PEAT

Development of Building Maintenance E-Report System Using Building Information Modeling

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Abstract: The aim of this study is to produce the Building Maintenance e-Report system using Building Information Modelling (BIM) tools. In this study, the 3D model of one block of UTHM Pagoh staff block will be view using Autodesk 360 viewer. The experimental study is design to evaluate the effectiveness of the Building Maintenance e-Report system. Next, the project is carried out by create the database using Glide and create the 3D BIM model using Revit Software. A web-based is built for simulation of the system and 3D model. Last but not least, all the objectives are achieved after a simulation be made to show how to operate this UTHM Pagoh E-Maintenance Report system.

Keywords: Building Information Modeling, Facility Management, Operation and Maintenance, Web-Based Apps

1. Introduction

Today, the most up-to-date technology is Building Information Modeling (BIM). This advanced technology is both a visually accurate model of a building and a database to record the information generated and associated with building components in a complete 3D digital representation of a building system or subsystem. It is expected that BIM will fill the gap throughout the building life cycle as a visual model and a database.

BIM is a smart model-based process, providing insight into the quicker, more economic and less environmental impacts of building and infrastructure projects [1]. A BIM provides all building information including the physical and functional characteristics of the building and the information on the project life cycle. It may be helpful to reflect what is appropriate for the built environment in architectogenic, engineering and building engineering and to identify the capability of potential design, construction or other problem.

The Malaysian National Institute of Cancer was first to carry out BIM in Malaysia on August 31, 2013 [2]. Azhar (2011) states that BIM implementation is much better than conventional construction, as BIM application can identify potential problems before construction.

BIM was used in all programmes in the United States in 2007. In the case of state-owned Senate properties that provide property services mainly to government clients, BIM has also been compulsory in Finland since 2007 [3]. BIM will be used in the Netherlands from 2012 for large-scale maintenance programmes [4]. The UK government will need a full three-dimensional cooperation in the UK (3D) [5].

In view of the early planning stage of Facility Management (FM), maintenance efforts during the operating period of plant will theoretically be minimised. Early use of FM was recommended to help mitigate the needs for significant reparations and alternations that would otherwise arise during the operation. The building lifecycle can be provided by an integrated data base. Develops a structure for how FM can be seen by BIM in the design process. Centered on the system, it discusses how FM, for example space preparation and energy analysis, can be beneficially sponsored by the BIM [6].

FM contains multidisciplinary practises which needs comprehensive knowledge. While some current FM information systems meet several of these criteria, BIM is rapidly adopted by construction firms and has untamed options to include and endorse FM activities with its simulation, analysis, control functions, and so on [7].

However, the cost and time-related production, performance and efficiency losses face FM practitioners. BIM will strengthen and help to address these problems by incorporating the building life cycle. This thesis would investigate how BIM will develop the career of FM and add to it. The key problem in the development of a maintenance programme is the entries of preventive maintenance product and asset details. BIM models provide details about construction machinery and will remove months of work to fill up repair systems correctly [8].

A building management system consists of a computerised control system that controls mechanical and electrical machinery such as electrical services, plumbing systems, ventilation and electrical systems of the building. This device will computerise the maintenance schedule and promote the availability of details.

1.1 Problem Statement

At the design and development processes, BIM technology was used successfully. BIM must be applied past the design and building stage and BIM can be considered for the operation of services such as repair work. BIM is not just a 3D pattern. In the multiple stakeholders at different stages of the facility life cycle, a true building information model should provide information. In all phases of the facility, there is a need for details which can be added, deleted, modified or changed. Since BIM can be used as a knowledge sharing database for construction stakeholders, it is interesting to research which information is required and how information is required for various parties.

Weak and wrong construction maintenance, when left unattended, will cause further losses and expensive repairs. Buildings are being designed in Malaysia under strict supervision in compliance with British Standard. Unfortunately, the house is still poor in terms of repairs. Worse, building repair is often viewed as being just for the mechanical and electrical infrastructure of structures, independent of civil and structural components [9].

1.2 Objectives

To achieve these goals, the study covers the following objectives:

  i. Produce a Building Maintenance e-Report system using Building Information Modeling.
 ii. Evaluate the effectiveness of the Building Maintenance e-Report system.
iii. Making a simulation of this project application and maintenance report.

