HAPTIC FEEDBACK CHECKOUT SYSTEM

PROJECT 01: CONTROL DESIGN

STUDIO II: INTRODUCTION TO INTERACTION DESIGN (IXD)

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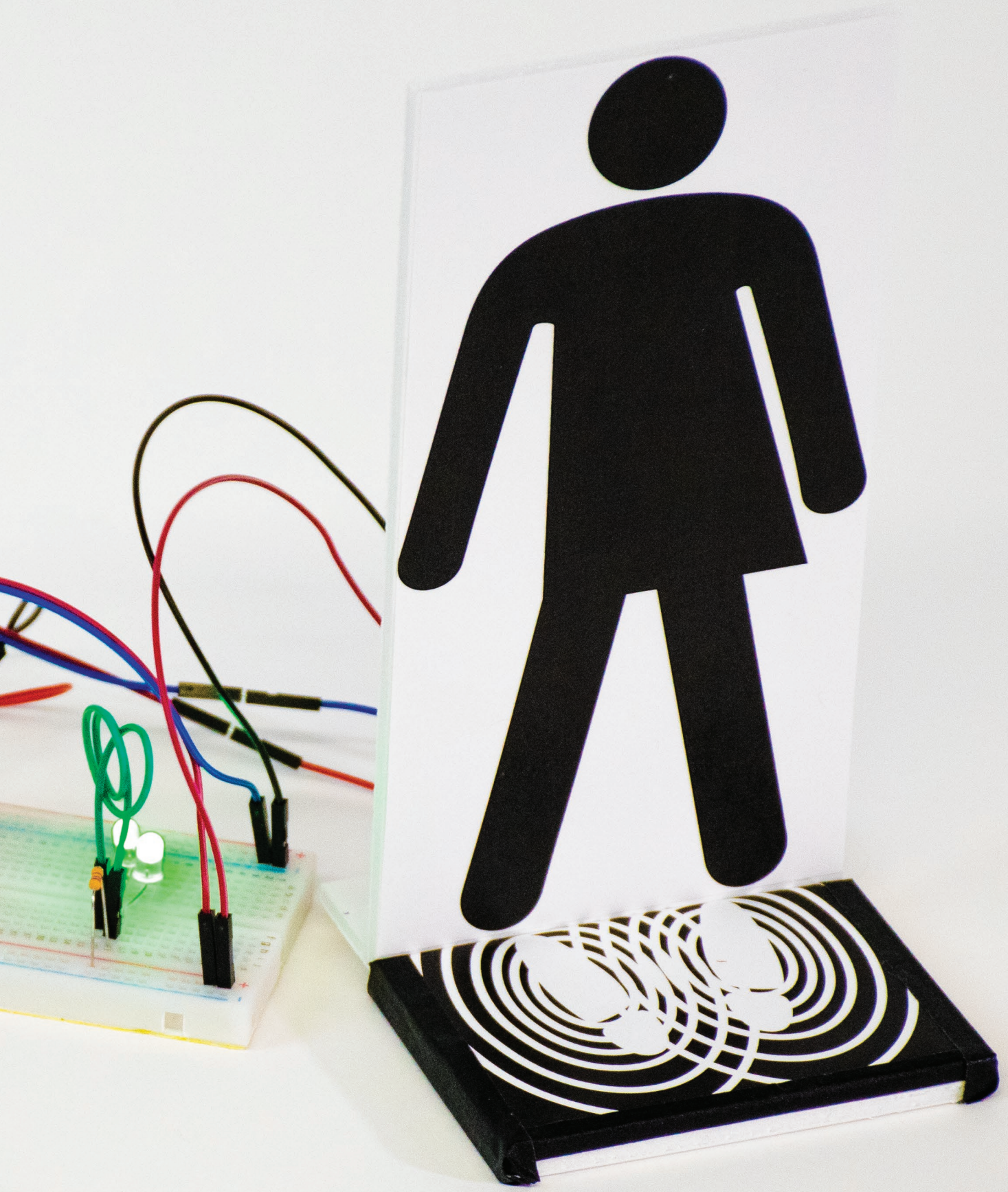
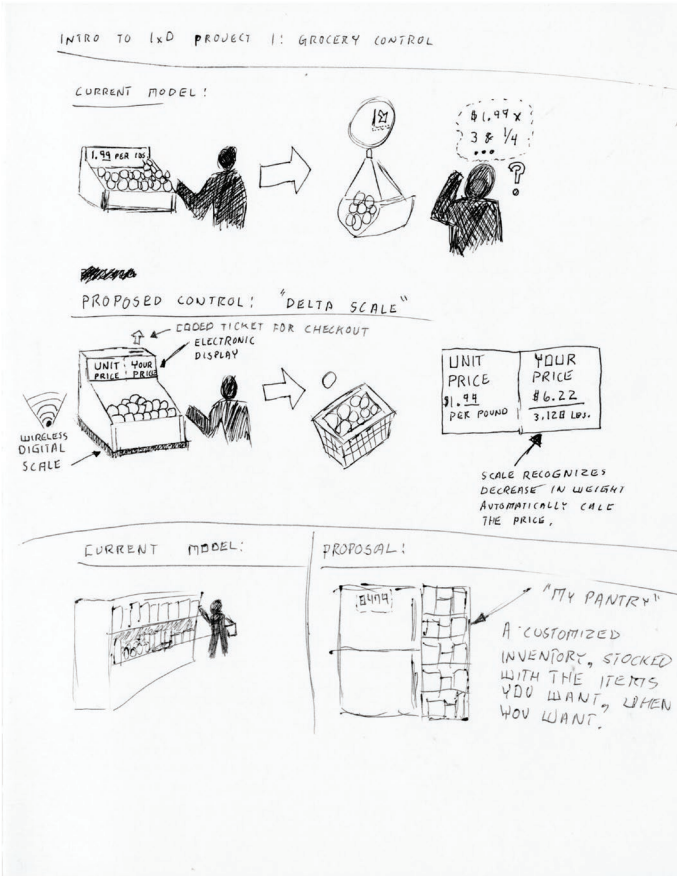
FEBRUARY 06



