

Multifunction Shoe Cabinet for Small Living Space

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Abstract:

Due to urbanization and population growth, the demand for low-cost housing has increased, resulting in limited living spaces for residents. To combat this issue, multifunctional furniture has become a popular solution. Shoe cabinets are a necessary household item that can benefit from multifunctional elements. The objectives of this study were to identify the design criteria for multifunctional shoe cabinets, design and develop a prototype suitable for small living spaces. A questionnaire was distributed to 60 respondents living in Johor Bahru, Johor, via Google Forms. The survey revealed that the preferred design criteria for multifunctional shoe cabinets were wood as the main material, extra shoe storage, seating, a mirror, a minimalist style, wood color, tilt-out drawers, and short-height shoe cabinets. The design process involved ideation, idea development, design survey, final design, technical drawings, mock-up creation, bill of materials generation, and fabrication of the prototype. Each phase contributed to improving the design of the multifunctional shoe cabinet to meet the design criteria. A full-size prototype was successfully manufactured based on the final design sketched at the end of the research. In conclusion, the multifunctional shoe cabinet can provide storage and additional functions while solving the problem of space efficiency. The findings of this research can serve as a reference for future research and improve the design of shoe cabinets.

Keywords: Multifunction furniture, Shoe cabinet, Small living space, Space saving, Apartment

1. Introduction

The general apartment's size has gradually decrease compared to 2 decades ago approximately from 70m² to only 30m² (Kilman, 2016). Therefore, while living space in apartments is slowly getting smaller, the demand of space saving furniture also shows an increasing trend in order to accommodate the limited space for efficiency. In urban area of Malaysia such as Kuala Lumpur, low-cost housing

apartments has always been an important residential concept (Karim, 2013). The low-cost housing apartments are one of the Government's initiatives that aim to help lower income group in the society in the urban areas. However, lower cost residential also leads to other issues, such as lower quantity and quality. The researcher stated that the low-cost housing apartments lacking quality for its residents in the aspect of infrastructural needs and others benefits (Karim, 2013). In addition, most of the B-40 income group people that lives in apartments with small living space, making them difficult to furnish their home with all the necessary furniture because of the limited space (Yahya, 2020).

Multifunctional furniture is known as the type of furniture that provides more than one or multiple purposes and supports multiple activities at the same time. Other terms for multifunctional furniture are such as space-saving furniture, multipurpose furniture, and transformable furniture (Husein, 2021). The main purpose of multifunctional furniture is to better increase space efficiency of a limited interior space. This type of furniture that serves multiple functions is most effective especially in places with small space such as apartments and flats. The concept of furniture containing multiple functions shows its most advantages especially on necessary furniture piece that is crucial in a house. According to Husein (2021), modern furniture designs should take into account of conserving time, space, and human effort, especially for the domestic furniture. The concept of multifunction has to be adapting to more furniture in the market to increase furniture space efficiency, and is very beneficial to living place with limited space.

Shoe cabinet as known by many is one of the shoe storage furniture serves as a storage unit for shoes. Shoe storage furniture is undoubtedly a necessary furniture piece for a household or anywhere else that requires shoes to be taken off. After research, the innovations of multifunction shoe rack were relatively less as compared to other furniture pieces such as table and cabinet. Therefore, shoe cabinet have been selected as the furniture to adapt with the multifunction concept in this research. Shoe cabinet serves its purpose as storage units to accommodate the increasing number of shoes a person owns in this modernization, not to mention the total pairs of shoes own in a family. Therefore, organizing shoes and maintaining tidiness of the floor become effortless. The shoe storage furniture in today's market comes in varieties of designs, shapes, dimensions, and materials. For instance, some of the common types of shoe storage furniture are such as shoe rack, shoe cabinet, wall mounted or built-in shoe rack and over-door shoe rack. When it comes to storing shoe, the number of shoes can be stored not only depends on the sizes and design but also the mechanism of the drawers. For example, tilt-out or pull-down drawers provide even more space for storage than normal shoe rack.

