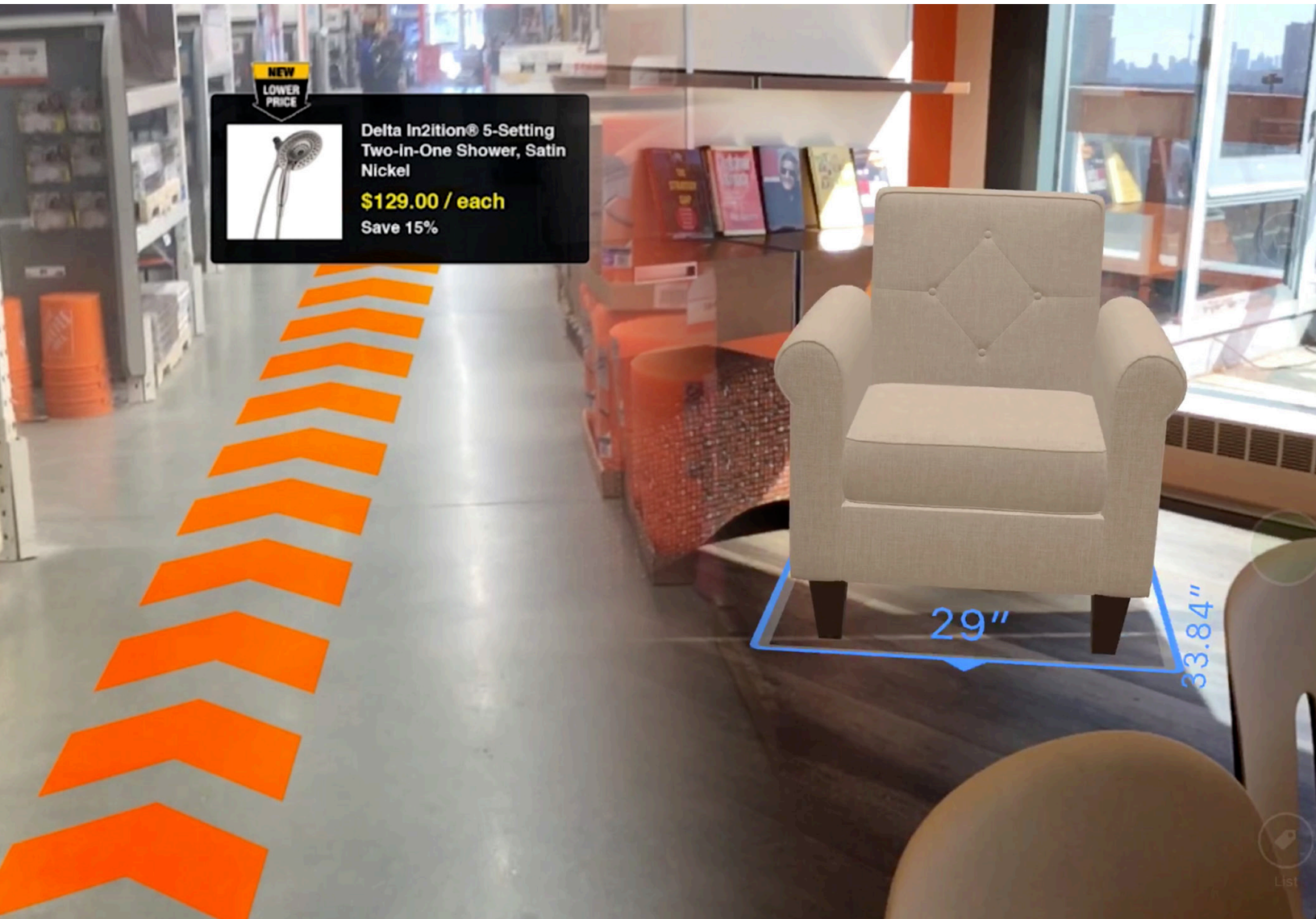


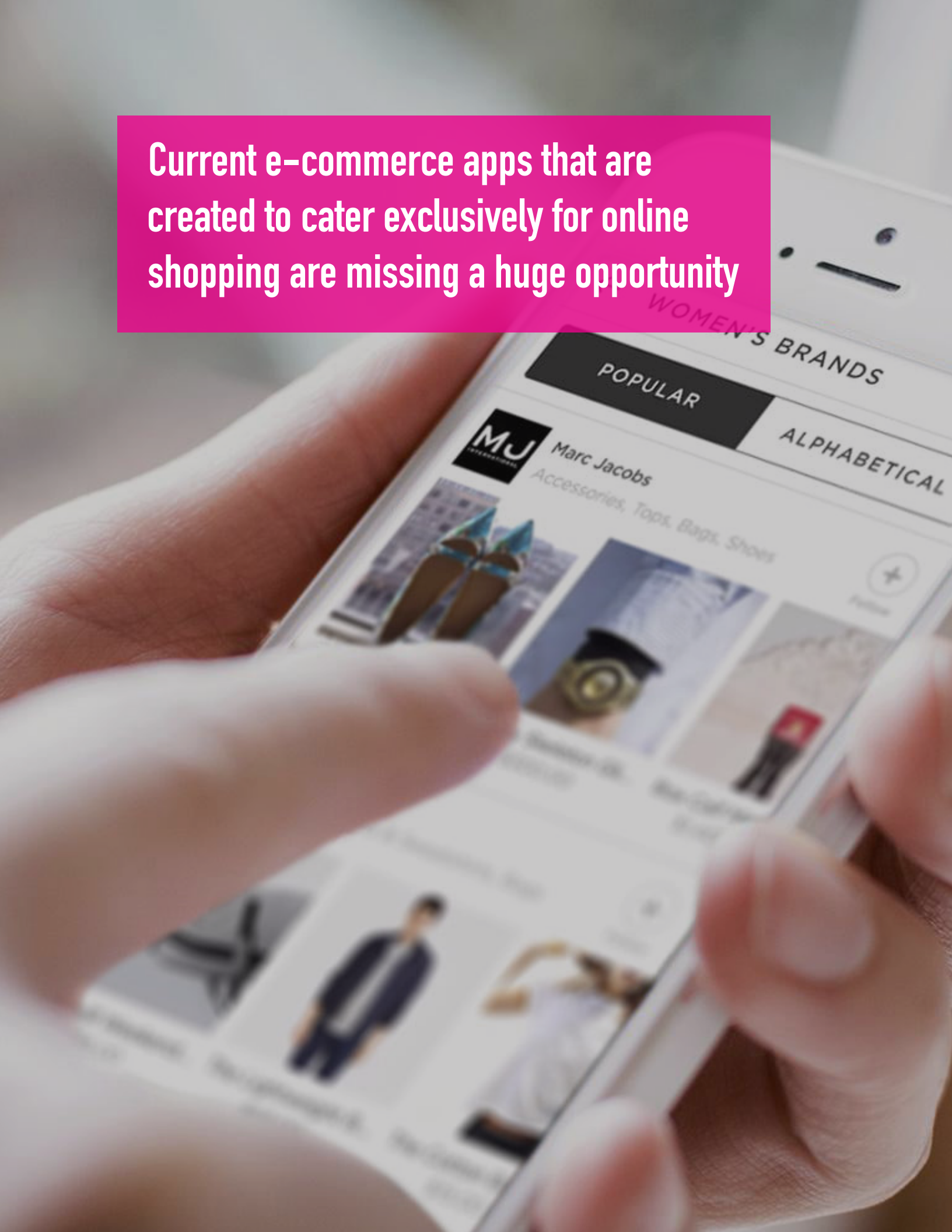
Reinvent Shopping by Connecting the Digital and In-store Experience



MA Interdisciplinary Design Strategies Final Report

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Current e-commerce apps that are created to cater exclusively for online shopping are missing a huge opportunity



Executive Summary

The customer's user experience while shopping online and in-store is very different and often fragmented. For customers shopping online, it's hard to envision the products in their home and so they hesitate to make a purchasing decision prior to evaluating the product in-store. For example, there are a lot of returns driven by décor and appliance products purchased online not actually fitting in the desired space. Current e-commerce apps that are created to cater exclusively for online shopping are missing a huge opportunity: these apps can also be used to enhance the customer journey while they are shopping in-store.

The customer experience can also suffer in the physical world as they navigate through high volume retail stores. Shoppers now have specific actions in mind with the information that they have gathered, which is increasingly found online.

Using Augmented Reality (AR), in-store beacons and geolocation features endemic to mobile devices can transform phones and tablets into a virtual portal through which a user can see digital layers imposed upon a physical layer. Users can see augmented reality overlaid onto wayfinding, product specs, videos and can interact with the products rendered in 3D. Customers can be shown real-time promotions and product suggestions according to their purchase and browsing history.

Online customers can use AR to superimpose true-to-scale products onto their desired living space, confirm the size and see how multiple pieces look together. Customers can scan their walls and see paint suggestions. Then, using AR they can apply paint and finishes to their room and see the results. When customers have AR tools and applications at their disposal, the uncertainty of applying real world products sourced from virtual platforms can be lessened, reducing decision fatigue.

To test the design strategy AR prototypes were built utilizing tools and software like Axure and Adobe Premiere Pro. The main aim of the testing was to see the effects of AR tools on consumer's decision-making process. Testing consisted of online and in-store users. Users in online tests placed 3D-AR products on to their environment. In-store tests consisted of user adding and following AR directional aids to locate a product. Users also tested AR directional aids for multiple items. In-store tests also consisted of pop up marketing messages and AR personalized promotional messages.

The tests yielded very positive responses from the users. With AR, the online users were able to visualize and interact with the products, reducing load on their cognitive decision-making process thus making a buying decision very easy. AR increased user engagement and immersion. The in-store users were able to locate the products very easily, this reduced decision-making load. The connection between online and in-store experience gave users a seamless experience across channels. This improved immersion and engagement.

The system gives a connected online and in-store shopping experience. The Customers have a seamless experience regardless of their location. The online AR experience coupled with in-store wayfinding and notifications increases the retailers' ability to meet their consumer's expectations of the digital experience.

When everyone is online and digital is everywhere than there is no offline. If there is no offline than differentiating between online and offline is a moot point



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A high-angle, wide shot of a modern shopping mall. The image shows multiple levels connected by escalators and stairs. In the foreground, a large, curved escalator with a glass railing leads down. The ground floor is a busy walkway with people moving in various directions. A prominent store named "NINE WEST" is visible on the upper level, with a large "50% OFF" sign in its window. To the right, another store named "BIRKS" is visible. The mall's architecture features clean lines, white walls, and a high ceiling with a grid of lights. A pink semi-transparent box is overlaid on the upper left portion of the image, containing white text. The overall atmosphere is one of a busy, contemporary retail environment.

The retailers are struggling to provide the level of digital experience that is expected from the consumer, especially when they are in-store.

NINE WEST

50% OFF
30% OFF

VR ZONE
ENTER

1.0. Problem Definition

In 2017 the e-commerce sales across the globe reached 2.3 trillion US dollars and these sales are projected to reach 4.48 trillion us dollars by 2021(• *Global Retail E-Commerce Market Size 2014-2021 | Statista*). The growth in online sale resulted in a decline in store traffic. Consumers behaviour about buying convenience, online delivery and in-store pickup changed as well (*Maximizing Mobile to Increase Revenue*). Many organizations are investing more in online and as a result often neglect the in-store customer experience. This has resulted in a fragmented experience. According to a survey conducted by Accenture in 2015 customers across the world were asked to identify which shopping channel required the most attention, 34% said that physical store needed the most improvements (*Rescuing the In-Store Experience - Accenture Outlook*).

The retailers are struggling to provide the level of digital experience that is expected from the consumer, especially when they are in-store. This gap between consumers' expectations and reality has been dubbed as a digital divide (*NAVIGATING THE NEW DIGITAL DIVIDE Capitalizing on Digital Influence in Retail*).

Today's customers shop differently than before. The percentage of customers who have decided what to buy with online research even before they enter a store is becoming substantially larger. The inspiration to buy and the information needed to make a decision has been separated from the physical store visit. Shoppers have now personalised actions in mind because of the information they have gathered. This information, in many cases is not provided or facilitated by the retailer (*NAVIGATING THE NEW DIGITAL DIVIDE Capitalizing on Digital Influence in Retail*).

According to Deloitte Digital surveys conducted in 2015, about 34% of the people shopping in-store were using digital. Their data shows that the value of customer's in-store shopping experience and browsing journey is steadily decreasing. This also makes its very critical for retailers to leverage the digital experience to create a seamless and exciting in-store customer journey. If retailers continue to expand their e-commerce business only and gauge success only by measuring channel sales, than there will be a significant digital divide between in-store and online that will cause many missed opportunities for the retailer (*NAVIGATING THE NEW DIGITAL DIVIDE Capitalizing on Digital Influence in Retail*).

According to customers surveyed over three years, the digital interaction can affect multiple points along the customer's journey. Retailers should focus on the key points along a customer's journey both online and in-store. If they fail to gauge the consumer's mental model at key points along the journey they will suffer a loss in sale. (*NAVIGATING THE NEW DIGITAL DIVIDE Capitalizing on Digital Influence in Retail*)

With the recent advancements in digital technology mobile and tablets will feature more in the customers' journey. The future of retail industry is not about connecting channels but instead utilising digital in altogether new and creative ways. The future is a connected digital ecosystem where e-commerce sales alone are a tiny number as compared to the vast opportunities out there (*NAVIGATING THE NEW DIGITAL DIVIDE Capitalizing on Digital Influence in Retail*).

