Visual Encroachment in AI-Enabled Digital Commercial Interfaces

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Abstract. In contemporary commercial space, digital visual interfaces combine attention capture, interface-mediated interaction, and behavioral datafication. This paper uses visual encroachment as an analytical term for how digital commercial interfaces occupy perceptual space while inviting users into platform-mediated action. The issue is therefore not only advertising clutter or visual disturbance. It also appears through QR-code prompts, mobile service entrances, digital screens, membership registration, location requests, and app-based promotional routines. Based on conceptual analysis and repeated nonparticipant observations in Guangzhou's Shangxiajiu and Shipaiqiao commercial districts, the paper develops a spatial-interface-data framework to examine how visible commercial interfaces create conditions under which visual exposure may become data-relevant interaction. It identifies three mechanisms: the infrastructuralization of digital commercial interfaces, conditional data anchoring, and interface pathways toward predictive commercial organization. It also discusses user evasion practices, including gaze diversion, permission refusal, data obfuscation, and algorithmic misdirection. The argument contributes to AI-enabled media design by showing how ordinary promotional interfaces may operate as spatial objects, interactional prompts, and data-pathway infrastructures.

Keywords: digital commercial interfaces; visual encroachment; AI-enabled media design; attention capture; behavioral datafication; data anchoring; user evasion; interface ethics

1 Introduction

Digital media now shape contemporary commercial and urban space. In malls, pedestrian streets, transport connections, restaurants, and platform-mediated consumption settings, people encounter advertising screens, interactive storefronts, QR-code prompts, mobile ordering systems, coupon interfaces, recommendation feeds, and location-based services, often during payment, registration, promotion, information retrieval, or app-based service use.

This paper uses visual encroachment to describe how digital commercial interfaces occupy perceptual space while inviting interface-mediated interaction. Earlier discussions

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of visual pollution and digital advertising remain useful for describing environmental disorder, perceptual overload, attention competition, and unwanted commercial messages (Dukes & Liu, 2024; Gao et al., 2024) [6, 8]. However, they do not fully explain the data-related implications of digital commercial interfaces. In many current settings, visual elements may also invite users to scan, register, authorize, pay, follow an account, collect a coupon, share content, or enter a platform-mediated service routine.

This shift matters for AI-enabled digital media and design. Commercial interfaces are increasingly connected to recommendation, targeting, profiling, platform analytics, and adaptive promotional systems. A QR code, coupon prompt, or membership interface may appear as a small convenience while also becoming a data point within a wider commercial system. The issue is therefore not only how attention is attracted, but how visual exposure becomes attached to recordable interaction.

The paper asks how digital commercial interfaces capture visual attention, invite interface-mediated actions such as scanning, authorization, account login, payment, location access, or sharing, and anchor visual exposure in data-related interaction. It also asks how users respond in everyday situations, drawing on repeated nonparticipant observations in Guangzhou's Shangxiajiu and Shipaiqiao commercial districts.

To clarify this contribution, the paper develops a spatial-interface-data analytical framework for AI-enabled digital commercial interfaces. The framework treats such interfaces as spatially embedded visual objects, interactional prompts, and data-pathway infrastructures. It does not assume that visual exposure automatically produces datafication; rather, it identifies the conditions under which commercial interfaces make visual attention available for data-relevant action.

2 Conceptual Background and Method

Visual pollution usually refers to visible disorder created by excessive signage, billboards, lighting, commercial symbols, and advertising displays. This literature identifies the public burden of dense visual information but often treats visual elements as physical objects added to space (Gao et al., 2024) [8]. Advertising and attention research explains why users experience commercial messages as interruptive, competitive, or unwanted, yet it often emphasizes reception and avoidance at the message level (Dukes & Liu, 2024; Loewenstein & Wojtowicz, 2025) [6, 12]. Digital commercial interfaces require a further step because a visible prompt may connect physical presence with platform-mediated interaction.

