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CSE 440 AD/BD

Check Yourself: Checkout Without A Workout

Team

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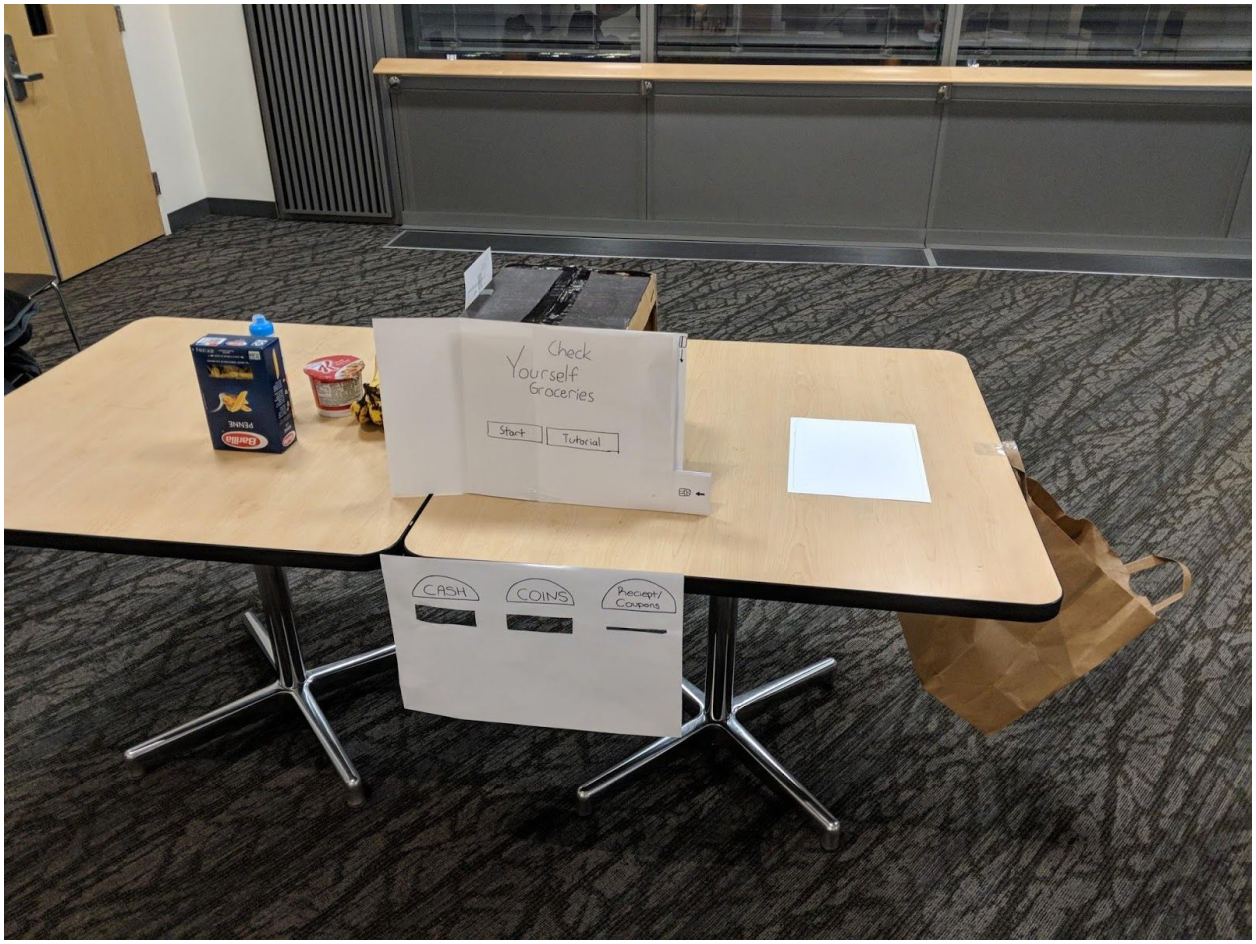
Problem and Solution Overview

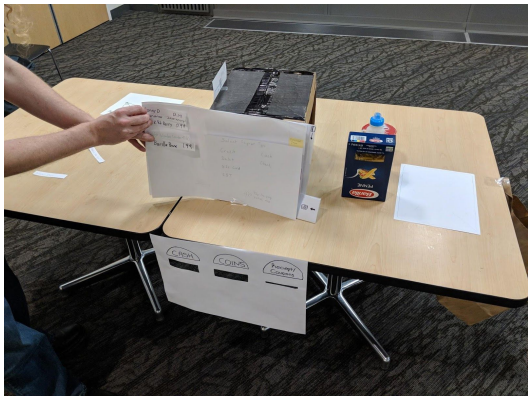
The current self-checkout experience leaves a great deal to be desired. Most systems are difficult to use, unintuitive, and put a number of obstacles in the customer's path. Customers have to scan and bag items carefully, one at a time, or risk the machine entering an error state due to 'unwanted items'. Items without barcodes have to be searched for, sometimes forcing the customer to guess at how a particular store classifies its produce. Our design addresses many of the pain points found in current self-checkouts for the benefit of all stakeholders, especially in two key areas: checking out multiple items at once and scanning items without barcodes. By means of a conveyor belt and optical scanners, we will leverage computer vision to identify and tally items. This same system will help identify produce or bulk purchases, suggesting a match to the customer while they weigh the item. Our newly designed self-checkout will be easier, faster, and simpler.

