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Article

Integrating Smart Farm Systems into Office Environments: A Design Exploration Based on IoT and the Pasona Case

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Abstract: As environmental concerns and workplace well-being gain increasing attention, the integration of nature-inspired systems into office environments has emerged as a promising design direction. This study explores how smart farm technologies—particularly those based on the Internet of Things (IoT)—can be embedded within office spaces to enhance user experience, improve employee health, and contribute to a company's ecological image. Taking the Pasona headquarters in Tokyo as a case study, the research examines how plant cultivation systems, such as hydroponics and aerosol-based techniques, can be harmoniously incorporated into daily office life. Using a service design approach, the study identifies key service targets (employees, branding, partner relations), values (health, confidence, emotional reward), and components (plant species, cultivation systems, spatial layout). A conceptual model is proposed that integrates smart agriculture into various office zones—from cafeterias and rest areas to underground growing spaces—supported by IoT sensors and intelligent nutrient delivery systems. The results suggest that smart farms offer both tangible and emotional benefits, including enhanced air quality, physical wellness, and psychological satisfaction. This research contributes to the growing discourse on biophilic and sustainable workplace design, providing actionable insights for the application of IoT-enabled agriculture in urban commercial environments.

Keywords: Smart Farm; Office Space Design; User Experience; Internet of Things (IoT); Biophilic Environment

1. Introduction

The proliferation of community group-buying platforms has transformed grocery shopping in China, particularly in urban and suburban settings(R. Yang & Qi, 2023). These platforms allow users to purchase fresh produce and daily necessities at low prices through neighborhood-based orders, offering convenience, speed, and affordability(Kong et al., 2024). Among them, Duoduo Grocery, affiliated with Pinduoduo, has emerged as the dominant player, boasting the largest market share in this sector. Despite its commercial success, the platform has attracted widespread user dissatisfaction, especially in its after-sales service experience. On major consumer complaint platforms such as Sina's "Black Cat," Duoduo Grocery consistently ranks among the highest in unresolved user complaints, many of which center on refund processing, vague financial flows, and unresponsive customer service(Sander, 2023).

This growing discrepancy between platform popularity and user satisfaction reveals a significant gap in interaction design, particularly within the refund and return process(B. Yang et al., 2019). These issues are not only technical but experiential, often creating emotional stress, confusion, and frustration for users. The challenges are especially pronounced for elderly users, who often struggle with understanding interface logic, identifying actionable elements, or navigating through refund policies. As digital service platforms become increasingly central to daily life, addressing such usability gaps is essential not only for business performance but also for ensuring digital inclusivity(Fanea-Ivanovici & Pană, 2020).

While prior studies have explored the functionality of e-commerce interfaces, fewer have addressed after-sales experiences as a distinct phase of the customer journey(Sheth et al., 2023). Moreover, limited research has focused on the needs of senior users within fast-paced digital retail environments. This study seeks to fill this gap by investigating the pain points that emerge during the after-sales phase in the Duoduo Grocery app and proposing targeted design improvements grounded in user-centered design (UCD) principles(Cheng et al., 2020).

To this end, the study adopts a mixed-methods approach combining in-depth user interviews, journey mapping, persona construction, and interface audits(Al-Mhdawi et al., 2024). The research process revealed that refund-related operations often lack transparency, rely on overloaded interfaces, and fail to provide clear emotional feedback. Through synthesis of the user data and pain point analysis, we developed a design proposal that simplifies the refund path, improves the visibility of financial information, and enhances accessibility for less digitally literate users.

This study contributes to the broader discussion of how service design and interaction design intersect in mobile applications, especially in the context of daily-use platforms where user frustration can accumulate over time. It also highlights the role of emotional mapping and age-inclusive thinking in designing smoother, more reliable after-sales experiences.

