

## IoT-based Targeted Advertising

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### KEYWORDS:

Internet of Things, Internet of Behaviors, Targeted Advertising.

### ABSTRACT:

Technological developments always impact and contribute to the development of advertising theory and practice. The Internet of Things (IoT) is one of the latest and most important technologies that have an impact on advertising, as it provides huge and updated data of its users. The development of Big Data, Data Analytics and using Behavioral Science led to the emergence of the concept: Internet of Behavior (IoB), which is an extension of the Internet of Things. This research aims to study the impact of Internet of Things and the Internet of behavior -extended from the Internet of Things- on advertising, and how IoT/IoB can be applied to raise efficiency and develop strategies of advertising. The research also explores the most important challenges facing the application of Internet of Things and Internet of Behaviors in advertising. To achieve the research aims, the used methodology relies on the descriptive, analytical, deductive approach by studying the concepts of the Internet of Things, the Internet of Behavior, and targeted advertising, as well as studying various examples for different applications of the Internet of things and the Internet of behavior in advertising: its application, its purpose, and its impact. The results indicate that the application IoT and IoB in advertising paves the way for a future advertising environment with superior deep knowledge and ability to connect with everything. The importance of the research lies in keeping pace with the various technological developments and its important role in the development of advertising theoretically and practically.

## 1- Introduction

The Internet of Things (IoT) describes the network of physical object “things” that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. These devices range from ordinary smart home objects to sophisticated industrial tools. With more than 7 billion connected IoT devices today, expecting this number to grow to 22 billion by 2025.

The wide spread of the Internet of Things, and the huge amounts of data derived from it have paved the way for the emergence of the concept of the Internet of Behavior. The Internet of Behaviors aims to analyze human behavior data on the Internet of Things from the perspective of behavioral psychology, obtain insights about human behavior, and better understand the intention behind the behavior. In this way, the Internet of Behavior can predict human behavioral trends in the future and even change human behavior.

Everything is connected, everything collects and sends data that offers unprecedented, deep, and continuously updated knowledge about the target advert recipients. Therefore, advertising is witnessing a revolution that holds opportunities and challenges.

Accordingly, the research problem revolves around the Internet of Things and the Internet of Behavior as a new technological trend and how it can be employed to achieve advertising goals with a futuristic perspective through investigating the most important applications of the Internet of Things and the Internet of behavior in the field of advertising, also highlighting the most important challenges facing the application of Internet of Things and Internet of Behavior technologies in advertising.

In addition, the research explores the different ways used to take advantage of the Internet of Things and the Internet of behavior to raise advertising efficiency.

The importance of the research lies in the expansion of the phenomenon of the Internet of Things (IoT) and the huge amounts of information about behavior of its users, which will make the Internet of Behavior (IoB) the promising future direction in the field of digital advertising design, which will lead to providing an advertising environment supported by information about users, their behaviors, and their future’s plans. Also, the use of Internet of Behavior (IoB) is a promising direction towards raising advertising targeting and influencing efficiency.

The research aims to study the most important IoT/IoB applications in advertising. Besides, study the challenges facing the application of IoT/IoB in advertising. Also, find out methods and benefits of IoT/IoB applications in advertising.

The research scope is limited to the Internet of Things (IoT), Internet of Behavior (IoB), and Their Applications in Advertising during the years 2012 to 2023, worldwide.

The Internet of Things and Internet of Behavior technologies provide the ability to identify and track users, which provides abundant and real-time information that can be analyzed using Behavioral Science to provide informed, deep and unprecedented knowledge about users. This deep and updated knowledge about users can be employed to raise the efficiency of advertising targeting.

User privacy and security considerations are probably the most important challenges facing the employment of the Internet of Things and the Internet of behavior in advertising.

The Internet of Things and the Internet of Behavior offer opportunities to raise the efficiency of advertising in various fields, including adding connectivity & user data collection to static, offline advertising mediums as packaging, magazine ads, OOH.

The research follows the descriptive approach methodology to describe and analyze the theoretical framework of the research through a

review and analysis of academic literature, followed by an analytical study of intentionally selected examples. The examples were chosen from various advertising channels, to show that IoT/IoB implementation is not limited to a specific advertising field.

With the rapid advancement of computer technology, network technology, and sensing technology, the Internet of Things (IoT) has also come into being. It combines various information-sensing devices and networks to form a huge network, realizing the interconnection of people, machines, and things at anytime and anywhere. The term "Internet of Things" was first coined by Kevin Ashton in 1999 in a speech to illustrate the potential of RFID tracking technology. In the decades since, devices connected to the IoT have evolved from mobile phones and computers to daily devices like refrigerators and vending machines, and now smart home devices like smoke alarms, speaker boxes, and tablet computers are all connected to the Internet.

