ERURJ **2025**, *4*, 2, 2686-2706

(Article)

Designing Digital Out-of-Home Advertising in Light of Benefiting from Artificial Intelligence Technology

Rana Adel Mostafa[1, *]

[1] *Teaching Assistant, Faculty of Applied Arts, Egyptian Russian University.*

*Corresponding author(s): Rana Adel Mostafa, E-mail: rana-adel@eru.edu.eg

Received 2nd December 2024, Revised 20th Febrauary 2025, Accepted 24th Febrauary 2025.

DOI: 10.21608/erurj.2025.332840.1198

ABSTRACT

In recent years, the digital out-of-home (DOOH) advertising industry has undergone significant transformation with the integration of advanced technologies, particularly the power of artificial intelligence (AI). These developments have revolutionized audience engagement, shifting perspectives on traditional advertising by enabling more personalized marketing communications and precise audience targeting. Many of these innovations utilize AI-powered facial recognition and are bolstered by technologies like the Internet of Things (IoT) and big data analytics. This allows advertisers to target audiences in real-time while identifying and understanding their needs and preferences, fostering stronger connections and building audience loyalty. Conversely, the adoption of artificial intelligence technologies and applications has transformed the digital out-of-home (DOOH) advertising landscape. This research emphasizes the significance of AI in DOOH advertising and examines its impact compared to traditional methods. By delivering immersive, interactive, and highly personalized experiences, AI significantly enhances consumer engagement, strengthens brand loyalty, and improves brand recall.

Keywords:Digital Out-of-Home Advertising, Artificial Intelligence, Machine learning, Deep learning.

1.Introduction

Diabetes The rapid technological advancements in digital out-of-home (DOOH) advertising have positioned artificial intelligence (AI) as a groundbreaking tool for enhancing the consumer experience. This evolution stems from the integration of diverse AI technologies within advertising, enabling the creation of DOOH campaigns that emphasize interaction and engagement between the audience and the advertisement. Such innovations have enriched consumer interactions with products and services. The development of DOOH advertising has surged with the incorporation of AI-powered systems, leveraging computers and the Internet of Things (IoT) to collect and analyze data. Additionally, the concept of AI-driven robots that simulate human-like thinking, working, and emotional responsiveness has further expanded the possibilities for dynamic and engaging advertising solutions. Increasing evidence highlights the profound impact of artificial intelligence (AI) on societal productivity and everyday life. AI continues to demonstrate its ability to gather insights from recipients and swiftly address their needs. Additionally, it excels in creating intricate designs that were once deemed highly advanced, leveraging cutting-edge technologies to implement them effectively and efficiently.

Artificial intelligence has played a crucial role in delivering interactive and immersive advertising experiences, which have been shown to significantly influence consumer behavior. Brands have leveraged AI to engage consumers, evoke positive emotional responses, and enhance the overall brand experience. In conclusion, the advancement and application of AI, particularly in out-of-home advertising, has brought about a major shift in how companies interact with their audiences. However, further academic research is needed to fully explore and assess the potential impact and effectiveness of AI in shaping consumer behavior.

1.1. Research problem

The research problem can be formulated as:

How can the functional performance requirements for designing advertising campaigns be activated in light of Artificial Intelligence Technology?

1.2. Research Importance

The importance of the research lies in revealing the extent to which the effectiveness of advertising communication is increased through Artificial Intelligence Technology to impress and influence the recipient, which affects the success of the advertisement and affects the recipient.

1.3. Research objectives

The research aims to:

Study the impact of artificial intelligence technology on the functional performance of advertising campaign design through its impact on the recipient.

1.4. Research Methodology

The research followed the descriptive approach to describe the methods of using artificial intelligence technology in advertising campaigns in the global market, an analytical study, then the deductive approach to conclude the dimensions of design communication for advertising campaigns using artificial intelligence technology and then the applied study.

1.5. Research Assumptions

The research assumes that:

Benefiting from the effectiveness of artificial intelligence to influence the interaction of the target audience increases the response rates to the content of the campaign's advertising message.

1.6. Research Tools:

Some procedures will be used to verify the research hypotheses and will be as follows: Personal interview to find out the echo to clarify the extent of the audience's response to the campaigns of artificial intelligence technology applications in delivering the advertising message and the success of the campaign.

1.7. Research limitations:

- Spatial Limits: The research will present models of global advertising campaigns using artificial intelligence technology and apply new advertising campaigns in light of artificial intelligence technology.
- Temporal Limits: The study of advertising campaigns starting from 2012, the period in which the demand for the use of technology increased and the awareness of recipients increased.
- Objective Limits: Studying applications of artificial intelligence technology, which increases the effectiveness of advertising campaigns.

2. What Is Artificial intelligence?

Artificial intelligence (AI) is a branch of computer science focused on creating intelligent machines that can perform tasks and react like humans. Some of the key functions that AI-powered computers are designed for include speech recognition, natural language processing, decision-making, problem-solving, and visual perception. These technologies enable machines to understand and respond to human inputs, making them useful in a variety of applications such as virtual assistants, autonomous vehicles, and customer service [1-11].

This is achieved with the help of the Internet of Things (IoT), where devices exchange information and collect data from the target audience. Through IoT-enabled sensors and connected systems, valuable insights are gathered to understand consumer behavior, preferences, and interactions in real-time, enhancing the personalization and effectiveness of AI-driven applications.

The Internet of Things (IoT) refers to a network that connects various devices to the Internet using specific protocols. It relies on information-sensing equipment to facilitate the exchange and communication of data, enabling intelligent functions such as identification, positioning, tracking, monitoring, and management. This interconnected network allows devices to collect and share data, creating smarter environments and improving efficiency across various industries [12-15].

