This phase involves mobile application development and database integration. Following sub-sections elaborates the mobile apps development comprehensively.

3.2.1 Mobile Application Development

The development of mobile application involves the development of on-the- site complaint application, development of map tools for visualization which involves the integration of the application of complaint with map. The development involves the use case diagram and interface design. Figure 3 shows the use case diagram for the application.

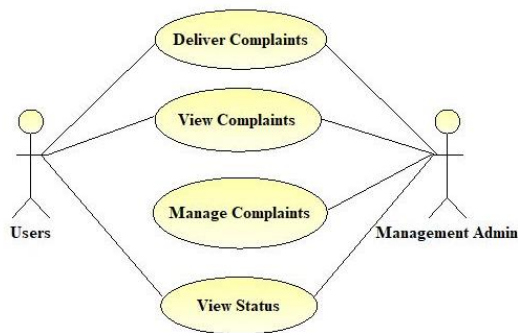


Figure 3. Use case diagram of complaints for developed mobile application

For the development of the application, this research used Thunkable as a mobile apps development platform that can build for cross platform system like iOS and Android. It uses the functionality of drag and drop blocks which has the capabilities to test the developed application using live testing without publishing to Google Play Store and App Store. Figure 4 shows the example of blocks in the platform.

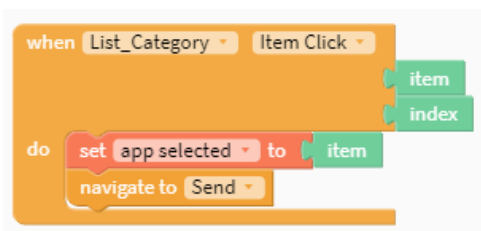


Figure 4. Drag and drop blocks in Thunkable.

3.2.2 Database Integration

Database integration stage involves the construction of fields and columns needed in the database (database design). The purpose of the integration is because the database acts as a back end so that the information can be retrieved by front-end application. Figure 5 shows the general flow diagram of information send and retrieval from the database.

For this research, Airtable is act as a database bases to store all the user's information. Airtable is a spreadsheet-database hybrid, with the features of a database but applied to a spreadsheet. The fields and column in an Airtable table are identical with a spreadsheet, but the difference is Airtable have types such as 'drop-down list', 'phone number', and 'checkbox' and reference file attachments like video and image. This application's database involve only one table. Table 1 shows the structure of table that involves in this research and figure 6 shows the drop and drop block to integrate front-end (interface) with back-end (database).



Figure 5. Database acts as data storage for complaints and record management.

Table 1. Structure of table in Airtable.

DataPSM	
ID (primary key)	Auto Number
PhoneNumber	Text
Complaint	Text
Description	Text
Manual Address	Text
Generated Address	Text
Latitude	Number
Longitude	Number
Image	Attachment
Date	Date
Google Map	Link
Status	Single Select

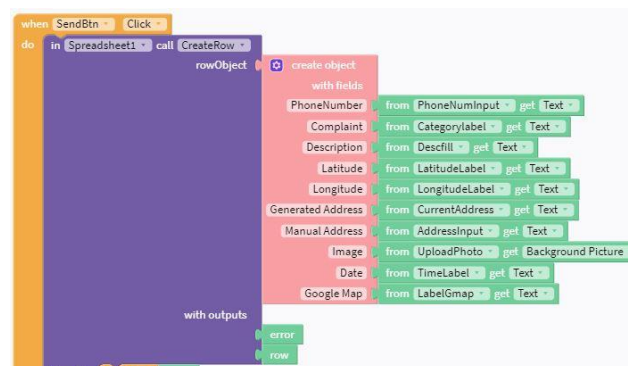


Figure 6. Drag and drop block to connect data input with database in Airtable.

3.3 Phase III: Application Implementation and Testing

This phase focuses on testing the developed application on the mobile devices for its functionality, usability and consistency. Thunkable platform have the ability to be implemented in iOS and Android. Figure 7 shows the interface of the develop application in both Android and iOS platform.

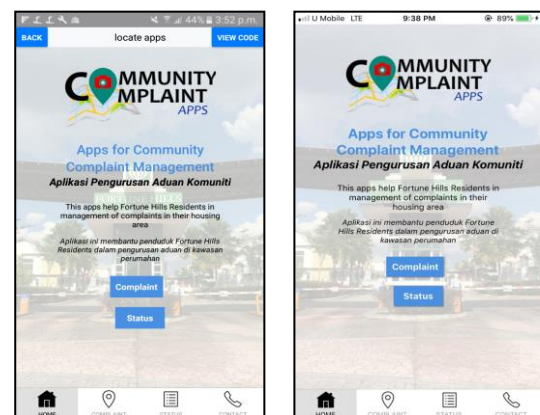


Figure 7. User interface (Android and iOS) of Home page

3.4 Phase IV: Evaluation of the Application

The last phase in the research methodology is the evaluation of the application. This phase involves two tasks which are accuracy of the application and user testing survey. The detailed assessment is discussed in Results and Discussion section.

