Movewise: Home-to-Home Moving and Verified Interior Design, with a Step-by-Step Journey for Every Item

Short Proposal — CS491 Senior Design Project, Bilkent University

Hüsnü Arkca husnu.arkca@ug.bilkent.edu.tr
Aral Müftüoğlu aral.muftuoglu@ug.bilkent.edu.tr
Onur Ege Yakar ege.yakar@ug.bilkent.edu.tr
Yunus Emre Aslan emre.aslan@ug.bilkent.edu.tr
Mehmet Dizdar mehmet.dizdar@ug.bilkent.edu.tr

1. Introduction

Moving to a new home combines two problems. The first is **moving:** every large item must leave the source home through its rooms, corridors and stairs, be loaded into a truck and reach its place in the destination home, and a sofa that fits the old home may not pass the new door or staircase. The second is **design:** people must decide how to furnish the new home with the items they own and new pieces they buy, usually without interior design training and with tools that ignore real dimensions. Separate tools exist for parts of this process, such as room scanning, virtual moving surveys, layout design and single-item fit checks, but to our knowledge no single application brings them together and follows an item's whole journey, from its place in the source home to its place in the destination home. Movewise addresses both problems in one system for moving companies and individual users: a mobile app is used to enter home information and scan the homes, while the main work of modeling, design and move planning runs on a web panel.

2. Problem Definition and Constraints

Movewise takes a **source home** and a **destination home** as input. The user defines the layout of each home in the mobile app: its floors, rooms and their types (bedrooms, living room, kitchen, one or more bathrooms), corridors, stairs and entrances, and which rooms are scanned. The source home has an inventory of large items with categories and dimensions. The output is (i) a layout for each room of the destination home, (ii) a feasibility decision for each item along its path out of the source and into the destination, (iii) an ordered plan of removal, truck loading, unloading and placement, and (iv) a summary for moving companies with estimated crew size, time and items to disassemble. The number of rooms, floors, kitchens and bathrooms is not restricted; the scope is bounded by Table 1.

Table 1: Scope constraints.

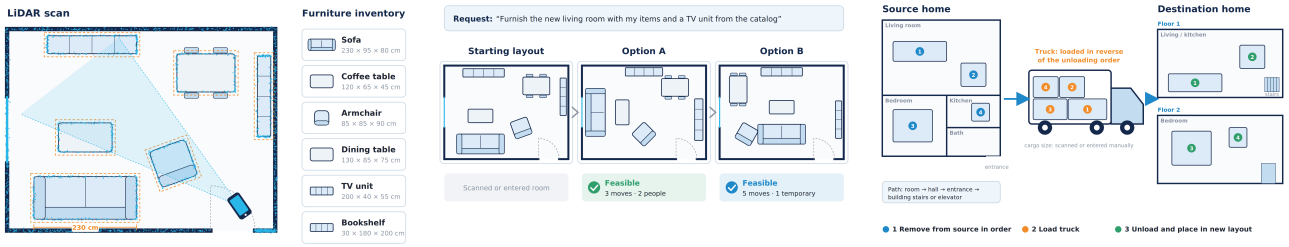
Constraint	Definition
C1. Residential spaces only	Apartments and houses, including multi-floor homes; warehouses, hangars and other large-scale logistics are out of scope.
C2. Truck transport stage	Planning covers the truck's cargo space and loading order; vehicle and transport details can be entered manually.
C3. User-defined layout and manual input	The user sets up each home's layout; unscanned or incompletely scanned rooms, corridors, stairs or entrances, such as a destination home not yet accessible, are entered as dimensions or a floor plan.
C4. Catalog-based design	New items come from a fixed product catalog with known dimensions, alongside the scanned inventory.
C5. User-defined fixed elements and utilities	Electrical outlets, water and plumbing points and other installations that LiDAR cannot detect are entered by the user; items and fixtures marked immovable are fixed in design and moving.

3. System Overview

Movewise has a mobile app for entering home information and LiDAR scanning on iPhone, and a web panel where the main work of 3D modeling, design and move planning takes place. Design and moving are the two core features, sharing one 3D representation and planner (Figure 1).

Scanning. The rooms the user selects are scanned with a LiDAR-equipped iPhone; missing or unscannable parts are entered manually. The result is a per-floor 3D model of rooms, doors, corridors and stairs, and an inventory with dimensions, positions and measurement uncertainty that the user can verify (Figure 1a).

Design. Using room dimensions and the inventory, users furnish each room of the destination home, or rearrange an existing one, by placing items by hand or asking for suggestions such as "more open space" or "a reading corner". Clearances, walkways and door swings are checked in real time. Suggestions follow established interior design guidelines (clearance, circulation, alignment, conversation distance and pairwise relations such as a TV facing the sofa) formalized in [1], [2], and respect fixed items and user-entered outlets and plumbing points. New pieces come from a fixed product catalog with known dimensions, so every suggested purchase is checked for both fit in the room and delivery along the path (Figure 1b).



(a) LiDAR scan and inventory (b) Verified layout alternatives (c) Home-to-home moving plan

Figure 1: Scanning, design and home-to-home moving on one shared model (concept illustrations).

Moving. For each item, the planner checks the chain of bottlenecks from its room in the source home to its room in the destination: doors, corridors, stairs or elevators. Blocking items move first, the truck is loaded in the reverse of the unloading order, and items are placed room by room in the destination (Figure 1c). Plans are ranked by measurable terms: number of moves, path length and rotations, minimum clearance as a proxy for damage risk, and required number of people estimated from item size and type.

4. Target Users and Value

Table 2: Target user segments; moving companies are the primary business customers.