The remainder of this paper is organized as follows. Section 2 reviews related work on after-sales interface design, user experience in grocery apps, and the challenges faced by elderly users in mobile interaction. Section 3 outlines the research methodology and data collection process. Section 4 presents the major findings from user studies and interface evaluations. Section 5 proposes a design intervention and interface revisions based on the pain points identified. Section 6 discusses the theoretical and practical implications of the findings. Finally, Section 7 concludes the paper and offers directions for future research.

2. Literature Review

2.1 Smart Farm and IoT-Based Agriculture

The Smart farming represents a transformative shift in the agricultural sector, where digital technology—particularly the Internet of Things (IoT)—is used to monitor, control, and optimize farming processes in real time(Soussi et al., 2024). Unlike traditional agriculture that relies on manual labor and environmental intuition, smart farms use interconnected systems of sensors, automated equipment, and data platforms to manage variables such as temperature, humidity, light intensity, soil moisture, and nutrient delivery. These systems reduce labor dependence, increase yield precision, and support sustainable resource usage.

At the heart of smart farming is the application of IoT technologies. Sensors embedded in soil, water tanks, air circulation systems, and plant beds continuously gather data about growing conditions. This data is then transmitted to centralized systems that analyze trends and send feedback commands to automated actuators. For example, nutrient pumps may adjust the chemical composition of water based on plant growth stages, or ventilation fans may be triggered if temperature thresholds are crossed. Combined with cloud platforms and AI analytics, this infrastructure enables predictive farming(Mansoor et al., 2025), where decisions are made based on historical data patterns and real-time input(Sloat, 2025).

Initially designed for use in large-scale outdoor farms and controlled-environment greenhouses, smart farming has begun expanding into indoor and urban agriculture(Dutta et al., 2025). With the rise of vertical farming, hydroponics, and aeroponics, food production is no longer confined to rural areas(Khan et al., 2020). Soilless cultivation techniques—especially nutrient misting systems used in aerosol-based farming—allow crops to be grown in compact, stacked environments, making them suitable for rooftops, basements, and indoor walls. These innovations significantly reduce water and land requirements while enabling hyper-local food production close to the point of consumption.

Smart farm adoption has grown steadily in East Asia, particularly in China, Japan, and South Korea(Babar & Akan, 2025), where dense urbanization and rising health consciousness have created demand for pesticide-free, traceable produce. According to industry reports, the global smart farming market is expected to exceed $30 billion by 2025, driven by rising investment in agri-tech and government sustainability initiatives. Yet, while much attention has been given to rural and peri-urban implementations, there remains a significant research gap in integrating smart farming into non-agricultural, human-centered spaces such as offices, schools, and public buildings（Figure 1）.

In such settings, the value of smart farming goes beyond food production(Fraser, 2022). It becomes part of a multi-functional design system that delivers environmental aesthetics, psychological comfort, and educational opportunities(Mohamed & Ali, 2023). Smart farms in offices are not primarily about yield—they are about experience, visibility, and symbolic value. The ability to see, interact with, and benefit from living plants can enhance perceptions of corporate sustainability, foster a sense of care among employees, and encourage workplace engagement. These benefits align closely with the principles of biophilic design and environmental psychology(Valor et al., 2024).

