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SPATIAL ANALYSIS OF CONTEMPORARY ONE-ROOM APARTMENT LAYOUTS IN TASHKENT'S NEW RESIDENTIAL BUILDINGS

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Abstract: This paper presents an in-depth analysis of over eighty "one-room" apartment floor plans from newly built residential buildings in Tashkent, Uzbekistan. The study identifies common spatial patterns in these compact dwellings, examining how rooms are arranged, how circulation flows, and how effectively the limited space is utilized. We evaluate the ergonomics and usability of typical layouts, highlighting frequent design issues such as overly tight kitchens, constrained bathroom areas, single-sided natural lighting, and inefficient use of hallways. These observed patterns are then compared against Uzbek residential building norms and standards – for example, minimum room sizes and daylight requirements – to assess compliance and areas for improvement. Based on best practices in micro-apartment design and Uzbekistan's building codes, the paper proposes design improvements to enhance compact unit livability, such as more open-plan configurations, multi-functional furniture integration, and better access to natural light. We further explore how generative design tools and AI-based approaches can optimize layouts for space efficiency and ergonomics, even beyond the solutions seen in current plans. The use of AI is illustrated through examples of floor plan generation and layout optimization, demonstrating potential innovative configurations that meet or exceed human design outcomes. The findings aim to inform architects, developers, and policymakers on creating more functional and comfortable one-room apartments in the context of Tashkent's rapid urban development.

Keywords: One-room apartment; micro-apartment design; floor plan typology; ergonomics; residential standards; Tashkent housing; generative design; AI in architecture.

Introduction

Tashkent's housing market has seen a surge in one-room apartments (studio and one-bedroom units) in new multi-story developments, driven by urbanization, affordability concerns, and changing household sizes. These compact units – typically ranging from about 30 to 45 m² in new buildings – must balance functionality and comfort within a limited footprint. Historically, Soviet-era one-room "1 room" apartments in the region were around 32–33 m² in standard panel buildings [2], with a separate small kitchen and a combined living/sleeping room. Contemporary developments are gradually increasing unit sizes (often 38–45 m² for a one-room in improved designs) and adopting more open layouts, but the challenge of designing an efficient small home remains significant.

There is a strong need to analyze the prevailing spatial layouts of these modern one-room units to understand how well they address residents' needs. Prior studies on residential design in Uzbekistan have mostly focused on macro-scale planning or Soviet-era housing norms [2], with less attention to the interior layout of small apartments. This paper addresses that gap by examining 80+ floor plans collected from Tashkent's recent residential projects (2018–2025). By identifying common layout typologies and evaluating them against human ergonomic needs and local building standards, we can pinpoint design shortcomings and suggest targeted improvements.

Building regulations in Uzbekistan provide a baseline for evaluating these layouts. According to the Uzbek construction and sanitary norms (e.g. ShNK 2.08.01-05 and SanPiN 0146-04), a one-room apartment should have a minimum total area of about 38 m² [1], including a living/sleeping room of at least 20 m² and a kitchen of at least 8 m² [1]. The standards also prescribe minimum widths for corridors and bathrooms (e.g. an entry hallway ≥1.6 m wide, a combined bathroom ≥2.2 m in the smaller dimension) to ensure usability [1]. Adequate natural light and ventilation are emphasized: at least one room must receive 2.5 hours of sunlight in a one-room unit and cross-ventilation or operable windows should facilitate air flow [1]. Our study uses these norms as a benchmark to evaluate whether contemporary designs are meeting or exceeding traditional requirements.

In addition to code compliance, we consider best practices from residential microarchitecture around the world. Designers of small apartments often employ strategies to maximize the sense of space – such as open-plan layouts, built-in storage, and multi-functional furniture – and to ensure every square meter serves a purpose [3]. Innovative solutions (for example, sliding partitions, mezzanine beds, or transforming furniture) can greatly enhance livability in a studio apartment. The introduction of AI tools and generative design in architecture offers new opportunities here: recent advances show that AI can generate novel floor plan configurations and optimize layouts based on various criteria. This paper will also explore how such AI-generated suggestions could be applied to Tashkent's one-room apartments, envisioning improvements in layout, ergonomics, and even aesthetics beyond what is found in current practice.

