ECE Capstone Project Summary & Review

Fall 2020
(Each team should complete one form per team)

Project Title

Socially Distanced Dispenser

Team members & Roles (list each of the members of the team (plus their majors) and the role they played on the team)

Justin Nguyen-Galante (CpE & CS) Mobile App Developer

Jake Moses (CPE) Embedded Code Developer

Jonathan Burkher (CS & CpE) Mobile App Developer

Short Project Description
(A few sentences; maybe a picture also)

The Socially Distanced Dispenser is a new, safer way to quickly dispense food to people by limiting surface contact to avoid contamination from multiple people using it. It consists of five main parts: a mobile application, Bluetooth connector, a microcontroller, a motor, and a physical food dispenser to store and output the desired quantity of food. The overall order of operations for the device is as follows: A mobile application wirelessly connects to the microcontroller and establishes two-way communication. The mobile app tells the microcontroller how much food to dispense and the microcontroller responds with success/error messages.

Requirements
(Describe the requirements of a successful solution. Include metrics and target goals for each requirement.)

Requirements for a successful solution included the following: allowing 1 user (and only 1 user) to connect to the dispenser at a time, with that connection taking less than 3 seconds to establish, establishing a direct line of communication between the user and the machine with very low latency (less than 1 second), the motor needs to spin a specified number of times (determined by the user) and report an error when the motor has taken too long to spin (error goes to the user), and there must be a guarantte that no private data (from the user) is exposed over the bluetooth connection to the dispenser.

Constraints
(Describe three constraints that affected the design of your project and how these constraints shaped your design. Examples of constraints include accessibility, aesthetics, codes, constructability, cost, ergonomics, extensibility, functionality, interoperability, ethical or legal considerations, maintainability, manufacturability, marketability, performance, policy regulations, power consumption, schedule, standards or usability. For the three constraints that affected your design, list the degree to which it was considered in your project, write a few sentences describing the effect of this constraint on the design.)

One of the primary constraints of this project is accessibility. This was strongly considered for our project, as we needed to ensure parts we wanted would be available before we began assembly. All parts that we had to order from Digikey were checked to ensure there was a enough in stock. Other board components, such as resistors and capacitors, could be taken from our lab kits from the Fundamentals of Electrical Engineering series. Other non-electrical components could be

Another constraint of the project was cost. This constraint was a very important consideration in our project, as we had a stern budget limit of $500 we could not go over. This meant that we had to be careful in our spending to efficiently acquire needed quality parts and not overspend in areas where cost could be reduced.

One of the biggest constraints for the development of the mobile app was exisiting Bluetooth communciation libraries and the corresponding hardware that was available to us. There are no BLE libraries that can be used for a pure React Native project, so we had to choose between either iOS or Android. Since all of the team members owned only iPhones, we were forced to

Standards
(Describe at least one engineering standard that was used in the design of this project and how it was used)

External factors
(Describe the external factors being considered in your STS research paper. External factors include public health, safety and welfare as well as global, cultural, social, environmental and economic factors.)

The biggest external factor that the Socially Distanced Dispenser aims to consider is that of public health. Currently, the Covid-19 pandemic shows no signs of slowing down. The main goal of the dispenser is to reduce the number of shared surfaces between users so that there are less opportunities for the virus to spread. Even after the pandemic eventually comes to a close, the dispenser could still serve to reduce the spread of other contact-based infections or diseases.

Trade-offs
(Describe at least one tradeoff facing your design. Describe at least two approaches that could be used to produce a workable solution to your design goals and what analysis you performed to evaluate the tradeoff.)

One of the trade-offs that we experienced in our design was whether we were going to allow users to customize how many ounces of food that they wanted, versus having set options that were dependent on the number of “turns” of the dispenser handle. This trade-off impacted the flexibility the user has when using our product, as well as the need for using more components that needed to be in constant communication.

Approach 1

The first approach was to have pre-set values for the user to choose from, for example: a user could select 3 turns which would mean that they would get 3-turns worth of food from the dispenser. This made it easier for our team, as instead of having to perform intermediate calculations to determine how long the motor had to turn for we could instead write a program to turn the motor X number of times. The downside of this was that the user has less flexibility in terms of needing to choose from concrete values and would need to estimate how much food would be dispensed in a single turn of the

Approach 2

The second approach was to allow users to enter a positive integer specifying the number of pounds or ounces they desired from the dispense. The downside of this approach was that we would have needed a lot more components on our device: we would have needed a scale or measuring system that gave timely feedback to the MSP so that it new to keep turning or stop turning, and we would have had to find our own “internal spinning mechanism” that would allow the dispensing of smaller increments of product. The upside would be that the user had more control over how much product they were receiving from the dispenser.