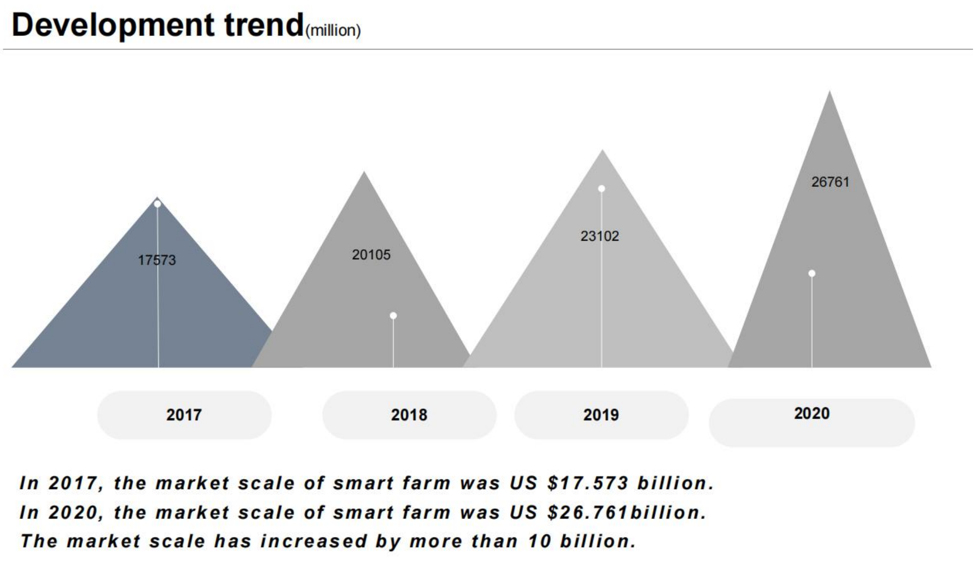

Figure 1. Growth Trend of the Global Smart Farming Market

However, the integration of smart farming into office environments presents unique challenges. Issues of air quality control, lighting infrastructure, system maintenance, and spatial compatibility must be addressed through thoughtful design. Additionally, the emotional and behavioral responses of users interacting with living systems in professional contexts require deeper exploration. This study builds upon existing smart agriculture research while shifting the focus from productivity to experiential integration—laying the foundation for a design-led approach in the following sections.

2.2. Biophilic Design and Workplace Well-being

Biophilic design is an architectural and spatial design philosophy that emphasizes the incorporation of natural elements into built environments to promote psychological and physiological well-being. Rooted in Edward O. Wilson’s “Biophilia Hypothesis,” which posits that humans possess an innate affinity for nature, this approach has evolved into a widely recognized framework in architecture, interior design, and environmental psychology. The goal of biophilic design is not merely aesthetic—it aims to create environments that reduce stress, improve cognitive performance, and restore attention through exposure to natural forms, materials, and processes.

A growing body of empirical research has validated the health benefits of biophilic interventions. Studies have shown that visual access to greenery, the presence of indoor plants, and even indirect representations of nature (such as natural patterns and organic materials) can lower cortisol levels, enhance mood, reduce perceived fatigue, and increase task performance(Chen et al., 2025). In office settings specifically, biophilic elements have been associated with improved employee satisfaction, reduced absenteeism, and enhanced productivity(Hebb et al., 2010). These outcomes make biophilic design not just a wellness strategy, but also a tool for organizational resilience and performance optimization.

Traditionally, biophilic interventions in workplaces have taken the form of passive or decorative additions: potted plants, green walls, daylight optimization, and nature-inspired surfaces. While these have proven effective in many cases, their impact is often limited by static presentation and low user engagement. In recent years, there has been increasing interest in interactive biophilic systems—design features that allow users to participate in the growth, care, or observation of natural elements in real time. This is where the integration of smart farming technologies presents a unique opportunity.

Smart farms offer a new layer of biophilic interaction by making natural systems both visible and intelligent. Unlike traditional indoor plants, smart farms evolve over time, respond to environmental inputs, and provide real-time feedback to users(Hati & Singh, 2021). The presence of nutrient delivery systems, LED lighting, and IoT-enabled sensors transforms the act of observation into an experience of co-living with nature. For office workers, engaging with a dynamic plant system—one that visibly grows, reacts, and even produces edible results—can foster a sense of connection, purpose, and continuity that static greenery cannot achieve(Shahda, 2025).

Moreover, workplace-based smart farms can address multiple wellness dimensions simultaneously. Physically, they contribute to better indoor air quality and humidity regulation. Psychologically, they offer moments of rest, reflection, and accomplishment(Shahda, 2025). Socially, they can become shared touchpoints where employees gather, discuss, or even collaborate in tending the crops. From a symbolic perspective, they communicate organizational values such as sustainability, innovation, and care.

