Principles of Engineering
Spice Dispenser Project Proposal

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Abstract

For our PoE project, we will address the task of creating an automatic spice dispenser that will be able to autonomously dispense desired amounts of spices into a collection vessel, as indicated by a user in a computer graphical user interface. This device would consist of a platform with containers of spices positioned on a turn-table above. A dc motor and an optical encoder would control the rotation of the turn-table to automatically spin it to a specified spice. A release mechanism would then automatically measure and dispense a set amount into a vessel, as desired by the user. A GUI would allow the user to easily create and store spice recipes. For any created recipe, the turn-table would rotate sequentially to the designated spices and release the appropriate amounts.

Project Description

Project Goals/Requirements

We intend to create a mechanical and electronic device with a computer interface that can be used to measure and dispense spices automatically into a bowl. The device should hold multiple spices, which can be specified by the user via a graphical user interface. The device should be able to autonomously position a specified spice for dispensing, and then dispense a particular amount of that spice into the desired vessel (such as a bowl). Entire recipes should be able to be created and saved with the GUI, and then executed by the device on command. The user should be able to create spice mixtures by interacting solely with the GUI.

Proposed Solution

Our device will be in the form of a circular turn-table, with individual containers for spices located near the perimeter of the turn-table. The turn-table will be constructed primarily out of a plastic such as Delrin. To turn the table, we will use a simple geared-down 12V dc motor. An alternative to spinning the structure holding the spices would be to spin a platform beneath the spices; this may end up being simpler depending on what sort of release mechanism we use and how much torque the spice table has. Positioning of the table will be

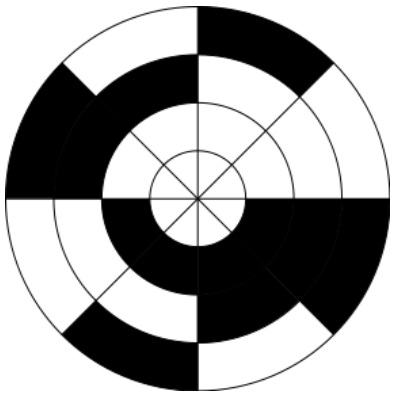

Figure 1: An example of a disk for use with an optical encoder.

accomplished by using an optical encoder; an example of a disk for use in this application is included in Figure 1. We are currently researching how to construct an optical encoding device using LED's and phototransistors. The motor will be interfaced to a PIC, which will control the table's rotation and trigger the release of a spice.

The method of dispensing the spices is still undetermined; we will most likely model our dispense mechanism using those found on preexisting spice carousels, though we have already done a few hours worth of brainstorming our own original ideas. We could have one dispensing mechanism on our device, to which the spice containers will turn before spice can be released, or we could put a separate mechanism on each spice container. For the release mechanism we anticipate needing one or more small motors. We have included some sketches of release mechanism ideas generated during our brainstorming sessions.

The GUI will be programmed using TkInter. The GUI will consist of text fields to input which spices are located on which positions of the turn-table, sliders to select how much of each spice currently on the table should be dispensed, and a window in which users can create recipes. Additional capabilities may be added. The information input by the user in this GUI will be passed to the PIC so that the spices may be dispensed. We have done preliminary sketches of a GUI layout to give an idea of what we envision; they are included at the end of this proposal.

Statement of Work and Scheduling

The members of our team will each work on all aspects of the project. We believe that we will have a better learning experience if we each are involved in the entire project, as opposed to splitting into teams to work on one of the mechanical, electrical, or software components. By not designating specific roles for our team members, we will ensure that each person understands all the project's aspects. And since the three components of our mechatronic system are so integrated, by working together on each part, we will ensure that there is no disconnect in the system.

At each of our three scheduled meetings per week (two class periods and one out of class meeting) we will decide whether to split up to work on two separate parts or to stay together as a group. This decision will be made on a daily basis as opposed to pre-

designating each member's role or job. Also, each meeting will have a particular agenda defined by upcoming deadlines and progress made on each task.

