Taco Box

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ABSTRACT

Our prototype aims to represent a potential commercial endeavor, an autonomous taco truck in a box offering different types or courses of tacos for different moods and times of day. Complete with a tortilla cart, our fun and visually appealing rail system in a box will send a tortilla through the multiple stages of tortilla assembly. The machine dispenses various ingredients, like proteins, vegetables, salsas and sauces, and serves them directly to the customer in a pre-folded tortilla shell. A small ordering kiosk would accompany our prototype so that potential customers could choose the ingredients being put into their taco, or indicate a need for extra or the removal of an item. The current build for the Taco Box allows for four solid ingredients and one liquid ingredient, but with minor changes to the Taco Box's physical design and the possible future addition of an automated food preparation system, the number and ratio of solid and liquid ingredients can change drastically to fit a much wider variety of ingredient flavors and taco styles.

INTRODUCTION

Casual, cheap, and quick. For many, this is the ideal for food. Delicious street snacks, especially tacos, are often served from food trucks or sidewalk stands for the sake of convenience and saving time, and when served in restaurants, they can reach high costs and lose their appeal as cheap, quick eats. Since rapid prototyping champions utilizing cutting-edge innovation and design in accessible formats, the automation of a complete dining experience to serve tacos, a popular, easy-to-assemble food, allows us to think about the role of the chef in the preparation of the food.

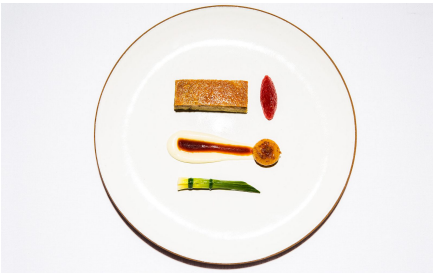

Image 1. Example of a fancy meal being artistically placed onto an expensive plate by another person.

In these street food contexts, and even in some commercial restaurant contexts (like Chipotle), it is part of the dining experience to be able to watch your food being assembled. We thought that allowing the customer to see the making of their food would be the perfect way to bridge the gap between our robotic chef machine and a regular chef. While something may be lost in the experience of receiving food from a robot rather than from the hands of a person, something may be gained in how novel, intricate, and smoothly the robot operates. With this design, not only do we create a unique dining experience where production costs drop and efficiency increases, we also change the experience of ordering and eating a food typically made and served in public, social experiences.

RELATED WORK

While there have been many food related projects similar to The Taco Box, The Taco Box fulfills a niche of personal, taco creating machines that has not been done by a competing machine. Similar Products are either Prepared Food Dispensers, which contain premade meals that are distributed. Prepared Food Dispensers give users less agency over the meal they get from the machine. Another similar product archetype is the Fully Automated Restaurant. The major difference between The Taco Box and a Fully Automated Restaurant is that The Taco Box is the demographic the product is attempting to reach. Fully Automated Restaurants are intended as an alternative to traditional restaurants, which attempt to cut out a human chef and staff in place of a series of devices. They look to automate the full order to plate process. The Taco Box however seeks to reach a smaller more personal audience, and streamline the assembly process. The Taco Box does not seek to replace restaurants. The last similar product type are other Personal Food Preparation Devices. These devices are intended to assemble foods for smaller audiences, but none of these devices create tacos.

Prepared Food Dispensers

Pizza Vending Machine

This device houses up to 70 ready-to-eat pizzas. It can heat up the food or dispense the food cold, depending on what option the user chooses, and uses a vending-machine like mechanism to retrieve the food from a designated slot.