However, despite these potentials, very few studies have examined smart farms through the lens of biophilic design. Existing literature tends to separate agricultural innovation from spatial wellness, treating smart farming as a technical tool rather than a human experience platform(Mansoor et al., 2025). This study bridges that gap by exploring how IoT-driven agriculture can serve not only as a food system but as a living biophilic infrastructure embedded within everyday office environments. In doing so, it contributes to a more holistic understanding of how digital systems and natural processes can be co-designed to enrich workplace well-being.

3. Methodology

3.1 Research Methodology and Case Selection

This study adopts a design research approach grounded in service design thinking, combining case-based analysis with speculative modeling(Caratelli & Misuri, 2024). Rather than relying solely on empirical testing, the project emphasizes conceptual exploration, user-centered value mapping, and system integration logic. The methodology is informed by precedents in biophilic design, smart agriculture, and spatial experience research.

As a representative case, the Pasona Group headquarters in Tokyo was selected for its pioneering role in integrating agricultural elements within a corporate office environment(Caratelli & Misuri, 2024). This case demonstrates the feasibility of large-scale indoor farming in a high-density urban building and provides inspiration for how greenery, food production, and workplace functionality can be harmonized. The observational data and architectural layout from this case inform the spatial strategies and user scenarios modeled in this study（Figure 2）.

In addition to case analysis, a component-level breakdown of smart farm elements was conducted, focusing on three domains: (1) plant types and health values, (2) IoT technologies supporting cultivation, and (3) human-service touchpoints throughout the office environment.

Figure 2. Community at Pasona

3.2 Design Intent and Planning Strategy

The planning of the office-integrated smart farm was guided by three interrelated aspects: functional objectives, perceived user value, and implementation components. These aspects emerged naturally during the early-stage system configuration and layout ideation, and reflect both the operational intent of the design and the expected experiences it aims to deliver.

First, the functional objectives of the system were defined through proportional allocation of agricultural output. Approximately 60% of vegetables are reserved for internal use, primarily for employee meals in the cafeteria or for hosting guests. This ensures freshness, encourages trust in the growing process, and fosters a sense of ownership among staff. 25% of the produce is designated for online sale, serving as a brand communication strategy and enhancing the company's ecological image in the digital space. The remaining 15% is used as part of internal incentive schemes or gift exchanges, such as rewarding high-performing employees or presenting produce to partners, strengthening social bonds（Figure 3）.