Initial Paper Prototype



Our initial paper prototype consisted of a large cardboard box with holes cut into it to represent the scanning area, a large sheet of paper which represented the terminal screen, a second large sheet of paper which represented the cash/coin receptacles and receipt printer, and a third smaller sheet of paper which represented the scale. We used several smaller sheets of paper to represent the various screens users might see while performing our two tasks. Additionally, small strips of paper were used to fill out the customer's ledger as the various items in our prototype were 'scanned' by the machine, allowing the customer to keep abreast of the self-checkout process.

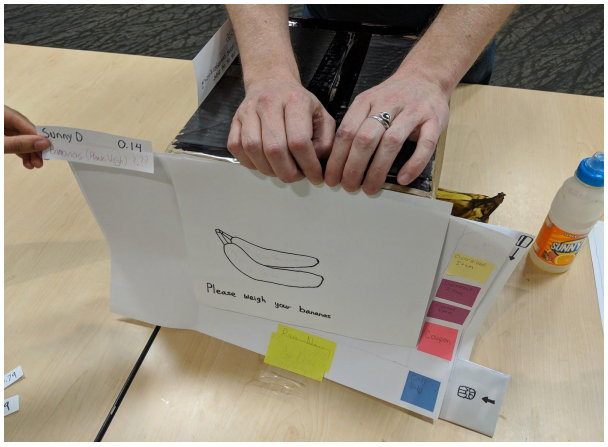
We found the most important physical components of our design to be the 'scanning area' box, the 'metal' scale, and the customer's terminal. We wanted to ensure that the manifest model would be as close as we could make it to a customer's mental model. One key component for this was the live feed provided on the terminal, which would allow the customer to see what was happening inside the scanning area. The scale was prototyped with what we hoped was a familiar shape and location. We deliberately chose not to include a conveyor belt, and left the task of moving items up to the computer. The reasoning behind this decision was that a paper conveyor belt would be too fragile and difficult to use without causing items to constantly fall off of the table, which would disrupt the usability testing.



Task 1- Scanning Multiple Items

The scanner box and terminal were critical for this task, and facilitated its completion remarkably well. Because the design features a live video feed of the customer's items as they pass through the scanning area, it is easy for the customer to see that their items are being processed safely and without added inconvenience.

Task 2- Scanning Items Without Barcodes



This task was handled primarily through the terminal. The customer is required to verify the computer's findings and possibly weigh the item that they have placed on the conveyor belt. Although this is not as swift as simple recognition, it is important to give the customer a sense of control when they use the machine. As such, the prototype asks them to identify the item and if necessary, to weigh that item. The goal here was to provide a minimal, streamlined experience that required limited but vital input from the customer, giving them a sense of control over their own shopping experience.

Testing Process

Environment: All three of our usability tests were conducted in the MHCI+D studio space. Our entire paper prototype was brought to this location, which was spacious and provided the right table size we needed. All of the participants are either enrolled in MHCI+D or work in a design environment, which was the deciding factor in using this space. Unfortunately, we were not able to otherwise simulate the 'shopping experience', as that was well beyond the scope of our resources.

Participants: All of our participants are tech-savvy, young adults. Two are male, one is female. Two of them are graduate level students in the MHCI+D program. One is employed in the

technology sector. All use self-checkout frequently and have a great deal of interest in improving the process.

Method: We performed our usability tests by having the participants walk through what we considered to be a normal, small checkout experience. This included one item which had no barcode and needed to be identified, several items which had barcodes and would present no difficulty, and an optional ‘member rewards’ card swipe. If the card swipe was not performed, then a discount was not applied to the purchase. Otherwise, the participants received a discount on their simulated purchase. The computer performed all tasks that the self-checkout device would normally do, including moving items as if a conveyor belt were present, and updating the customer-facing terminal as appropriate. Participants were provided only the feedback that the device would provide, which led to us realizing some changes were required both in the process as well as in the prototype itself.