Although the process of serving the food is similarly automated to our design, our prototype emphasizes live assembly of the food in front of the user. [1]

Full Automated Restaurants

Spyce

Spyce has automated a full restaurant and can serve a variety of salads and mixed cooked foods. While Spyce is designed to be used for a full sit-down restaurant, the Taco Box hopes to reach an audience interested in faster grab and go food. [2]

Eatsa

Eatsa was similar to Spyce in that it was intended to be a fully automated restaurant that made fast casual food. While this is closer to the Taco Box thematically than Spyce, Taco Box does not intend to target restaurant goers, and looks to serve smaller audiences faster. [6]

Taco Bell Taco Maker

Designed by Taco Bell to automate and speed up the Taco Making process, this serves as proof that taco making machines work. Our design is not intended for restaurant or mass production use, but looks to serve at a smaller and more personal level. [3]

Personal Food Preppers

Automatic Tortilla Maker

Creates taco tortillas which are then hand topped. The Taco Box intends to automate the other half of the process, preparing the rest of the taco from preset ingredients. [7]

Burger Conveyor Belt

Dispenses and builds a burger for a user with user specified toppings. This device is more precise than the Taco Box, as ingredients are placed in specific locations on the plate. However, the Burger Conveyor Belt is also large and clunky, and takes up more space than the Taco Box. While the Burger Conveyor Belt takes up a full wall from table to ceiling, the Taco Box is intended to be more compact. [4]

Kolice Automatic Donut Making Machine

In addition to making a different food, the Kolice Automatic Donut Making Machine pours ingredients into a mold that then gets fried and dispensed. Our ingredients would have to be pre-cooked, but would have a greater variety in choices for what can and will be dispensed. The Taco Box will also have the capability to make a full meal, which the Kolice Auto Donut Making Machine lacks. [5]

Smart Barusa

While the nozzle system to dispense drinks will be similar to the systems the Taco Box uses to dispense fluidic components of tacos (i.e. salsa), the Smart Barusa dispenser exclusively deals with liquids. The Smart Barusa also assembles the drink internally and pours only the finished product. On the other hand, Taco Box will make the taco in front of users. We hope that watching the taco preparation will be part of the fun of using the Taco Box. [8]

SYSTEM DESIGN

Overview

The Taco Box itself contains the following major components: the taco cart and its rail system, the tortilla presser, four ingredient dispensing drums, and the sauce nozzle. Each of these components is encased inside a clear acrylic box so that customers can watch their taco be constructed in front of them, while the ordering kiosk is placed on the table next to the acrylic box.

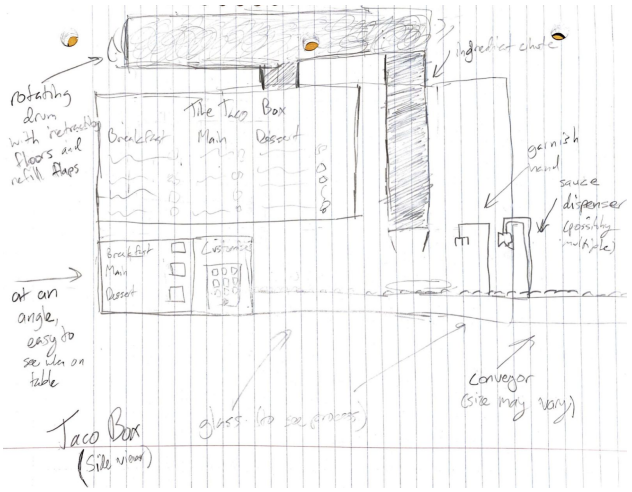

Figure 1. An illustrated version of an early ideation of the Tac Box with several prototyped components.

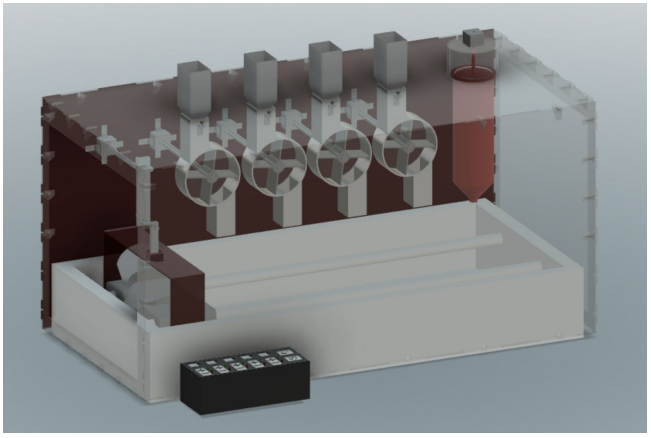

Image 2. This image contains the model of the Taco Box in its final prototyped form. Involved is a rail cart system, rotating drums, a sauce squeezer, and an ordering kiosk.

