

## Utilizing Artificial Intelligence in Digital Out-of-Home Advertising

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### Abstract:

Digital Out-of-Home advertising has evolved in terms of form, content, and the ability to reach the target audience thanks to recent technical advancements. On the other hand of traditional Out-of-Home advertising, AI-based advertising has enabled the most specific audience targeting and marketing connection with customers depending on the latest technologies. Artificial intelligence is dependent on some technologies such as big data, internet of things IOT, facial recognition, temperature recognition, vehicle and object recognition and real-time audience targeting. All of these technologies and more have caused a revolution in the field of Out-of-Home advertising. This research aims to highlight the latest technologies used by AI, that could be applied in the field of advertising. Impacts of these applications, in addition to examples of already applied AI-powered advertisements are introduced. Some extra new ideas for AI-based advertisements are also proposed by the research.

### Keywords:

Artificial intelligence-  
Digital Out- of- home  
Advertising- Big data-  
Internet of Things IoT

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### 1- Introduction:

The world is heading towards a new boom driven by artificial intelligence because the applications of artificial intelligence are numerous and expanding in a way that is difficult to stop, as it has entered into many humanitarian fields. Artificial intelligence (AI) is a digital revolution in the field of advertising, especially outdoor advertising. AI use has surpassed the idea of robots and robots that work, think, and feel like humans.

As an example of this, are the digital screens used in outdoor advertising that can be programmed to show different advertisements depending on the weather. A restaurant might show breakfast meals in the morning and different advertisements at noon and in the evening depending on the time of each meal. Data on demographics and traffic can be used to determine the most effective locations to place outdoor advertisements.

The exponential growth of Internet businesses, the vast amount of Internet data, and technological advances in computer power and algorithms are all contributing to the rapid development of artificial intelligence technology. More and more evidence of AI's strong impact on societal production and daily life is emerging. (Lai 2021) Advertising is one of the most impacted fields by the current revolution of AI.

AI is less of an option and more of a need for businesses to be competitive as they continue to collect vast volumes of data annually. Since 2018, more than 75% of consumers have used a service or product using AI. Global digital advertising revenue has reached \$517.51 billion with AI accounting for 80% of this. (Rodgers 2021)

Traditional DOOH advertisements face a lot of challenges that urge us to look for more suitable advanced alternatives. These challenges include:

- Very high cost for short advertising period.
- Failure to target the appropriate audience.
- Difficulty measuring Return on Investment ROI of these advertisements. (ESZTER KOBZA 2022)

### Research problem:

- 1- The research problem can be summarized in the following question:
- 2- How could applications of artificial intelligence (AI) contribute to the development of digital out of home advertising (DOOH)?

### Research objectives:

The main objective of this research is to highlight the impact of utilizing artificial intelligence technology on the field of digital outdoor advertising. Subsidiary objectives include: Investigation of Artificial Intelligence AI in the field of advertisement. Identification of AI technologies as base for the application of smart digital out-of-home DOOH advertising. Defining the contributions of AI to the advertising field. Specifying challenges that could face this new technology and its applications. Highlighting the current ideas applied in the digital out-of-home advertising, that depend on AI. Introducing new ideas that could benefit from AI to be applied to the DOOH advertising.

### Research methodology:

This research depends on the descriptive methodology in the introduction of some digital out of home advertisements that already took advantage of the artificial intelligence techniques. New ideas for the application of AI techniques in the field of DOOH advertising are also introduced.

### Research terminology:

- **Digital Out of Home DOOH Advertising :** Any type of outdoor digital advertising that promotes your company's products and

services and reaches consumers outside their homes. Digital billboards, bus benches, Digital screens in the interiors and exteriors of buses, taxis, commercial vehicles, and properties are all examples of digital out-of-home advertising.(Gurumoorthy 2015) Advertisers could depend on the DOOH software to remotely manage what material is displayed on displays at any time, customizing it to the location, current weather, the people who frequent the area, and much more.