The IoT is promoting the transformation of human society from "information" to "intelligence" and promoting tremendous changes in information technology and industry (Atzori et al, 2010).

The IoT has brought human society into a highly intelligent era in which things are connected. Since the advent of the Internet, data has been crucial to determining who uses it and which sites people visit. The advent of the IoT provides more data to collect and analyze. The more data an advertiser has, the more information an advertiser can get about the user's behavior.

The usage of IoT devices and data collection can provide valuable insights about relevant user behavior, interests, and preferences, known as the Internet of Behavior (IoB). The IoB attempts to understand the data collected from users' online activities from a behavioral psychology perspective. It seeks to address how data can be understood from a human psychology perspective and how this understanding can be applied to

influence or change human behavior. (Sun, Jiayi et al, 2022)

With the emergence of IoT technology, new advertising communication modes are constantly updated. The Internet of Things is at the forefront of information technology and provides a major impetus for the development of the advertising industry today.

As advertisers can know a lot more about users and their interests through tracking their data on IoT devices, advertisers can use data reaped from the IoT to influence target users' behavior, achieve their goals and enhance the effectiveness of their campaigns through accurate targeting and deep user knowledge. Such strategy may lead to more user engagement. This allows planning digital advertising strategies aiming to improve efficiency and quality for a variety of purposes.

## Literature Review

### Internet of Things

Kevin Ashton was the first to coin The Internet of Things in 1999. The world's first internet connected refrigerator was introduced by LG in 2000, allowing users track what's in the fridge using a screen and tracker. However, it didn't get a great success because of its high cost and the ambiguity of the problems it was meant to solve. In 2004, media articles and book topics began to circulate around the term "Internet of Things". Savi Program by the US Department of Defense and in business by Walmart have applied RFID. The IoT gradually gained recognition in the European Union in the period 2006 to 2008. The first International Internet of Things Conference was held in Zurich, Switzerland in 2008. It was the year that the number of IoT devices exceeded the number of humans on earth for the first time. According to the Cisco Internet Business Solutions Group (IBSG), the IoT was born between 2008 and 2009, making more things or objects connected to the network. Google began developing self-driving cars in 2009. The year

2013 had a revolutionary advance in wearable technology and the IoT by releasing Google Glass. Blockchain and artificial intelligence have begun to be integrated into the IoT platforms.

### Internet of Things Structure & Process

The IoT is normally described as a four-layer infrastructure:

- The first layer is Data Capture Layer: Using sensors defines how the smart physical world (e.g., networked-enabled devices, devices embedded with sensors) interact with the physical world.
- The second layer is the Data Sharing Layer: Data is sent to the cloud through a network connection, and IoT devices can access the data according to instructions. It is in charge of providing the necessary connectivity between devices and the Internet.
- Further, the third layer is Data Processing Layer: It processes data in the cloud, uses data analytics tools, artificial intelligence, and machine learning to gain actionable and productive insights, and makes the data useful incorporates data aggregation and other preliminary data processing.
- Finally, the fourth layer is the User Interface Layer: It transfers the processed data to the user. It is responsible for feeding the control centers and providing IoT cloud-based services. (Fig.1)



Figure 1: The workflow of the IoT. (Sun, et al., 2022).

With the increasing prosperity of the IoT, more and more behavior-related data is collected on the Internet by connected devices such as sensors. People and behavior are connected through the Internet of Behavior (IoB) extended from the Internet of Things (IoT).

### Internet of Behaviors

The psychology professor Gote Nyman was the first to announce the concept of the IoB in 2012. Nyman believes it is possible to understand what is about to happen in the connected world by understanding human intentions. (Nyman, 2020)

Nyman’s novel views did not receive much attention at that time. Since then, there has been a long-term gap in information about the IoB on the Internet. The interaction between the Internet and Behavior has been concerned constantly, but the related concepts of the IoB are not explicitly mentioned. Until October 2019, Gartner proposed the Internet of Behavior, which links people to their actions. Gartner emphasizes the importance of the IoB in their lives, which makes the IoB gradually come into public view, and the number of articles and discussions related to it on the Internet is gradually increasing. (Sun, et al., 2022)

Chrissy Kidd presented a pyramid of knowledge related to IoT and the IoB, as shown in (Fig.2). (Sun, et al., 2022). Consider the IoT the bottom of this pyramid gathers data and turn it into information. The IoB, then, attempts to turn that information into knowledge. The development in Data Analytics, Artificial Intelligence, and Behavioral Science, made it possible to transform that data into Wisdom. (Chrissy Kidd, 2019)

