Two Fragrances Designed for Brazilian Millennials

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Abstract

There is an art and a craft to making an appealing fine fragrance that takes perfumers many years to master. The *IBM Research AI for Product Composition* system was created to assist perfumers to design novel fragrances that are appealing, well balanced and technically sound. The system has been used by Master Perfumers at Symrise to develop 2 fragrances for Brazilian millennials. This creative submission presents the two fragrances, one designed for men and the other for women.

Introduction

Symrise AG and IBM Research are exploring the use of computational creativity to aid professional perfumers in the design of new fragrances. Our collaboration has produced the first AI-enabled commercial fine fragrances. These fragrances were developed for the millennial market in Brazil and will be on sale in May 2019 (Goodwin 2019).

Perfumery is both a craft and an art. A good fragrance needs to be well balanced, with top, middle and base notes that complement each other. It needs to last on the skin and smell good both when first applied and 8 hours later when many of the more volatile elements have evaporated. It needs to be shelf-stable for at least 3 months and not separate or form a precipitate. The fragrance must be safe to apply to the skin. It can't be a skin irritant and it needs to meet a large and ever-changing set of regulatory requirements. Perfumers learn the craft of perfumery in perfumery school and through apprenticing to a master perfumer. To become fully trained takes a perfumer 7 to 10 years.

Beyond the craft of creating a good fragrance, the perfumer also needs to be an artist designing unique fragrances that appeal to the nose and the emotions. Smell is one of the most primitive of our senses and linked closely with memory and emotion (Herz 2004). The right fragrance can help convey the personality of the wearer and create the right emotional environment.

To design a perfume, a perfumer iteratively creates trial formulas, has them compounded by a robot and smells them. They typically work with an evaluator who also smells the

Figure 1: Image of the two fragrances.

sample and provides feedback. The process continues until the perfumer and evaluator have arrived at a sample or two that they want to send to the client. The client may have requested samples from multiple fragrance houses and will select a winner. The client may request changes and are likely to put the selected fragrances into a consumer test with people from the target market segment before putting the fragrance on the market.

The Fragrances

IBM Research AI for Product Composition is a co-creative system that applies computational creativity to fragrance design. The system takes one or more inspiration fragrances to indicate the general area of the fragrance space to explore. The system also takes a creativity level from 1 to 10 as input. Specifying a large creativity level causes the system to explore a very wide area of the fragrance space. Specifying a lower creativity level causes the system to focus on the region of the inspiration set more closely and fine tune the fragrances.

The first fragrance we present is designed for millennial women in Brazil. The fragrance is a well-balanced floral fragrance that is fresh and modern. The main structure is similar to a classic floral violet with white flower, raspberry and a passion flower accords.

The formula generated by the system was adjusted slightly by the master perfumer to increase its freshness. One ingredient was decreased from 1.35% of the formula to 1.0% of the formula, a total change of 0.35% from the generated formula. The result has performed very well in consumer tests with millennial women in Brazil.

The women's fragrance formula was interesting not only because it has an pleasant scent, but also the way it achieved the result. The formula used a large amount of an expensive Chinese floral absolute. Typically, a perfumer would not use such an expensive ingredient in large amounts in a mass-market fine fragrance because it makes it hard to achieve the target raw material cost. In this case, the system was able to balance the expensive ingredient with a set of less expensive ingredients to create a beautiful fragrance that met the cost target. This is an example of how the system can spur creativity by suggesting ways of achieving a goal that the perfumer would not normally consider.

The millennial men's fragrance has the structure of a classic fougère, a common style for men's fragrances. It goes beyond the classic style to add gourmand elements of cardamom, fenugreek, tonka lactone and a lait chaud (hot milk). The combination of elements makes the fragrance unique and the balance between the various elements makes the fragrance appealing to the target market, millennial men in Brazil. The master perfumer did make one adjustment to the formula, reducing the tonka lactone by 0.04%

Fragrance Creation System

IBM Research AI for Product Composition, sketched in figure 2, is a data driven machine learning system that helps the perfumer iterate over designs by suggesting alternative formulations for olfactory experiences under development. The system makes suggestions by learning from Symrise's extensive historical repository of formulas and sensory tests.

The formula generator uses a generate and test methodology in which multiple candidate formulas are created and then evaluated. The generation process is designed to mimic how perfumers usually learn and work. The training data for the system consists of 100,000s of previously created formulas. The data includes not only the final formula, but all the intermediate formulas created en-route to the final formula. The system learns about raw material substitutes, complements and dosing. It learns about formula structure and how the structure for a fine fragrance differs from the structure for a shampoo or a candle fragrance. The system also learns a fragrance space distance and a model to predict likely success.

Since novelty is key to designing a new fragrance, the fragrance distance we learn is critical for the system to identify novel fragrances. There are many ways to achieve the same olfactory result and two formulas that share no ingredients may be indistinguishable to most people. On the other hand, two formulas that share all the same ingredients but have different dosing may smell completely different. Our distance model tries to predict which fragrance formulas people will judge to be more similar. This allows the system

to identify when a fragrance formula is not too similar to a formula already on the market.

Once the system has generated formulas, identified which are valid for the intended application and removed those that are too similar to existing formulas, we score them on likely success in the intended market. For each historical fragrance we know the intended market, which formulas were selected to send as samples, whether the sample won with the client, how well it did in consumer tests and its sales longevity. A variety of fragrance formulas with the highest scores are presented to the master perfumer for consideration.

IBM Research AI for Product Design

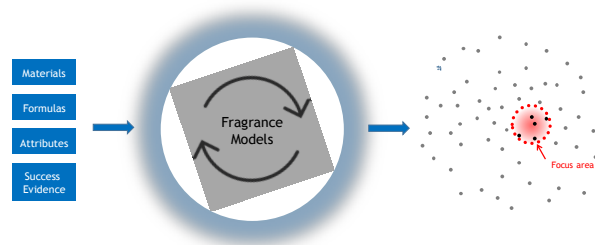*Figure 2: IBM Research AI for Product Design learns to produce fragrances based on historical product data, an inspiration set and a desired level of creativity.*

Conclusion

The first fragrance products developed with *IBM Research AI for Product Composition* will be available for retail sale in Brazil from O Boticario in May 2019.

The underlying technology can be generalized to other products such as cosmetics, flavors (Lougee 2019), detergents, adhesives, lubricants and construction materials.

Acknowledgements

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