Researchers define artificial intelligence as the replication of human intelligence through the use of programs, algorithms, systems, and machines. It involves the field of engineering intelligent machines, programs, and applications that are capable of thinking in a manner similar to the human brain. This involves studying human behavior by conducting experiments on their actions and placing them in specific situations. The resulting reactions and thought patterns are then observed and simulated through complex systems.

Machine Learning (ML) and Deep Learning (DL) are both subsets of Artificial Intelligence (AI), as shown in Diagram 1. In addition to neural networks, natural language processing, robotic process automation, physical robots, and rule-based expert systems are some of the key technologies employed by the Internet of Things (IoT) to enable advanced functionalities. These technologies work together to enhance the ability of IoT systems to learn, adapt, interact, and

automate processes, making them more efficient and intelligent in handling complex tasks and real-time decision-making [16-18].

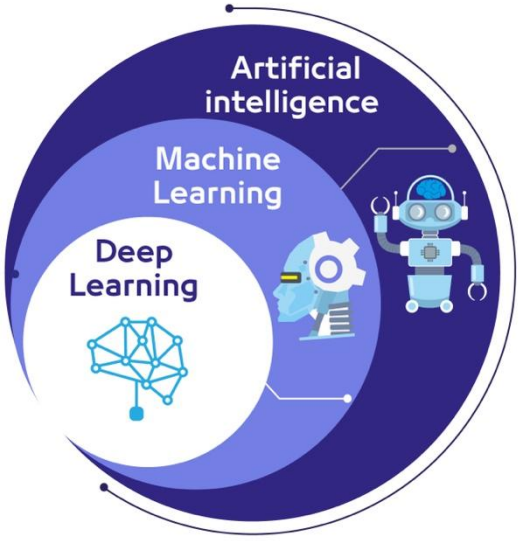

Diagram 1. The relationship between Machine Learning (ML), Deep Learning (DL), and Artificial Intelligence (AI) [19]

2.1 Machine Learning (ML)?

Machine learning is an application of artificial intelligence (AI) that enables systems to automatically learn and improve from experience, without being explicitly programmed. By analyzing large amounts of data, machine learning algorithms can identify patterns and make predictions or decisions based on that data, continually refining their performance over time as they are exposed to more information [3].

Machine Learning is highly dependent on data, as it is a data-driven method for solving problems and making decisions. The core idea behind Machine Learning is to allow computers to recognize patterns, make predictions, and enhance their performance through experiences derived from data. By providing ML algorithms with a broad and representative dataset, they can uncover hidden patterns, which help them generalize and make accurate predictions on new, unseen data, as shown in Diagram 2.

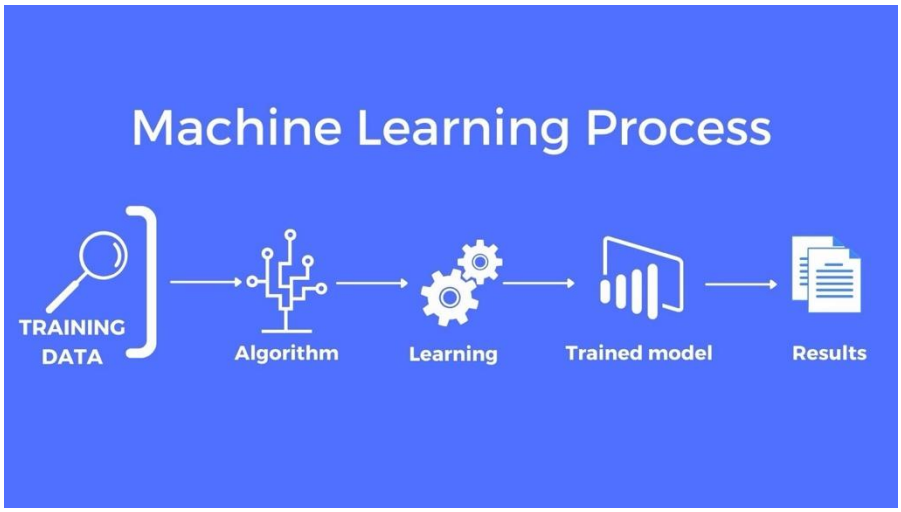

Diagram 2. Machine leaning Process [20]

2.2 Deep Learning (DL)?

Deep learning is a subset of machine learning (ML) and artificial intelligence (AI) that has become a central technology in today's Fourth Industrial Revolution (4IR or Industry 4.0). Originating from artificial neural networks (ANN), deep learning is capable of learning from large datasets, enabling it to identify complex patterns and make decisions. It has gained widespread attention and is now applied across various fields, including healthcare, visual recognition, text analysis, cybersecurity, and many other industries, due to its ability to process and analyze vast amounts of data with high accuracy [6].

Deep learning models are built on neural network architectures, which are inspired by the structure and function of the human brain. A neural network consists of interconnected nodes, or neurons, arranged in layers that map inputs to the desired outputs. The layers between the input and output layers are known as hidden layers. The term "deep" typically refers to the number of hidden layers in the network. Deep learning models can have hundreds or even thousands of hidden layers, allowing them to learn and represent complex patterns and relationships in large datasets [21, 22], as shown in Diagram 3.