Segment	Problem	Value of Movewise
Moving companies	Quotes without knowing both homes	Survey with crew, time, disassembly and loading plan
Individuals moving house	What fits the new home, and how	One plan from the old home to the new one
People furnishing a home	Layouts that ignore real sizes	Guided design with inventory and catalog items
Furniture retailers	Failed deliveries of large items	Catalog items checked against rooms and path

5. Innovation and Related Work

To our knowledge, no existing application combines scanning, interior design and home-to-home move planning under one roof. Moving a rigid object among obstacles is a classic motion planning problem (the piano movers' problem [3]); the contribution of Movewise is not a new planning algorithm, but applying these methods to real scans of homes. Existing solutions cover only parts of this pipeline (Table 3).

Table 3: Comparison with existing solutions.

Solution	Strength	Limitation
Apple RoomPlan [4], magicplan [5]	LiDAR room scanning, floor plans, measurements	No feasibility check or movement planning
IKEA Kreativ [6], Planner 5D [7]	Furniture visualization and automatic arrangement	No check whether items can reach the layout
Smart Moving [8], ItemFits [9]	Fit checks through doors, hallways, stairs and elevators, including rotation and tilting	Dimensions entered per item and opening; no multi-object move planning
Yembo [10]	AI video survey with inventory, volume and quotes for moving companies	No documented path feasibility, destination layout or move ordering
Research: layout [1], [2], [11]; robotic rearrangement [12], [13]	Good final layouts; move order for blocking objects	End state only, or robots with exact geometry

- **Design verified by physics:** every layout is checked against real dimensions, with the moves needed to reach it.
- **Whole-journey planning:** each item is followed from its source room through stairs and the truck to its new room.
- **Scanned geometry and uncertainty:** rotation, tilting and removable parts are planned on the scan, with confidence from scan errors.
- **Multi-object reasoning:** blocking items, temporary relocation and loading order are handled together.

6. Evaluation Plan and Scope

The system will be evaluated on **measurement accuracy** (scans against tape measurements), **decision accuracy** (fit predictions against real outcomes in home-to-home moves, focusing on tight cases), **plan executability** (whether movers can follow the removal, loading and placement order, and actual against estimated time), **design quality** (blind pairwise comparison of layouts by interior designers, following [1]) and a **user study** with moving companies and individual users.

Scope. The initial version covers one source and one destination home, including multi-floor homes, with a limited number of large items and a single truck; multiple trucks, detailed disassembly planning and crew scheduling are future work.

References

[1] P. Merrell, E. Schkufza, Z. Li, M. Agrawala, and V. Koltun, “Interactive furniture layout using interior design guidelines,” *ACM Trans. Graph.*, vol. 30, no. 4, Art. no. 87, Jul. 2011.

[2] L.-F. Yu, S.-K. Yeung, C.-K. Tang, D. Terzopoulos, T. F. Chan, and S. J. Osher, “Make it home: Automatic optimization of furniture arrangement,” *ACM Trans. Graph.*, vol. 30, no. 4, Art. no. 86, Jul. 2011, doi: 10.1145/1964921.1964981.

[3] J. T. Schwartz and M. Sharir, “On the ‘piano movers’ problem I. The case of a two-dimensional rigid polygonal body moving amidst polygonal barriers,” *Commun. Pure Appl. Math.*, vol. 36, pp. 345–398, 1983, doi: 10.1002/cpa.3160360305.

[4] Apple Inc., “RoomPlan,” Apple Developer Documentation. [Online]. Available: https://developer.apple.com/documentation/roomplan. Accessed: Oct. 22, 2026.

[5] Technologies magicplan Inc., “magicplan: AR and LiDAR scanning,” Apple App Store. [Online]. Available: https://apps.apple.com/app/427424432. Accessed: Oct. 22, 2026.

[6] Ingka Group, “IKEA launches new AI-powered, digital experience empowering customers to create lifelike room designs,” IKEA Newsroom, Jun. 22, 2022. [Online]. Available: https://ikea.com/us/en/newsroom/corporate-news/ikea-launches-new-ai-powered-digital-experience-empowering-customers-to-create-lifelike-room-designs-pub58c94890. Accessed: Oct. 22, 2026.

[7] Planner 5D, “AI furniture placement.” [Online]. Available: https://planner5d.com/use/ai-furniture-placement. Accessed: Oct. 22, 2026.

[8] E. Tushina, “Smart Moving: Furniture helper,” Apple App Store, ver. 1.2.4. [Online]. Available: https://apps.apple.com/us/app/smart-moving-furniture-helper/id1666262699. Accessed: Oct. 22, 2026.

[9] ItemFits LLC, “Will it fit through your door? Free doorway calculator.” [Online]. Available: https://itemfits.com/fit/door. Accessed: Oct. 22, 2026.

[10] Yembo, “AI-powered video survey software.” [Online]. Available: https://yembo.ai/moving/surveys. Accessed: Oct. 22, 2026.

[11] W. R. Para, P. Guerrero, N. Mitra, and P. Wonka, “COFS: COntrollable furniture layout synthesis,” in *Proc. ACM SIGGRAPH 2023 Conf.*, 2023, doi: 10.1145/3588432.3591561.

[12] D. M. Saxena and M. Likhachev, “Planning for manipulation among movable objects: Deciding which objects go where, in what order, and how,” in *Proc. Int. Conf. Automated Planning and Scheduling (ICAPS)*, vol. 33, no. 1, 2023, pp. 668–676.

[13] R. Wang, K. Gao, D. Nakhimovich, J. Yu, and K. E. Bekris, “Uniform object rearrangement: From complete monotone primitives to efficient non-monotone informed search,” in *Proc. IEEE Int. Conf. Robot. Autom. (ICRA)*, 2021.