Before diving into the connected commerce solutions, it is important to understand how customers conduct their shopping journey and how they interact with products. In addition, each customer undertakes a decisions-making process at each step of their journey, so it is vital for companies to leverage this knowledge to craft a better customer experience.

1.1. Customer Experience

A customer experience is essentially the touchpoints at key moments between a customer and organization throughout their business relationship. A customer experience lifecycle usually consists of six stages as illustrated in Diagram 1 and detailed below: (*7 Ways to Create a Customer Experience Strategy*) (*A Quick Walk-Through the 6 Stages of Customer Lifecycle*) (*Customer Lifecycle Mapping - Getting to Grips with Customers | Interaction Design Foundation*).

1.1.1. Awareness

A customer's buying journey starts with some kind of research on the discovery of their needs and wants. Customers use channels like social media, website, word of the mouth recommendations and their own memory banks, to collect the details about product or service. In this step, a brand makes contact with the customer.

1.1.2. Consideration & Evaluation

After the awareness step of a product or a service, a customer enters into a consideration stage. In this stage, customers are aware about different features, options pros and cons of a product/service offered by different brands. They consider solutions provided by different brands that best meet their needs. Customer evaluates various options, offers and features either online or in-store before he/she makes a purchase.

1.1.3. Purchase

After customers are finished with evaluating different options and are aware of the available buying options, they trigger the buying decision and make a purchase either online or in-store.

1.1.4. Experience

After the purchase, the customer must become familiar with the product. They learn how to interact with it, use it and consume it. Customer satisfaction after the purchase depends upon the user experience that is provided by the company. After sales services, live assistance, self-services and different customer engagements technologies are some important examples of the customer experience stage.

1.1.5. Loyalty

A satisfying experience with the brand will keep the customers back to the same brand. Eventually they will become loyal to the product and possibly to the organization. High levels of customer retention often translate into maximum revenue generation.

1.1.6. Advocacy

When customer loyalty moves up to the next stage, they will become an advocate for the brand. Not all customer makes this transition but the ones who do, will become brand ambassadors. This usually happens when they have superlative experience in every customer experience step. Advocacy can be through word of mouth in the physical sphere or through the word of social in the digital sphere.



Diagram. 1 Connected Customer Journey - Modified from the diagram 'Customer Lifecycle Mapping'

1.2. Managing the Customer Lifecycle

With the ever-changing technological landscape and the rise in mobile computing, managing the customer lifecycle is more important than ever. A single wave of reviews or negative tweet can make or break a brand. With numerous competing choices available at a click of a button, customer can easily deflect to competing brands. The six areas of the customer lifecycle that are crucial for an organization to manage are discussed below. These areas are also depicted in Diagram. 2 which details the steps of the customer journey overlaid with how an organization can manage them (*Customer Life Cycle Management in 5 Stages*) (A Quick Walk-Through the 6 Stages of Customer Lifecycle).

1.2.1. Creating a clear customer experience vision (Awareness)

This is the step where consumer becomes aware of the brand. The content should be properly marketed so the brand's target audience can become aware of its existence. This can be done by creating a clear customer experience vision. This vision should create a set of statements that can act as a guiding principle and can be referred back to.

1.2.2. Understanding who my customers are (Consideration)

In this stage, an organization should be able to understand the wants and needs of the potential customers and understand who are my customers so organisation can provide appropriate products or services that customers want to purchase. One way of doing that is to create archetypes and personas. This can help customer support teams in recognising and understanding their customers.

1.2.3. Creating an emotional connection with customers (Purchase)

After the purchase, it falls upon customer services to remain in touch with the customer and build a relationship. Ensure they are satisfied with their purchase and purchase journey. The purchase habits of current and prospective customers provide valuable data to the brands and help them improve the experience and provide them information on the competitive landscape.

The best customer experiences are the ones when a member of the team creates an emotional connection with the customer. According to a research conducted by the Journal of Consumer Research, more than 50% of an experience is based on an emotion since emotions shape our attitude that triggers our decisions.

1.2.4. Capturing customer feedback in real time (Experience)

After using the product/service, a customer can become a repeat customer or choose a different brand. As long as a brand is satisfying customer needs, chances are they will keep coming back. Caring about the customers and carving a relationship with them is the key. To know that a brand is delivering a great customer experience they need to capture customer feedback in real time. This can be done by post-interaction surveys through automated tools like emails, phone calls etc. Customers will feel happy that a brand is caring about them and they will feel like a part of the process.

1.2.5. Using a quality framework for team development (Loyalty)

From the above steps, an organisation can measure the quality of service they are providing against their defined principles. From here the organisation can create a training plan for their customer support team that addresses the needs of their customer support team. This will keep the experience customer-centric and in turn create satisfied customers.

1.2.6. Capitalising on the advocacy with current channels (Advocacy)

Satisfied customers will advocate for the brand. They will spread the word and awareness in their social circles. It is an organisation's responsibility to make it easier for satisfied customers to spread the word. An intuitive Omni channel experience can reduce and resolve the customer queries in time and lay a foundation for advocacy. The customer cycle will become a full cycle when an organisation gains new customers with advocacy.



Diagram. 2 Managing customer experience overlaid with connected customer Journey

1.3. Consumer Decision-Making Process

In each step of the customer experience, a customer goes through different decision-making phases. All the decisions made by consumers are in response to a problem. The problems can range from what to wear tonight to my friend's party to what is the correct career for me. Not all purchase decisions carry equal weight so the amount of mental effort we put into them also differ. At times the decision-making process is intuitive and automatic based upon first impressions or gut feelings. On the other hand, we can spend days or weeks on important decisions such as buying a new car, home or choosing a right computer or phone. Consumers' decision-making is based on a spectrum, for an important decision deep thought and careful decisions are needed to evaluate all the pros and cons of each option. On the opposite end of the spectrum, for simple or routine decisions we let our gut feeling and emotions take charge of the process with little thought involved. The three categories of how a customer makes a decision are cognitive, habitual and affective (Solomon et al.). These categories are discussed in more detail below.

1.3.1. Cognitive Decision-Making

The traditional approach to studying the consumer behaviour looks at decision making through the information-processing perspective. Consumers carefully compile their knowledge about the product, gain all the information and evaluate the pros and cons of all the choices and then make an informed decision. Usually this decision-making process is employed when we want to make a big decision, like financial planning for our future. But even in this form of decision making we economise and collect just enough data that is required. We gather additional information only when we think it will add to what we already know. Basically, we collect information as long the process does not start to burden us.

The steps involved in cognitive decision-making are; (1) problem recognition, (2) information search, (3) evaluation of alternatives and (4) product choice (Solomon et al.). Diagram. 3 depicts the steps involved in cognitive decision-making in a customer's journey.

1.3.1.1. Problem Recognition

Problem recognition happens at the start of journey also known as the "upper funnel" by the marketers. Here a company targets a need or puts out an idea that creates a need. We recognise a problem when we feel

a considerable difference between our current state of affairs and a state we desire to be in. To put this in perspective; an individual who is out of gas on a highway has a problem however so does a person who is not happy how his car looks, even though the car is functioning properly. The individual who is out of gas on the highway experiences a decline in the quality of its actual state. This decline needs recognition. The person who desires a newer, better-looking car is pushing his actual state upwards. This upward push presents with an opportunity for marketers and is known as opportunity recognition. In both cases there is a divide between the consumer's actual and ideal state (Solomon et al.).

The main difference between online as compare to traditional medium is that user has more control while online. Traditionally the problem/need recognition has been stimulated by the mass media and print. On the websites, the stimulants include: targeted ads, targeted events promotions, banner adds, discussion forums, social media adds and shopping agents (Consumer Decision Making Process).

1.3.1.2. Information Search

The process of scanning and gathering relevant data to make an informed decision is an information search. With big ticket items and important purchasing decisions, we tend to search more than when the information is easy to gather. Younger people with a higher rate of education seem to search more and are keener to uncover facts about the products. Women tend to search more than men. It is interesting to know who searches more. The answer is not straight forward. People who are moderately knowledgeable about the product engage more in the search process. There is an inverted U relationship between consumer's knowledge and external search activities. People who are not knowledgeable about the product might feel they are not equipped for in-depth search. In comparison, people with extensive knowledge about product know which information is helpful to them and what is not. They engage in selective search. Their search is focused and precise as compared to less knowledgeable consumers who are often swayed by other opinions of friends and family, they also get trapped in non-functional attributes of a product, like price, brand and features to make a choice (Solomon et al.).

In the age of Internet customers are interacting with other customers and exchanging pros and cons of the products. In most cases consumer decisions are based on information not provided by the vendor. If consumer does not like a product on a website there are dozen others available with just a click away, providing similar options. All the features and functionalities are just a click away unlike in the physical store. This gives user boundless choices and freedom. According to current research users think that websites give better product information than traditional sellers. (*Consumer Decision Making Process*)

In the current market, search engines, user groups and web directories are excellent sources for information searches. User reviews are a great source for gathering first-hand knowledge about products. The goal here is not to gather any technical information but rather to get an overall picture of the user experience from the people who have actually engaged with the product. In this way consumers can narrow down the search by eliminating some brands from their further searches.

1.3.1.3. Evaluate Alternatives

Today's society is loaded with choices, it's not easy to choose a product from all the available options. Most of the mental effort in a purchase decision happens in this stage. In today's marketplace, we are bombarded with hundreds of different brands (as in clothing) or variations of a same brand (as in shades of nail polish). If we try to recall a brand let's say in shoes, we can recall three to five names very quickly, then we pause and think a bit and remember some more names. When we shop for shoes, it is likely that we will buy some or most of the brands that we recalled earlier. We might consider some more brands than we come across while in-store. The brands we know about are called the evoked set and ones we seriously consider are called the considered set.

Even with all the choices available per product consumers usually consider a surprisingly small number of options. Research has shown that people keep only a handful of products in their considered set. But the amount is different by product category and by culture (Solomon et al.).

Evaluation is lot easier in the internet world. When the consumer has the ability to perform easy comparisons and attain comparative information, the heuristic and perception based decisions fade away. Some of these web tools are; product comparisons, FAQs, most rated, samples and trials, consumer testimonials and discussions. *(Consumer Decision Making Process)*

1.3.1.4. Product Choice

After putting and evaluating relevant options in a category, now we have to select a product. Choice is not getting easier. Brands are pushing more and more features on the market. We are presented with digital cameras with hundreds of features, cell phones cameras rivaling digital cameras, streaming services competing with cable services, multiple remote controls doing similar things and too many buttons that can be easily misunderstood. This phenomenon is called a feature creep. Philips Electronics discovered that 50% of the returned products were working perfectly fine, only the consumer failed to figure out how to use them (Solomon et al.).

While making a purchase in store we have to consider the checkout lines, out of stocks, wrong sizes and much more. The online shopping gets rid of this all and much more. The ease of ordering and payment and delivery to our home are a major consideration in online shopping. *(Consumer Decision Making Process)*

1.3.1.5. Post-Purchase Evaluation

After we have bought a product or service and have experienced it for while we are able to evaluate it. Post-purchase evaluation completes the circle, after having gone through the decision-making stages and experiencing the product we decide if we are happy with the product or not. This is called consumer satisfaction/dissatisfaction (CS/D).

