
The effective of augmented reality in the interactive print design

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Abstract:

The research deals with the effectiveness of augmented reality in the design of interactive publications, as augmented reality is one of the newest and most widely used technology techniques. the latest popularity in print advertisements, and it supports advertising with sound and movement, which makes it more attractive than traditional advertisements, where advertisement is displayed on phone screens, which is a process of merging Virtual objects in a real environment in Real-time , augmented reality combines the real and the virtual.

Augmented Reality aims to simplify a user's life by bringing virtual information not only to their immediate surroundings, but also to any indirect view of the real world environment, such as a live video broadcast. Augmented reality enhances the user's ability to visualize and interact with the Real world.

Here, the advertising designer seeks to attract the uninterested user of passers-by about the print advertisement, and attracting their attention is achieved through the use of impressive interactive techniques beyond the limits of their expectation, and here the passing user becomes involved in the Augmented experience, and that the goal of the advertisement design is to show the consumer the ability of a particular brand to Satisfying his specific needs, the use of modern digital technologies such as augmented reality will add an interactive element to the print advertisement whereby the consumer will be able to participate positively in the interactive print advertisement.

Advertising media has clarified augmented reality in facilitating the interaction process between print advertising and consumers. Near communication technology and quick response codes have become part of the print advertisement design process and facilitated the link between the real and virtual world, the physical factors of the augmented reality printed advertisement represent the elements of sound, movement and colors, so they are in radio and television advertisements. As for the printed advertisement, it is silent and does not contain movement or sound. It shows that the augmented reality came to link the old printed advertisement with what is new and its importance as one of the most important publications for advertisement.

Key words: Augmented - interactive - print design

Introduction:

After the development of augmented reality and its spread in the field of print advertising, it has many applications that differ from one advertisement to another, and it had an impact on posters, packaging and other publications, where the advertisement became more attractive than the traditional printed advertisement, and it is a way to transmit virtual information through the real environment to enhance the user experience, Animated design has the ability to grab attention and deliver information faster than traditional print advertising. The Augmented Reality application aims to simplify the user's life by bringing virtual information not only to his immediate surroundings, but also to any indirect view of the real world environment, such as a live video broadcast. Augmented reality enhances the user's ability to visualize and interact with the real world.

Augmented reality makes print advertising interactive, allowing marketers and advertisers to connect with consumers in entirely new ways. Several companies have already used this advanced technology as it has gained popularity with a wide range of consumers.

Research problem:

The research problem lies in a number of questions:

What is the role of augmented reality in developing print ad designs?

What is the extent to which augmented reality interacts with the audience and is linked to the creation of interactive content for print ads that attract consumers?

- What is the impact of augmented reality on the process of perception towards advertisements?

Research importance:

The importance of the research is due to the frequent use of augmented reality in displaying advertisements in the current era to consumers. The communicative ability of augmented reality helps facilitate the process of creating content that attracts consumers. And the power of interactive advertising as an effective marketing tool for brands.

Research aims:

The research aims to:

- Clarifying the possibilities of augmented reality through its developments in the designs of print advertisements.

Linking augmented reality to the field of graphic communication and creating interactive content.

- Shedding light on design methods to address modern technology to create moving elements that attract the consumer.

Research limits:

Time limits: from the beginning of the emergence of augmented reality in advertising (1997) until the present era.

Spatial limits: Available from countries around the world.

Sample Limits: Marketing Publications.

Research Methodology:

The research depends on the historical and descriptive method.

Augmented Reality

Due to the recentness of the concept of augmented reality globally, the terms that have been called upon have abounded, including added reality, compact reality, expanded reality, enhanced reality, and augmented reality, all of which refer to augmented reality, which is the most widely used among them. Augmented reality (Pedaie, Jon (2017) p.1)

The birth of augmented reality advertising

Augmented reality is the latest buzz in advertising; advertisers have found a unique and interactive way to engage audiences with a brand. On the other hand, it keeps users in charge of the conversation process allowing them to retrieve the information they need, when they want it and anywhere.

(Panday, Mrinalini (2014) P3)

The use of augmented reality in films can be traced back to 1907 when the French magician and film maker Georges Méliès (1861-1938) created his hilarious posters; the characters appeared in the posters and interacted on the screen. (Peddie, Jon (2017) PP12-13)

In the nineties, Ronald Azuma in 1997 used augmented reality technology to display virtual text ads on buildings, and this is the first step for augmented reality technology that has become universal in use.