- **Artificial intelligence AI:** Artificial intelligence, according to researchers, is a simulation of human intelligence using programs, algorithms, systems, and machines. It is the science of engineering the intelligent machines, programs, and applications capable of thinking in a way that simulates the human brain.(Lai 2021) This depends on studying human behavior by conducting experiments on their actions and putting them in certain situations, then reactions and thinking patterns are monitored, in order to be simulated through complex systems.(Davenport et al. 2020)
- Machine learning, deep learning, neural systems, natural language processing, robotic process mechanization, physical robots, and rule-based expert systems are among the main technologies it employs.(Davenport et al. 2020)
- **Big data:** Huge and big amounts of multi resource data sources that could not be processed using the traditional software programs, because their size exceeds the traditional databases' tools of capturing, storing, managing and analyzing these data.(Salim 2012)
- AI works with two sorts of input data to make sense of big data: Traditional, uniform datasets, such as ultimate customer demographics, transaction records, or web-browsing history, are examples of structured data. AI, with its massive computer power, performs complicated computations on massive amounts of structured data and frequently produces findings in real time. Unstructured data: Approximately 80% of nearly 2.5 billion gigabytes of daily user produced data is unstructured and distributed as written texts, voice, and photos. The ability of AI to process vast volumes of this type of data immediately distinguish it from traditional computing systems.(Kietzmann, Paschen, and Treen 2018)
- **Internet of Things IoT:** A popular term in information technology is "Internet of Things"

(IoT). IoT is anticipated to soon turn everyday things into virtual ones that have intelligence. The Internet of Things (IoT) aims to provide us information about the things around us as well as control over them.(Madakam, Ramaswamy, and Tripathi 2015) IoT is described as the idea of connecting the internet to any device having an on/off switch. It ensures individualized and exceptional marketing and advertising as opposed to the one-size-fits-all method.(Shah et al. 2020)

## 2- Digital Out-of-Home DOOH Advertising in the scope of AI

AI is considered a digital revolution in the field of advertising, particularly outdoor advertising. It will shape how digital marketing is done today and in the near future, how marketers carry out their campaigns, as well as how campaigns are measured and run.(Shah et al. 2020) The world is on the verge of a new boom led by artificial intelligence, because the applications of artificial intelligence are numerous and increasing in a way that is difficult to remedy.(Ehab Khalefa 2020) Targeting specific audience, choosing the most suitable timing and site for advertising and calculating possible investments out of advertisements are some of the very important potentials of the AI-dependent DOOH advertising. AI can be used in outdoor digital advertising panels, where these screens can be programmed to display different ads depending on the weather condition, timing and data on demographics and traffic to determine the most effective sites to place the outdoor advertisement in. (Lai 2021)

A restaurant displaying breakfast meals in the morning and changing those advertisements at noon and evening depending on the time of each meal is a very simple example about the powerful potentials using AI in DOOH advertising. (Ehab Khalefa 2020)

## 3- Types of technologies AI depend on

Big data, machine learning, pattern recognition (image recognition, voice recognition, face recognition), natural language processing, blockchain, and other technologies relevant to the advertising sector are examples of artificial intelligence technology.(Lai 2021)

### 3-1 Big Data technology:

Big data and artificial intelligence technologies are making the heart of the advertising industry smarter, from consumer insight to the dissemination of advertising information to the creation of advertising content..(Lai 2021) Big Data allows skilled and online advertisers and marketers to get priceless observations and insights about their target demographics. Now, businesses may acquire,

store, and analyze both structured and unstructured data employing big data analytics platforms. Big Data enables both online and offline advertising activities, in which the specified analytics approaches are utilized to assign advertising

recommendations based on Big Data collected on mobile users' access behaviors, profiles, and mobility patterns.(Shah et al. 2020) Figure 1 illustrates the new advanced process of advertisement depending on AI. (Lai 2021)

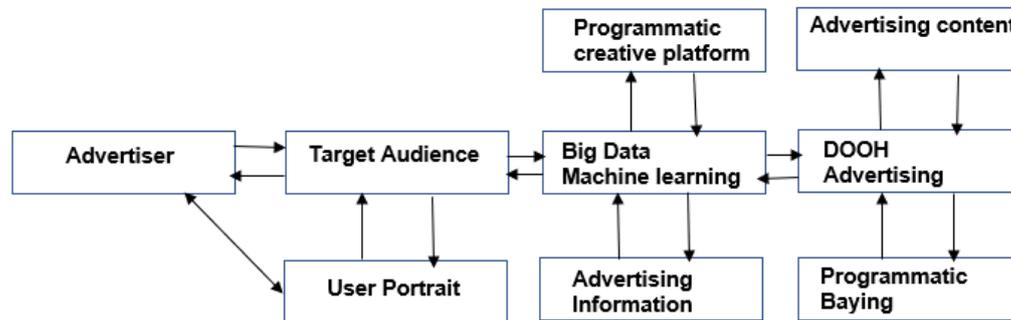


Fig. 1: Advertising driven by AI.(Lai 2021)