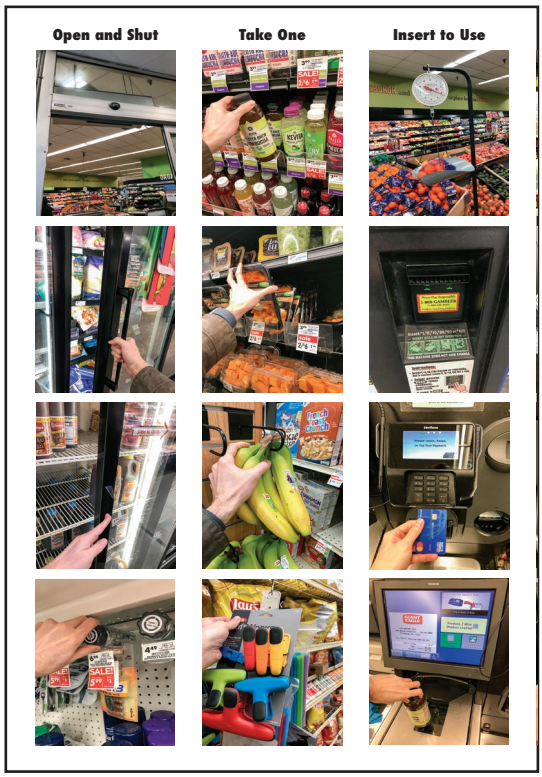
MATT GEIGER | MA STUDIO II: INTRO TO IXD

PROJECT TIMELINE

ABOUT

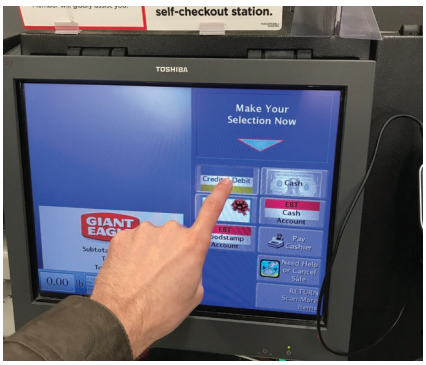


THE GOAL OF THIS PROJECT WAS TO RESEARCH INTERACTIONS IN THE CONTEXT OF GROCERY STORES, RECOGNIZE OPPORTUNITIES FOR IMPROVEMENT, AND TO EXPLORE NEW DESIGNS THROUGH SKETCHING AND PROTOTYPING.



PITTSBURGH, PA.
Field research began and concluded at Giant Eagle Supermarket on Murray Avenue. Like most modern grocery stores in the United States, Giant Eagle follows a predictable user flow: customers enter through automatic sliding doors, navigate through discrete categories of products, and then arrive at a point of sale section. This final stage is either completed by the customer (self-checkout) or cashiers.
I recorded more than twenty interactions throughout the store, many of these were part of the self-checkout. This process was rich with interactions, and ultimately became a focal point of observational research.

WEEK 01: OBSERVATION

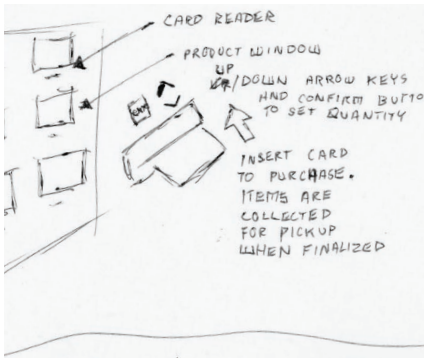


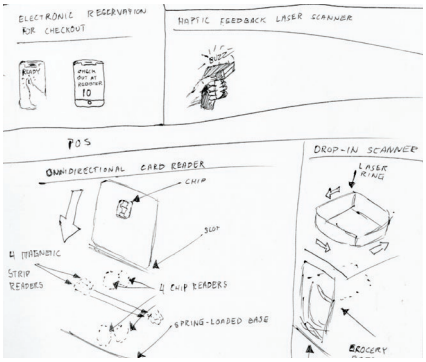
KIOSK: CUSTOMER CONTROLLED

The process of self-checkout is unpleasant. It is unpaid labor, executed by the customer.

Touchscreen: virtual buttons

The touchscreen has many advantages but it lacks flexibility for user feedback. Skeuomorphisms can result in poorly executed metaphor.





Centralized Process: Checkout lines

Checkout lines are not inevitable, they are designed. If not replacing this system, an alternative approach is to make the process more enjoyable.

Seeking Efficiency: Faster, not better

The design of self-checkout is narrowly focused on simplicity and speed. It is not made to be enjoyable, only quick.

WEEK 02: INVENTORY OF INTERACTIONS

CATEGORIZATION

INTERACTION	GOAL	MENTAL MODEL	AFFORDANCES	SIGNIFIERS
Selecting frozen items	**Grocery store goal:** keep perishable items cold, to prevent premature loss of inventory **Customer goal:** select perishable items for purchase	The frozen food section of a grocery store is similar in most respects to the function of a household refrigerator. The items are kept cold, behind a door, and customers need only open the door to retrieve the frozen items	The frozen food is kept behind a glass door; the glass affords viewing the items before the door is opened; the handle of the door affords either pulling (hinge type doors) or sliding (sliding track type doors) open; reversing the action closes the door	The frozen items are placed on shelfs with price tags affixed along the edges, corresponding to the item placement; the frozen food aisle includes overhead signs, indicating what kinds of frozen items are offered, and where they are located within the aisle; the doors include arrows and text, instructing customers of how the door opens and closes
Weighing produce	**Grocery store goal:** provide customers with an easy way measure the quantity of produce and to anticipate the cost of their purchase **Customer goal:** to know how much (weight) of a particular item they have selected	The produce section of a grocery store includes many items that are priced by weight; this is primarily due to the lack of uniformity with unprocessed foods; the store provides customers with a simple hanging scale to measure the weight of their products; the scale is placed in close proximity to a variety of unpacked, fresh produce, building the association between the scale and times; when items are placed on the scale's basket, the basket lowers, and the arrow moves a corresponding distance	The scale hangs from a fixed position on an anchored metal pole; the face is glass, affording the viewing of a needle and rotational array of measurement values, while also preventing customers from interacting with the needle or internal mechanics of the scale; the basket hangs from a few metal chains, it is large enough to place several items; it also affords the mixing of several items, which provides a total weight, but not the weight of individual items (including those with different prices)	The scale face includes numbers, lines, and text (indicating weight limits, clarification of accuracy); it does not, however, indicate what the units actually are (lbs. are assumed); the red arrow tappers to a single point on one end, with a counterpoint that extends only half of the radius, this indicates which end of the arrow is for customers to focus upon