Augmented reality forms in the field of print advertising

With the advent of 360-degree imaging techniques, the recipient can see the visual product completely and in different aspects, and not just from one side, transforming the recipient's behavior in reading the advertisement from a traditional habit to a daily pleasure that he craves, which means an increase in the opportunity to respond to the advertisement. (Abdul Muhaimin, Heba (2020) p. 525)

The physical factors of advertising include the elements of sound, colors, and movement, while we find that most companies consider color as an essential element in advertising, such as magazine ads or television ads. As for movement, it becomes an important requirement for products that need clarification, and the advertising are more interactive and attract attention, advertisers were turning towards television. And cinema to display a kinetic advertisement, and now kinetic advertising has appeared more in social media (digital ads), so print ads have declined, as few advertisers are turning to print to promote their products. (Mahmoud, May (2016) p. 14)

Poster

Posters are a type of functional art. They are a communication tool that is suitable for addressing a large number of audience members, and its goal is to communicate information by drawing attention to something or modifying the behavior of the viewer. In the advertising process, he has the ability to invent new ideas, which are the basic requirement for his success as an advertisement, and to achieve the communication goals between him and the recipient.

(Mohammed, Amr (1998) pp. 136-138)

The characteristics of the poster and the advertising media are the first factor in advertisers choosing the appropriate medium for them, because it determines the type of message that can be delivered. (Al-Mohammadi, Saad (2014) p. 164)

Create interactive posters with augmented reality

Posters in augmented reality are the advanced way to transmit virtual information through an interface to a real world environment to augment the user experience. Multidimensional visualization is essential for effective vision. It also adds a virtual element to print and is supported (image, text, sound, 3D models, clips, video, web links).

When presenting a poster at conferences, the ability to understand your project can get lost in a wall of text and static data. This is where augmented reality (AR) comes in to enhance and highlight your project with movement and sound.

The type of information and data that you find and create while conducting your research are important sources for a recipient's AR poster. Saving the photos and videos you encounter gives the ability to complete the poster, as long as the information is available online. Live digital data and information you generate during browsing should be used, but these are not the only ways to use augmented reality in the recipient's poster.

Although images, graphics, or 3D models produced during a poster project visually display information that is difficult to describe or imagine for viewers, it is static. Augmented reality allows the design to become animated to bring more focus to the recipient within the design. Sound effects and sound clips attract the viewer's sense of hearing, which increases his interaction.

Gaining information directly from the audio that was recorded, this is a great opportunity to highlight excerpts from the audio interviews in (AR) posters. If video interviews are recorded, it is more interesting to introduce the topic through a segment rather than a written description.

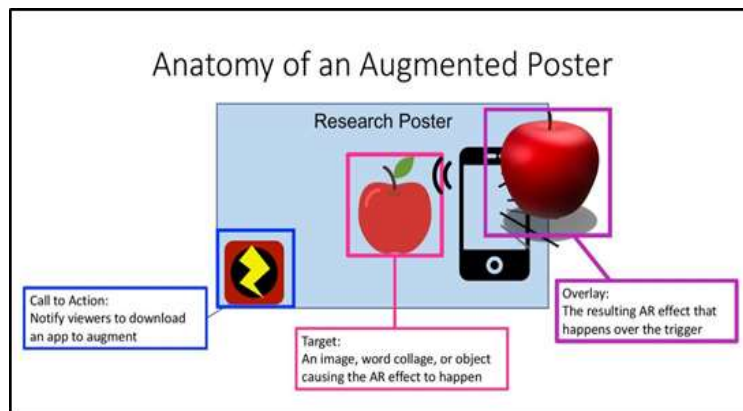


Figure 1 shows the use of the Augmented Reality poster

Advantages of the Augmented Reality poster

Augmented reality added features in the poster:

1. A new way to promote products and services.
2. An influential intermediary to deal with users.
3. Augment user participation.
4. Easily communicate with clients.
5. -Real-time analysis of customer behavior.