Our attached Gantt chart shows the layout of each process and task with deadlines to allow us to visualize processes that can be worked on in parallel. We also made deadlines for some important facets of the project, taking into account the dates of our design reviews. These deadlines are as follows:

October 23	Final decisions, sketches, and purchasing made for all required parts, save the containers.
November 2	Prototype 1- the mechanical and electrical elements, not including the release mechanism. GUI- Design 1 shell. Web Page- Home Page.
November 16	Prototype 2- revisions of Prototype 1 plus release mechanism. GUI- Design 1 complete and Design 2 shell. Web Page- Complete.
December 11	Complete design with integrated GUI. Web page complete.

Budget

An itemized budget is included in Table 1. Research for approximate prices was done on www.allelectronics.com (for motors), McMaster-Carr's website (for Delrin sheets and rods), and www.sdp-si.com/eStore/CoverPg/Gears.htm (for gears). So far we have allotted $220 of the $350 we are allowed, so we have some slack in our budget, but there are a few places in particular that we may need to use this extra allowance. We may be under or over-estimating the amount of Delrin we will need; in another week, after further designs are drawn, we will be able to approximate this better. Also, we may opt for a different thickness of Delrin or find a better material, in which case our budget will have to be adjusted accordingly. We are counting on the ECE stockroom to have our basic circuitry needs such as resistors, capacitors, a PIC, etc., but it is possible we may end up needing a more specialized component for something, which we will have to purchase ourselves.

Benchmarking

There are spice dispensers available to the public that dispense a premeasured amount of each spice for each click of a dial. KitchenArt has a number of such spice carousels, such as Select-A-Spice Ultimate Spice Carousel, or Auto Measure Select-A-Spice Carousel, ranging from $30 to $40. These spice dispensers are manual, and the user needs to turn a dial for each quarter teaspoon, which can be exhausting for a few tablespoons. The spice carousel does have a top that pops up to reveal a hole for pouring out spices in larger amounts. This model has also been transferred to liquor, with Global Dcor's Rotating 4 Bottle 1-1/2 Ounce Drink Dispenser, which will dispense 1.5 ounce shots.

KitchenArt also makes a salt and pepper dispenser, Easy Measure, which dispenses a pinch, 1/8 teaspoon, or a quarter teaspoon of spice (usually salt or pepper) by turning to

Figure 2: Some pre-existing spice carousels.

the labeled amount, and pressing on the top. This model differs from the previous one by being able to vary the amount by rotating a dial, and then dispensing the entire amount.

I&J Fisnar's robotic dispensing mechanisms are automated to dispense a proper amount of fluid. They make a variety of automated liquid dispensers for very precise measurements; applications are mostly for industry, replacing assembly lines in factories. Their rotary tables in particular are for dispensing circular patterns on areas that are difficult to access. These machines are far too expensive and more advanced than the scope of this project. The precision of these robots are not required to dispense an amount of spice.

Table 1: Budget

	Item	Budgeted Amount	Notes
Motor/ Positioning			
	12V dc motor	$5.00	For spinning the table.
	optical encoder	$10.00	In case we have to buy parts for this.
Electronic Components			
	vector board	$5.00	
	smaller motor(s)	$10.00	For the release mechanism(s).
	miscellaneous circuitry components	free?	Mostly get from stockroom.
Turntable Prototyping Supplies			
	scrap plywood/plastic	$25.00	
	blue foam	free?	
Final Turntable Materials			
	Delrin	$35.00	Pricing based on 12" x 24 " x .25 " sheet of white Delrin
	Gearing	$80.00	probably won't be this much, unless we need separate gears for several dispensing mechanisms
	Plastic rods	$10.00	For gear shafts.
Miscellaneous			
	spice containers	$25.00	(or for material to make custom containers)
	spices	$15.00	
Total Budget:		$220.00	