

## **Introduction:**

It has been almost three years with Covid-19. While a lot has changed, recently, businesses are bringing their employees back to the office. Therefore, the demand for touchless solutions to keep the virus from spreading among the returning workers is relatively high. Thus, touchless systems have become necessities to comply with social distancing rules and reduce germ spread.

Coffee corners, whether at an office, a hotel, or a coffee shop, coffee corners are natural gathering spots for people. According to the National Coffee Association statistics, coffee is the most consumed beverage after water. Every seven out of ten Americans drink coffee every day [/ref{link}](#). It is an essential daily item for office workers in modern office environments. Additionally, one of the key findings by the National Coffee Association includes that the average American coffee drinker drinks just over 3 cups per day. According to a survey published by Market Inspector in 2017, coffee drinkers in North America purchased around 29 million coffee machines in 2014 [\ref{link}](#). However, with so many buttons to press/touch, regular coffee machines can appear a potential source for viruses, as those do not facilitate touchless gestures. Some modern coffee machines use touch-based interfaces, which were once a convenience before the spread of the COVID19 virus.

Usually, gesture-based technologies involve the remote detection of static or moving hand gestures that correspond to a predefined set of movements. With a 'natural' [{link}](#) hand-gesture interface, users can interact with technology using the same movements they use to interact with objects in everyday life. Compared to touching a screen, operating a mouse/remote control, twisting a knob, or pressing a switch, hand gesture-based applications allow us to utilize our natural "language" to manage the device, which is far more intuitive and effortless[{link}](#). It also contributes to the increasing need for comfort and convenience in product usage. Moreover, it reduces the communication gap between humans and devices, and it requires minimal intellectual effort from the human side to interact with the device.

In light of these considerations, we propose the concept of a touchless coffee maker, which uses hand gestures to brew coffee from coffee beans without requiring any physical interaction with the coffee maker. Our research question is how convenient it is to use gesture-based coffee makers in workplaces to reduce the spread of germs and viruses? Our findings will aid further studies of gesture-based interaction with everyday appliances to identify if people welcome this type of interaction of appliances.