The attention economy provides a second background. Commercial interfaces compete for attention through brightness, motion, placement, novelty, reward, and convenience (Loewenstein & Wojtowicz, 2025) [12]. In dense commercial settings, users encounter visual prompts while walking, waiting, searching for directions, entering a store, ordering, or paying. Attention capture is often only the first step: a user may scan a code, open a mini-program, follow an account, accept a location request, or complete a platform-mediated transaction. Behavioral surplus helps explain how data beyond immediate service provision may become valuable for prediction, targeting, and commercial organization (Zuboff, 2019) [15].

Interface studies are useful because the objects examined here are not only signs or advertisements. They are interface forms through which visual attention may become operation, system access, or data relation (Galloway, 2012; Hu & Yao, 2022) [7, 9]. Recent Chinese-language studies of digital interfaces further emphasize embodied interaction and technological mediation (Dong & Wu, 2025; Zhao, 2025) [5, 14]. Spatial and interface-layout studies show that placement and proportion can affect visual guidance and interface perception in node spaces (Huang et al., 2025; Yang et al., 2025) [10, 13]. Spatial theory also matters because placement changes the meaning of a prompt (Lefebvre, 1991) [11]. Interfaces around entrances, corridors, elevators, shopfronts, waiting areas, restaurant tables, service counters, and payment areas may be read less as external advertisements than as part of ordinary commercial service.

Everyday practice theory helps explain user response. Users do not simply absorb commercial prompts or follow platform invitations (de Certeau, 1984) [4]. They look away, ignore, delay, refuse permissions, provide minimal information, or complete only the interaction necessary to obtain a service. In privacy studies, obfuscation names practices that generate ambiguous or misleading information to weaken data collection or interpretation (Brunton & Nissenbaum, 2015) [3]. These practices are limited, but they reveal that visual encroachment is negotiated in practice.

This study is based on conceptual analysis supported by repeated nonparticipant observations conducted in October 2025 in Shangxiajiu and Shipaiqiao, Guangzhou. The observations focused on recurring digital commercial interfaces and mobile service entry points, including QR-code ordering and payment systems, mobile coupon and membership mini-programs, location-based service prompts, digital advertising screens, branded photo installations, and app-based promotional or service interfaces. The sites present complementary commercial conditions: Shangxiajiu contains historical retail streets, dense pedestrian flows, signage, storefront displays, and established commercial visibility, while Shipaiqiao contains shopping complexes, digital retail history, transport access, offices, restaurants, and platform-mediated commercial environments.

The study does not aim to produce a statistical account of user behavior. Its purpose is to identify how digital commercial interfaces attract attention, invite platform-related interaction, and create conditions for data anchoring. The analysis focuses on observable front-end interface arrangements rather than platform backend systems. Claims about data reuse and prediction are therefore made at the level of interface-mediated pathways, not as direct evidence of specific databases, recommender systems, or algorithmic models.

3 Mechanisms of Visual Encroachment

Figure 1 summarizes the spatial-interface-data analytical framework. The first layer concerns spatial embedding, through which digital commercial interfaces become part of commercial environments. The second concerns conditional interface prompting, through which visual exposure may become interface-mediated action. The third concerns data-pathway creation toward predictive commercial organization. These layers should be read as connected conditions rather than as a deterministic sequence.

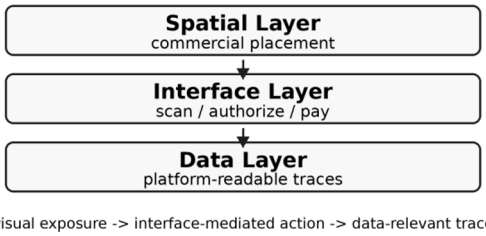


Fig. 1. Spatial-interface-data analytical framework of visual encroachment.

3.1 Infrastructuralization of Commercial Interfaces

The first mechanism is the infrastructuralization of digital commercial interfaces. In the observed districts, digital interfaces were not limited to advertising screens or decorative displays. They also appeared as QR-code signs on tables, payment signs near counters, mobile service entrances, coupon interfaces, branded photo spots, and screens placed along routes of movement. These elements were integrated into ordinary commercial consumption.

This mechanism is visible at store entrances, mall corridors, escalator exits, restaurant tables, waiting areas, and service counters. In such settings, users are already entering a shop, looking for information, waiting for service, ordering, paying, receiving a discount, or joining a membership program. The visual interface is therefore encountered not only as a message, but also as an invitation to interface-mediated commercial interaction.

