



KWARA STATE POLYTECHNIC

**RESEARCH ON DESIGNING AND FABRICATING AN
ELECTRIC POPCORN MACHINE**

BY

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**A PROJECT REPORT SUBMITTED TO THE DEPARTMENT OF
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CERTIFICATION

The undersigned certify that this project report prepared by: Adeniji Boluwatife Isreal, ND/23/MCT/FT/0069 Entitled: Research on designing and Fabricating an Electric Popcorn Machine meets the requirement of the Department of Mechatronics Engineering for the award National Diploma [ND] in Mechatronics Engineering, Kwara State Polytechnic, Ilorin.

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DECLARATION

I hereby declare that this research project titled Research on designing and Fabricating an Electric Popcorn Machine is my work and has not been submitted by any other person for any degree or qualification at any higher institution, I also declare that the information provided therein is mine and those that are not mine are properly acknowledged.

Adeniji Boluwatife Isreal

Signature and Date

DEDICATION

This project is dedicated to Almighty God, the Omnipotent and Omniscience who has spared my life from the inception to the end of my academic programme and also to my parent Mr. & Mrs. Adeniji thank you for standing by me.

ACKNOWLEDGEMENTS

All thanks, praise and adoration are due to the Almighty God, the uncreated creator of all creature, the intelligent who sought intelligence from no one and nothing supersedes His authority on earth and beyond.

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My outmost gratitude goes to my loving and untiring parent Mr. & Mrs. Adeniji for their consistent prayer and godly advice also, their support both morally and financially, thank God for the gift of my parent.

With intense gratitude, I appreciate the effort of my siblings for their tremendous support and assistance on me during the course of my programme, may Almighty God continue to be with you all.

Lastly, to my amazing friends, who contributed ideas and perspectives that enriched the project, thanks to everyone I'm so Grateful May God bless you all.

ABSTRACT

This project focuses on the design and fabrication of an electric popcorn machine aimed at providing a cost-effective, energy-efficient, and hygienic solution for popcorn production. The research investigates the principles of heat transfer, mechanical design, and electrical integration necessary for efficient popcorn popping. Key components of the machine include a stainless steel popping chamber, an electric heating element, a temperature control unit, and a motorized stirring mechanism to ensure uniform heating and prevent burning. Locally sourced materials were utilized to reduce production cost and encourage indigenous technology development. The performance of the fabricated machine was evaluated based on popping efficiency, time of operation, safety, and ease of use. Results indicated that the machine could pop corn kernels effectively within 3–5 minutes, with minimal un-popped kernels and without requiring external fuel sources. This study demonstrates the viability of small-scale electric popcorn machines for domestic and commercial use, promoting self-reliance in local machine design and fabrication.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 BACK GROUND TO THE STUDY

The basic aim of this project is to improve the quality and standard of production of a pop-corn machine and how it is producing the popcorn. Therefore, it acts or promotes and improves production rate and limits the frying time, as much as it could perform. The design and construction of popcorn machine is brought from the perspective of its availability in market. Also this project is also a means of promoting the diversity in utilization to suit different tastes.

Popcorn, a timeless and beloved snack, has a rich history rooted in culinary traditions. Central to the popcorn experience is the popcorn machine, an invention that has evolved over the years, shaping the way we enjoy this crunchy delight. This chapter introduces the journey into the fabrication of the popcorn machine, exploring its historical significance and the need for advancements in its design and production. Popcorn, a popular and cherished snack, has a rich history deeply embedded in various cultures. Central to the enjoyment of popcorn is the popcorn machine, an invention that has undergone significant evolution over the years. Nigeria's economy has suffered a terrible setback over the year; the common man finds it difficult to make for his livelihood, some people take pop-corn as one of their favorite food especially bachelors, spinsters who can take pop-corn as super, breakfast and even lunch.

The University and Polytechnics graduates no longer find good employment thereby embark on self-employment by constructing popcorn machine to meet their needs. This unemployment constitutes the economic depression of our nations. The popcorn-making machine is constructed with locally made materials at a reduced cost. The design, construction and fabrication of the machine i.e. not in any known text at the moment, the project group therefore faced design, construction and fabrication problems.

1.3 DESIGN, CONSTRUCTION AND FABRICATION PROBLEMS

The problems associated with the design of the machine are discussed below.