Changes: Our first major change was a result of our first usability test. In the scenario we originally placed the groceries on the same table the prototype was located at. As a result, we did not accurately simulate the shopping cart/basket stage of the checkout process, meaning that a signifier that was originally part of our design was completely missed. We discussed this as a group and removed the signifier entirely- a sign located at the top of the scanning area- and instead put a set of textual instructions directly on the terminal. These instructions would appear after the customer touched the ‘start’ icon, which we felt would help funnel customers into our streamlined checkout process. We also began placing all the items on a rolling chair, telling the participants that this was their ‘shopping basket’. As a result, we no longer assumed the conveyor would automatically start, and that the customer instead chose to initiate the process through a direct, unambiguous interaction with the device. Because of these changes, our participants did begin to use the device in a fashion that helped them to understand the process better, and the feedback they gave us indicated that this understanding was a direct result of the changes.

It should be noted that one participant in specific had difficulty starting the process, but during the post-test wrap up, they said that they did not realize that the terminal screen on the prototype was a touch screen, and if they had realized this, they would have immediately approached it to assess the current state of the device. We took this to be a failing of the prototype due to fidelity, rather than the overall design itself.

Testing Results

The fundamental components of our paper prototype include 1) the scanner box, where all items passing through are identified and scanned 2) the main screen that the customer interacts with throughout the checkout experience 3) the conveyer belt, which moves the items to the scanner box and bagging area 4) the scale, where customers weigh items such as produce, if necessary, and 5) the simplified payment terminal that includes 3 slots, one for cash, one for coins, and one for receipts/coupons. These fundamental components have

remained throughout our testing, but have been refined based on heuristic evaluation, usability testing, and design critique.

Our first heuristic evaluation was done in class by Adam. He tested our paper prototype and gave us exposure to some of the iterations that were necessary and therefore implemented in our later paper prototypes. This includes that 1) we needed a screen after the “Start” button that tells customers to “Place all items on conveyer belt” and some way to indicate that after the “Start” button is pressed that the conveyer belt automatically activates. (heuristic: visibility of system status/user control) 2) Adam did not know how to place the items (i.e. have the barcodes facing up or at the side) and ignored the sign on the scanner that wrote out the instructions. This told our team that we need a better way of telling customers how to place their items (heuristic: recognition) 3) he would also place items one by one, instead of placing multiple items at a time. We think that having an image of multiple items being placed on the “Place all items on conveyer belt” screen will help alleviate this issue (heuristic: recognition) 4) during payment, Adam swiped the credit card instead of inserting it in the chip reader. This showed our team that we need to create a screen that lets the customer know their payment method failed and where they stand. We also need to make the credit card payment sections more prominent (heuristic: error prevention) 5) we need to create a “Payment confirmed / Thank you” screen so customers know that their payment went through and the process is completed (heuristic: visibility of system status).

Our second heuristic evaluation was done outside of class by Zol, a Masters of Human-Computer Interaction + Design student. Before we started this evaluation, we made changes based on our first heuristic evaluation. We created the “Place all items on conveyer belt” screen, made the credit card sections more prominent by having them light up once a customer selects “credit” and made the “Payment confirmed / Thank you” screen. All of this proved very helpful because the second heuristic evaluation went smoother. From this interaction, the main things we learned were: 1) the total price should appear in real time on the ledger (heuristic: system status) 2) there should be the ability to scroll on the ledger if necessary (heuristic: system status) 3) we should relocate the “coupon” button at the bottom side and only display that when it is necessary, which is during the payment phase (heuristic: recognition) 4) the issue of putting only one item in at a time and not knowing how to place the items (i.e. with the barcode facing up or at the side) still remained a problem (heuristic: recognition).

When we moved on to our three usability tests, more issues and iterations were made. Our first participant, Melody, studied Technology and HR in college, currently works in the tech field, and uses self-checkouts a lot. We learned from the testing process that our transitions are slow, mainly because we have many individual pieces in our paper prototype. We helped fix this in later testing by having more team members involved to make the process smoother. More importantly, the changes we made based on our prior evaluation included 1) adding the total price in real time on the ledger as items go through the scanner box 2) adding scroll arrows to the ledger 3) relocating the instructions on how to place the items from the scanner

box to the terminal 4) relocating the “coupon” button at the bottom side and have it display only during the payment phase, 5) relocating the swipe “member rewards” card to display during payment phase 6) having the suggested items in the “Items Not Recognized” screen be rounded so customers know they’re clickable buttons. These iterations helped the usability test with Melody go smoothly, but with our two remaining usability tests we wanted to add a scanner gun for oversized items, such as dog food, to see how participants react, give them a members rewards card, and see if the new iterations work well with them.