Methodology

Our research began with the collection of floor plans for one-room apartments in newly built Tashkent residential complexes. Plans were gathered from open sources: developers' brochures, real estate listings, and architectural portfolios. We focused on apartments labeled as "1-room" units (which typically include one main living space plus kitchen and bath), ensuring a sample representing various districts and building types. In total, 84 distinct floor plans were compiled. Each plan was standardized for analysis by extracting key parameters: total area, room dimensions, presence of a separate kitchen vs. open kitchenette, number of windows and orientation, existence of a foyer or corridor, bathroom type (combined or separate WC), and any special features (e.g. balcony, alcove, irregular shape).

We employed both quantitative and qualitative analysis. Quantitatively, we tabulated room areas and proportions: the average one-room unit in our sample measured 40.2 m², with the smallest at ~28 m² and the largest ~52 m². We compared these against Uzbek standards – for example, checking if the kitchen area met the 8 m² minimum and if the living room was at least 20 m² [1]. We also measured corridor lengths and bathroom sizes to evaluate circulation efficiency and compliance with ergonomic guidelines (such as the 1.6 m minimum hallway width) [1]. Qualitatively, we examined how each layout allocated the functional zones (entry, kitchen, living/sleeping, bathroom, storage) and mapped the circulation flow from the entrance through the space. This allowed us to identify recurring typologies – patterns of layout configuration that appeared across multiple apartments.

Using a comparative approach, we clustered the plans into three primary typologies based on kitchen arrangement and spatial organization (see Table 1). For each typology, we assessed advantages and disadvantages in terms of ergonomics, daylight access, privacy, and flexibility. We then evaluated each cluster against local building norms and modern best practices. Any

design issues – such as awkward room proportions, under-lit areas, or wasted circulation space – were noted for discussion.

Finally, we explored AI-driven generative design methods as a means to propose alternative layouts. We reviewed recent research on AI in floor plan generation, including Generative Adversarial Networks (GANs) that learn from existing layouts and rule-based algorithms, to understand how an AI might rearrange a 1-room apartment for optimal use. We did not generate new plans from scratch in this study; instead, we conceptually integrated AI suggestions (drawn from literature and precedent) into our improvement proposals. For instance, if many human-designed plans failed to provide a dedicated sleeping nook, we considered whether an AI-generated layout could incorporate one without sacrificing other functions. These AI-informed proposals are discussed in a dedicated section, bridging the gap between identified issues and potential innovative solutions.

Table 1. Common layout typologies identified among one-room apartments in Tashkent (sample of 84 units).

Typology	Description	Prevalence
Type A: Separate Kitchen	Traditional layout with a walled-off kitchen (8–10 m²) and a single living/bedroom. A small entry hall leads to each room and the bathroom. Offers clear functional separation but can feel cramped in kitchen; living area ~18–20 m² [1]. Typically one window in living room and one in kitchen (if on exterior wall).	~40% of plans
Type B: Open-Plan Studio	Modern layout combining kitchen and living space into one multi-functional room. No full-height wall between kitchen and main room (often an open kitchenette along one wall). Maximizes sense of space and light [3], at the expense of visual separation. Often has an entry vestibule opening directly into the living/kitchen area. One large window or balcony door lights the entire space.	~45% of plans
Type C: Semi-open or Niche	Hybrid layout with a partially separate kitchen or a sleeping alcove. E.g., an L-shaped room where the kitchen is around a corner, or a sliding partition to section off a bed area. A small foyer may be present. Aimed to combine benefits of separation and openness, but require sufficient area (usually larger units ≥45 m²). Many include a balcony extending the living space.	~15% of plans

(Note: Prevalence is approximate, based on our sample. Balconies were present in ~70% of all units, typically 3–5 m² in size.)

Results and Discussion

Spatial Patterns and Layout Typologies: The analysis revealed clear recurring patterns in how one-room apartments are organized. Type A (Separate Kitchen) units closely resemble the legacy Soviet layouts – a compact foyer connects to a small enclosed kitchen, a bathroom, and the main multi-purpose room. For example, in several plans around 35 m², the entry opens to a 4 m² corridor leading to a ~9 m² windowed kitchen on one side and a 18–20 m² living/bedroom on the other, with a combined bath of ~3.5 m² near the entrance. This aligns with older standards that called for a vestibule and separated rooms [2]. The advantage is that cooking

smells and clutter are confined to the kitchen, and the living/sleeping area can be kept more private. However, the kitchen's tight size (often near the minimum 8 m² [2].) sometimes makes it barely eat-in, and the extra walls reduce natural light penetration. In such layouts, the living room is the only true living space – ergonomically, it must serve as living room, bedroom, and often dining area, which can be a challenge when its area is at the lower end of standards (some observed as low as 16–18 m², under the 20 m² norm) [2]. Circulation in Type A is straightforward – one can typically move in a T-shaped route from entry to each separate room – but the corridor, while providing a buffer, consumes precious space for mere passage.

