Prospectus

Applying Intelligent Autonomous Systems to Make Breakfast Faster and Easier

(Technical Topic)

The Case of the Wonderbag: How Social Factors Influence Culinary Innovations

(STS Topic)

By

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

Currently, more than 811 million people worldwide face hunger, a state in which they struggle to obtain food security and experience terrible malnutrition due to the lack of balance in their diet (Action Against Hunger, 2021). In the United States, more than 42 million Americans experience food insecurity each year, with every single community in the country housing families that face hunger on a day-to-day basis (Feeding America, 2021). For the least fortunate in the United States, the primary reasons for hunger are financial instability and lack of sustainable food programs (Feeding America, 2021). Regardless of economic status or background though, many Americans end up experiencing hunger frequently due to poor eating habits or the inability to access nutritious food. According to a study conducted by the American Society of Nutrition, one in four Americans (approximately 26%) regularly skip meals each day, usually due to either a lack of time or lack of access to nutritional food (Brodie et al., 2020). Moreover, breakfast is the most common meal passed over by people in the United States, with 25% of adults and up to 36% of adolescents skipping this important meal (Spence, 2017). Notably, the most common reasons people skip breakfast include not having enough time to prepare meals and being bored of the same old breakfast foods ("Breakfast", 2021).

This technical project offers a convenient and less time-consuming alternative to traditional breakfast, and as such can help reduce the number of people who skip breakfast in the United States. With a significant fraction of the United States' population skipping this essential meal each day, there arises a need to make breakfast appealing for the fast-paced lifestyle of the average American. Using inexpensive computing devices, actuators, and computer vision, the process of making pancake art can be automated to create a quick, effortless, and fun breakfast. Not only does this technical project produce aesthetically pleasing pancakes for ready

consumption, the device requires minimum skill and time on the user's part, which are attractive features for the typical American looking to minimize their meal preparation time and having little to no experience with making pancake art.

Beyond the technical aspects of this project, the social and economic factors of this innovation must be examined as well. As such, the social construction of technology framework, also known as social constructivism, will be applied in a case study of the Wonderbag to analyze how it was developed and how it fills a need in the communities that use it. Since the Wonderbag is a culinary innovation that aims to meet the needs of specific communities, similarly to how this technical project will fulfill the needs of Americans looking for a convenient breakfast, analyzing it will provide insight into the design process of culinary innovations and how they are influenced by social and economic factors.

Technical Project

The process of making pancake art by hand requires a certain degree of skill, a good amount of time, and constant attention. This process consists of mixing pancake batter, filling up a squeeze bottle with said batter, carefully squeezing the batter out of the nozzle of the bottle to draw the edges of an image on a cooking surface, waiting for the edges to darken from cooking, filling the rest of the image in with batter, and then waiting for the whole thing to cook before flipping it over. Even if this process is followed faithfully step-by-step, the final outcome can wildly vary based on the artistic ability of the person and how long they cook the pancake on each side. Since the average person tends to lack the time and skill required to make adequate pancake art, it would beneficial to have a device that reduced the duration and effort of this process. The proposed technical project will use an array of electronics to construct a device that automates the process of making pancake art, involving fewer steps for the user, requiring less

time and effort, and producing culinary delights with greater artistic detail than the average human hand could produce.

Consequently, building a product that provides an easier, faster, and more fun option for breakfast offers Americans an appealing incentive to not skip this crucial meal. A survey polling 2,000 Americans found that the average person eats eggs or cereal for breakfast and drinks coffee, but that the preference for breakfast food is typically savory dishes like breakfast sandwiches and bacon, or sweet dishes like pancakes and French toast (Shoup, 2019). Given this, a clear question arises: why don't Americans eat the food they actually want to eat for breakfast? The answer is simple: breakfast foods like eggs, cereal, and coffee can be prepared in a few minutes with little effort, whereas breakfast sandwiches, bacon, French toast, and pancakes all require relatively greater preparation and cook time. In the morning, Americans are strapped for time, and they rather do what's quick and easy or pick up a grab-and-go option rather than take the time to make food they'll actually enjoy (Shoup, 2019). Thus, the proposed technical project offers the ideal solution to the fast-paced American lifestyle, allowing the user to produce aesthetically pleasing pancake art that's ready to eat within minutes.

This technical project will essentially function using the same basic elements a three-dimensional printer uses: an electrical motor carriage system for moving the printer nozzle, embedded processors for image processing and coordinate conversion, and a digital platform for uploading images to print. The planned pipeline for this device involves four basic stages: image uploading, image processing, coordinate conversion, and pancake printing. The user will first upload an image to the printer using an intuitive mobile application on their phone. A Raspberry Pi will host a web server to receive the transmitted image, and then image processing techniques will be used to detect the edges and colors present in the image. Next, the edges will be

converted into steps of coordinates, which will then be transmitted using the UART communication protocol to a MSP432 microcontroller that will interpret the coordinates as instructions for stepper motors that move the printing nozzle along the x and y axes. Then the stepper motors will move the printing nozzle along the appropriate path to recreate the uploaded image, using a peristaltic pump connected to a tank of pancake batter to push batter out the nozzle onto a cooking griddle at a consistent rate. Once the pancake art is done cooking, the device will beep to indicate to the user that the pancake is ready to be flipped, and then the pancake is ready for consumption once the other side is done cooking. The only steps the user will have to take are to fill up the plastic tank with pancake batter, upload the image to the printer using the app, and then flip the pancake a few minutes later. A simplified visual of the planned device pipeline can be seen in Figure 1. Overall, this technical project is an ideal candidate for an electrical and computer engineering project, as it demands knowledge and experience with application development, computer vision, embedded programming, and analog design, which are all at the core of the ECE curriculum.