Most of the apartments' users especially in big cities, having to deal with problem of small living spaces (Tahir & Qaradaghi, 2020). Small living space in apartments has limited user's to be smart and creative with furniture selection with the limited interior. Besides that, most of the people who lived in a small space in an apartment or flats located in cities encounter problems of having not enough spaces in their homes for necessary furniture such as storage furniture. While the overall size of apartments kept shrinking, the size of furniture however still remains the same and takes the same amount of space in a room (Husein, 2021). When living in a small space packed with several different kinds of furniture, it causes user to feel uncomfortable staying in the room and possibly causes stress, which counters the meaning of home and shelter of being the place to feel safe and to relax. Thus, multifunctional or multipurpose furniture is a smart approach and solution for small room problems. Multifunction furniture does not only serve more than one purpose, but also gives the advantage of saving room space. The concept of multifunctional furniture has been established and implemented in many types of furniture for many years. However, the significance of these inventive has not been fully taken into account until now (Canepa, 2017).

On the other hand, many existing shoes rack own by most of the people lack of possible added function for better used of the design. For instance, most of the shoe racks in the market are not designed with seating and only basic rack stacking storage, which cause the problem of lacking space to store

shoes (Muhammad *et al.*, 2020). Therefore, the effectiveness of shoe rack has to be improved by adding possible functions to its design while increase the storage space at the same time.

The scope of study was limited to the design of multifunction shoe cabinet for small living space. The research will be conducted by using survey questionnaire method through an online namely “Google Form” and social media platform such as “WhatsApp”. Target respondent of this study are the apartment residents that reside in Johor Bharu of Johor, Malaysia. The total numbers of target respondents that will be contributing to this research are 60 respondents.

This research will introduce a new innovative design of shoe cabinet to the furniture industry, which focused on multifunction and space efficiency. The proposed multifunction shoe cabinet are estimate to provide the maximum storage comes with added function while remain its main purpose as a space-saving furniture. Therefore, the multifunction shoe cabinet aims to help residents that lives in apartments or flats that encounter the problems of shoe storage and space efficiency. Furthermore, all the analysis and information provided in this research can be used as reference for relating research in the future and for improvement.

2. Literature Review

Furniture can be defined as the objects for comfortable living or working that are place in a house, office, and other places such as chairs, tables, beds, and many more (Cambridge Dictionary, n.d.). A furniture piece is made for helping in human activities in their daily lives. Furniture can be considered as a crucial component in an interior or exterior space that can be designed according to its surrounding and use (Husein, 2021). According to Chen (2016), furniture that are put inside of buildings often has its relation in attributes similarly to the architecture. A furniture piece has to fulfil its function for supporting human activities and bring convenient in their daily life. Furthermore, the 4 purpose of furniture is to make humans live easier and provide comfortable living (Astonkar & Kherde, 2015).

For many years, furniture pieces were created and designed to support or served their only function. For example, tables for writing, chairs for seating, beds and sofas for resting, cabinets and wardrobes for storing and so on (Husein, 2021). Multifunction furniture started to show up as times moved on when urbanization rate was growing. Multifunctional furniture is known as the type of furniture that provides more than one or multiple purposes and supports multiple activities at the same time. Other terms for multifunctional furniture are such as space-saving furniture, multipurpose furniture, and transformable furniture (Husein, 2021). According to Xie (2016), multifunctional furniture can be regarded as a revolution in furniture design. The reason behind that is because multifunctional furniture does not only shine as a solution for limited spaces, but also serve their aesthetic appearance to its surrounding area.

Shoe storage is a flexible furniture item that used for storage for many types of foot wears and other small accessories (Imam, 2017). Shoe storage can be manufactured with different kind of materials such as wood, metal, stainless steel, plastic and others depends on preferences of users. There exist varieties of shoe storage available in the current market that built different in designs, functions, dimensions, and materials according to where the shoe storage will be located at. According to Kaori (2019), shoe storage furniture for living space has variety of options that suit from large houses to tiny apartments.

In urban places, the rapid growing population has push for faster rate of urbanization and causing more pressure on housing. Hence, to counter this issue, Malaysia government has started to increase more projects on building small sized apartments. Hence, the issue of small living space mostly occurs in apartments of urban cities (Karim, 2013). Generally, furniture is the most important element inside a house or and interior space to provides functions that support human activities in their daily lives and most of the furniture are irreplaceable with other objects. Lack of space in apartments required smart

solutions such as multipurpose furniture, space saving furniture, or transformable furniture. The reason of that requirement is because limited space is impossible to furnish with all the necessary furniture pieces as furniture will occupy a lot of interior space. A room that is packed with furniture make the limited room feels even smaller and space for activity will decrease gradually (Husein, 2021). According to Gentili (2017), apartments' residents do not have the space to fully accommodate their furniture.