(<https://educationaltechnology.wooster.edu/ar-posters> 5/3/2021, 06:22AM)

Augmented reality poster for “the Stockholm” art exhibition (2015)

Swedish agency M&C Saatchi brought this campaign for Art Week in “the Stockholm ART WEEK” to bring the city's art scene to life with an augmented reality application that allowed everyone to submit their work and display it in posters and the official catalog. Users only had to scan the designed codes on the poster to see the surprising artwork on their phones, they relied on designing the posters on QR code with different designs and shapes without placing any special images on the exhibition board in order to make the recipient more interactive and effects. (<https://catchoom.com/blog/16-cool-augmented-reality-advertising-22/3/2021-05:22AM>)



Figure (2) An illustration of the use of the promotional poster for the art exhibition



Figure (3) shows the design of the exhibition posters

“Burger King” poster (2019)

With the motto "After all, flamed grilled is always better" After all, flamed grilled is always better", Burger King came up with a brilliant idea to burn up the competition in Brazil. They integrated a feature into their app that allowed users to scan and burn any competition ad in the virtual world using Augmented reality The goal is not only that users have fun by smashing the Burger Kings contest, but that they also get a free offer by using the feature or technique. Use an AR lens in an app to identify and then fire competing billboard advertising, magazine advertising, and discount coupons (virtual or at least onscreen in AR).

Plus if the customer shares this experience, they will get a free Whopper coupon, I think a lot of people would see that as a bit of fun, and definitely something different to show off. This unusual marketing hack also promotes augmented reality, which allows customers to pre-order their meals to avoid "real-world" queues.

([https://prsmith.org/2019/03/28/how-can-ar-turn-a-competitors-ads\(10-4-2021-11:47PM\)](https://prsmith.org/2019/03/28/how-can-ar-turn-a-competitors-ads(10-4-2021-11:47PM))



Figure (4) shows a Burger King advertisement. When you click on the label, it shows special offers for the product

Create interactive augmented reality packaging

Packaging designs are turning to augmented reality technology for all kinds of products, to unleash augmented reality that helps the product user understand or communicate with brands. QR codes, augmented reality interactions and experiences are all powerful features that can make the customer connect with the brand beyond purchasing products, and they can be easily incorporated into the packaging design. These and other technologies are sure to become more prevalent in the upcoming future of the packaging industry. (Khaled, Kholoud (2020) pp. 267-268)

AR technology offers other ways for marketers and advertisers to increase sales. Consumers can try out various products from shoes, clothes, jewelry, watches, games, etc. This makes AR advertising a powerful tool for driving sales and increasing revenue. We find that Lego has used augmented reality in its stores, and has developed a device that if children point toy boxes at it, the final toy designs will appear on the screen as 3D models.



Figure (5) The Lego packaging

Product packaging on store shelves and malls can also come alive as advertisements can jump off the printed page to identify objects in 3D shapes and provide interactive “how-to guides” about products, ingredients, prices, and purchases. (Abdul-Maheen, Heba (2020) p. 526)

“Bombay Sapphire” Augmented Packaging (2017)

The Gin brand has partnered with Bombay Sapphire to add augmented reality (AR) elements to its physical product. This means that users can scan a special mark on the bottles to bring them to life with (AR) images and sound including blooming flowers and wildlife, users can also discover videos detailing hidden recipes and other additional information related to the product.

In turn making the augmented reality experience unmissable for consumers, hoping that the mark will remain on the bottle even after purchase, bringing the packaging to life, it has used visual technology to reach out to the thinking stage audience and encourage them to see its latest offerings and it has been used by others to deliver value at different points of the consumer journey.

(<https://econsultancy.com/how-shazam-is-using-augmented-reality-to-help-brands-come-to-life-22/4/2021-10.31PM>)



Figure (6) Bombay Sapphire Reinforced Packaging

“OREO” (2020) Augmented Packaging

Use OREO, the famous product of augmented reality technology (AR), when using the Spark AR application and installing the phone screen on the packaging. An animated advertisement appears on the package that inserts it explaining the components and methods of its use, converting the graphics downloaded by the computer into augmented reality. You can get a good chance of getting a chance of getting a chance of getting creative and attractive floors or filters.

<https://visualise.com/case-study/oreo-ar-box-dem-22/4/2021-1.15AM>)



Figure (7) OREO augmented Packaging

Newspapers and magazines

Newspapers

The press is the first advertising medium in all countries of the world in terms of the amount spent on advertising, and the press remained the leading medium in the field of advertising despite the emergence of modern advertising means such as television and social media.

The press is of particular importance as an advertising medium among those interested in advertising activity (advertising agencies, consumers, producers).

Newspapers also give an opportunity to the advertiser to put a large amount of information that the reader can keep for future reference. (Mohamed, Amr, (1998) p. 167)

Magazines

It is a type of periodical publication that contains different topics. The magazine designer uses the same elements that the book designer uses and it includes typography, graphics and shapes. The magazine design is more colorful and colorful than newspapers. The Gentleman's Magazine, first published in London in 1731, is considered to be the first magazine, and Edward Kief was the first to use the word "magazine" and he used the term, historically for the first time, in 1731, to describe the newspaper. Newspaper-shaped, diverse in content, because the newspaper is specifically devoted to news and fast, local news, while magazines offer stories, articles, serious studies and other materials for entertainment.