3.4.1 Accuracy of Application

According to Bauer (2013), every smartphone device have different GPS accuracy. This application was tested using different devices to observe the maximum accuracy measurement. When user navigate to Complaint page, there is a point of location (POI) indicates that is their current location (Figure 8). To test the accuracy of the point, two devices is used simultaneously at the same time. The detailed discussion will be discuss in section 4.3.1

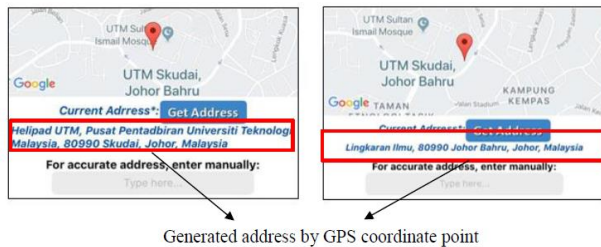


Figure 8. Different devices have different GPS accuracy

3.4.2 User Testing Survey

After completing the testing phase, the application is tested by 10 users. The users are then asked to fill the survey after the testing. The aim of the survey is to identify the effectiveness and the functionality of the developed application.

4. RESULTS AND DISCUSSION

The user interface must be designed to be user friendly so that it is interesting and also interactive. Via this, it will attract more users to access the application. Furthermore, the application based testing is needed to test the function and performance of the application to increase the effectiveness of the application.

4.1 User Interface

The mobile application consisted of four major user interfaces which is Home, Complaint, Status and Contact. The explanation of each page is as below:

- **Home** - Introduction to the Community Complaint Apps application and consists of button link to the Complaint page and Status page.
- **Complaint** – This page displays all the information needed for the complaint. User need to input information such as address, phone number and take picture of the complaint's site.
- **Status** – User will have a choice to either click to 'View Map' or 'View List' page. View map button will navigate user to page that display all the point of the complaint in one map. While do 'View List' button will navigate user to the page that display all the information in a card form. User also can click to the link to display directly to the point in map.
- **Contact** – Contains information about the address of the housing area and management phone number and chairperson's contact number.

In the status page, user can choose to either view the map or view in the list. Figure 9 shows the information that was being sent and view in the form list (left) and map view (right).

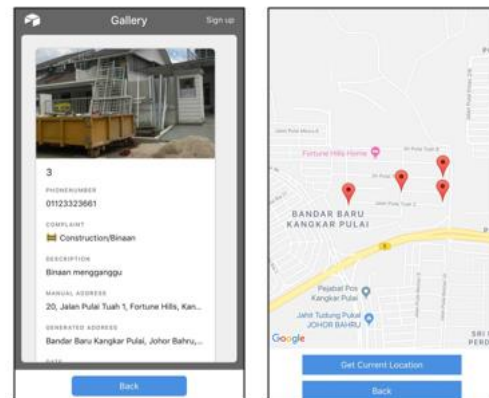


Figure 9. The information of the sent data can be view in the status page

4.2 Evaluation of the Application

Section 3.4 is the evaluation of the application. The evaluation involve the accuracy assessment and user testing assessment. This chapter discuss detailed on the output of the evaluation

4.2.1 Application Accuracy

Based on the testing, it is found that there are differences in the devices accuracy. In order to overcome the issue on the accuracy, user must input the address manually. If the address is unknown, they must describe the location as accurate as possible. Besides that, user must input the image of the site in order for the management to identify the location and clearly describe the condition of the site. Figure 10 shows the interface of the Complaint page. User need to input the location manually and take a picture of the current complaint site.

