Development of a Generic 3d Interactive Lay-Out Creator Application Software

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Abstract

This study, Development of a Generic 3D Interactive Layout Creator Application Software, aims to provide a realistic map of a building specifically when looking for a person or area in an unfamiliar place. The application software was created using Unity 3D and Android programming language. It allows the users to create floor lay-out of an establishment, adjust viewing of layouts according to preference, and provides the possible route from current location to a destination. The application software has two types of accounts: the administrator and user. Administrator accounts may create, load, and modify lay-out designs previously made and may add users into the system. User accounts may only view the lay-outs and be provided with the possible routes between places in the whole area. The Android-based app was tested in two devices both running Android Operating System and dual-core processors but of different screen size display. The software works well in 2D and 3D views of the layout, navigation around the saved layout as well as showing possible route to destination. Creating floor layouts in a mobile device with a 7 inches screen display proved to be functional. Thirty evaluators consisting of first-time visitors and other stakeholders of the tested locale, Colegio de San Juan de Letran Calamba, gave a "Very Good" rating with a mean of 4.15. This proves that the application software is an interactive tool capable of providing routes in 2D or 3D views using an Android-based mobile device.

Keywords: 2D, 3D, Interactive Layout, Map, Android-based App

Introduction

Getting lost is one of the major concerns of vacationists when going to unfamiliar places for the first time. They often times get overwhelmed with the majesty of the place or get awed with this experience that they just simply forget where they came from and get puzzled with the crossroads and intersections. Normally, it takes them a lengthy period of time before finding their way back or receiving help. Now, there is a solution to that: the development of application software capable of creating interactive 3D maps for tablet devices.

The application software developed aims to break free from the traditional 2D maps widely available usually in print.

The idea of having this software was conceived with the increasing concern of guests and visitors as to getting lost and having limited knowledge as to the whereabouts of certain areas of an establishment such as offices, function rooms, restrooms, and classrooms. Such queries are answered only through available maps placed in strategic areas of the facility, signage, and inquiries to personnel of the company or institution–all of which are time consuming. In addition, 2D maps, those in papers and tarpaulins, are easy to deteriorate and get worn out. Moreover, updates in location of destinations may be changed as a result of renovations and reconstructions for improvement, making earlier versions of 2D maps easy to get outdated. These concerns are simple, yet definitely needs to be addressed.

One major factor to consider in the existence of this problem is software availability. Very few, if not none at all, programs are available to create floor layout that can display a building's floor lay-out. In

turn, these institutions resort to utilizing the traditional maps as guide for visitors. These maps are printed in paper, painted in walls, posted in bulletin boards, or placed in tarpaulins. Such maps also contain legends to signify certain instructions and directions for users. As a result of these, not a single map is available that can not only cater to the needs of guests and visitors for a long time reflecting the actual lay-out of the building but also ensuring comprehensibility for all its users.

The Generic 3D Interactive Lay-out Creator Application Software is perceived to be a stand-alone application software that is compatible and ready for installation in tablets. This software will allow institutions to create a floor layout of their buildings to provide information to users as to the location of their key offices and establishments. With just one click, users can now determine the fastest possible way they can take to reach their destination from where they are.

This system intends not only to address the concerns of the guests and visitors of specific institutions, but it will also be widely utilized and be considered as a helpful application for users.

Methods

The 3D Interactive Lay-out Creator Application Software is developed to help owners and administrators in designing their establishment's floor layout. The software is capable of rendering both 2D and 3D views of layout and provides a navigation system that would help guest and visitors familiarize themselves in the area. The software was designed to be interactive, thus providing users the ease of understanding on how to use the developed application software.

There are two major entities who will operate the Lay-out Creator Application Software, namely the user and the administrator. Each has their own designated access rights in using the software. The users are those who are new to a place or locale. These include guests, visitors, and the so-called "foreigners" who are anticipated to be in need of directions in going to a particular office or room. The system will provide a 3D floor lay-out representation that will include the route going to the target destination. Meanwhile, the administrators are personnel in-charge of creating the 3D floor lay-out using the system. They have the access on the backend of the developed system, thus creating, editing, and deleting function are on their rights. Figure 1 shows the hierarchical diagram of the developed application software.