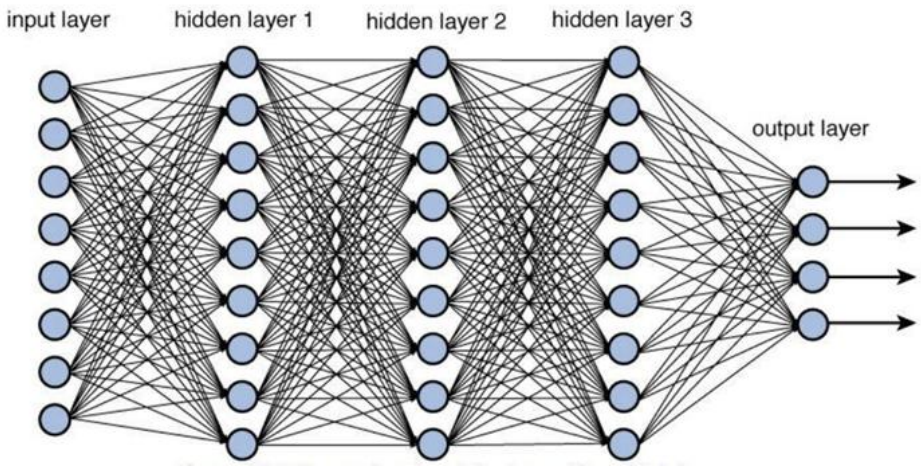

Diagram 3. Deep network architecture with multiple layers [21]

2.3 AI Techniques and Applications:

The following paragraphs highlight examples of artificial intelligence technologies and how they are utilized in managing digital content and enhancing the services of advertising agencies. Key characteristics of AI technologies include their seamless integration of various systems into a cohesive framework, their rapid impact across multiple sectors, and their ability to drive creativity and innovation.

AI also facilitates the easy transfer, storage, and exchange of data and information, making it highly adaptable. Furthermore, AI spans multiple scientific fields, with a vast number of applications across diverse industries, making it a versatile tool for advancing business operations and services [16]. Through the diversity of Al Techniques and Applications We will discuss some of the applications of artificial intelligence in advertising, as there are many applications of artificial intelligence technology. Such as Facial Recognition Technology, Speech Recognition Technology, Personalized Marketing Technology, Smart Chatbots in Developing, Natural Language Processing Technology, Augmented Reality Technology and Near-Field Communication, as shown in Diagram 4.

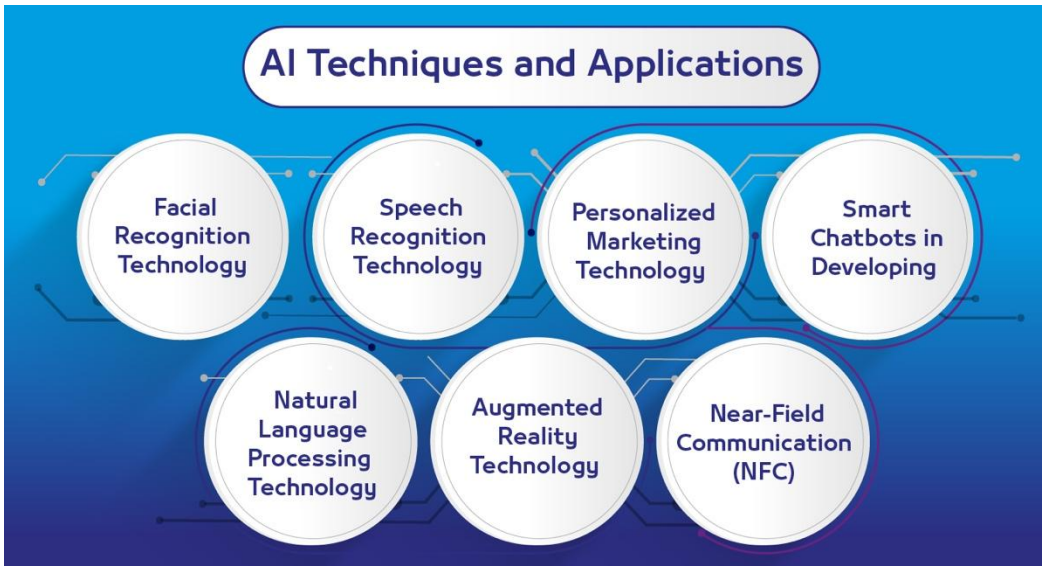

Diagram 4. AI Techniques and Applications (by author)

2.3.1 Facial recognition technology:

AI can be combined with facial recognition technology to collect and store DOOH (Digital Out-of-Home) audience data in a semi-anonymous way. Platforms use anonymous video analytics software that relies on video analysis algorithms to track the number of individuals near the screen, assess whether they are engaged with the content (i.e., looking at the screen), and gather basic demographic information such as age and gender. This data is collected in a way that respects privacy while providing valuable insights for targeted advertising and audience engagement [10].

These various types of data are used to create a comprehensive yet anonymous profile of the audience. By analyzing this information, it becomes possible to identify patterns in typical behaviors related to demographic characteristics, such as age, gender, and engagement levels. This enables advertisers to better understand their audience's preferences and tailor content accordingly, while still maintaining privacy and anonymity [12].

This technology can also be used to assess a person’s emotional response to an advertisement by analyzing their facial expressions. Based on this real-time feedback, the content can be dynamically adjusted and updated to better resonate with the viewer, taking into account their gender, age, and emotional engagement. This allows for more personalized and effective advertising, optimizing viewer experience and impact [4].

2.3.2 Speech Recognition Technology:

Speech is the primary mode of communication between humans and is becoming increasingly important for interaction between humans and machines, especially as its reliability improves. Speech recognition involves converting an acoustic signal into a set of words, enabling various applications such as voice commands, data entry, voice user interfaces, and automating tasks like those of telephone operators. Additionally, speech recognition can serve as the input for natural language processing (NLP), allowing machines to better understand and respond to human language [1].