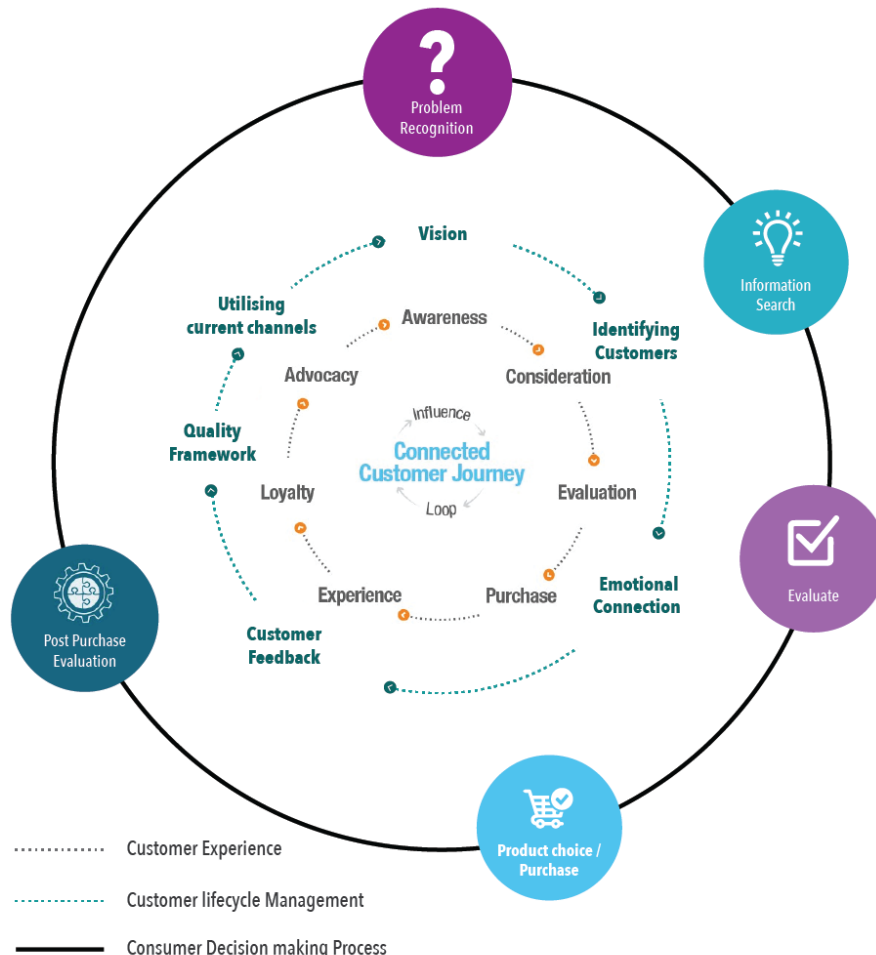


Diagram. 2 Managing customer experience overlaid with connected customer Journey

In the offline world, an unhappy customer will tell nine others about the negative experience. In the online world, that customer has the ability to tell 10,000 potential buyers or even more. Obtaining advice for a specific product can be done by posting a question on social media and get dozens of detailed answers. (*Consumer Decision Making Process*)

1.3.2. Habitual Decision Making

Due to the amount of purchase decisions required every day, we do not go through the complex steps described above. Sometimes we buy things with no advance planning at all. Like putting a candy bar in the basket while waiting in the checkout line. Some-times our behaviour is opposite of the model described above. Like a buying spree, also known as purchase momentum. This happens when our initial impulse purchase increases the chances of more shopping as oppose to less, because we have satisfied our need. Habitual decision-making are choices that are made with very little or no conscious effort. Most of our purchase decision are so routine that we do not even realise we have made them. We employ surprisingly very little external search for most of the product. These decisions although based on snap judgments can be very accurate (Solomon et al.).

1.3.2.1. Decision-Making Shortcuts

Most of the times, we search for an easy way out in making a decision. Unlike the cognitive decision-making process where our intention is to make the best possible choice (maximising solution). Actually, in most cases we are happy to make an adequate decision while not exerting a lot of mental effort to arrive at a passing outcome (satisficing solution). Researchers in the recent years have discovered that many decisions are not based on a maximising strategy (Solomon et al.).

1.3.2.2. Heuristics: Mental Shortcuts

In addition to mental accounting biases in our habitual decision-making we often employ other shorts cuts in filtering our choices as well. Such as Like higher-priced products mean higher-quality products or buy the same brand I bought the previous time. These shortcuts are called **heuristics** (Solomon et al.). Following are some of the common heuristics we use:

Covariation. We relate the health of a dominant visible variant to all the invisible variant and make our decision based upon that visible variant. Like judging a car's engine condition by how it looks from outside. Usually a seller cleans the exterior of a car to a polished shine. We often co-relate the whole car performance based upon the exterior looks.

Country of Origin. The products origin matters a lot. North American would buy Japanese cars, Italian Shoes, French perfumes.

Familiar brand names. According to a study conducted by the Boston Consulting Group of leading brands in 30 product categories, 27 brands that were top performing in 1930 were still at the top more than half a century later.

Higher prices. Many of us thing higher prices means higher quality. This assumption is usually right.

1.3.3. Affective Decision Making

Sometimes we make decisions as a result of emotional reaction rather than thinking something through. These reactions are known as affect (Solomon et al.).

1.3.3.1. Emotions and Consumption

Marketing companies try to target our emotional reactions to their products. They try to link their products to an affective response. Nike with their slogan "Just do it" try to put us in the frame of mind that anything is possible and we can be what we want to be if we try. This has nothing to do with shoes or their products but it put us in a positive and heightened frame of mind.

Lush Cosmetics introduced a brand "Emotional Brilliance", Customers pick the cosmetics according to mood (e.g. "Confidence") which dictated their colour choices of the day (Solomon et al.).

1.3.3.2. Social Media and Emotions

Usually the bulk of social media activity is about expressing affect, be it positive or negative. Emoticons, Facebook likes, tweet storms, Instagram shares are all about conveying our mood and feelings. These opinions and reactions are a gold mine for brands and marketers. It is the feedback equivalent of straight from the horse's mouth. Companies use a technique called analysis (analytics) also known as opinion mining that crawl through the web and collect, catalogue and analyse user opinion about a product or service.

User reviews play a critical part in customer's purchasing decision and they increase the capacity of a user to make an informed decision. According to a test, 95% of the users used reviews to rate and get information about the product (Holst) In some cases, the decision was only made based upon the reviews instead on going through the product specifications supplied by the company (Holst)

1.4. Effect of AR on Decision-Making

It has been shown by research that consumer's ability to make a decision decreases as the amount of information they are presented with increases. (Malhorta, 1982). Most researchers are in agreement that while making a decision a consumer shows both cognitive and emotional approaches (Cehovin and Ruban). The following chapter analyses the effect of AR on consumer decision-making process. (Cehovin and Ruban)

Augmented reality (AR) can be described as a digital layer superimposed on the physical world where people can see the digital information in the real time through an AR enabled device.(Carmigniani and Furht)

In their paper, Chevovin and Ruban considered three main characteristics of AR – augmentation, interactivity and registration. They compared these characteristic with the emotional (affective) and cognitive decision-making process of a consumer in their conceptual framework. This framework provides a good testing structure for the proposed AR concept in this project as well.

Augmentation is the digital layer superimposed on the physical layer. The concept is to combine augmented layer to physical layer so the quality of physical world is enhanced.

The second characteristic **interactivity**, is the about user being able to interact with the augmented layer. A user can position, rotate and scale the content in real-time. The interaction can be from a user's point of view (changing augmented objects) and from an object's point of view (user moving around and the object remaining fixed like a real-life behavior)

To be able to provide an accurate illusion of an augmented object displayed in the real world, the systems needs to calculate and understand the environment. This is called **registration**. If the registration is correct, the object will appear placed correctly in the environment with correct size and depth, even shadows. If the registration is incorrect, than the object will appear to float or be optically incorrect (Chevovin and Ruban).

1.4.1. Effect of Augmentation on Affective Decision-Making

Augmentation of the personal space of a consumer generates a strong feeling in them. The augmentation of one's own self will increase the views of that person about themselves. Belk's theory of 'the extended self', states that consumer's regard their belongings and possessions as part of themselves and their consumptions are to construct their identities. That's why the addition of augmented information to consumer's surrounding (or body) solidifies and extends their sense of identity which that triggers positive emotions in them. Research shows that this emotional trigger is heightened when consumers can touch a digital product (using cell phone or tablet), hence creating positive feelings. These positive feelings stay with the user and are linked to the brand. So, the augmentation not only triggers positive feelings about the consumer's self but also about the brand as well. These emotions than create positive customer behavior and satisfaction response (Cehovin and Ruban).

1.4.2. Effect of Augmentation on Cognitive Decision-Making

When a user places a virtual object in their environment, they can see how the virtual objects fits in their real environment. Shape, size, colour and details are not just an estimation in the consumer's mind anymore. This

shortens the consumer's research and information gathering process.

Augmented reality enhances consumer's cognitive process as the user can see new types of information in their own surroundings that was not possible before. Moreover, the user feels they are experiencing the product firsthand so they can absorb and accept the information more quickly. This aspect is very important as we are constantly bombarded with information overload. With our abilities of feature recognition and pattern perception, we can gather more information from images in short amount of time. On the whole, augmentation appears to help process the information and have a positive effect on cognitive decision-making process of consumers in their search and evaluation phase (Cehovin and Ruban).

1.4.3 Effect of Interactivity on Affective Decision-Making

Interactivity gives a sense of control to the users in their digital experience. This control makes them more satisfied. Interactivity also helps form rich memories within the user, this in turn triggers positive customer experience and higher customer satisfaction. Research has shown that interactivity features of AR instill feelings like satisfaction, joy and absorption in the users (Cehovin and Ruban).

1.4.4. Effect of Interactivity on Cognitive Decision-Making

The method of interaction with the data dictates the process of how we search for information (Samek et al.). Many researchers confirm that interactivity have a positive effect on the user in their evaluation and information search (Hoffman & Novak; Yaoyuneyong). According to Yaoyuneyong, consumer immersion increased due to interactivity which usually results in more energetic search performance. Interactivity creates a deep feeling of connection and absorption, which results in the consumer losing sense of time and focused only on the content. (Hyun & O'Keefe, Huang).

1.4.5 Effect of Registration on Affective Decision-Making

A proper registration combines augmented layer with physical layer and creates perfect illusion of immersion. (Azuma). If the registration is not accurate it will yield an unsatisfactory experience and negative impact on emotional dimension (Olsson & Salo (2012).

With the current advancement in AR technologies (as described in section 2.3), it is possible to attain perfect registration, thus giving a positive impact on the emotional dimension of the consumer decision-making.

1.4.6 Effect of Registration on Cognitive Decision-Making

If registration is not calculated properly, the virtual information appears to float on the physical world rather than belonging to it. This makes the digital content less realistic. An imperfect registration will affect the sense of immersion (Azuma) that will cause the consumer to spend less time with the application and hence reduce their investigative actions. Lack of registration will impact negatively on the search and evaluation phase of cognitive decision-making process.

With the current advancement in AR technologies (as described in Section 2.3), it is possible to attain perfect registration, thus giving a positive impact on the cognitive dimension of the consumer decision-making.

1.5. Vision of the Project

With current and upcoming technologies, there is a possibility to connect in-store and online shopping experience. Instead of asking a store associate for information, 61% customers prefer to search online before making a purchase purchasing (*How to Merge Online and Offline for Retailers*).

This presents a huge opportunity for retailers to connect online and in-store experience and enhance the in-store customer's journey with digital technologies. Leveraging mobile phones and tablets will be the key factors for retailers to provide a connected seamless shopping experience (*Maximizing Mobile to Increase Revenue*).

One research study found that 75% of shoppers use smartphones when they are shopping in-store. Although only 25% will make an actual purchase with their phones while they are in-store. Companies are creating e-commerce apps with the idea of online shopping only. Hence they are missing a huge opportunity since these apps can be used to enhance the customer's experience while they are in-store and provide a seamless

experience regardless of whether a customer in at home or in-store (*How to Merge Online and Offline for Retailers*).

One way to achieve this is to leverage the new AR technologies and enable smart phones and tablets to display AR content while the customer is browsing and shopping in-store. Augmented reality will help customers in many areas of the decision-making process.

Therefore, the vision of the project is to “Connect the online and in-store shopping experience”.

The mission is to support the decision-making process in each stage of the customer’s journey using augmented reality, wayfinding aids, machine learning, and Internet of Things.

The objective is to make online shopping robust enough so that a user does not need to visit the physical store to verify the product. Moreover, to bridge the digital divide by offering digital aids while shopping in-store and providing a seamless-digital experience for both online and in-store customers.



The design strategy aims to connect the online and in-store shopping experiences

2.0. Design Strategy Description

By leveraging the research undertaken, this design strategy identifies ways to connect the online and in-store shopping experience. Using existing and upcoming digital technologies, this design strategy imagines new possibilities for companies to design a seamless connected shopping experience, boosting user experience, customer satisfaction and sales.

2.1 Overview

This design strategy aims to connect the online and in-store shopping experiences by creatively using existing and upcoming technologies like Augmented Reality, Spatial scanning, Wayfinding beacons, Machine Learning and the Internet of Things.

2.2 Proposed Strategy

The proposed strategy for this project is focused on applying AR to three areas of customer experience:

1. Customer can interact with 3D virtual products, using Augmented Reality; a mobile phone or tablet can be transformed into a virtual portal allowing users to see a digital layer imposed on physical layer.
2. In-store customers can use AR projected wayfindings to map out the direction to find a desired product.
 - A lot of time in retail is wasted when customers struggle to find an aisle and bay or a product in a large store.
 - Beacons coupled with mobile phones and tablets can pin point customer's location in real time and point the user towards the desired product.
 - Customers can locate different brands and other services by a searchable index.
3. In-store customers can be shown real-time promotions and product suggestions according to their purchase and browsing history.

2.3 Design and Technical Requirements

Recent AR technologies struggled in understanding the environment in which they are projected, so an accurate digital overlay on the physical world was problematic. In mid 2017, Apple launched an AR kit for their iOS devices that enabled these devices to calculate positional tracking and scene understanding using only this AR kit software. This makes the use of wide scale AR possible in homes, stores and outdoors (*Introducing ARKit: Augmented Reality for iOS - WWDC 2017 - Videos - Apple Developer*) (*Inside Apple's ARKit and Visual Inertial Odometry, New in iOS 11*).

More recently, Google joined the AR scene with the beta launch of its AR platform called ARCore. This platform was launched in early 2018 and provided more or less the same capabilities to Android phones and tablets that Apple's AR kit gave to its iOS devices (*Google Joins the Augmented Reality Party with ARCore | WIRED*) (*ARCore Overview | ARCore | Google Developers*).

