POV

Digital Olfaction:
Can We Sell "The Sweet Smell of Success" Yet?

Overview

Smell is a complex and profound sense. According to early research, olfactory stimuli can significantly impact motivation, work performance, and levels of arousal. And yet, the olfactory system is seemingly difficult to transmit digitally. Digital olfaction technology can mean countless possibilities in various industries like healthcare, retail food, gaming, automobiles, and manufacturing.

According to Emergen Research, the global digital scent technologies market size is expected to cross USD 4 billion in 2030 from USD 536.1 million in 2019. However, since odors cannot be represented like vision and sound, it may take a long time for this to be the most reliable and sought-after technology.

What is digital scent technology?

Olfactory technology or digital scent technology is the ability to digitally identify, send, and receive olfactory media with olfactometers and electronic noses.

All-immersive experience being the motto of every manufacturer and service provider, digital olfaction is now being considered a lucrative technology that can be used to offer products and services with clearly distinguishable quality and superiority.

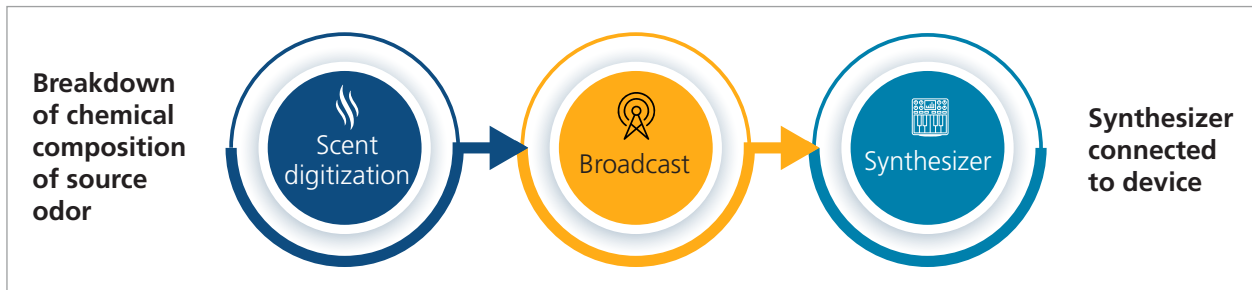# The complex process can be explained in three basic steps:

Breakdown of chemical composition of source odor → Scent digitization → Broadcast → Synthesizer → **Synthesizer connected to device**

Figure 1: Three steps in digital scent technology

Scent creation

During this initial phase, a particular scent is recognized and brought to life. It involves using various chemical compounds to mimic the desired natural odors.

Scent digitization

Once the scent is created, it is digitized. This involves creating a different digital signature for each odor, a specific grouping of data representing the unique scent.

Scent reproduction

Smell reproduction is the final stage. This is where the digital signature is deciphered, and the scent is reconstructed using an apparatus known as a "scent synthesizer". These devices use a fusion of chemicals to recreate the scent based on its digital sign.

Devices utilized

Smell synthesizer	Cartridge	Smell broadcasting device
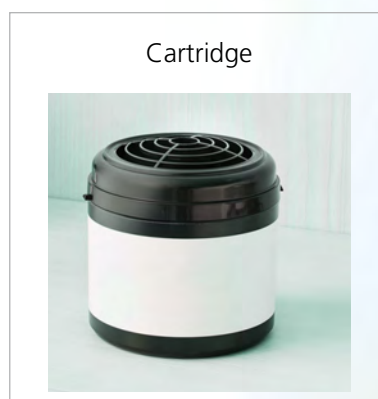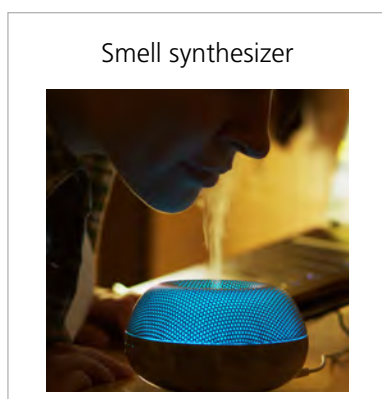
Digital olfaction technologies market

Digital olfaction technology attempts were made in the past by Hans Laube. He designed the Smell-O-Vision in 1950, an odor-spreading system during a film projection, for the viewers to effectively smell what was happening in the movie. However, it wasn't successful in efficient odor distribution during moving screen.

There are two branches of digital olfaction technology.