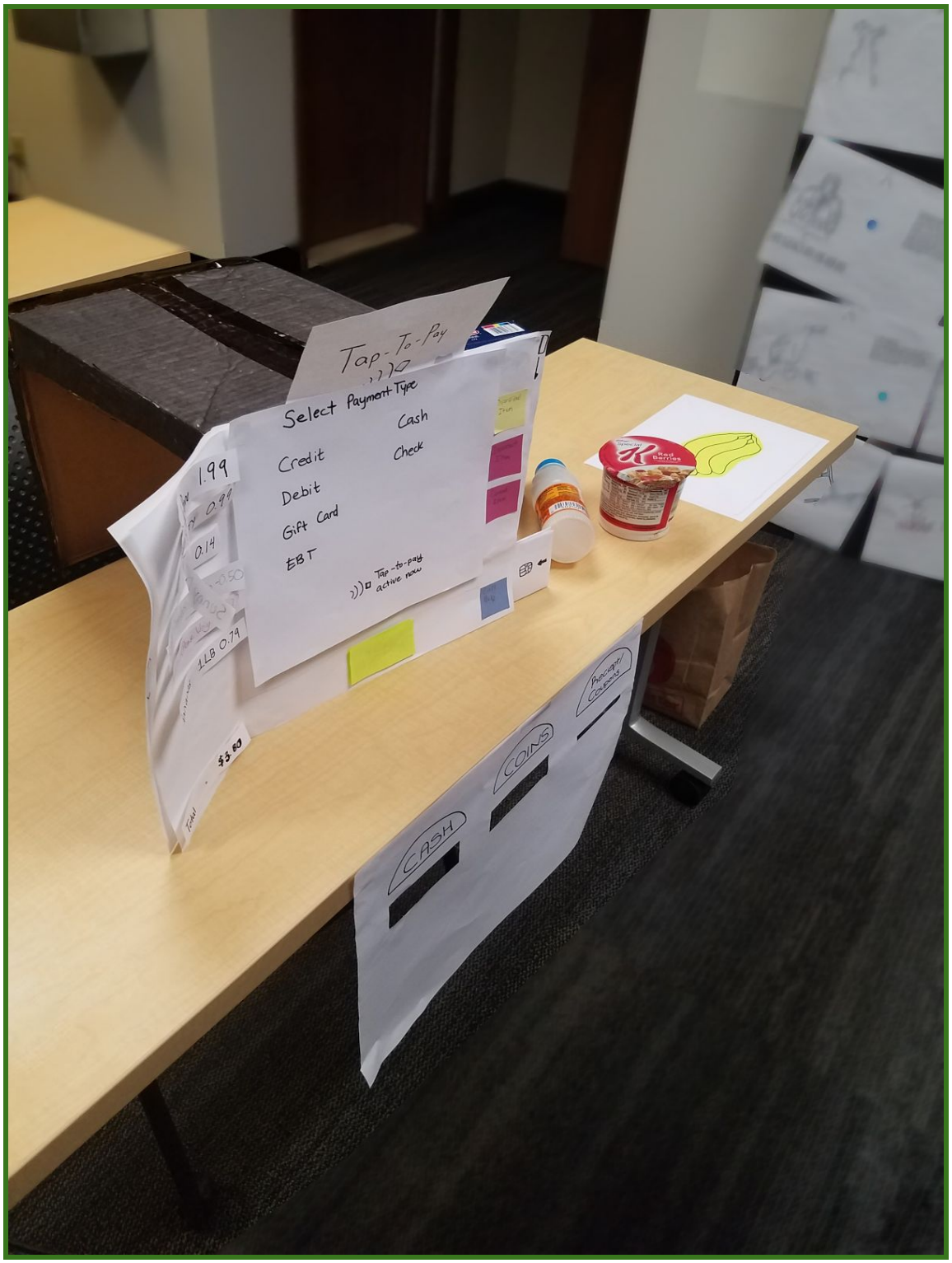
Our second participant was Varun, a tech-savvy adult that is getting his Masters of Human-Computer Interaction + Design and frequently uses self-checkouts. We learned from this usability test that the scanner gun was a great implementation. Varun used the scanner gun to checkout an oversized item, dog food, and found it intuitive to use. He also mentioned that if he had just a couple of items, instead of placing all of the items on the conveyer belt, he would just scan them with the scanner gun because it’s even faster. Varun also swiped his rewards card after clicking “Pay Now.” This is not the ideal flow. The card should be swiped earlier to reveal discounts. This helped us decide to create and leave the “Member's Rewards” button on the right side of the terminal throughout the checkout process so that the card can be swiped earlier. Later on, we decided to also add more proactive audible instructions, such as “scan rewards card,” with closed captions to help the customer know what to do at every stage, and input video/image instructions when necessary. We also removed the words “tap-to-pay” on the contactless payment system to reduce confusion and clutter.

Our third usability test was with Edward, a tech-savvy adult who is also an MHCI+D student and frequently uses self-checkouts. We gave Edward a shopper card, but this time, we told him that he knew that there was a member-only deal with the items he purchased. He swiped the card early in the process, which was the right course of action. Everything went smoothly in this usability test, including usage of the new scanner gun. However, in the beginning Edward thought the terminal was static, and not an interactive touch screen. This made him confused about how to start, and further confirmed our idea that audio instructions with closed captions are necessary at times to guide the customer on what to do.