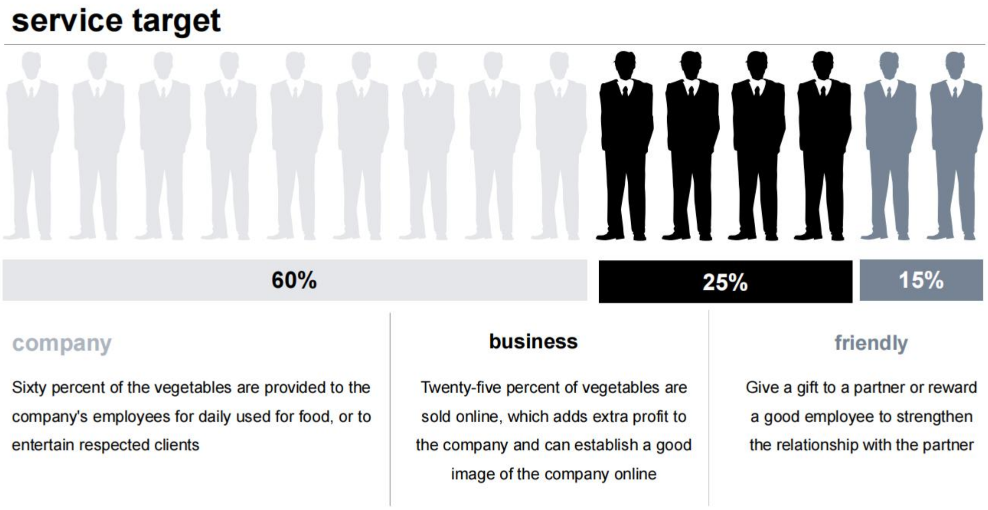

Figure 3. Allocation Strategy of Farm Output for Different Service Targets

Second, the project is driven by a clear set of user-oriented value propositions. Health is central to the system’s philosophy—crops are cultivated using pesticide-free hydroponic or aerosol techniques, and include varieties known for their nutritional and functional benefits (e.g., cardiovascular protection, immune enhancement, skin rejuvenation). Beyond physical health, the system also aims to promote emotional well-being. Employees have the opportunity to participate in light planting and harvesting tasks, which can foster confidence, engagement, and satisfaction. This interactive experience allows users to not only consume, but also witness and contribute to the life cycle of the plants—transforming food from a passive resource into an active co-created process.

Third, a diverse set of implementation components were selected to support the system’s functionality and integration into the office environment. These include:

A variety of vegetables tailored for short growth cycles, high nutritional density, and indoor compatibility, such as sprouted greens, water celery, and microspinach;

Soilless cultivation systems (hydroponics and aerosol-based) that reduce spatial footprint and allow modular vertical installation;

IoT-enabled controls for irrigation timing, nutrient solution concentration, temperature, and lighting—automated and optimized for low-maintenance operations.

These components are distributed across various zones in the workplace—including the reception area, rest spaces, corridors, cafeteria, and basement—based on their visibility, function, and environmental suitability. Rather than functioning as a singular farm unit, the system is envisioned as a network of micro-environments embedded throughout the office. This layout allows employees to encounter, observe, and interact with the smart farm in diverse contexts and moods throughout their daily routine.

Together, these planning strategies establish the foundation for the design proposal outlined in the next section, which focuses on spatial integration, user interaction points, and aesthetic-technical cohesion across the smart farm office ecosystem.

4. Design Proposal

4.1 Spatial Integration Strategy

The design proposal aims to reimagine the office not as a passive container for work but as a dynamic, living ecosystem that integrates plant life, technological systems, and user interaction. To achieve this, the smart farm system was distributed across five key spatial zones in the office. Each zone was selected for its functional potential, visibility, and experiential affordances, ensuring that the farm is not centralized in a single area but embedded throughout the daily flow of office life.

4.1.1 Reception Area

As the first point of contact for visitors and employees alike, the reception space is designed to act as a symbolic and communicative interface. A vertical farm installation featuring visually striking leafy greens or flowering plants welcomes guests while subtly expressing the company's ecological identity. Display panels can showcase harvest status or upcoming crop cycles, reinforcing transparency and technological sophistication.

4.1.2 Open Workspace

In the main office area, smart farm modules are installed along the periphery of open-plan desks or against windows, where light access allows for optimal growth. Here, the emphasis is not on harvest productivity but on creating a psychologically restorative environment. The presence of live greenery improves air quality, reduces stress, and introduces natural rhythms into the digital workflow. Employees can observe plant development passively throughout the day, offering micro-moments of calm and sensory variation.

4.1.3 Cafeteria and Lounge

The cafeteria serves as the most direct connection between cultivation and consumption. Smart farming units in this space are scaled for higher yield and include fast-growing edible crops such as lettuce, celery, or microgreens. Employees witness the transformation from plant to plate, reinforcing perceptions of freshness, safety, and self-sufficiency. The lounge area, adjacent to the cafeteria, offers occasional harvesting experiences where employees can pick selected vegetables for their own meals, introducing a tactile dimension to the otherwise digital office environment.

4.1.4 Corridors and Transition Zones

Transitional areas such as hallways, stairwells, or elevator lobbies often remain underutilized in office layouts. In this proposal, these spaces are activated through narrow, vertical hydroponic units that turn walls into ambient green surfaces. While less interactive than other zones, these installations contribute to spatial continuity and biophilic cohesion across the building. They also serve as ambient wayfinding elements, helping to orient users in a multisensory spatial landscape.

