Initial Project Proposal

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1.0 Description of Problem:

Organization for commonly used items is highly valued by many people today. In particular, organization is important in a kitchen, and keeping ingredients organized helps to speed up the cooking process. Having a way to organize spices, find the desired one, and generate a shopping list of needed spices without having to examine every container, would allow everyone who cooks to always have enough spices on hand and be able to easily access them when cooking. Therefore, a more intelligent organization system would be of great use.

2.0 Proposed Solution:

The proposed device, the Super Susan, is an automated lazy Susan which has the capability to monitor the amount of spices remaining in each container. The turntable will have a user interface which allows the user to select the desired spice from the list of spices on the Super Susan. The Super Susan then rotates so that the desired spice appears in front of the user. Additionally, the Super Susan monitors the amount of spice left (either by weight or volume) and supplies a list of which spices are almost gone upon user request. Additional modularity can be added so that the Super Susan will respond to voice commands, and so that the Super Susan connects to a phone app which allows the user to check the list of needed spices from the grocery store. See Appendix 1 for a concept sketch.

3.0 ECE477 Course Requirements Satisfaction

3.1 Expected Microcontroller Responsibilities

ECE477 requires the use of one or more student-programmed microcontrollers. For the purpose of this design, a microcontroller will be used to accept input from a simple hardware interface, to sample analog values from a weight measurement circuit, to read and remember the RFID cards of the various bottles, to control motors to reposition these bottles, and to interface with a Bluetooth module to take signal input from mobile phone devices. Additional functionality can be expanded to interface with barcode readers to look up bottled item information via access to the internet.

3.2 Expected Printed Circuit Responsibilities

ECE477 is an embedded systems course which requires the use of a student-designed and built printed circuit board (PCB). For the proposed project, the PCB will incorporate the microcontroller, external memory if necessary, the analog weight measurement circuit, the motor control circuitry, and the Bluetooth module interface. The scope of this project permits having a regulated external wall adapter, so power circuitry will not be included. Due to the need to weigh and identify bottles, the circuit board will be oriented toward the center of the packaging; and the user interface, (including buttons, dial and LCD screen), will have external wires connected to the board. Although not strictly required, the user interface may be upgraded with an additional PCB that collects these components.

4.0 Market Analysis:

A market analysis assessing the uses for a product such as the Super Susan has been conducted, and the expected use is primarily as a kitchen accessory used to help organize and manage household spices. Based on gauged interest of standard spices [1], it appears that the average number of spices used comes to about 20. This number varies based on experience cooking and preference for specific cuisines [2], but a device such as the Super Susan would be helpful to all cooks. As a quality-of-living device, it is not a necessity but rather a convenient piece of technology; and the Super Susan would appeal to the typical middle-class household which prepares homemade food on a regular basis.

5.0 Competitive Analysis:

5.1 Preliminary Patent Analysis:

A patent analysis was conducted with respect to our idea of a motorized lazy Susan with automatic choice selection capabilities, and no patents for related commercial products were found, even for those listed in the commercial product analysis. As a result, a patent analysis was conducted for the individual components of our design with those being the lazy Susan itself, weight sensing technology, and near field communication. Furthermore, it is unlikely that our project will be subjected to infringement claims on the basis that nothing like it has been patented.

5.1.1 US Patent Application US3448701A:

Patent Title: Motorized lazy-susan table
Patent Holder: Elmer R Cordova
Patent Filing Date: November 22, 1967

This patent [3], assigned to Elmer Cordova, pertains to a way of motorizing a lazy Susan table to automate the spinning process. This process would involve a small circular area which is connected to a shaft, which is then surrounded by a larger circular perimeter and long legs to provide support. This lazy Susan seems to be able to support heavy loads. The disadvantage of this design compared to the proposed design is the lack of a selection mechanism which would automatically control the motor. It is worth noting that in this patent, the design is that of a table;

what we wish to design is a regular-sized lazy Susan.

5.1.2 US Patent Application US7881665B2:
Patent Title: Near field communications, NFC, communicators and NFC communications enabled devices
Patent Holder: NXP USA Inc
Patent Filing Date: March 10, 2006

This patent [4] is mainly concerned with how near field communications (NFC) devices interact with each other, with a variable impedance that allows the communication range to be varied. This patent seems to be more of a framework which other projects can incorporate into their designs. Our use of this patent would be to study how NFC communicators work and incorporate a design that would work with the Super Susan's bottle system.

5.1.3 Chinese Patent Application CN203885207U:
Patent Title: Electric lazy susan
Patent Holder: Luō Àiguó
Patent Filing Date: December 4, 2013

This patent [5] talks about converting a standard lazy Susan into an electric version by using a motor that provides rotation for the assembly through the addition of a storage battery that provides power. This is in essence what we would like to accomplish with our design, bar the battery system. What this design does not have, however, is precise motor control which would be used to present the user with the selected spice.

