

JobSeekr
(Technical Report)

softwareEngineers — Socially Distanced Dispenser
(Technical Report)

Researching the Rise and Consequences of Food Delivery Services
(STS Topic)

A Thesis Prospectus in STS 4500
Presented to the Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia
In Partial Fulfillment of the Requirements of the Degree
Bachelor of Science in Computer Engineering
In Partial Fulfillment of the Requirements of the Degree
Bachelor of Science in Computer Science

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December 02, 2020

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On my honor as a University Student, I have neither given nor received unauthorized aid
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Introduction

SARS-CoV-2, the virus behind COVID-19, has caused a worldwide pandemic. Since its first report on December 31, 2019, the virus has killed over one million people worldwide and has had an effect on every aspect of human life as we know it (Nicola et al., 2020). The Centers for Disease Control and Prevention (CDC, 2020) reports that this virus produces symptoms including coughing, and that the virus spreads through respiratory droplets or small particles produced when an infected person coughs, sneezes, sings, talks, or breathes. These droplets can be inhaled, which is the main way the virus spreads, but they can also land on surfaces and objects and be transferred by touch. This raises many pressing concerns, such as how careful we have to be around other humans as well as touching surfaces previously touched by others. Avoiding coming into contact with shared surfaces can be simple in some aspects, but more difficult and tedious in others, such as food. With a global pandemic looming over nearly every establishment, how do people keep themselves safe?

To mitigate the risk coronavirus poses, many people look to guidelines from official sources. With respect to restaurants and bars for example, the CDC states the lowest risk for food services are drive-through, delivery, take-out, and curbside pickup (“Considerations for Restaurants and Bars,” 2019). To facilitate these methods, companies and consumers alike have developed a more pressing need for virtual platforms. “Panic-buying and fear of contagion are driving many consumers to download apps for groceries and meals during the coronavirus crisis” (Dishman, 2020). According to a survey done on grocery shopping during the pandemic, 35% of United States (US) consumers in June 2020 used online grocery delivery services, an astonishing three times more than in August 2019 (Bishop, 2020). We also see a rise in popularity of food delivery services. One such service is Grubhub, an online and mobile food ordering platform that

connects users to restaurants. According to Grubhub's quarterly reports, from the second quarter of 2019 to the second quarter of 2020, they have seen an increase of 35% in number of active diners, which interestingly enough is the same increase as the number of US consumers using online grocery services.

To combat one of the big risks of contagion, the technical project focuses on eliminating shared points of contact for public food dispensing machines, specifically, machines that dispense dry food, such as rice or beans in grocery stores or cereal in dining halls. Currently, users of dispensary machines must physically touch the same surface as every other user. The technical project encompasses a physical dispenser with a motor attached. This motor is controlled by a microcontroller, which receives instructions from a Bluetooth module component. These physical components are encased in a 3-D printed enclosure connected to the food container. This dispenser will have a platform for the consumer to place their personal bowl or other container. The user will be able to connect to the dispenser through a Bluetooth connection from an app on their phone. The app will display a simple, intuitive user-interface where the customer can select a desired amount of food to dispense. At the press of a button, a signal will be transferred from the phone, through the Bluetooth module, interpreted by the microcontroller, and relayed to the motor. This motor will deliver the appropriate amount of food into the user's container, which they can just pick up and take with them to the front register of a grocery store, or to their table in a dining hall. Throughout the entire process, the only physical contact from the user is with their own bowl and mobile device, effectively eliminating same surface points of contact for customers.

Contactless Food Dispenser

Grocery stores or dining halls are high-risk zones for contraction of the virus, which poses the inconvenience of having to frequently sanitize common surfaces between customers. To ensure these common surfaces are cleaned, effort on either the customer's end or an employee's end has to be spent, and given the countless number of common surfaces, it is increasingly hard to guarantee that all surfaces are cleaned between each customer's use. A study done in the United Kingdom on McDonald's touchscreens show that every single screen swabbed showed traces of feces and gut bacteria, which causes the kind of infections people pick up in hospitals (Smith, 2018). This shows that these kinds of surfaces are not cleaned reliably, if at all, and alternatives must be explored. The Socially Distanced Dispenser addresses this issue by eliminating any need for contact in the first place, which allows for more focus and effort to be directed to other surfaces that require frequent cleaning.

The concept of contactless dispensers is not novel. Most hand sanitizer dispensers rely on infrared or photo sensors to dispense product without contact ("An Insight on How the Best Automatic Soap Dispensers Work," 2019). This approach, however, would not make sense in the context of our problem. Dispensers akin to the automatic hand sanitizer can only dispense a set, static amount. If the user wants more sanitizer than the set amount, they would have to trigger the dispensing mechanism repeatedly. If the user wants less than the set amount, that's simply not an option and some product would have to go to waste. In the context of the hand sanitization problem, most users are content with one dispense of the set amount. Food, however, is a different issue. Users in dining halls and grocery stores will desire different quantities of food, and having to repeatedly trigger the dispensing mechanism to receive the desired amount is

inconvenient. And if the user wants less than the set amount, food will have to be wasted, which is not good practice.

