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Development of Multifunctional Pet-Human Nightstand (CatNook 2.0)

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Abstract

This study focuses on the design and development of a multifunctional pet-human nightstand intended for cat owners living in modern Malaysian homes. The objectives of this research were to identify key design criteria, propose design solutions, and construct a functional prototype. Data collection was conducted through two methods: in-depth interviews with three long-term cat owners in Malacca with over thirty years of experience, and a Google Forms survey completed by 280 respondents in Melaka. The combined qualitative and quantitative findings revealed essential design criteria, including easy-to-clean materials, a bottom-positioned cat resting compartment, adequate ventilation, changeable scratching mats, the use of rubberwood, and a minimalist visual style. Based on these criteria, 36 thumbnail sketches, 6 ideation sketches, and 42 design development drawings were produced, resulting in three final design alternatives. Design 3 was chosen as the preferred option by survey respondents. Technical drawings were produced using SolidWorks software, and a 1:8 mock-up was constructed to evaluate form and functionality. The final full-scale prototype, CatNook 2.0, was developed using solid rubberwood, epoxy resin, optical fibre lighting, and traditional joinery. The prototype measures 680 mm in height, 560 mm in length, and 500 mm in width, featuring a motion-activated fibre-optic lighting tabletop, a removable tambour-door drawer, and a ventilated cat resting nook. The results demonstrate that a systematic and user-centred design process can effectively translate user needs into an integrated furniture solution that enhances both human convenience and feline comfort. This study concludes that multifunctional pet-human furniture can address common issues of clutter, underutilized pet products, and spatial inefficiency. Recommendations for future development include improving the lighting system, exploring modular variations, and conducting long-term user testing to further refine functionality.

1. Introduction

In Malaysia, cats have become the most popular companion animals, reflecting the growing human-animal bond (Intellect Worldwide, 2024). While pets increasingly play emotional and psychological roles in urban life (HABRI,

2022; Pet Honesty, 2023), local furniture design has not kept pace with this trend. This study introduces a multifunctional pet-human nightstand, integrating traditional mortise-and-tenon joinery with modern modular design, to enhance co-living quality for Malaysian cat owners. Recent studies highlight the emotional and psychological importance of pets, with cats becoming the preferred choice for urban Malaysians due to their adaptability and independence (Edwards, 2025; Petfinder Malaysia, 2023). Globally, designers are integrating pet-friendly features into furniture, yet Malaysia still relies on imported designs that often neglect local spatial and cultural realities (GlobalPETS, 2023). This research addresses the gap by proposing a multifunctional nightstand that combines traditional mortise-and-tenon joinery, known for its durability and elegance (VisitBeijing, 2023; Wikitia, 2023), with modern modular principles, offering a sustainable and culturally resonant solution for Malaysian households. Although the pet furniture market offers various products such as cages, scratching posts, and cat trees, many existing items are aesthetically unappealing, space-consuming, and often underutilised by cats, which leads to clutter and inefficiency in the home (Ma, 2021). At the same time, traditional solid-wood craftsmanship, including mortise-and-tenon joinery, is declining in modern furniture production due to industrialisation (Zhang, 2024). Despite growing interest in pet-human shared furniture, current designs still lack a systematic and user-centred methodology. Xu and Xia (2023) emphasise that many designs rely on intuition rather than empirical user data, resulting in products that do not effectively translate user needs into practical design strategies. This gap represents the central problem addressed in this study. Furthermore, existing designs often fail to accommodate both the emotional and spatial needs of pets and owners. Han and Zhao (2025) note that non-smart pet furniture rarely supports meaningful interaction, while Yurttaş and Altuncu (2022) observe that spatial planning for pets remains insufficient in interior design. Real-life issues such as clutter, mismatched aesthetics, and low product utilisation are experienced by more than 90% of pet owners (PetsThing HK, 2025).

Additionally, affordability-driven Ready-To-Assemble furniture may compromise durability and emotional value (Mehtab *et al.*, 2022), and typical indoor ergonomics still prioritise human needs over animal behaviour (Drarch.org, 2022). Collectively, these limitations highlight the need for a data-driven, user-centred, and context-appropriate multifunctional furniture solution. This study focuses on designing and developing CatNook 2.0, a multifunctional pet-human nightstand prototype for domestic cats in households, using rubberwood, traditional mortise-and-tenon joinery, and modular Ready-to-Assemble (RTA) features. It aims to provide comfort for cats while integrating functionality and aesthetic value for owners. The research will be conducted in Malacca, Malaysia, which is selected for its growing population of approximately 1,027,500 (2023 estimate) and a population density of 622 persons/km^2 (Department of Statistics Malaysia, 2023). Local animal-welfare initiatives further reinforce Malacca as an ideal field site. Pertubuhan Pencinta Hidupan Melaka (PPHM) currently operates a 2.3-acre shelter at Jasin Rim, caring for 400–500 stray cats and dogs on any given day; on 2 October 2024, PPHM secured a pioneering 2-acre state-land lease at Wanliwang, at an annual rent of RM 2,000 with three-year renewals, marking the first such government approval for an NGO in Malacca and guaranteeing stable local collaboration for CatNook 2.0 user interviews. In addition to PPHM, other organizations such as the TNR Project Melaka, which focuses on trap-neuter-return programs for stray animals, and the Malaysian Animal Welfare Association (MAWA), which implements nationwide stray management and adoption programs, contribute to the region's active animal welfare landscape. In conclusion, the combination of high high-growing population and active animal welfare groups supported by the government makes Malacca a suitable and compelling focus area for this study. The study aims to identify the key design criteria for a multifunctional pet-human nightstand, to design a multifunctional pet-human nightstand, and to construct a prototype of a multifunctional pet-human nightstand.

2. Literature Review

2.1 Cat Behaviour

Understanding feline behaviour is essential in designing functional pet-friendly furniture. Cats require opportunities to scratch, climb and hide, which support both physical and emotional well-being (Atkinson, 2018; Ma, 2021). Without proper outlets, household furniture often becomes the target of scratching. Their territorial nature and preference for elevated or enclosed spaces highlight the need for designs that accommodate instinctive behaviours.

2.2 Cat Furniture

Interactive and behaviour-driven cat furniture focuses on modularity, adaptability and sustainability (Ai, 2022). Prior studies emphasise the importance of human–pet interaction in design concepts. However, long-term usability, durability and real user satisfaction remain insufficiently explored, indicating the need for more grounded design validation.

