# Poster: PizzaBox: Studying Physical Object Manipulation based Fast Food Ordering

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## ABSTRACT

This paper presents the designing and evaluation of PizzaBox, a 3D printed, tangible food ordering system that aims to differ from conventional food ordering systems and provide an unique experience when ordering a pizza by incorporating underlying technologies that support ubiquitous computing. The PizzaBox has gone through both low and medium fidelity testing while working collaboratively with participants to co-design and refine a product that is approachable to all age groups while maintaining a simple process for ordering food from start to finish. We utilised this artefact to conduct an user study at an independent pizzeria to uncover potential opportunities. We present two of the main themes identified through the discussions: 1) end user engagement (from entertainment to education), and 2) healthy eating and living. We found that our approach could potentially utilise towards promoting a healthier lifestyle as well as an educational tool.

## CCS CONCEPTS

• **Human-centered computing → Empirical studies in ubiquitous and mobile computing**.

## KEYWORDS

Internet Connected Objects, Physical Objects Interaction, Human-Food Interaction

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## 1 INTRODUCTION

*Can we help people who have difficulties in use a mobile app or a browser to order pizza? What are the challenges and opportunities it offers ?* With the increase in Internet of Things (IoT) devices entering our daily lives in the form of smart home devices such as plugs, thermometers and speakers people are now becoming more accustom to seeing and using these interactive devices. In our work, we look at how IoT technologies could be used to develop new ways in which pizza ordering can be accomplished. The lessons we learnt are applicable to other types of food as well.

Our work lies at the intersection of food ordering, tangible objects, tabletop designs, and connected devices. Based on the framework proposed by [1], our work focus more on exploring individual experiences while supporting personal needs. Further, we focuses on the task of *'food ordering'* and opportunities the artefact (i.e., PizzaBox) provides as a by product of facilitating the task. Apart from the more commonly known website and smartphone application ordering systems, Dominoes now provide the availability to order pizza over Google or Amazons digital assistants, Google Home and Amazon Alexa respectively [5], as well as branching into in-car systems and allow Ford vehicles with *'Ford Sync'* to order a pizza while driving (anyware.dominos.com).

PizzaHut [6] concept shows each customer interacting with the tabletop system which encourages new social cues for discussion based on what each customer would like on their pizza or vice versa. As the tabletop system also allows for each person to interact and add their own touch to the final order it provides a sense of involvement in the order process which isn't found when simply interacting with a pizzeria employee or through mobile or web systems. In 2016 [4], McDonalds introduced interactive food ordering systems into their restaurants which consisted of touch screen devices which allowed customers to order their food instead of waiting in line to speak to a cashier. It was found that families and groups have been the biggest users of this system.

Our work has been inspired by [2], where we explore the breadth and complexity of fast food ordering behaviour which presents significant challenges towards designing meaningful artefacts that augments and supports community needs, especially across different demographics groups.

## 2 DESIGNING CONNECTED PIZZABOX

### Methodology

In high-level, we conducted three rounds of focus groups studies that involved co-design activities. The full details of the methodology, results, and discussions are presented in [3]. Study 1 utilized low prototyping techniques (Figure 1) where study 2 utilised medium-fidelity (Figure 2). In study 3, we evaluated our high-fidelity prototype (Figure 3). After gaining approval from University Ethics Committee, we used an open local university wide mailing list to recruit 5 groups of 3 participants (each) (Two groups from a STEM subject, and two groups from a non-STEM subject). The last group consisted of adults in full-time work. Due to ethical reasons, participation was not open to anyone under the age of 18. Each focus group was recorded, both audio and video for further analysis of feedback and how the prototype was used.

### Study 1: Low Fidelity Prototyping

For each group, we first explained in detail what our project entailed and then asked them to work together and sketch out their own idea for a prototype to fulfil the goal of our project. The idea behind this was to find common elements that each of the groups came up with and whether those common elements appeared in our own prototypes or the opposite if they didn't appear in our prototypes then we could consider a possible design change. Each group received a questionnaire to fill in and forms for leaving feedback on each of the prototypes that they will be shown.