1. Selection of Electric Motor: In the market, there are various types of motor with varying speed of rotation per minute. The automated popcorn machine has a striver which turns the corn inside the cast pots as heating on. The striver, which rotates due to the rod connected to it from the motor, should rotate with a low speed to produce the desired effect. In our research, we were able to discover that only a low speed motor could give the desired turning effect.
2. Heating Element: Another problem in the choice of heating element. There are various kinds of heating elements available in the market ranging from 850-1500watts. The elements come in different shapes, sizes, and makes e.g. spring type, ring type and plate type.
3. Third Design Problem is Control and Safety: In the system we discovered that there is the need for the finance circuit to control the operation of the electrical popcorn machine.

4. Construction and Fabrication of the Housing for the Machine: This is fourth problem, which involves the use of per pex holler rectangular aluminum bars in profile glasses and metal handle. With respect to safety. The machine was made to be safer for the users by incorporating the user of insulator in the design.

1.3 RESEARCH QUESTIONS

To guide the exploration and investigation, the following research questions will be addressed in this study:

1. What are the key design elements influencing the efficiency and safety of popcorn machines?
2. How can the fabrication process be optimized to reduce energy consumption and environmental impact?
3. What innovative materials and technologies can be integrated into popcorn machine production to enhance performance and durability?
4. Develop guidelines for optimizing the fabrication process to enhance overall performance and safety.

1.4 AIMS AND OBJECTIVES

The primary aims and objectives of this study are as follows:

1. Investigate the existing design features and mechanisms employed in popcorn machines.
2. Evaluate the environmental impact and energy efficiency of current popcorn machine models.

3. Propose innovative materials and technologies for the fabrication of improved popcorn machines.

1.5 SIGNIFICANCE OF THE STUDY

The fabrication of popcorn machines holds importance not only for the culinary industry but also for the wider cultural and entertainment sectors. Understanding the intricacies of popcorn machine design and production contributes to enhancing the efficiency, safety, and sustainability of these appliances, ultimately impacting the overall popcorn consumption experience.

1.7 LIMITATION OF THE STUDY

There was no conveyor that should remove the popcorn from the hot pot. There was no time to indicate when the corn is fully popped. There was no thermostat to regulate the temperature of the system. There was nothing like lagging to trap some of the heat.

1.7 DEFINITION OF TERMS

Popcorn Machine: A device designed for popping corn kernels, typically involving the application of heat, often for commercial or household consumption.

Performance: The ability of the popcorn machine to efficiently and consistently produce popped corn.

Sustainability: In the context of this study, it refers to the eco-friendly aspects of popcorn machine design, considering factors such as energy efficiency and material choices.

CHAPTER TWO

2.3 DESCRIPTION OF COMPONENTS PARTS

A popcorn machine, also known as a popcorn popper or popcorn maker, is a device designed specifically for popping corn kernels. It comprises several component parts that work together to produce the delicious, fluffy popcorn we all enjoy. Here's a comprehensive description of the key component parts of a typical popcorn machine:

1. **Kettle:** The kettle is a crucial component where the magic happens. It's a metal container with a heat-resistant handle and a hinged lid. The unpopped popcorn kernels are placed inside the kettle, and it is then heated to pop the corn. The kettle will be constructed from high-grade stainless steel. Stainless steel is chosen for its excellent heat resistance, corrosion resistance, and ease of cleaning. These properties are crucial for maintaining optimal hygiene and extending the kettle's lifespan.
2. **Heating Element:** The heating element is responsible for generating the heat required to pop the corn kernels. In most modern popcorn machines, especially those designed for home use, this is often an electric heating element. The heating element is a crucial component of a popcorn machine, responsible for efficiently and evenly popping corn kernels. This project component focuses on the design and fabrication of an advanced heating element to enhance the performance of our popcorn machine.