Tortilla Presser

When the Taco is initially placed into the Taco Box and the machine starts, a pusher will slowly move down onto the taco to shape the taco into a U shape. This allows dropped food to be rest at the bottom of the taco and lowers the risk of food falling out. This, combined with the shape of the Taco Cart is our primary way of ensuring that food stays in the taco.

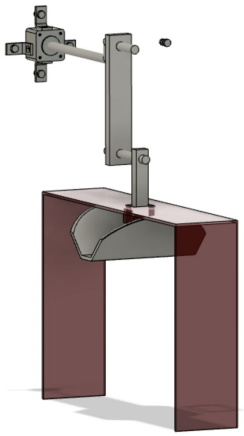

Image 3. The tortilla presser is leveraged by a motor that rotates and pushes the presser onto the taco holder when it is directly above the taco cart.

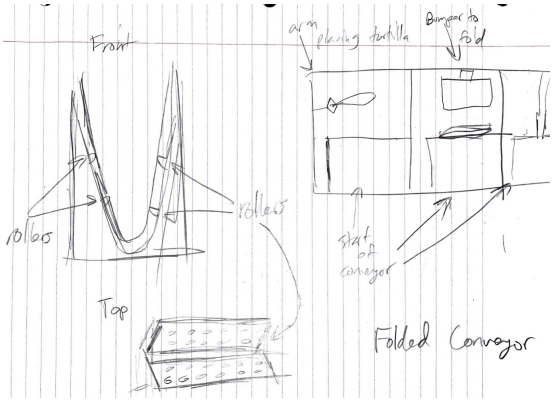

Figure 2. This figure displays several designed ideas of folding the tortilla into the desired shape of a taco.

Methods to Keep Ingredients Inside the Taco

Since taco ingredients are messy, loose, and saucy, we need a way to best keep ingredients inside the tortilla, if possible. We considered the design options of (1) Bumpers on each side of preliminary taco bowl: This design features four bumper plates at a tilt, gently forcing the tortilla into a makeshift bowl as it travels across the conveyor (2) Bumpers around tortilla (if flat): If the tortilla remains flat, bumper plates on all sides of the tortilla help to contain ingredients. (3) Bumpers around the pre-folded tortilla: assuming the taco is folded before entering the conveyor, this design only needs two bumper plates for the ends of the taco, so ingredients don't spill from the lower sides. We decided to go with our third option for our final prototype design.

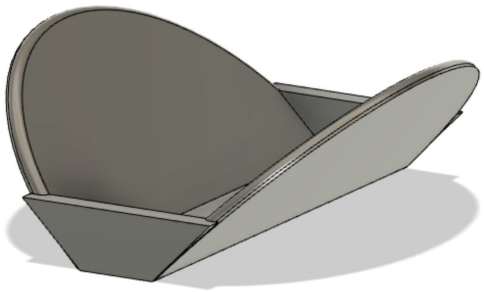

Image 4. The taco holder that is shaped at the precise angles to keep the ingredients inside of the taco while maintaining the shape of the taco.

Conveyor Belt System

The process of moving the taco through various stages means some sort of conveyor, progressor, or pushing system is needed. We considered (1) Rolling wheels: conveyor belt consists of rollers/wheels, on top of which the tortilla rolls along. Would be difficult to clean/lots of materials used / lots of mechanization (2) Moving surface: a large belt surface moves the tacos, which would make for smooth and continuous movement (3) Flipping pieces to propel forward: this design attaches flippable plates to push tacos forward, the belt itself doesn't move. Overall, this mechanism can either be a continuous rolling belt, or it could be one flat surface that moves back/forth and resets between foods. The final version of the conveyor belt that was decided upon was a rail system with a cart that is levitated through two bars on each side, as seen in Figures 1 and 2 below. The bars would support the weight of the taco while being carried through by the cart which has DC motors connected underneath it to move the cart along the rail system.