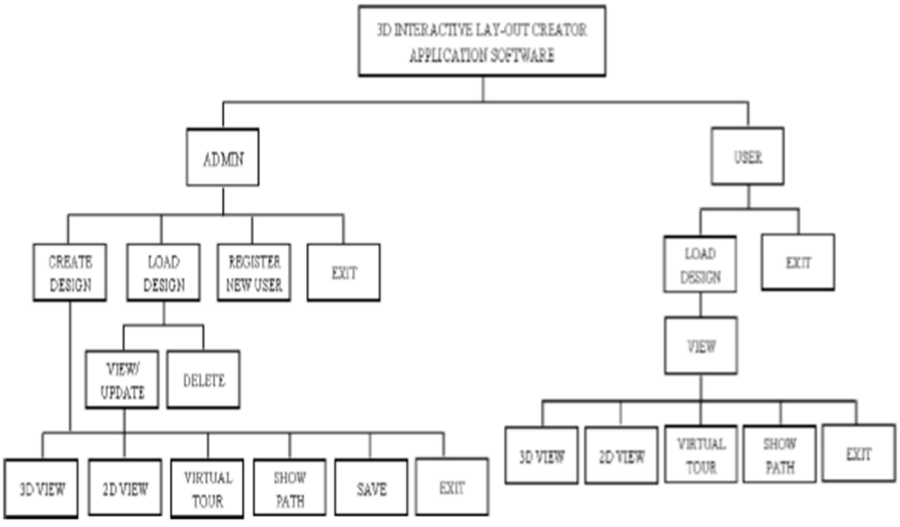

Figure 1. Hierarchical Diagram

The Iterative Life Cycle Model was used by the researcher in developing the Generic 3D Interactive Lay-out Creator Application Software. The model has the capability to go back to the previous phase to facilitate improvement.

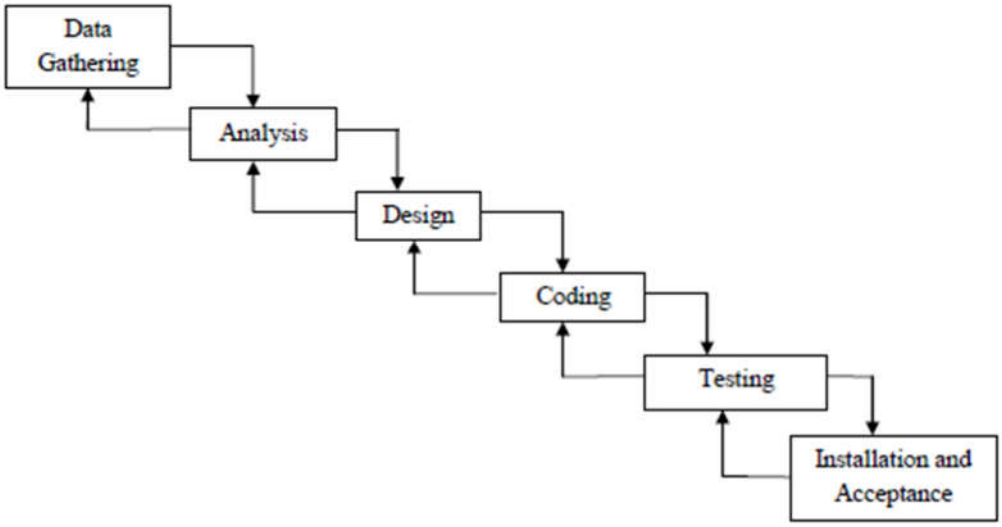

Figure 2. Iterative Life Cycle

Data Gathering

In the process of data gathering, the researcher searched for data and information needed in developing the application software. This was done by visiting libraries and reading books, articles, journals, and magazines. Related studies and bodies of literature were searched for in order to have a basis on how the researcher will improve the research. The data gathered shall help the researcher in starting and developing the system.

Analysis

After gathering the necessary data, analysis of problem and formulation of the solution were done. The researcher analyzed the related studies and literatures in terms of their structure, usefulness, difference, and similarities to the developed system.

Design

The system design focuses on the design, architecture, and interface of the system. The reliability, usability, and efficiency of the system were the components tested and verified by the researcher in this phase.

Coding

The coding process was done after designing the system. In this part, the design was converted into program. The researcher uses Eclipse for coding because it is the most efficient software in constructing an application in an android OS environment. On the other hand, Unity 3D was used in handling the 3d representation of objects. Coding was done based on the architecture from the last phase in order to meet the researcher's objectives.