3. **Stirring Mechanism:** Some popcorn machines, particularly those used in commercial settings, have a stirring mechanism inside the kettle. This mechanism ensures even heating and prevents the popcorn from burning by continuously moving the kernels. The stirring mechanism in a fabricated popcorn machine is designed to evenly distribute heat and ensure that all popcorn kernels are popped uniformly.
4. **Kernel Dispenser:** Located at the top of the machine, the kernel dispenser is an opening through which unpopped popcorn kernels are poured into the kettle. Some machines come with a built-in measuring device to control the amount of popcorn being popped. A specially designed kernel dispenser allows users to pour unpopped popcorn kernels into the kettle seamlessly. The dispenser is strategically placed for user convenience and accuracy in controlling the amount of popcorn being popped.
5. **Popcorn Tray or Bin:** Positioned at the bottom of the machine, the popcorn tray or bin collects the popped popcorn as it falls from the kettle. It often features a perforated design to allow for ventilation and to keep the popcorn from becoming soggy. The popcorn tray is designed for easy collection of popped corn. It features a perforated design for ventilation, maintaining the popcorn's freshness. The tray is easily removable for cleaning and maintenance.
6. **Warming Lamp:** Commercial popcorn machines may come equipped with a warming lamp. This lamp keeps the popped popcorn warm and fresh, maintaining

its temperature until it is ready to be served. The warming lamp in a fabricated popcorn machine serves the purpose of keeping the popped popcorn warm and fresh for an extended period, especially in commercial or concession settings where popcorn is made in batches and served over time.

7. **Control Panel:** The control panel contains the operational switches or buttons for the machine. It allows users to turn on the heating element, activate the stirring mechanism (if applicable), and control additional features such as a warming lamp. The control panel is equipped with user-friendly switches and buttons. It allows users to adjust settings easily, controlling the popping process. Safety mechanisms are included, such as an emergency stop button and temperature controls.
8. **Cabinet or Housing:** The cabinet or housing serves as the outer shell of the popcorn machine, encasing all internal components. It provides structural support, protects the machine's internal mechanisms, and contributes to the overall aesthetics. The housing is typically made of materials like stainless steel, aluminum, or other durable materials. The cabinet is often constructed from materials that are durable and easy to clean, such as stainless steel, aluminum, or painted steel. The choice of material depends on factors like durability, cost, and aesthetic considerations.
9. **Door:** The door is an access point to the inside of the machine, allowing users to load popcorn into the kettle and retrieve the popped corn. Some doors have a

transparent window, enabling users to observe the popping process without opening the door. The door of a fabricated popcorn machine is an essential component that provides access to the popping chamber, making it easy to load popcorn kernels, add oil or flavorings, and perform maintenance tasks. The design and features of the door contribute to the overall functionality, safety, and convenience of the popcorn machine.

10. Kernel Catcher: Some popcorn machines feature a kernel catcher or tray beneath the perforated bottom. This catcher collects any unpopped kernels that fall through, preventing them from mixing with the popped popcorn. The kernel catcher in a fabricated popcorn machine is a component designed to collect and separate unpopped or partially popped kernels, commonly known as “old maids” or “widows.” The kernel catcher helps ensure that only fully popped popcorn is dispensed, enhancing the quality of the popcorn served. Here are key features and functions of the kernel catcher

11. Serving Scoop or Popcorn Bags: Depending on the design of the machine, there may be a serving scoop or a designated area for dispensing popcorn into bags for easy serving. The serving scoop and popcorn bags are essential accessories in a fabricated popcorn machine, especially in commercial or concession settings where popcorn is served to customers.

2.4 BODY FRAMEWORK

The body framework of a popcorn machine is a critical aspect of its fabrication, determining its structural integrity, durability, and overall functionality. The framework is typically constructed using materials like stainless steel or aluminum due to their strength, corrosion resistance, and ease of maintenance. The design includes components such as a sturdy base frame, supporting legs, side panels, a front panel with a hinged door and transparent window, a top cover for protection, and a back panel for additional support. The control panel is strategically mounted for easy access, and there are designated areas for the kernel dispenser, popcorn tray, and, if applicable, the mounting of a warming lamp and stirring mechanism.

The body framework of a fabricated popcorn machine, also known as the machine's chassis or frame, serves as the structural foundation that supports and houses various internal components. The design and construction of the body framework are crucial for the machine's durability, stability, and overall functionality. Proper care and maintenance of the body framework, including regular cleaning and inspections, contribute to the overall longevity and performance of the popcorn machine. Manufacturers typically provide guidelines for the proper use and maintenance of their machines.