The field of speech recognition has gained significant attention over the past decade, fueled by the availability of powerful computing resources and large volumes of training data. The use of deep learning (DL) models and algorithms has further enhanced the accuracy and performance of speech recognition systems. As a key component of natural language processing (NLP), speech recognition involves the perception and understanding of spoken words, often combined with capabilities such as transcription and translation. This enables machines to effectively interpret and respond to human speech in various applications [7].

2.3.3 Personalized marketing technology:

Today, a wide range of social media platforms offer mobile users personalized marketing messages tailored to their preferences. These services differ based on the type of content being delivered, such as targeted ads, product recommendations, or tailored promotional offers, all designed to enhance user engagement and drive conversions [2]. For example, Facebook uses user data to deliver ads tailored to an individual's interests and relevance based on their past interactions. Similarly, AI-powered DOOH (Digital Out-of-Home) advertising has access to similar data points as smart device applications, allowing advertisers to gather deeper insights into consumer demographics, attention-spending behavior, locations, and specific physical characteristics. This data enables the creation of highly personalized content, which can be utilized in targeted strategies across various communication channels to enhance engagement and drive better results [8].

2.3.4 Smart chatbots in developing advertising campaigns (13)

Smart chatbots are among the key technological innovations used for customer communication today. Advances in technology, the widespread adoption of mobile devices and applications, and recent developments in artificial intelligence (AI) and machine learning have spurred growing interest in chatbots. The term "chatbot" combines "chat" and "robot" and refers to a computer program designed to simulate human conversation through a textual dialogue system. Chatbots are equipped with an identity that conceals the text input and output, giving users the impression of interacting with a real person. In these conversational interfaces, powered by natural language data, the intelligent system learns to automatically generate responses to users based on historical customer interactions, creating a more personalized and efficient communication experience.

2.3.5 Natural language processing Technology

Natural language processing (NLP) is a technology focused on interpreting and utilizing human language through computer systems. Key areas of NLP include machine translation, text mining, and sentiment analysis. While NLP has made significant progress, it is still an evolving field and faces several technical challenges [9]. Due to the complexity of semantics, AI currently struggles to match human understanding of meaning, relying primarily on deep learning techniques based on big data and parallel computing. However, it is expected that AI will eventually advance to a stage where it can automatically extract features and grasp deeper semantics, transitioning from its current ability to understand only shallow semantics. In the future, AI will likely evolve from single intelligence (machine learning) to hybrid intelligence, combining machine learning, deep learning, and reinforcement learning. Currently, NLP technology is widely used across various industries and applications.

2.3.6 Augmented Reality Technology

Augmented reality (AR) involves overlaying real-world environments with virtual elements, such as 2D and 3D visuals, sounds, and video clips, in a seamless and integrated manner. It can also incorporate immersive features like touch and audio effects for enhanced interaction. While AR technology is already being used in fields like video game development and cinema, its current capabilities remain limited compared to fully intelligent or self-learning systems. However, research centers are pushing boundaries, working towards an augmented reality integrated with an

intelligent virtual world that evolves dynamically by analyzing and processing real-world data. These advancements will enable algorithms to make autonomous decisions, benefiting industries such as design, maintenance, and healthcare, particularly in areas like diagnostics and surgical procedures.

2.3.7 Near-Field Communication (NFC):

NFC (Near Field Communication) is a modern, standards-based, short-range wireless communication technology that uses magnetic induction to facilitate communication between nearby electronic devices. In digital signage, NFC tags are attached to products, advertisements, billboards, or other designated areas. These tags interact with NFC readers or smartphones, directing customers to a dedicated URL that provides additional information about the products or services. This enhances the customer experience by offering easy access to relevant details, while also helping businesses better understand and cater to their customers' needs. NFC technology shifts advertising and brand engagement away from traditional, less effective methods, offering a more convenient and impactful approach for both consumers and businesses.

2.4 Role of the advertising designer in this technology

The advertising designer plays an important role in producing different types of designs to meet the promotional needs of products and goods, especially in today's digital technology industry. This is closely related to artificial intelligence technology, which requires the implementation of a design thought that keeps pace with technological progress, as it takes advantage of the data collected about the recipient by artificial intelligence technology and then innovates to provide new innovative advertising campaigns. This research explains the role of the graphic designer who carries out distinguished creative implementation and produces content with high interaction and achievements that tries to keep pace with the era and the new media industry through an interactive communication approach. The designer focuses on providing distinguished content to meet the needs of recipients through attractive visual displays in the form of groups of different technologies that serve the design.

2.5 What is the importance of using artificial intelligence in advertising?

Intelligent technology has the potential to transform the entire advertising and marketing process. This includes analyzing promotional concepts, enhancing the creation of extensive marketing content, delivering targeted content to segmented audiences, and improving the overall user communication experience. By leveraging AI and other advanced technologies, marketers can optimize every stage of the process, from idea generation to content distribution, ensuring more personalized, efficient, and impactful engagement with consumers [5].

2.6 Employing artificial intelligence in designing outdoor advertisements

AI technology applications in Digital Out-of-Home (DOOH) advertising have made significant contributions and brought about important implications in the field. These include shifts in how advertisers engage with their target audiences, improvements in advertising media, and advancements in precision marketing. AI enhances the ability to deliver highly personalized and relevant content, driving more effective audience targeting. Additionally, it has transformed intelligent propagation, enabling real-time content adjustments based on audience data. Furthermore, AI has led to changes in the decentralization of information, allowing for more dynamic and localized advertising strategies that cater to diverse consumer needs.