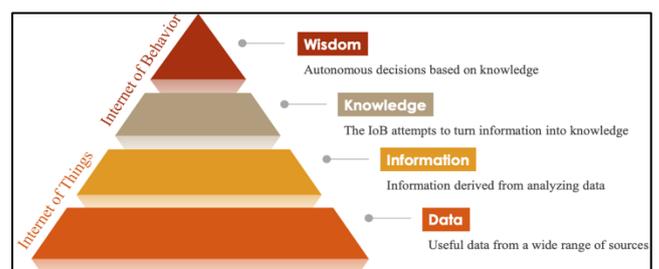


Figure 2: The IoT and the IoB Pyramid. (Sun, et al., 2022).

Nyman mentioned in his April 2020 blog that the IoB can be used for tracking, monitoring, and managing human social activities during the COVID-19 epidemic. It can even predict the possible behavior in a place to propose and implement countermeasures as soon as possible. (Nyman, 2020) A brief history from the IoT to the IoB is shown in (Fig.3). (Sun, et al., 2022)

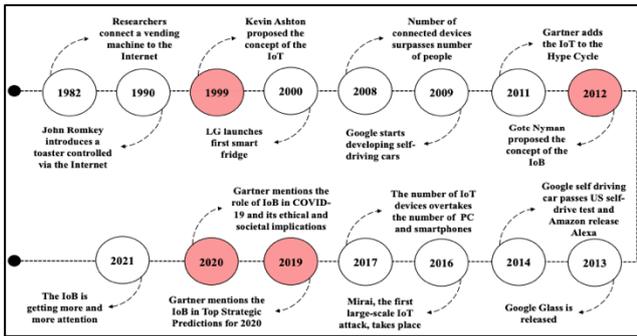


Figure 3: The Timeline of the IoB. (Sun, et al., 2022).

Gartner named Internet of Behavior IoB among the world's biggest strategic technology trends for 2021 and announced that the Internet of Behaviors is something we'll become increasingly aware of and that we might have to grapple with as a society. Gartner predicted that 40 percent of people globally (more than three billion people) will have their behavior tracked through the IoB by 2023, and that by the end of 2025, more than half of the world's population will be subject to at least one IoB program, whether it be commercial or governmental. (Gartner, 2019)

The IoB is an extension of the IoT. IoT connects things to the Internet through information-sensing devices to exchange information to achieve intelligent identification and management. The IoB also works with the same parameters, but the difference lies in the process of data analysis. IoB takes user behavior into account and analyzes what specific patterns represent and how they affect the user by trying to understand the behavior and intention. It can draw conclusions from changing circumstances and make groundbreaking decisions based on those conclusions. (Sun, et al., 2022)

### The workflow of IoB

The IoB is a network of interconnected physical objects that collect and exchange information over the Internet, linking this data to specific human behaviors.

IoB workflow is as follows:

- Use sensors and terminal devices connected to the IoT to track the behavior of users;
- Collect and make available for analysis all types of useful data generated by IoT devices on an ongoing basis;
- Use data analysis and machine learning algorithms to sort and analyze the processed data to obtain logical and structured information;
- Mining useful information with specific patterns and using behavioral science and artificial intelligence algorithms to understand exactly how those patterns affect human behaviors;
- Use corresponding knowledge to make decisions independently, predict user behavior, or influence user behavior towards the expected direction. (Fig.4) (Sun, et al., 2022)

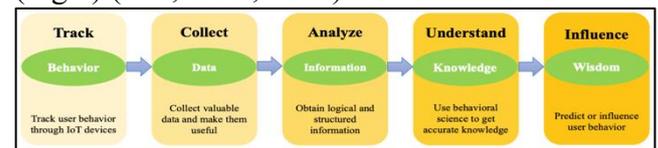


Figure 4: The Workflow of the IoB. (Sun, et al., 2022).

The Internet of Behavior aims to analyze user behavior data reaped from IoT devices through a behavioral psychology perspective, providing user behavior insights, and better understand the intention that leads certain behavior. Therefore, the Internet of Behavior can predict and even influence users' behavioral trends in the future, which can provide opportunities for advertising.

At present, the Internet of Things Internet of Things (IoT)– the Internet of Behavior (IoB) have gradually started to be implemented in advertising. However, many opportunities and challenges are emerging.