Different type of shoe storage is unique in dimensions according to user preferences. Standard height of a short shoe cabinet should be around 40 to 45 cm, 30 - 33 cm depth, and 78 to 80 cm length. However, the standard dimension can be varying depend on the type of shoe cabinet. Spacing or shelf height between the storage of shoe cabinet also has different dimensions according to preference, but the standards dimension of the storage space to store shoes is 30 cm.

3. Research Methodology

3.1 Questionnaire

Questionnaire was the method used to collect information and later to investigate the design criteria of the multifunction shoe cabinet that is preferred by the users currently. "Google Form" was utilized to construct a series of questions. The questions constructed were divided into two main sections. Section A is to collect the respondents' demographic and personal information, while Section B contains questions on the design criteria of the multifunction shoe cabinet preferred by the respondents. The questions contain in the survey questionnaire is close-ended questions, which respondents are provided with choices or options for each question. The survey questionnaire is later spread to respondents through social media such as "WhatsApp". The target respondents for the survey questionnaire are 60 respondents that reside in apartments in Johor Bahru of Johor, Malaysia. The results of the questionnaire helped the researcher to understand better the users' needs and precise desired features. Hence, it determined the design of the multifunction shoe cabinet.

3.2 Visual Research

Visual research is the act of brainstorming the design draft of a product by researching the current available product in the market along with other design elements and features that are related. Visual research helps to provide a direction where, what and how the outcome of a product's design will be. For instance, pictures from articles and journals as well as furniture catalogues are very useful to be reviewed before the sketching process started as it is one of the sources of inspiration for designing. Visual research is important before beginning any sketching process because it will determine the first drafting of the multifunction shoe cabinet design. For example, the result of the questionnaire determines the design criteria to be implemented into the design of the shoe cabinet and visual research will be done based on those obtained design criteria.

3.3 Thumbnail and Ideation Sketches

Thumbnail sketches are the early drawing phase of brainstorming all the possible design of a product. Generally, designs are sketched not detailed, small and each design is differed with the others. The main reason of drawing thumbnail is simply to visualize the plain design with the base concept of the design along with others design elements. In this research, thumbnail sketches of the shoe cabinet were sketched on a piece of A3 paper containing 15 different designs. Ideation sketch is the process followed after thumbnail sketches to present the base design concepts. Few designs are chosen from the thumbnail sketches to further evaluate by drawing in more details. During this process, the obtained design criteria from the survey questionnaire are implemented into the design.

3.4 Idea Development

After ideation sketches, the next step is idea development where researcher revises the sketches from ideation by modifying more details into the design. Sketches of idea development were colored to present the desired appearance of the design. Different views of the design were also sketched during this phase, such as isometric view, top view, front view and side view. Besides, the ideations were also drawn using AutoCAD software in 3D to have a better vision of the designs. The AutoCAD drawings were rendered and used in design survey.

3.5 Final Design

The 3 selected possible design of multifunction shoe cabinet were proceeded to the next step which was design survey. The purpose of conducting this second survey is for respondents to determine which design gives the highest satisfactory. Besides, the design survey also contains question such as their willingness to buy the design, at what price is the design worth, suggestion for improvement and so on. The survey was distributed to 30 respondents through "WhatsApp". The 3 design ideations were shown in the survey with descriptions for each of the design to provide better perspective for the respondents.

Final design of the multifunction shoe cabinet was chosen according to the design survey's result. The design that was chosen by the respondents through the design survey will undergo further evaluation process in terms of detailing, modifying, and dimensioning. The final design was sketched with perspective view and orthographic view. Besides, the final design also was constructed in 3D form using AutoCAD software to make dimensioning adjustment to get more accurate sizes of the design.

3.6 Mock-up

Mock-up is the scaled model of the actual product used for present accurately of the design of the desired product to be made but in a smaller scale. In this study, the mock-up of the multifunction shoe cabinet was built in a scale ratio of 1:6 based on the actual real size dimensions. The materials used for the mock-up are 2mm plywood sheets, cutter knife, pencil, L shape ruler, super glue, 80 grit and 600 grit sandpapers, modelling clay, and aluminium foil.

3.7 Technical Drawing

Technical drawing is the drawing done based on the final design where all dimensions are shown in detail and emphasize accuracy information. Technical drawing is important as it is the main references for manufacturing process. Therefore, all dimensions have to be done in detail from every different view. Technical drawings were done using the AutoCAD software to construct the final design of the multifunction shoe cabinet in different views. The unit used for technical drawings is millimetre (mm).