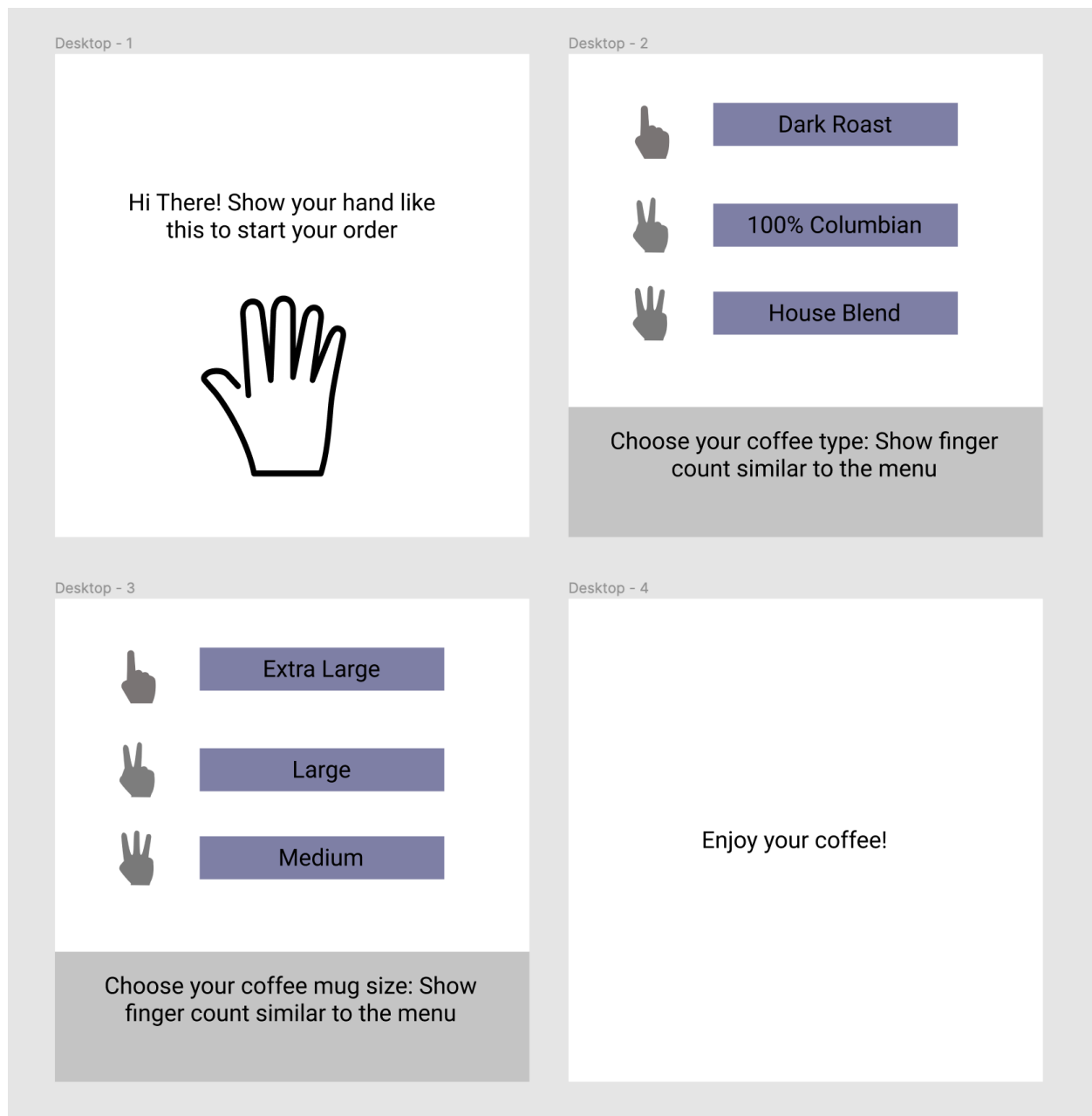
## **Prototype Description:**

This section will show how our prototype offers a touchless coffee experience for the user by enhancing current inbuilt smart technologies.

The coffee machine will feature a single digital screen and a camera beneath it. The screen will function as a digital menu, with the user's gesture captured by the camera. Initially, the user must keep a mug at the bottom of the coffee machine and be 12cms away from the screen and within 3ms of it. While the coffee machine is plugged in, the screen displays instructions for beginning the order process. To begin, the user must extend his hand in front of the coffee machine screen, stretching all five fingers and palm in a greeting gesture('hi')\ref{figure1}. Once the system registers the 'hi' gesture, the menu will appear on the screen. The menu will display the options for different types of coffee to choose from, for example, Show 1 (index finger) to select Dark roast coffee, Show 2 (index and middle finger) to select 100% Columbian coffee. Once the user selects the coffee type, the screen will display options for the amount of coffee in respect to mug size, for example, Show 1 (index finger) to select Large, Show 2 (index and middle finger) to select Medium. When the machine detects the user's gesture, it brews the coffee for that precise mug size. Once the coffee has finished dripping, the user can simply take the mug and depart. The screen will return to its initial position, displaying instructions on how to begin the interaction.



The only physical component that the user will touch during the entire process is the coffee mug. It can be a one-time use mug or a personal mug, and it won't involve contacting any of the machine's actual components. This also eliminates the need to touch any machine button or touchscreen, which is the primary goal purpose of this research project.



To evaluate the prototype, we'll place the version-0 prototype of this coffee machine at an office's coffee corner. The evaluation will be carried out in two stages. In the first step, the coffee area will have two types of coffee makers. One is with the button-based interface, while the other is with our gesture-based prototype. When someone arrives to use the coffee machine, we will take note of whatever type of coffee machine they are using. Then they will be asked the following question:

1. (If you chose the coffee machine with buttons) What was the reason for choosing a coffee machine with buttons?
  - i) The Previous familiarity with the interface
  - ii) More convenient to use
  - iii) No particular reason

2. (If you chose the gesture-based coffee machine) What made you decide on a coffee machine that works by gestures?
  - i) Hygiene concern
  - ii) Trying out new technology
  - iii) No particular reason

In the second phase, we will gather a group of people who use a button-based/touch-based coffee machine at least once a day. Then they'll be asked to use the gesture-based coffee machine, and when they've done so, they'll be asked the following questions:

1. On a scale of 1 to 5, rate your experience.
  2. On a scale of 1 to 5, How concerned are you about hygienic conditions when using a public coffee machine?
  3. On a scale of 1 to 5, How likely are you to prefer a gesture-based coffee machine versus one with buttons or a touchscreen?
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