5.2 Commercial Product Analysis:

5.2.1 Rotadine:

The Rotadine [6] is an electric, battery-powered lazy Susan which can rotate continuously for up to 12 hours, or turn to a position based on the user pressing the on/off button. Features of the device include a removable glass top for easy cleaning, controlled acceleration that prevents contents from spilling, and a quiet rotation system. The Rotadine is approximately $220.

The removable top, smooth acceleration, and quiet rotation are all advantages of the Rotadine. The quiet and smooth rotation are both things we plan to include in the Super Susan, and we may want to consider adding a removable top. Being battery powered makes the Rotadine convenient to use and is a significant advantage, but it is also a disadvantage because the battery must be charged and has a limited life. Because we want the Super Susan to operate for several months without needing maintenance, it will need to be powered directly from a power outlet and not by batteries. A major disadvantage to the Rotadine is the cost – we are hoping to make something that is affordable for the everyday user (under $50).

5.2.2 Prime-Spin 12" Electric Turntable:

The Prime-Spin Electric Turntable [7] has quiet rotation, and it can rotate in either direction at a speed of 3.5 revolutions per minute (17 seconds per rotation). The turntable can hold up to 175 pounds and costs $170. The product must be plugged in to operate. Advertised uses include photography, product display, and cake display.

The quiet rotation is the most advantageous aspect of the Prime-Spin Electric Turntable. Its durability and weight capacity are also quite impressive, though the Super Susan will not need to hold this much weight if it is simply holding spices (however, we may consider making it more durable so it can be used for other purposes such as organizing hardware parts). The slow rotation is good for keeping the contents stable, but we may be able to turn faster since we are not trying to make a product for photography. The cost is again much more than we had hoped; perhaps our original goal of $50 is unrealistic.

5.2.3 7-inch Battery Operated Lazy Susan:

This turntable [8] is very lightweight (0.93 pounds) and has two speed levels at which it can rotate. The product is smaller than most - only 7 inches in diameter. It is battery operated, and it only costs $40.

In terms of cost, this is the closest to what we hope to achieve. However, it is rather small, and the Super Susan will need to be bigger, both to accommodate the spices and to have sufficient space for the electronics. The two speeds of this design are a nice feature, but multiple speeds are probably not necessary for the Super Susan since it will only be presenting the desired spice and not rotating continuously.

5.3 Open Source Project Analysis:

5.3.1 DIY Motorized Lazy Susan:

This project [9] is a demo for a do-it-yourself electric lazy Susan. The builder's purpose for the project is a rotating display for his photography hobby, and therefore the idea uses a servo that spins continuously in only one direction.

The project uses a servo motor, which is not in sync with our design process since we have decided to use stepper motors for the ease of precise turning. This project introduces important factors for our design which we had not previously considered, such as the ability to bare loads and the need for it to be quiet so it is not distracting in the environment of its intended use.

5.3.2 Android NFC Tagging:

Near-field communication (NFC) [10] is the protocol we have chosen to use for tagging the spice containers. The intended use for NFC is to provide a way to tag containers so that each spice does not necessarily have to be replaced to the same fixed position each time. Instead, the tagged containers will be identified each time they are placed on the Super Susan.

Because NFC is a passive circuit and because a team member has prior experience using this technology, we chose to include NFC. An apache open source license is available with the code and a tutorial.

5.3.3 Open Source Project #3:

One of the ways by which we aim to improve the quality of the user's experience is to implement a barcode scanner. The barcode scanner would return a serial numbers belonging to the spices which we could use to find out the original amount the product in the container. Then we could refer to this to track the percent remaining. The large serial number database used to reference the product is Google's barcode API [11]. It is an open source library started by Google and is usable under Apache 2.0 license.

6.0 Sources Cited:

[1] Reddit (2016). *Best/essential spices everyone should have in their cupboard?* [Online]. Available: https://www.reddit.com/r/Cooking/comments/3padio/bestessential_spices_everyone_should_have_in/

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[4] Symons, Peter (2005). *Near field communications, NFC, communicators and NFC communications enabled devices*. Available: https://patents.google.com/patent/US7881665B2

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[8] VXB.com Bearings (2017). *7 inch Battery Operated Lazy Susan.* [Online]. Available: http://www.vxb.com/7-inch-Battery-Operated-Lazy-Susan-p/BatteryLazySusan.htm

[9] YouTube *(2015). Motorized (but quiet) display turntable from scraps.* [Online]. Available*:* *https://www.youtube.com/watch?v=JFo6Tpr_6jA*

[10] Wondratschek, R. (2017). *Reading NFC Tags With Android*. [Online]. Available: https://code.tutsplus.com/tutorials/reading-nfc-tags-with-android--mobile-17278

[11] Barcodelookup (2015). *UPC, EAN and ISBN Search*. [Online]. Available: https://www.barcodelookup.com/api

Appendix 1: Concept Sketch