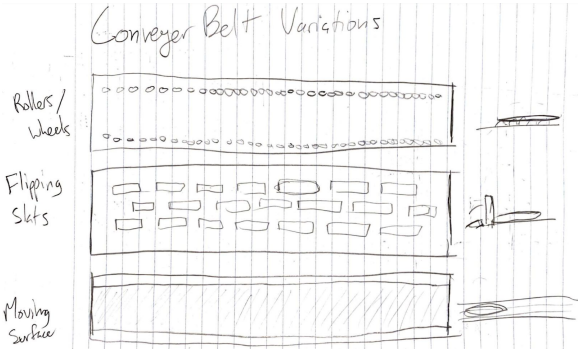

Figure 3. This figure demonstrates different variations of implementing a conveyor belt.

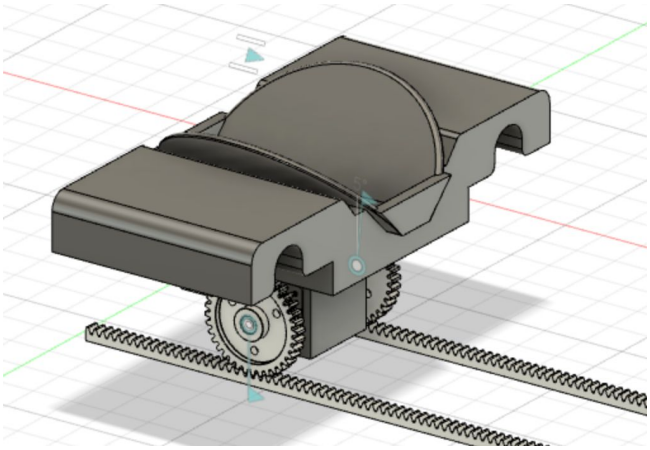

Image 3. The final cart and combined with the taco holder on top. The gears at the bottom being controlled by motors are combined with a rail system to move the cart forward.

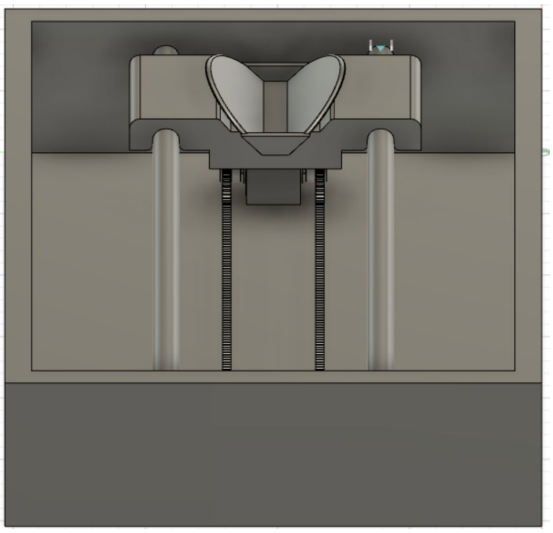

Image 4. The cart system being placed onto the base, levied by the control of the bars on the side of the cart.

Different Mechanisms for Switching Ingredients

Since our design involves giving users choice between different ingredients, we need responsive mechanisms to switch between whatever options they choose. Design wise, we considered: (1) Precise pivoting arms: with multiple arms attached to one pivot point, each arm has a different ingredient container attached to it and when selected, rotates into position to release ingredients. (2) Trapdoor dropper with rotating drum on top: in this design, multiple ingredient cups are attached to a rotating trapdoor module that blocks all other cups from releasing ingredients other than the one selected. (3) Sauce nozzle(s): sauces are contained in tubes/nozzles and the nozzles become unblocked when the respective sauce is selected. (4) Scooper/ spoon arm: scooping arms locate correct ingredient bins, perform a scooping maneuver, and unscoop to release onto tortilla (5) Claw machine grabber arm: useful for dry/dense ingredients such as cheese, meat, or onions, this mechanism performs a contracting grab to scoop some ingredients from containers and release them onto the tortilla.