WEEK 02: INVENTORY OF INTERACTIONS

MAPPING	CONSTRAINTS	FEEDBACK
The frozen items are sorted in a manner similar to the rest of the store, with categories of items divided into sections with the aisle. The division of frozen items by categories (e.g., meat, vegetables, desserts, pre-packaged meals) helps orient users toward their selection.	Items cannot be retrieved without first opening the door. The doors are designed with springs or inclined hinges to automatically close, which might cause difficulty for customers when selecting multiple items (one hand or the customer's whole body must intervene against this automatic action)	There is little feedback involved this interaction. The doors respond to mechanical force, and some items (e.g., canned dinner rolls) automatically move to the front edge of their respective shelf (gravity fed), when a customer retrieves their items
The use of traditional conventions for measuring weight are used with this produce scale; prominent lines divide the weight by full pounds, while smaller lines divide this amount into fourths, repeated with smaller incremental sets (for ounces); the arrow moves clockwise, matching the format of the scale face with a familiar analog timepiece	No more than a total of 20 lbs. can be weighed at a time; customers cannot interact with the scale face; nor can they perform any kind of calibration or offset adjustment;	The device is a simple arrangement of input (the basket) and output (the movement of the arrow on the scale face)

CATEGORIZATION

WEEK 02: INVENTORY OF INTERACTIONS

CATEGORIZATION

INTERACTION	GOAL	MENTAL MODEL	AFFORDANCES	SIGNIFIERS
Selecting packaged food items (non-perishable)	**Grocery store goal:** provide appealing food items for customers to purchase **Customer goal:** buying food for later consumption	The standard "shopping" model: customers navigate through different sections, divided by aisle, searching for their desired items, while also being presented with multiple alternatives (brands, quantities, etc.)	Items are placed on shelves, typically with most expensive toward the top, and heaviest, least expensive toward the bottom, affording customers to pick up items and place them in a basket or cart	Products are packaged with graphics, nutritional information, branding, weight, quantity, and price
Self checkout, purchase payment	Pay for items selected at the end of grocery shopping	Based on the more traditional checkout model, customers perform the tasks of a salesclerk during checkout, guided by visual and audio information provided by an automated kiosk. Customers have observed checkout countless times, and have seen the sequence of scanning barcodes, entering item information, bagging, and processing payment. Customers are prompted to perform these actions in a sequence	The scanner affords placement of items; grocery bags are hanging from a self-dispensing rig, pulling one bag from the rig expands an opening in the next bag; the touch screen is within reach while standing in front of the kiosk; the receipt dispenser feeds out a paper receipt, pulling on it causes tearing against a set of metal teeth; the credit card scanner affords insertion of a credit card (including incorrect orientations), and the buttons on the keypad afford pressing. A cash and coin slot allow for non-electronic payment, by insert bills and coins into the kiosk. Change is fed out to a small tray	The touchscreen includes graphics that represent virtual buttons, signifying the mechanical push-button interaction; the credit card keypad includes numbers (0-9), letters (english alphabet), symbols (arrows, card abstraction, sequential lights for the "swipe" slot (deprecated by the chip reader), and colors to indicate function (red for cancel, green for enter, yellow for erase); the cash/money slot includes a picture of an upright facing dollar bill.