Finally, design critiques were also very important in regularly refining our paper prototypes. It mainly helped us learn to place one main screen in the middle of the self-checkout, instead of having multiple screens at different points, which was an idea we toyed with initially. It further helped us learn to leave the scale at the end of the checkout process, instead of on top of the scanner, for accessibility purposes. And, it helped us refine our text, add more images, such as in “suggested items,” and know to have the conveyer belt be automatic for speed purposes.

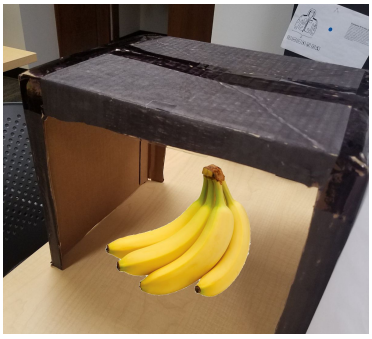
Final Paper Prototype

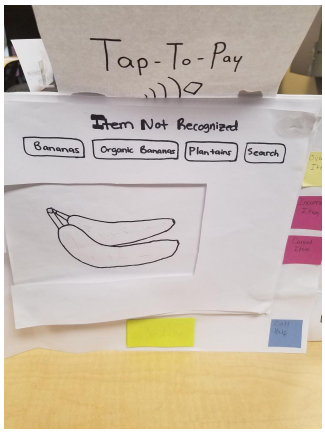
Overview

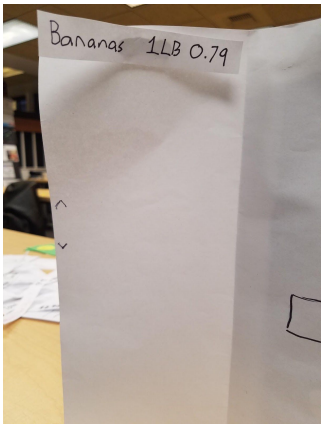


Our final paper prototype features multiple UI changes such as adding bubbles around buttons so they are recognized as buttons, adding a reward card option, and making the coupon button only available during the select payment screen.
A few physical changes were made which includes adding a scanner gun for oversized items and moving the instruction label on the scanner box to the UI screen.

Task 1: Scanning Items without barcodes

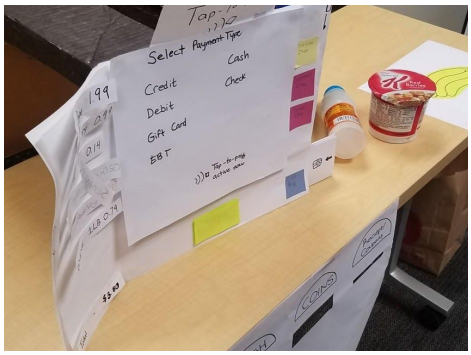






These images display the process of scanning an item with no barcode. The conveyer brings the item inside the scanner box. Ideally, the item is recognized automatically and added to the customer's log. If the item is not recognized, the UI prompts to user to select from a list of possible choices or search for the item in the database. Then the item is added to the customer's log.