3.8 Bill of Materials (BOM)

The purpose of a bill of material (BOM) is to list out and estimate all the materials or items needed to create a product along with their costs and quantity. The final design was constructed in exploded view using AutoCAD software, where all parts of the product were separated to show how all pieces of the material were assembled. The BOM were divided according to the type of cost which are direct material cost, overhead cost, and miscellaneous cost. By doing the BOM for the product, researcher can have a clearer estimation for the cost for manufacturing the product, and also to estimate profit margin and the selling price.

3.9 Prototype

Prototype is the early model of the final design manufactured in actual size. The purpose of building a prototype is to give a visual representation of the design to have clearer view of the product, either the design works or functions according to plan. Due to cost limitations, the main material used for

prototyping in this study is plywood and finish neatly with laminate. The manufacturing process of the prototype was recorded and will be explained in the further part in this research.

4. Results and Discussion

4.1 Questionnaire Analysis

In this research, a comprehensive survey questionnaire was done to collect data and information regarding the design criteria for the multifunction shoe cabinet based on the preferences of the target users. The questionnaire contained 2 main sections where section A is demographic and respondents' information, and section B is questions on design criteria. The survey questionnaire was distributed to 60 respondents in Johor Bahru of Johor. The result of the questionnaire was then analysed to identify the preferred design criteria of the multifunction shoe cabinet based on respondents' needs. Table 1 below shows the summary of the questionnaire results. Through the questionnaire, the design criteria of the multifunction shoe cabinet were obtained according to the majority preference. These design criteria are wood as main material, designed with extra shoe storage, seating, and mirror, minimalist style, wood colour, built with tilt-out drawers, and short height.

Table 1: Summary of questionnaire results

Section	Percentage (%)	Description
Demographic and personal information	53.3	Female respondent
	55.0	Children
	30.0	4 family members
	35.0	10-15 pairs, and 16-20 pairs
	71.7	Yes
Design criteria	100.0	Yes
	68.3	Wood
	75.0	Extra shoe storage
	55.0	Seating
	56.7	Mirror
	48.3	Minimalist
	55.0	Wood colour
	60.0	Short
	66.7	Tilt-out drawers
	73.3	Between RM200-RM399

4.2 Visual Research

There are 6 pieces of visual research done during the early design brainstorming phase in this study. Each visual research pieces shows the example of existing shoe cabinet with the similar design criteria selected by respondents or users.

4.3 Thumbnail and Ideation Sketches

After reviewing the visual research, the next step was thumbnails sketching based on the design criteria obtained from the questionnaire result. Thumbnail sketches were drawn in 2 dimensional forms. Figure 2 below shows the thumbnail sketches of the multifunction shoe cabinet. 3 ideas were chosen among the thumbnail sketches were framed with red rectangle. These 3 ideas were taken into the next step for further design development for ideation.



Figure 1: Visual research

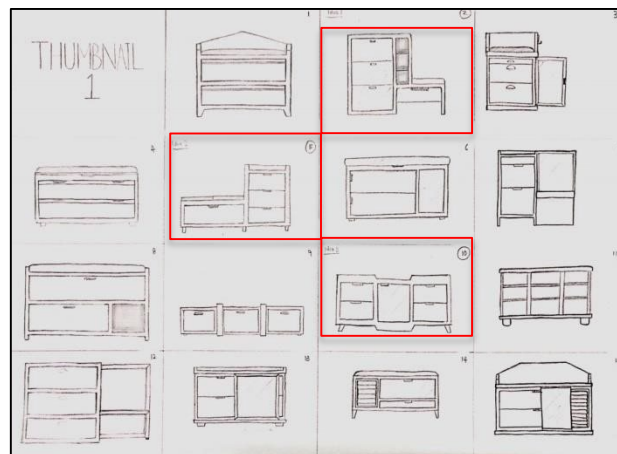


Figure 2: Thumbnail

In the ideation phase, the sketches were drawn in 3 dimensional views and sketched with more detail. Detail of design criteria were implemented and sketched into the design. Figure 3 below displays the 3 ideation sketches.

