

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 automatically dispenses and weighs powders/spices conforming to various recipes. The use of different spices and kitchen powders (Cinnamon, Salt, Sugar, Red Pepper Flakes, Oregano, Basil), presented 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 focused on making the measurements accurate and efficiently stored the powders/spices.</p> <p>The advantages of our automated spice mixer is that it connects 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 performed precise measurements and unit conversion capabilities. The use of a Raspberry Pi allowed the mixer to be connected to the Internet and a mobile application allowed the user to interface with it. Additionally, algorithms were implemented to create precise measurements along with simple calculations to convert units.</p> <p>The device used a touch-screen LCD interface and a simplified UI to quickly allow the user to perform the desired function. Because this device is used in household kitchens, the durability doesn't need to be equivalent to commercial grade materials.</p> <p>The prototype spice mixer device costs approximately \$260 in parts: it requires three motors, a stand/base, a touch screen LCD display, six to eight containers, an mBed, a micro load cell, and a Raspberry Pi. From an architectural point of view, back-end servers is be required to store and access information from and to the mobile application as well as the mixer.</p>

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<p>List codes and standards that significantly affect your project. Briefly describe how they influenced your design.</p>	<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) 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.
<p>List at least two significant realistic design constraints that applied to your project. Briefly describe how they affected your design.</p>	<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. The actual design took roughly 30 seconds to dispense one order. 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. The actual design was roughly the size of large microwave.
<p>Briefly explain two significant trade-offs considered in your design, including options considered and the solution chosen.</p>	<ol style="list-style-type: none"> 1) Wifi vs. Ethernet - The device must connect to a network, whether it is through Wifi or Ethernet. Each has different costs and advantages. Ethernet was chosen because it allows the mixer to connect to the internet directly without worrying about Georgia Tech Wifi security. 2) Choice of computing platform - Raspberry Pi vs. Qualcomm Dragonboard vs. Beaglebone. Each has different pricing, power requirements, and computing capabilities. Raspberry Pi was chosen because it is cheap, and has a strong CPU and GPU for handling all compute and display requirements, it also has good software support for the screen we are using.
<p>Briefly describe the computing aspects of your projects, specifically</p>	<p>The target application of the mixer is in a connected environment. The Pi uses serial as its primary communication mechanism to the mBed, and higher level protocols such as RPC were implemented abstracted control.</p>

<p>identifying hardware-software tradeoffs, interfaces, and/or interactions.</p> <p><i>Complete if applicable; required if team includes CmpE majors.</i></p>	<p>In addition to this, the Raspberry Pi has an operating system since the mixer. KivyPie was the OS distribution chosen as it was both lightweight and fully featured for GUI (Graphical User Interface) applications.</p> <p>Hardware and software tradeoffs were made so engineering effort was maximized. We used software over hardware when software computation was feasible. Very few decisions were made in hardware. Some use cases required both hardware and software interaction. The GUI needed to be responsive and software rendering was only able to achieve a hundredth of what a dedicated GPU was able to handle. The three motors are controlled using Low Voltage motor shields integrated with the mbed. Communication between the mBed and the Raspberry Pi was established on the Serial port.</p> <p>The mixer computes the quantities of each spice. This is done via an interaction between sensors and the computing device. Recipes are downloaded from the web via ethernet. The GUI was built to run on the Raspberry Pi and display on the touchscreen. Additionally, other user-facing interfaces, such as buttons, are supported in the hardware and software layers.</p>
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