

ECE 4011/ECE 4012 Project Summary

Project Title	Automated Spice Mixer
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Project Abstract (250-300 words)	<p>The automated spice mixer is a device that will automatically dispense and weigh powders/spices conforming to various recipes. Currently the use of different spices and kitchen powders (such as Cinnamon, Cumin, Salt, Pepper, Flour, Sugar and other spices), presents challenges in both storage and proper measurements. Currently, users use measuring tools and containers for their powders/spices, but these methods are inefficient and inaccurate. Our automated spice mixer will focus on making the measurements accurate and efficiently storing the powders/spices.</p> <p>The advantages of our automated spice mixer is that it is connected to the Internet, which allows the user to be notified when the quantity of the powders/spice is low and access a recipe database. Also, our automated spice mixer will perform precise measurements and unit conversion capabilities. The use of a Raspberry Pi will allow the mixer to be connected to the Internet and a mobile application will allow the user to interface it. Additionally, algorithms will be implemented to create precise measurements along with simple calculations to convert units.</p> <p>The device uses a touch-screen LCD interface and a simplified UI to quickly allow the user to perform the desired function. Because this device will be used in household kitchens, the durability doesn't need to be equivalent to commercial grade materials.</p> <p>The prototype spice mixer device will cost approximately \$200 in parts, which will require a motor, stand/base, touchscreen LCD display, ten containers, and a Raspberry Pi. From an architectural point of view, back-end servers will be required to store and access information from and to the mobile application as well as the mixer. The back-end server will also data-scrape recipe websites to give the user recipe suggestions and access to a recipe database.</p>

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List codes and standards that significantly affect your project. Briefly describe how they influenced your design.	<ol style="list-style-type: none"> 1) FDA Food Code 4-201.11 Equipment and Utensils. Regarding durability and strength, the equipment shall be designed and constructed to be durable and to retain their characteristic qualities under normal use conditions. 2) FDA Food Code 4-202.11 Food-Contact Surfaces. Regarding cleanability , the nozzle shall be smooth, free of breaks, open seams, cracks, chips, inclusions, pits, and similar imperfections. Free of sharp internal angles, corners, and crevices. Finished to have smooth welds and joints; and accessible for cleaning and inspection with being disassembled/ 3) IEEE 802.11b/g - This is a standard for wireless local area connection communication. It will be used with the device and a router supporting the 802.11b/g standard will be required to form the wireless network. 4) LCD Interface - Several interfaces exist to connect monitors to embedded device including the prominent LVDS, and VGA connectors. Additionally, touch screen sensors require a controller which typically interfaces with the embedded device through a Serial/COM or USB port. Even though different controllers are required for the different touch sensors, the computer connections are standardized.
List at least two significant realistic design constraints that applied to your project. Briefly describe how they affected your design.	<ol style="list-style-type: none"> 1) Manufacturing cost and testing - Must minimize the quantity and cost of the different component purchased. This is done to reduce the potential sale price of the final product. 2) Accuracy of weight measurements - The weight measurements must match the desired quantity with a minimal error. 3) Speed of service - The machine speed is a constraint as the user expects rapid delivery, and factors such as the architecture of the machine, the design of the software, and the choice of programming language all impact the end performance. 4) The product must be as small as possible to fit on a kitchen counter. It must still be large enough to have a large number of containers to fit all kitchen spices.
Briefly explain two significant trade-offs considered in your design, including options considered and the solution chosen.	<ol style="list-style-type: none"> 1) Wifi vs. Ethernet vs. Bluetooth - The device must connect to a network, whether it is through Wifi, Ethernet or Bluetooth. Each has different costs and advantages. Wifi was chosen because it allows the mixer to connect to the internet directly. Kitchens usually do not have ethernet ports and therefore a wireless option is best. 2) Material and size of the containers - Glass vs. Plastic vs. Metal, Small containers to reduce size of machine vs. larger containers to handle more volume. Plastic was chosen because it is easy to manufacture with 3D printers and is widely used in food delivery. 3) Choice of computing platform - Raspberry Pi vs. Qualcomm

	<p>Dragonboard vs. Beaglebone. Each has different pricing, power requirements, and computing capabilities. Raspberry Pi was chosen because it is cheap, has camera and IO support, and has a strong CPU and GPU for handling all compute and display requirements.</p>
<p>Briefly describe the computing aspects of your projects, specifically identifying hardware-software tradeoffs, interfaces, and/or interactions.</p> <p><i>Complete if applicable; required if team includes CmpE majors.</i></p>	<p>The target application of the mixer is in a connected environment. The mixer will require low-level software such as device drivers and firmware to control the device the computer is connected to. In addition to this, the device will need an operating system since the mixer will be connected to the internet and would benefit from multiprogramming.</p> <p>The operating system that will be used is Linux. All hardware devices used will have device drivers so that programs in user space could easily interact with them.</p> <p>Hardware and software tradeoffs will be made so that benefit for engineering effort is maximized. This implies using software over hardware when computation is feasible. In certain cases, a mix of both will be needed. For example, real time computer vision will be difficult to be achieved on a traditional CPU, but a dedicated DSP such as a GPU would be able to handle the task. Decisions will be made on how motors are controlled; device drivers are easily reprogrammable, but dedicated hardware may provide better performance.</p> <p>The mixer will need to compute the quantities of each spice. This will be done via an interaction between sensors and the computing device. Recipes will be downloaded from the web via a web interface such as WiFi. Software will be written for the screen, which may include touch screen functionality. Additionally, other user-facing interfaces, such as buttons, will have to be supported in the hardware and software layers.</p>