2.3 MATERIALS NEEDED FOR CONSTRUCTION

The fabrication of a popcorn machine requires several materials to ensure its robustness and longevity. Common materials include:

Stainless Steel or Aluminum Sheets: For constructing the main body framework. The choice between stainless steel and aluminum sheets in the fabrication of a popcorn machine depends on various factors, including the specific requirements of the machine, budget considerations, and desired properties.

Metal Tubes or Bars: For creating the supporting legs and internal structures. The choice between metal tubes and bars in the fabrication of a popcorn machine depends on the specific application, design requirements, and structural considerations.

Transparent Material (Glass or Polycarbonate): For the window on the front panel. The use of transparent materials, such as glass or polycarbonate, in the fabrication of a popcorn machine can serve various purposes, ranging from visibility for the user to aesthetic appeal.

Hinges and Latches: To facilitate the opening and closing of doors.

Hinges and latches are crucial components in the design of various equipment, including popcorn machines. They play essential roles in ensuring proper functionality, accessibility, and safety.

Insulation Material: To prevent external surfaces from getting too hot during operation. Insulation in a popcorn machine is important for maintaining consistent temperatures, enhancing energy efficiency, and ensuring user safety. The choice of insulation material

depends on factors such as the operating temperature, space constraints, and budget considerations.

Electrical Wiring and Components: For the control panel, heating element, and any additional features. The electrical wiring and components in a fabricated popcorn machine are critical for its operation, safety, and functionality. These components include wiring, switches, controls, heating elements, and safety features.

2.5 VARIOUS TYPES OF HEATING ELEMENTS

The heating elements in a fabricated popcorn machine are essential components responsible for generating the heat needed to pop the popcorn kernels. These elements are crucial for the popcorn popping process, and their design influences the efficiency and performance of the machine. Here are key aspects of the heating elements in a typical popcorn machine. The heating element is a crucial component in a popcorn machine, responsible for popping the corn kernels. Different types of heating elements are used in various popcorn machines, each with its unique characteristics:

A Pan with a Lid on It

Traditional stovetop method using a pan and lid for popping popcorn. Requires constant monitoring and manual stirring. A pan with a lid is a common kitchen utensil used for various cooking tasks. The combination of a pan and a lid serves several purposes, providing a versatile tool for a range of cooking methods.

Microwave Popcorn Machine

Utilizes microwaves to heat and pop the corn kernels. Common in household settings due to its convenience. A microwave popcorn machine is a specialized device designed for popping popcorn using a microwave oven. These machines typically consist of a microwave-safe popping container, often with a vented or perforated lid, and sometimes include additional features for flavoring or serving.

An Open Fire Popcorn Machine

Pops popcorn over an open flame, often used in outdoor or camping settings. An open fire popcorn machine, often referred to as a campfire popcorn popper, is a device designed to pop popcorn directly over an open flame. These devices are commonly used during camping trips, outdoor gatherings, or any setting with access to an open fire source.

Hot Air Popcorn Machine

Uses hot air circulation to pop kernels without oil, providing a healthier option. A hot air popcorn machine, also known as a hot air popper, is a kitchen appliance designed to pop popcorn using hot air circulation. This method eliminates the need for oil or butter, making it a healthier option compared to traditional stovetop or microwave popcorn methods.

Manually Operated Popcorn Machine

Involves manual operation, requiring the user to turn a handle or crank for popping. A manually operated popcorn machine typically refers to a stovetop popcorn

popper that requires human intervention for the popping process. These poppers come in various designs, but they share the common characteristic of relying on direct heat from a stove or other heat source, with users manually agitating the popcorn to ensure even popping.

Electrically Operated Popcorn Machine

Utilizes an electric heating element for automated and efficient popping. Common in commercial and home theater applications. An electrically operated popcorn machine, commonly referred to as an electric popcorn popper, is a kitchen appliance designed to pop popcorn using electricity. These machines come in various styles and sizes, offering convenience and ease of use.

2.5 BEST OF THE PROJECT

The success of the popcorn machine fabrication project lies in various factors:

Efficient Heating Mechanism: Choosing an effective and energy-efficient heating element is crucial for optimum popcorn popping. The efficient heating mechanism in a popcorn machine is crucial for achieving optimal popping results, ensuring uniform and timely popping of popcorn kernels. Various types of popcorn machines may employ different heating mechanisms, and the efficiency of this process contributes to the quality of the popcorn.