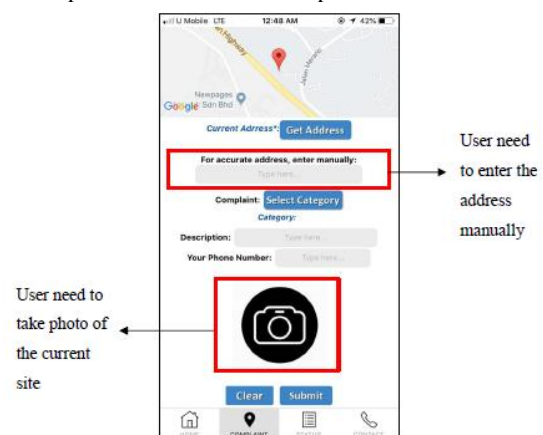


Figure 10. Information input needed from the user

4.3 User Testing Survey

User Survey Testing (UST) is a type of testing in which the purpose is to verify the functionalities of the developed mobile application so that it works efficiently for the users. The focus is to identify bugs and to ensure the end users agree that the application is acceptable and satisfies them.

There are about 10 users were selected to do the UST testing in this. Those users have different profile backgrounds. As stated before, the Community Complaint Apps can be used by anyone to find report the complaint from their current location. Users will generate their current address and input the address manually. The need to input all required information display on the user interface. Variety of users are needed to get more appropriate and accurate results regarding the acceptance of the users. There are five questions have been asked in the survey question. Below is the list of the questions:

- i. What is the platform of your mobile application?
- ii. Is the application understandable to use?
- iii. Is the app fast enough?
- iv. Do you find the functionality is good? (button, navigation and location marker)
- v. Do you know the importance of spatial (location) in solving daily's issue?
- vi. Do you feel the apps will help in solving the issue in complaint management?
- vii. How likely are you recommend the app to a friend or colleague?
- viii. Give recommendation and suggestion to improve the developed application.

Table 2 shows the detailed feedbacks given by the users who involved in User Survey Testing.

Users	Response
User 1	<ol style="list-style-type: none"> i. iOS ii. scale : 4 iii. scale: 5 iv. scale: 3 v. scale: 5 vi. Yes vii. 81 -100 % viii. Improve the visualization of map
User 2	<ol style="list-style-type: none"> i. Android ii. scale : 4 iii. scale: 5 iv. scale: 4 v. scale: 4 vi. Yes vii. 81 -100 % viii. Everything is good except need to increase functionality such as to inform user what they have to do next
User 3	<ol style="list-style-type: none"> i. Android ii. scale : 5 iii. scale: 5 iv. scale: 3 v. scale: 4 vi. Moderate vii. 81 -100 %
User 4	<ol style="list-style-type: none"> i. Android ii. scale : 3 iii. scale: 4 iv. scale: 4 v. scale: 4 vi. Moderate vii. 61 - 80% viii. Improve user experience
User 5	<ol style="list-style-type: none"> i. iOS ii. scale : 4 iii. scale: 4

	<ol style="list-style-type: none"> iv. scale: 5 v. scale: 3 vi. Yes vii. 61 -80 % viii. Improve User Interface
User 6	<ol style="list-style-type: none"> i. iOS ii. scale : 5 iii. scale: 4 iv. scale: 3 v. scale: 4 vi. Yes vii. 81 -100 %
User 7	<ol style="list-style-type: none"> i. Android ii. scale : 3 iii. scale: 4 iv. scale: 4 v. scale: 4 vi. Yes vii. 61 -80 % viii. Improve the visualization of map
User 8	<ol style="list-style-type: none"> i. iOS ii. scale : 4 iii. scale: 4 iv. scale: 4 v. scale: 4 vi. Moderate vii. 81 -100 %
User 9	<ol style="list-style-type: none"> i. Android ii. scale : 3 iii. scale: 4 iv. scale: 3 v. scale: 4 vi. Yes vii. 81 -100 % viii. Send page marker location not too accurate
User 10	<ol style="list-style-type: none"> i. Android ii. scale : 3 iii. scale: 4 iv. scale: 3 v. scale: 3 vi. Yes vii. 61 -80 % viii. Improve the visualization of map

Table 2. User response on survey question

Table 3 shows the summarization of user survey testing on the Complaint Community Apps. Based on the survey, this apps give cross platform users to experience the application that integrated technology with geospatial elements. From the survey, 60% of the users are using the iOS platform indicates nowadays people not using only Android platform.

Based on the survey, user rate the apps is moderate in terms of understandable and mostly agree that the apps is fast enough. For the functionality, the score is moderate as it depends on user location accuracy during the testing environment. For the spatial question, this is aim to ask users either they have the understanding in importance of geospatial in daily's life. Majority of the users agree that element of location is needed in solving daily's problem. 60% agree that the apps is helping in solving complaints problem. This indicates that users agree the apps is good in managing complaint.