Furthermore, the projected AR content will be made interactive so customers can interact with the projected content just like they interact with content on their browsers. They can play videos of the product, see details, rotate the 3D image and read the specifications. Gestures like one-finger tap, one and two-finger pan, and two-finger rotation will be used for interacting with the AR objects (*Augmented Reality - Technologies - iOS Human Interface Guidelines*).

A lot of time in retail is wasted when customers struggle to find an aisle and bay or a product in a large store. iBeacons coupled with mobile phones and tablets can pinpoint customer's location in real time and point the user towards the desired product.

Harrods of UK has launched an instore mapping systems covering their 1 million square feet of retail space

using iBeacons. Customers can locate different brands and other services by a searchable index (*The Deloitte Consumer Review Digital Predictions 2017*).

A complete inventory of a retail store can be made available on the AR search and customers can be guided to their desired product via AR wayfinding (*Gatwick Uses Augmented Reality for Wayfinding - PASSENGER SELF SERVICE*) (Kim et al.).

Smart phone GPS will be used for push notifications, when user is out of store. When user is in store, location beacons will be used to calculate user's accurate location within a few centimeters of accuracy. (Mulloni et al.) (Bhorkar) In a closed environment like a big retail store, a detailed map of the store can be pushed to user's device when user is in the store's range or user can install all the maps beforehand while installing a store's app. The map will have all the necessary information about store layout, physical environment, aisles height/width and terrains etc.

There are two different types of AR, marker-based AR and marker-less AR. The Connected shopping experience will require both types. Marker less AR will help customers in wayfinding, general product promotions and product location. It will also work in online shopping where user can place products in their own environment. Like furniture, lights and flooring etc. Marker based AR is triggered when the system scans an AR marker placed in physical world. This method will be used to display specific AR content related to that marker. It can be product details, promotions, assembly videos etc. (Augmented Reality Fundamentals: Markers | Kudan).

Using data analytics, customer behaviors and social media profiles, AR displays will be customized for each individual. For customers who have account with the stores their experience can be taken further by suggesting products according to their purchase history and giving them personalized welcome screens when they enter the store.

While customers are in-store, promotional messages and product options can be pushed to their devices in real time according to their location in the store. Customers who are signed into their store's account can be reminded of the products according to their purchasing and search history.

Online e-commerce AR apps are already getting sophisticated like Ikea's newly relaunched app IKEA Place that utilizes capabilities of Apple's AR kit. This app projects very detailed 3D images of the furniture into your space. Ikea claims that the projected 3D furniture is 98% according to scale. The AR furniture is very realistic with accurate representation of texture, fabric, colours and shadows. This app takes care of measuring up your room and furniture and comparing swatches. You can also project multiple items and see how different pieces behave together (*The Ikea Place App Shows the Practical Promise of AR Kit | WIRED*).

Wayfair (an online furniture company) has also improved its app using ARCore from Google. Enhancements in AR represent huge opportunity in on-line shopping experience. Recently, AR virtual dressing rooms have been developed where consumer can try on clothes.

Combining online and in-store AR experience will truly give customers a connected experience. According to Forrester Research, half of all retail sales in the USA are digitally influenced, this means a consumer used a digital device before or during a shopping journey. The company estimates that figure will rise to 58% by 2022. According to projections made in the Deloitte study, the concept of online is over. When everyone is online and digital is everywhere than there is no offline. If there is no offline than differentiating between online and offline is a moot point (*NAVIGATING THE NEW DIGITAL DIVIDE Capitalizing on Digital Influence in Retail*).

2.4 Design Strategy Process

The design strategy formulation was driven by interdisciplinary research. A charrette was designed and conducted based on investigating the consumer experience and decision-making. The charrette had participants from design, performing arts and marketing disciplines.

2.4.1 Brainstorming

Participants brainstormed and came up with ideas, concerns and suggestions around the research goals. All the ideas were grouped into different buckets. This provided an idea on which aspect of the research has potential and which areas needed to be addressed.

2.4.2 Journey Mapping

Next, the participants mapped out the mental decisions made by a person while shopping online and instore. One group mapped out mental decisions made while buying a dress in-store and the other mapped out mental steps while buying a food processor online. After mapping out the experience, participants were asked to highlight the steps where technology can help in the decision-making process.

2.4.3 A Day in the Life

To dive deep into the shopping behavior, “A Day in the life” experiment was performed. The group was sent to store(s) and told to act like real shoppers and note down the decisions they make while buying a specific item(s). Two participants were asked to go to Woodie’s and shop for renovating the bathroom (one participant was making the shopping decisions and thinking aloud, the other was taking notes). Another group was asked to shop for painting their living room.

Afterwards the participants mapped out their in-store customer experience. In the end, they pointed out steps where AR technologies, wayfinding and notifications could have improved their shopping experience and better support their decision-making.

2.4.4 User Testing Ikea App

Ikea has recently launched an AR app called IKEA place. This app is best in class, in which a user can project AR products into his/her living room. Ikea claims the projected AR products are 98% according to scale. We decided to user test the app and see how it performs while buying living room furniture. Participants tested this app features like user experience, accuracy, buying convenience etc. After testing the IKEA app, participants highlight the benefits and downfalls of this AR user experience.

2.4.5 Wireframing

On the basis of the early stage research, a low fidelity paper prototype / wireframe was created highlighting some of the key features of the proposed shopping journey. Moving forward fully interactive prototypes were created for specific AR use case experiences.

2.5 Outcomes

The interdisciplinary charrette was highly effective in creating a design strategy for the project. The existing conceptual research was tested and fresh consumer behavior and decision-making ideas were injected into it. The primary research proved to be very valuable in creating the concepts and ideas.

The following areas are some of the key outcomes of the preliminary user research that formed the prototype/wireframe design.

2.5.1. 3D-AR products for online users

Participants found the AR projected products very helpful in making a purchase decisions. While testing the IKEA App they pointed out that it needs to be connected to their main app and also, they wanted to see the dimension of the product in the AR mode as well. They suggested to include related product and ratings in the AR mode.

2.5.2 Wayfinding

Wayfinding with AR guidance is a main part of the proposed strategy. Participants provided useful clues about the importance of wayfinding aids in a big store (most of their time was spent in locating the products). The charrette provided a complete picture of how it could work in the retail stores. We also considered wayfinding for multiple products. After typing in a product in the search bar on the phone/tablet, user sees AR wayfinding

arrows on the physical environment. User can then zoom out using finger gesture (pinch/zoom) to see the full store AR map and zoom in to see directional aids.

2.5.3 AR Filters

While brainstorming and testing the Ikea app, we realized in order to make the experience beneficial to the users we need to give them more control and meaningful information. Similar to using the filters on the product page of a website, we introduced AR filters that will help users in shopping in store and online.

2.5.4 Use case for different store types

The main design strategy question going into the charrette was to develop a solution that caters different business types. Through brainstorming and journey mapping we were able to figure out some use case scenarios. User can try out digital apparel products with physical products, like trying out digital shoes with a physical dress. The use case for the home renovation business is apparent, where users can create a digital place using store's AR product before doing any actual remodeling or construction. User can Project AR furniture at home and see how it measures and looks in their home space. User can apply AR paint on the walls and see how different colour combination look like in the room without even applying a single brush stroke.

2.5.5 AR Assistant

AR assistant will assist users with questions, search queries, product information, location etc. This feature has huge potential. It will run on Machine Learning principals and will become smarter as it gathers information from the user. In time, the AR assistant will be able to predict a user's behavior and then suggest appropriate products/services accordingly.

2.5.6 Personalized notifications and product choices

Real time personalized notifications are a large part of the whole consumer experience. The user group pointed out that adding social media bubbles with AR notifications will enrich the experience. The team added a product suggestions bar that appears in the AR mode. This suggestion bar will help customers find related products and see what other customers bought. Unlike the Ikea app, this AR prototype will have product dimensions and static images as well.

2.5.7 Spatial Scanning

The Participants explored how the online customers will use the AR system. Along with projected AR products the app will be able to scan the room then user can put furniture, other items into a digital room. This room can be saved then the user can project it anywhere. With special scanning, the user can calculate the surface area, scan the room and get a quantity survey estimate.

2.5.8. A Connected App

Unlike the current AR apps that are standalones thus not connected to the companies' other apps, the proposed App will be merged with the existing app. Hence, the app can behave seamlessly in both AR and non-AR modes, while being used online, in-store or anywhere else. A true connected seamless experience.

2.5.9. Systems Map

Leveraging all the research made it possible to map the connection between the shopping experience and the digital tools, namely AR products, wayfinding and personalized notifications (as outlined in Diagram 4). This map visualizes how the online and in-store experiences will connect together in the prototype.

Online & In-store connected experience map

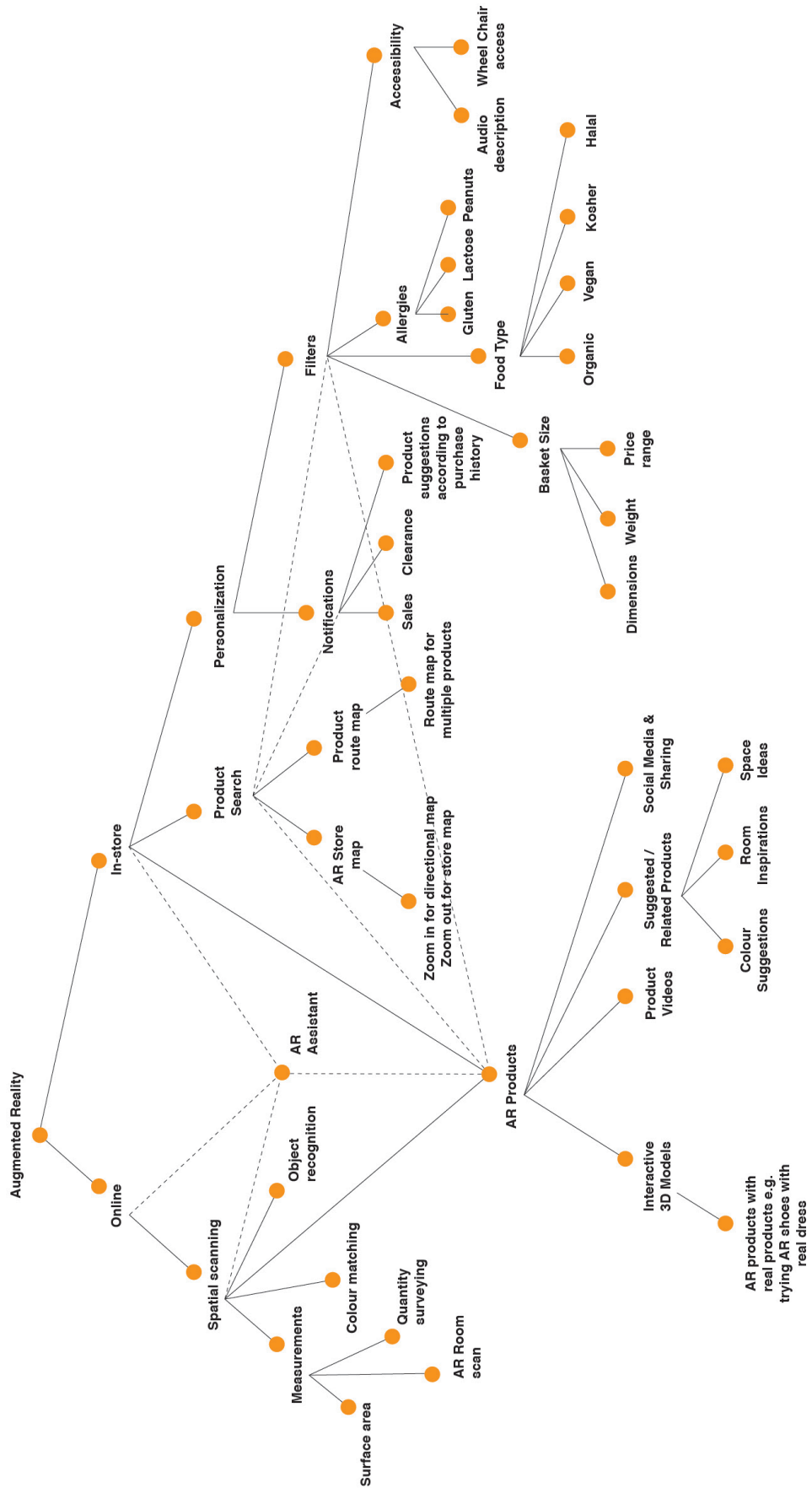
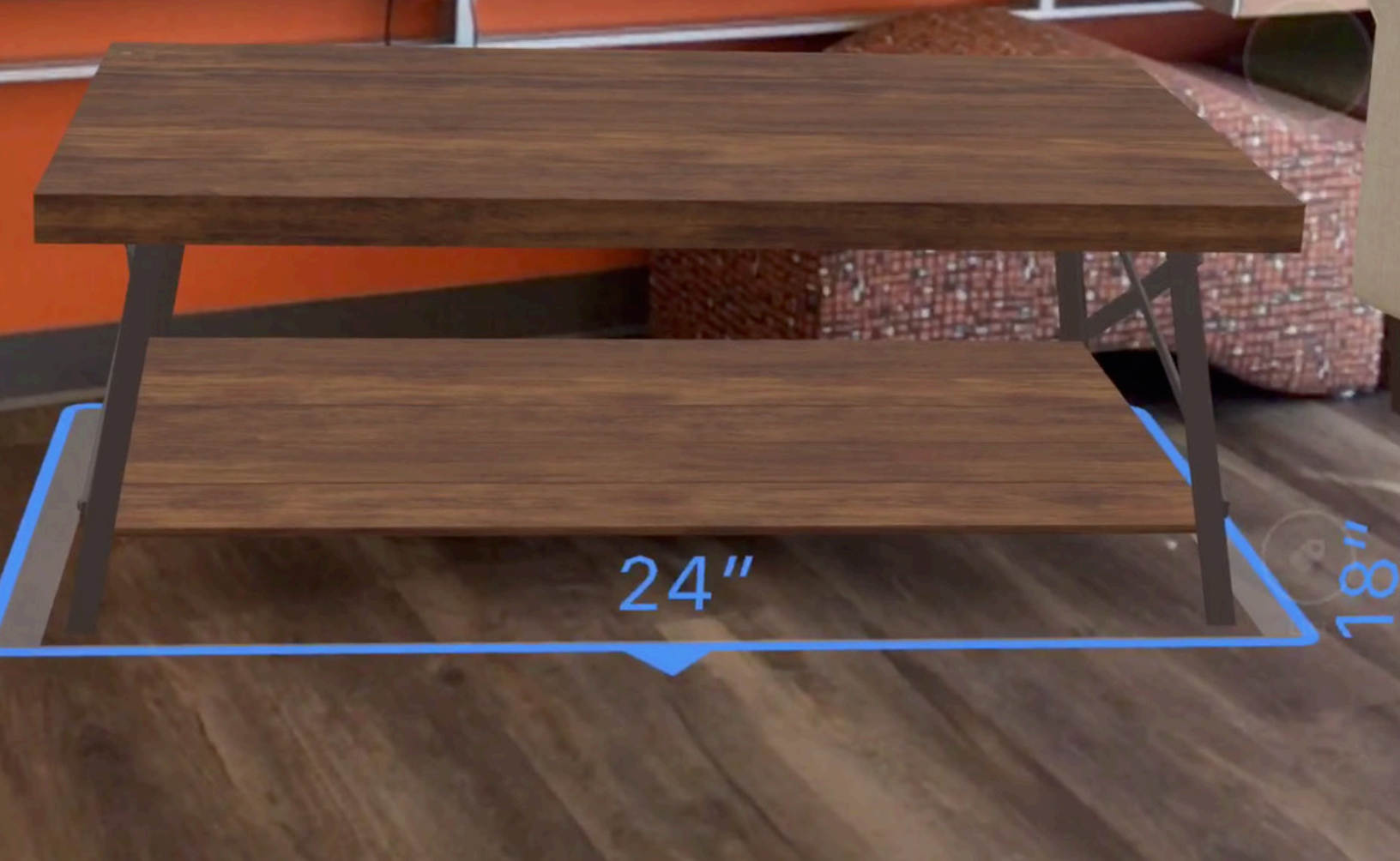