Sturdy and Aesthetic Design: The body framework should not only provide structural support but also be visually appealing. A combination of functionality and aesthetics enhances the machine's marketability. A sturdy and aesthetic design in a popcorn

machine enhances both its functionality and visual appeal. Whether the machine is intended for home use, commercial purposes, or entertainment venues, a well-designed and robust structure adds to the overall user experience.

User-Friendly Controls: The control panel should be intuitive and easy to operate, allowing users to adjust settings effortlessly. User-friendly controls in a popcorn machine are essential to ensure ease of operation and enhance the overall user experience. Whether the machine is intended for home use, commercial settings, or entertainment venues, intuitive controls contribute to efficient popcorn preparation.

Safety Features: Incorporating safety features, such as heat insulation and secure door latches, ensures user safety during operation. Safety features in a popcorn machine are crucial to ensure the well-being of users, prevent accidents, and promote responsible operation. Whether the machine is intended for home use, commercial settings, or entertainment venues, the incorporation of safety features is essential.

Versatility: Designing the machine to accommodate various types of heating elements allows users to choose the popping method that suits their preferences.

Versatility in a popcorn machine refers to its ability to offer diverse functionalities, accommodate various preferences, and adapt to different settings. A versatile popcorn machine can cater to a wide range of user needs, making it suitable for both home and commercial use. By incorporating these considerations, a versat

Versatility: Designing the machine to accommodate various types of heating elements allows users to choose the popping method that suits their preferences.

Versatility in a popcorn machine refers to its ability to offer diverse functionalities, accommodate various preferences, and adapt to different settings. A versatile popcorn machine can cater to a wide range of user needs, making it suitable for both home and commercial use. By incorporating these considerations, a versatile popcorn machine can cater to a broad spectrum of user preferences, environments, and use cases, making it a valuable and adaptable appliance.

Ease of Maintenance: Access panels and removable components should facilitate easy maintenance and repairs, ensuring the longevity of the machine.

Ease of maintenance is a crucial factor in the design of a popcorn machine to ensure its longevity, consistent performance, and user satisfaction. An easily maintainable popcorn machine minimizes downtime, facilitates routine cleaning, and allows users to address common maintenance tasks without difficulty. By prioritizing ease of maintenance in the design process, popcorn machine manufacturers can empower users to keep their machines in optimal condition, resulting in increased user satisfaction and prolonged product lifespan.

Cost-Effectiveness: Balancing quality and cost in the selection of materials and components is essential to create a competitively priced product. Designing a cost-effective popcorn machine involves optimizing the balance between manufacturing costs, features, and overall performance. Manufacturers need to consider both the initial cost of production and the long-term value provided to customers.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

In this chapter, the research methodology employed for the extensive design and fabrication of an electric popcorn machine is outlined. The methodology serves as a roadmap for conducting the research, outlining the steps taken to achieve the objectives of the study.

3.1 RESEARCH DESIGN

The research design for this study is based on a combination of qualitative and quantitative approaches. Qualitative methods such as literature review and expert consultations were utilized to gather information on existing popcorn machine designs, electrical components, and fabrication techniques. Quantitative methods were employed for data analysis, including calculations for power requirements, material costs, and performance metrics.

3.2 POPULATION OF THE STUDY

The population for this study consists of various stakeholders involved in the electric popcorn machine industry, including manufacturers, engineers, and end-users. Additionally, relevant literature and existing designs serve as a population of information sources essential for informing the research process.

3.3 SAMPLING OF THE STUDY

A purposive sampling technique is employed to select participants for expert consultations and interviews. This approach ensures that individuals with expertise in

relevant fields are included in the study, providing valuable insights and guidance for the design and fabrication process.

3.4 METHOD OF DATA COLLECTION

Data collection methods include literature reviews, expert consultations, interviews, and observational studies. Literature reviews involve gathering information from academic journals, patents, and industry reports. Expert consultations and interviews facilitate the collection of qualitative data, while observational studies provide firsthand insights into the performance of existing popcorn machines.