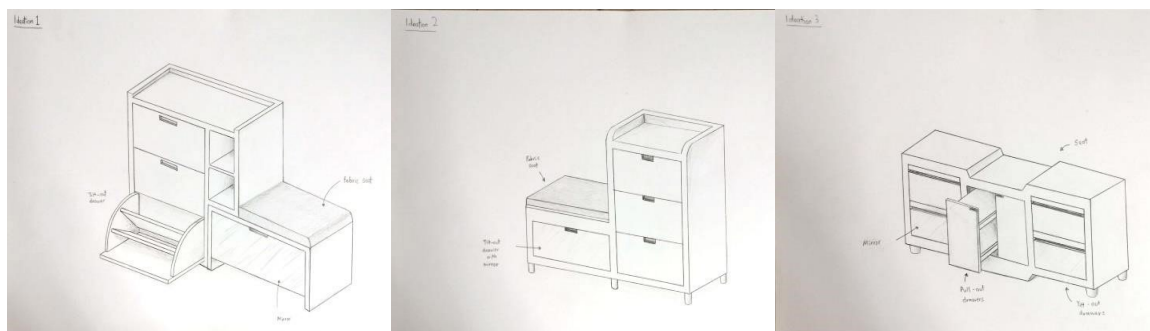


Figure 3: Ideation

4.4 Idea Development

After ideation sketches, the designs were further improved by adding small more detail and orthographic view (top, front, side view). Figure 4 shows the idea development sketches of the multifunction shoe cabinet and the rendered 3D models.