### Online Targeted Advertising

Online advertising – also referred to as Internet advertising – leverages the Internet to deliver promotional contents to end users. Online advertising allows web content creators and service providers to monetize yet providing their business for free to end users. (Aksu et al., 2018)

Online ad platforms can tailor or personalized ads, and thereby target specific customer segments. Targeted Online advertising is based on Big Data analytics, where user's personal information is collected and processed to enable segmenting users into groups based on interests, location, or personal attributes like age, gender, etc., with a varying size of the selected customer segment, down to the level of an individual.

Targeted Online Advertising systems rely on user profiling and tracking to tailor ads to users with specific interests and to increase advertising revenue.

The advertising companies, e.g., Google, profile users based on the information they add to their Google account, data collected from other advertisers that partner with Google, and its estimation of user's interests based on mobile apps and websites that agree to show Google ads. (Ullah, Imdad, 2022)

### IoT based Advertising

The Internet of Things (IoT) extends the idea of interconnecting computers to a plethora of different devices, collectively referred to as smart devices. These are physical items - i.e., "things" - such as wearable devices, home appliances, and vehicles, enriched with computational and networking capabilities. Due to the huge set of devices involved - and therefore, its pervasiveness - IoT is a great platform to leverage for building new applications and services or extending existing ones. In this regard, expanding online advertising into the IoT realm is an under-investigated yet promising research direction, nonetheless, it possibly includes many interesting opportunities and challenges. (Aksu, 2018)

Indeed, IoT advertising would enhance traditional Online advertising by taking advantage of three key IoT features (G. Chen, 2016): device diversity, high connectivity, and scalability. IoT device diversity will enable more complex advertising strategies that truly consider context awareness. For example, a car driver could

receive customized ads from roadside digital advertisement panels based on his habits (e.g., preferred stopping locations, hotels, and restaurants). Furthermore, IoT high connectivity and scalability will allow advertising to be performed in a dynamic environment as new smart devices are constantly joining or leaving the IoT network. Finally, different from the traditional online advertising where a limited number of user interactions occur during the day, IoT advertising might count on users interacting with the IoT environment almost 24 hours a day. (Fig.5) (Aksu, 2018)

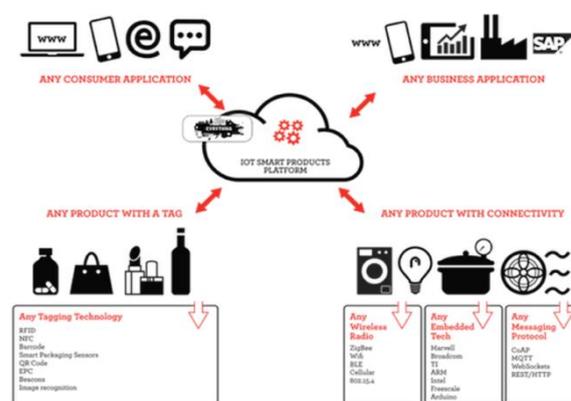


Figure 5: IoT-Based Digital Marketing. (Mahajan, K. & Sahu, Mr., 2022).

### Challenges of implementing IoT/IoB in Advertising

Traditionally, Online advertising has compromised user privacy by tracking people's browsing habits. IoT advertising would go further by tracking user behavior based on day-to-day activities. Here, dataveillance becomes more valuable considering that IoT user data is much more diverse if compared with regular web browsing data which represents a challenge for implementing IoT in advertising. (Chen et al., 2016)

#### Security

The IoB collects and analyzes a large amount of useful data, and this data often reveals the behavior and habits of users. The digital information is exactly the key knowledge that the attacker wants to obtain. With the

expansion of the IoB and the increase of access devices, the risk of important information loss or tampering due to attacks on the network or devices will increase. Therefore, the security of the network and equipment must be considered at the beginning of the construction of the IoB. Predicting and preventing attacks on time is an important way to solve security problems. (Al-Qaseemi et al., 2016)

### Privacy, Ethics, and Law

The most basic and important issue in the IoB is people's behavioral data. This data reveals all aspects of a person's living habits, and the problem of privacy leakage will follow. Hence, several issues need to be considered regarding how to protect private data. (Ullah et al., 2022)

### Security and Privacy Considerations

**Determine the appropriate extent and scope of data collection.** When the IoB enters people's lives in an all-around way, people's behavior will be recorded in various ways, such as software, sensors, locators, etc. The type, extent, and scope of data collection need to be considered. This not only reduces the burden of the whole system but also protects people's privacy.

**Ensure the reliable storage of data.** A large amount of data is stored on the server or in the cloud and used for calculations and analysis. If the data is not protected properly, it may be stolen by hackers and sold to other companies that violate data privacy rights. Therefore, the behavior data should be encrypted, and the database should also take preventive measures, such as user identification, failure recovery, and strengthening server security.