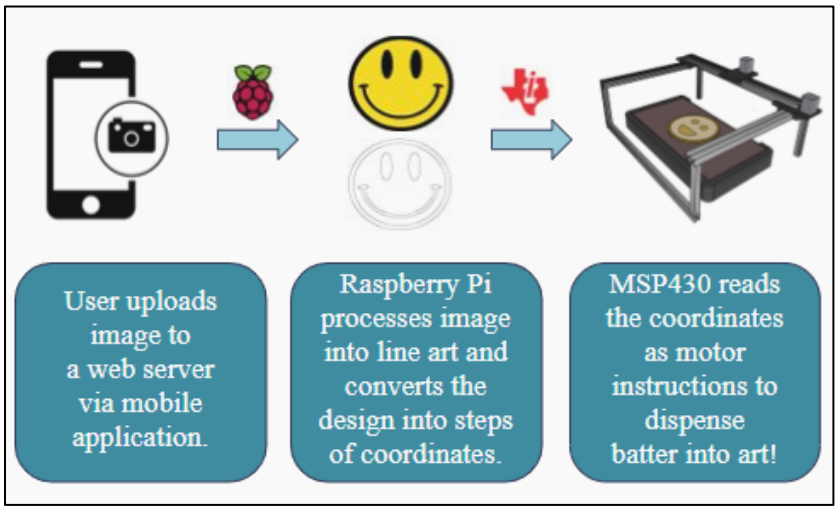

Figure 1: Simplified Pipeline for Pancake Printer

STS Project

The proposed technical project will need to fit the desires of modern American consumers who are looking to create fast, easy, and fun pancakes, and as such the social and ethical factors that will affect the development of this kind of product must be analyzed. In 2008, the entire region of South Africa was experiencing frequent power outages, which affected the citizens' ability to prepare safe food and drinking water. Wanting to provide a solution to this urgent issue, social activist and entrepreneur Sarah Collins invented the Wonderbag, a general-purpose culinary innovation designed to cook food without the need of electricity (Wonderbag, 2021). Collins, who was raised in Africa, was inspired by the way her grandmother used to wrap cushions around her pans after taking them off of the stove, and realized she could use the same principle of heat retention cooking to slow cook food without a constant heat source for hours at a time (Knutson, 2019). Essentially, the Wonderbag is a large bag woven out of material with low thermal conductivity, where the bag traps the heat from any container placed inside to continue cooking the food inside the container like a slow cooker or crockpot would. In an interview regarding the story behind the Wonderbag, Collins admits she originally began developing the product with the intention to reduce the amount of indoor air pollution in the African home due to the smoke produced from cooking with fire for a prolonged period of time (Wonderbag World, 2015). It was not until she introduced the Wonderbag to African users that she realized the profound social, economic, and environmental impacts her innovation could have. As Collins received feedback from the great deal of African women who used her product, she altered the design of the bag to use more sustainable resources and be lighter for travel. Certainly, the design of the Wonderbag was heavily influenced by the community of users for which this culinary innovation fulfilled the needs of.

In this project, I propose that the development of the Wonderbag, a culinary innovation designed for a specific community of users, was heavily influenced by the social and economic factors of the community that adopted it. The framework of social constructivism will be applied to a case study of the Wonderbag to provide evidence for this claim. The fundamental principles of this framework assert that technology does not develop independently from society but instead is shaped by human interests and needs, and as such it is typically utilized to demonstrate how technology is shaped by society and its users (Johnson, n.d.). This framework opposes the tenets of technological determinism, which asserts that technology does in fact develop independently from society and shapes social and political factors upon popular adoption instead. The analysis of the Wonderbag from the lens of social constructivism will help provide a better understanding of how social factors affect the development of culinary innovations such as the proposed technical project. Corresponding evidence and data regarding the Wonderbag will be used to consider how the product was adapted to the average African consumer, similarly to how the proposed technical project may be influenced by the average American consumer.

Conclusion

In short, this project as a whole will offer a potential solution to the dilemma of Americans skipping breakfast, while also taking the time to analyze how the development of other culinary innovations were shaped by the needs of the community that adopted them. The proposed technical project will use actuators and computing devices to produce an automatic pancake printer capable of producing artistic culinary delights within minutes, saving the user time and effort in their morning meal. The proposed STS project will use the social construction of technology framework, also known as social constructivism, to analyze a case study of the Wonderbag invention in order to understand how the human needs and social factors of a user

base can influence the design of culinary innovations. Through a proper understanding of how the proposed culinary innovation will function from a technical aspect and be influenced by social factors, we can achieve a design for this product that will allow it to achieve optimal functionality and impact for the greater good of the community. At the end of the day, no technology can be truly understood from solely a technological or social perspective: it takes both to understand how to make our innovations truly change the world as engineers.

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