Detection and analysis

Transmission and re-creation

Aryballe, a digital olfaction startup based in France, combines biochemistry, advanced optics, and machine learning to mimic the human sense of smell, using silicon photonics technology to detect, record and recognize odor data.

Aromajoin, based in Japan, developed an innovative product which allows users to control scents via smartphones, VR equipment, PCs and IoT devices.

Major companies operating in the digital scent technologies market:

Aryballe	Aromajoin Corporation	Aromyx	Olorama	Moodify

Digital olfaction technology can be combined with mixed reality and other similar advanced systems to create an all-immersive digital environment.

Industry applications and innovations

Digital smell technology is employed in various applications by many end-user industries, including military & defense, food & beverage, medical, marketing, entertainment, environment monitoring, and others, such as communication, agriculture, public security, transportation, and R&D.

It has a range of applications including:

Online gaming	**Online product sampling on websites**	**Food order placing through scented QR codes**
Precision-based odor transmission for immersive movie experience	**Scented mobile notifications, scented emails**	**Presentation, training, and simulation**

Some important automotive sector use cases:

User comfort – rental car services

The ratings in the rental or carpool fleet serve as the first impression for the next user of the service – and any negative feedback can damage their reputation. Olfactory sensors can help evaluate the fleet in real-time.

A notification is sent whenever an unexpected smell is detected, and signals are transmitted when the car needs to be taken out of rotation for maintenance. The data provided by odor sensors could bring impartiality and improve user comfort.

Forever new car smell

Car manufacturers could standardize the "new car smell" with the help of odor sensors. These could enable car providers to develop branding strategies around the ideal "new car smell."

Manufacturers could use odor sensors to monitor the cabin and adjust materials as and when required to warrant an enjoyable experience that matches the area-wise cultural expectations.

Through pattern recognition and analysis, automobile manufacturers can bring objectivity by setting odor standards in vehicles. This would help mitigate variations that occur due to manually driven processes, which often have subjective results rather than standard results.

Safety in vehicles

Safety is a huge element impacting the ever-changing automotive industry. Some related applications of digital olfaction are:

I). Vehicle hazard prevention

Olfactory sensors can be used to diagnose car malfunctions early and before any disaster could occur. Hazardous situations like oil leakage, aging brakes, or heated wires, which have unique, recognizable smells, could be immediately identified to detect early warning signals and provide objective safety data. This can also be extended to factories and workshops for better hazard management.

II). Driver fatigue

Most accidents are typically due to driver fatigue. Certain smells, if released on time after detecting sudden changes in the driver's vitals, can improve driver behavior so they can recognize dangers sooner, staying more alert on the road. The olfactory device of the empathetic car system can disperse a relaxing pheromone that can be used to calm down a stressed driver. Studies show that the reaction time is significantly faster with odor-induced stimulation than that with visual or auditory stimulation.

In addition, improved air quality monitoring by automatic source recognition can reduce the adverse effects of high CO_2 levels on the driver.

III). Safety in electric vehicles for the visually impaired

One of the important USPs of EVs is the noise-free experience. But engine noise also serves as a warning mechanism for the visually challenged and pedestrians by communicating the vehicle's direction, speed, and other signals.

Making a noise-free automobile would mean losing out on some of the safety benefits associated with it.

Some EV and hybrid car manufacturers in the U.S are working to resolve this by adding an acoustic vehicle alerting system (AVAS) that emits noise from external speakers based on speed limits.

To enhance safety, digital olfaction can help by releasing distinct odors immediately after sensors detect the presence of pedestrians on the road.

Scent	Positive Effect
Peppermint and cinnamon	Improve concentration levels and make drivers less irritable
Lemon and coffee	Help drivers achieve high concentration levels and clear thinking
New-car smell	Tend to make people more cautious about their driving and improve concentration
Sea ozone	Salty sea air may make drivers breathe deeply, helping relieve stress, relax the muscles and calm the mind

Table 1: Scents and positive effects

Human Smell-Technology Initiatives: Can Smell Improve Road Safety?, Easa SM, Yang YQ, Arkatkar S, Xu Z, Ma Y, Wang S and Lai Y, Ergonomics International Journal, September 2, 2022: https://medwinpublishers.com/EOIJ/human-smell-technology-initiatives-can-smell-improve-road-safety.pdf

Challenges

Digital olfaction technology has many use cases and potential areas of application and implementation in various industries. However, certain restrictions might prevent sectors from leveraging this technology to the fullest.

I). High precision and accuracy requirements

With the rising competition in the manufacturing industry, real-time transmission remains a challenge even in the established and popular technological advancements.