**Use data reasonably.** Currently, many companies share data with other departments or subsidiaries. For example, the acquisition of software by Google, Facebook, and Amazon brings users of one application into the entire ecosystem. This will bring significant legal risks. These issues have almost no legal

protection. The use of specific behavioral data necessitates the creation of relevant laws and regulations to protect users' legitimate rights and interests, such as privacy rights.

**Setting New rules for the ethical use of information.** The IoB needs to change the cultural and legal norms established for big data. If countermeasures are considered in response to the above problems, the IoB will be more acceptable to people. (Sun, et al., 2022)

### Analytical Study

This section analyses selected examples of the IoT/IoB applications in advertising.

The separation between print and digital advertisement was clear for years. However, print advertising has its unique strengths. Furthermore, adding IoT technology to the Print Ads is gradually blurring the separating line between Print and Digital advertising as shown in Examples 1 and 2 (Magazine ad & Packaging).

### Example 1: Nivea Sun Kids, 'The Protection Ad'.



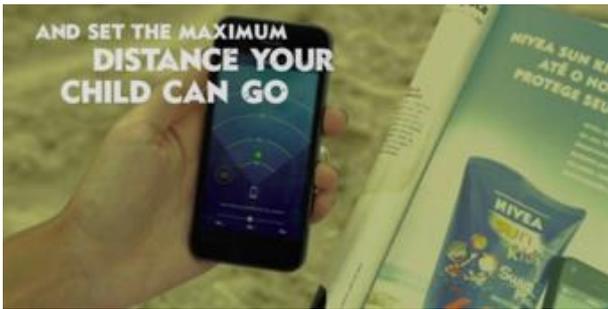


Figure 6,7,8: Nivea Sun Kids, ‘The Protection Ad’ (Marion, 2017)

Table 1: Analysis of Nivea Sun Kids, ‘The Protection Ad’.

Ad QR code	
Brand /Year	Nivea Sun Kids/2017
Target Consumer	Young Mothers Subscribers of the biggest Brazilian Magazine, who own smartphones and live nearby Rio De Janeiro’s beaches.
Ad Type	Printed Magazine Ad includes a connected Cut out Bracelet.
Ad Description	<p><b>Nivea Bluetooth embedded Print Ad features a Bracelet that Stops Kids from Running Off at the Beach.</b></p> <p>Nivea Sun has successfully positioned itself as the leading sun protection brand for both adults and children.</p> <p>However, to help parents, protect their children from getting lost on the beach or from swimming too far, the brand Magazine Ad innovative idea was designed to help parents avoid a constant surveillance of their kids on the beach.</p> <p>The magazine ad included a protector bracelet with a built-in locator, which is embedded with Bluetooth technology, and can be detached and placed around a child’s arm.</p> <p>Then, parents are required to download the <u>Nivea Protege app</u> and link it to the bracelet code. Finally, the app alerts parents if the child goes beyond the distance they pre-set.</p>

IoT/IoB use	Printed bracelet is embedded with <b>BLE</b> wireless communication technology, that turns the bracelet into an IoT device that collects distance/location data about the kid wearing it and sends it to the parent’s Nivea mobile app.
IoT/IoB Benefits	<p>The printed connected magazine app helped Nivea Sun parents relax and become more than just a sun protection product which reinforces brand positioning around the concept of removing stress while promoting benevolence and protection.</p> <p>The company can show that it is not just a skin care brand, but an organization that cares about its customers’ needs beyond its product range.</p> <p>The IoT (wireless connection) of BLE adds connectivity to static printed magazine ad.</p>

Example 2: Blue Label Smart Bottle:



Figure 9: Blue Label Smart Bottle. (RCRWirelessNews, 2015)

Table 2: Analysis of Blue Label Smart Bottle.

Ad QR code	
Brand/Year	Johnnie Walker/2015
Target Consumer	Young Adults, technology users.
Ad Type	<b>Smart Packaging:</b> Smart Bottle Label: NFC printed sensor tags on <b>Thin Electronic Films</b> .