Type B (Open-Plan Studio) layouts were slightly more prevalent in our sample, reflecting contemporary design trends. These units eliminate or lower the partition between kitchen and living area, instead creating one open great-room that accommodates cooking, dining, and sleeping functions. We found many examples ~40 m² where the entrance door opens directly into the main space (sometimes with a short foyer or wardrobe niche by the door, sometimes not). The kitchen appliances and cabinets line one wall of the living room or occupy one corner as an L-shaped kitchenette. This openness improves sight lines and daylight – the single window or balcony in the living area also lights the kitchen zone, avoiding the claustrophobia of a closed tiny kitchen. Residents and designers often prefer this for its spacious feel in a small footprint [3]. Indeed, as Mizrahi et al. note, "the most important thing in designing a small apartment is to create a sense of space – remove walls, widen openings…choose bright and well-lit colors" [3]. Our observations confirm that these open studios feel larger than their square meterage, especially when light finishes and minimalistic furnishings are used (a common feature in staged new units). The trade-off is functional: with no separation, cooking odors and noises permeate the living area, and there is no visual privacy – a concern if, for instance, one person is sleeping while another cooks or works. Another issue is entry direct into the living space, which about half of Type B plans exhibited. Without a vestibule or even a small partition by the door, there is no "transition" space to drop shoes or coats, meaning the outside dust and noise can spill right into the living area. Some plans tried to mitigate this by a partial height screen or closet near the door, creating a tiny entrance alcove, which is a wise design choice for both practicality and Feng Shui (in local culture, a direct view from door to bed is often undesirable). Despite these issues, Type B layouts generally offered more flexible furnishing options – e.g. one can place a sofa-bed, a small dining table, and reconfigure the space as needed, since it's one continuous room.

Type C (Semi-open or Niche) represents a creative middle ground and was less common, found mostly in larger one-room units (45 m² and above) or corner apartments with multiple windows. These layouts include some form of partial separation within the main space. A typical example is a studio with an alcove or recess that can fit a bed, sometimes enclosed with a sliding glass partition or a curtain – effectively creating a pseudo-bedroom. Another example is a plan where the kitchen is semi-enclosed by a half-wall or placed in a niche around a corner, so it's out of direct sight from the living area but not fully a separate room. One 50 m² one-room plan we studied had a small L-shaped hallway; one branch led to a corner kitchen (with a wide opening instead of a door) and the other branch to the main 22 m² living room – this is essentially a "Euro" two-room layout marketed as a one-room, where the kitchen is large enough to serve as a kitchen-diner. The benefit of Type C configurations is an improved sense of order: the bed or kitchen mess can be screened off, making the rest of the space feel tidier and purpose-specific. It also aligns with the idea of "zoning" a small apartment without full walls, which experts recommend – using elements like glass partitions, shelving, or different materials to demarcate areas while keeping openness [3]. However, such designs demand a bit more floor area or an

extra window. In units that had a corner position in the building (with two exterior walls), architects sometimes could give the living area one window and the kitchen alcove another smaller window – achieving a rare dual-aspect one-room apartment. Those are very desirable for cross-ventilation and daylight, but naturally limited in number. Overall, Type C plans show an effort to enhance functionality (nearly creating a mini two-room unit) but must be carefully designed to avoid awkward angles or excessively subdividing the limited space.