**Figure 1: Participants engaging with a prototype in round one. Use of the prototype was unguided to understand how intuitive and easy to use the prototype was.**

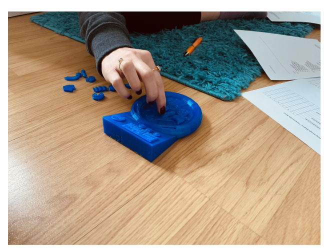
In this study, each group was provided with set tasks to complete while using four different prototype (shown in Figure 1). Each task contained 6 to 8 steps and aimed to utilise as many of the features of the prototype as possible. **Task 1:** Could you order me a tomato base pizza medium onion mushroom beef / cheese stuffed crust? **Task 2:** Could you order me BBQ base large pineapple sweetcorn and chicken? **Task 3:** Could you order me tomato base medium pineapple chilly and pepper? **Task 4:** Could you order a pizza of your own?

After designing their own prototype, we then moved on to show each of our own four low fidelity prototypes and without explanation of how the prototype was intended to be used, we asked the participants complete tasks laid out in the scenario that we discussed in the previous subsection. Throughout each prototype, we constantly engaged with the participants to keep them thinking aloud and expressing their thoughts and opinions. Using the think-aloud method encouraged the participants to point out features that the prototype was lacking.

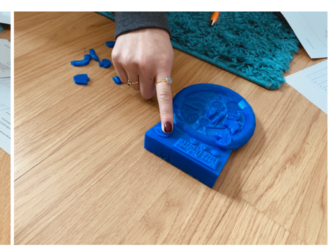
### Study 2: Medium Fidelity Prototyping

After the completion of the low fidelity stage of prototyping and analysis of the results from the Likert scale questions as well as the feedback received for each of the four prototypes, we decided on two prototypes that were to be taken forward and turned into a 3D model to then be used in the medium fidelity tests.

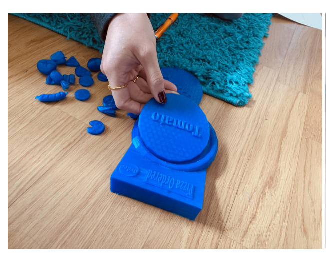
From the data collected from study 1, slight alterations were made to the prototypes that we presented to the participants in study 2. The first alteration was the addition to control the cheese topping as this was the main bit of negative feedback we received from the first study. Second was to make the feature of adding stuffed crest options easier to understand by using 3D printed ingredients that slot directly into the crust of the pizza prototype. We hoped this would remove the ambiguity of the original design of having yellow or brown hexagon shapes to represent cheese and sausage stuffed crust option that just slotted into the crest section of the prototype.



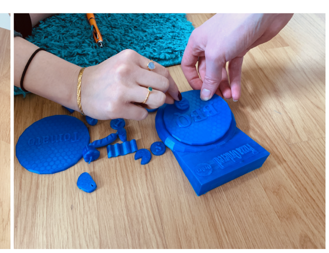
(a) Participant adding an ingredient to the prototype.



(b) Participant completing a task by pressing the order button.



(c) Participant adding an ingredient to the prototype.



(d) Participants working together to complete a task.

**Figure 2: Participants engaging with the prototype during the study 2 medium fidelity tests.**

For the medium fidelity testing stage, we still encouraged participants to give feedback on the design but our main focus of this iteration of tests was to look at the ergonomics and aesthetics of the prototype. We asked the same Likert scale questions as the low fidelity tests as well as added questions that related to the size of the prototype overall, the size of ingredient parts, the logical layout of the product and how easy components were to recognise. As the idea behind the product was to make ordering a pizza fun and unique experience, having small or awkward components that caused frustration, for example, would negatively affect the experience for the user. The medium fidelity prototyping evaluations were conducted under similar conditions, with same group of participants as the low fidelity tests.

