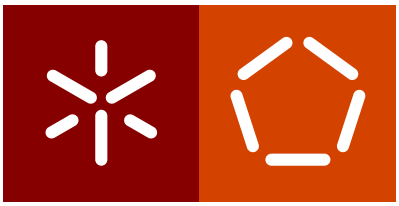

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Project: Report

Marketing Digital Outdoor with gesture interaction — Problem statement

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List of Listings

List of Abbreviations

Notation	Description	Page List
BN	Billions	2, 3, 5
CAGR	Compound Annual Growth Rate	3
CPS	Cyber–Physical Systems	1
DOOH	Digital Out-Of-Home	2
R&D	Research and Development	3

1. Introduction

The present work, within the scope of the Embedded Systems course, consists in the project of a Cyber–Physical Systems (CPS), i.e., a system that provides seamless integration between the cyber and physical worlds [1]. The Waterfall methodology is used for the project development, providing a systematic approach to problem solving and paving the way for project's success.

In this chapter are presented the project's context and motivation, the problem statement — clearly defining the problem, the market research — defining the product's market share and opportunities, the project goals, the project planning and the document outline.

1.1. Context and motivation

COVID pandemics presented a landmark on human interaction, greatly reducing the contact between people and surfaces. Thus, it is an imperative to provide people with contactless interfaces for everyday tasks. People redefined their purchasing behaviors, leading to a massive growth of the online shopping. However, some business sectors, like clothing or perfumes, cannot provide the same user experience when moving online. Therefore, one proposes to close that gap by providing a marketing digital outdoor for brands to advertise and gather customers with contactless interaction.

Scenting marketing is a great approach to draw people into stores. Olfactory sense is the fastest way to the brain, thus, providing an exceptional opportunity for marketing [2] — "75% of the emotions we generate on a daily basis are affected by smell. Next to sight, it is the most important sense we have" [3].

Combining that with additional stimuli, like sight and sound, can significantly boost the marketing outcome. Brands can buy advertisement space and time, selecting the videoclips to be displayed and the fragrance to be used at specific times, drawing the customers into their stores.

Marketing also leverages from better user experience, thus, user interaction is a must-have, providing the opportunity to interact with the customer. In this sense, when users approach the outdoor a gesture-based interface will be provided for a brand immersive experience, where the user can take pictures or create GIFs with brand specific image filters and share them through their social media, with the opportunity to gain

several benefits.

1.2. Problem statement

The first step of the project is to clearly define the problem, taking into consideration the problem's context and motivation and exploiting the market opportunities.

The project consists of a marketing digital outdoor with sound and video display, and fragrance emission selected by the brands, providing a gesture-based interface for user interaction to create pictures and GIFs, brand-specific, and share them on social media.

Brands can buy advertisement space and time, selecting the videoclips to be displayed and the fragrance to be used at specific times, drawing the customers into their stores. Customers can be captivated by the combination of sensorial stimuli, the gesture-based interaction, the immersive user experience provided by the brands — feeling they belong in a TV advertisement, and the opportunity to gain several benefits, e.g., discount coupons.

1.3. Market research

A Digital Outdoor is essentially traditional outdoor advertising powered up by technology. The pros of a digital outdoor to a traditional one is mostly the way that it captivates the attention of consumers in a more dynamic way. It can also change its advertisement according to certain conditions, such as weather and/or time. Some researches tells that the British public sees over 1.1 Billions (BN) digital outdoor advertisements over a week [4], which can tell how much digital marketing is valued nowadays.

When talking in numbers, "At the end of 2020, despite the Covid wipeout, the Digital Out-Of-Home (DOOH) market was estimated to be worth $41.06 BN, but by 2026, nearly two out of three (65%) advertising executives predict this will rise to between $50 BN and $55 BN. A further 16% expect it to be worth between $55 BN and $60 BN, and 14% estimate it will be even bigger" [5].

Scent market is the art of taking a company's brand identity, marketing messages, target audience and creating a scent that amplifies these values. That's because " a scent has the ability to influence behavior and trigger memories almost instantaneously. When smell is combined with other marketing cues, it can amplify a brand experience and establish a long lasting connection with consumers" [6].

Ambient scent uses fragrance to enhance the experience of consumers with different purposes, whereas scents in scent branding are unique to each company's identity. According to a Samsung study: "when consumers were exposed to a company scent, shopping time was increased by 26% and they visited three