Ergonomics and Circulation: Across all typologies, we evaluated how comfortable and efficient the layouts would be for daily use. Many of the Tashkent one-room plans are ergonomically sensible in basic dimensions – thanks in part to adherence to building norms – but some recurring problems were identified:

Compact Kitchens: In Type A and some Type C units with separate kitchens, the kitchen often measures 8–9 m², just meeting the minimum standard [2]. While technically sufficient for a single user, this size allows only limited counter space and perhaps a two-person breakfast table. We noted instances where the refrigerator or oven door could conflict with the entry door due to tight layouts, or where the sink/stove/refrigerator work triangle was not optimally arranged (e.g. all appliances crammed on one wall segment). In open-plan studios (Type B), the "kitchen" is essentially a kitchenette along one wall of the living room – typically about 2–3 m of linear cabinets. This saves space, but care must be taken in design: ergonomically, one should have at least 1.2 m free in front of the kitchen counter for a working aisle. In a few very small studios (~30 m²) this was violated – e.g., a sofa was placed only 0.8 m opposite the kitchen counter in the developer's furnished plan, which would make it hard for two people to pass. In general, circulation around the kitchen and entry areas tended to be the tightest. An AI-based layout analysis could potentially flag these pinch points; for instance, a deep-learning model could learn ideal clearances and suggest nudging a wall or using a space-saving sliding door for the bathroom to improve movement flow (a consideration we did not see in any human-designed plan, where most bathroom doors were standard swing types).

Bathrooms: All one-room apartments in the sample had combined bathrooms (toilet, sink, and shower/bath in one room), as expected for space efficiency. Sizes ranged from 3.2 m² to about 5 m². The smallest often struggle to fit a washing machine – a necessity in most Uzbek apartments – leading developers to sometimes omit it in the plan graphics. A combined bath of ~3.5 m² (commonly 1.7 m × 2.1 m) can squeeze in a tub or shower, but if a washing machine is added, it impedes circulation. The building norm requires 3.5 m² minimum for a combined bathroom in a one-room unit [1], which most meet, but the layout within the bathroom is critical. Some plans cleverly used a corner shower to free up floor space, or recessed a washing machine under a counter. Others had the door swing inward, nearly hitting the sink – a poor design choice that could be improved by reversing the door or using a sliding door (none of the surveyed plans showed sliding bathroom doors, perhaps due to cost or convention). Also, the norms specify not to place toilets directly adjacent to bedrooms in multi-room units (to reduce noise) [1]; in a studio, this translates to not locating the bed immediately next to the bathroom wall if possible. A few layouts did have the bed or sofa backing onto the bathroom wall – residents may later realize noise from flushes and plumbing could disturb sleep if insulation is poor. Better layouts placed the wardrobe or kitchen storage along the bathroom wall, buffering the sound – a subtle ergonomic consideration.

Circulation and Entrances: The entry zone in these small apartments is critical for functionality. Roughly half the plans provided a distinct entry hall or corridor (1–2 m² in studios, up to 4–5 m² in larger units), often with a coat closet niche. The other half opened directly into the living

space with minimal transition. While eliminating a corridor saves space for the rooms, it can diminish privacy and neatness. Best practices suggest having an entry foyer, even if compact, to serve as a drop zone and to psychologically mark the entrance [3]. Our evaluation favors layouts that allocate ~4 m² for entry and corridor in a one-room unit – indeed Uzbek norms list 4 m² as a guideline for one-room apartment hallways [1]. Some Type B studio layouts barely had 1.5–2 m² by the door, which likely means shoes would end up cluttering the living area. In terms of flow, simpler layouts (with fewer doors and turns) generally felt more spacious. The presence of a long corridor (>3 m) in a small unit was actually a negative from a space-use perspective – it's essentially "dead" space solely for walking. Only 10% of plans had such long corridors (usually legacy-inspired designs or in penthouse-like one-rooms), but those units felt much less efficient. Ideally, circulation is integrated with living space in micro-apartments – for example, an entry corridor that doubles as a gallery wall or a bookshelf passage. One standout plan in our sample placed a bookcase and a small desk along a 1.8 m-wide entrance hallway, turning it into a usable home office nook rather than just a pass-through. This clever utilization aligns with expert suggestions to use every inch: "using the hallway wall with proper carpentry can provide storage space" [3]. Overall, the best layouts minimized purely circulatory space and instead made necessary pathways do double-duty (e.g., a widened corridor becomes a closet or laundry zone).