***Prototyping PizzaBox:*** As detailed in [3], the hardware that we have chosen to use in this project attempts to remain true to the low-cost ethos. Arduino Uno, and LCD screen, SparkFun Simultaneous RFID Tag Reader, and RFID tages were used to build the prototype.

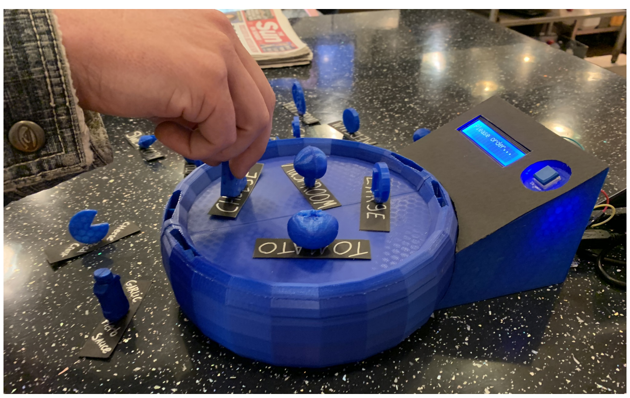



**Figure 3: Participant placing 3D printed ingredients onto the base of the PizzaBox before pressing the order button.**

## 3 EVALUATION

The evaluation (study 3) was conducted in a local independent pizzeria and so participants were recruited upon visitation of the pizzeria. As participants were customers of the store, the demographics of each customer varied slightly with the majority of participants being 40 years of age plus with a mix of genders. Participants were asked if they would like to take part in the test and if they agreed a simple explanation of what the project entailed was given as well as explaining that any information shared with us remains anonymous and no data could be linked back to the participant. In this paper, we refer to participants as C1 (Male, 21-30 years old), C2 (Female, 21-30 years old), C3 (Male, 41-50 years old), C4 (Female, 41-50 years old), C5 (Male, 41-50 years old). Participants under the age of 18 were not asked to participate unless accompanied by their parent or guardian. Participants were then asked questions from a question pool that we felt were applicable to the individual. As we were based in a local pizzeria the owner (and sole worker) also agreed to participate in the evaluation test to be able to give a different perspective. We refer to the pizzeria owner as P1 (Female, 41 - 50 years old).

The scenarios were not pre-planned like the previous low and medium fidelity testing but were based on what the customer had recently ordered from the pizzeria. Each participant that was willing to take part in using the PizzaBox and answering questions based on their experience was simply asked to order the same pizza or similar based on what ingredients we had available, that they ordered with the pizzeria employee. This was agreed to be the best way to evaluate the PizzaBox as it gave the customer the ability to easily compare their experiences of ordering face to face with the pizza maker and then with the PizzaBox. It also gave an easy introduction into how using the PizzaBox could affect their choice of food order as they're able to see the ingredients they ordered making questions regarding eating habits easier to think about for the participant.

## 4 DISCUSSION AND FUTURE DIRECTIONS

### End User Engagement: Entertainment to Education

***Nutritional Education:*** Overall, most customers that participated saw a greater appeal to a younger audience as the PizzaBox provided an entertainment value that would be more attractive to a lower age range. A conversation with the pizzeria owner introduced a new concept that we had not thought about when initially coming up with the PizzaBox concept and considering the use cases for the PizzaBox. She pointed out the idea of educational interactivity where we could enhance our approach towards introducing children to where meat products such as beef or ham come from and their impact on environment and society.

P1: *"I was surprised to read that children often don't know that beef comes from a cow or ham comes from a pig, at least with this system they can see the animal and relate that to the food that is being put on their pizza providing a learning experience without them really knowing it."*

C1, being one of the younger customers that we interviewed being within the 20 - 30 years bracket, expressed that their older family members are not knowledgeable about current technologies like smartphones/tablets to use food ordering applications or laptops to be able to use a browser to order their food and so an intuitive ordering system like the PizzaBox would appeal to them.