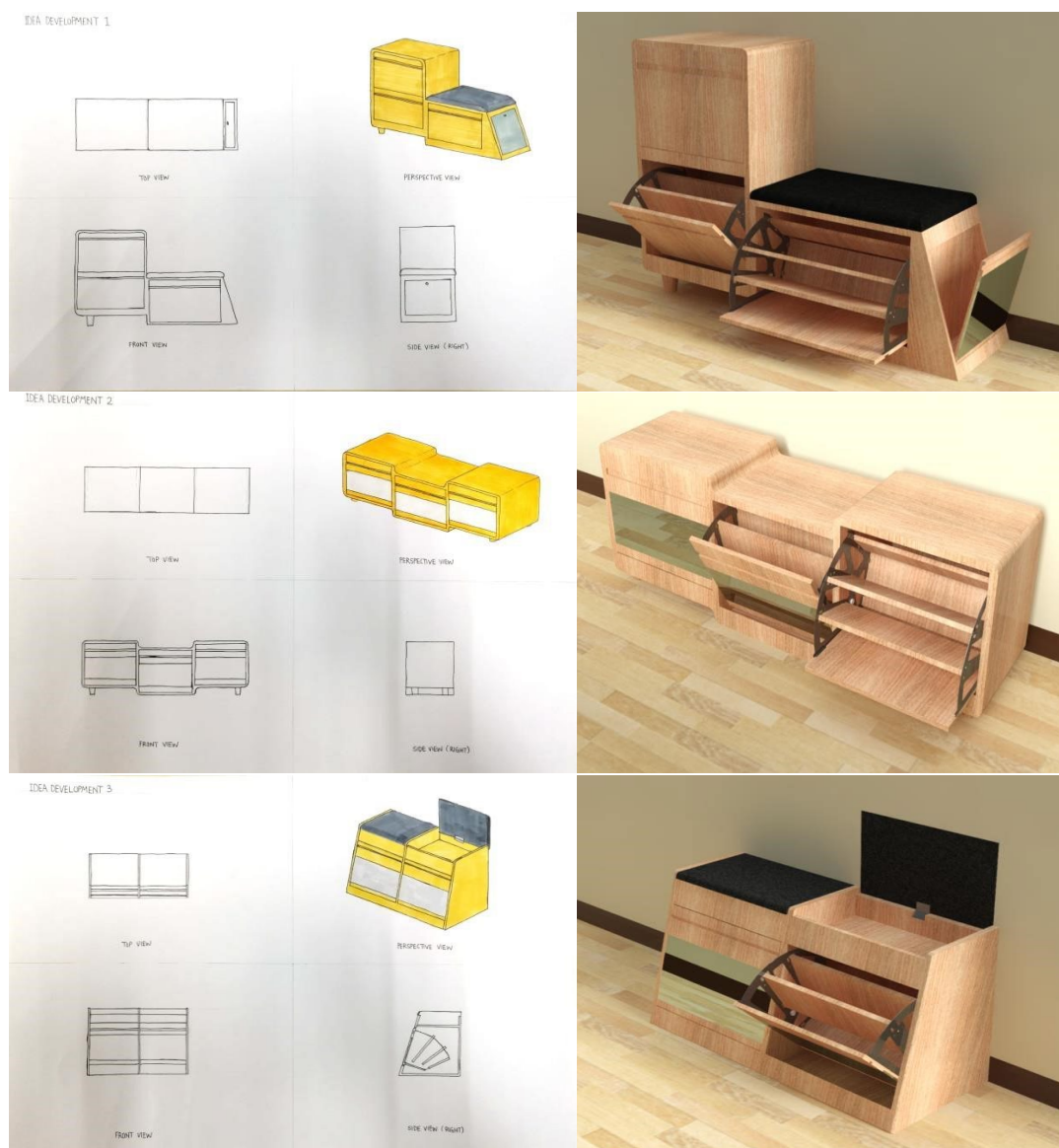


Figure 4: Idea development

4.5 Final Design

Design survey is the second questionnaire conducted for determine which potential design the respondents liked or satisfied the most. The survey contained total of 8 questions and were distributed to 30 respondents through social media such as “WhatsApp”. The targeted respondents were working adults, and majority of the respondents were those who participated in the first questionnaire for the design criteria. The design survey contained questions such as respondents’ willingness to buy the design, which design they liked the most, and more questions related to their preferences on the design. The result of the design survey determine which design is to be carry on for further steps which was prototype development. Table 2 below shows the summary of design survey analysis.

Table 2: Summary of final design survey

Question	Percentages (%)	Description/Option
Age group	40.0%	26-44 years old
Monthly income	40.0%	RM2500 - RM3999
Type of housing	73.3%	Apartment
Preferred design	63.3%	Design 2
Main reason of choosing the design	40.0%	Appearance
Preferred price range	66.7%	RM301 - RM400
Willingness to buy	73.3%	5 (very willing)
Suggestion and recommendation	100.0%	No

The final process of determining the overall design idea of the multifunction shoe cabinet was the final design sketch. Design 2 was chosen by the respondents through the design survey and undergone further modified in terms of detailing, modifying, and dimensioning. The carved in handle of the cabinet doors were modified to using cabinet door handles because according to expert manufacturer’s opinion, carving the 18 mm plywood might damage the plywood’s durability. Cabinet door handles can provide better experience for users when opening the cabinet doors rather than just carved because with handles can be hold when pulling. Besides, a cushion seat was added for the middle section which provides comfortable seating. Apart from that, LED light stripe was considered into the design particularly at the small open space under both side of the shoe cabinet to further enhance the shoe cabinet’s appearance.

The overall height for the shoe cabinet was 428 mm, overall length is 1272 mm, and the depth is 319 mm. All cabinets adapt the tilt-out or pull-down drawers’ design with 3 layers, which provide users more space to store more shoes than usual shelving design. The main material of the multifunction shoe cabinet was plywood. Figure 5 shows the final design sketch and the rendered model using AutoCAD software of multifunction shoe cabinet for small living space.