1.3 Scope of Work

The scope of this study is developing the simulation of UTHM Pagoh A1 building completed with detail of information and building components and appliances. Database is created by using Glide application. Revit software will be used for the Building Information Modelling component detail such as architectural component, structural and Revit Family. The uses of A360 Autodesk Viewer will help the maintenance supervisor to view the one block of UTHM Pagoh A1 building detail location of the room as it helps the technical team in time savings.

2. Literature Review

2.1 BIM

BIM is a dynamic, multi-phase process that collects team members' input to model elements and resources used to create a specific view on the construction process. Figure 1 shows the BIM loop. The 3D process is meant to save by collaborating and visualising construction materials, which contributes to early design cycles that alter and adjust the real process. It is a very useful tool that saves resources, time and simplifies the building process when used correctly.
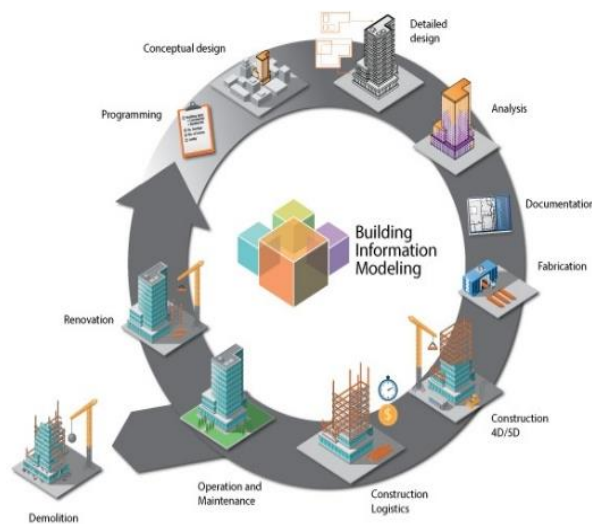
Figure 1: Building Information Modeling (BIM) Cycle

2.2 Model Type in BIM

In the building industry, there are different BIM models that are projects models, virtual models and intelligence models. With BIM, 3D designs can now be planned, and specifics can be created in order to improve the degree of collaboration with the evolution of the project. This provides an incredible ability to imagine and share knowledge that has traditionally been only available to those who can 'read plans.' It also provides much earlier and more detailed input from someone who can appreciate 3D modelling in relation to the project.

2.3 Revit

Revit is a single archive of files that many people are allowed to share. The plans, parts, heights, legends, and schedules are all interconnected, with the other views changed immediately in the event that a user switches one view. Revit plans and preparations are also often completely coordinated for the structural objects shown in drawings. Using 3D artefacts, this base building is built to render walls, floors, towers, structures, windows and doors, as required. Generally, a design feature is generated using

a 3D object if a part of the design is seen in more than one view. For modelling and drawing purposes, users may create their own 3D and 2D objects.

2.4 BIM in Facilities Management

Facilities Management (FM), in order to support the key goals of the occupants, owners and managers, may be described as an organised strategy for the management of, sustaining and developing, adjusting and assets in construction and infrastructure. FM provides an extensive field of multidisciplinary and autonomous fields, the ultimate goal of which is to optimise construction roles while guaranteeing the well-being of inhabitants. In order to serve their objective, FM functions need comprehensive data and knowledge from different areas and disciplines. FM data and knowledge in dispersed information networks are typically coordinated and preserved. Open platforms and structured information libraries are important, which can be used by any FM system. The facilities administration in BIM is shown in Figure 2.2.
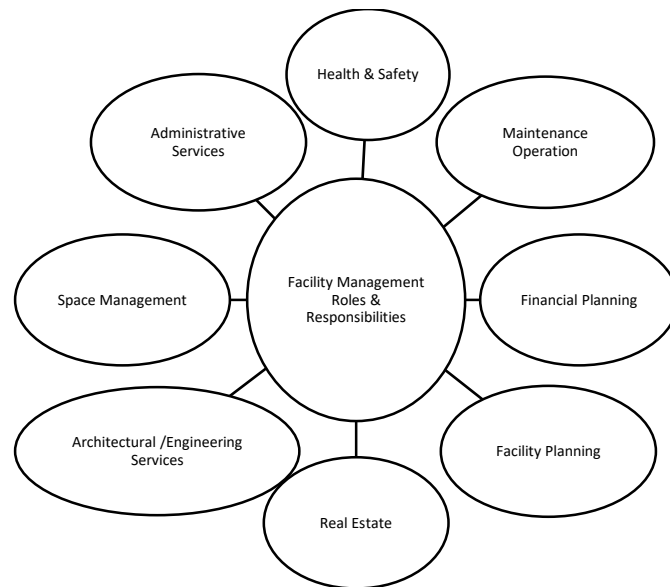
Figure 2: Facility Management in BIM