### 3-2 Facial recognition technology:

AI can be used in conjunction with facial recognition technology where DOOH audience data is collected and stored in a semi-anonymous manner. Platform uses anonymous video analytics software that depend on video analysis algorithms to count the number of individuals in front of the screen and all around it, and to assess whether they are there, whether the user is looking at the screen or not, and captures basic personal information such as age and gender. These many types of data are used to provide a comprehensive yet anonymous portrait of the audience. This makes it feasible to identify patterns of typical behavior towards people's demographics.(Mršić 2023)

This technology can also be applied to assess how much a person enjoys an advertisement based on their facial expression, and content can be modified and updated in real time based on gender and age demographics.(Shah et al. 2020)(Dawson 2020)

### 3-3 Personalized marketing technology

Now, a variety of social media platforms provide mobile users personalised marketing messaging services. These services vary depending on the sort of content.(Appel et al. 2020)

For instance, Facebook makes use of user data to provide ads they think the user would find more interesting or relevant based on past interactions. However, since AI-powered DOOH has access to the same type of data points as smart device applications, advertisers can learn more about consumer demographics, attention-spending behavior, locations, and particular physical characteristics, enabling them to create highly personalised insights that are then employed in strategies across the communication landscape.(Longgear n.d.)

### 3-4 Real-time target specific audiences:

Real-time audience targeting Modern technology makes it possible to crunch and analyse enormous amounts of data, which helps guide the creative

process and improve the media and message while the campaign is running.(Dawson 2020)

When the conditions are right, flexible, data-driven campaigns can be launched throughout the year to promote various brands or goods.

Using data to understand the context of campaigns to the "here and now" implies that messages may be linked with consumer mindsets in the moment, thus becoming valuable and relevant.(Dawson 2020)

Contextual relevance, such as the time of day, the weather, or the amount of traffic, may be increased by the brand owner to manage the brand architecture and maximize media value. The method of dynamic creative optimization makes the connection between data-driven media planning and the thoughts of a customer at a certain moment and location.(Dawson 2020)

Certain digital screens may integrate atmospheric sensors, which can provide more context to ad performance. This enables more precise messaging, such as offering cold drinks on hot days.(Longgear n.d.)

AI in the field of DOOH has the potential to boost brand awareness through the usage of smart signs that investigate different people viewing specific products. For example, a consumer who wears short pants or backpacks may gain insight about distinct target groups who are interested in a given product.(Longgear n.d.)

### 3-5 Object and vehicle recognition

Object identification is one of the most powerful AI tools currently being used in DOOH advertising.(Longgear n.d.)

Object recognition employs strategically placed smart cameras to accomplish three tasks:

- Object Detection - Recognizing items filmed by the camera.
- Image Recognition- Interpreting and categorizing those items.
- Image Localization - Determining the position and distance of an object from the

camera.(Sankaranarayanan, Veeraraghavan, and Chellappa 2008)

According to ESZTER, similar practice, known as "ads that can see," is already being applied in the form of digital screens that can recognize objects using AI. Once recognized, relevant personalized recommendations based on previous experience are made.(ESZTER KOBZA 2022)

Advertisers have greater awareness of the value of a specific place by tracking the number of vehicles or people that pass by these smart ads. Aside from that, detecting foot and vehicle traffic patterns, projected financial demographics of passersby (based on apparel or car model), and other trends can assist in determining what types of advertisements should run and when.(Longgear n.d.)