Advertising media now plays a multifaceted role beyond simply transmitting commercials. It is also responsible for targeting specific consumers, understanding and clarifying consumer psychology, creating personalized advertisements, and conducting statistical analyses to measure the effectiveness of campaigns. Through these processes, advertisers can gain deeper insights into audience behavior, optimize content, and refine strategies to enhance the impact and relevance of their advertising efforts [14]. For Example, of currently Applied digital out-of-home advertising that rely on AI Technology:

The AI-driven campaign, launched in the Australia in 2019, was created to harness the unique engagement opportunities offered by the Movember Foundation, a men’s health charity. Launched in the UK and Australia, the initiative utilized pattern detection algorithms developed by Quividi to identify facial features of men with beards or moustaches. This technology then triggered interactive content tailored to the detected patterns, simultaneously boosting brand awareness. When individuals stood in front of the posters and looked into the camera, their faces were captured

and recognized. This campaign transformed out-of-home advertising by introducing a groundbreaking approach to fostering consumer loyalty, as shown in Figure 1.

Figure 1-a

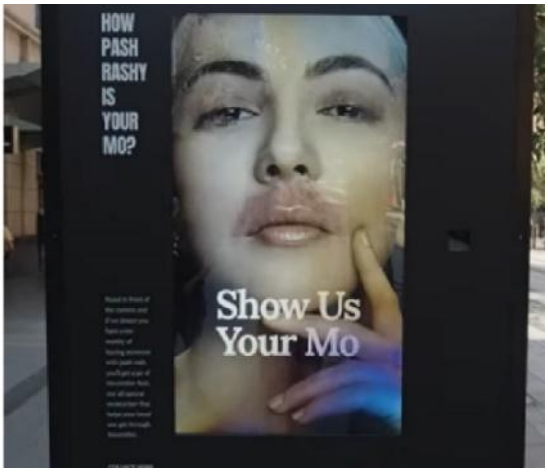

Figure 1-b

Figure 1-c

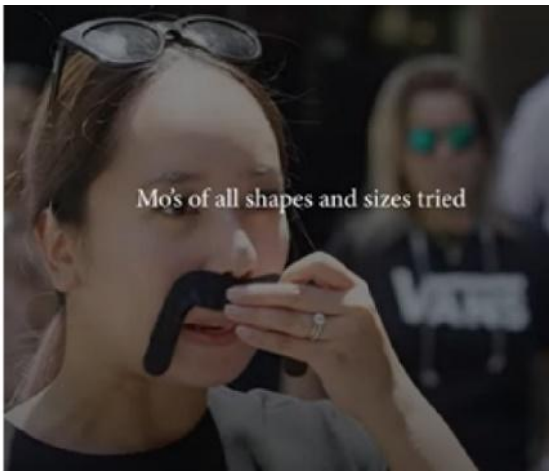

Figure 1-d

Figure 1 (a.b.c.d) Facial recognition in support of Movember campaign [18].

Scan to watch the campaign Ad

Constant technological breakthroughs in AI have significantly advanced DOOH (Digital Out-of-Home) advertising. AI helps advertisers reach a broader audience by delivering real-time, personalized content, ensuring the right message reaches the right person at the right time.

Meanwhile, the Internet of Things (IoT) enhances the effectiveness of DOOH ads by enabling smarter, more interactive experiences, allowing for dynamic content adjustments based on real-time data and audience behavior. This synergy between AI and IoT creates more engaging and impactful advertising campaigns.

3. Analytical study

There are many examples that have already been applied to digital out-of-home advertising that rely on AI technology. These examples highlight how AI is transforming DOOH advertising by enabling more personalized, adaptive, and efficient advertising strategies.

3.1 The first analytical model

The advanced Galaxy SIII smartphones campaign, launched in the USA in 2012, feature the ability to automatically share smartphones, allowing users to seamlessly transfer content and information by simply touching two phones together using Near Field Communication (NFC) technology. Samsung has leveraged this smart innovation by introducing groundbreaking billboards that offer free, instant content exclusively for Samsung users. Content can be seamlessly exchanged by simply bringing the devices close together. Leveraging this innovation, Samsung has transformed NFC into a location-based smartphone content delivery tool, revolutionizing out-of-home advertising by integrating traditional media with emerging smartphone technology**,** as shown in Figure 2.

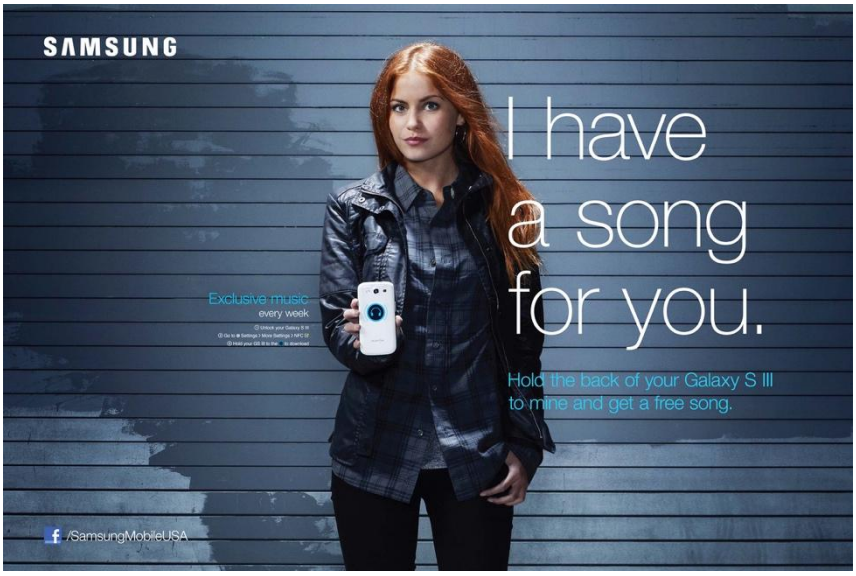

Figure 2-a

Figure 2-b

Figure 2 (a.b) Samsung Share to Go' NFC Posters Campaign [17]