<https://al-ain.com/article/magazine-editing-london/13/5/2021-7:10PM>))

Incorporating augmented reality in newspapers with advertising as a marketing

With the global digital transformation in all fields, newspapers and magazines around the world faced a severe crisis in editorial and production techniques, which threatened the continuation of the print newspaper in publication and called for the need for change.

Where the newspaper and the printed magazine lack the elements of the moving image and the direct interaction, which represent two essential elements in the digital communication process and are what drives the public to turn to electronic journalism and digital media in general. Although the digital revolution threatened the existence of the printed newspaper, it also created new opportunities for survival. A new strategy has emerged for print newspapers and magazines, which is to integrate augmented reality (AR) technology within their pages, so that the print newspaper becomes one of the hybrid multimedia styles.

Through this technology, a digital overlay is created on the printed page by adding multimedia content, including video and audio files, links to social media, and more. This technology transforms the static image that we see in the newspaper and the printed magazine into a moving image and video that we see through smart devices of all kinds and shapes. (Ibrahim, Marwa (2018) pg. 601)

Augmented reality technology has renewed the hopes of publishers in the world of print journalism, and opened new and wide horizons for newspapers in terms of editorial and advertising. In the newspaper, watching these images turns on the mobile screen into a three-dimensional exhibition through which the reader reviews everything he wants to know about the product or the news. When applying augmented reality technology to magazines, it was called “live magazine.” Augmented reality discovered a mass market for smartphones last year, enabling users to see additional layers of data or 3D objects when they viewed normal things through smartphones or webcams, not It is surprising, then, that at the end of 2009 there was only one "Esquire" magazine making a big fuss about it.

(<https://www.theguardian.com/media/pda/2010/jan/06/journalism-augmented-reality>30/3/2021-5:36PM)

For example, the American Cosmopolitan magazine published an interactive advertisement for a beauty company offering a cosmetic product so that readers can try it through augmented reality technology to find the right shade of color, and they can then order the purchase of the product directly through the application.

In our Arab world, there are also some experiences in this field. Recently, Al-Jazeera Printing and Publishing Corporation in Saudi Arabia launched the Aljazeera snap application for IOS and Android users, an application that converts some of the images in Al-Jazirah newspaper into interactive multimedia to increase the effectiveness of the newspaper and as an additional income. Important, and to achieve a competitive advantage. Augmented reality is able to achieve values for the required returns from printed advertising by renewing its dry and static nature. Many large companies have accepted to advertise their services or products through printed newspapers again to create a strong and attractive interaction with their customers, and one of the first press advertising campaigns supported by augmented reality is the Nissan campaign the cars were a huge success and watched by more than eight million readers in one day.

(Ibrahim, Marwa (2018) pg. 602)

Advantages of augmented reality in print newspaper advertisements

Augmented reality is an interesting newspaper feature that takes readers beyond the printed page. It enables people to watch a video, animation, or other seemingly unexpected content on a page of their newspaper. A virtual environment is created when the augmented reality software and the camera software of a smartphone or tablet work together. The newspaper must be viewed through the camera of the mobile device, in addition, the device must be connected to the Internet.



Figure (8) illustrates the augmented reality sign in newspapers

Even though the augmented content isn't actually in the newspaper, I've found that the augmented reality feature can sometimes be a fun augment to the printed information. Show although the content uploaded is often a video, there are many other possibilities.

<https://turbofuture.com/misc/Augmented-Reality-in-Newspapers-/3/5/2021-5:48AM>

Augmented magazine "Top Gear Mag" (2011)



Figure (9) An advertisement for an augmented in the "Top Gear Mag" magazine.

The December 2011 release of “Top Gear Mag “combined print and video with attractive covers and vibrant content using augmented reality technology. Besides winning awards, they have published over 8 issues with 50,000 to 100,000 views per issue, an engagement rate of 27%, and a click-through rate of 25%. World, using the expertise of motion graphics designers to create smooth, engaging covers and editorial content that comes to life through the magic of augmented reality. The magazine, which has a monthly readership of 1.8 million people, has seen an increase in video views as a result of simulation and interaction.