Diagram: 4 Connected online and in-store systems map

The main purpose of using AR technology in the connected shopping experience is to simplify the decision-making process.



3.0. Evaluation

The main purpose of using AR technology in the connected shopping experience is to simplify the decision-making process. A user is presented with the accurate product projections in their surroundings; thus, assisting the consumer's decision-making process of searching and evaluation.

Creating prototypes for Augmented Reality is very complicated. Because this is a relatively new field, there are no prototyping tools available that can provide a tailored experience. Augmented Reality is created through ARKit (IOS development) or ARCore (Android development). ARKit is part of Apple's SDK (software development kit) known as Xcode. The main programming language that Xcode uses is Swift, that is based upon Objective C. AR SceneKit is added to calculate the position, size and other attributes of the projected 3D object. The ARSCN kit is linked with the UI and menu controllers, that we see in a normal app. This whole process is obviously very time consuming and complicated. Creating even a simple prototype through this method takes a lot of development time.

With this project's requirement of testing different AR experiences in rich detail, the coding method of development was not practical.

For the purpose of testing my ideas, I used a combination of software tools and techniques.

3.1. Augmented Reality testing for online users.

3.1.1. Prototype Implementation

The User interface was designed in a prototyping tool called "Axure". This tool has the ability to produce fully functional interactive prototypes for websites and mobile apps. As shown in Figure 1, the user can interact with the interface and can click the AR button to view the chair in AR mode. Adding the augmented reality experience is the hard part. I was able to connect the prototype to a live AR app and leverage the AR experience from the app. This way I was able to test my ideas. As shown in the Figure 2, the user's view had a menu and an AR model superimposed onto the environment with further functionality that allowed the user to control the image placement.

3.1.2. Testing

The goal of testing was to evaluate the user experience of the online prototype. Another objective was to determine to what extent the AR experience facilitates a user in their decision-making process.

For the online version, I created a journey of a user going from the product category page of the Home Depot app then selecting a product (chair) and placing the 3D-AR model into their environment. Then the user interacts with the chair, rotating, placing/panning and judging the size of the chair. Afterwards, the user added another product (table) alongside the first AR product (chair). Finally, the user interacted with both products and placed them in the desired position as if placing the real products. Full details of the user journey script are found in Appendix A.

The prototype was tested with two subjects. Both of them found the AR experience very helpful. The user feedback revealed that both of them wanted all the relevant information related to the product (such as 'price', Add to Cart Button) coupled with the AR model, not on the menu or separated elsewhere from AR experience. Because AR is a new experience they also wanted some tips of help features to support them along the journey.

3.1.3. Evaluation of outcome

The AR mode was very helpful in the user's search and Information gathering stage of cognitive decision-making process. It made their buying decisions very easy. Subjects found the AR mode to be entertaining, pleasantly surprising and absorbing. AR made the decision-making process relatively easy. Augmentation, interactivity and registration has positive effect on consumer's affective and cognitive decision making. This finding supports the research covered in sections detailing effects of AR on affective decision-making (1.4.1) and in section (1.4.2), effects of AR on cognitive decision-making. The finding also confirms the findings uncovered during the charrette (2.5.1).

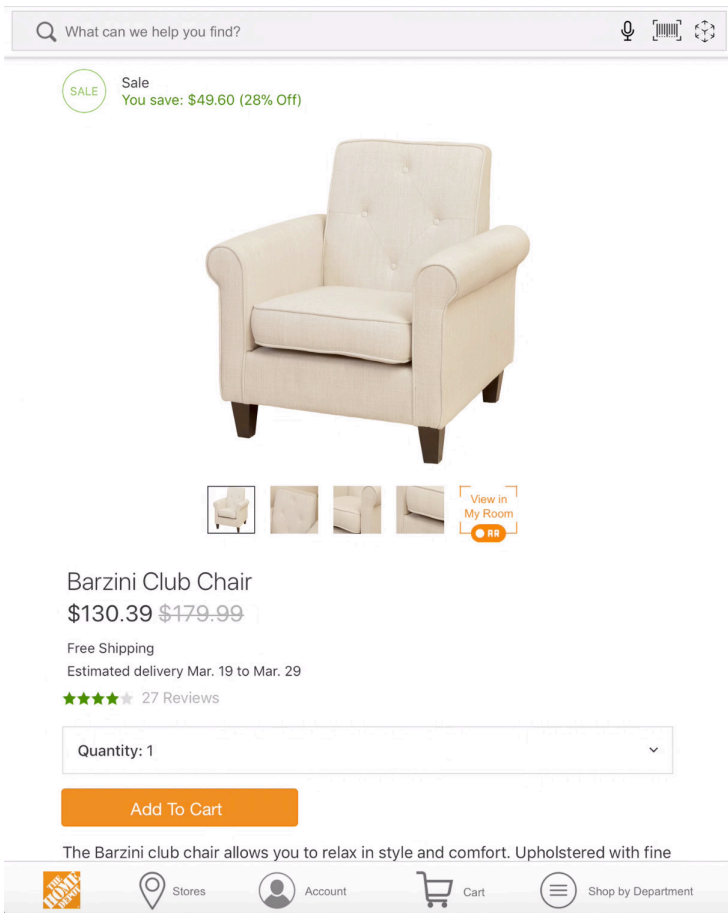


Figure 1. Product Page of the Online Prototype

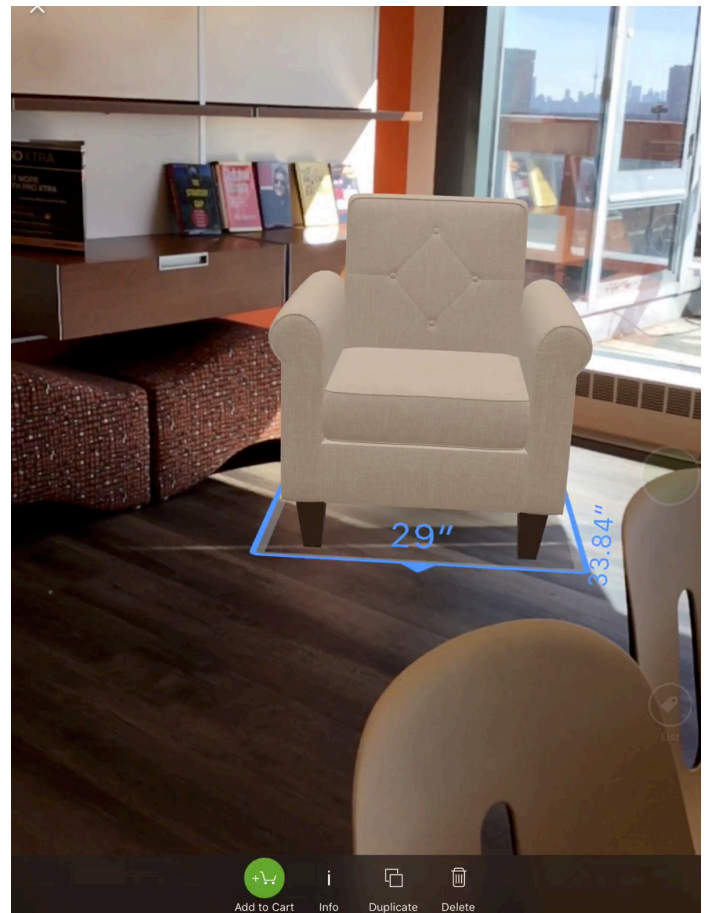


Figure 2. Adding AR Chair in the online prototype

3.2. AR experience testing for in-store users.

3.2.1. Prototype Implementation

Axure was used to design the user interface, providing a functional interface for the in-store experience. There is currently no wayfinding/AR app that gives the experience I am proposing. So, I used video compositing to test my prototype. In this method video frottage is combined with different objects to attain the desired results. The video editing and compositing tools like Adobe After Effects and Adobe Premieres, were used to create the experience. I shot the footage in the store aisles where I wanted users to see the AR wayfinding aids. I connected Axure prototype to the video composites of the projected AR wayfinding, so when the user tapped on the directions button while walking in the store aisles, they saw the AR projected arrows, as if they were projected from their phones. They then followed the arrows to the product. As shown in the Figure 3, the user's view had the AR projected directional arrows along with the selected product, that moved according to user's position in real time.

3.2.2. Testing

The goal of testing was to evaluate the user experience of the in-store prototype. Another objective was to determine how the AR wayfinding experience facilitates users in their decision-making process and to understand how the users react toward personalized promotional messaging.

The prototype was tested with the same two subjects who tested the online experience. The in-store experience consisted of directional arrows, shopping list, pop up notifications and personalized messages.

3.2.2.1. Directional arrows and shopping list

To test the AR wayfinding experience I created a journey of a user searching for a product (Delta showerhead) on their phone while in the Home Depot store and then tapping on the direction button on the product tile. As shown in the Figure. 4, user has the option to click (In store Directions) button to get directions for a product. The user found the directional arrows (as shown in the Figure. 3) very helpful and rated the experience '9'

from a scale of 1-10.

The shopping list lets the customer create a list in the app and when they are in-store they can find directions to the products via tapping on the products in their list.

For testing this experience, I created a journey of a user who had already created a shopping list of 4 items. Then upon entering the Home Depot store, the user activated the shopping list. First, the user taps on the first product (TurboRoll Battery) from the list and follows the AR directions, then the user changes her mind and taps on the third product (ClosetMaid) and starts following the new directions. As seen in the Figure 5, the user's view has the product list and AR arrows for the selected product.