2.5 Operation and Maintenance

O&M encompasses operations, systems and workflows used to manage the whole environment. This covers both preventive and predictive maintenance, as well as remediation (repair). Preventive maintenance (PM) consists of a variety of time-based maintenance criteria that form a framework for preparing, planning and conducting scheduled maintenance (planned vs remedial). PM involves part modification, lubrication, purification and removal. Intensive time PM, such as new bearings, is usually programmed for daily shutdowns. Corrective servicing is required for the restoration of the machinery and is possible to either schedule or unplanned to restore it to its normal operating conditions or operation. Certain appliances could warrant overhaul at the end of its life.

2.6 Autodesk Viewer

Autodesk Viewer is one of this project's BIM functions. Most 2D and 3D formats including DWG, Move, RVT, Solidworks are supported. It's quick to share concepts from Autodesk Viewer. Users will share design through the URL and beneficiaries do not have to instal or sign in apps to display it. Users will display the interface anywhere with Autodesk Viewer, whether they are using tablets or phones. Users will display the finished sketches with information in this application. For more intervention, users may even step through the sketches.

3. Methodology

Figure 3 shows a methodology flow chart to ensure the sequence of work is in track.
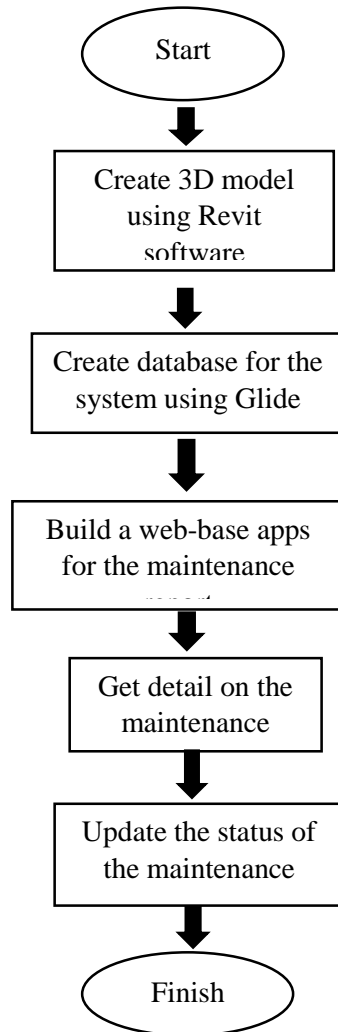
Figure 3: Methodology Flow Chart of the Building Maintenance e-Report System using Building Information Modeling

3.1 Project Design

In this work, the study will be carried out at five different stages to fulfil the specified objectives and each stage is described as follows. Which is first, create the model with detail information of UTHM Pagoh A1 building in 3D using Revit software. The 3D model of UTHM Pagoh A1 building is completed with floor levels and room tagging. In this project, only a few blocks of UTHM Pagoh A1 building been produced. Next, creating database of the Building Maintenance e-Report system using Glide application. In this stage, three part of database has been created which are the report form for lecturer or staff, check-in status part and technical part for update the maintenance report. All the data filled by lecturer or staff will saved in the database and can be saved through Word or Excel files for further action.

Besides, a web-based application for the Building Maintenance e-Report is built to help lecturer or staff to report their problem. In this web-based application, lecturer or staff can report the maintenance's problem and check their report's status. Part of the Technical team and management, as and admin to the system, can update the report's status also been produced in the system. The system is a user friendly with the variety of option button and menu. Then, the system of Building Maintenance e-Report will be

to A360 Autodesk Viewer. A360 Autodesk Viewer is used to identify the location of the room. It helps Technical Team to search the room the fastest way besides we can walkthrough to the whole building.

Lastly, the maintenance team can update the status of the maintenance in the system. The simulation of the system and 3D model of administration building is created. It shown that this project has reach the effectiveness of the framework of Building Maintenance e-Report to UTHM Pagoh.