The two observed sites show different but overlapping forms of commercial spatial production. In Shangxiajiu, a historic pedestrian street with dense foot traffic and small-scale retail, QR codes, mobile payment prompts, membership signs, and promotional stickers are often added to storefronts, table tents, printed receipts, and temporary promotional materials. Visual encroachment is frequently retrofitted into established consumption routines. Shipaiqiao presents a more heterogeneous environment, including shopping complexes, transport-connected retail areas, office-related consumption spaces, platform-mediated restaurants, and urban-village-adjacent commercial streets. Some digital interfaces are built into architectural and service sequences, while others are attached to storefronts, counters, receipts, posters, and mobile payment points. This condition suggests that visual encroachment varies by commercial morphology, service sequence, and platform dependency.

3.2 Conditional Data Anchoring

The second mechanism is the translation from visual exposure to data anchoring. In a traditional advertising setting, seeing a poster or sign may leave no direct record. In digital commercial interfaces, by contrast, the visual encounter may invite recordable interaction: a user sees a QR code and scans it, sees a coupon prompt and opens a mini-program, sees a branded installation and shares a photo, or sees a service prompt and authorizes location, notification, camera, or account access.

However, this translation should not be understood as automatic or universal. Observed cases included users walking past QR codes without scanning, ignoring coupon prompts, or declining permission requests after initial engagement. Conversion depends on service relevance, consumption urgency, prior platform relationships, and refusal costs. Some interfaces appear at moments where interaction becomes practically necessary, such as payment, ordering, or queue entry, while others remain optional. Data anchoring therefore describes a possible outcome of interface design, not a guaranteed result.

QR Codes as Data Anchoring Devices. QR-code interfaces show this process clearly. In restaurants, malls, promotional campaigns, and service settings, they are often presented as convenient entrances to ordering, payment, queuing, membership, or information retrieval. The code is a visual prompt, but once scanned, the encounter may become connected with a device, browser, payment channel, account identity, or platform record.

Location-Based Data Anchoring. Location-based services create another form of data anchoring. When location permission, WiFi connection, app use, or platform interaction is involved, movement and dwell time may become technically linkable. This does not mean that every observed interface collects all such data; rather, these interfaces create conditions under which visual exposure may become data-relevant through scanning, authorization, payment, location access, or account binding.

3.3 Predictive Commercial Organization

The third mechanism concerns how digital commercial interfaces create data pathways that may enable cross-platform association and predictive commercial organization. This claim does not require direct verification of backend databases or algorithmic models. It focuses on observable interface conditions through which scanning, authorization, payment, location access, and account binding can connect commercial encounters to platform-readable traces.

This paper therefore uses the term predictive commercial organization cautiously. The observed materials do not show a fully unified system of predictive governance in every case. They show a front-end environment in which attention is invited to become interaction, and interaction may become useful for recommendation, targeting, profiling, traffic analysis, and commercial organization. In Chinese platform contexts, such predictive relations are observable in everyday platform participation, as suggested by research on Xiaohongshu-based algorithmic imagination (Bie & Zeng, 2024) [1].

In this logic, the digital commercial interface is not only a channel for communication but also a possible data anchor for future commercial relations. Dwell time, scanning behavior, repeated visits, coupon use, content sharing, and payment routines can become indicators of preference, mobility, interest, or consumption likelihood. The mechanism also clarifies platform asymmetry: the user encounters a local prompt, while the platform may accumulate, compare, and reuse traces across contexts.

4 User Evasion and Design Implications

Users are not entirely passive in digital commercial interface environments. They develop small practices to reduce exposure, weaken data capture, or interfere with algorithmic interpretation. These practices are limited and fragmented, but they show how users negotiate digital commercial interfaces in everyday settings.

User evasion practices should be read alongside the convenience that makes platform-mediated consumption attractive. Mobile payment research shows that convenience can mediate consumers' willingness to use and pay through such systems (Boden et al., 2020) [2]. In the settings examined here, scanning, authorization, login, and mobile payment are often tolerated because they lower participation costs while raising refusal costs, thereby naturalizing data-relevant interaction within ordinary commercial routines.