Both users pointed out that it will be helpful to add a distance indicator (how many steps to go) in the

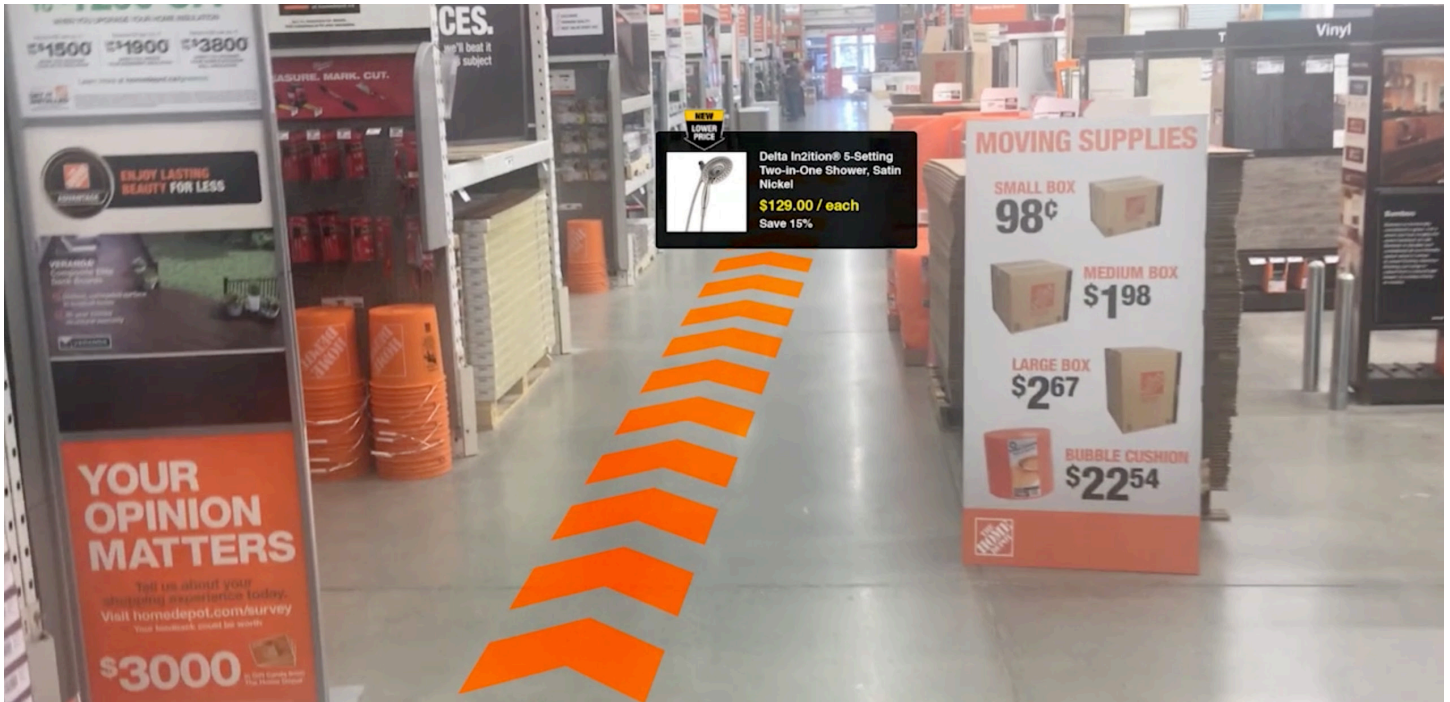


Figure 3. In-store wayfinding

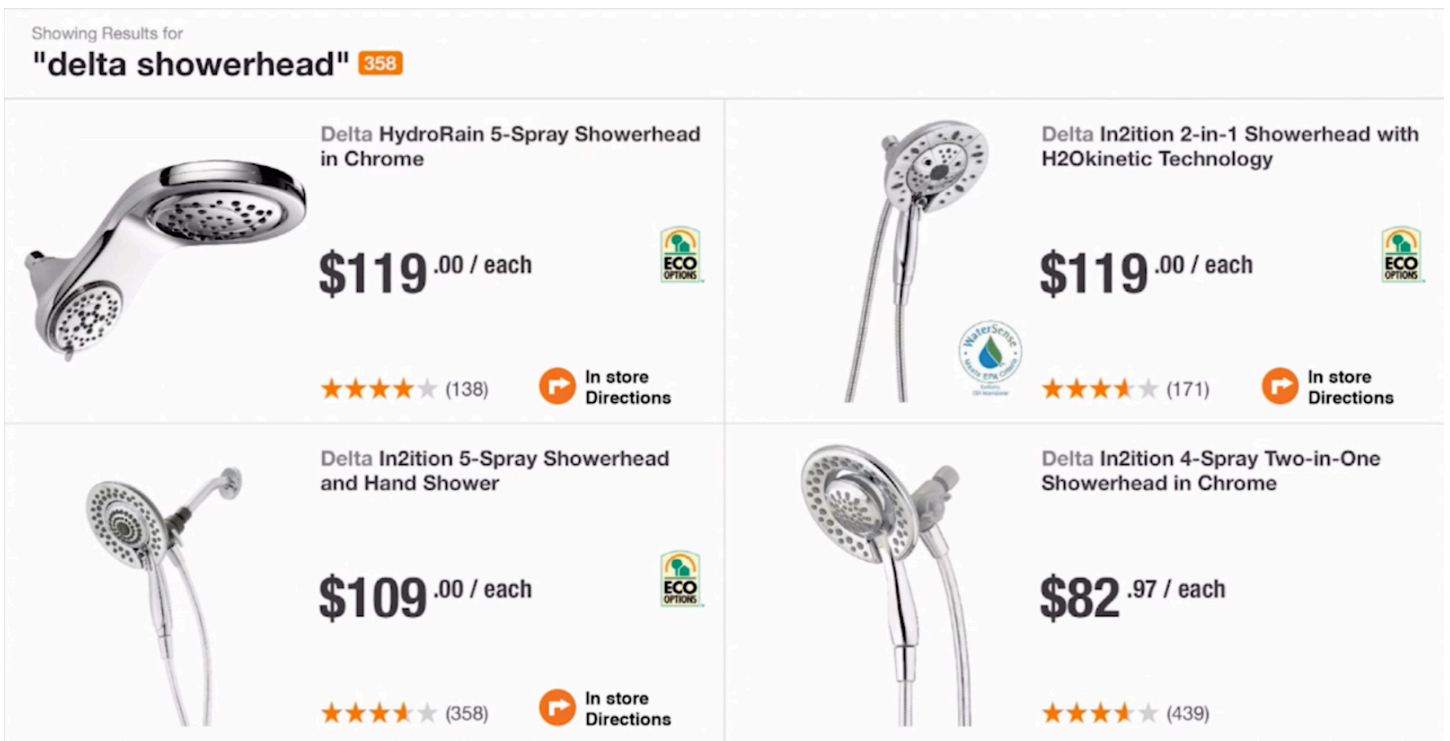


Figure 4. 'In-store Directions' button alongside product descriptions

wayfinding. In addition to the directional arrows, both users proposed prompts to be shown before a left or right turn is required (like in Google maps). Interestingly, one user kept comparing the experience with the google maps experience. One user felt it will be helpful to add aisle number with the product in the digital shopping list so she can judge how far to the product is located in the store.

3.2.2.2. Popup messages

Pop up messages are the AR promotional messages that appear from a product as the user passes. For testing the Popup promotional messages, I created a journey of a user walking in the aisles of the Home Depot with AR mode enabled on the phone. As shown in Figure 6, the user walked by different product, he/she will see different Pop up messages. Users had mixed reactions to them. One liked them and one did not. The one who did not like the pop up messages was of the view that they can be intrusive and can get in the way of the customer's real objective.

In the finished app, the user will have the ability to customize the app and turn the pop up message on/off as well as customize what kind of message they want to see. Furthermore, these messages will be linked to the customer's browsing history and searches so that they can be tailored to each person's wants and needs.

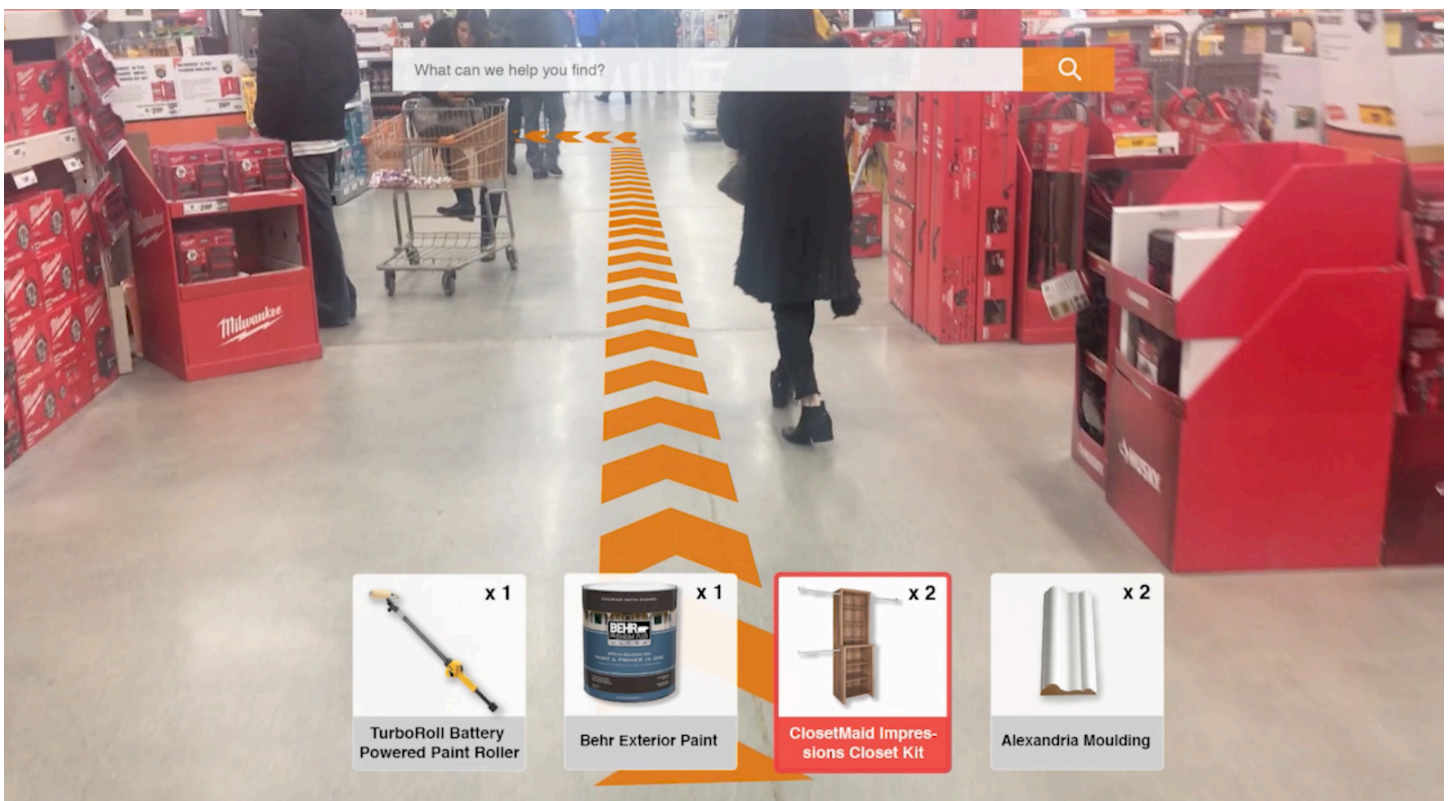


Figure 5. In-store shopping list

3.2.2.3. Personalized welcome messages

Customers will see personalized messages when they enter the store. These can be sales messages from the store and customized welcome messages reminding users to shop for a certain product according to their browsing and purchase history. I created a user journey of a customer who enters into a Home Depot store and after enabling the AR mode sees a personalized welcome message along with the reminder that the store is having an Appliance event. User then taps on the GO button to get the directions to the Appliance event. Figure. 7 shows the user view with the personalized welcome message showing store promotion.