Because the DVLA does not permit the use of its number plate database information for advertising purposes(Huang et al. 2022), machine learning was used to recognize the model and color of automobiles passing by billboards in order to target that individual driver. There are unlimited options for creating adverts that may then be personalized to each driver, whether it's presenting ads for a new model of the same automobile or advertising new things relevant to that specific driver demographic.(Dawson 2020)

#### **4- Contributions of AI to the DOOH advertising**

Intelligent technology has the potential to be applied to the entire advertising and marketing process, including analyzing promotion ideas, interfering in extensive content of marketing creation, driving precise content transfer to segmented groups, and improving user communication experience.(Dwivedi et al. 2021)

AI technology applications in DOOH advertising have great contributions and implications on the field. These implications include changes in the advertisers and target audience, enhancing advertising media, boosting precision marketing, changes in intelligent propagation and changes in the decentralization of information.(Shah et al. 2020)

Consumer decision-making , consumer advertising intellectual experience, and consumer behavior and lifestyle have all been altered by artificial intelligence. According to Lai, Artificial intelligence aids in customer decision-making and product purchases.(Lai 2021)

Enterprises may communicate with customers directly and efficiently, providing personalized and customized products. There is no call for marketing to promote already produced bulk products to consumers. All of this has resulted in a decrease in advertiser demand.(Shah et al. 2020)

Advertising media not only transmits commercials but also targets specific consumers, clarifies target consumer psychology, produces advertisements, and conducts statistical analyses of advertising effects.(Shah et al. 2020)

One of the most advanced applications of commercial artificial intelligence is in precision marketing. The foundation of precision marketing is reliable data sources. When Apple promotes a particular model, the platform may target advertising to persons between the ages of 20 and 40 who have a middle-income level and a propensity for mobile purchasing depending on the target consumers of the marketers. This is an example of precision marketing in action.(Shah et al. 2020)

AI constant technological breakthroughs have aided in the progress of DOOH advertising. AI assist reaching a larger audience and delivering real-time content, targeting the appropriate person at the right moment, while IoT enables you to create smarter DOOH advertisements.(ESZTER KOBZA 2022)

#### **5- Challenges facing AI advertisement**

As stated by Shah, a few drawbacks of AI include an unstructured data pattern, difficult access and transfer of data, a lack of direct user-level results display, invasions of client privacy, and manipulation of consumer data.(Shah et al. 2020) Any development in the technology that gathers information about people in public settings is always associated with some concerns over privacy. According to Longgear, facial recognition technology is the most dangerous one in the scope of privacy.(Longgear n.d.) Bearing in mind the legal agenda and guard of people privacy, companies should assure that AI technologies do not store any private data, all data are anonymous, and that customer habits are not tracked.(Dawson 2020)

There is more than one solution for the privacy issue including designing with consideration to confidentiality. Advertising companies could build their systems with strategies like security-forward, such as depending on real-time data to drive ad placement, rather than depending on the long-term data storing.(Longgear n.d.) According to Mršić, privacy problems are eliminated when tracking audience of DOOH advertisements is different from online data tracking.(Mršić 2023)

#### **6- Examples of currently applied DOOH advertisements depending on AI**

There are a lot of already applied examples of DOOH advertising powered by AI technologies.(ESZTER KOBZA 2022) This section will introduce some of these examples.

Coca-Cola company has merged facial recognition technology with the digital screens to change the one-way advertising into a double-way conversation between the customer and the brand as shown in figure 2.(ESZTER KOBZA 2022) The

same company depended on temperature recognition technology to push smart water in the underground of London, when the temperature exceeded 21 degrees (Dawson 2020).



Figure 2: Facial recognition technology applied in Coca-Cola DOOH advertisement(ESZTER KOBZA 2022)

MacDonalds', the world-biggest fast-food chain has already started applying AI technologies to their DOOH advertising in London. DOOH advertising screens show specific advertisements based on both temperature and time of the day. As an example,

screens show ads in the morning related to breakfast meals, or showing ice cream ads when the temperature is high.(Dawson 2020) Figure 3 shows the ice cream ad depending on temperature recognition technology.