Testing

After the coding was done, testing was conducted. The researcher tested the application software into a tablet and a phone to make sure that the software is properly running. The application works well with the tablet; the model used in particular Samsung Galaxy Tab P6200 with the following specifications:

- 1.2 GHz Dual Core Processor
- 7 inches screen display
- Running Android Honeycomb 3.2 and Jelly Bean 4.1 versions.

With the phone testing, the software also works quite well, only that objects are a little bit smaller. It is therefore not recommended to use phones for those who have problems seeing small things and who have big and fat fingers. The testing was done in a Cherry Mobile Flare smart phone having the following specifications:

- 1.2 GHz Dual Core
- 4 inches screen display
- Running Android 4.0 Ice Cream Sandwich.

It is expected that lags and hangs may be encountered in the course of the actual navigation and design through the system. The evaluation of the software was done in this process in order to determine the errors and changes to be made. The researcher immediately made changes to the system after finding errors.

Operation and Testing Procedure

1. Application Software Installation Procedure:
2. Copy and save the .APK file in the SD card or in the phone or tablet's built-in memory.
3. Browse your device and look for the saved .APK file. The phone or tablet must have a file manager or file browser application.
4. Install the application and wait for it to completely install.
5. Open and use the application.

System Operation Procedure:

1. Design the floor layout by selecting the objects (such as Doors, stair, walls, label and gates) from the item box.
2. Save the created floor layout design.
3. Display the created design in 2D and 3D.
4. Navigate around the layout using the "Virtual Tour" functionality.
5. Identify the current and designated location to see the possible route.

System Testing Procedure

1. The developed application software was installed in a tablet and selected guests, visitors and employees were asked to test and evaluate the software.
2. Users were given the default user name and password for regular and admin account.
3. Users who logged in as administrators, were presented with the following options so as they could test the features available as administrator user.

a. Create Menu

- Select and drag objects to the designer window.
- Test the 3D rendering of the layout design.
- Use the virtual tour to navigate around the layout design.

- Designate the starting point and the ending point area to locate the route going to the designated office or area.
- Save the newly designed floor layout.

b. Load Menu
- View the saved designs.
- Delete the saved designs.

c. Register Menu
- Register new user account.

4. Users who logged in as regular user, were presented with the following options so as they could test the features available as regular user.

a. View
- Preview layout in 2D and in 3D
- Use the virtual tour to navigate around the floor layout design.
- Designate the starting point and the ending point area to locate the possible route.

Evaluation Procedure

The software was installed in a smart phone and in a tablet for testing. After this, the software was evaluated. This study adopted the TUP-formulated evaluation instrument for software materials (see Appendix 1) during the evaluation of the pilot testing. It uses a rating scale of 1 to 5 for each criterion, with 5 being the highest score and 1 being the lowest. The evaluation instruments were given to a minimum of 30 evaluator-respondents. The selected respondents were newbies to the selected place who most probably needs direction going-in and out of the establishment. Colegio de San Juan de Letran in Calamba, Laguna was the locale used in the pilot testing, specifically the Bartolome delas Casas ground floor.

Mean scores were used to interpret results of the evaluation conducted. However, the Likert Scale below was used as the basis for the interpretation of the data.

Table 1 Likert Scale for the Interpretation of Data

Numerical Scale	Descriptive Scale
4.51 – 5.00	Excellent
3.51 – 4.50	Very Good
2.51 – 3.50	Good
1.51 – 2.50	Fair
1.00 – 1.50	Poor

Results and Discussion

The study developed a Generic 3D Interactive Lay-out Creator Application Software. The application software is accessible by using any of the two users—administrator and regular user—which has their own access rights and levels.

Creating a lay-out is simply done by selecting the objects from the item box while in 2D view. Objects placed in the floor tiles could be removed, rotated, and deleted. The application also includes 3D rendering of the layout and navigation system, making it more realistic as if the user was actually roaming around the actual area. Further, showing possible routes is also included to help users determine the way going to the target office or location.

The software is run in a high-speed tablet having 1GHz dual-core processor, 1GB RAM, 7 inches screen display size, and Android Operating System versions 2.3 to 4.1.

Project Capabilities and Limitations

The developed application software has the following capabilities:

- The software allows the creation of 2D Floor layout designs.
- The software allows the user to select objects such as walls, doors, stairs, and gates from the item box and use it as representation of real objects used in floor layout designs.
- The software allows the 3D viewing of the layout design.
- The software shows possible route/s from the user's location to the target destination.
- The software allows the virtual tour. Users may go forward, backward, and sideways, or circle around as if he/she was in the real place.