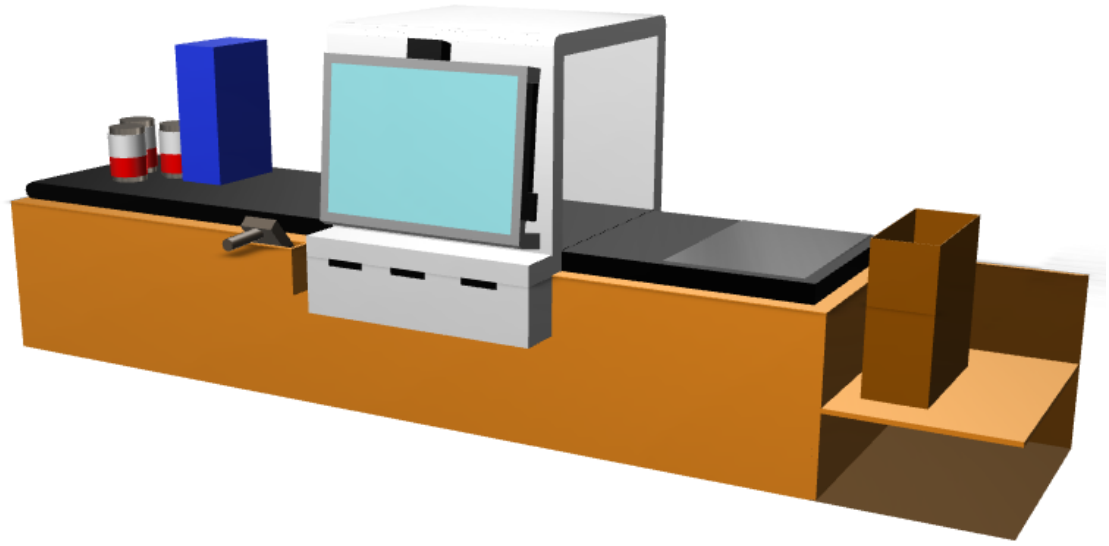
Task 2: Scanning multiple items

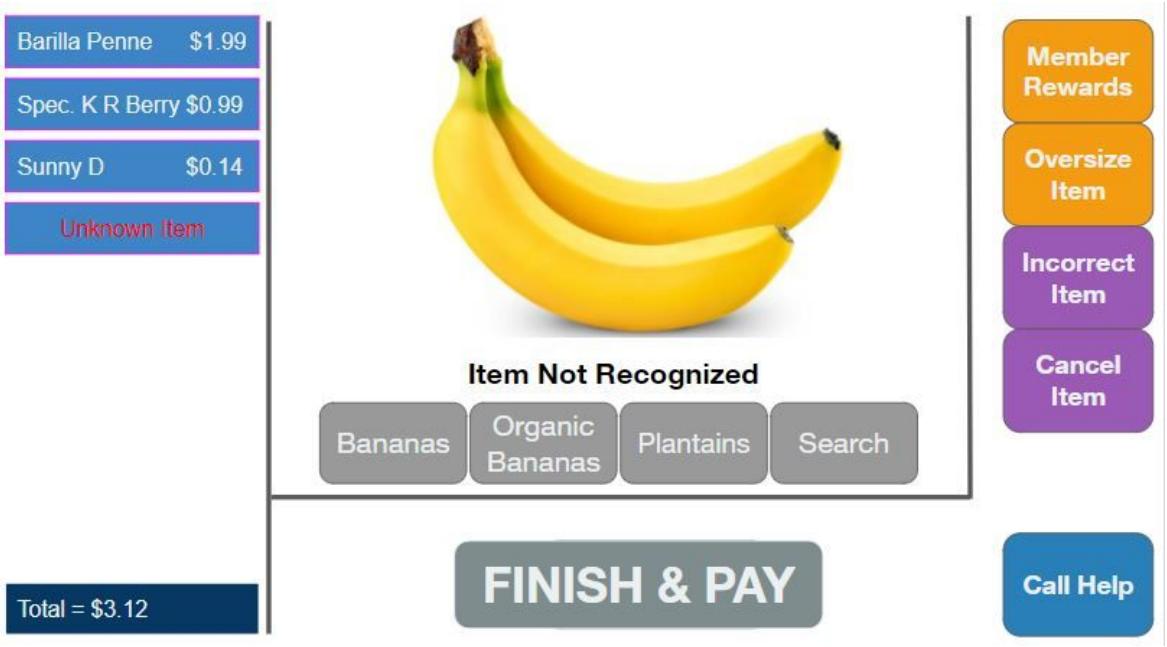


These images display the process of scanning multiple items at a time. Multiple items can pass through the scanner box which will scan every item through use of barcode scanners and cameras. As a result, all the items are accounted for.