3.2 Project Procedure

The occupant will report any breakdown appliances by using the Building Maintenance e-Report application system. The occupant will send the report to the Management including name, date, room, appliance's problem and pictures. The Management will receive the report. They will check the detail of reporter and the detail of breakdown appliances. Then, they will inform the technical team about the problem. The technical team then refers to the 3D model of building by using BIM. The technical team will use A360 Autodesk Viewer to look over the maintenance location. They only need to search the room's number it will show the location of the room.

The maintenance process will take part. This is the part which the supervisor will operate the maintenance's problem within the times given. After that, they need to update the action of the procedure, date of work has been done and the date of the next maintenance. They also can update the outcomes, result or output after the maintenance has been done. Lastly, the occupant can check the status of their report from the Management about the maintenance that have been done.

3.3 3D Model

The 3D Model of UTHM Pagoh A1 building were made by using Revit. This model will show the structure and location of each room that are available at the site. This model can be used to facilitate the work of the reporter to know the location and can also help the maintenance to know where the room area are.
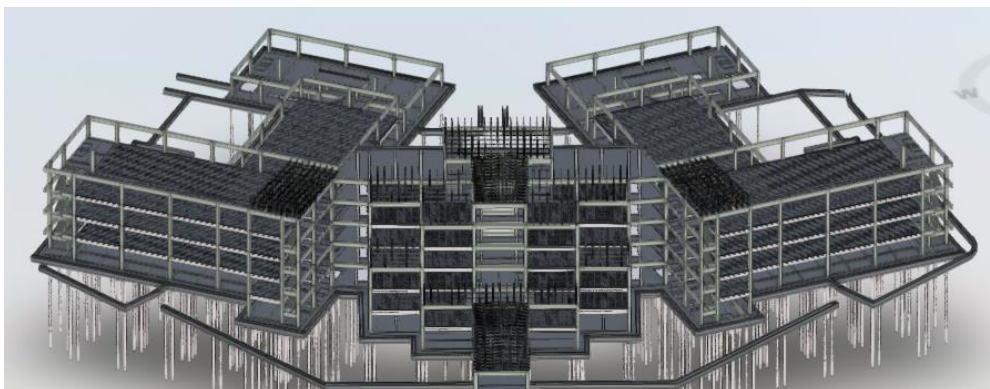
Figure 4: 3D model of UTHM Pagoh A1 building

3.4 Database using Glide

This database is created using a glide website where it will record the name, time, type of maintenance, image and maintenance status. This data can be accessed by the owner of this application and anyone can provide a report if there is a maintenance problem. Management can monitor the work that has been done or is still pending.

Figure 5: Database such as room tag

Table 1, as are all tables, should be referenced in the text. Items in the table can be aligned to the cell-centre, the right, or the left whenever appropriate. All tables must have a caption that is aligned left. Only horizontal lines should be used within a table, to distinguish the column headings from the body of the table, and immediately above and below the table. Tables must be embedded in the text and not supplied separately.

3.5 Web-based apps

A web-based apps are made to make it easier for all lecturers and staff and students to provide their reports at an instant rate. These apps can also be used in computer, but they are more effective if used on mobile phones because it can make it easier to take pictures of components or damaged things.

4. Simulation and Discussion

4.1 Simulation of the application

The application to provide this report can be accessed using a computer, laptop and even a mobile phone. But it is more recommended to use on mobile phones to facilitate the work of users who want to make a report because it can give users the facility to capture pictures of equipment or components that have problems to report. For first time use of mobile phones, they only need to scan this QR code first to gain access to the application.

Figure 6: QR code for the apps

After the scan is completed, the user will be taken to a website where the user can place this website as a fixed application on their mobile phone or just want to browse it from the website. Next, the user needs to fill in the user email to get the code to confirm the verification. After filling out the email, users will receive an email in their inbox that will provide a code to use when logging in to this application. After entering the code, the user will be verified and will be brought into the main menu of the application.