2.3 Pet-Human Furniture

Pet-human shared furniture aims to harmonise daily interaction and spatial integration. Existing research highlights the importance of incorporating resting nooks, climbable structures and species-specific needs within human furniture (Lin & Li, 2021). Xu and Xia (2023) further propose systematic design tools such as QFD and TRIZ, but gaps remain in material considerations and long-term functional testing.

2.4 Multifunctional Furniture

Multifunctional furniture enhances spatial efficiency in compact homes. It is often designed to adapt to various living scenarios through flexible components and adjustable layouts (Garip *et al.*, 2019). Although successful in optimising space, issues such as high cost and limited market accessibility are recognised challenges (Husein, 2020). Examples like lift-top tables demonstrate how single furniture items can serve multiple functions.

2.5 Nightstand (Bedside Table)

Modern nightstands increasingly incorporate modular and user-centred features to improve accessibility and lifestyle fit (Garip *et al.*, 2019). Design studies highlight the integration of charging systems, lighting and optimised storage layouts to enhance usability (Liu & Zhang, 2024). Sustainable materials and recycled wood have also been applied in bedside table development, as demonstrated in the Mejikar project (Shamsul *et al*., 2022).

2.6 Mortise and Tenon Joints

Mortise-and-tenon joinery is a traditional woodworking technique that forms strong, nail-free structural connections (Jiang *et al.*, 2024). This method remains valued for durability, precision and craftsmanship. Modern adaptations show that simplified mortise-and-tenon structures can be combined with contemporary furniture systems while maintaining strength and visual refinement (Ma, 2021).

2.7 Ready-To-Assemble

Ready-To-Assemble (RTA) furniture is widely appreciated for affordability, portability and ease of assembly (Mehtab *et al.*, 2022). Younger consumers in particular favour RTA products, although concerns about long-term durability persist. Research indicates that while RTA systems succeed globally, cultural preferences and market fit still require further exploration.

2.8 Modular Furniture

Modular furniture systems feature standardised units that can be combined or expanded to suit different living environments (Garip *et al.*, 2019). Their flexibility supports personalisation and efficient use of limited space. Visual studies using scale models demonstrate how modularity enhances versatility in modern households and allows adaptive reconfiguration based on user needs.

3. Research Methodology

This study adopts an exploratory sequential mixed-methods research design conducted in two phases, to ensure that the design development process is based on empirical user data rather than intuition. The study explored user behaviour, challenges, and expectations through preliminary interviews and surveys, which informed the refinement of research direction. All data collection in both phases involved cat owners in Melaka, Malaysia, ensuring contextual relevance. The overall research flow and design process are illustrated in Figure 1.

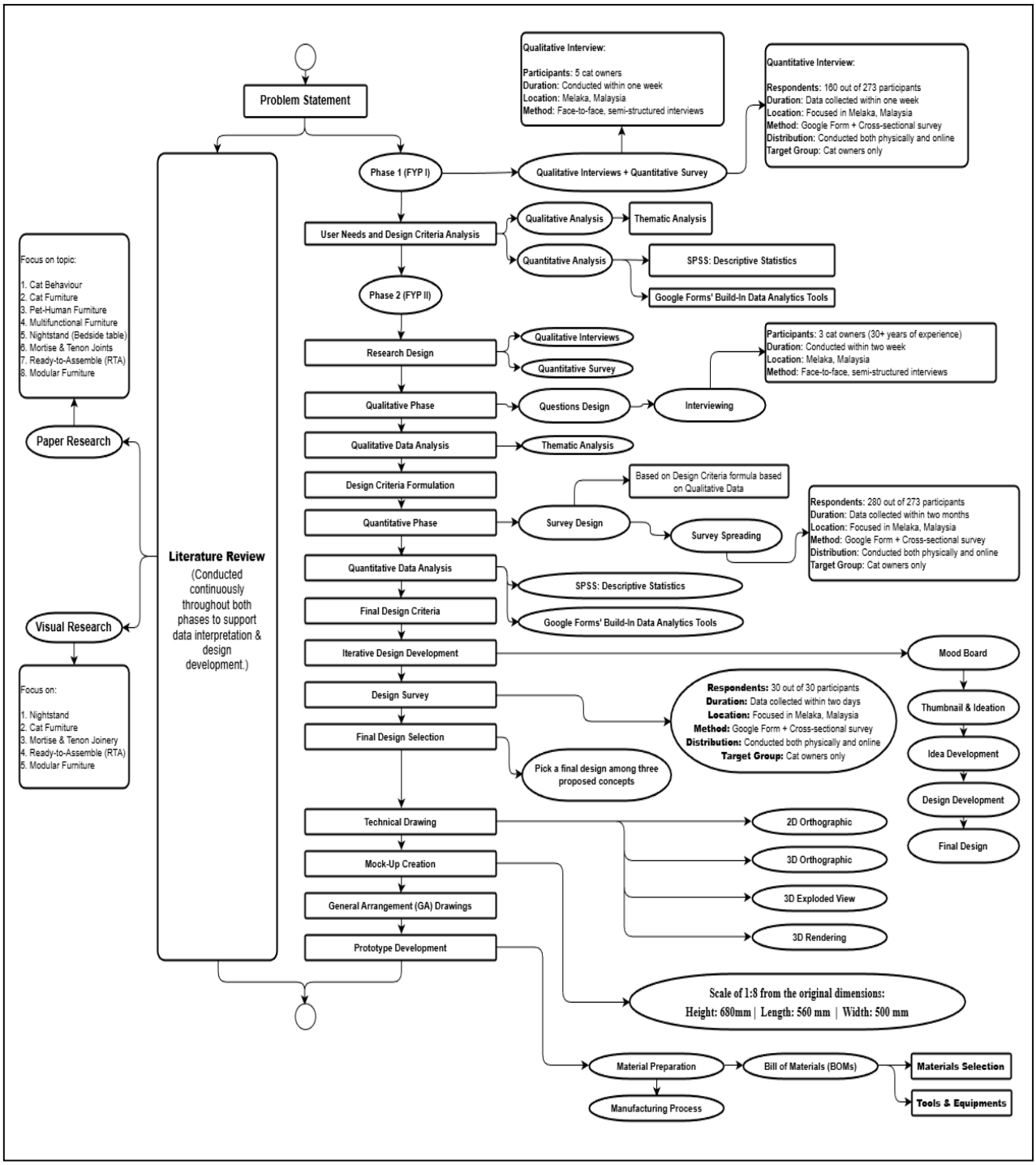

Fig. 1 *Flow Chart of Design Process*

4. Results and Discussion

4.1 Survey Response

Data collection sequence began with a survey followed by interviews. While this order was later identified as a methodological limitation, the results remain valuable as exploratory data. The survey provided a broad overview of user behaviours and preferences, while the subsequent interviews offered preliminary qualitative insights. Together, these findings served as a foundation for refining the research focus and informed the development of the more structured and systematic approach. The user needs and design criteria are summarized in Table 1.

