Using AI to develop new flavor experiences

February 4 2019, by Robin Lougee

Screen shot of technology based on IBM Research AI for Product Composition used by McCormick & Company for flavor development. Credit: McCormick & Company

McCormick & Company, a pioneer in flavor and food innovation, and my team at IBM Research have created a novel AI system to help product developers more efficiently and effectively create new flavor experiences. This year, we will celebrate a milestone in our ongoing collaboration that's been four years in the making: Our first AI-enabled

retail products will be available on grocer's shelves.

McCormick & Company heard about early work at IBM using AI to pair flavors and generate recipes. They reached out to IBM Research to explore AI's potential in their environment as a leader in custom flavor and food product development. You may be familiar with McCormick & Company as the name on the label of some your favorite seasonings and flavoring products. In fact, McCormick & Company has two segments. The Consumer segment has brands globally with a retail portfolio that includes spices & herbs, recipe mixes, extracts, condiments, marinades, stocks and more. The Flavor Solutions segment has a portfolio consisting of flavorings, branded food services products, condiments, coating systems and ingredients for food manufacturers, food service operators and restaurants around the world. Our work encompasses both segments.

Flavor experience creation is a challenging domain. The science of how humans experience flavor is not well understood. It's a combination of at least three senses: smell, taste and appearance. The idea that the tongue can be mapped into four taste areas (sour, sweet, salty and bitter) has been debunked. It's just not that simple. Most scientists agree there is at least one more taste (umami) and that tasting occurs in more places than just the tongue. Every taste receptor, wherever it occurs, can detect all five tastes. There is also is a genetic component involved which helps explain why some people experience cilantro as a delightful herb, while others experience it as unpleasant.

Designing new flavor experiences is an art and science requiring many years to become proficient. There are thousands of available ingredients. The product developer must not only determine which combination of ingredients to use but also the ratio of amounts needed to meet specific targets and a host of other requirements. Even the smallest change in the amount of an ingredient can make or break a flavor. Product developers gain expertise over years of hands-on experimentation, iteratively

creating candidate formulas, manufacturing samples, running a variety of laboratory and consumer tests on the samples, and learning from the results. It is a time and resource intensive process.

Yet speed is of the essence. A significant portion of product development work in the Flavor Solution segment is responding to competitive requests; being first to respond with an innovative product/flavor is a compelling competitive advantage.

Designing new flavor experiences at McCormick is a good fit for AI technology because of the nature of the problem and the wealth of available data accumulated over decades of operations, including data on historical flavor formulas, raw material components, experimental results, consumer test results, success in the market and more. Building on previous IBM research experience using AI to pair flavors, as well as our proprietary IBM Research AI for Product Composition, we created a system that uses new and advanced machine learning algorithms to sift through hundreds of thousands of formulas and thousands of raw materials, helping to identify patterns and novel combinations that fit specific design objectives.

Our system includes algorithms that can learn and predict:

- Possible alternative raw material complements and substitutes for a formula
- Appropriate ratios of raw materials based on usage patterns
- Human response
- Novelty of system-generated flavor formulas as measured by a derived distance function (the larger the distance between a flavor formula and its nearest neighbors, the more novel the flavor formula is predicted to be)

A key part to building an AI system that is an essential tool in the daily

workflow of product developers is supporting different degrees of novelty. One size doesn't fit all. In some scenarios, the goal is to optimize a flavor formula by tweaking it to perfection. For instance, there are a multitude of flavor nuances from different vanilla beans sourced from many parts of the world. What is the best combination of vanillas to deliver the desired flavor experience?

In other scenarios, the goal is to develop truly novel flavor experience. Here, the variation or distance between ingredients (e.g. vanilla vs strawberry) is likely more significant than the choice within any one ingredient family (e.g. vanilla). Our system learns and uses a distance model to suggest desired flavor formulas.

Image of a dish being cooked using new seasoning blend from McCormick & Company that was developed with the help of AI technology from IBM Research. Credit: McCormick & Company

Because our AI system is data driven, the insights it delivers evolves as the data changes. Product developers have an overwhelming number of combinations and proportion of ingredients to choose from. They may have some go-to solutions for certain component flavor challenges. For example, because of the time sensitive nature of their work they may use their favorite "bacon" standby any time the formula calls for a bacon flavor component. Having an AI apprentice that can intelligently explore more options quickly helps them avoid using habitual standbys when evidence suggests better alternatives may exist.

Our team is delighted that products from our four-year joint effort with McCormick will be available for retail consumption with their new ONE product family launching in mid-2019. Our AI system helped the ONE product developers find solutions to flavor challenges that they weren't otherwise aware of, accelerating the time to value while achieving high ratings with consumer testers.

Based on the promising results to date, McCormick plans to roll out the AI system globally to operations in more than 20 labs in 14 countries encompassing over 500 product and flavor developers and their support staff. Meanwhile, our ongoing research collaboration with McCormick will continue to tackle more dimensions of product development and leverage previously untapped sources of data.

This is just the beginning of what's possible for IBM Research AI for Product Composition. The underlying technology can be generalized to other products such as cosmetics, fragrances, detergents, adhesives, lubricants and construction materials.

AI is becoming a practical reality in a growing number of domains, touching ever more dimensions of our lives. Since the dawn of time, humans have pursued creating new and delicious flavor experiences. The evidence of how pervasive AI tools have become may be as close as the

AI-enabled seasonings in your next meal.

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