Digital Mockup

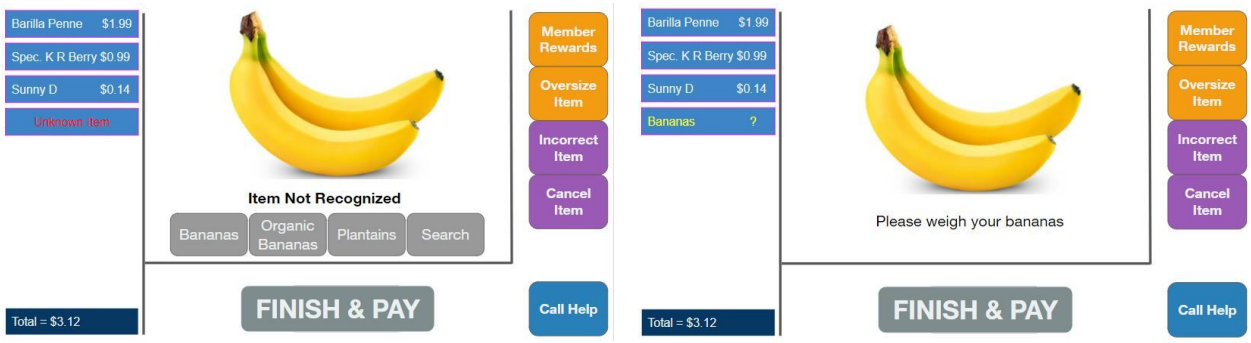
Overview





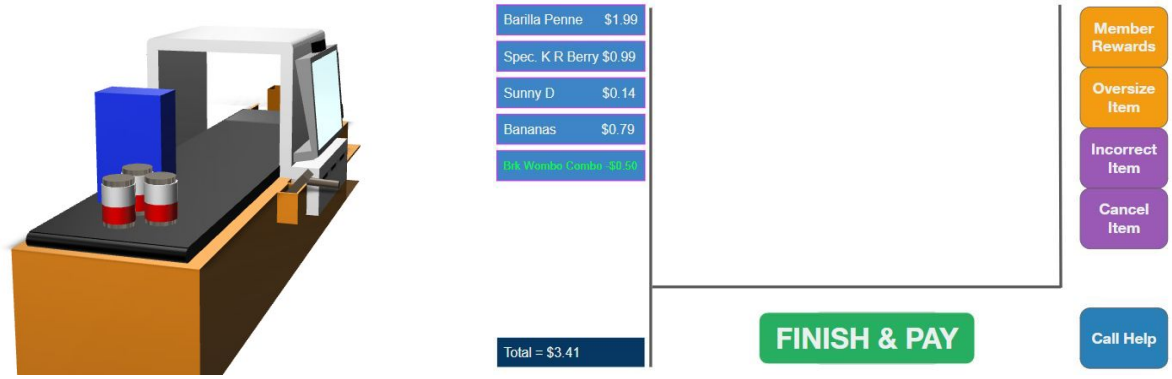
For our digital mockup we mainly copied our paper prototype with a few UI changes to make it look cleaner. Transitioning from our paper prototype to our digital mockup required us to use generic store items, such as cans, as our modelling program did not have specific items in it. In response to critique for improving the UI, we highlighted each item in the log, changed the colors of the buttons to complement each other, and moved the buttons from the top of the item not recognized screen to the bottom.

Task 1: Scanning Items without barcodes



From here we see the process of scanning items without barcodes on our digital mockup. An item that is not recognize will prompt the user to choose what the item is or search for it by pressing the search button. After doing that, the customer is told to weigh the item if applicable. If the item is automatically recognized, then the customer would just need to weigh the item and then the conveyer will continue moving.

Task 2: Scanning multiple items



The process of scanning multiple items in our digital mockup involves placing multiple items on the conveyer as seen in the first image. All items can pass through the box at once and are automatically recognized. A few interruptions to this clean workflow would be if an item needs to be weighed or if an item is not recognized. Both of which, require user intervention.

Discussion

We learned a lot from the process of iterative design. Since we had a lot of exposure our own project, we knew our product's implementation inside an out. This meant we did not have an impartial view of the true usability of our self-checkout. The iterative design process allowed us to figure out shortcomings in our design, solve them, implement those changes and test once again quickly, allowing us to quickly narrow-in on a design that was clear and allows our customers to complete their tasks (scanning multiple items and scanning items without barcodes) quickly and efficiently.

For Check Yourself, most of our issues were due to the designed from the ground up nature of our design. We did not have a platform to work off of like mobile apps do, and we didn't have a UI kit, so we could assume the user had less context than for an app. This meant that our issues were mainly with making sure the customer never loses track of where in the process funnel they were, and what they needed to do next. Our final design is significantly different because of this fact. Mainly we use a lot more of two things because of our design process. We added more contextual help such as the first screen after the welcome screen, since we saw that first time customers didn't always naturally put their items on the conveyor, and that screen helped them understand what they needed to do to get going. We also added more false affordances, like the member rewards button, you can always swipe your member rewards card, but without that false visibility, people sometimes missed the opportunity to before their lack of doing so caused them confusion.

In regards to tasks, our solution is unique. Our two main tasks were scanning multiple items, and scanning items with bad barcodes or no barcodes. Most groups probably added functionality in their projects to allow users to explicitly accomplish their tasks; however, we decided to solve the tasks by removing our customers' need to do them themselves in the first place. Instead, we had the machine completely take over the responsibility of scanning all items, which included multiple of the same item as well as items without barcodes. This means our tasks have always been the same. Where our tasks changed was in the "edge cases" like what if a barcode-less item still can't be identified despite using ML? The way we handled this changed quite a bit from the original design. Our interface for selecting the correct item used to just show the suggestions, but one of our preliminary designs revealed it was important to keep showing the item in question as to not let the customer lose context. Figuring out how to best account for these unplanned cases were where most of the changes to our tasks were realized.