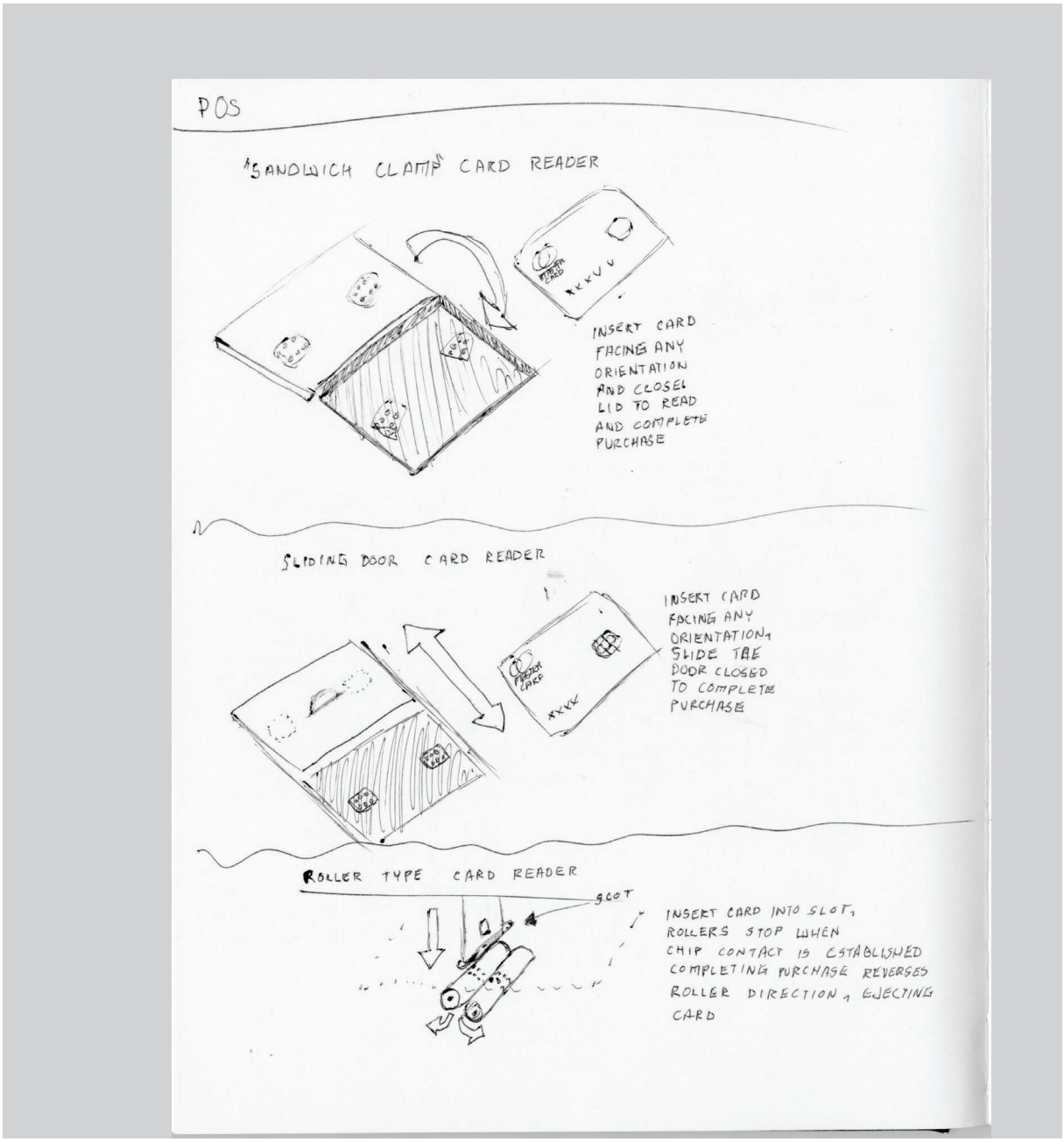
WEEK 02: INVENTORY OF INTERACTIONS

MAPPING	CONSTRAINTS	FEEDBACK
Similar to other kinds of retail shopping (e.g., big-box stores with parking lots, retail items, sales, etc.), the grocery store layout follows a template; items are divided into categories for shoppers to navigate while making selections	Aisle prevent customers from directly traveling from one section to the next; there are bottlenecks at the end of each section, and not all items can be easily retrieved (due to physical disabilities, height, reaching ability)	While some items may be stored with a gravity-fed, inclined shelf, there is usually little or no feedback when customers select items; they simply pick the items, review package labeling, and either place in cart, or return it to the shelf
The scanner has two axis (vertical and horizontal) laser sweeps; there is no way to definitively know the position of the laser relative to the barcode of items; the credit card reader slot matches the dimensions of the short side of a credit card, and is thin enough to insert only one card at a time; the card reader is placed to the right of the main kiosk screen, which might be confusing for folks who are left-hand dominant; the credit card scanner includes a stylus for customers to provide a signature (for large purchase amounts), and it is also within reach for use on the main touchscreen, which could also confuse users. Also, the keypad on the card reader matches the layout of an ATM (starting with "1" in the upper left corner), helping to situate customers to a familiar context.	The laser scanner is in a fixed orientation, making it difficult to scan large items (e.g., a 20kg bag of dog food); the open exposure of the laser scanner also makes it difficult to conceal the purchase of potentially embarrassing /private items (e.g., adult diapers, prophylactics, over-the-counter medicines); the system only allows one item to be scanned at a time - items must be placed in the bagging area before the next item will be scanned; payment cannot be selected or entered before all items are scanned; the cash slot does not constrain users from inserting credit cards, coupons, or other small papers.	The main touch screen provides visual information about the checkout process, while audio feedback (voice recorded instructions, beeps) provides additional clarity; blinking lights indicate when certain functions (weighing produce, inserting coupons, making payment) are active/ expected.

CATEGORIZATION

WEEK 03: IDEATION

Consideration of controls	PROJECT 01: Control Design



WEEK 03: IDEATION

CHALLENGE	RESULT
The efficiency-centered design of self-checkout systems offered many areas for improvement, but no distinct path forward. To overcome this challenge, I needed to first consider what different approaches might look like. One area I briefly considered was the point-of-sale components. I observed customers struggle with the payment process during check out. Despite several years of market adoption, the credit card chip-reading mechanism remains ambiguous and prone to both mechanical and user error.	I completed a series of sketches to explore possible design improvements, but ultimately chose to abandon this route. While it was interesting to consider these possibilities, I believe that this technology is already approaching obsolescence with the introduction of contact-less payment systems, smart watches, smart phones, and other low-friction transaction technologies.

Credit cards are a temporary bridge to a fully electronic system for the exchange of value. Improving an endangered technology cannot save it. The humane thing to do is allow it a natural death.

PRINCIPLE OF DESIGN

“FEEDBACK MUST BE IMMEDIATE: EVEN A DELAY OF A TENTH OF A SECOND CAN BE DISCONCERTING.”

DON NORMAN

THE DESIGN OF EVERYDAY THINGS

WEEK 03: IDEATION

FORM CONSIDERATION

To improve on the existing feedback, I had to either augment the sound source or select another form of sensory stimulation. Sound design, while compelling, would not address the concerns of accessibility. I decided to explore other means of stimulation, and landed on haptic feedback as my choice for interaction.

PROTOTYPING

One of the key challenges in designing an effective prototype to evaluate this interaction was scale. Self-checkout kiosks are large, expensive, and technically sophisticated. They have several internal components, electromechanical devices that work in concert, proprietary software, and even lasers. These devices are as complex as they are unpleasant. I would need to simplify the interaction to understand how users would respond.

VIDEO SIMULATION

To demonstrate the concept of a whole system, while only prototyping a single interaction, I decided to leverage 3D motion video to illustrate the process. This was achieved using Fusion 360, model assets from GrabCAD.com, and Cinema 4D. These tools allowed for rapid visualization, and to consider some the practical elements at a higher fidelity than would be permitted with physical materials.

TESTING

After completing a series of sketches to consider the complete system, I began constructing simplified models to evaluate sub-components that users would interact with. Parts included a full-scale mat for users to stand on (with graphics to indicate the function), and a miniaturized electronic device to transmit vibrations.