Another system that could be considered similar to the Socially Distanced Dispenser is Coca-Cola's Freestyle® dispenser. Coca-Cola's dispenser allows users to choose from a wide variety of drinks by having users scan a QR code on their smartphone, which then directs them to a web application where users can select their beverage (Magloff, 2020). This web page allows the user to choose from hundreds of different items and customization options which necessitates serving large amounts of user-facing views and having a database. This approach saves the user from having to download an app and from having to form a Bluetooth connection with the machine, but the overhead is far greater than what the Socially Distanced Dispenser would need. A web application is far out of scope as each module only dispenses one type of food item and the only customization option is quantity. In addition to the large overhead of a web application, the price of a single module of the Freestyle Beverage Dispenser can range from \$2,000 to \$11,500 ("How Much Does Coca-Cola Freestyle Cost In 2020?", 2020). So, while having to download an app is inconvenient for the customer, it is a one-time action, and the inconveniences would be diminished with each use of the Socially Distanced Dispenser.

The Socially Distanced Dispenser is a unique solution to the problem it addresses because it serves as a simple, cost-efficient, easy-to-use, and appropriately scaled contactless dispenser. In addition, all of the aforementioned contactless dispensers were for liquid products, whereas the Socially Distanced Dispenser serves solid products. This difference necessitates a completely different automated dispensing mechanism, which the Socially Distanced Dispenser provides. The prototype we develop will also be portable and is essentially ready-to-use out of the box,

only needing to be plugged into a wall socket. As soon as our dispenser is powered and the desired food item is loaded, it will be ready to go, which allows for simple installation.

This project draws directly from much of our past coursework. In order to dispense the food, a stepper motor will be attached to the knob of the dispenser. This motor will be controlled using a MSP430 microcontroller, incorporating knowledge gained from ECE3430: Introduction to Embedded Computing. The MSP430 will be connected to the Bluetooth module and the motor driver using a printed circuit board (PCB), the circuit design of which will be informed by our experience in the Fundamentals of Electrical Engineering series (ECE2630, ECE2660, and ECE3750). We will also be using some signal processing and control systems techniques to allow communication between the motor and the microcontroller, conveying information such as how much to dispense or whether the dispenser is empty or jammed. The user interface also utilizes our previous classes, including Advanced Software Development and Mobile App Development (CS3240 and CS4720). These classes helped us learn to create a clean and intuitive user interface that does not discourage customers from using the product. The application will also need to establish a secure Bluetooth connection that does not jeopardize user privacy, which will require cyber security knowledge from Defense Against the Dark Arts (CS4630) and Introduction to Cybersecurity (CS3501). Finally, as 3D printing will be an aspect of our project, the experience of designing objects in CAD software from the Introduction to Engineering (ENGR 1620 and 1621) course will be useful as well.

Actor-Networking Virtual Platforms in the Food Industry

Even before coronavirus struck the world, virtual platforms and mobile applications in the food industry have been on the rise, and it is easy to see why. These platforms make it easy for

establishments to sell their products and convenient for customers to purchase them. One aspect I will be considering is the upward trend of online grocery shopping and food delivery services. One viewpoint is that a user's intention to use an online-to-offline (O2O) service is influenced by "societal pressure, delivery experience, customer experience, ease of use, quality control, convenience, listing, and search of restaurants" (Ray et al., 2019). Another view is on why virtual platforms is rising looks at the types of people who use them. According to Andrew Murphy (2006), these seem to be wealthy households with time intensive jobs, parents with young children, those without cars, the less-abled and elderly, those who prefer using a computer to socialization, and those for whom ordering is the best way to obtain hard-to-get items. A third perspective is the affect marriage has in use of O2O food delivery services. It appears that moral obligation, particularly marriage in this case, "restricts people from acting on their basic convenience orientation in meal preparation", which causes them to be "more reluctant to convert their basic convenience-seeking tendencies into actual adoption intention than those with low moral obligation" (Roh & Kiwan, 2017).

I will also be considering how businesses and individuals are affected and the societal consequences and effects of these services. Health, financial, and ethical concerns will be addressed. One ethical concern is that restaurants must invest in digital platforms to stay afloat amongst their competition. Because of this, restaurants that are not typically suited for food delivery, often due to how quickly the quality of food deteriorates, are joining this trend. (Kell, 2017). Additionally, the ease of access these platforms provide has facilitated ordering food, particularly unhealthy pleasure foods. One article claims that frequency of eating food from outside the home is positively correlated with body mass index, which is supported by a survey

showing that the most frequently ordered items mainly consist of calorie-dense dishes (Stephens, 2020).