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Table 1 *User Needs and Design Criteria*

Design Criteria	Description
1. High Semi-Open Platform	Allow light and airflow. Provides a balance of security and transparency for cat.
2. Scratch Surface (Inside/Outside of Nightstand)	Easy to maintain or replace (Changeover) for a longer service life. Grainy wood, twine wrapped or replaceable grip panels
3. Modular Hanging Toy System	Designed with hooks, magnets, or slot devices for hanging toys. Toys can be changed at any time. Ensures structural safety and is not easily swallowed or pulled off.
4. Wood as a Core Material	It has certain abrasion and scratch resistance. Aesthetic and environmentally friendly.
5. Easy to Clean Structure	Surface as flat as possible, avoid dead ends and gaps that are too small. Detachable structure.

Next, building on the exploratory findings, user needs and design criteria identified were used to address the methodological gap. The process began with in-depth qualitative interviews to capture detailed user perspectives and behavioural insights. Findings from these interviews were then used to develop a refined questionnaire, which was distributed to a larger sample of 280 cat owners in Melaka. This sequential approach ensured that the design criteria for CatNook 2.0 were grounded in qualitative depth and supported by quantitative validation. The combined findings formed a consolidated framework for design development, as summarised in Table 2.

Table 2 *Summary of Design Criteria*

Category	Design Criteria
1. Structural	1. Easy to dismantle and reassemble 2. Cat's resting space located at the bottom (stability, safety) 3. Open resting platform preferred over enclosed space (interaction, accessibility) 4. Rounded edges to ensure safety 5. Base without legs for stability and easier cleaning
2. Material & Aesthetic	1. Solid rubberwood as primary material (durable, sustainable, natural appeal) 2. Minimalist furniture style preferred 3. Matte surface finish favoured 4. Dark wood colour tones recommended for elegance and timelessness
3. Functional	1. Storage compartments (drawers/compartments) for human use 2. Interchangeable scratching surfaces for cats 3. Replaceable cat toys to support enrichment 4. Shared top platform for cats to rest and humans to place items 5. Motion-activated lighting system for functionality and play
4. Safety & Maintenance	1. Structurally stable and resistant to scratching/biting 2. Replaceable components (cushions, scratching panels) for cleaning and maintenance 3. Reduce risks such as cable biting and unstable climbing surfaces

4.2 Design Survey

The Design Survey represents the final stage of the data collection process, conducted after the identification of design criteria through both qualitative (interviews) and quantitative (survey) phases. The purpose of this validation stage is to evaluate user preferences among three developed design concepts of the multifunctional pet-human nightstand, known as CatNook 2.0. Each concept integrates features inspired by the key findings from the earlier phases, such as a semi-enclosed cat resting space, motion-sensor lighting, and interchangeable accessories (scratching mat and toys). A total of 30 valid responses were collected from cat owners residing in Melaka, Malaysia. According to Table 3, preliminary findings indicate that respondents favoured designs offering open accessibility and simple cleaning features, particularly Design 3, which combines openness and user convenience.

Table 3 *Final Design Selection Analysis*

Design Concept	Figure	Number of Votes	Percentage (%)
Design 1		1	3.3
Design 2		1	3.3
Design 3		28	93.3

4.3 Visual Research

To support CatNook 2.0's development, visual research was conducted by studying market products that meet the selected design criteria (refer Fig. 2). This helped clarify current trends, user expectations, and design opportunities, providing a solid foundation for shaping the final design.