WEEK 03: IDEATION

CONCEPT

The current paradigm for self-checkout systems requires constant feedback for scanning items. The use of sound is an extremely limited application

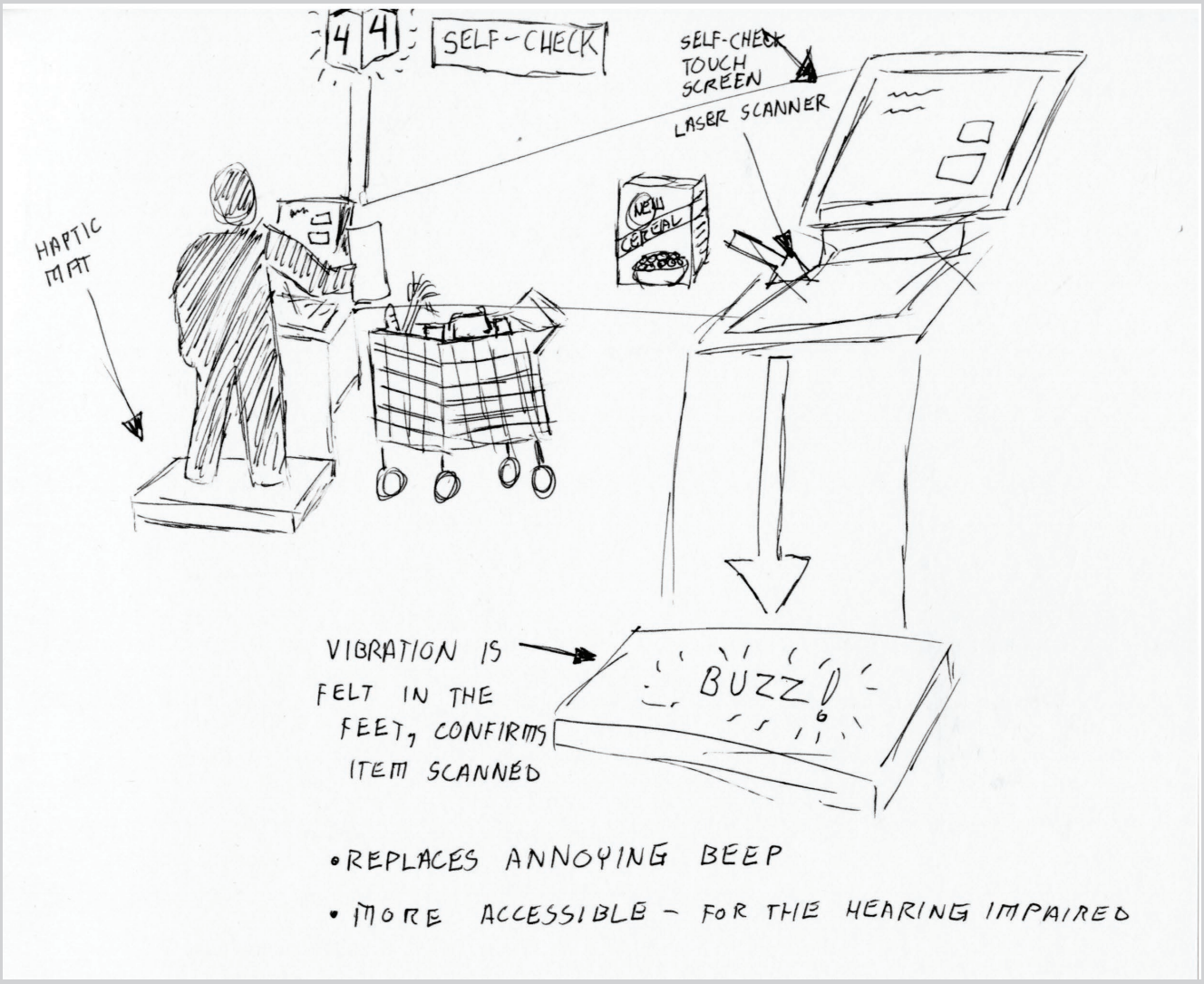
PRODUCTION

Prototyping to test and evaluate a different feedback mechanism: one that customers can feel, instead of only hearing.

FINAL DELIVERY

A combination of prototypes built at different levels of fidelity and scale to communicate a new design.