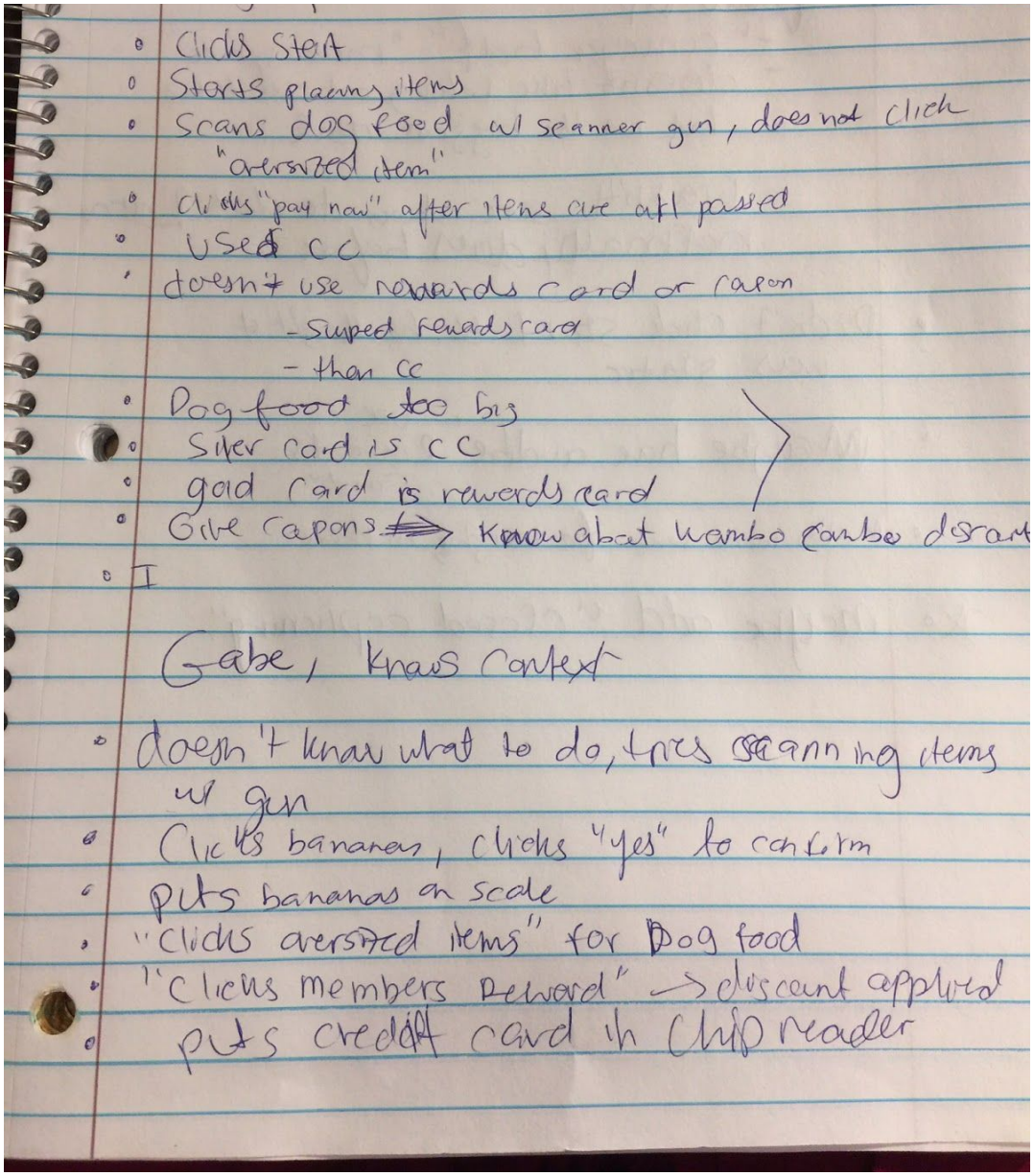
In terms of the number of iterations of the design, our design was also unique in that the display was necessarily vertical. This made paper prototyping tests much more cumbersome than if the interface could have been horizontal. We agree that we could have used more iterations in prototyping the user interface of the display, but with the vertical interface, each extra iteration cycle would take up a lot of time, and the some of the paper UI would start wearing out (due to the added wear from with our setup.) We think if we could have an iteration

or two with a simulated touch screen using a tablet running PowerPoint or something would have been most ideal. Our prototype runs in PowerPoint, and is interactive, so that would have been possible without too much extra work.

Overall, our prototyping process was very informative to our final design, and our self-checkout is much more clear and easy to use because of it.

Appendix

These are the notes we took in paper during our usability testing:



- places items oddly
- then clicks start
- clicks "bananas" normal
- places bananas on scan
- Do I click Pay now or bag first?
- Clicks "credit card"
- Swipes card
- bags items

* Price in real time ledger

"fun, interesting"

- Make explicit that you can use multiple items

- wasn't sure what to do w/ fruits
- "Do I put all items then click Go?"
- When to bag instructions? IDC
- Interface was helpful
- Remove "Cupon" on side & have insert Coupon screen after payment screen

- I want to scroll on ledger
- Put scanner, maybe buy payment section

- follow up
  - "conveyer belt" "more space"
  - doesn't like taking out all items but not the biggest deal
  - wasn't sure when to click button, normally does before
- Didn't click start bc he thought it was static
- Maybe have audibe "use Rewards Card"
- Makes more sense for weights on there
- Maybe add "closed captioning"