C1: *"Being a simple system for anyone, including my grandparents that try and avoid all sorts of technology, means they will probably give it shot [if it was presented to them]"*

***Supporting Special Needs:*** While on topic of appealing to an older generation, C3 expressed a different angle for the appeal of the PizzaBox explaining that many of the older populous, including their own family, suffer from medical conditions such as communication problems, hard of hearing or physical disabilities that make it difficult for them to use conventional ordering systems and that the PizzaBox would allow them to easily make a food order without having to be anxious or nervous about approaching a pizzeria waitress. These views reinforce the point that our system would be able to target an audience that suffers from medical conditions such as Parkinson's disease.

### Healthy Eating and Living

***Healthy Options:*** It's well known that pizzas are generally an unhealthy food option, so this theme looks at how the PizzaBox in the future could be used to introduce healthier food choices and habits for the consumer. Based on the current version we discussed with customers based on their promote that they had with the PizzaBox would they alter their choice of toppings or reduce the number of unhealthy options they chose. C1 expressed that being able to see the ingredients available to them gave them a greater choice and would be more likely to pick a different option than their normal choice of a heavy meat-based pizza.

C1 - *"Be able to see more options would encourage me to pick something else than the usual meat feast I go for, although might not be a healthier option but I would be more likely to consider it."*

***Ingredients Awareness:*** Expanding on that view, C4 expressed that actually seeing the ingredients would alter their choice as being able to see the food and the quantity that is being added to the PizzaBox gave the customer a sense that they are adding an unneeded quantity of food and so they would be more willing to take off an ingredient.

**Visual Calorie Counter:** A popular opinion across most of the customers was a display on the screen of a total calorie count of each ingredient that was on the PizzaBox. Another popular idea that came up was using a traffic light LED system that represented low to high-calorie content as well as being able to warn people easily of allergens in the food that they are ordering. The pizzeria owner explained that allergens can be deadly to some customers so a clear warning must be in place when creating a new ordering system and that an amber warning on the lights and a message on the display would be greatly beneficial to customers that have an allergic reaction to certain foods. Each of the customers agreed that these features would make them more likely to change to healthier options.

C1 had a similar idea that sections of the pizza representing fat, salt etc. would light up to show that there is a high content of that nutritional value in the pizza, essentially providing the customer with a greater break down of nutritional values in the pizza that's created. C2 described themselves as being health conscious, (They also explained they were on a cheat day meaning they can eat what they want for the day hence being in pizzeria) and use an app called *'MyFitnessPal'* to input data on food they had consumed that day to help them with gym progression and that integration into these popular health apps would benefit them greatly.

***Enforcement and Safety:*** The discussion of new features for a healthier choice of eating also introduced the idea of being able to add limitations or restrictions to certain aspects of the pizza ordering process e.g. ingredients, quantity or the amount of calories/salt etc. As this does not help to aid a healthier choice but more along the lines of enforcing a healthier choice, we discussed use cases with the customers that could take advantage of this feature. C3 presented the idea that the restriction implementation could be useful to avoid accidental ordering of food that are disliked or are against dietary choices e.g. vegans, vegetarians etc. or that customers avoid due to religious views e.g. Halal diet.

Another interesting suggestion from C3 was that a spouse / parent / friend would be able to set a limitation to how many calories etc. you are able to order per pizza. This would help in making sure children don't order a pizza that a parent deems too unhealthy or it could help with aiding a partner or spouse loose weight by taking away the opportunity to order an unhealthy pizza (or repetitive behaviour). C4 also presented an idea that the restrictions feature would be a popular feature for customers with allergens as they can block any transaction which included an item that would induce an allergic reaction.

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