The constant sound of beeps is not only unpleasant, it is also ambiguous when in close proximity to several identical machines. Furthermore, it does not provide utility or value for the hearing impaired. How can we improve this interaction? We can leverage other human senses.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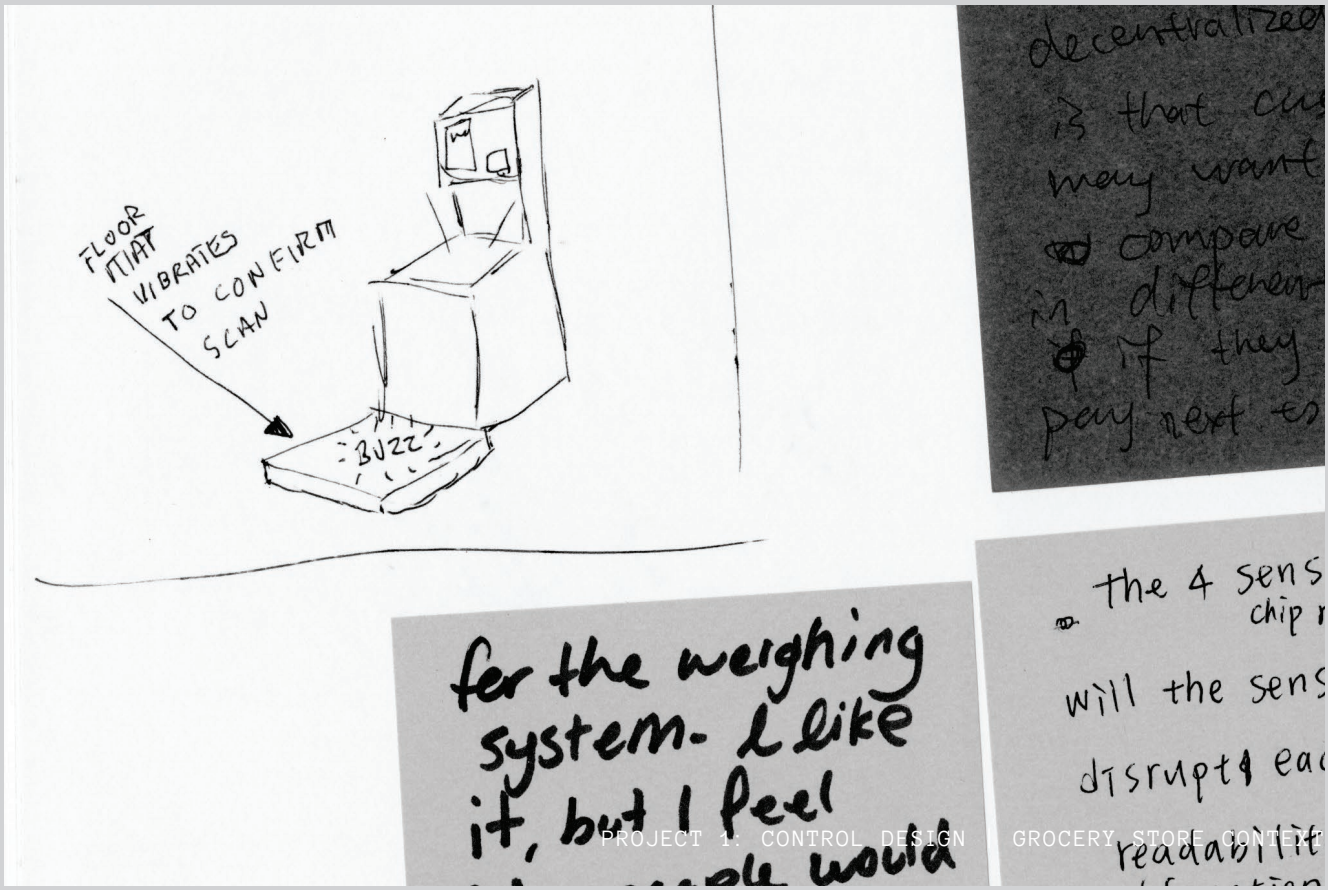
SELF-CHECK
SELF-CHECK TOUCH SCREEN
LASER SCANNER
HAPTIC MAT
NEW! CEREAL
VIBRATION IS FELT IN THE FEET, CONFIRMS ITEM SCANNED
BUZZ!
• REPLACES ANNOYING BEEP
• MORE ACCESSIBLE - FOR THE HEARING IMPAIRED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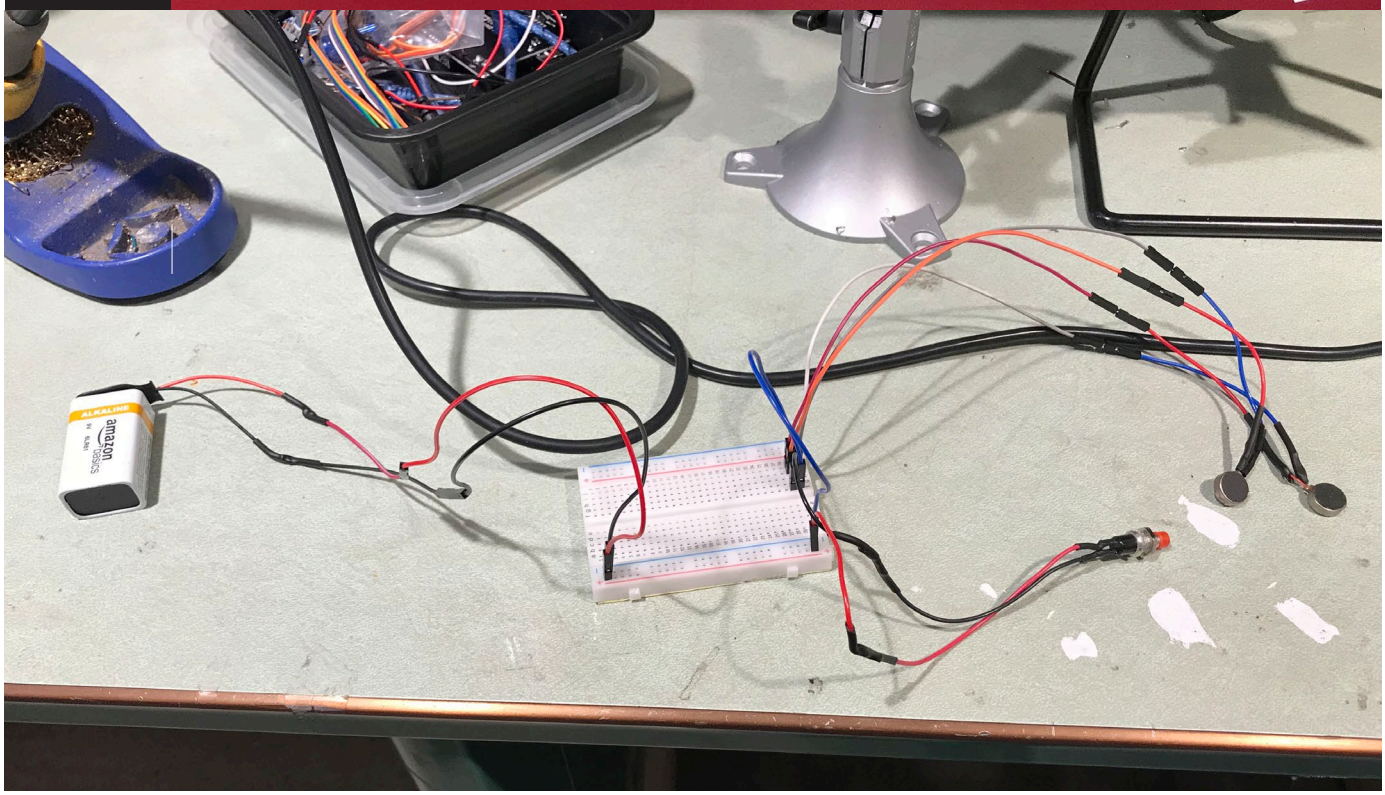
WEEK 04: PROTOTYPING

CONSTRUCTION



BUILDING TO LEARN
LEARNING TO BUILD

0.1 FEEDBACK

Knowing that users needed to be able to feel their feedback, I began constructing a miniature scale model. Users would not be able to stand on something this small, but by placing their fingers to match the drawn figure (an image based on a gender neutral icon from TheNounProject.com), users could still experience a felt form of feedback. I constructed a simple circuit with manually actuated vibration motors hidden under the base.