Scan to watch the campaign Ad

The campaign's response, through a personal interview with multiple recipients over two days (February 10-11, 2025), is clear that it has indeed achieved its intended purpose and engaged the recipient. The campaign revolutionized out-of-home media, bringing the posters to life through the use of NFC technology. The outdoor activation was a key element in Samsung's biggest and most successful product launch ever, helping the Galaxy SIII outsell the iPhone during the campaign period. Samsung said engagement was three times higher than expected, generating 1.4 million impressions and over 90,000 interactions with the posters and kiosks. The activation generated a lot of buzz, with articles appearing in publications such as Wired, Inc., BGR, and Contagious.

3.2 The second analytical model

The “Drinkable Poster” campaign, launched in the United States in September 2015, was created for Coca-Cola Zero by the advertising agency Ogilvy. This outdoor advertising initiative, focused on the soft drinks industry, featured a single media asset and was introduced around nine years ago. Designed with the aid of artificial intelligence, the campaign leveraged innovative engagement strategies to enhance brand awareness. When a person stood in front of the poster and held their smartphone, the display simulated the experience of drinking from a Coca-Cola cup depicted on the poster, as shown in Figure 3.

Figure 3-a

Figure 3-b

Figure 3-c

Figure 3 (a.b.c): Coke Zero campaign, The Drinkable Poster [23]

Scan to watch the campaign Ad

The campaign response, through face-to-face interviews with many recipients over the course of a day (February 13, 2025), clearly achieved its intended purpose and engaged many recipients. The campaign revolutionized out-of-home media, with technology bringing a lot of audiences to the table through the use of AI technology. The outdoor activation was a key element in Coca-Cola's largest and most successful product launch ever, with Coca-Cola saying engagement was the highest they had ever created. They created the largest Shazamed ad ever and with 155,000 free drinks redeemed during the first weekend, they also created the most successful Coca-Cola tasting campaign ever.

4. Applied study

An interactive advertising campaign that demonstrates the use of artificial intelligence technology in advertising (outdoor-indoor) using smart digital panels and NFC technology via Bluetooth to take advantage of the ability to share music and songs between the recipient's smartphone and smart digital panels with changes in the sizes, spaces and color contrast of the elements, which helps increase the interaction of recipients with the Spotify application brand and gain new recipients as shown in Figure 4.

