

**Smart Coffee Bean Roaster**  
Capstone Design Proposal  
Spring 2024  
Electrical and Computer Engineering  
Auburn University

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**Figure 1: Coffee Bean Roaster 1**



**Figure 2: Coffee Bean Roaster 2**

### Summary:

The main goal of our project for Capstone I and II will be to design and construct a “Smart Coffee Bean Roaster”. It will use state-of-the-art technology to accurately, precisely, efficiently, and more conveniently roast coffee beans than normal roasters. This machine would be plugged into an outlet where it would use a whole host of sensors to monitor the beans as they roast. There is also a possibility that we could implement a way for it to connect to your smartphone to receive live updates.

### Introduction:

In the bustling world of coffee enthusiasts and connoisseurs, the demand for premium-quality, freshly roasted coffee beans has reached unprecedented heights. As discerning consumers increasingly seek unique and exquisite flavor profiles in their daily brew, there exists a growing challenge for coffee aficionados to access freshly roasted beans that align with their discerning taste preferences. The need for a reliable and dedicated coffee bean roaster becomes apparent, catering to a diverse market of individuals who appreciate the artistry and science behind the perfect roast. In addressing this demand, our coffee bean roasting venture aims to be the solution, offering a range of meticulously roasted beans that promise to elevate the coffee experience for enthusiasts and novices alike. Whether for home brewing, specialty cafes, or artisanal coffee shops, our commitment is to provide an unparalleled selection of freshly roasted beans to satisfy the diverse palates of our customers.

Prompt: “Can you write an introductory paragraph for a coffee bean roaster mentioning the potential customers and the problem statement.”

In the initial stages of the project our group will need to think of unique and innovative ideas on how to approach the problem of creating a Smart Coffee Bean Roaster. Many such methods include, but are not limited to:

The following portion of text utilizes ChatGPT:

### Mind Mapping:

Create a visual representation of ideas by starting with a central concept and branching out to related ideas. This helps to explore different aspects and connections, fostering a holistic understanding of the problem and potential solutions.

### Reverse Engineering:

Begin with the end goal or desired outcome and work backward. Identify the final result you want to achieve and then brainstorm the steps or components needed to reach that goal. This approach can uncover innovative solutions by challenging traditional thought patterns.

### SCAMPER Technique:

SCAMPER stands for Substitute, Combine, Adapt, Modify, Put to another use, Eliminate, and Reverse. Using this technique, systematically go through each of these actions and apply them to different aspects of your design. It encourages creative thinking by prompting you to consider various modifications and adaptations.

### Six Thinking Hats:

Developed by Edward de Bono, this technique involves looking at a problem from six different perspectives, each represented by a different "thinking hat." For example, the white hat represents facts and information, the red hat focuses on emotions and feelings, and the green hat encourages creative thinking. By switching between these perspectives, you can explore a problem comprehensively.

### Storyboarding:

Create a sequence of visual representations or a series of sketches that illustrate different stages of your design or problem-solving process. This technique helps in visualizing the flow of ideas and identifying potential issues or improvements at each stage. It is particularly useful in projects with a sequential or iterative nature.

Prompt: "List 5 brainstorming techniques for an engineering design project."

The following portion of text utilizes ChatGPT:

Designing an electronic coffee bean roaster involves addressing several technical challenges to ensure optimal performance, safety, and user satisfaction. Here are some key technical challenges to consider:

#### Temperature Control and Uniformity:

- Achieving precise temperature control is critical for the roasting process. Ensuring uniform heat distribution within the roasting chamber is challenging and requires advanced temperature sensors, PID controllers, and possibly airflow control mechanisms.

#### Roasting Profile Customization:

- Providing users with the ability to customize roasting profiles for different coffee beans and flavor preferences requires a sophisticated control system. This may

involve developing user-friendly interfaces and incorporating programmable logic controllers (PLCs).

#### Energy Efficiency:

- Designing an energy-efficient roaster is essential for sustainability and cost-effectiveness. This involves optimizing heating elements, insulation, and airflow systems to minimize energy consumption without compromising roasting quality.

#### Safety Features:

- Implementing safety features to prevent overheating, electrical malfunctions, and other potential hazards is crucial. This may include temperature sensors, emergency shut-off mechanisms, and robust electrical systems compliant with safety standards.

#### Cooling System:

- Rapid cooling of roasted beans after the roasting process is crucial to prevent over-roasting. Developing an efficient and quick cooling system, such as forced air cooling, is a technical challenge.

#### Data Logging and Connectivity:

- Incorporating data logging capabilities allows users to track and analyze roasting profiles over time. Adding connectivity features, like Wi-Fi or Bluetooth, may enable remote monitoring and control, presenting challenges in terms of security and data transmission reliability.

#### Maintenance and Cleaning:

- Designing a roaster that is easy to clean and maintain is important for longevity and consistent performance. Considerations for removable parts, access to components, and easy cleaning procedures are essential.

#### Material Selection and Durability:

- Choosing materials that can withstand high temperatures, resist corrosion, and meet food-grade standards is critical. The roaster's construction should be durable and capable of handling the stresses associated with repeated heating and cooling cycles.

#### Noise Reduction:

- Roasters can generate significant noise during operation. Implementing sound insulation or designing components to minimize noise without compromising performance is a challenge in electronic roaster design.