Two types of welcome messages were tested. The one with the store promotion button described above and the second one is a personalized welcome message based upon the user's search and browsing history. These messages will be based upon the user's search, browsing and purchase history. Figure. 8 shows user view personalized welcome message with a kitchen renovation message based upon the user's search and purchase history. For testing this message, I created a story of a user who has arrived at the Home Depot store with the intention of buying car coolant. A few weeks ago, the user had bought a few kitchen renovation

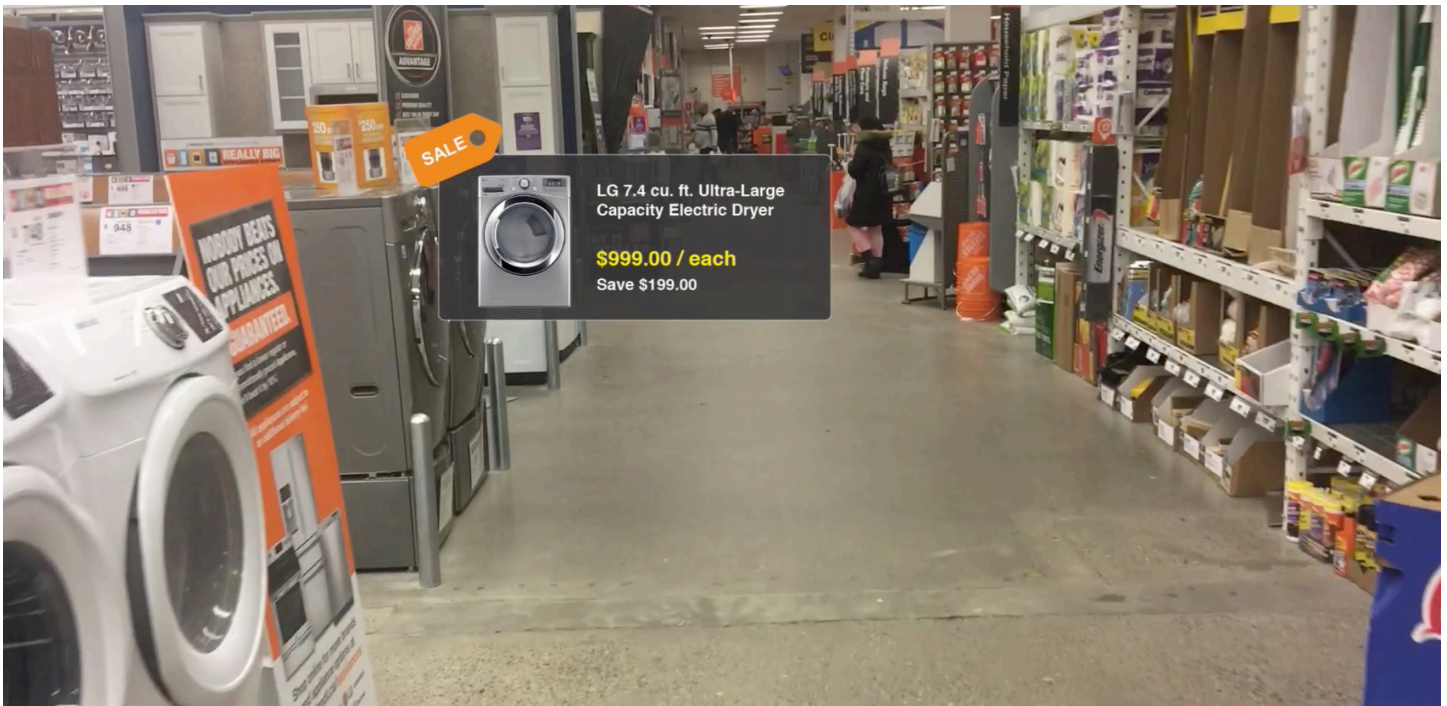


Figure 6. Pop up messages

products online and had been searching for these products in the recent weeks. Upon entering the Home Depot store, the user is presented with a personalized message reminding him/her to finish renovating the kitchen.

Two users found these messages very helpful and a great way for stores to promote the events and products. One user did not find these reminders very helpful as for her they went by very quickly.

3.2.3. Evaluation of outcome

The in-store AR directions were very easy to use and follow for the users. User found it helpful in searching for the products. The AR arrows, and messages triggered playful and positive emotions in consumers. This finding supports literature detailing effects of augmentation on affective decision-making (section 1.4.1). The AR directional arrows also helped in the decision-making process as they reduced the cognitive decision-making load on the consumer confirming the research in (section 1.4.2) which details effect of Augmentation on cognitive decision-making. The ability to interact with the wayfinding aids and personalized messaging instilled positive feelings among users and an overall increase in customer satisfaction, supporting the findings covered in the (sections 1.4.3). The ability to interact with AR objects made the user experience very intuitive, simplifying their decision-making process thus reducing load on cognitive decision-making process. These finding also support the literature detailed in the (section 1.4.4).

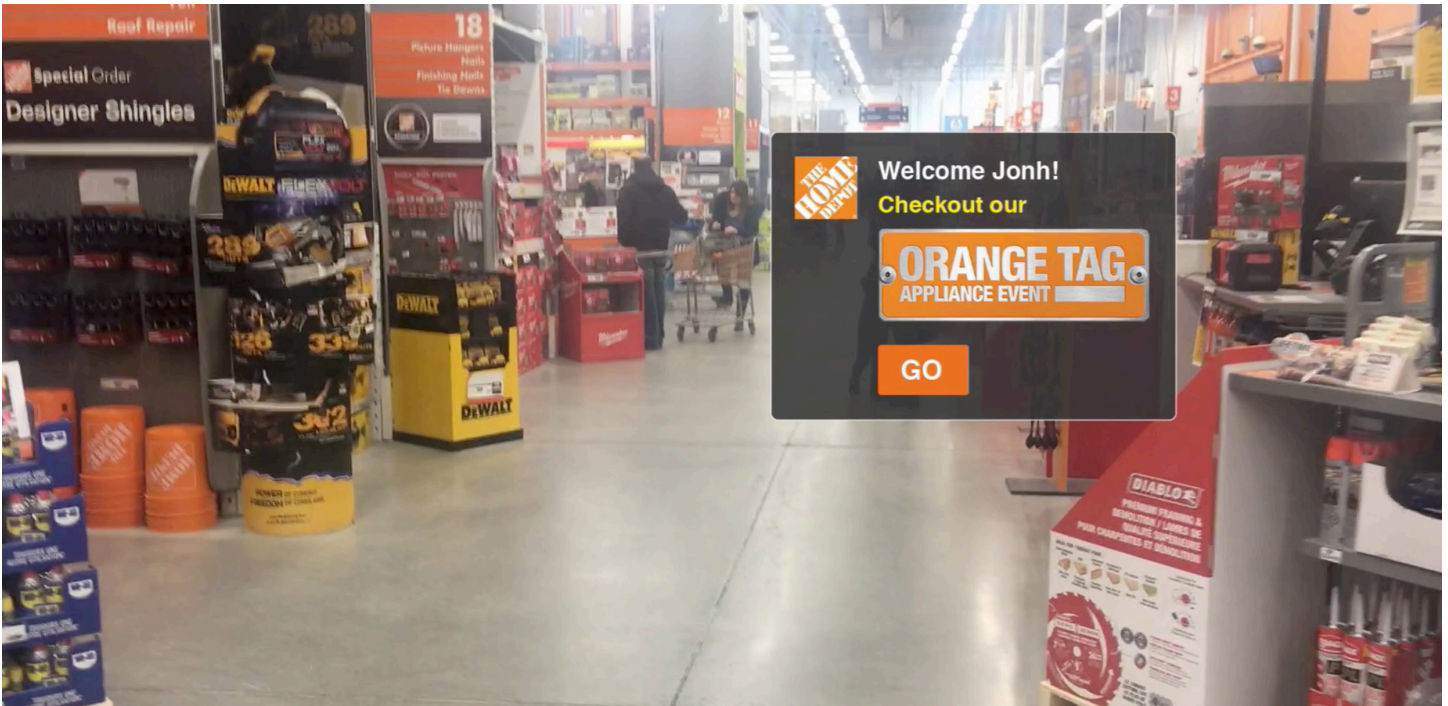


Figure.7 Personalized welcome message showing store promotion

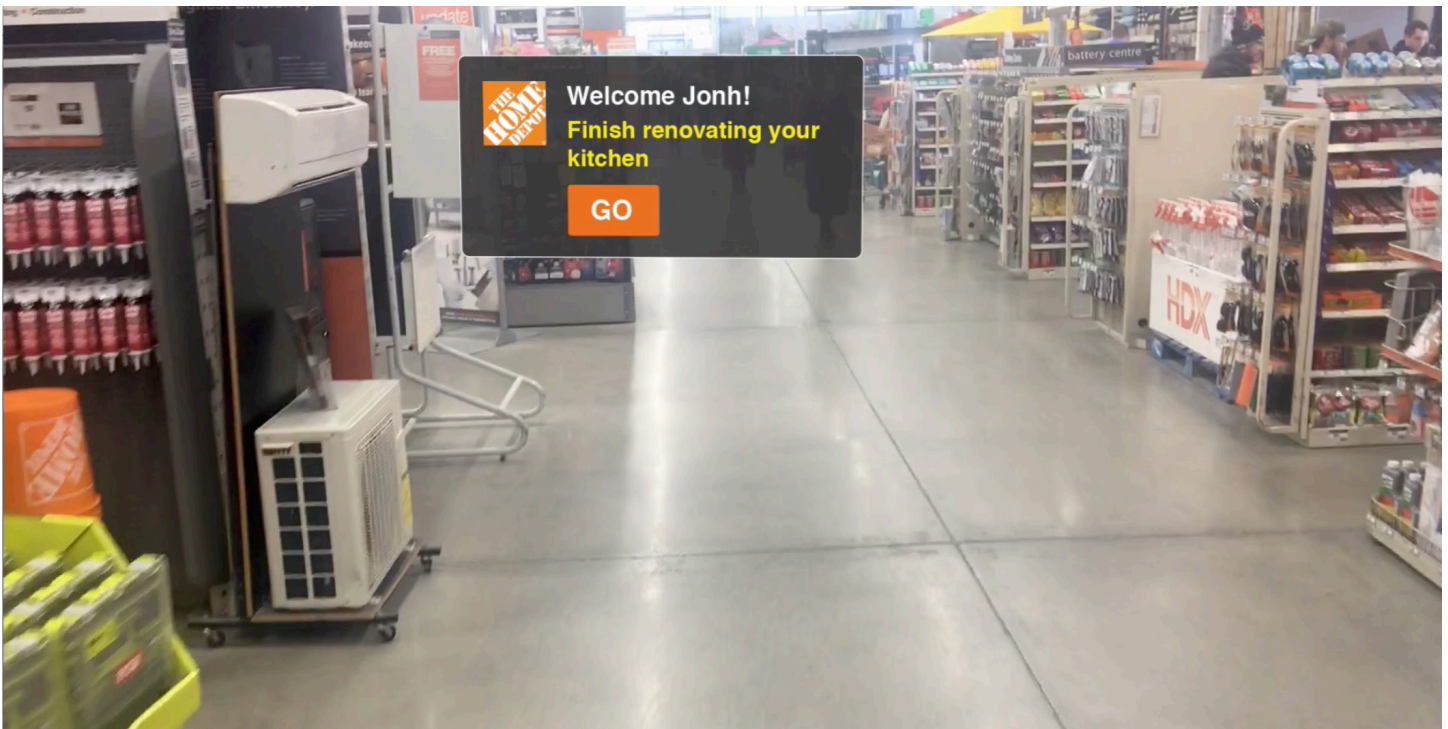


Figure.8 Personalized welcome message based upon user browsing and search history

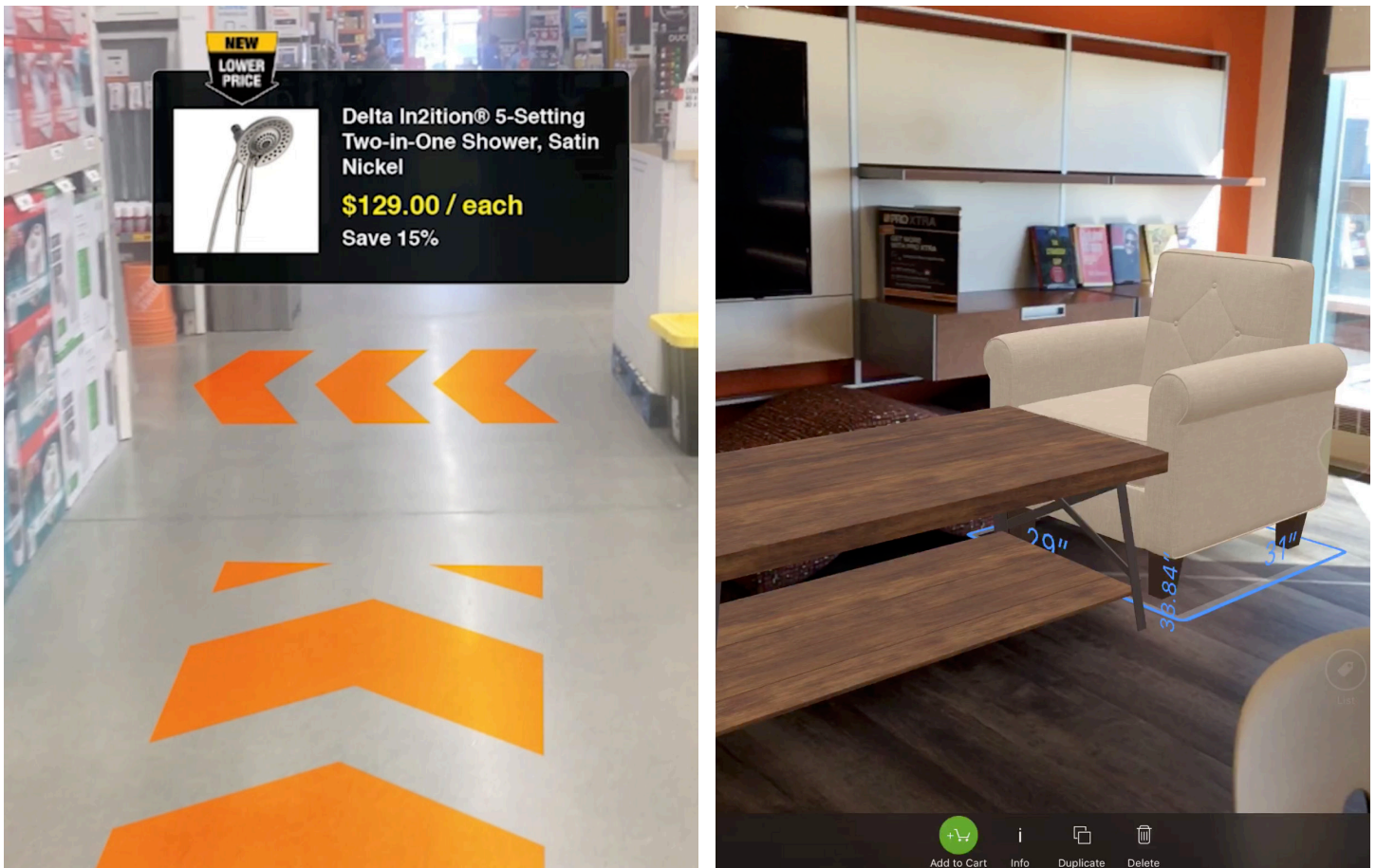


Figure. 9 In-store and online prototypes

3.3. AR experience testing for online users and in-store users.

3.3.1. Prototype Implementation

The above-mentioned prototypes (3.1.1) and (3.1.2) were tested on the same users so they can give the feedback of how a connected online and in-store experience will function. Figure. 9 shows in-store and online experiences side by side.