The efficiency of the synthesizer to accurately prepare the exact composition selected by the sender will be a key factor in successfully transmitting the intended scent online.

Even though artificial intelligence and machine learning have enabled machines to mimic humans and allow faster completion of tasks, the specificity of smell transmission is still dependent on manual intervention and assistance to choose the exact combination of smell or odor.
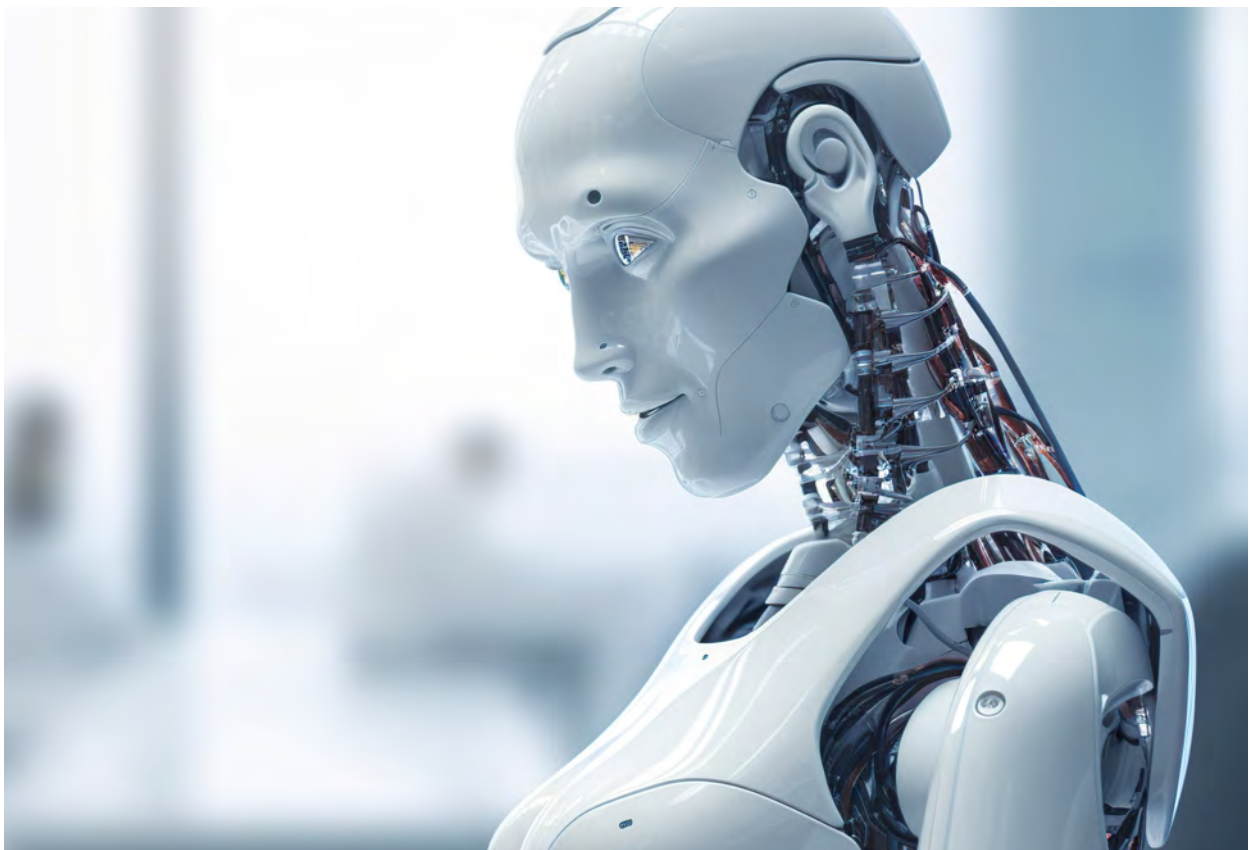
II). Infrastructure limitations

The infrastructure to train e-noses and share the data is limited, and there needs to be more standardization. Human Smell-Technology Initiatives: Can Smell Improve Road Safety?, Easa SM, Yang YQ, Arkatkar S, Xu Z, Ma Y, Wang S and Lai Y, Ergonomics International Journal, September 2, 2022: *https://medwinpublish-ers.com/EOIJ/human-smell-technology-initiatives-can-smell-improve-road-safety.pdf*

The use of cheaper and low-quality sensors and higher-value software places a significant load on training artificial intelligence devices. However, the inherently higher-performance hardware for e-noses, such as printed carbon nanotubes, are not yet manufacturable at a larger scale.