4.1.5 Basement and Subfloor Cultivation Zone

To support the higher-yield aspects of the system, the basement or subfloor level is repurposed as a controlled growing environment. Here, aerosol-based soilless cultivation is employed to optimize resource efficiency. The area is equipped with artificial lighting, climate control, and automated nutrient misting, allowing the growth of larger or more demanding vegetable species. While primarily functional, this zone is not closed off from users: guided tours or internal showcases can be offered periodically to highlight the system's operational depth and sustainability features.

Together, these five zones form a distributed smart farm system embedded within the architectural and experiential structure of the office. By spreading greenery throughout high-traffic and high-impact areas, the design avoids the pitfalls of centralization and maximizes employee exposure to living systems. More importantly, each zone offers a different mode of interaction—visual, symbolic, tactile, and consumptive—allowing users to engage with nature in ways that align with their roles, preferences, and rhythms at work.

4.2 Smart Farming Technology Deployment

To ensure the sustainability, functionality, and seamless integration of the smart farm system within an active office environment, a combination of soilless cultivation techniques and IoT-enabled environmental controls was deployed. The goal was to create a self-regulating agricultural infrastructure that requires minimal human maintenance while remaining sensitive to the rhythm and aesthetic expectations of workplace culture（Figure 4）.

The cultivation methods selected for the system include hydroponics and aerosol-based mist farming, applied according to spatial constraints and environmental needs. Hydroponic systems are distributed in areas with ambient light and open airflow—such as corridors and open workspaces—using compact troughs or vertical columns with nutrient-rich water cycles. In contrast, the aerosol-based approach is primarily implemented in the basement zone, where artificial lighting and climate control allow for precision farming. In this method, nutrient solutions are atomized and sprayed directly onto plant roots suspended in air, maximizing absorption efficiency and minimizing substrate use.

Figure 4. Smart Farm Components: Cultivation Results and Planting Equipment

Across these zones, a network of IoT sensors continuously monitors temperature, humidity, nutrient levels, light intensity, and CO_2 concentration. These inputs are collected and processed by a centralized control system that automates irrigation timing, lighting adjustments, and nutrient delivery. For instance, if light levels in a corridor drop below the preset threshold, full-spectrum LED grow lights are activated to ensure consistent photosynthetic support. Similarly, nutrient concentration sensors adjust the mixture in real time to align with the crop’ s growth stage, preventing both deficiency and waste. This automation minimizes the need for on-site personnel and ensures optimal plant health without interrupting office operations.

To further adapt to the architectural rhythm of the office, the system emphasizes modularity and low maintenance. Each cultivation unit is detachable and serviceable, allowing for seasonal crop rotation, deep cleaning, or spatial reconfiguration as needed. Maintenance cues—such as reservoir refills or system alerts—are signaled through embedded LED indicators, and interventions are scheduled during off-hours to avoid disrupting the workday. The modular approach also enables the selective expansion or scaling down of the system depending on spatial or organizational needs.

While the system largely operates autonomously, visibility and transparency are preserved through a digital dashboard that visualizes plant growth data and environmental conditions. Real-time information—including crop types, harvest timelines, and sensor readings—is displayed on screens in shared office spaces like cafeterias or lounges. This passive communication interface is not designed for management use, but rather to increase general user awareness and stimulate informal engagement. A companion mobile interface can also deliver personalized updates or harvest invitations, further strengthening the connection between employees and the living system around them.

In essence, the smart farming technology is embedded not as an isolated feature, but as an invisible infrastructure that supports both plant life and human experience. Its presence is not disruptive but ambient, forming a silent dialogue between automation and organic growth. The result is a technologically sophisticated but experientially calming system—one that promotes sustainability, well-being, and curiosity within the everyday logic of office life.

4.3 User Interaction and Feedback System

The smart farm system is not designed as a task platform for employees to manage, but as a living presence that invites observation, emotional connection, and occasional engagement. The interaction design focuses on lightweight, voluntary, and low-effort behaviors that align with the rhythms of daily office life while subtly enhancing users' sense of agency and participation.