0.2 ABSTRACT

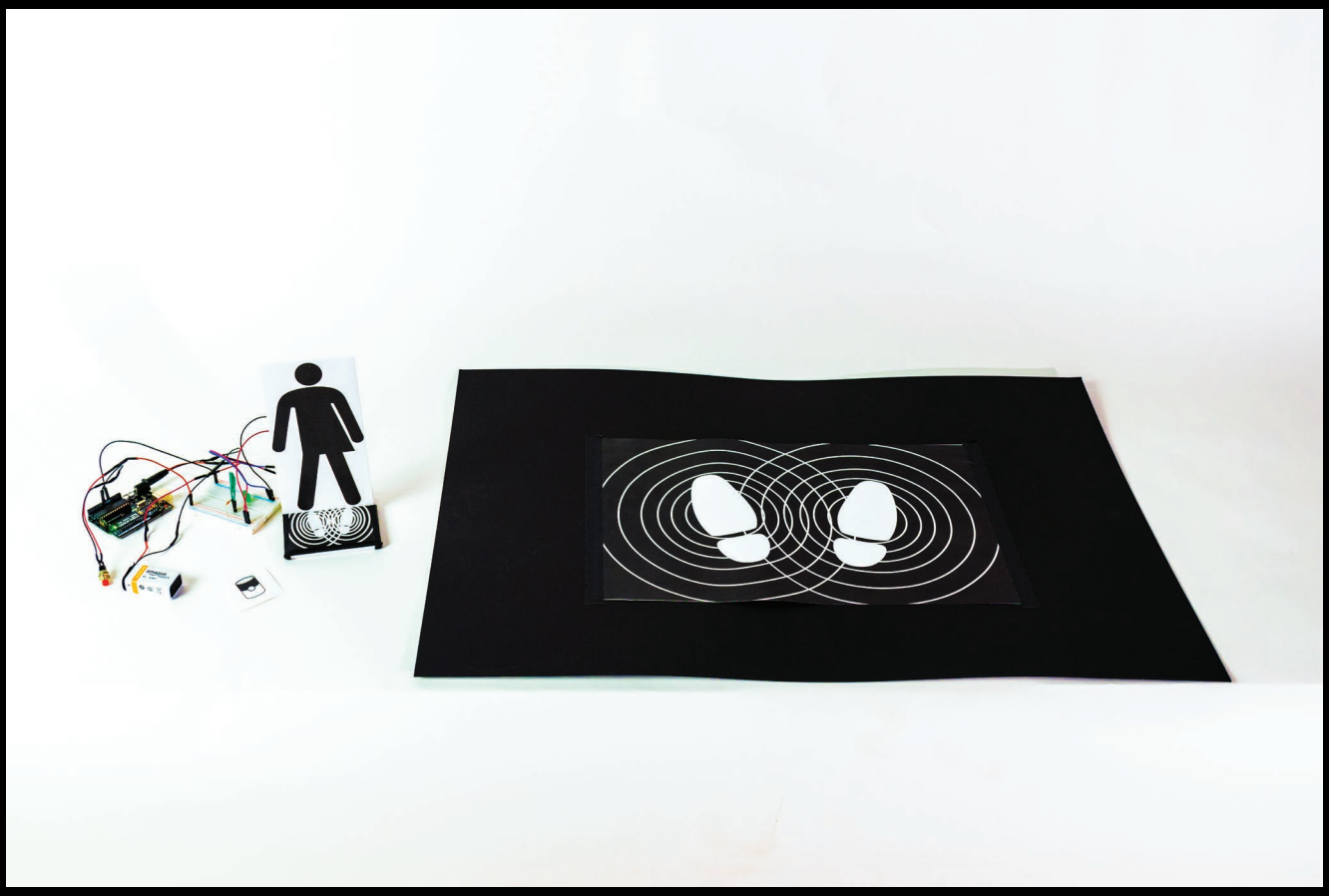
For the purposes of exploring feedback, it felt excessive to construct any kind of detection or scanning mechanisms. Instead, I used a simple push button to open and close the circuit. This allowed me to manually induce vibrations in the platform, while users placed simple mock-ups of grocery items onto a "scanner." Because these models are familiar, it was relatively easy to get users to fill in the gaps with their own creativity.