3.3.2. Testing

All users found it helpful that both online and in-store functionalities were in the same app. This way they had the same experience in both scenarios. One user found the online version more helpful and one found both equally helpful in supporting their shopping needs.

3.3.3. Evaluation of outcome

Supporting the finding from the Design charrette (section 2.5.8), the user testing generated the same conclusions that the online and in-store versions will function better as a **connected experience**. This will provide them with seamless experience and identical user interface across online and instore channels.

3.4 Final outcomes

In all the tests, AR mode proved to be very helpful for users in their decision-making process. The online user found augmentation very engaging and helpful, they were pleasantly surprised by the life-like digital model projected on to their environment. They exhibited feelings of joy and their behavior became more engaging. This is also supported by the research detailing effects of interactivity on affective decision-making in the section (1.4.3).

The online user found the 3D-AR model extremely helpful in determining the size of the projected models (chair and table). They were able to get the correct sense of scale and how the product looks in their

surroundings. By adding multiple AR products, they were able to see how the two products behave with each other. They were also able to see specific details and textures of the products. This made the section of the products really easy for them. They were able to decide very quickly if they wanted or did not want the product. This also simplified their research and information gathering process and reduced the amount of cognitive load in their decision-making process. This confirms the research in the section (1.4.2) that describes the effects of augmentation on cognitive decision-making.

By interacting with the AR objects, the online users were able to move, rotate and place the AR products in their desired position. This experience was very absorbing and entertaining for them. One user exhibited feelings of amazement, joy and youthfulness. They appeared very satisfied with their experience. These observations are also supported by the research of the section (1.4.3 effects of interactivity on affective decision-making).

The users were able to rotate and move the product. This gave them a detailed view of the product from each angle. By placing the product on different points in their environment, they could judge how the product looked in their environment. This Interaction gave them an immersive experience. They felt absorbed in the experience. The interactivity was very helpful in evaluating the products thus confirming the literature described in the section (1.4.4. effects of interactivity on cognitive decision-making).

All users were able to scan the floor from the mobile camera as directed by the AR app. By scanning the floor, the AR product aligns correctly to the physical environment. The users were amazed with how real the AR product look. With the correct registration, they were able to move the product to a different location. They exhibited positive feelings with the correct registration and their involvement increased in the experience This supports the research in chapter (1.4.5. effects of registration on affective decision-making).

The in-store users found the AR direction easy to use, the information presented in the directions was clear. Both users agreed that the AR directions will save them time in the store. They suggested some addition to the experience, like how many steps to the product and directional arrows. The AR directional arrows helped them in locating the products and reduced cognitive load in their decision-making process. This is supported by the literature in section (1.4.2. effects of augmentation on cognitive-decision making).

The pop up promotions and personalized messaging had interesting feedback. All users seem to be ok with them as long as they are relevant and less intrusive. One user liked the personalized sales promotions more than the popup promotions. Overall, they found this idea to be very interesting and engaging.

Both users overwhelmingly wanted both online and in-store experiences in one app. This way they will get both experiences in one download and will not need a second app. Therefore, their customer journey will have a connected experience. All user confirmed that AR makes it easy to shop, since users do not need to visualize anything.

3.4. Next Steps

Augmented Reality has great potential not only in the augmentation sphere but also in Machine Learning (ML) and Artificial Intelligence (AI) domains as well. The AR technology comes equipped with ML and AI. With the use of machine learning it is possible to recognize objects in the real world (i.e a pen, laptop, glass, remote control, etc.) This knowledge can be used to project information about the objects in the real world, like product information. Also with ML, we can replace real world objects with virtual objects.

AI feeds on data and becomes more intelligent as it gathers more information. With enough data AI can predict consumer behavior and choices. This technology can be used to build an AR assistant for the consumer that can guide them in their next decision-making process, making their purchasing journey easier.

To develop the AR experience a company, need its product to be converted into 3D models. This can be done with the help of a 3D scanner or with the modeling software like 3D studio, Maya or Unity. AR capabilities can be added by leveraging the ARkit for IOS devices and ARcore for Android device.

To activate the in-store experience, a company needs install Beacons in the store. Beacons are also known

as BLE Beacons. BLE stands for blue-tooth low energy. These beacons send a signal to user's cell phone via blue-tooth and can determine user's accurate location within their range. Big companies like Home Depot usually have a build in inventory systems to track their inventory and position of a product in the store. The In-store wayfinding system will leverage companies digital inventory data coupled with Beacon's ability to locate and track users position. This will allow a user to see AR projected arrows and messaging relative to their position in the store.

3.4. Conclusion

The systems will give a connected online and in-store shopping experience. The Customers will have a seamless experience regardless of their location. The online AR experience coupled with in-store wayfinding and notifications will increase the retailers' ability to meet their consumer's expectations of the digital experience. This will help retailer's ability to connect the digital divide as described in (chapter 1.0).

The in-store AR system will bring the out-of-date shopping experience into the digital age. This will also increase store sales and connect online and in-store channel. The need to uplift the in-store experience is apparent from the research detailed in (section 1.0)

The approach of investing in the digital experience of both online and in-store as a whole system will bring companies out of investing in separate channels, that often overlap or compete with each other.

The future of the retail industry is not about connecting channels but instead it is about utilizing digital in altogether new and creative ways. The future is a connected digital ecosystem where e-commerce sales alone are a tiny number as compared to the vast opportunities out there.

The online AR will bring in the retailer's product in users' homes. User can see and interact with the 3D models. Giving them the confidence to make the buying decision without visiting the store to confirm their product choice.

The user's ability to place correct sized 3D digital model in their environment will reduce a lot of returns driven by décor and appliance products. With the detailed AR model, user can get an accurate idea of the product, which will reduce the returns due to the fact that the shipped product looks different than what it looked like online. For customers buying furniture, redoing décor, paint and finishes, it's hard to make decisions between endless virtual options without some sort of curation, rendering the customer reticent as to which product to choose. These indecisions leave a potential of \$60 billion worth of sales on the sidelines. (Why Lowe's Is Doubling down on AR for Mobile | Retail Dive). Enabling AR mode for online users will give companies a chance to cash in this lost revenue stream.

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Appendix I

User Testing Videos

<https://youtu.be/lj62vqXUrAg> **AR online test 1**

<https://youtu.be/j1qBDEHVeFk> **AR online test 2**

User Testing Questioners

Wayfinding and personalised notification with AR Test1

Scenario 1: (Shower head _1)

You are visiting a home depot store with the intention of buying a Delta Hydro rain 5 speed showerhead. You have just entered the store and are not sure where to locate the product.

Look for the product on your iPad.
You land on the shower head page.
Click on the first shower on the list.
You see an instore Direction button.
Tap on the button and the directional arrow appears on the floor.
Follow the arrows.
The arrows are leading you to the showerhead.

How was your experience using the AR wayfinding? Using a scale from 1-10 where 10 is the highest, how would you rate your experience.

The experience was good I will rate it as 8

Did you have trouble following the directional arrows?

No, the arrows were fairly big and obvious

What could make your experience better?

If like a google map there was a reminder of where I should turn before I make an actual turn than that will be more helpful

Did the AR mode help you find the product quicker?

Definitely, I just had to follow the arrows

Any other comments you would like to add.

I keep thinking of google directions, if there was a way to tell me how much distance I had to go before I get to the product

(Multiple items directions)

You are visiting a home depot store. You have created a digital shopping list on the Home Depot app. On entering the store, you activate your shopping list in the AR mode.

Click on the Paint Roller icon.

Follow the directional arrows.

Click on the Closet Kit icon.

Follow the directional arrows

Does this digital shopping list make your experience better?

Yes, they did, but changing the directions was subtle, it should be more clear

Did the Digital Shopping list help you find the products quicker?

Yes, it did

Any other comments you would like to add.

May be something to indicate the product alongside arrows

(Pop up messages)

You are walking through a home depot store using AR mode on the Home Depot App.
While walking through the aisles you see various promotional notifications appearing from the products.

What do you think about these messages?

I like them, it's a good way to tell them that a product is on sale

Did the messages influence you in any way?

I would buy the product if I was looking for something on sale

Would you like to see more of these messages or less?

Yes, I like these messages so I will like to see them more

Any other comments you would like to add.

I like the fact that they disappear as I walk pass them so I don't have to close them, and they are a good reminder to promotions

(Promotions_ Welcome)

You have just entered a home depot store, you are using AR mode on the Home Depot App.
Upon entering you see a personalised welcome message and a reminder that the store is having a sale on appliances.
You push the GO button to go to the Appliance department.
The directional AR arrows appears.

What do you think about the personalised message?

I think they are ok I did not like them much

Did the message influence you to press GO?

No, it did not

Would you like to see more of these messages or less?

I would like to see less of these messages

Any other comments you would like to add.

Well I don't like the store promotion message

(Kitchen message)

You were renovating your kitchen a few weeks ago. You ordered some items online from HD. You are visiting the HD store today to buy coolant for your car.

You are using AR mode.

Upon entering the store, you see a personalized welcome message.

The message reminds you to finish your kitchen renovation.

The message also has a GO button that will guide you to kitchen section.

What do you think about the personalised reminder?

I don't like these reminders.

Would you click on the GO button?

No

Any other comments you would like to add.

I think the reminders went by quickly and I won't interact with them

-
1. *Is it helpful to have both online and in-store functionality together in 1 application?*
Definitely, this way I will have the same experience
 2. *How does the in-store (wayfinding) experience compare to the online (chair and table sizing) experience?*

I think the online version was better as I was more relaxed and could experiment a bit more. It was a very good way to see the products without going to the store

Which do you think is more helpful - instore or online - to support your shopping needs?

I think the online version was more helpful

Wayfinding and personalised notification with AR Test 2

Scenario 1: (Shower head _1)

You are visiting a home depot store with the intention of buying a Delta Hydro rain 5 speed showerhead. You have just entered the store and are not sure where to locate the product.

Look for the product on your iPad.

You land on the shower head page.

Click on the first shower on the list.

You see an instore Direction button.

Tap on the button and the directional arrow appears on the floor.

Follow the arrows.

The arrows are leading you to the showerhead.

How was your experience using the AR wayfinding? Using a scale from 1-10 where 10 is the highest, how would you rate your experience?

Somewhere around 9

Did you have trouble following the directional arrows?

No.

What could make your experience better?

I think it is a good experience, nothing i can think of.

Did the AR mode help you find the product quicker?

Yes, it did

Any other comments you would like to add.

Not really it was a good experience

(Multiple items directions)

You are visiting a home depot store. You have created a digital shopping list on the Home Depot app. On entering the store, you activate your shopping list in the AR mode.

Click on the Paint Roller icon.

Follow the directional arrows.

Click on the Closet Kit icon.

Follow the directional arrows

Does this digital shopping list make your experience better?

Yes, it did

Did the Digital Shopping list help you find the products quicker?

Yes

Any other comments you would like to add.

No

(Pop up messages)

You are walking through a home depot store using AR mode on the Home Depot App.

While walking through the aisles you see various promotional notifications appearing from the products.

What do you think about these messages?
These are nice messages
Did the messages influence you in any way?
I look for sales so yes

Would you like to see more of these messages or less?
When there are big sales than I want to see these messages not on small sales
Any other comments you would like to add.
No

(Promo welcome)
You have just entered a home depot store, you are using AR mode on the Home Depot App.
Upon entering you see a personalised welcome message and a reminder that the store is having a sale on appliances.
You push the GO button to go to the Appliance department.
The directional AR arrows appears.

What do you think about the personalised message?
I like the personalized feature in these messages
Did the message influence you to press GO?
Yes, if I had time
Would you like to see more of these messages or less?
Yes, whenever there are sales
Any other comments you would like to add.
No

(Kitchen message)
You were renovating your kitchen a few weeks ago. You ordered some items online from HD. You are visiting the HD store today to buy coolant for your car.
You are using AR mode.
Upon entering the store, you see a personalized welcome message.
The message reminds you to finish your kitchen renovation.
The message also has a GO button that will guide you to kitchen section.

What do you think about the personalised reminder?
Yes, I get the idea that that's I reminder
Would you click on the GO button?
Yes, if I had time
Any other comments you would like to add.
It's a nice way to promote items in the store