Natural Light and Ventilation: Most one-room apartments are single-aspect, meaning they have windows on only one exterior wall (typically the side with the balcony or main window). This is inherent to multi-family buildings – one-room units are often placed in the middle of floor plates, with only one side facing outside. Consequently, achieving abundant natural light and cross-ventilation is challenging. We found that about 75% of the plans had a single large window (often a glass balcony door ~1.5 m wide) in the main room, and no window in the kitchen (if separate) or bathroom. The Uzbek norms mandate a certain level of daylight and insolation: at least one living space should receive ~2.5–3 hours of direct sun [4]. This depends on orientation – something we could not assess from plans alone – but assuming many units face east or west, they might meet that in the living room. However, separate kitchens without windows (few cases where kitchen was oddly interior) would violate daylight requirements. In our sample, all Type A separate kitchens did fortunately have a window except one plan (which was a peculiar L-shaped unit where the kitchen borrowed light from the living room via a pass-through – an awkward design likely done to fit the building shape). Ventilation is another concern; cross-ventilation (breeze through two sides) is typically not possible in a one-room unit unless it's dual-aspect on a corner. The building guidelines encourage through ventilation in low-rise buildings [1], but for high-rises, mechanical ventilation is often provided. Some modern Tashkent buildings include air ducts or at least exhaust fans in kitchens and baths. None of the plans explicitly showed HVAC systems, but it's expected in new construction. We did note the presence of balconies with operable doors in many units – a valuable feature for air exchange and an extension of living space. A balcony effectively acts as a "semi-outdoor" room, useful in the warm climate of Tashkent for drying clothes or sitting outside. Uzbek norms consider balconies and loggias as "summer spaces" and recommend at least 1.5 m depth for usability [1]. Most plans met this, with typical balcony depths around 1.2–1.5 m and widths that varied. A few "French balconies" (shallow Juliet-style) were seen in smaller units, offering just a railing and door – these provide less utility but do allow floor-to-ceiling glazing for more light. Overall, while daylight in the main space was usually adequate, lack of natural light in bathrooms (standard) and sometimes kitchens can make those areas dependent on artificial lighting even during day. Designers could consider solutions like transom windows or glass

blocks to borrow light from the living room into the kitchen or bath – none of the surveyed plans used this trick, but it's a known tactic to brighten interior rooms without direct windows.

Design Issues and Compliance with Standards: When juxtaposing the observed layouts with Uzbekistan's residential design standards, a mix of compliance and deviations emerges. On one hand, the new one-room apartments often do adhere to or even exceed the minimum area requirements set out in regulations. For instance, the average total area in our sample (~40 m²) is above the 38 m² minimum [1]. This reflects a trend towards slightly more spacious units compared to Soviet-era norms (where many one-room flats were 32–35 m² [2]). Kitchens in nearly all plans were around 8 m² or larger, aligning with the minimum size [1], – a notable improvement over the tiny 5–6 m² "Khrushchevka" kitchens of the past [2]. The inclusion of a balcony in most designs also shows compliance with modern expectations for amenity, and the sizes were within the allowed 25% of unit area [1].

However, several issues stood out that suggest room for better alignment with ergonomic best practices (if not strict code violations). Storage space is one. The norms recommend built-in storage (closets or storage rooms) totaling around 2.5 m² in a one-room apartment [1]. In reality, only about 30% of the plans explicitly showed storage closets (usually a 0.6 m deep closet near the entrance). Many plans rely on the occupant to furnish wardrobes in the living area, which can clutter the space. Dedicating a small walk-in closet or at least a recessed wardrobe in the layout would vastly improve functionality – a few larger one-room layouts did this, but the majority did not seem to prioritize storage beyond kitchen cabinets. Given that "any item that doesn't have a designated place will become a problem" in small homes [3], providing adequate storage volume is crucial.

Another concern is compactness vs. comfort. Some plans, in pursuit of compactness, resulted in awkward proportions – for example, very long and narrow main rooms (one was 3 m × 7 m, making furniture arrangement difficult, essentially a bowling alley problem). While that unit technically had the required area, its shape was not optimal for usability. A square or gently rectangular room tends to be more flexible. Overly narrow rooms violate no specific Uzbek norm but can fail the furniture layout test: one should be able to fit a bed or sofa and still walk around it easily. In one narrow plan, placing a double bed left only a 0.5 m sliver to reach the balcony – an obvious functional flaw. This hints that some plans may be dictated by structural constraints (like column spacing or facade composition) more than interior design logic. Architects should iterate to avoid such outcomes, potentially with computational tools that test multiple layout variations for furniture fit.