Figure 7: Greeting screen
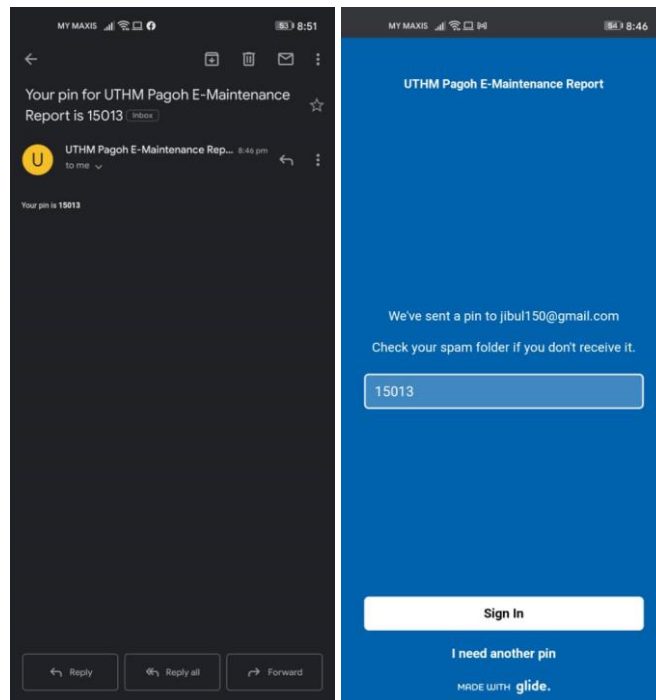

Figure 8: Sign in using email

Figure 9: A code that are send to the email will be used to login this apps
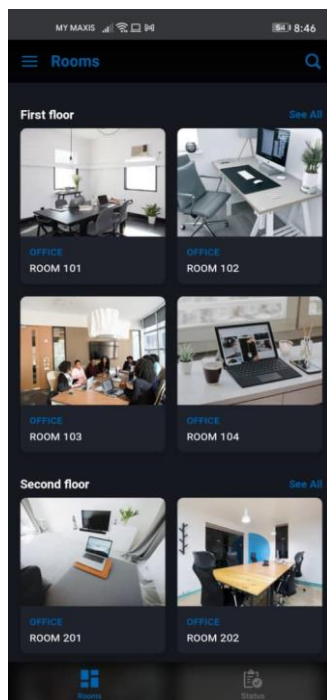

Figure 10: Main menu of the apps

In this main menu there are two tabs written where it says room and also maintenance status. On the left side of the menu there is an option for each floor and there is some info for users to access. There is also a space for comments and chats to management if users want to interact. Users can find the room they want to report in the main menu, or they can find it in the search bar above.
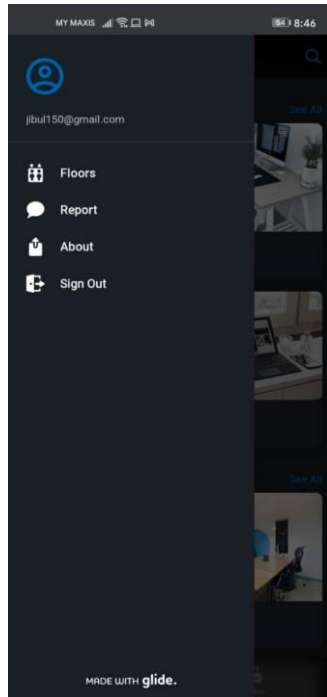
Figure 11: Left side menu option

After finding the room to be reported, the user just needs to click and then details about the room will be shown. Here users can check if this is the right room or not. If correct, users can continue to provide their report along with comments and photos. The use of mobile phones will facilitate the work of making this report because it requires a camera to take pictures. Comments provided by users can help management to find out what problems are faced by users who report the room.
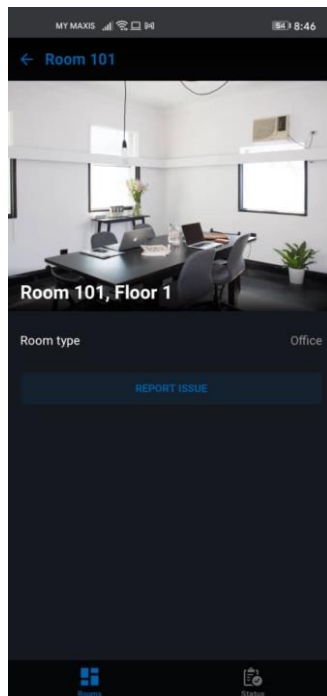

Figure 12: Room that need to be report
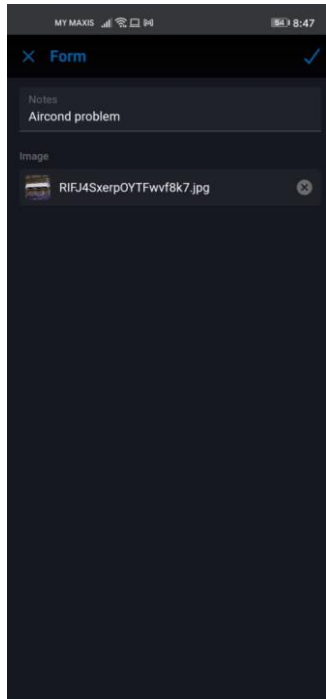
Figure 13: Report form interface