Risks
(Describe at least one risk that was considered and how the risk was mitigated. This can be a risk to the project or a risk to society related to the project)

One of the largest risks that we took in regards to the project was we did not do any end-to-end testing until the very end of the project. This was mainly due to a condensed timeline and several setbacks for the physical construction of the dispenser. We mitigated this risk as best we could by testing all of our independent components and testing the interaction they had with their immediate neighbors in the pipeline. For example, we tested if the mobile application could connect to the Bluetooth module and communicate with it. Then, we tested if the Bluetooth module would interface with the microcontroller correctly, and then finally if the microcontroller could get the motor to spin correctly. But as stated earlier, we

Application of Science, Mathematics and Engineering
(Describe at least three principles of science mathematics or engineering that were applicable to this project. This can be three topics that you learned in classes that impacted your design approach. A few sentences on each of three principles is sufficient.)

One of the most important principles of engineering that our group adhered to was concurrent engineering. As stated earlier, there were several independent components that had to come together for the final product, all of which had some delay in one form or another. Concurrent engineering was key in ensuring our ability to complete the project before the deadline. If we worked on all the components in a linear fashion, we certainly would not have been able to deliver the final product.

Another principle of engineering was testability. In order to create a smooth workflow in our project, we ensured the design had repeatable tests that could be performed on each part and on connections between the parts. This was essential in debugging, as we did come across a couple

One principle of engineering we adhered to was identifying priorities and milestones ahead of time. We planned out what was most important and core to the project to determine what had to be finished first. This included planning documents, budgets, and actual assembly of parts. Planning ahead of time what we had to do ensured that each group member knew what they had

Application of knowledge and skills acquired in earlier course work
(This is similar to the one above but here we want you to list at least three courses whose specific knowledge and skills were applied in this project. List three courses and the most relevant topics from

ECE 3430: Intro to Embedded Computer Systems. This course taught us how to utilize different parts of an MSP430 microntroller (UART, GPIO pins, ISR) and how to properly setup and execute the code in the microcontroller. This project would not have been doable without having taken this class.

CS 4720: Mobile Applications Development: This course taught us what tools and processes should be used to create a user-friendly mobile application. For example, we learned how to use Figma, a UI designing tool, to layout our app before any coding started. We also learned the

Test Plan
(Include a short summary of your test plan, the results that it produced and your interpretation of the results. This may be a separate document and should also be included in your final project report.)

Acquisition of new knowledge
(For each member of the team, describe one new thing that you had to learn and how you learned what you needed to know, one member per box)

Justin Nguyen-Galante: One new thing I needed to learn when creating the mobile application was how to transform a pure React Native project into a native iOS project. This was due to the fact that there were no Bluetooth libraries compatible with pure React Native, they were only compatible with either iOS or Android. I learened what I needed to know by reading lots of

Jonathan Burkher: Something new I learned was how to use Bluetooth communication. This was so that our mobile application could connect to the Bluetooth chip that was connected to the

Jake Moses: I learned a lot about the MSP430FR2311 chip and how to effectively use UART to communicate through a bluetooth device. I needed to know how to send out data through the Bluetooth and generate interrupts based on when data came back through the Bluetooth. I learned what I needed to through analyzing the MSP430 user guide as well as the HM-19 Bluetooth Module datasheet. By analyzing these documents I was able to create quick, efficient communication between a user's phone and the MSP430— by utilizing bluetooth.

Team Self-Assessment (the following is the first of two copies of an assessment form that will be used to evaluate your project success and team performance. Use the first one to perform a team self-assessment on these aspects. This self-assessment will not be considered as part of the grading for your project)

	5 - Excellent	4	3 - Adequate	2	1 - Unsatisfactory
Requirements & Success Criteria Has the team understood the problem clearly and the requirements for a solution? Are there a well-defined metrics for success with target goals? Does the metric adequately represent the desired success criteria?	◉	○	○	○	○
Constraints Were design alternatives and tradeoffs considered with respect to realistic constraints?	○	◉	○	○	○
Standards Did the team utilize appropriate standards? Are there other standards that should have been considered?	◉	○	○	○	○

	5 - Excellent	4	3 - Adequate	2	1 - Unsatisfactory
Evaluating Trade-offs Is there a well-defined model for evaluating the design and alternatives? Are design choices justified using a model?	○	○	◉	○	○
Risk Identification and Mitigation To what extent was the team successful in tracking and evaluating progress and negotiating changes required by unexpected events or other setbacks?	◉	○	○	○	○
Overall success of design Is the design well executed? What is the overall evaluation of the design?	○	◉	○	○	○

	5 - Excellent	4	3 - Adequate	2	1 - Unsatisfactory
Separation of concerns To what extent did the team succeed in defining and executing their individual roles? Did each team member have a clearly defined set of tasks? Were the functional relationships between the separate team members clearly articulated?	◉	○	○	○	○
Team Integration Were the interfaces between the artifacts produced by the separate team members clearly defined? Did each team member understand how their tasks fit in the whole?	◉	○	○	○	○
Team Interactions To what extent did the team work together to provide leadership and interact collaboratively and inclusively?	◉	○	○	○	○
Overall Team Satisfaction To what extent did the team succeed as a group?	◉	○	○	○	○

Comments