Natural lighting requirements are generally respected in that every unit had at least one sizable window. Yet, the spirit of the norms – ensuring a healthy, sunlit environment – could be better achieved by orientation-sensitive design. If many one-room units face north, for instance, they might receive limited direct sun, affecting insolation standards [4]. While our data did not include orientation specifics, this remains a consideration for large developments: planners could arrange building masses such that small units get more favorable orientations or are shallow enough to borrow light from two sides (e.g. via corner glazing).

Finally, sound insulation and privacy are areas not evident from plans but important in practice. Small apartments magnify any lack of privacy – e.g. having the bathroom open right into the kitchen or bed area is less than ideal (some norms suggest placing baths near entry or kitchen to keep them out of immediate view of living spaces [1]). Most plans did position bathrooms by the entrance or kitchen, which is good practice. However, none showed additional

soundproofing measures. Future designs might incorporate, say, a sound-insulated bathroom wall or a door foyer to buffer noise from the building corridor – these are subtleties often missed when developers focus on saleable area.

In summary, current one-room layouts in Tashkent's new buildings demonstrate functional basics but leave room for improvement in compact space planning. By studying these patterns, we see an evolution from older separated layouts towards openness, yet also persistent issues like under-provisioned storage and reliance on a single light source. The next section discusses how we can address these shortcomings, leveraging both best design practices and emerging AI-assisted methods to optimize micro-apartment layouts.

AI-Based Proposals for Layout Optimization

While human designers have created competent solutions for one-room apartments, AI-generated suggestions offer a promising avenue to explore further optimizations that might not be immediately obvious. Recent advances in generative design show that algorithms can propose innovative configurations for small spaces, sometimes finding layouts that maximize usability in ways a human designer might overlook. In this section, we integrate AI-based ideas into our improvement proposals, addressing specific issues identified in the preceding analysis.

1. Generative Layout Alternatives: Generative Adversarial Networks (GANs) [7] and other machine learning models have been applied to floor plan design to create new layout options. For instance, FloorplanGAN [5], can produce realistic apartment layouts by learning from thousands of examples. Such a model, if trained on compact apartment plans, might generate variations that reorganize the space more efficiently. In our context, an AI might suggest swapping the position of the kitchen and living area, or reconfiguring internal partitions in ways not tried by the original architects. An example from research is ArchiGAN, [6], a generative system that produces apartment floor plans given a building outline. ArchiGAN can fill in internal walls and room arrangements autonomously – when applied to a one-room unit footprint, it could explore different ways of partitioning the space (including perhaps creating that semi-open niche for a bedroom that many human-designed plans lack). Figure 1 illustrates a concept where an AI has been given the outer boundary of a one-room apartment (say 6 m by 7 m rectangle with one entry door and one balcony door) and is tasked with allocating zones. The AI might output multiple options: one with a central sleeping pod and circulation around it, another with all wet zones aligned on one side and open living area on the other, etc. By evaluating these, architects can gain fresh perspectives. Notably, a recent model called GenPlan [8], uses deep learning (with encoders and graph-based decoders) to automatically generate floor plans, first predicting room centers then refining room shapes. GenPlan was shown to produce creative layouts comparable to human designs. Integrating such AI tools, a designer in Tashkent could generate dozens of one-room apartment layouts in minutes, all meeting basic adjacency rules, then filter them for the best ergonomic outcomes. This could, for example, reveal a layout where a diagonal partition creates a foyer and angled kitchen that improves sightlines and flow – a non-intuitive solution a GAN might propose.

2. Space Optimization and Multi-functionality: AI can assist not only in wall layout but also in furniture placement and multi-functional design. Small apartments benefit hugely from built-in, transformable furniture (a fact well recognized by interior designers [3]). We envision using algorithms to optimize furniture arrangements and storage solutions. One approach is applying reinforcement learning to space layout, as explored by Kakooee and Dillenburger [11], who used AI to iteratively improve room layouts and furniture positioning. In a one-room apartment,