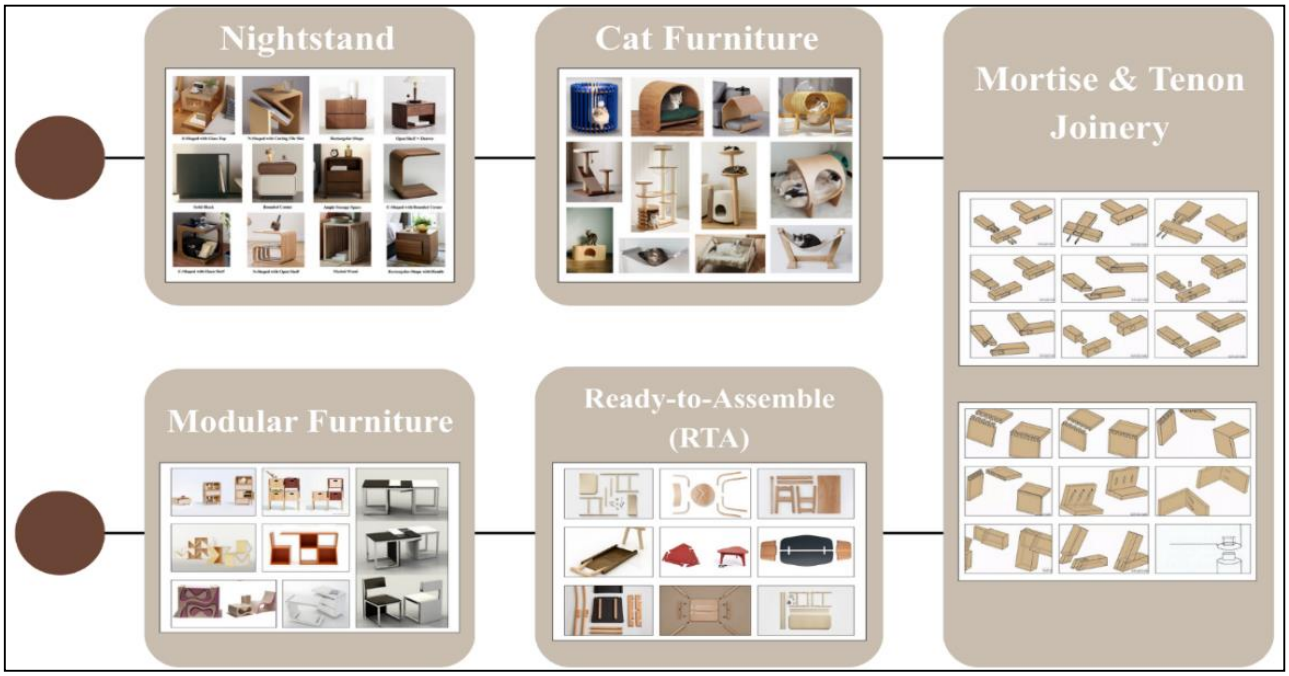

Fig. 2 *Flow Chart of Visual Research*

4.4 Iterative Design Development

After conducting visual research, the iterative design development process began (refer Fig. 3), progressing through five key stages: Mood Board, Thumbnail & Ideation, Idea Development, Design Development, and Final Design. Each stage was developed entirely through hand-drawn sketches, ensuring a strong emphasis on creativity and visual exploration. The Final Design stage included three design options, each tailored to support feline behaviour while maintaining spatial efficiency and visual harmony. To determine the most suitable solution, a design survey was conducted with 30 cat owners in Melaka. Based on their preferences and feedback, Design 3 was selected as the final outcome.

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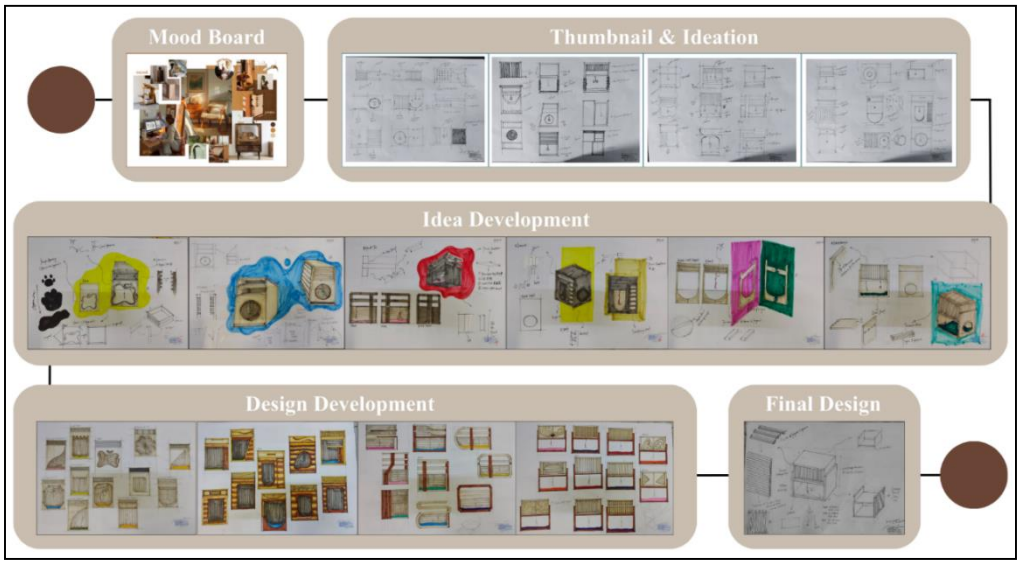

Fig. 3 *Flow Chart of the Iterative Design Development Process*

4.5 Technical Drawing

The final design was translated into detailed technical drawings using AutoCAD and SolidWorks, followed by a 3D simulation to evaluate its feasibility and structural practicality (refer to Fig. 4 and Fig. 5). The process simulated real jointing, provided insights for refinement.

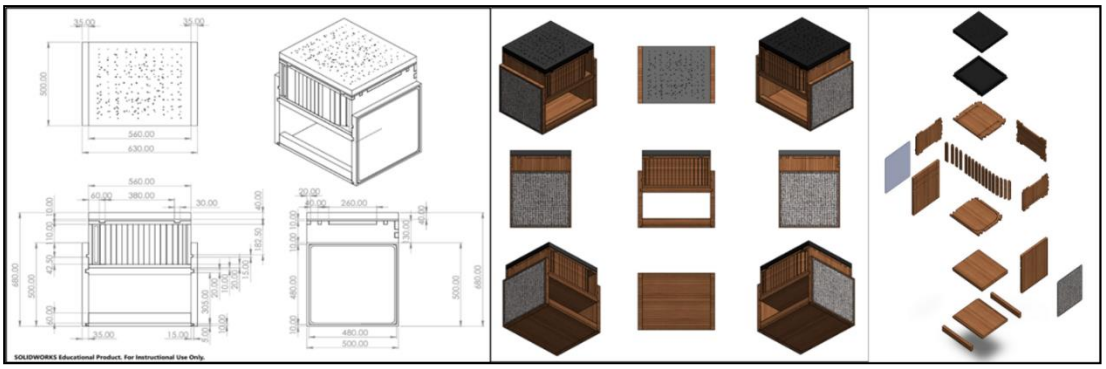

Fig. 4 *2D & 3D Technical Drawings for Final Design*

Fig. 5 *3D Rendering for Final Design*

4.6 Mock-Up Creation

Based on the final design development, a 1:8 scale mock-up of CatNook 2.0 was produced to demonstrate its appearance, proportions, and feasibility. Constructed from lightweight balsa wood with super glue and double-sided tape, the model incorporated hemp rope for scratching panels and masking tape for the tambour door connection. Precision cutting and assembly were carried out on an A3 mat, with black spray paint applied for finishing. Fig. 6 illustrate the mock-up from multiple views. The process simulated real production, provided insights for refinement, and validated the design's functional and structural potential.

Fig. 6 *Physical Mock-Up of CatNook (1:8 Scale)*

4.7 Bill of Materials

The Bill of Materials (BOM) for CatNook 2.0 lists all main components, materials, and dimensions required for the prototype, serving as a reference for production planning and cost estimation. The structure was built with rubberwood for strength and sustainability, epoxy resin for a durable drawer finish, and sisal hemp rope for scratching mats. Table 4 lists the material specifications used in fabrication.