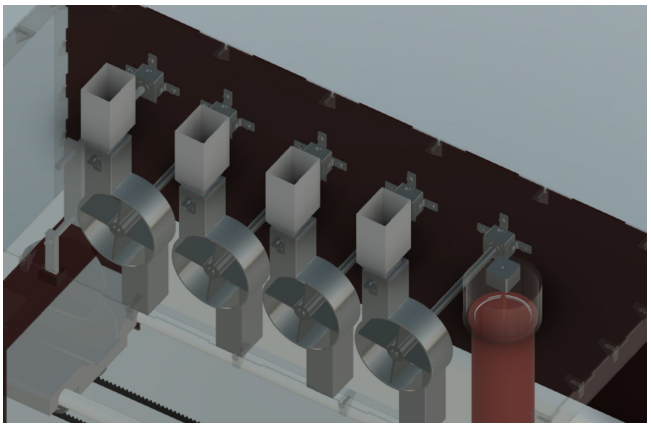

Image 5. The four rotating drums contain different unique ingredients that will be distributed to each taco equally. A sauce squeezer is at the end of the belt to squeeze your favorite sauce onto the taco!

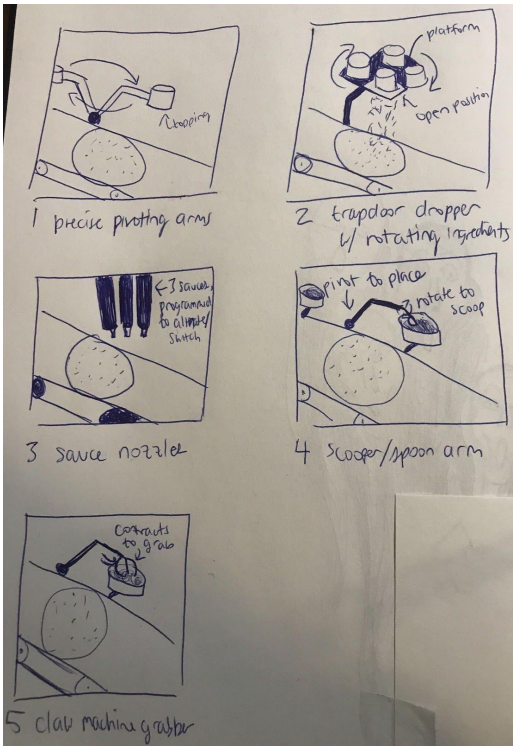

Figure 4. These pictures demonstrate the different designed methods of distributing ingredients onto the tortilla roll. 4.1 illustrates pivoting arms while 4.4 and 4.5 shows a similar arm mechanism but with a scooper. 4.2 is a raised platform with a trapdoor. 4.3 is a sauce nozzle to squeeze sauce.

Ordering Kiosk

The final element of the system design is an ordering kiosk. This kiosk is the user interactivity component of the Taco Box, empowering the user to decide which and how many of each toppings they would like to include in their taco. The kiosk enables the user to remove or add double of each topping and sauce, with a green or red light next to a picture of each topping to give the user feedback of what their current order looks like. After deciding their order, the user then presses an accept button (or decline button if they would like to reset their order) which would thus begin the process of making the taco right in front of their eyes.