(<https://www.enginecreative.co.uk/portfolio/tg-mag-extra-augmented-reality>14/1/2021-6:40PM)

Augmented “Ledger Dispatch” (2018)



Figure (10) augmented Ledger Dispatch

In a dramatic move that promises to boost newspaper revenue while delighting its readers, a Northern California newspaper is using augmented reality technology to bring its newspaper to life. , Snapshots of editorial topics covered by videos on smartphone screens. Converting the press topic from a two-dimensional static topic on the left to an interactive three-dimensional topic The Interactive News Initiative allows readers to use their smartphones to view images in newspapers and access a deeper level of content. After downloading an app, readers simply hold their Android or iPhone devices over images or blocks of text to begin the interactive experience. With this tool, readers can use their newspaper as a launching pad for watching movie trailers, shopping for a new car, or exploring different dimensions, Ledger Dispatch publisher Jack Mitchell said. On everyone's smartphone, it turns the newspaper into a portal to access unlimited opportunities in the reader's community and beyond."

(<https://www.thevrara.com/blog2/2018/3/2/amazing-california-newspaper-ledger-brings-its-pages-to-life-with-augmented-reality-4/4/2021-6> :36PM)

Catalog and brochure

The catalog is one of the most important advertising means that clarify the vision of companies, their products and ideas, and which links ideas between the company and its customers by displaying visions, products, marketing offers, work plans and other contents included in the brochure to be presented to customers, whether electronically or printed, and to clarify what the facility wants to deliver to its audience of users or Consumers and according to the type of field in which the establishment operates. The brochure is presented on a sheet of paper, usually the size of A4, and divided into more than one page in the same design in two sections, three or four sections on each side of the brochure to clarify specific ideas for the company with writing a brief about the history of the company, its vision of the market and the nature of its work, or to display products New to the company or some of the company's marketing offers.

(https://www.eltamayoz.com/ar/graphic/Brochures_and_catalog-2/5/2021-6:30AM)

"Pizzahut" brochure with augmentative technology (2014)

The Pizza Hut brand in the Middle East in 2014 published what is known as augmented reality applications for fast food restaurants to promote the family meal to enhance its market share in the Middle East countries, where augmented reality applications provide a vision for the new offers that Pizza Hut launches from time to time By downloading the Oggle app, users can scan images on pizza boxes and menus to access the Family Trivia Challenge, browse the interactive menu and even place an order directly from the app.

(Abdul Muhaimin, Heba (2020) p. 525)



Figure (11) Augmented Pizzahut brochure

(<https://catchoom.com/blog/16-cool-augmented-reality-advertising-campaigns/22/4/2021-5:31AM>)

Augmented IKEA Catalog (2012)

The Swedish company IKEA has launched a catalog of its products with interactive images with augmented reality technology, turning paper pages into interactive display platforms. Furniture, then directed to the place chosen by the customer to show them a thumbnail of the product in this space, allowing them to know the suitability of the furniture for their homes or offices and even choose the color and material, and the company decided to expand the scope of the experience thanks to the positive response from consumers.

It displays 3D animations with the IKEA catalog in the background, for ease of use linking the physical world to the digital world by scanning QR codes, but the main barrier to certification in most of these attempts is the need to install certain apps before they can interact with Everything that lies behind the code or activate the augmented reality (AR) features.

(<https://beantin.se/testing-ikeas-augmented-reality-catalogue-14/4/2021-6:38AM/>)



Figure (12) Augmented IKEA Catalog

The effect of using modern technologies on printed advertising

Recently, augmented reality has been an influential technology that has been used to improve the performance of users with the efficiency of perception through computer-generated media content, and since the goal of advertising design is generally to demonstrate to the consumer the ability of a particular brand to satisfy certain needs, we find that for interactive advertising, in addition to The content of his advertising message and the ability it suggests to satisfy one of these needs. The interaction itself has a value in satisfying the social needs of this consumer and his feeling of acceptance and respect from others and his self-esteem when many creative methods are used to attract the customer's attention and arouse his interest in noticing the advertisement, and interaction is one of these methods.

Interactive advertising can be used to support the correct delivery of the message to the consumer by identifying some of the characteristics of the person interacting with the advertisement and addressing him with an advertisement specifically directed to him, and the consumer does not remember all the information he saw, heard, or read even after receiving and interpreting it, which is known as selective remembrance. Therefore, advertisers are also keen to ensure that the information will remain in the consumer's memory in order to be available until the purchase decision is made. The use of symbols, rhythms, images, and association helps in this recollection, and also the use of interactivity in advertising will certainly help to keep the advertisement in the mind and not give it a sense. Important as it gives a good mental image of the brand, which facilitates the retrieval of this information when making a decision.