The developed system has limitations that are workable and may still be improved, such as the following:

- It is installable only with tablets and phones running an android operating system.
- Objects in the collection box are fixed. There is no feature of uploading new objects.
- Objects are not resizable.
- The system could not show all possible routes for the user to have the option to use other routes going to the target destination.
- Orientation is fixed to landscape.
- User accounts' registration has no maintenance facility for deleting and changing of username and password.

Project Test Results

Table 2 Test Result

Parameters	Behavior during the Testing	
	7 inches Display	**4 inches Display**
2D Viewing and Designing	The objects in the item box appeared big enough.	The objects in the item box appeared smaller.
	The objects can be easily placed, rotated, and moved in the floor tiles.	The objects are difficult to be placed, rotated, and moved in the floor tiles.
3D Viewing	The software showed the rendered 3D objects smoothly.	The software showed the rendered 3D objects but experienced some lags.
Virtual Tour	The software smoothly moved around the floor layout designs.	The software experienced lags and hangs when moved around the floor layout designs.

Possible Route	The software showed the route from the user location to its target destination.	The software showed the route from the user location to its target destination.

Project Evaluation

The developed system was evaluated in terms of the following criteria: (a) Functionality, (b) Content, (c) Reliability, (d) Availability, (e) Maintainability, and (f) Saleability. These were rated by 30 respondents who were asked to try the program during its pilot testing. These respondents include inquiring guests, parents, students, and personnel of Colegio de San Juan de Letran Calamba, the tested establishment. Shown in Table 3 are the mean evaluation ratings for each criteria.

Table 3 Overall Evaluation Result

CRITERIA	OVERALL MEAN SCORE	DESCRIPTIVE RATING
A. Functionality	4.39	Very Good
B. Content	4.14	Very Good
C. Reliability	3.88	Very Good
D. Availability	4.22	Very Good
E. Maintainability	4.10	Very Good
F. Saleability	4.14	Very Good
Overall Mean Score	**4.15**	**Very Good**

Based from the evaluation results, the application software is satisfactory in terms of the abovementioned criteria. It got a rating of 4.15. Users were impressed most with the system's functionality, which refers to the users ease in operation, convenience, and user-friendly interface. On the other hand, its reliability was the least rated criteria with only 3.88. This may have resulted from the inconsistencies noted by the users as they compare the structural designs with the actual lay-out. It may also be a result of occasional failures and bugs that occur during navigation in the system.

Recommendations

For the improvement of the study, it is recommended:

1. That the developed software should be written in a programming language which could be installed also to devices running other operating software aside from Android;
2. That the application software developed has the facility for uploading new objects so that users will not be limited only to the fixed objects available;
3. That the objects can be resized;
4. That the software will include showing all possible routes to provide convenience to those looking for an alternative route in going to their desired destination; and
5. That the orientation may be changed and is not fixed to one-side landscaping.

Appendix

Appendix 1

Sample Evaluation Criteria for Software Materials

Instruction to the Evaluator: Please evaluate the prototype by using the given scale and placing a checkmark (√) under the corresponding numerical rating:

NUMERICAL RATING	EQUIVALENT
5	Excellent
4	Very Good
3	Good
2	Fair
1	Poor

INDICATORS	5	4	3	2	1
A. Functionality					
1. Ease of operation					
2. Provision for comfort and convenience					
3. User-friendliness					
B. Content					
1. Accuracy of content					
2. Updatedness of content					
3. Presentation of content					
C. Reliability					
1. Conformance to desired results					
2. Absence of failures					
3. Accuracy in performance					
D. Availability					
1. Performance according to specifications					
2. Provision for security requirements					
3. Completeness of the system					
E. Maintainability					
1. Ease of maintenance					
2. Provision for diagnostic tools and procedures					
3. Provision for enhancements and modifications					
F. Saleability					
1. Presence of market demand					
2. Competitiveness of price					
3. Attractiveness of design					

Summary	**Sum**
a. Functionality	_____
b. Content	_____
c. Reliability	_____
d. Availability	_____
e. Maintainability	_____
f. Saleability	_____
Total Score	_____
Action Taken:	_____

Note: Adopted from TUP Evaluation Instruments for Instructional Materials

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