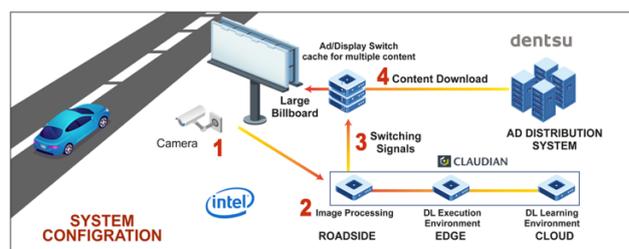
<p><b>Ad Description</b></p>	<p>The bottle could communicate with consumers providing valuable information when, where and how consumers wanted it.</p> <p><b>ThinFilm</b> and <b>Diageo</b> have joined forces to reinvent the role of bottle plays in the consumer experience, transforming the iconic <b>Johnnie Walker Blue Label</b> into a prototype smart bottle that speaks to consumers in an entirely new way.</p> <p>With <b>ThinFilm</b> revolutionary <b>OpenSense</b> technology, this unique bottle wirelessly talks with a consumer's smartphone, instantly delivering custom content while providing an added layer of authenticity protection.</p> <p>These patent-pending sensor tags detect whether a bottle seal is intact or opened, while unlike today's technologies, remaining readable even after the factory seal has been broken.</p> <p><u>As a result, the technology empowers Diageo to:</u></p> <ul style="list-style-type: none"> <li>• Extend the dialogue with its consumers.</li> <li>• Enhance the relationship it has with its consumers with a touch of an <b>NFC smartphone</b>.</li> </ul> <p>Each bottle's unique identity triggers real-time marketing experiences and supply chain analytics managed by the <b>IOT</b>.</p> <p><b>Johnnie Walker Blue Label</b> becomes an interactive medium capable of delivering timely and targeted digital content, whether:</p> <ul style="list-style-type: none"> <li>• Engaging in store shoppers with promotional offers and relevant information.</li> <li>• Serving cocktail recipes to consumers at home.</li> <li>• Assisting retail employees on the shop floor.</li> <li>• Streamlining the supply chain all with a simple effortless tap of an <b>NFC enabled smartphone</b>.</li> </ul> <p>Diageo and thin-film transforming bottles for a new digital generation and setting the bar for technology innovation in the drinks industry.</p>
<p><b>IoT/IoB use</b></p>	<p>The smart bottle uses printed sensor tags with Near Field Communication (NFC), to let consumers interact with the package using NFC-enabled smartphones.</p>

	<p><b>OpenSense' sensors</b> can tell if the bottle has been opened or not and where it is in the supply chain.</p>
<p><b>IoT/IoB Benefits</b></p>	<p>Providing relevant content in a more seamless way for the digital generation.</p> <p>Providing a more interactive experience to packaging.</p> <p>Build brand loyalty among existing users.</p> <p>Delivering advertising messages with a <b>tap</b>.</p>

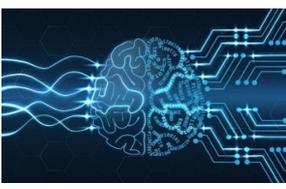
### Example 3: "DeepAd Project" (2017)

Digital Out of Home Advertising (DOOH) is gradually replacing Traditional Out of Home Advertising (OOH), offering dynamic, engaging and interactive advertising content. However, DOOH still lacks the ability to target groups of audiences accurately according to their preferences and behaviors.

IoT technology created a new generation of Intelligent DOOH billboard, which can recognize target audience's gender and age range, recognize things like vehicles: speed and model, also connect, send, and receive data from the network and surroundings. Intelligent billboards targeting system includes intelligent board connected to the internet, system network, sensors, cameras, processors. The system collects data from the billboard surroundings, defines the audience exposed to the billboard at a certain time with contextual awareness, process and analyze these data using Artificial Intelligence (AI) & Machine Learning (ML), then match the result with the most relevant advertisement to display for recognized targeted audience. (Intel, 2017)



**Figure 10:** DeepAd Project by Intel, Dentsu, Clouidian Architecture: Vehicle & Face Recognition functions. (Researcher, 2022, Intel, 2017)

	
a) No car detected: current weather data displayed	b) Luxury car detected: golf resort ad was displayed
	
c) Family car detected: popular amusement park Ad was displayed	d) DeepAd Project member's car detected: unique graphic image was displayed

**Figure 11:** DeepAd Project by Intel, Dentsu, Cloudian, showing selected ads responding to target car model. (Researcher, 2022, Intel, 2017)