#### User Interface and Experience:

- Designing an intuitive and user-friendly interface for controlling the roaster, setting parameters, and monitoring the roasting process is crucial. This involves considerations for display screens, buttons, and controls.

#### Regulatory Compliance:

- Ensuring that the electronic coffee roaster complies with safety and quality standards for electrical appliances is essential. This may involve certification processes and adherence to relevant regulations in different regions.

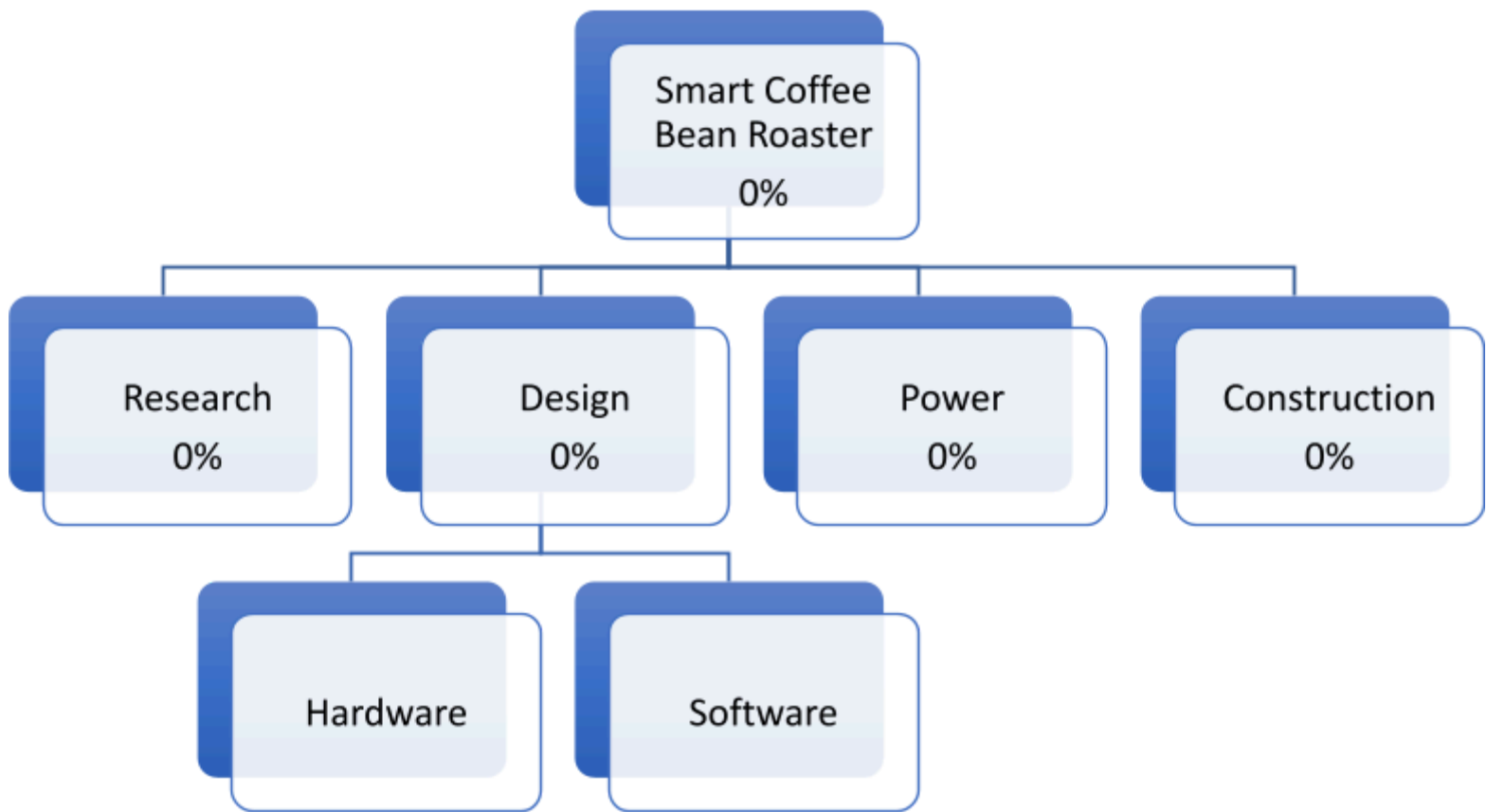
Addressing these technical challenges requires collaboration among electrical engineers, mechanical engineers, software developers, and other specialists in product design. Thorough testing and quality assurance processes are also crucial to ensure the reliability and safety of the electronic coffee bean roaster.

Prompt: “What technical challenges do we need to overcome when designing an electronic coffee bean roaster?”

There are many people among the electrical engineering staff that could aid us during the development of the roaster. One notable person would be Dr. Geiger since he was the person that proposed the project for our engineering design class.

Our project will consist of all kinds of electrical components as well as other basic building materials. These materials include but aren't limited to:

- An array of basic components (varied resistors, capacitors, inductors, transistors, MOSFETS, etc of both through-hole and SMD versions)
- Wires of varying gauges
- Test boards
- Array of basic building materials such as plastic, glass, silicon, etc.



**Figure 3: Project Design Flow Chart**