Table 4 *Bill of Materials for Prototype*

No.	Part Name	Description	Material	Qty	Dimension (L*W*H)(mm)
1	Drawer Top	Top	Epoxy Resin	1	560*5*500
2	Sensor Motion	Top	Rubberwood	1	560*20*500
3	Sensor Motion	Bottom	Rubberwood	1	560*30*500
4	Drawer	Top	Rubberwood	1	560*20*500
5	Drawer	Bottom	Rubberwood	1	560*20*500
6	Drawer	Left	Rubberwood	1	500*20*280
7	Drawer	Right	Rubberwood	1	500*20*280
8	Drawer	Back	Rubberwood	1	560*20*280
9	Tambour Door	First	Rubberwood	1	50*20*260
10	Tambour Door	Second	Rubberwood	15	40*20*260
11	Tambour Door	Last	Rubberwood	1	30*20*260
12	Main Body	Left	Rubberwood	1	500*20*500
13	Main Body	Right	Rubberwood	1	500*20*500
14	Main Body	Middle	Rubberwood	1	560*40*500
15	Main Body	Bottom	Rubberwood	1	560*20*500
16	Main Body	Front	Rubberwood	1	560*40*65
17	Main Body	Back	Rubberwood	1	560*40*65
18	Scratching Mat	Left	Sisal Hemp Rope	1	480*10*480
19	Scratching Mat	Right	Sisal Hemp Rope	1	480*10*480

4.8 Prototype Development

The manufacturing process of CatNook 2.0 transformed technical drawings into a 680 × 560 × 500 mm prototype composed of three sections: an epoxy resin tabletop with motion-sensor lighting, a removable tambour-door drawer, and a lower cat resting compartment. Each part required specific fabrication methods, with the overall process (refer Fig. 7) emphasizing precision, stability, and faithful realization of the design intent.

4.8.1 Material Preparation

Before fabrication began, all required materials were prepared and inspected. The primary material used for the structure was twenty-millimeter thick rubberwood (see Appendix A, Fig. 7), supplied in boards measuring eight feet by four feet. Optical fibres with diameters of one point five millimetres, two millimetres, and three millimetres were prepared for the lighting system. Additional materials included polyester webbing for the tambour door, sisal hemp rope for the scratching mats, ultraviolet resin glue, epoxy resin, motion sensor modules, LED bulbs, and various finishing products. All boards were marked using a retractable measuring tape, a one-meter steel ruler, and an L square to ensure accurate layout according to the finalized technical drawings.

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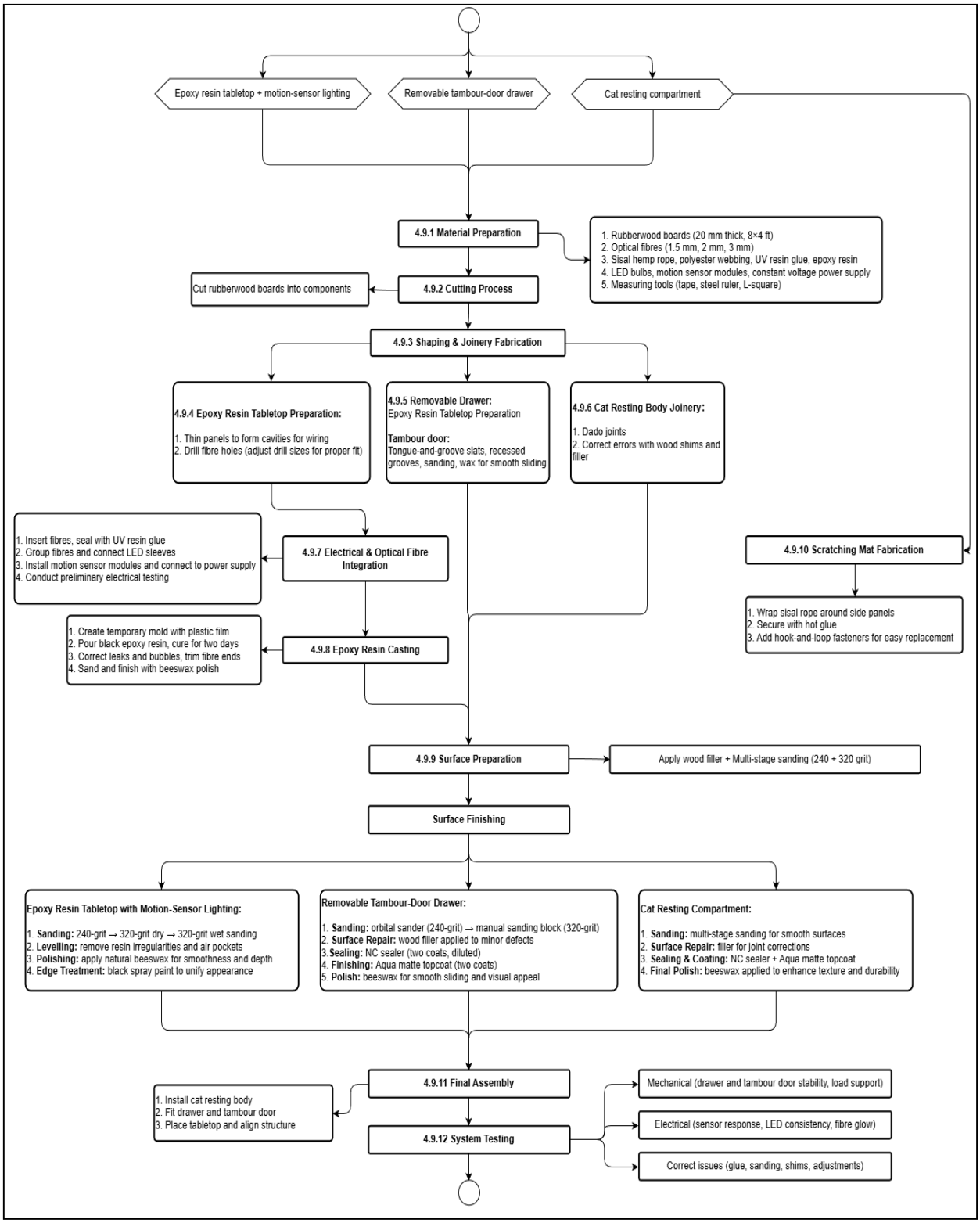

Fig. 7 *Flow Chart of Prototype Development Process*

4.8.2 Cutting Process

The fabrication process began with the cutting of the rubberwood boards to form individual components (see Appendix A, Fig. 8). A table saw with adjustable blade height and angle was used to cut structural panels for the tabletop assembly, the drawer unit, the tambour door slats, and the cat resting body. Each component was separated according to its required dimensions and labelled for easier identification during assembly (see Appendix A, Fig. 9). After cutting, the edges of each part were refined using sanding tools to remove loose fibres and to prepare the surfaces for subsequent shaping.