**Table 3:** Analysis of DeepAd Project.

<b>Brand/Name</b>	Intel, Dentsu & Cloudian. / 2017
<b>Target Consumer</b>	<b>DOOH Audience: Family Cars and Luxury Cars driver &amp; passengers.</b>
<b>Ad Type</b>	Intelligent DOOH billboard system for Dynamic, Targeted Advertising.
<b>Ad Description</b>	<p>Advertisement selection and display content were based on the types of vehicles detected. The system was trained to recognize specific vehicles models, which were classified in three different categories for the purpose of delivering targeted messages: Luxury cars, Family cars, Project member car.</p> <ul style="list-style-type: none"> <li>• Until a car triggered the system: the digital billboard displayed current weather data.</li> <li>• When a luxury car was detected: golf resort ad displayed.</li> <li>• When family car was detected: content about a popular amusement park was displayed.</li> <li>• When DeepAd Project members car were detected: a unique graphic image was displayed.</li> </ul>
<b>IoT/IoB use</b>	The Intelligent DOOH billboard system uses Artificial Intelligence (AI)/Machine Learning, combined with the Internet of Things (IoT) and Big Data and other technologies to detect and identify vehicles: make and model (94 % accurate results), in addition to

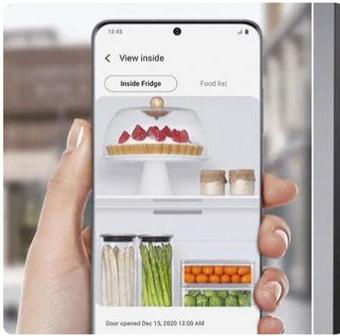
	face recognition function: detect gender and age. The system constructed mainly of video cameras to detect and recognize vehicle make and model, image processing unit, ad distribution system, ad display/switch unit, large billboard. The process took about one-half of a second (500 msec) from the time the camera detected the vehicle to the ad content selection. The ad content is displayed for about ten seconds.
<b>IoT/IoB Benefits</b>	<p>Detecting and identifying vehicles: speed, make and model (94 % accurate results).</p> <p>Face recognition function: detect gender and age.</p> <p>Revolutionize DOOH advertising with more effective content delivery by targeting audiences with specific Adverts just for them.</p>

**Example 4: Samsung's Family Hub (2018).**

Smart home devices are one of the main applications of IoT technologies. As more users adopt smart home devices, advertisers will have an increasing number of opportunities to reach and interact with their users if they keep privacy needs in mind.



**Figure 12:** Samsung Family Hub smart Refrigerator with Smart Sensors, tracking food vision, temperature, humidity levels, and usage patterns. (Samsung, 2022)



**Figure 13:** Smart Fridge AI-equipped cameras that can scan what's inside, identify food and let users know what items they're short on, suggest shopping deals from partner markets. (Samsung, 2022)

**Table 4:** Analysis of Samsung Family Hub. (Samsung, 2022)

<b>Ad QR code</b>	
<b>Brand/Year</b>	Samsung/2018
<b>Target Consumer</b>	Family members living in a Smart Home & owning an LG Family Hub. Each family member can get advertising and promotional materials based on his/her: consumption, behavior patterns, interests, occasions, plans etc..
<b>Ad Type</b>	Smart Home Devices In-App Advertisements.
<b>Ad Description</b>	The recent smart home innovation from Samsung is connecting every family member with each other and with their smart home, giving advertisers and marketers an endless source of updated data and information about each family member needs, interests, habits, consumption rates, activity rates, health, expansions, and much more. The insight from this information could be used in personalized advertising plans. For example, Samsung's Family Hub has AI-equipped cameras that can identify food inside refrigerator which can scan what's inside and let users know what items they're short on, even suggesting shopping recommendations from Samsung partners as: <b>AmazonDash, instacart, shoprite.</b>

<b>IoT/IoB use</b>	Connection and data collection through Smart Home Devices and Applications.
<b>IoT/IoB Benefits</b>	Unlimited sources of information can be gathered through <b>smart home devices</b> different features, as a result, it opens an unprecedented opportunity for advertisers and marketers: For example, targeting users with ads based on their: <ul style="list-style-type: none"> <li>• Food consumption rate: let users know what items they're short on, sending shopping recommendations from advertisers.</li> <li>• Smart fridge recommended recipes, especially clicked on ones: sending advertisements on recipe's ingredients.</li> <li>• Calendar Occasions as kids' birthday parties or anniversaries: sending suggested gifts advertisements.</li> </ul>

## Results

- IoT (wireless connection as BLE, NFC) adds connectivity & user data collection to static printed advertising as packaging, magazine ads.
- IoT-enabled DOOH advertising adds more effective content delivery by targeting audiences with specific adverts just for them through targeting functions as:
  - ⇒ Intelligent DOOH Vehicles detection and identification recognizes speed, make and model (94 % accurate results).
  - ⇒ Intelligent DOOH Face recognition estimates gender and age.
- Unlimited sources of information can be gathered through smart home devices different features, as a result, it opens an unprecedented opportunity for advertising based on users' behaviors and preferences.