Interactive advertising can also be used with new products very effectively, as it allows the possibility to try the product virtually so that it gives the viewer an idea of the capabilities and features of the product and provides him with the information he is looking for and motivates inside him and she wanted to explain to the viewer the "Mercedes Benz CL63 AMG" to buy, as well Mercedes, when presenting its new car, did the power of this car through a printed external advertisement, so it decided to provide them with a "virtual" opportunity to drive it.

To convey the feeling resulting from the actual driving of this powerful car.



Figure (13) An interactive advertisement for Mercedes that enables the viewer to experience the virtual product

The interactive print advertisement using modern digital technologies was able to overcome most of the difficulties that were facing the traditional advertising communication, so it became a two-way communication between the advertiser and the consumer. And raise the level of their association with advertising.

(Mahmoud, May (2016) pg. 15:16)

Reactions of augmented reality technology in the field of advertising

The integration of sensory feedback with augmented reality is one of the most important challenges in the field of advertising, which achieves increased user interaction with different applications. Among them we mention the following:

Haptic Tangible Feedback

Perceptual (tangible) reactions are based on providing a physical connection between the user and virtual objects that are projected into the real environment, so this integration requires high calibration and accuracy to increase the user's interaction with it. Materials, for example, in one of the applications used in the field of augmented reality, the installation of clothes on the user's body "Virtual Dressing Room" without the need to wear it, but through sensory reactions that enable the user to identify the type of fabric.

The vibration device is one of the most important devices used to improve and add tactile perception the tactile feedback with augmented reality can be applied in many ways to identify what the material is or to force the user to follow certain commands.

A team from Disney released "Reveal", which is one of the technologies that combine augmented reality with tactile feedback through the principle of reverse electric vibrations, which would be used in the future in libraries by passing the hand on the cover of books to infer their content, as another example in An automated teller machine (ATM) to retrieve the password in case the user forgets it. It also enables the blind to infer the way by touching surfaces.

Auditory feedback

Sound is of great importance in communication, communication and perception. Augmented reality attempts to integrate auditory reactions by moving virtual objects to increase interaction, and many modern sound technologies such as 3D sound and spatial sound to increase accuracy in inferring the sound source and thus Increase interaction. Through the glasses, educational print graphics or products will appear before the viewer, with audio synchronization and synchronization of everything visible. Reflexes are automatically updated to match the user's head movements.

Smell and taste reactions

The sense of smell can play a role in augmented reality by integrating it with the sense of taste in the field of advertising, and perhaps the most famous experience in this field is the "Augmented Reality Flavor", where an odor emitting pump and glasses were used to install images of biscuits with different foods to control the user's sense of taste, Which would benefit from it to improve the sense of taste in the elderly.

(https://en.wikipedia.org/wiki/%D8%D8%A7%D{2%D8%B9_%D8%B9%D8%B2%D8%B/2/12/12%2020-6:02AM)

Printing, publishing and the future of augmented reality:

Through the foregoing, it is expected that augmented reality technologies will provide advantages for the following field of printing and publishing:

- Develop open APIs that support the integration of content from visual recognition into the existing publisher's CMS or vice versa.
- Tools and workflows that simplify and speed up the production of 3D objects of appropriate importance while interacting and adapting to the needs of a variety of user devices.
- Testing new technologies with current content as well as using new digital printing materials designed for printing.
- Awareness of the market for readers and consumers with information about the new experiences available to them. (Perey, Christine (2011) p.p38-39)

The research reached several results:

- From the foregoing, it became clear to us the strength and impact of the augmented printed advertisement in communicating the message of the advertiser to the recipient.
- Employing augmented reality technology in print advertising to achieve an impact on the interactive process and the recipient's conscience in the interactive advertising environment.
- As it turns out, augmented reality helps create augmented reality ads to increase product sales and change the advertiser's shopping movement.

The research also reached the following recommendations:

- The research recommends inviting the official authorities to pay attention to an extensive study on the applications of augmented reality in the field of advertising, as there is no single application that works for all advertisements, but each advertisement has its own application.
- Inviting technical educational institutions to pay attention to the field of augmented reality as a technology to create advertising forms in which the technology is close to reality to attract consumers to advertising, to produce designers compatible with the interactive technologies that characterize this era.

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