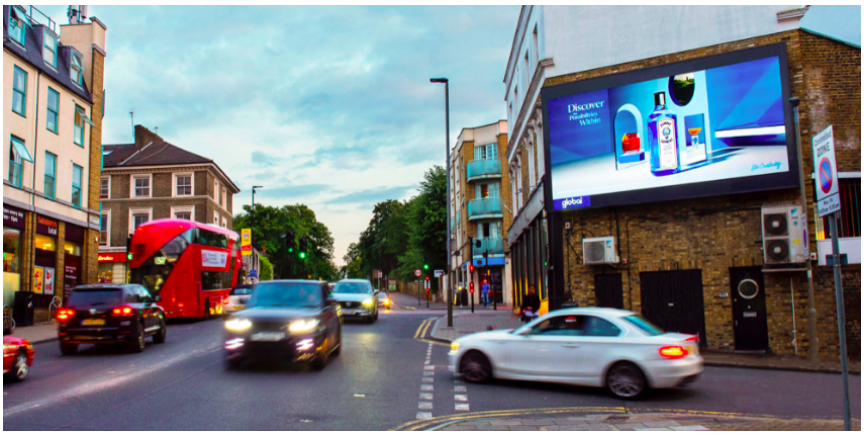

Figure 1.1.: Example of a Digital Outdoor, withdrawn from [4]

times more product categories" [7]. Also, "the digital scent technology market is expected to grow from $1.0 BN in 2021 to $1.5 BN by 2026, at a Compound Annual Growth Rate (CAGR) of 9.2%." [8].

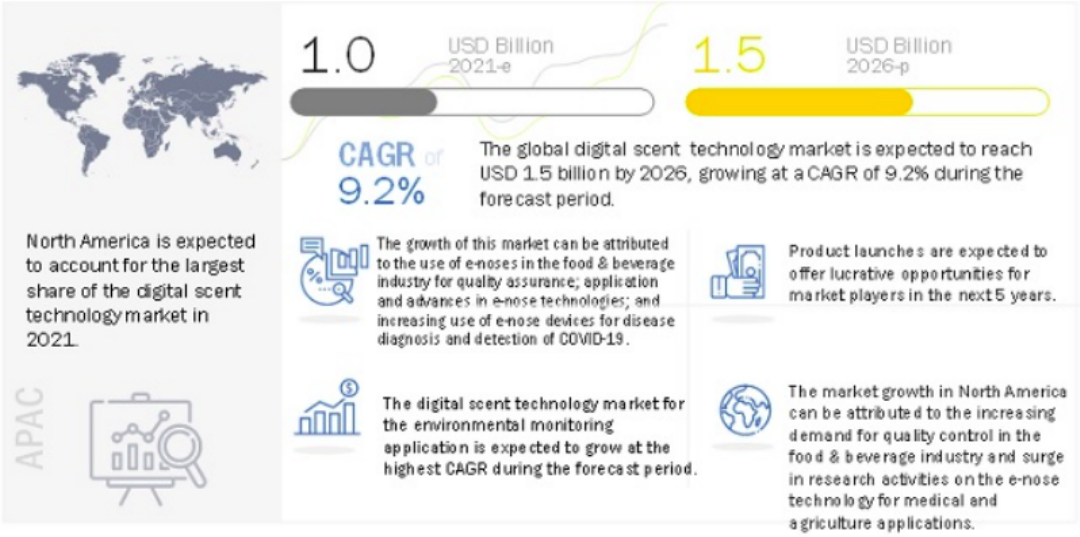

Figure 1.2.: Attractive Opportunities in the Digital Scent Technology Market, withdrawn from [8]

The market growth can be attributed to several factors, such as expanding application and advancements in e-nose technologies, increasing use of e-nose devices for disease diagnostic applications, emerging Research and Development (R&D) activities to invent e-nose to sniff out COVID-19, and rising use of e-nose in food industry for quality assurance in production, storage, and display.

1.4. Project goals

Project goals

1.5. Project planning

In Appendix A is illustrated the Gantt chart for the project (Fig. A.1), containing the tasks' descriptions. It should be noted that the project follows the Waterfall project methodology, which is meant to be iterative.

The tasks are described as follows:

- Project Kick-off: in the project kick-off, a brainstorming about conceivable devices takes place, whose viability is then assessed, resulting in the problem statement (Milestone 0).
- State of the Art: in this stage, the working principle of the device is studied based on similar products and the system components and its characteristics are identified.
- Analysis: In the first stage — Analysis 1 — contains the analysis results of the state of the art. It should yield the specifications document, containing the requisites and restrictions to the project/product, on a quantifiable basis as required to initiate the design; for example, the vehicle's desired speed should be, at maximum, $2\ \mathrm{m/s}$. The second stage — Analysis 2 — contains the analysis of the first iteration of the development cycle.
- Design: it is done in two segments: modules design — where the modules are designed; integration design — where the interconnections between modules is designed. It can be subdivided into conceptual design and solution design.
    - In the conceptual design, several problem solutions are identified, quantifying its relevance for the project through a measuring scale, inserted into an evaluation matrix, for example, QFD.
    - In the solution design, the selected solution is developed. It must include the solution modelling, e.g.:
        - Control system: analytically and using simulation;
        - Transducer design: circuit design and simulation;
        - Power system: power supply, motors actuation and respective circuitry design and simulation;
        - Communications middleware: communication protocols evaluation and selection;
        - Software layers: for all required modules, and considering its interconnections, at distinct levels:

    * front end layer: user interface software, providing a easy and convenient way for the user to control and manage the system.
    * framework layer: software required to emulate/simulate and test the required system behaviour, providing seamless interfaces for the dependents modules
    * back end layer: software running behind the scenes, handling user commands received, system monitoring and control.