an AI agent could trial different furniture configurations (bed against wall vs. sofa-bed, table near window vs. near kitchen) and evaluate them based on criteria like walking clearance, functional groupings, and even aesthetics. For example, an AI might discover that angling a sofa at 30 degrees in a corner yields better circulation to the balcony and a perceived spaciousness, something a human might not try by default. Another AI-driven idea is generating modular furniture designs tailored to the specific dimensions of the unit. There are already parametric design tools that, given a room's measurements, can output an optimal storage unit or "living wall." We could feed the exact shape of an alcove or corridor into a generative design program and have it propose a built-in unit that fits perfectly and serves multiple purposes (wardrobe + desk + entertainment center). Such solutions were seen in one case by human designers – the "white box" in the Studio XS project which incorporated a TV stand, folding dining table, and storage all in one wall unit [3]. AI could take this further by rapidly exploring combinatorial possibilities: e.g., what if the entire bathroom wall becomes a built-in cabinet from the living side, or if the bed is elevated to incorporate drawers or a pull-out desk beneath? These kinds of integrated solutions can dramatically increase usable space without enlarging the apartment. We propose using generative design to create such custom multi-functional elements. A generative algorithm could output dozens of permutations of a "storage wall" given a 3 m stretch of wall, and optimize for maximum storage volume and utility. The designer can then pick or refine the best idea (perhaps a wall bed that folds up to reveal a dining table – concepts which exist commercially but can be fine-tuned to the specific layout via AI suggestions).

3. Enhanced Daylight and Ventilation Solutions: AI tools can also contribute to improving environmental quality in these units. One might assume there is little to be done if a unit has only one window, but AI-driven analysis software like Autodesk's Spacemaker uses algorithms to evaluate sunlight and airflow in urban designs. On the scale of a single apartment, similar principles apply – for instance, an AI could assess how far daylight penetrates from the window and whether a partition or furniture piece is blocking light. If an AI finds that a proposed sleeping partition significantly darkens the living area, it might suggest using translucent glass or a lower partition height. We suggest employing illumination simulations (which AI can automate) to determine optimal placement of any new partition or large furniture so as not to impede natural light. Additionally, AI could help design passive ventilation features: perhaps identifying the optimal position for a transom above a partition or a secondary vent to encourage air flow from the main room to the bathroom. While these are minor architectural details, in small apartments they make a difference in comfort. A generative approach might, for example, test various sizes of an interior window between the kitchen and living area (in a Type A layout) to see which provides the best balance of light sharing and privacy.

4. AI as a Creative Collaborator: Beyond direct generation of layouts or furniture, AI in the form of language models (like ChatGPT) can serve as a creative assistant to architects during the design process. This can be valuable in brainstorming solutions for the challenges found in Tashkent's one-room apartments. Recent work by Rane et al. [9], and others has shown that integrating conversational AI tools can enhance the early design stage by providing suggestions and even critiquing layouts. For example, an architect could prompt an AI: "Given a 35 m^2 studio with one window, how can I separate a sleeping area?" and the AI might suggest a few ideas (curtains, sliding door, bookshelf divider, etc.), possibly referencing known designs. The RBDS AI Lab [10], reported an experiment where ChatGPT acted as an "Architect's Collaborator," generating design options in dialogue with the human. We propose employing such an approach: using a chatbot with architectural knowledge to iterate on floor plan tweaks.

In practice, the architect could say, "I have 1.2 m of unused corner near the entry, what can I do with it?" and the AI might respond with proposals like "Add a built-in corner bench with shoe storage" or "Place a translucent shelving unit to create a foyer feel". These suggestions, while not guaranteed to be novel, can inspire the human designer to consider solutions outside their initial repertoire. This human-AI co-creation can lead to more refined outcomes – the human ensures practicality and compliance with codes, while the AI contributes outside-the-box ideas and helps evaluate multiple scenarios rapidly [3].

In implementing AI-based proposals for Tashkent's one-room apartments, it's important to tailor the technology to local context. AI models should be fed data that reflect local living patterns (for instance, recognizing that a washing machine is usually placed in the bathroom or kitchen here, or that having a separated entrance is culturally valued). With such contextual training, AI could, for example, prioritize keeping the entry area distinct when generating layouts – aligning with local preferences for a dehliz (foyer). Moreover, AI tools can be constrained to follow Uzbek building norms as hard rules (minimum areas, etc.), ensuring that any generated design is not just creative but also viable and legal. By blending AI's exploratory power with the architect's contextual understanding, the resulting designs for micro-apartments could achieve new heights of efficiency and comfort.

To summarize the AI-driven suggestions: we see potential in using GANs and generative models to offer fresh layout configurations that break the monotony of current typologies, employing optimization algorithms to fine-tune space usage (especially regarding furniture and storage), and using conversational AI to enrich the design brainstorming process. Even if the original 80 floor plans did not explicitly use AI, integrating these tools now could lead to next-generation one-room apartments in Tashkent that are more adaptable, ergonomic, and pleasant to live in.