This paper identifies two broad categories: physical perceptual evasion, concerning how users manage visual attention in commercial space, and digital data slowdown, concerning how users reduce the amount, precision, or interpretability of platform-readable data.

Physical perceptual evasion includes gaze diversion, personal-screen diversion, and cognitive filtering. These practices may reduce direct engagement with commercial visual interfaces, but they do not remove the surrounding interface environment. Digital data slowdown includes permission refusal, data obfuscation, algorithmic misdirection, and interaction noise reduction. These practices may reduce access, precision, or interpretability, but they remain partial because platforms can draw on multiple data sources and longer behavioral histories.

Because these practices are inferred from visible interface arrangements and conceptual interpretation, their frequency and subjective motivation require further verification through interviews, diaries, interface audits, or platform-side analysis. They are everyday tactics under asymmetrical conditions rather than institutional resistance. User evasion therefore reveals both agency and constraint: users can negotiate the digital commercial interface environment, but they rarely control the conditions under which it is built.

The analysis suggests several implications for AI-enabled interface design and multimedia governance. First, digital commercial interfaces combining visual display with data-related functions should make this relation explicit at the point of use. If a screen, QR-code prompt, mobile service entrance, or interactive installation leads to location access, account login, behavioral tracking, or personalized recommendation, users should understand that relation before entering the interaction. Commercial intent and data capture should not be hidden behind art, convenience, or service.

Second, basic service access should be separated as far as possible from marketing-oriented profiling. Users often scan a code or enter a platform because it is the most convenient, or sometimes the only practical, way to order, pay, queue, receive information, or obtain a discount. If refusal creates substantial inconvenience or exclusion, user choice becomes formal rather than meaningful. Basic ordering and payment should require only necessary service information, while precise location, contact lists, album

access, persistent camera access, compulsory social media binding, marketing notifications, and profiling-oriented tracking should not be mandatory.

These implications are especially relevant for AI-enabled media design because interface sequences can become cumulative data paths. Responsible design should address the ordering and payment sequence, not only the screen. Interfaces should explain data-related requests before blocking continuation, avoid unnecessary coupon, location, account, or recommendation prompts, offer limited permissions, and preserve alternatives such as physical menus, cash payment, or human service options. These measures shift design from maximizing data capture to supporting informed participation.

The spatial placement of digital commercial interfaces should also be treated as part of design responsibility. Interfaces at entrances, payment counters, ordering points, elevators, and waiting areas meet users when they are seeking continuation. In such moments, refusal can become difficult not because it is formally impossible, but because it interrupts service flow. Meaningful consent therefore depends not only on the presence of a choice, but also on its visibility, cost, and timing.

This study has a clear empirical boundary. The observations show how commercial interface arrangements invite data-relevant actions, but they cannot prove how particular platforms later process, combine, or monetize the resulting traces. The object examined here is the visible interface condition under which visual exposure becomes available for data anchoring. The link between visible prompts and backend data processing remains a limitation and future research direction.

5 Conclusion

This paper has examined visual encroachment in AI-enabled digital commercial interfaces as a process linking attention capture, data anchoring, and behavioral datafication. Its central argument is that visual encroachment cannot be understood only as excessive signage, advertising intrusion, or perceptual overload. In moments of consumption, payment, registration, promotion, and app-based service use, visual exposure may invite scanning, authorization, account login, payment, location sharing, or social media distribution.

The paper identified three mechanisms within a spatial-interface-data framework. First, infrastructuralization describes how digital commercial interfaces become embedded in ordinary commercial environments and shift from external visual messages to elements of service access. Second, data anchoring names the conditional translation from visual exposure to recordable interaction, depending on interface placement, service dependency, and user situation. Third, interface-mediated actions create data pathways that may enable cross-platform association and predictive commercial organization, although this study does not directly verify backend processing.

The study contributes a spatial-interface-data framework that reframes visual encroachment as an interface-level process linking attention, interaction, and datafication. This perspective supports evaluation beyond visible content by foregrounding data-anchoring practices, permission requests, and platform dependencies in ordinary promotional sequences.

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