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# Towards a smart retail environment

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**Abstract**

Over the last decades, the advancements in digital technologies pervasiveness increasingly transformed regular physical spaces in smart ambients, where humans and objects are seamlessly hyper-connected. Large screens are commonly part of these smart environments, although most of these displays are single and not personalized installations that provide general contents and features, regardless the actual users interacting with them. This work presents challenges and opportunities of our interactive system that, applied to a smart retail environment, takes advantage of technologies that are already familiar to shoppers (smartphones, smart watches, touch screens, etc.), offering new interaction methods to virtually present to users personalized products information.

**Author Keywords**

Public displays, retail environments, smart spaces, smart retail, ambient intelligence

**ACM Classification Keywords**

H.5.m [Information interfaces and presentation]:  
Miscellaneous.

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## Introduction

This work starts from the observation of an increasing trend in retail domain, the *showrooming*. Showrooming is the practice of experiencing products in traditional brick and mortar shops and then buying them online, sometimes at a lower price. Traditional retailers are suffering this approach: they have higher overhead costs compared to online sales channels so they cannot compete on prices; therefore they are looking for alternative solutions to attract back customers.

The pervasive availability of enabling technologies and users' increasing familiarity with smart objects and devices are the starting point of our approach. The consumers look for innovative comprehensive experiences instead of simple products during their shopping activities: e.g. most popular bookstores offer not only books but also experiences that include reading spaces, workshops with authors, etc. With ambient connectivity and intelligence widely available, these experiences can become *digital* and really personalized on every customer's needs, offering plenty of opportunities to retailers.

In our approach we combine visualization technologies, digital contents and interactivity into a comprehensive solution that provides digital innovative customer experiences in showrooms, single stores, chains, malls, product launches & marketing events or exhibitions. Our solution is driven by captivating personalized contents, delivered via large displays in smart retail installations, making sure that contents perfectly matches user's preferences and the specific interactive application. Also, the system can collect insights on customers' interactions, providing measurable statistics on their engagement.

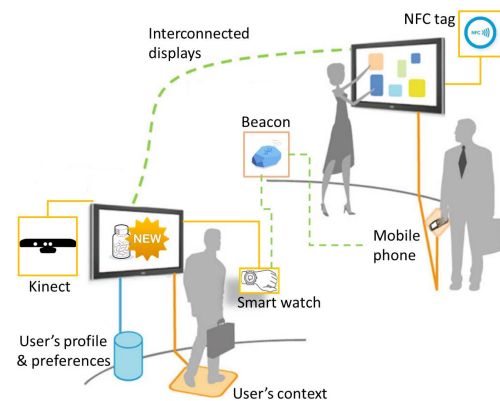
## Related works

Researchers are paying increasing attention to pervasive display systems and applications, with a strong focus on human-computer interaction (HCI) related research challenges. Here we provide a short selection of the most relevant works with respect to retail environments. Muller et al. [2] propose a smart bidding application for display advertising that learns viewers' content preferences depending on measured context variables. In [4], authors present a study conducted in a small-scale supermarket about the way to provide user-adaptive advertisement using various display technologies that take into account client's information to provide personalized shopping experiences. Our work is related, but not limited to the solution proposed in [1], in which authors combine pervasive displays with mobile computing devices (such as tablets and mobile phones) to improve the users' experience inside the shops. We provide an extended solution which includes several interaction technologies, having a stronger focus on retail-related applications in general, so that our system is suitable for different application domains.

## Design principles

We designed and built the technological infrastructure reported in Figure 1 and we're progressing through the phase of development by integrating all the components with the large displays. The proposed solution implements interactive installations, which directly involve consumers enabling bidirectional communication between shop owners/advertisers and shoppers. In particular, the system provides personalized information, thanks to available sensors data related to the real world. It includes multiple context agents that offer to the application the data retrieved from several sources. Moreover, each agent has access to information provided by other connected agents

thanks to a central controller that triggers policies and rules to provide the users with expected contents by means of Spaceify ecosystem [3]. The controller interconnects all the smart screens available in the smart shop, delivering the proper content (e.g. info for single customers vs. contents for groups or families) on the proper screen (e.g. the nearest available or the best one according to the content that has to be displayed). The displays interconnection allows also complex scenarios where customers are followed screen by screen during their visit, taking into account the previous interactions every time a new screen is approached. In this way a user can access a unified interface, perfectly adapted according to his current situation, his available personal equipment and the screen he is using, to obtain information generated by any supported source.



**Figure 1:** Overall system and interaction technologies

The available interaction devices and methods consist of:

- NFC, since each display is NFC-tag equipped;
- BLE beacons. Taking advantage of Bluetooth

proximity beacons, strategically placed throughout the store, the mobile app provides personalized messages and special offers, based on user's location, his personal preferences (it's an opt-in service), the time of day, etc.;

- AR: Augmented Reality is a key technology used to deliver in overlay on user's smartphone camera view additional personalized contents about recognized products. In this way, product recognition enables AR as new paradigm to interact with products and space;
- interconnected touch screens & personal devices (smartphones and smart watches), used for: (1) user's situation recognition, (2) interaction purposes (e.g. contents launched from personal devices to screens or taken away from shared displays to users' smartphones), (3) haptic feedbacks (e.g. vibration alarms) and (4) fast information access (a quick look to currently needed information);
- Microsoft Kinect depth sensor for body tracking and gesture-based content navigation on the big screens.

### Originality and value

The three main points of value of our system include: *connectivity*, seamless access to contents anywhere in a customized way, *context*, the ability to filter out all the noise out of the detected situation, and *control*, intuitive interfaces for digital contents and physical objects. Several reasons provide advantages to use this solution in retail environments:

- *movement* catches our attention. Our brains react quicker to motion objects than to static ones;
- *space* is saved. An entire collection or catalogue can be shown in a space less than two square feet. An interactive screen can be seen as an infinite virtual

shelf that increases available exposure space without acting on store architecture, which results in both time and money saving;

- *portability* makes shop digital catalogue readily available to all departments or locations within the store to support stock clearance promotions;
- *customers recognition* enables exclusive promotional opportunities changing the content displayed on the interactive screens according to detected shopper's profile attributes and situation (e.g. gender or age range, single or in a group).

### An application domain

As application example we refer to a next generation pharmacy, a store that handles not only medicines but also cosmetics, special foods, etc. These kind of stores manage voluminous products that often are quickly perishable. This implies the impossibility of having all the products always available and exposed. Using interconnected screens and integrating several interaction methods, our framework provides an immediate service that is both useful and accurate (complete catalogue, up-to-date prices, useful and personalized advices about products and services, order numbers, loyalty, product information leaflets, etc.). In return, pharmacists can gather data about their customers, such as profiles, needs, trends, or even advertise products which are valid alternative to the most used ones and mainly result as a cost in their deposit. Large screens and user's personal devices are all involved in the interactions: the catalogue can be browsed on screen, an order can be sent to the backend and then transferred to the smartphone as a reminder or the product selection can be started on the smartphone and then shared on the screen to be finalized. With this interactive solution limited shelf space is no

more a problem; missing items can easily be located and ordered from the virtual catalogue, increasing chances of converting shoppers into satisfied purchasers.

### Conclusion

The appeal of smart screens is, beside the marketing possibility, the connectivity to other devices. Smart screens should not be regarded as standalone devices but an integral part of a smart ambient environment. This requires new concepts for the integration of heterogeneous and distributed displays and interaction devices.

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