The most basic level of interaction is visual exposure. By distributing cultivation units across various zones—reception, workspace edges, corridors, cafeteria—employees encounter the farm as part of their everyday movement. These spontaneous and passive moments of exposure are intentional: they reintroduce natural time cycles into otherwise uniform office routines. Employees may notice new leaves forming, plants gradually ripening, or mist systems activating briefly during breaks. These micro-observations anchor attention in the present, providing quiet satisfaction without requiring explicit action.

A second level of interaction is harvest engagement. In cafeteria or lounge zones, the system occasionally allows employees to pick selected vegetables for immediate use. Harvest events may be scheduled weekly or monthly, with notifications delivered via a mobile app or public dashboard. Participation is optional, framed more as a reward or ritual than as a duty. The act of picking a vegetable grown inside one's office reinforces feelings of trust, transparency, and personal investment in the system. It also fosters informal conversation and social cohesion—employees might share recipes, compare tastes, or discuss plant growth.

To support this light-touch engagement, the system includes a digital feedback interface. Displayed on wall-mounted screens and accessible through QR codes, the interface visualizes plant health, estimated harvest timelines, and system activity (e.g., "Today's nutrient mix: 40% spinach, 30% sprouted greens…"). This content is rendered in simple language and friendly visuals, avoiding technical overload. It is not meant to teach users agronomy, but to create a sense of shared journey—users see what the farm sees, and feel what the system feels.

In certain areas, interactive prompts may be introduced. For example, when a harvest nears, a screen might display: "This week's lettuce is ready! Take one home, leave a note." Or near a flowering installation in the corridor, a small placard might read: "Did you notice these bloomed since Monday?" These micro-prompts create narrative continuity and invite mindfulness, without demanding time or effort. Such elements function as emotional touchpoints—reminders that the office is not only a place of output but also a space of growth.

Importantly, interaction also extends to symbolic and social dimensions. The farm's output—vegetables, flowers, or herbs—can be used as corporate gifts, employee rewards, or wellness tokens. Receiving a salad grown in-house or offering a harvested gift to a coworker embeds meaning beyond the product itself; it becomes a gesture of care, recognition, and shared ecology. These designable rituals convert passive observation into memorable moments, bridging workplace function with emotional resonance.

Through this tiered interaction model—passive exposure, light participation, narrative prompts, and symbolic gestures—the smart farm system cultivates not only plants, but also relationships. It offers a low-barrier, high-reward channel through which employees can reconnect with natural processes, reframe their perception of office environments, and experience sustainability not as a policy, but as a presence.

5. Discussion

This study proposed a smart office farming system that blends Internet of Things (IoT) technologies, spatial planning, and user-centered design to reintroduce natural elements into the digital workspace. The findings reveal that beyond sustainability and automation, the system brings cognitive, emotional, and social value to users. This section discusses the broader implications of the design from three key perspectives: spatial meaning, emotional interaction, and design scalability.

First, the project redefines how nature can be embedded within office environments. Unlike traditional potted plants or passive greenery, the system' s spatial deployment—across entrance areas, corridors, windows, workstations, and rooftops—transforms these overlooked zones into dynamic sites of cultivation, observation, and reflection. These spaces serve not only ecological purposes but also act as experiential nodes that promote mindfulness, attentional restoration, and visual variation within otherwise monotonous workspaces. The integration of real-time environmental data and plant health feedback further enhances the spatial meaning, turning mundane corners into responsive micro-ecosystems.

Second, the design challenges conventional human-computer interaction paradigms by prioritizing emotional continuity over functional immediacy. The slow growth of plants, the gradual accumulation of environmental data, and the delayed but visible changes in the interface—all contribute to a slower, more reflective rhythm of interaction. This stands in contrast to typical IoT systems that emphasize speed, alerts, and control. In this proposal, interaction is ambient, indirect, and even contemplative. Users are not prompted to act, but are invited to feel. This opens new possibilities for designing emotionally resonant interfaces where the value lies not in utility but in presence.