4.8.3 Shaping and Joinery Fabrication

Following the cutting stage, detailed shaping was performed to create the necessary joinery and functional features (see Appendix A, Fig. 10).

4.8.4 Epoxy Resin Tabletop Preparation

The tabletop consisted of a top layer and a bottom layer. These two panels were selectively thinned in specific areas to create internal cavities that would later conceal the electrical wiring (see Appendix A, Fig. 11). Holes for the optical fibres were then drilled through the top panel. Although the design initially specified drill bit sizes that matched the fibre diameters, it was discovered during fabrication that the 2mm and 3mm fibres could not pass through holes of equal size. Therefore, slightly larger drill bits measuring 2.5mm and 3.5mm were used to ensure proper fitting.

4.8.5 Removable Drawer and Tambour Door

The drawer was constructed using box joints formed on the left, right, top, bottom, and back panels (see Appendix A, Fig. 12). These joints provided structural strength and allowed the drawer to withstand repeated use. The tambour door required extensive shaping work. Each wooden slat was formed with a tongue and groove profile to allow flexibility and sliding movement (see Appendix A, Fig. 13). Sliding channels were also created by carving long recessed grooves using a vertical drilling machine. The grooves were refined through sanding to achieve smooth curvature. A small amount of wood wax was applied inside the grooves to improve the sliding quality of the tambour door.

4.8.6 Cat Resting Body Joinery

The cat's resting body compartment was assembled using dado joints. The middle board, which supported the removable drawer, was formed with a central recessed dado joint. Additional dado joints were created on the left, right, middle, bottom, front, and back panels. Although the technical drawings were prepared in SolidWorks, a minor error occurred during layout marking and resulted in inconsistent dado heights on the left and right supporting panels. This issue was corrected using wood shims and wood filler to relevel the joints (see Appendix A, Fig. 14). While the correction slightly affected the visual appearance upon close inspection, the structural integrity remained unaffected.

4.8.7 Electrical and Optical Fibre Integration

Once the structural shaping was completed, the electrical components were installed. Each optical fibre was inserted through its designated hole from the surface of the tabletop (see Appendix A, Fig. 15). The fibre lengths had been premeasured, but later it was discovered that the longest three-millimetre fibres were insufficient for bundling. During group alignment, several fibres broke due to tension. These broken fibres were left as they were since the surrounding LED bulb installations could still provide ambient illumination. To prevent epoxy leakage during casting, ultraviolet (UV) resin glue was applied around the fibre roots on the underside of the tabletop (see Appendix A, Fig. 16). The glue was cured using an ultraviolet lamp, forming a hardened seal around each fibre. Once the fibres were secured, they were grouped according to lighting zones and fastened onto the underside of the tabletop using a staple gun (see Appendix A, Fig. 17). Small metal sleeves provided with the LED kits were then placed around each fibre root. These sleeves served as connectors, allowing LED bulbs to be inserted securely and aligned with the fibre bundles. A total of twenty motion sensor modules were prepared for installation. The sensors were placed near each fibre group and secured using double-sided tape and super glue. All sensor modules were connected in series (see Appendix A, Fig. 18). The first module was wired to a 20-volt, 24-watt constant voltage (CV) power supply unit designed for cabinet lighting. The power supply included universal connectors and a built-in switch line, which facilitated a stable and reliable power delivery system. A preliminary electrical test confirmed that all LEDs and sensors were functioning properly.

4.8.8 Epoxy Resin Casting

The epoxy resin tabletop required a deep pour cast. Wooden strips wrapped in plastic film (see Appendix A, Fig. 19) were fixed around the tabletop to create a temporary mold (see Appendix A, Fig. 20). The plastic film functioned as a release layer. Black coloured epoxy resin was mixed (see Appendix A, Fig. 21) and poured slowly at a low angle across the surface (see Appendix A, Fig. 22). The depth of the resin was estimated between one and two centimetres. During casting, some resin seeped through several fibre holes that were not completely sealed. These instances were corrected by curing additional ultraviolet resin glue at the leaking points. Air bubbles were also present, but because the resin was tinted black, the bubbles were not visible during the pouring process. Their presence was only discovered during later standing. The resin was left undisturbed for two days to achieve full

curing (see Appendix A, Fig. 23). After curing, the mold was removed and the excess fibre ends protruding from the surface were trimmed using a chisel. The surface required extensive levelling due to resin irregularities and air pockets. Initial sanding was performed using 240-grit sandpaper to remove uneven patches. This was followed by 320-grit dry sanding to achieve a smoother texture. A final wet sanding process using 320-grit sandpaper with running water produced a refined matte finish (see Appendix A, Fig. 24). Natural beeswax was later applied to enhance the smoothness and visual depth of the surface (see Appendix A, Fig. 25).

4.8.9 Surface Preparation and Finishing

All wooden components were prepared for finishing through a multi-stage process. Each part was sanded using 240-grit sandpaper with an air orbital sander (see Appendix A, Fig. 26), followed by 320-grit sanding using a manual sanding block. Dust was removed using an air compressor blower. Wood filler was applied to minor defects and allowed to dry completely (see Appendix A, Fig. 27). Subsequent sanding ensured a smooth and even surface. A first coat of NC sealer was applied using an air spray gun (see Appendix A, Fig. 28). The sealer had been diluted at a ratio of one part sealer to two parts thinner. After drying, the surface was lightly sanded (see Appendix A, Fig. 29), and a second coat of sealer was applied (see Appendix A, Fig. 30). Additional sanding prepared the wood for the final finishing layers (see Appendix A, Fig. 31). Two coats of Aqua topcoat in a matte finish were applied using a paintbrush (see Appendix A, Fig. 32 & Fig. 33). After drying, natural beeswax polish was applied to all surfaces, including the resin tabletop. The edges around the resin panel were finished with black spray paint to unify the appearance.