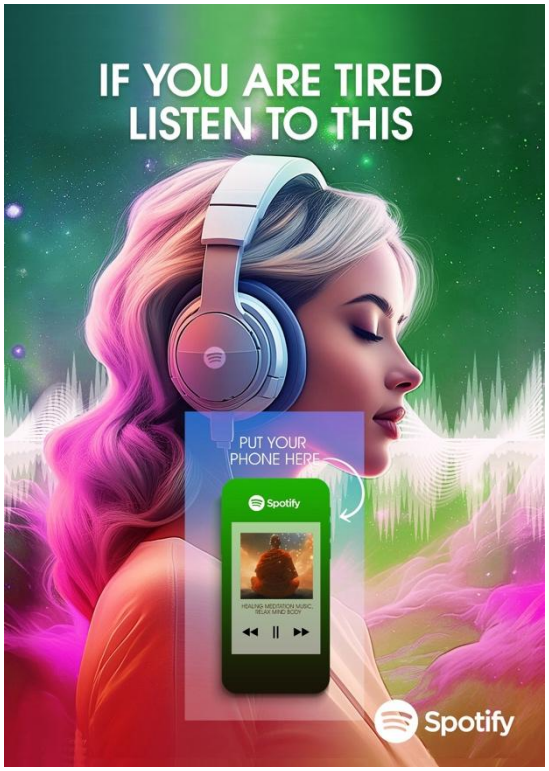

Figure 4-a

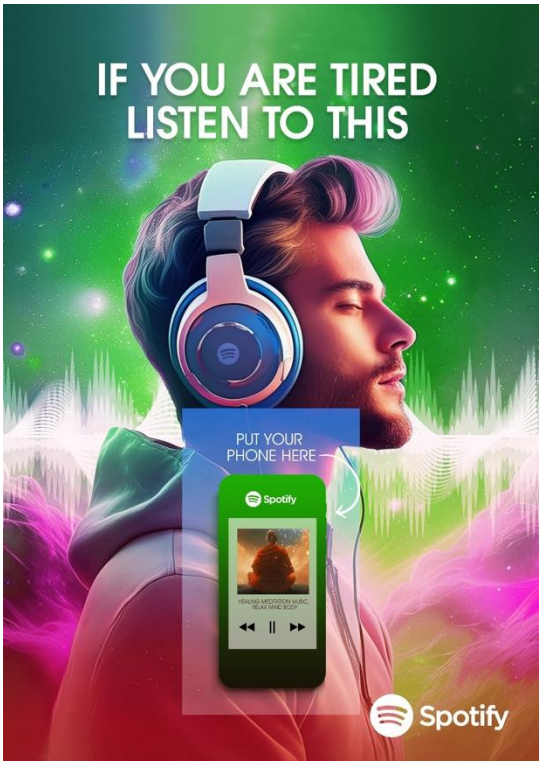

Figure 4-b

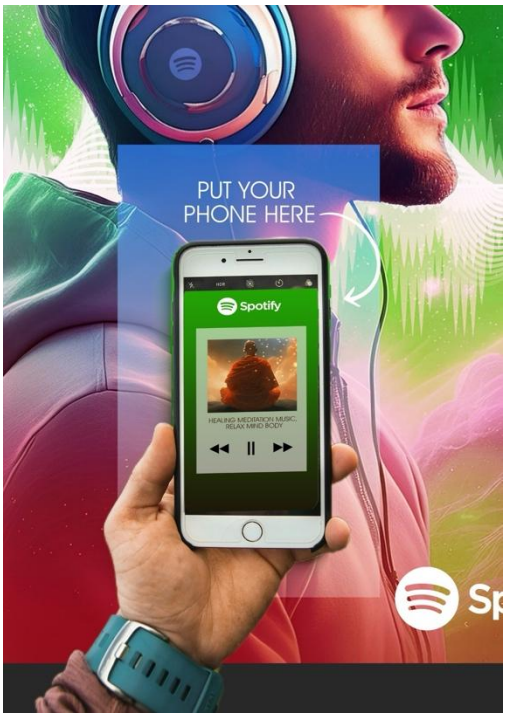

Figure 4-c

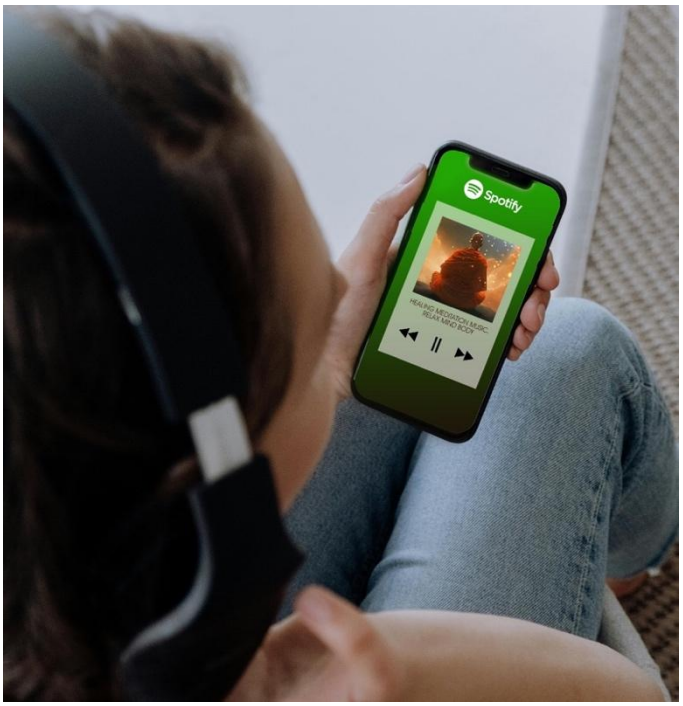

Figure 4-d

Figure 4 (a.b.c,d) Spotify App (Music and Songs) "If You Are Tired Listen to This"

The main goal of the campaign was to gain new recipients who do not have Spotify App, as it provides them with comfort and relaxation from the pressure of work at any time Spotify App by using people who listen to the song through the application as if they are in another world to attract attention with the presence of multiple colors that make the recipient feel the experience, through the spread of smart digital boards in malls, airports and cinemas and integrating them with NFC technology, so that they issue notifications that work to share a calm song via Bluetooth, which opens automatically from the recipient's smartphone.

While the smart digital boards showed the use of people how they feel when they listen to the song through the Spotify App, it conveys to them a feeling of calm and comfort as if they are in another world to attract attention with the presence of multiple colors that make the recipient feel the experience, and thus artificial intelligence helped recipients keep their smartphones connected to the smart digital boards. Smart digital boards were employed that integrate NFC technology through which the recipient's smartphone is connected via Bluetooth, and a sensor is issued when the recipient's smartphone is placed vertically on the application screen in the smart digital board, and the song is shared within seconds.

5. Results:

1- AI technologies enable out-of-home (OOH) advertising to become more interactive, helping achieve several key goals. These include increasing recipient loyalty to the brand, strengthening the relationship between the brand and the audience, and enhancing the overall interactive experience. By leveraging AI, OOH ads can engage viewers in real-time, deliver personalized content, and create more meaningful connections, ultimately driving higher brand engagement and customer retention.

2- AI enables advertising agencies to target highly specific audiences by gaining a deep understanding of their needs and desires. This precision allows for more effective ad campaigns, achieving high levels of audience engagement and interactivity. By leveraging AI's data analysis capabilities, agencies can tailor their messages to resonate with the audience, leading to improved advertising outcomes and stronger connections with consumers.

3- Multiple AI technologies can be utilized in countless applications within out-of-home (OOH) advertising and across various industries. These technologies, such as machine learning, deep learning, facial recognition, and natural language processing, can be integrated in diverse ways to enhance the effectiveness of advertising. From personalized content delivery to real-time audience engagement and predictive analytics, AI enables a wide range of innovative solutions that can be applied to improve the reach and impact of OOH advertising across different sectors.

6. Recommendations

1- The research recommends creating academic programs for digital design students that balance the technological aspect and focus on enhancing the user experience through interactive advertisements, implementing advertisements and interacting with them.

2- Linking smart technology means to combine sensors, artificial intelligence (AI) and human-computer interaction (HCI) to implement interactive advertising campaigns.

3- Attention should be paid to AI technology to collect information about recipients to determine their different goals and segment them, and use this information to track their behavior and motivations.