After completing the report, this data will be entered directly into the database and can be accessed directly by the management. This can speed up the maintenance process and the management will get continuous information about it. Users just have to wait and can monitor this maintenance status in the status tab.
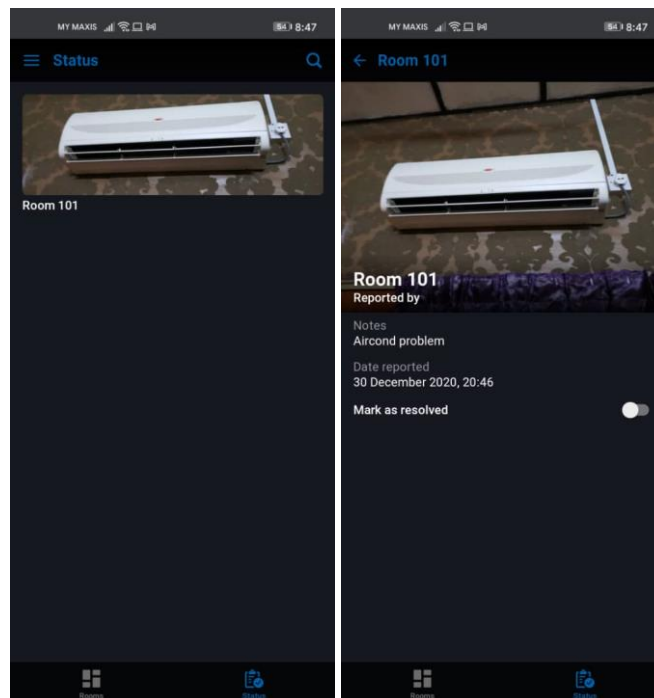
Figure 14: Status tab (left) and report status (right)

Each report will be recorded directly on the databased and it will record the name of the reporter, date, type of damage, and picture. So, this will facilitate the work to contact each reporter if necessary.

Figure 15: The database will record each login to the apps

Figure 16: The database will also record each report it received

After completing the maintenance, the management only needs to mark the status of the report to completion. The reporting party will be able to see that his report has been completed through the status column.

4.2 Discussion on this project

At the end of this project, the occupant can report any breakdown appliances in the UTHM Pagoh A1 building by using the Building Maintenance e-Report system completed with the reporter's name, date, room, the appliance's problem and pictures. The reporter can check the status of the report after the sending report is linked. The top management then view the one block UTHM Pagoh A1 building by using A360 Autodesk viewer and manage the technical team. The technical team can maintenance the problem without going to site and check the completed information by using BIM and then updated the status of the report.

5. Conclusion

Based on this project, the occupant can report any breakdown appliances in the block by using the UTHM Pagoh E-Maintenance Report system completed with the reporter's name, date, room, the appliance's problem and pictures and they can check their report's status. The top management view the location of the block by using A360 Autodesk viewer. The technical team can get completed information about the problem without going to site by using the applications. They will update the

status of the report in web based. This will save time and provide improvements in maintenance service. It also friendly users as it is paperless.

5.1 Recommendation

Based on the system that have been done, I would suggest for future project to make facilities on Revit apps such as showing damaged tools or furniture into the 3D models. This can further facilitate the maintenance work because they can directly see the damaged object or where the actual location of the damage occurred. Again, if possible, plumbing features in the system should be added. The reason is to help the technical team detect the plumbing problems in a quick time. This problem often happens in this type of building. It will be the easiest way for technical team to solve it.

Next, we suggest that the system can also be used in all blocks of UTHM Pagoh. This is because, the maintenance problems not only occur in the one block, but in other buildings as well. In order to reduce the problem in reporting, this system not only use for lecturer and staff but also student of UTHM Pagoh. So that, it will prove the online system is the better way in reporting.

Lastly, next recommendation for this system is, it can be used for the building inspection purpose. It can be the best way to detect cracking or building failure at the building structure. So, this system then can give us many advantages as it have more features to decrease the problem in maintenance.

Acknowledgement

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