As described above, there are many factors to consider, and the rise and effect of virtual platforms in the food industry will be further investigated in the STS research paper. To do this, I will be looking at the research topic through the lens of actor-network theory (ANT). In this approach, I analyze actors such as the internet of things, internet accessible devices, consumers, employees, business owners, large and small businesses, and more. In this section, I will develop an understanding of how these actors inter-relate in various complex ways, and how they can come together in complex groups to cause greater change. For example, internet accessible devices and people can be grouped into “internet accessible users”, which distinguishes themselves from their individual parts, as this pairing is now capable of being involved in online shopping and food delivery. This pair can also be an influence and be influenced by the virtual platforms involved in the food industry. Additionally, as Bruno Latour did in “Where Are the Missing Masses? The Sociology of a Few Mundane Artifacts” (1992), I will look at how many of the technological artifacts used in the food industry replace human action, as well as how they compel and constrain choices available to humans. One such example is software restricting delivery orders unless the user purchases a minimum acceptable order price. In this example, a few lines of code are capable of telling a human being, “No, you cannot order delivery unless you purchase more from this store.” Another aspect to explore is the ways virtual platforms can discriminate against certain subgroups of people. These applications can affect groups of people differently through intentional and unintentional choices in the software. I will be looking into specific questions such as how this software is implemented in different regions, the types of people in these regions, and how these people have been affected by the software choices of the

virtual platforms. Finally, the progression of anthropomorphism will be detailed, beginning from human figurative of a person taking your order at a restaurant to non-human, non-figurative, non-sign, such as the software which records the user's order.

While ANT is incredibly useful, it does come with faults. Some critics have argued against the ANT approach because it requires the researcher to judge which actors are important enough to be included in the network. These critics claim that the importance of actors cannot be realistically determined without "out-of-network" criteria (Amsterdamska, 1990). Another area of critique argues that actor-networks risk degenerating into endless counts of connections. This critique is supported by the six degrees of separation argument – a collection of studies that indicate everyone is a small number of connections from one another. To combat these criticisms, I will ensure that the actors chosen for ANT are important and supported by evidence suggesting so, as well as detail and limit the networks between these actors so that it does not run the risk of degenerating into a meaningless mix of relations.

Research Question and Methods

For research in the thesis, the following question is proposed: What factors have spurred the growth of virtual platforms in the food industry and how have they affected the actors in it? This is important to analyze, as these services have been advancing rapidly and without check on their influences. This issue is more pressing than ever, as the COVID-19 pandemic has accelerated rise of virtual platforms. The research question will be analyzed through the scope of actor-network theory by identifying important actors in the food industry and determining how they relate to and affect each other. I plan on using data from past surveys, as well as conducting some of my own, to gain an understanding of why virtual platforms have risen in popularity.

Studies including participant observation and numerical statistics will provide concrete evidence about how many people and what kinds of people are using these services. This is helpful to keep in mind as I determine if there is bias or discrimination from virtual platforms. These studies will be prepared beginning in December 2020 to January 2021. Additionally, I will analyze prior literature to further support my assertions. I plan to investigate articles containing views from other regions, which will be used to compare how e-commerce in the food industry is affected by different cultures. Other articles I hope to find may form interesting conceptions about the role of e-commerce in the food industry. To collect this research, I will be using specific groupings of keywords or phrases to discover and select evidence. Phrases such as 'virtual platform', 'mobile application', and 'e-commerce' will be grouped together with as one category. These will be cross referenced with another grouping of phrases such as 'food industry', 'grocery', and 'food delivery'. This would result in literature with at least one phrase from each group. I will then be organizing the information I collect by theme and logical order. I will first investigate information relating to the rise of virtual platforms in the food industry. Then, I will look at the effects these platforms have had, such as the high-level effect on businesses, and smaller effects on individuals. I plan on collecting this research around January-February 2021. Another method of evidence collection that will be utilized is agency reports. I hope to compare companies' usage with virtual platforms with various facts such as company growth, prices, food quality, customer satisfaction, and more to determine what affects these applications have had on the food industry. This will also be done around January to February of 2021.

Conclusion

In conclusion, the technical deliverable is aimed at solving the problem of eliminating shared surfaces as a means of reducing the spread of COVID-19. Once implemented, multiple users will no longer need to touch a shared surface, risking the spread of coronavirus. Instead, they will wirelessly connect to the dispenser from their mobile application, which will communicate to the dispenser and allocate the correct amount of food into the user's personal bowl. The STS research paper will evaluate why virtual platforms in the food industry are increasing in popularity and analyze their affects. I hope that an understanding of this topic will prove useful as a foundation for further research into the effects of virtual platforms and e-commerce, as well as be applied to design choices virtual platforms in the food industry.

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