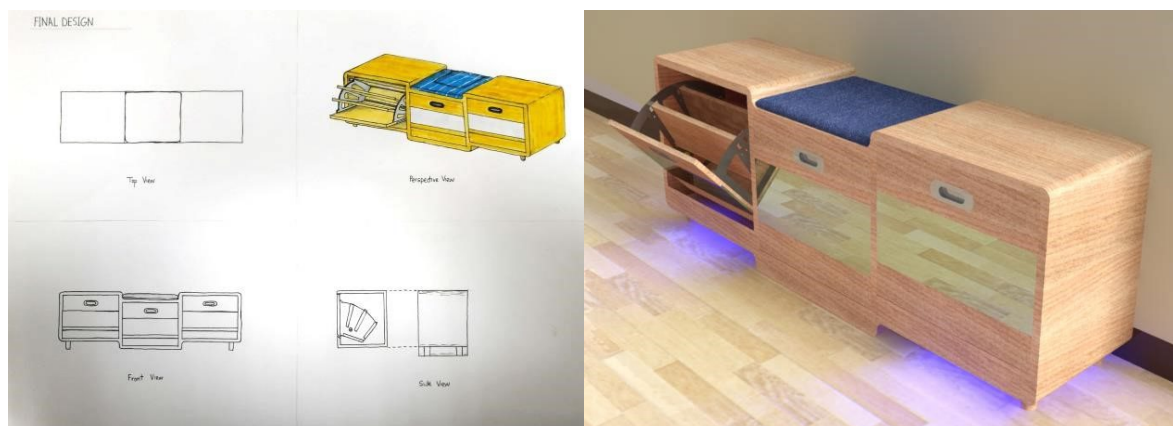


Figure 5: Final design

4.6 Mock-up

A mock-up of the multifunction shoe cabinet was done with the scale of 1:6 ratio according to the exact dimensions from the final design. The materials used for the mock-up are 2mm plywood sheets, cutter knife, pencil, L shape ruler, super glue, 80 grit and 600 grit sandpapers, modelling clay, aluminium foil, plastic sheet, foam, and cloth. Figure 6 shows the mock-up result of the multifunction shoe cabinet.



Figure 6: Mock-up

4.7 Technical Drawing

Figure 7 shows the technical drawings of the final design from different views. These technical drawings were constructed using the AutoCAD software in 2D and separated into different views accordingly. The final design was separated into front view, top view, side view, close-up view for cabinet doors, and plywood layers in cabinet drawers. The unit used for the all the dimensions in technical drawings are in millimeter (mm). These technical drawings were also given to the manufacturer who was helping with some early processes in manufacturing the prototype.

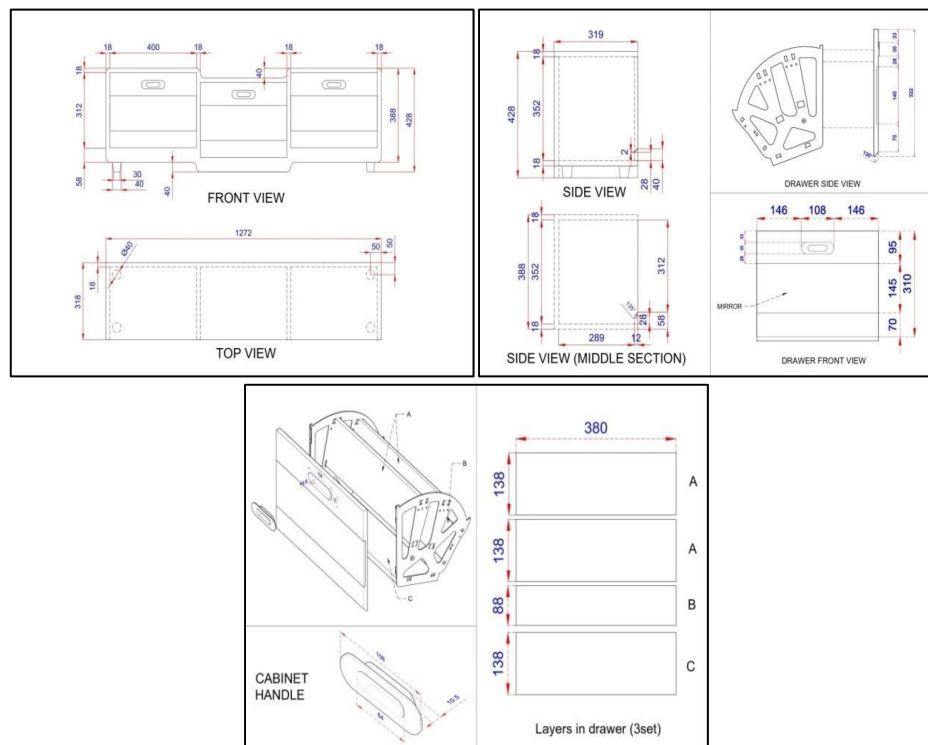


Figure 7: Technical drawings

4.8 Bill of Materials (BOM)

Bill of material (BOM) was done to record and estimate cost used for all the materials needed to manufacture the design. Figure 8 below has listed out the direct materials used in this product, such as 18mm and 12mm plywood, cabinet hinge, cabinet door handle, mirror, rubber stopper, wood sticker, LED strip light, magnetic cabinet door catches, and cushion seat. The total cost of these direct materials was RM312.55. Adding on with the overhead costs and miscellaneous costs, the total cost for manufacturing the prototype was RM420.45. Profit margin is estimated to set at 25% of the total cost, which is RM105.12, hence, the estimated selling price for this design is set at RM525.57.