4- Working to increase awareness of technological development and how to use it in advertising and setting mechanisms for developing and implementing interactive advertising campaigns based on AI technology.

5- Advertising companies should use advanced and attractive technological methods to reach new ways to make the environment more adaptable to the recipient's needs in order to achieve advertising goals more effectively.

7. Conclusion

Recent technological advancements have significantly impacted out-of-home (OOH) advertising, as it increasingly relies on innovative artificial intelligence (AI) technologies that differ greatly from previous approaches. These new technologies have a deeper impact, greater interconnectivity, and a higher level of interaction with the audience. AI in OOH advertising is rooted in knowledge and technology, incorporating fields such as robotics, the Internet of Things (IoT), machine learning, deep learning, and more. This study aims to highlight the applications of AI and demonstrate its impact on the effectiveness of digital content management, as well as the services provided to target audiences. By understanding their needs and desires, AI facilitates easier access to the information they seek. The study will also focus on the strategic importance of AI's impact on key tasks within the OOH advertising industry, enhancing engagement and relevance in the communication process.

8. References

[1] Ahmed Moawad, Speech Recognition System, International Design Journal. 4, P 11, 2012, https://www.researchgate.net/publication/261995967_Speech_Recognition_System

[2] Appel, Gil, Lauren Grewal, Rhonda Hadi, and Andrew T. Stephen. 2020. "The Future of Social Media in Marketing." Journal of the Academy of Marketing Science 48(1): 79-95. http://link.springer.com/10.1007/s11747-019- 00695-1.

[3] Azmir Alam, What is Machine Learning?, P2, 2023, https://www.researchgate.net/publication/373015635_What_is_Machine_Learning.

[4] Dawson, Dan. 2020. "AI Applications for Digital out of Home Advertising." august10. https://www.clickz.com/ai-applications-for- digital-out-of-home-advertising/262467/ (May 5, 2023).

[5] Dwivedi, Yogesh K. et al. 2021. "Setting the Future of Digital and Social Media Marketing Research: Perspectives and Research Propositions." International Journal of Information Management 59: 102168. https://linkinghub.elsevier.com/retrieve/pii/S0 268401220308082.

[6] Iqbal H. Sarker, Deep Learning: A Comprehensive Overview on Techniques, Taxonomy, Applications and Research Directions, SN Computer Science 2(6), P 419, 2021, https://www.researchgate.net/publication/353986944_Deep_Learning_A_Comprehensive_Overview_on_Techniques_Taxonomy_Applications_and_Research_Directions

[7] L. Besacier, E. Barnard, A. Karpov, and T. Schultz, "Automatic speech recognition for under-resourced languages: a survey," Speech Communication, vol. 56, PP. 85-100, 2014. https://doi.org/10.1016/j.specom. 2013.07.008

[8] Longgrear, Judah. "How Artificial Intelligence Is Transforming Out-Of-Home Advertising For Small Businesses." Forbes Technology Council.https://www.forbes.com/sites/forbestechcounci 1/2022/11/03/how-artificial-intelligence-is- transforming-out-of-home-advertising-for- small-businesses/?sh=3cbe80e4cd21 (May 5, 2023).

[9] Ltd. Huawei Technologies Co, Artificial Intelligence Technology, (ResearchGate) 2023, P 29, https://www.researchgate.net/publication/366763885_Artificial_Intelligence_Technology

[10] Mai Mahmoud Radwan Sayoh, Utilizing Artificial Intelligence in Digital Out-of-Home Advertising, International Design Journal, Vol. 13 No. 4, P 419, 2023.

[11] Marwa Mohamed Eid Ibrahim, Effect of Artificial Intelligence on Advertising Decisions An applied study on advertising campaign, 2021, P14.

[12] Mršić, Leo. 2023. "Impact of Artificial Intelligence on DOOH Advertising: Message- Persuasion Level Enhancement Using Illusion Board and Personalized Insights." In, 142-51. https://link.springer.com/10.1007/978-3-031- 19958-5_14.

[13] Omneya Sabry Riad Abdel Wanes, Artificial Intelligence Role For Advertising Campaigns Development, International Journal Of Artificial Intelligence And Emerging Technology, Volume 4, Issue 1, 2021, P10.

[14] Shah, Neil et al. 2020. "Research Trends on the Usage of Machine Learning and Artificial Intelligence in Advertising." Augmented Human Research 5(1): 19. http://link.springer.com/10.1007/s41133-020-00038-8.

[15] Sunil Patel, Carlos Salazar, Internet of Things-IOT: Definition, Characteristics, Architecture, Enabling Technologies, Application & Future Challenges, Volume 6 Issue No. 5, P6122, 2016. https://www.researchgate.net/publication/330425585_Internet_of_Things-IOT_Definition_Characteristics_Architecture_Enabling_Technologies_Application_Future_Challenges

[16] The Fourth Industrial Revolution: Building Digital Industrial Enterprises (2016), The Fourth Industrial Revolution in the Middle East Survey 2016.

[17] https://aaroncacali.com/portfolio/samsung-nfc-posters/

[18] https://www.adsoftheworld.com/campaigns/the-drinkable-poster

[19] https://link.springer.com/chapter/10.1007/978-981-19-5053-7_2

[20] What is Machine Learning?, https://www.sparkfun.com/news/7369.

[21] Ravindra Parmar, Training Deep Neural Networks, Towards Data Science, 2018, https://towardsdatascience.com/training-deep-neural-networks-9fdb1964b964

[22] What Is Deep Learning?, https://www.mathworks.com/discovery/deep- learning.html

[23] https://www.youtube.com/watch?v=o5uJpMj2kKQ