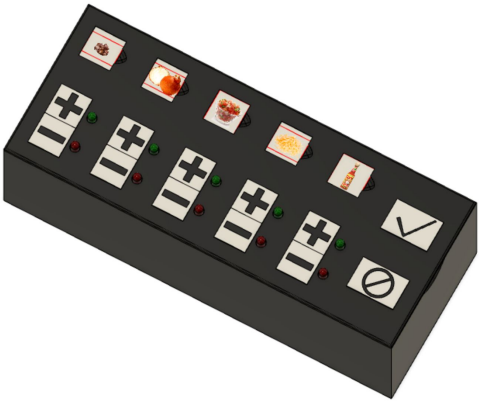

Image 6. This is the prototyped version of the working kiosk. It has many buttons and LEDs to indicate how many of each toppings has been selected for the current order.

Courses

Our current build of the taco box is designed to be able to support a variety of potential courses depending on which food is placed into the holder above the drums. With slight modifications to the design, like extending it and adding additional drums or swapping out drums for squeezers, a larger variety of meals can be created. Below are some potential courses with the design of four drums and one squeezer.

Breakfast

- Meat
  - Chorizo (drum)
  - Bacon (drum)
- Eggs (drum)
- Mixed Veggies (drum)
- Hot Sauce (squeezer)

Main

- Meat
  - Steak (drum)
  - Chicken (drum)
- Diced Onion (drum)
- Chopped Lettuce (drum)
- Salsa (squeezer)

Dessert

- Banana slices (drum)
- Mini Marshmallows (drum)
- Brownie chunks (drum)
- Strawberries (drum)
- Chocolate Syrup (squeezer)

All of these sample meals are supported by the current build of the Taco Box. However, users will be able to decide for themselves the makeup of the taco they want to make.

DISCUSSION AND FUTURE WORK

While the overall design of the Taco Box has not changed much from the initial design, there are a few potential changes that could create a better and more fully automated Taco Box. One of the few components that did not make this design build was a garnish arm. The garnish arm was going to add a small amount of spice at the end of the taco, and open up the ability to add additional ingredients to the Taco, like cilantro or other herbs.

Another change to the Taco Box that could increase its utility would be to make small adjustments to the components to allow the parts to be modular. The current build is locked at four solids and a liquid ingredient. If we designed the drums and the squeezer to be removable. replaceable, and fit in the same locations, the Taco Box would be able to handle a larger combination of potential Taco Ingredients. This could be further facilitated by increasing the length of the Taco Box to accommodate more squeezers and drums. However, this would also require redesigning the ordering kiosk both to accommodate empty parts and to allow for more dynamic portion controls.

One thing that would be admittedly hard to address in a completely autonomous implementation of this design would be cooking the food, and keeping it at its safe resting temperature for consumption. This means not only will we need a system that cooks our meats and veggies to the exact same degree consistently, but that they then stay at that temperature until serving so as to not be unsafe legally. This is one of the biggest concerns we had with this overall concept design, which is why we felt that tackling the assembly experience would be more fruitful and reasonable for our project and those who might want to work forward on this concept in the future can tackle the added challenge of cooking, heating and refrigerating and thawing food safely, and extruding them successfully and cleanly. Since this process would take up much more space, I would guess that the design, if taken to these extremes, would begin to resemble many of the entries in our related work section, like the Pizza ATM.

Finally, any implementation of the Taco Box would require the inclusion of sanitation equipment on the inside, such as

a lining to keep the food from touching the hardware. While this part likely would not be 3d printed, it is crucial for the functionality of the Taco Box. With this in mind, some slight modifications to each component may have to be made when it is printed to allow this lining to be more easily added and removed.

CONCLUSION

The Taco Box hopes to provide a unique dining experience to customers by crafting delicious tacos in front of them for a fraction of the price one might pay for them in a retail establishment, but with a similar overall experience. Our final design is semi-portable and with the right materials should be durable. It could function as either a static placement on a University or Workplace campus that gets regularly serviced and refilled, or as something that gets assembled in preparation for a party or other gathering (with the assistance of some non-robotic sous-chefs). We believe that the Taco Box could be a fun fixture for any crowd to be engrossed in.

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