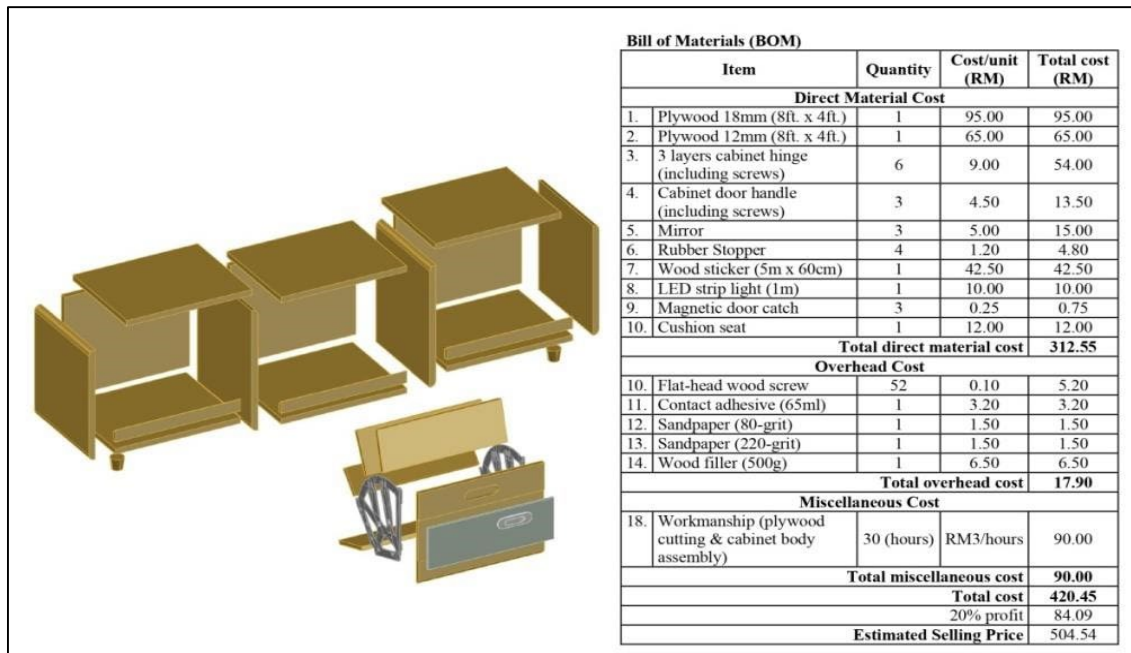


Figure 8: BOM

4.9 Prototype Manufacturing

A full-scale prototype of the multifunction shoe cabinet was built following the final design and technical drawings. The prototype was fabricated with the help of a manufacturer in the furniture at the early stage. The body of the shoe cabinet was manufactured along with the layers for the cabinet drawers by the manufacturer. The cabinet drawers were self-assembled by researcher, and finish with wood sticker. The LED light strips were also successfully installed at the bottom left and right side of the prototype, as well as the cushion seat for middle seating. Figure 9 shows the finish prototype model of the multifunction shoe cabinet. The fabricated prototype model was fully functioning and performing well.



Figure 9: Prototype of multifunction shoe cabinet for small living space

5. Conclusion

In conclusion, this research will benefit not only apartment residents but also those who live in other places that have the problems to limited living space. The designed multifunction shoe cabinet in this study is able to provide multiple function and space saving features as it provides enough storage for shoes. Apart from that, closed-storage designed enables the users to tidy up their shoes making the space look cleaner and more organized. At the end, the set objectives of this research have also been successfully achieved, whereby, design criteria have been identified through survey questionnaire. The design criteria obtained for the multifunction shoe cabinet were made by wood, designed with extra shoe storage, seating, and mirror, minimalist style, wood colour, built with tilt-out drawers, and short-height shoe cabinet. Besides, after gone through multiple designing processes, the multifunction shoe cabinet has been successfully designed. Final design of the multifunction shoe cabinet was evaluated starting from visual research, thumbnail sketches, ideation, idea development, and design survey. Based on the final design, technical drawing was constructed and a scaled mockup model was built to visualise the design. The constructed technical drawings were used as the main reference for fabricating process of the prototype. The manufactured prototype achieved every design criteria required, for example each of the shoe cabinet drawer can store up to 3 or 4 pairs of shoes with the adaption of the tilt-out drawer, finish with wood sticker and built low in height where seating feature is allow. Thus, all objectives of this research were accomplished.

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