- Implementation: product implementation which is done by modular integration. In the first stage, the implementation is done in a prototyping environment — the assisting framework developed, yielding version alpha; in the second stage it must include the coding on the final target modules, yielding prototype beta.
- Tests: modular tests and integrated tests are performed. Tests are generally considered as those performed over any physical component or prototype. Here, it is used as a broader term, to reflect the tests conducted into the system and the several prototypes.
- Functional Verification/Validation: System verification may be performed to validate overall function, but not for quantifiable measurement, due to the latencies involved. Regarding validation, specially for an external agent, thus, it should be limited to user interface validation.
- Delivery: — project closure encompassing:
    1. Final prototype
    2. Support documentation: how to replicate, instruction manual.
    3. Final report
    4. Public presentation

1.6. Report Outline

This report is organised as follows:

- Lastly, the appendices (see Section 1.6) contain detailed information about project planning and development.

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Appendices

A. Project Planning — Gantt diagram

In Fig. A.1 is illustrated the Gantt chart for the project, containing the tasks' descriptions.

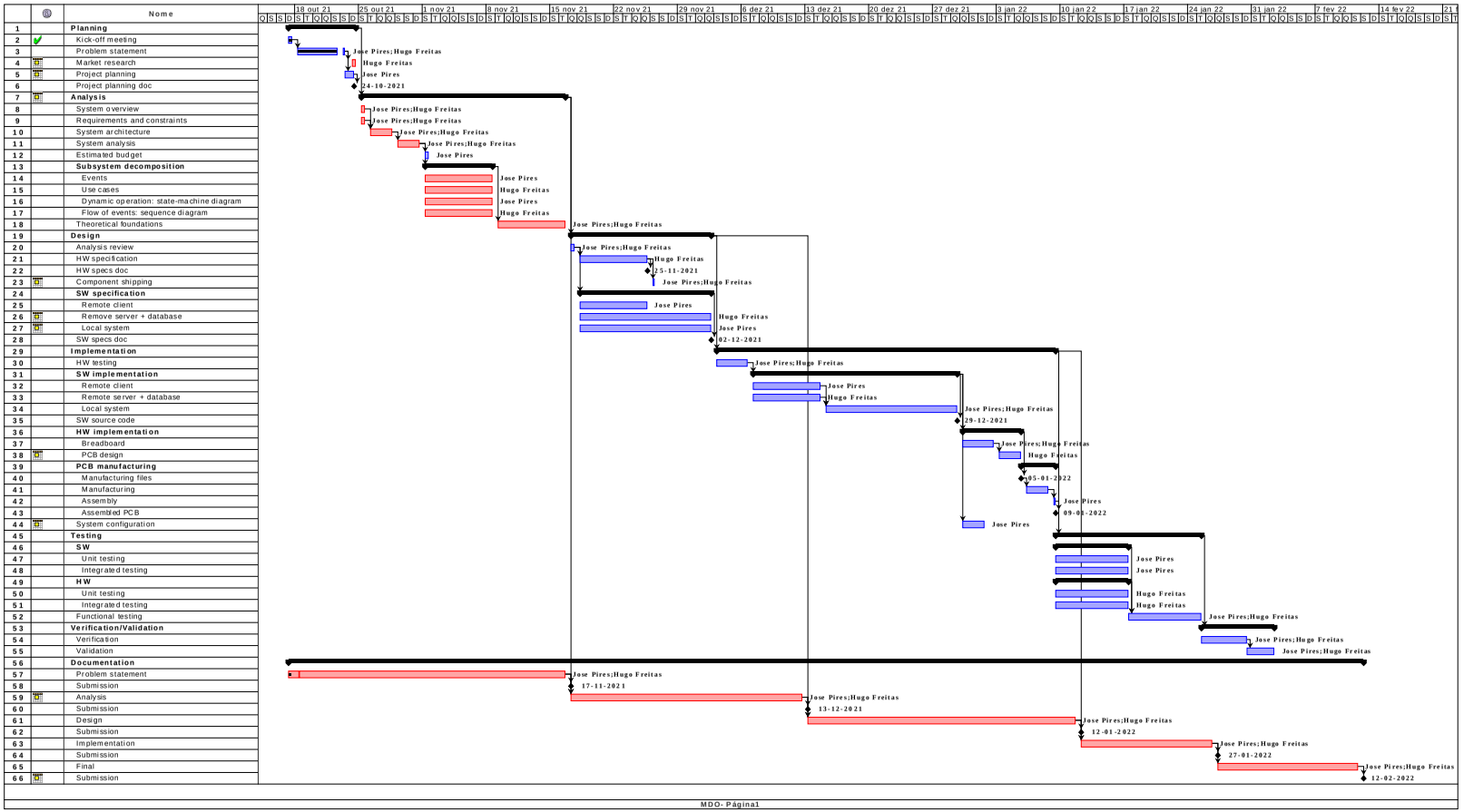

Figure A.1.: Project planning — Gantt diagram