III). Rationalization for costs

Preciseness in transmitting specific scents and odors means the availability of more chemicals and compounds to choose from. Eventually, the scent cartridges will be expected to perform the conversion and selection tasks in seconds, needing highly efficient processors and memory devices. This is not a cakewalk and can incur huge costs despite having 5G architecture for high-speed data transfer.

IV). Sustainability challenges

ESG considerations are necessary for any organization before taking the leap of implementing any new service relying on automation technology. The natural vs artificial odor ratio becomes crucial for investors to consider before investing.

V). Chemical side effects

Chemicals used in the scent and perfumes can cause fatal side effects and turn into diseases.

The choice of odor matters as certain smells may provoke drivers into dangerous behaviors.

Scent	Adverse Effect
Chamomile, jasmine, and lavender	Make drivers too relaxed
Fast food wrappers, fresh bread, and pastry	Make drivers hungry and get something to eat, resulting in irritability and an increased risk of speeding and road rage
Fresh-cut grass, pine woods, and roadside flowers	May bring a memory to the drivers such that their dreams take their minds off the road or speed. Also, drivers with allergies may sneeze and get watery eyes
Leather seats and oil	Older drivers may become nostalgic, thinking back to the thrill of their first cars, and adopt risky driving behaviors

Table 2: Scents and adverse effects
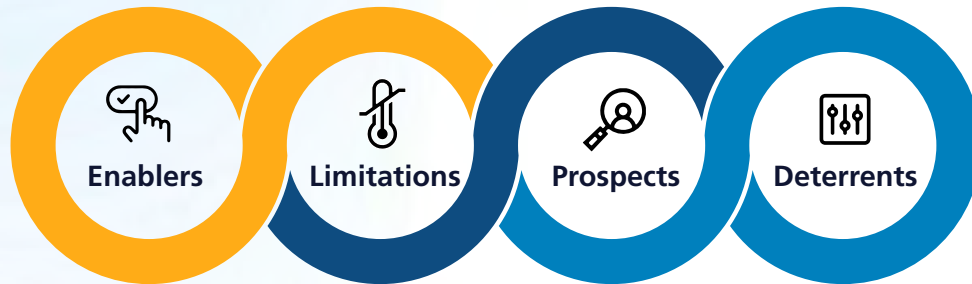
Outlook

Figure 3: Factors impacting the future of digital olfaction

The major usefulness of digital smell technology would be in its seamless transmission. We're nearing a saturation level with what we can do with text data, and smell technology shows great promise for deeper and personal connections that are far-reaching.

With the advent of AI, it could be feasible to catalog scents and comb through an immense amount of data scents created from billions of molecules.

However, it may take a long time for digital olfaction adoption and acceptance across industries due to its inherent interpretation constraints and subjectiveness.

References

1   Simple Odor Analytics, Aryballe, Moodify, CNN https://aryballe.com/

2   Ergonomics International Journal Review Article - Human Smell-Technology Initiatives: Can Smell Improve Road Safety?, Easa SM, Yang YQ, Arkatkar S, Xu Z, Ma Y, Wang S and Lai Y, Ergonomics International Journal, September 2, 2022:
    https://medwinpublishers.com/EOIJ/human-smell-technology-initiatives-can-smell-improve-road-safety.pdf

3   Digital Smell: The Sensor Opportunity Under Our Noses, Dr Tess Skyrme, July 13 2022:
    https://www.idtechex.com/en/research-article/digital-smell-the-sensor-opportunity-under-our-noses/27165

4   Digital Scent Technology Market is Likely to Upsurge USD 2,099.71 Million Globally by 2030, Size, Share, Trends, Demand, Growth and Opportunity Analysis, Data Bridge Market Research, March 14 2023:https://www.prnewswire.com/news-releases/digital-scent-technology-market-is-likely-to-upsurge-usd-2-099-71-million-globally-by-2030--size-share-trends-demand-growth-and-opportunity-analysis-301771386.html

5   What Is Digital Scent Technology and How Does It Work?, Bob Sharp, July 14 2023:
    https://www.makeuseof.com/what-is-digital-scent-technology

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Manasi Jadhav is a seasoned professional working in the automotive manufacturing domain for 5+ years. She is passionate about providing innovative solutions to complex problems and helping stakeholders in achieving their long-term digital business strategies. She has had extensive international exposure and is highly effective in a global business environment.