Conclusions

The extensive analysis of contemporary one-room apartment plans in Tashkent's new residential buildings reveals both strengths and weaknesses in current design practices. On the positive side, most units make efficient use of limited space and adhere to basic standards of functionality: they provide the essential rooms and amenities expected, often within 35–45 m², and reflect a gradual shift toward more open, flexible layouts. Common patterns include the traditional separate-kitchen typology and the modern open-plan studio, each with its own merits. We found that many designs meet the minimum requirements set by Uzbek building norms – for example, providing the stipulated living room and kitchen sizes [3], and including balconies for outdoor access. These new apartments generally improve upon Soviet-era precedents by offering slightly larger areas and a more livable configuration (e.g. fewer narrow rooms and more integrated spaces).

However, the research also identified recurring design issues that could be addressed to enhance the ergonomics and habitability of one-room units. Key among these are: insufficient built-in storage leading to clutter, lack of a defined entry space in many layouts, under-utilization of vertical space, and reliance on a single window for light and ventilation. Some apartments feel cramped not due to lack of total area but due to suboptimal internal organization – such as long corridors that waste space or partitions that unnecessarily block light. In a number of cases, kitchens and bathrooms, while meeting minimum size, are arranged in ways that hinder ease of use (for instance, tight appliance clearance or awkward door swings). These micro-level issues cumulatively affect residents' daily experience of the space.

Comparing current layouts with Uzbek residential standards and norms, it's clear that mere compliance is not enough; thoughtful design is needed to meet the spirit of those standards, which aim for comfort and hygiene (daylight, ventilation, noise control, etc.). For instance, a design might tick the box of 38 m² total area but still perform poorly if 4–5 m² of that are essentially unusable hallway. Thus, we recommend that architects and developers place greater emphasis on qualitative aspects of small apartment design – such as sightlines, furniture placement, and adaptability – in addition to quantitative metrics.

Based on best practices in residential microarchitecture, several improvements are proposed. Firstly, embracing open-plan configurations (where appropriate) can make small units feel larger and brighter, but should be complemented with clever zoning solutions (e.g. sliding partitions or half-walls) to allow privacy and mess containment when needed. Secondly, every one-room apartment should be designed with ample storage in mind – this could mean dedicating a closet room or building floor-to-ceiling cabinets in niches, as clutter is the enemy of small spaces [3]. Thirdly, multi-functional furniture and flexible elements should be considered early in the design phase; for example, designing a recess for a fold-down bed or a built-in dining table that can tuck away can significantly enhance usability. Incorporating these features at the design stage (rather than leaving it to the occupant later) ensures a more coherent and space-efficient outcome. Additionally, simple measures like using lighter color palettes, larger windows or French balconies, and mirrors or glass partitions can amplify the sense of openness and light [1] – techniques well documented in interior design literature and equally applicable here.

A distinctive angle of this paper was the exploration of AI-generated optimizations for these apartments. While still an emerging field, AI tools have shown they can produce valid and even innovative floor plans [2]. We discussed how AI could generate layout alternatives (potentially discovering new typologies), optimize the placement of elements for better flow, and assist architects in decision-making. The integration of AI is not meant to replace the human touch – especially important given cultural and lifestyle nuances – but rather to augment the designer's capability to find the best solution among countless possibilities. As the architecture industry in Uzbekistan and globally increasingly embraces AI [2], we anticipate that the next generation of micro-apartments might well be co-designed by humans and algorithms, resulting in dwellings that are smarter, more ergonomic, and more attuned to residents' needs.

In conclusion, one-room apartments will continue to be a vital part of Tashkent's urban housing stock, offering young professionals, couples, and small families an affordable entry into city living. By learning from the current patterns and proactively improving upon them, architects can ensure these small homes are not just minimal habitable units, but truly comfortable and efficient living environments. The findings of this study underscore the importance of careful interior planning in achieving that goal. We have highlighted practical design adjustments and introduced forward-looking AI-driven approaches – together, these strategies can lead to one-room apartments that feel far more generous and functional than their modest size would suggest. As Uzbekistan updates its housing standards and developers seek market differentiation, prioritizing quality of layout (the "inside-out" design approach) will be key. Ultimately, a well-designed one-room apartment improves the quality of life for its inhabitants, proving that good design, supplemented by intelligent technology, can make small spaces live large.

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