Third, the project demonstrates how such systems can be scaled or adapted to different organizational cultures and building typologies. The modularity of the farming units, the cloud-based monitoring system, and the customizable interface design allow the system to function across corporate offices, co-working spaces, and educational institutions. Moreover, its emotional design elements—such as ambient lighting, visualization of plant moods, and symbolic growth feedback—can be reconfigured to reflect brand values, user preferences, or seasonal themes. This flexibility strengthens the system' s viability as a sustainable and adaptable infrastructure.

Moreover, this study responds to the growing discourse in human-computer interaction around affective symbiosis. Traditional smart environments often center on control, speed, and task fulfillment. By contrast, the smart farming system presented here engages users through slow, non-verbal, and ambient feedback. Plants do not 'respond' in the digital sense, yet their growth, change, and vitality create a persistent emotional presence. This shifts the user-system relationship from one of control to one of companionship, suggesting a redefinition of what "interaction" means in the context of natural systems.

This reframing opens up a new design agenda for the post-digital office: one in which calmness, indirectness, and coexistence are not limitations, but design virtues. Instead of optimizing attention and reaction, we optimize restoration and resonance. As urban work becomes increasingly screen-based and accelerated, this kind of emotional and temporal recalibration—through nature—may be exactly what digital environments need to become more livable, meaningful, and humane.

6. Limitations and future research

Despite the conceptual richness of this design exploration, several limitations must be acknowledged. First, this study remains at the prototype and scenario-based validation stage. While user-centered considerations informed the interface and spatial system, the absence of long-term field deployment limits our ability to assess sustained engagement, maintenance challenges, or organizational scalability in real-world settings. Second, the evaluation lacks empirical user testing or comparative studies with existing office greening systems, which could offer more quantitative support for claims regarding emotional resonance or cognitive restoration. Third, cultural and climatic factors may affect plant selection, interface habits, and aesthetic preferences—meaning the current design might require significant localization to function effectively in other regions or workplace cultures.

Future work should consider pilot implementations in actual corporate environments, allowing researchers to study behavioral adaptation, emotional resonance, and spatial interaction over time. Longitudinal tracking, sensor data analysis, and ethnographic observation could also help evaluate how users' relationships with the system evolve, not just how they respond to it initially. Finally, interdisciplinary collaboration—with horticulturalists, building engineers, and organizational psychologists—would enrich the system's applicability and ensure that emotional design coexists with ecological and technical feasibility.

7. Conclusion

This study reimagines the role of smart agriculture in urban office environments by designing a biophilic, emotionally attuned IoT-based farming system that integrates seamlessly into everyday workplace routines. By focusing not only on technological functionality but also on emotional experience, the system reframes smart farms as agents of well-being—capable of restoring attention, evoking empathy, and enriching the spatial texture of corporate interiors.

Through a combination of spatial zoning, ambient interfaces, and natural metaphors, the proposed design addresses both sensory engagement and cognitive simplicity. Rather than treating plants as passive elements or decorative features, the system establishes a reciprocal relationship between users and the natural interface—one grounded in care, attention, and emotional resonance. It demonstrates how design can shape new human-technology-nature interactions in ways that are functional, meaningful, and restorative.

The findings contribute to both interaction design and workplace innovation by proposing a new design logic: one that merges emotional computing, ecological aesthetics, and participatory environments. By embedding interaction touchpoints across the office—from entrance to pantry—this system enables everyday interactions that are subtle yet psychologically impactful.

Looking forward, this project suggests that future smart environments should evolve beyond task efficiency and toward affective affordances. As workspaces become increasingly digitized and overstimulated, the need for quiet, living systems that communicate gently and evoke emotional grounding becomes ever more urgent. The integration of such systems requires not only technical competence but also an empathetic design philosophy—one that acknowledges the importance of emotional sustainability alongside environmental sustainability.

Ultimately, this research encourages a shift in how we conceptualize smart systems: from productivity tools to cohabitants that nourish not only space but the human spirit within it.

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