## Discussion & Conclusion

Targeted Online advertising was based mainly on web browsers and mobile application only. In the IoT era, where everything is connected, everything sends and receive data, targeted advertising is extending into things as wearables, smart home devices, smart billboards, connected

packaging, and many potential things which target users usually use or deal with constantly. Simply, any object has the potential to be used as an advertising channel to engage with its target user, which is paving the way to a revolution in advertising.

In this research, we presented examples of IoT applications advertising, highlighting its benefits. We also discussed possible main challenges to implement IoT in advertising as security, privacy, ethics, and law.

Targeted advertising-based on-IoT and its enabling technology is still in the beginning, however, it promises with an unprecedented advertising revolution that offers full connectivity, user knowledge and targeting abilities.

## References

- [1] Aksu, H. *et al.* (2018) "Advertising in the IOT ERA: Vision and challenges," *IEEE Communications Magazine*, 56(11), pp. 138–144. Available at: <https://doi.org/10.1109/mcom.2017.1700871>.
- [2] Al-Qaseemi, S.A. *et al.* (2016) "IOT architecture challenges and issues: Lack of standardization," *2016 Future Technologies Conference (FTC)* [Preprint]. Available at: <https://doi.org/10.1109/ftc.2016.7821686>.
- [3] Chen, G. *et al.* (2016) "In-depth survey of Digital Advertising Technologies," *IEEE Communications Surveys & Tutorials*, 18(3), pp. 2124–2148. Available at: <https://doi.org/10.1109/comst.2016.2519912>.
- [4] Elayan, H. *et al.* (2022) "Internet of behavior (IOB) and explainable AI systems for influencing IOT behavior," *IEEE Network*, pp. 1–8. Available at: <https://doi.org/10.1109/mnet.009.2100500>.
- [5] Intel. (2017) "Deep learning enables intelligent billboard for dynamic targeted Targeted Advertising on Tokyo Expressway". Available at: [https://builders.intel.com/docs/storagebuilders/deep\\_learning\\_enables\\_intelligent\\_billboard\\_for\\_dynamic\\_targeted\\_advertising\\_on\\_tokyo\\_expressway.pdf](https://builders.intel.com/docs/storagebuilders/deep_learning_enables_intelligent_billboard_for_dynamic_targeted_advertising_on_tokyo_expressway.pdf) (Accessed: January 16, 2023).
- [6] Mahajan, K. & Sahu, Mr. (2022). "IoT-Based Digital Marketing," In *Use of IoT*, Namya Press, chapter: 01, p:5,9.
- [7] Sun, *et al.* (2022). *Internet of Behaviors: A Survey*. 10.48550/arXiv.2211.15588. Available at: Doi: 10.48550/arXiv.2211.15588
- [8] Ullah, I., Boreli, R. and Kanhere, S.S. (2022) "Privacy in targeted advertising on mobile devices: A survey," *International Journal of Information Security* [Preprint]. Available at: <https://doi.org/10.1007/s10207-022-00655-x>.

## Websites:

- [9] Gartner\_Inc (2019) *Gartner top strategic predictions for 2020 and beyond*, Gartner. Available at: <https://www.gartner.com/smarterwithgartner/gartner-top-strategic-predictions-for-2020-and-beyond> (Accessed: January 16, 2023).
- [10] Marion (2017) *New nivea ad features a bracelet that stops your children from running off at the beach!*, *The Branding Journal*. Available at: <https://www.thebrandingjournal.com/2014/05/new-nivea-ad-features-bracelet-stops-children-running-beach/> (Accessed: January 16, 2023).
- [11] Nivea (2014) "NIVEA SUN KIDS - The Protection Ad," *Nivea Protege* [Preprint]. Nivea. Available at: <https://www.youtube.com/watch?v=BgXrTGIIFV8> (Accessed: January 10, 2023).
- [12] Nyman, G. (2020) *Covid-19, behavior knowledge and internet of behaviors (IOB)*, *Helsingin yliopisto*. Gote Nyman. Available at: <https://researchportal.helsinki.fi/fi/publications/covid-19-behavior-knowledge-and-internet-of-behaviors-iob> (Accessed: January 16, 2023).
- [13] RCRWirelessNews (2015) #MWC15: *Thinfilm NFC Smart labels for Johnnie Walker*, *YouTube*. YouTube. Available at: <https://www.youtube.com/watch?v=pDtgHLCYXXI&t=32s> (Accessed: January 16, 2023).
- [14] Samsung US (2022) *Samsung Family Hub™, Samsung US*. Available at: <https://www.samsung.com/us/explore/family-hub-refrigerator/features/> (Accessed: January 16, 2023).