Figure 3: Using temperature recognition technology in the DOOH advertisements. Source: <https://www.soracom.io/blog/digital-oooh-advertising/>

The British great company Shell for oil and gas has depended on the vehicle recognition technology to boost their advertisement systems. It used digital smart AI-based screens for more efficient advertising. These smart bill boards could define vehicles nearby that are most likely to purchase their products, then display a corresponding advertisement. This campaign has been displayed for one month in the Malaysian capital Kuala

Lumpur. It attracted 21% of the audience exposed to the advertisements, that lead to approximately 194,000 single visits to Shell stations. (ESZTER KOBZA 2022)

Virgin Trains depended on real-time traffic data and vehicle recognition technology to let car users recognize how much faster their ride would have been by train.(Dawson 2020)

## 7- Practical Framework: Application of AI to the DOOH advertising

Practical study of this research introduces proposals for some advertisements' designs and ideas, making use of the literature review part. The proposed DOOH advertisement is specialized for Fitness Map gym, located inside Future sports club, New Damietta, Egypt. The advertisement design is based on Artificial technology with featuring more than one technology. 4 different advertisements were

**1- First advertisement:** the gymnastics activity that targets children with age 3-12 years old.

designed that target different age groups and genders. Facial recognition, Real-time target specific audience and personalized marketing technologies are used in this proposal, so that the advertisement is changed once specific persons pass-by. Figure 4-6 show the 3 different proposed advertisement designs appearing on the same screen with recognition to the passers-by age group and gender.



Figure 4: Displaying ads that target children. Source: The researcher



Figure 5: Displaying ads that target children. Source: The researcher.

## 2- Second advertisement: Zumba classes for women of age group 16-60 years.



Figure 6: Displaying ads that target Women. Source: The researcher.



## 3- Third advertisement: for men with 16-60 years old.

Figure 7: Displaying ads that target men. Source: The researcher.

## 8- Results

- 1- Artificial intelligence technologies allow to display more than DOOH advertising on the same advertising area, depending on different conditions.
- 2- AI enables advertising agencies to reach very specific audience, leading to very high scores in reaching advertising targets.
- 3- AI technologies could have infinite number of applications in the DOOH advertising and in different fields.

## 9- Conclusions

Current huge technological advancements enable us to engage more and more with customers in real time. AI with its different technologies is the near future of advertisement industry especially DOOH advertising. Depending on facial, object, vehicle, weather recognition technologies and others, AI could make big mutation in targeting specific audience and engaging with customers in the field of DOOH advertising.

To keep up with the era of digital transformation and artificial intelligence, advertising stakeholders

should know more and more about AI different technologies, possibilities and applications. AI comprises different technologies that work together for delivering different advertisements applications. Technologies of AI include Big Data

technology, facial recognition technology, targeting specific audience and personalized marketing, object and vehicle recognition and others. Table 1 summarizes some different AI technologies with an example for each one.

Table 1: AI technologies and applications in the DOOH advertising

AI Technology	Description	Example for Application in DOOH Advertising
Facial Recognition	Technology depends on video analysis algorithms to detect the surrounding people to the screen, their number, demographic data, expressions, .... etc.	Displaying ads about makeup and cosmetic products when women of age group 16-60 pass by the screen of the ad.
Personalized Marketing	Creating advertisements that rely on huge data sets about people locations, behaviors, demographic data to create very personalized insights. Mobile applications are among these data sets. Technology detecting previous behaviors of the surrounding audience and displaying ads that match these behaviors.	Displaying ads about hotels and beach resorts when the surrounding audience are used to spending the summer in different hotels by the beach.
Real-Time Target Specific Audiences	Technology that processes massive data to customize the ad in the same time the campaign is running.	Customizing the ad depending on the expressions of the engaging customer with the ad.
Vehicle Recognition	Recognizing the type and color of the automobiles passing by the screen to target that specific driver.	Showing ads about specific car products when this specific car brand pass by the ad.
Weather Recognition	Detecting surrounding weather conditions to announce suitable advertisements.	Displaying ads about heaters or air conditioners depending on the weather conditions in specific area.

AI with all of these technologies and intelligent applications would greatly contribute to the field of advertising in nearly all of stages of the process. Starting with proposing new marketing ideas, production of mega content of marketing, reaching very specific target groups, and ending with improving the ads screening interaction process with audience; all of these stages of marketing advertising would depend to a great extent on AI in the very near future.

The main challenge facing AI dependent advertisements is the privacy issue. Corporations should design AI applications with taking privacy of data into consideration. Facial recognition and personalized marketing technologies should be used under surveillance to ensure people security.

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