4.8.10 Scratching Mat Fabrication

The scratching mats were fabricated by wrapping sisal hemp rope around the left and right-side panels of the cat resting body. Hot glue was used to secure the rope. The adhesive created visible glue clusters which slightly affected the visual appearance and could influence cat comfort. Hook and loop fasteners were then added to the backside of each panel, allowing the scratching mats to be removed and replaced easily (see Appendix A, Fig. 34).

4.8.11 Final Assembly

Final assembly began with the alignment and installation of the cat resting body (see Appendix A, Fig. 35). The drawer unit was then assembled and fitted into the central compartment. The tambour door slats were connected using polyester webbing applied across the upper and lower sections on the backside (see Appendix A, Fig. 36). This flexible joining method enabled the door to close smoothly since tongue and groove joints alone would only allow the slats to open. The tabletop assembly was placed on the structure, and all components were checked for alignment.

4.8.12 System Testing

Mechanical testing confirmed drawer and tambour door stability, while the cat compartment supported moderate loads (see Appendix A, Fig. 37). Electrical tests verified sensor response, LED consistency, and fibre glow, with minor wiring adjustments. Fabrication challenges included fibre breakage, resin leakage, air bubbles, tambour door jamming, drawer friction, joint misalignment, and rope wrapping issues, all corrected through glue, sanding, shims, or design adjustments. Overall, the process successfully produced a functional CatNook 2.0 prototype (see Appendix A, Fig. 38 and Fig. 39), demonstrating design feasibility and highlighting areas for refinement.

4.8.13 Cost Estimation

The total cost of the CatNook 2.0 prototype is calculated by combining the adjusted material cost and the marketing cost (refer Table 5). No additional charges were necessary for packaging or transportation.

Table 5 *Total Cost of CatNook 2.0 Prototype*

No.	Cost Component	Amount (RM)
1	Material	767.51
2	Marketing	50.00
3	Packaging	-
	Total Prototype Cost	817.51

5. Conclusion

In conclusion, this study achieved its objectives through user data collection, design development, and prototype fabrication of a multifunctional pet-human nightstand. The design criteria were established through two methods of data collection. The first method involved interviews with three Malacca cat owners, each with over thirty years

of experience, offering insights into feline behaviour and pet–human spatial dynamics. And data were successfully collected through a Google Forms questionnaire with 280 Malacca cat owners. Across both methods, several key design criteria were identified, including the need for easy-to-clean surfaces, a bottom-positioned cat resting compartment, changeable scratching mats, rubberwood material selection, and a minimalist design. Guided by these criteria, a total of 36 thumbnail sketches, 6 ideation sketches, and 42 design development sketches were produced. Three final design alternatives were then developed and presented to users for validation, after which Design 3 was selected as the preferred option due to its balanced functionality and visual coherence. A 1:8 mock-up of the final design was constructed to assess form, structure, and component interaction. The refined full-scale CatNook 2.0 prototype was built with rubberwood, epoxy resin, optical fibre lighting, and joinery, measuring 680 × 560 × 500 mm and featuring a motion-activated tabletop, tambour-door drawer, ventilated cat nook, and replaceable scratching panels. Overall, this study shows how a user-centred design approach can turn everyday needs into meaningful solutions. CatNook 2.0 not only serves as a functional nightstand but also creates a shared space that enriches daily life, bringing greater convenience for owners and comfort for cats in modern Malaysian homes. This study has several limitations that should be acknowledged. First, the demographic scope of the survey primarily represented young cat owners in Melaka, which may limit the generalisability of the design criteria to broader groups of pet owners. Second, the prototype fabrication relied heavily on workshop facilities, sponsored machinery, and specialised tools, making certain construction techniques less scalable for mass production. Third, although the prototype incorporated functional lighting and pet-oriented features, long-term user testing with multiple households and varied interior settings was beyond the scope of this study. These limitations highlight areas for further refinement and future research.

This study holds significance in several areas. Firstly, it contributes to the development of user-centred furniture design by addressing the specific needs of cat owners, a growing consumer segment. By combining functionality and pet-friendly features, the proposed CatNook 2.0 offers a solution that enhances both human and cat comfort within shared living spaces. Secondly, the research provides practical insights for the furniture industry, especially in Malaysia, by identifying key preferences and lifestyle patterns of cat owners. These insights can help manufacturers and designers create more targeted and innovative products that align with current market demands. Lastly, from an academic perspective, this study adds to the literature on multifunctional furniture and human–pet cohabitation and demonstrates the application of mixed-methods research in product design. The findings can serve as a reference for future design research, especially in integrating user data into the iterative development process. This study also contributes to the body of knowledge in user-cantered and pet-inclusive furniture design, providing new perspectives for future academic research and industry practice. Several recommendations are proposed to enhance the future development of multifunctional pet-human furniture and to guide further research in this field. First, future studies may involve a broader and more diverse group of participants to obtain a more comprehensive range of user needs. This would enable the design to accommodate various lifestyles, housing types, and multi-pet environments, resulting in a more universally adaptable product. Second, improvements to the lighting interaction system may be explored. For example, replacing optical fibres with modular LED strips or integrating low-voltage smart components could reduce manufacturing complexity and improve durability. A detachable lighting module would also make future maintenance easier for users. Third, the production process can be further optimized by redesigning joinery structures for scalability. Simplifying the tambour door mechanism or adopting prefabricated components may reduce fabrication time and increase manufacturing consistency. Material alternatives, such as laminated boards or engineered wood, may also help lower production costs while maintaining aesthetic appeal. Lastly, future research may consider expanding the multifunctional potential of the nightstand by incorporating modular or customizable components. Features such as adjustable interior dividers, or additional human–pet interaction zones could enhance adaptability to different household needs. Overall, these recommendations aim to refine the practicality, manufacturability, and long-term usability of CatNook 2.0 while contributing to a more systematic and user-centred approach in the evolving field of pet-human shared furniture design.