Question	Score
Platform of Mobile Application	iOS = 60% Android = 40 %
Is the application understandable to use?	3 = 40% 4 = 40% 5 = 20%
Is the app fast enough?	4 = 70% 5 = 30%
Do you find the functionality is good? (button, navigation and location marker)	3 = 50% 4 = 40% 5 = 10%
Do you know the importance of spatial (location) in solving daily's issue?	3 = 20% 4 = 70% 5 = 10%
Do you feel the apps will help in solving the issue in complaint management?	Yes = 60% Moderate = 40%
How likely are you recommend the app to a friend or colleague?	61 – 80% = 40% 81 – 100% = 60%

Table 3. Summarize of the findings

5. CONCLUSION AND RECOMMENDATION

The development of mobile application for gated and guarded community management is a platform to help residents to deliver information on the complaint and reporting around their housing area. The target user of this application is gated and guarded community where the management of the housing area are manage by an organization that being hired by the resident itself. This application integrate with the element of Location Based-Services; user need to give their real-time location of the place of report. This technology makes the time taken to manage the complaint become short and residents can view the status of their complaint.

At the end of this study, this developed application enable to help residents in deliver the information and help improve the management of the community. In conclusion, the aim of this study are achieved which is to develop a mobile application which focuses to provide better on-the-site complaints for gated and guarded housing community using GIS method.

As this is the first version of developed mobile application, there is a recommendation for the improvement. This application is develop to serve the residents with a platform to report complaints in their housing area. Other than that, it also helps management organization to manage the complaints in a proper way. Although the study had satisfactory results, the following aspects may be considered for future improvements. The recommendations are:

- Add more function in the developed apps:** The current developed application was focusing only on managing reporting and complaint around the residential area. It is good if the application can be integrate with other management other aspect such as common or shared facilities booking such as sensors (Azri et. al. 2019). G&G community have their own amenities and facilities such as hall, gym and sports facilities that being maintain by Management Corporation. Therefore, it is better if there is a platform where communities can check the availability of the facilities.
- Study on the accuracy:** Based on the limitation that has been discussed, some device has low accuracy thus the tagging point is far from the tagged place. It is better if the accuracy can be studied and been fix so that it can give better output to the application

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REFERENCES

- Azri, S., François, A., Ujang, U., Darka, M., Alias, A.R., 2015. Crisp Clustering Algorithm for 3D Geospatial Vector Data Quantization, Lecture Notes in Geoinformation and Cartography. Springer Verlag, pp. 71-85.
- Azri, S., Ujang, U., Castro, F.A., Abdul Rahman, A., Mioc, D., 2016. Classified and clustered data constellation: An efficient approach of 3D urban data management. ISPRS Journal of Photogrammetry and Remote Sensing 113, 30-42.
- Azri, S., Ujang, U., Abdul Rahman, A., 2019. 3D Geo-clustering for Wireless Sensor Network in Smart City. Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci. XLII-4/W12, 11-16.
- Bauer, C., 2013. On the (In-)Accuracy of GPS Measures of Smartphones: A Study of Running Tracking Applications. 11th International Conference on Advances in Mobile Computing & Multimedia (MoMM2013), At Vienna, Austria 11.
- Bhat, P., 2018. A Mobile App is Changing the Way Gated Communities Are Secured.
- FingerTec, 2016. Visitor Management on Mobile with i-Neighbour App.
- Izham, M.Y., Ujang, U., Alias, A.R., Ayob, K., Wan Ruslan, I., 2011. Influence of georeference for saturated excess overland flow modelling using 3D volumetric soft geo-objects. Computers & Geosciences 37, 598-609.
- Kannan, A., 2017. Complaint Management App: Make Infuriated Customers Realize They're Being Heard!
- Maguire, M., Bevan, N., 2002. User Requirements Analysis, Usability, pp. 133-148.
- Mohd Sohel Deshmukh, R.Rajput, S., 2016. Smartphone Based Citizen Complaint System for Urban Maintenance Using GIS. International Journal of Scientific & Engineering Research 7, 1591-1599.
- Mohd, Z.H., Ujang, U., 2016. Integrating Multiple Criteria Evaluation and GIS In Ecotourism: A Review. Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci. XLII-4/W1, 351-354.
- Mutalib, N.F.A., Aziz, W.N.A.W.A., Noor, N.A.M., Eves, C., 2012. Gated and Guarded Community (GACOS) in Malaysia: Worth or Not? . International Conference On Real Estate 2012 (INTEREC 2012).
- Roars, 2018. Community Social.
- Shamsudin, Z., 2016. The Safety Level of Gated and Guarded Community Scheme in Malaysia, pp. 577-583.

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