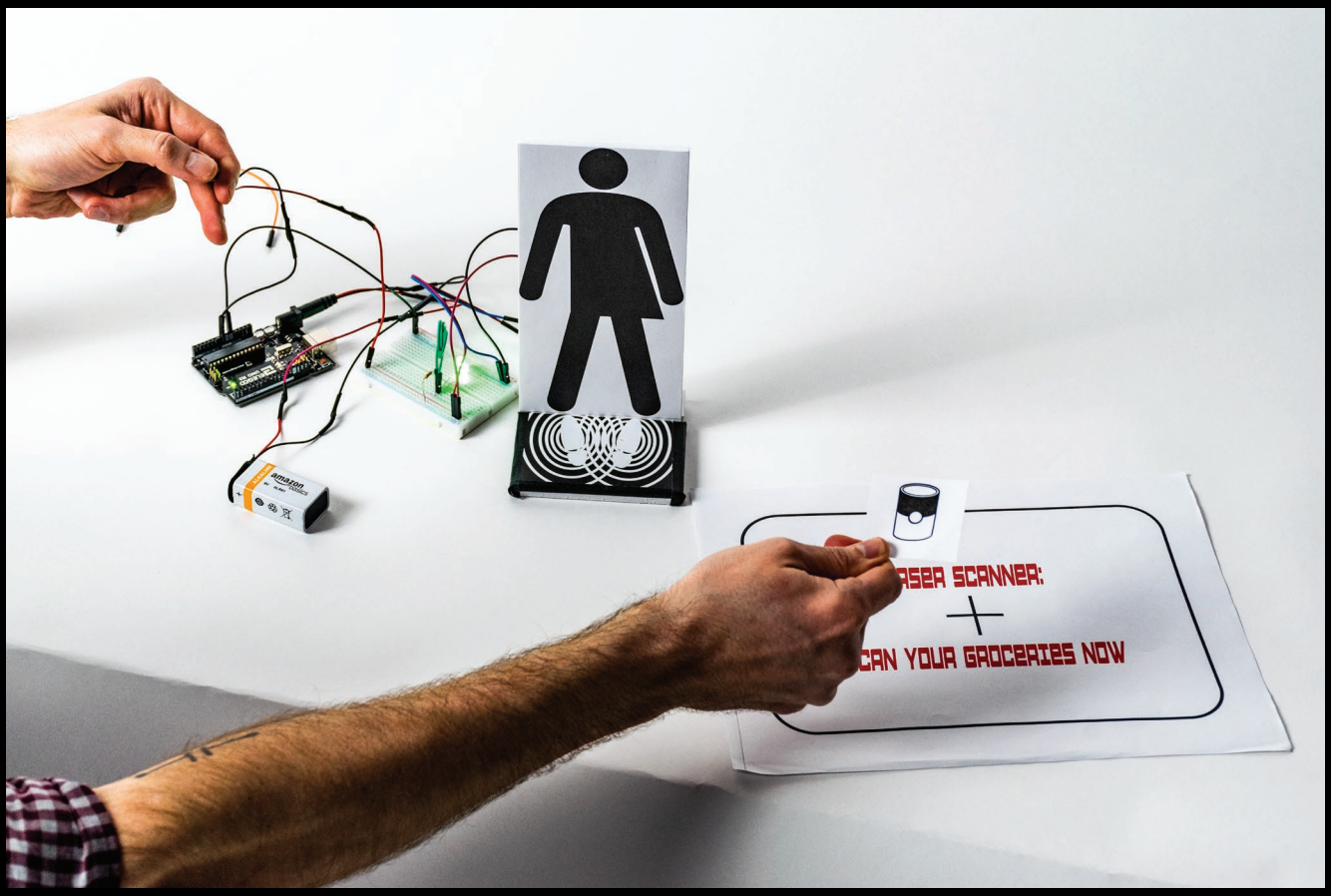
0.3 DISCOVERY

While constructing this simplified model, I realized a design flaw that would affect users who experience mobility challenges. Not all grocery store customers have use of their legs. This can be a temporary or life-long condition. According to the Reeve Foundation, nearly 1 in 50 Americans are living with paralysis. Realizing that I would need to provide additional feedback mechanisms, I decided to integrate LEDs with the circuit's vibration.

0.4 Full scale

To evaluate the embodied experience of users, some components were built to full scale, while minimizing the materials necessary to establish interaction. Non-electrical components were constructed with paper and mounting boards.

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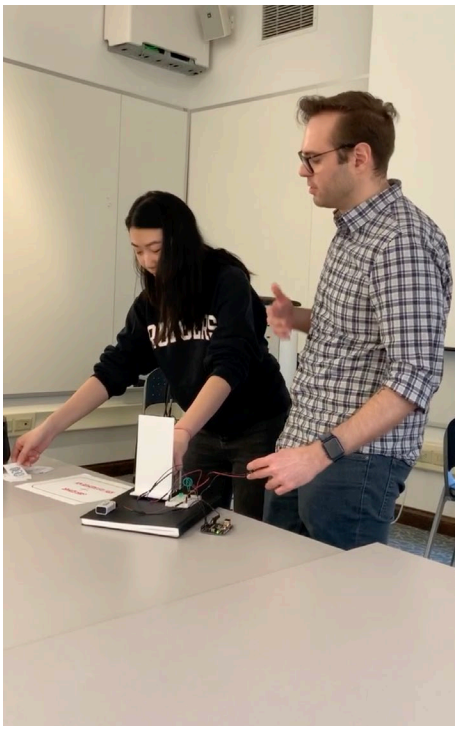
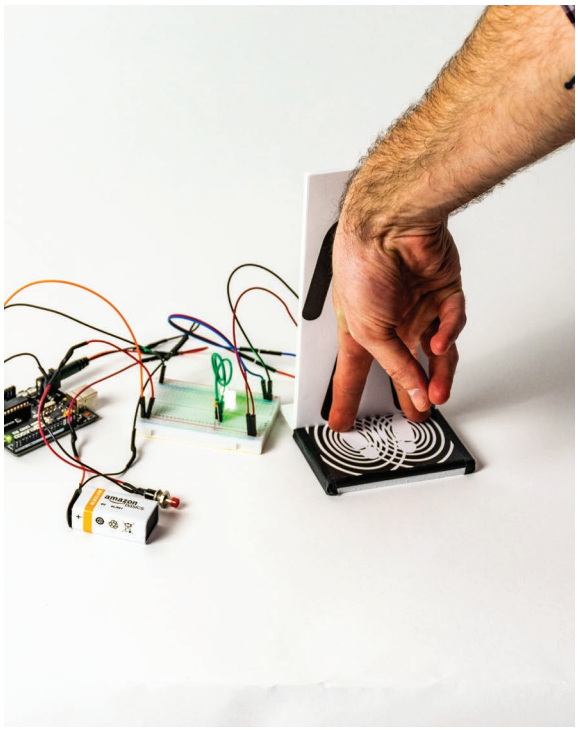
CAN YOUR GROCERIES NOW

CONCLUSION





By combining these simple elements, I was able to construct a working system to evaluate user interactions. The visual and haptic feedback mechanism proved to be a viable alternative, but with a few unknowns that are worth addressing:

- **Scale**
  Because the vibration feedback was not validated at scale, there might be additional considerations that remain unknown through this testing process.

- **Variability of users**
  The tests were conducted with able-bodied, healthy, young people. There might be hidden factors revealed if testing with a broader demographic.

- **Environment**
  A studio environment does not recreate the full experience of a crowded grocery store. To validate this system, environmental factors must also be considered.

Fingertips are sensitive enough to be excellent candidates for detecting even weak vibrations. This is one of many advantage of building to this scale. It only requires a little bit of imagination.

CITATIONS

“THE DESIGN OF EVERYDAY THINGS” BY DON NORMAN

Design principles, quotes, and concepts

THE NOUN PROJECT TheNounProject.com

Graphics assets, inspiration

GRAB CAD GrabCAD.com

3D models,inspiration

Giant Eagle Supermarket

Field research, staff interactions, photography and products

Ashley Deal and Raelynn O’Leary
Carnegie Mellon University
School of Design

Project scope, support, and guidance

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