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Conflict of Interest

Authors declare that there is no conflict of interest regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design:*** *Koh Ming Jia and Muhammad Firdaus Md Rawi;* ***data collection:*** *Koh Ming Jia;* ***analysis and interpretation of results:*** *Koh Ming Jia;*

draft manuscript preparation: *Koh Ming Jia and Muhammad Firdaus Md Rawi. All authors reviewed the results and approved the final version of the manuscript.*

Appendix A: Prototype Development Process Photos

Fig. 7 *Main Required Material (Rubberwood panel sized 8ft*20mm*4ft)*

Fig. 8 *Cutting Process for Each Component Part*

Fig. 9 *Each Component Part*

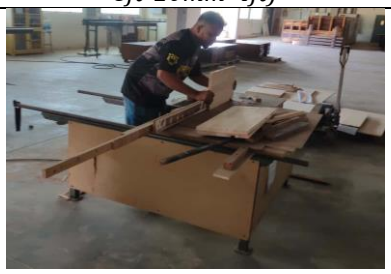

Fig. 10 *Detailed Shaping for Each Component Part*

Fig. 11 *Thinned panel to create internal cavities*

Fig. 12 *Movable Drawer Box Joint Cutting*

Fig. 13 *Tambour Door Tongue and Groove Joint Cutting*

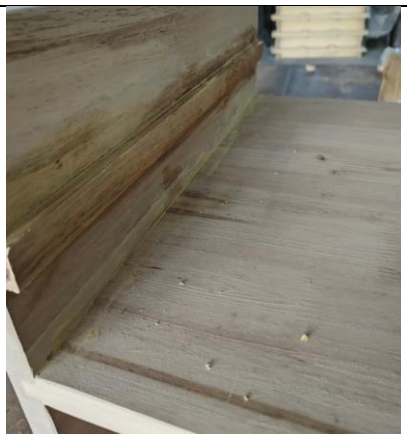

Fig. 14 *Process Relevel Joint*

Fig. 15 *Process Insert Optical Fibre through Over Panel*

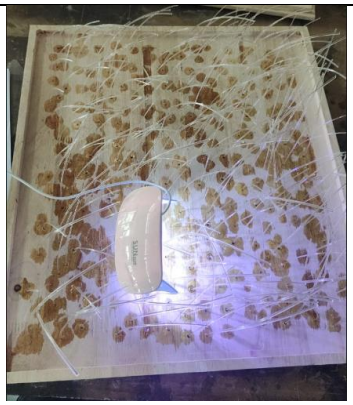

Fig. 16 *Process Apply UV Resin Glue Around Optical Fibre Roots and Cured by UV Light Lamp*

Fig. 17 *Process Fastened Optical Fibre on Panel Using Staple Gun*

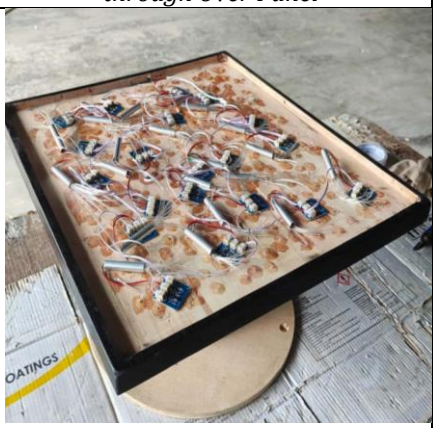

Fig. 18 *Process Install Motion Sensor Modules*

Fig. 19 *Wooden Strips Wrapped with Plastic Film*

Fig. 20 *Process Fixed Wooden Strips Around Tabletop*

Fig. 21 *Process Mixing Epoxy Resin with Black Colour Dye*

Fig. 22 *Process Pouring Epoxy Resin to Tabletop*

Fig. 23 *Process Curing Epoxy Resin*

Fig. 24 *Process Sanding Epoxy Resin Surface*

Fig. 25 *Process Applying Natural Beewax on Epoxy Resin Surface*

Fig. 26 *Proses Sanding with 240-Grit*

Fig. 27 *Proses Applying Wood Filler on Defects Area*

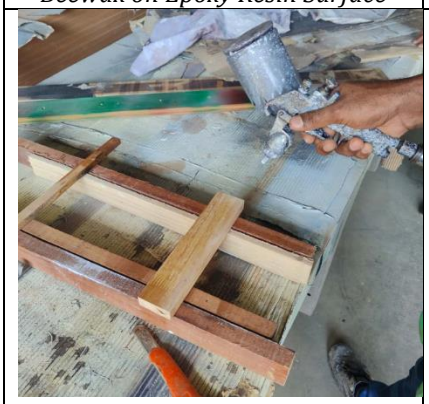

Fig. 28 *Process Applying First Coat of NC Sealer using Air Spray Gun*

Fig. 29 *Process Lightly Sanding with 320-grit Sandpaper*

Fig. 30 *Process Applying Second Layer Coat of NC Sealer*

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Fig. 31 *Process Lightly Sanding for Matt Topcoat*

Fig. 32 *Process Applying First Layer of Matt Topcoat with Paint Brush*

Fig. 33 *Process Applying Second Layer of Matt Topcoat*

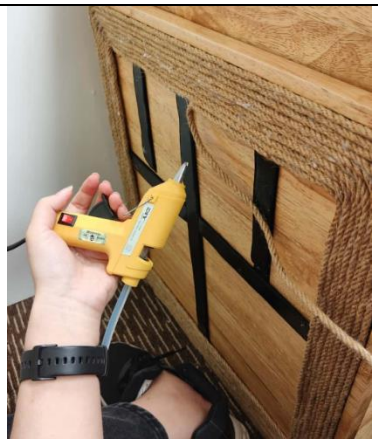

Fig. 34 *Process Making Scratching Mat for Left and Right-Side Panel*

Fig. 35 *Final Installation of CatNook 2.0*

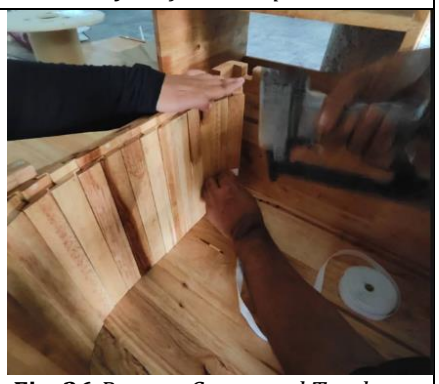

Fig. 36 *Process Connected Tambour Door Slats using Polyester Webbing*

Fig. 37 *Process of Testing Motion Sensor Lighting System*

Fig. 38 *Final Prototype of CatNook 2.0 (Front)*

Fig. 39 *Final Prototype of CatNook 2.0 (Side)*

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