3.5 METHOD OF DATA ANALYSIS

Data analysis encompasses both qualitative and quantitative techniques. Qualitative data obtained from literature reviews, expert consultations, and interviews are analyzed thematically to identify recurring patterns and themes. Quantitative data collected from testing and evaluation processes are analyzed using statistical methods to assess performance metrics and identify areas for improvement.

This research methodology provides a comprehensive framework for designing and fabricating an electric popcorn machine, ensuring that data-driven decisions are made throughout the research process to optimize the final product.

3.6 FABRICATION PROCESS

The fabrication process involved the assembly of components according to the conceptual design. Skilled technicians and craftsmen were involved in the construction of the machine, ensuring precision and quality in every step of the fabrication process.

3.7 TESTING AND EVALUATION

Once the electric popcorn machine was fabricated, it underwent rigorous testing to evaluate its performance and functionality. Tests were conducted to assess factors such as heating efficiency, popcorn popping rate, noise levels, and safety features.

3.8 ITERATIVE DESIGN

Based on the results of testing and data analysis, iterative improvements were made to the design and fabrication of the electric popcorn machine. Feedback from users and stakeholders was also considered in refining the machine for optimal performance and user satisfaction.

3.9 ETHICAL CONSIDERATIONS

Throughout the research process, ethical considerations were paramount. Safety standards were adhered to during the fabrication process to ensure the electric popcorn machine met regulatory requirements and posed no harm to users or the environment.

CHAPTER FOUR

4.1 DESIGN PLANNING

Designing a fabricated popcorn machine involves meticulous planning and consideration of various factors to ensure efficiency, safety, and ease of use. The process begins with understanding the primary requirements of the machine: it must efficiently pop corn kernels, maintain an optimal temperature, and ensure user safety. The design planning phase is critical as it lays the foundation for the entire project, encompassing research, conceptualization, material selection, and drafting of detailed design specifications.

The first step in design planning is conducting thorough research on existing popcorn machines, identifying their strengths and weaknesses. This research helps in understanding the key components required, such as the heating element, popping chamber, and cooling system. Additionally, it provides insights into the latest technological advancements and user preferences, which can be integrated into the new design to enhance functionality and user experience.

Once the research phase is complete, the next step is conceptualization. During this stage, brainstorming sessions are held to generate innovative ideas and solutions. Sketches and preliminary diagrams are created to visualize different design options. These concepts are then evaluated based on criteria such as efficiency, cost-effectiveness, and manufacturability. The best concept is selected for further development, ensuring it meets all functional requirements and constraints.

Material selection is a crucial aspect of design planning. The materials chosen must be durable, heat-resistant, and safe for food contact. Stainless steel is often preferred for the popping chamber due to its excellent thermal properties and ease of cleaning. For the heating element, materials with high thermal conductivity, such as aluminum or copper, are ideal. The exterior casing can be made from heat-resistant plastic or metal, ensuring both durability and user safety.

The final step in the design planning phase is drafting detailed design specifications and creating technical drawings. These documents provide precise measurements, material specifications, and assembly instructions. They serve as a blueprint for the manufacturing process, ensuring that the fabricated popcorn machine meets all design requirements and quality standards. Additionally, these documents are essential for troubleshooting and maintenance, providing a comprehensive guide for future reference. In summary, the design planning of a fabricated popcorn machine is a comprehensive process that involves research, conceptualization, material selection, and detailed documentation. Each step is crucial in ensuring the final product is efficient, safe, and user-friendly, meeting the needs of consumers and adhering to industry standards.

4.2 MATERIAL SELECTION

In the fabrication process of a popcorn machine, material selection plays a pivotal role in ensuring durability, performance, and safety. Careful consideration is given to choosing materials that are suitable for the various components of the machine, taking

into account factors such as heat resistance, mechanical strength, food-grade safety standards, and cost-effectiveness. Stainless steel is often favored for critical components such as the popcorn chamber and heating element due to its excellent heat resistance, corrosion resistance, and ease of cleaning. Tempered glass may be selected for viewing windows to provide visibility while withstanding high temperatures. Additionally, durable plastics or metals are commonly used for the casing and exterior components to ensure structural integrity and aesthetic appeal. It's essential to prioritize materials that comply with relevant food safety regulations and standards to ensure that the popcorn machine is safe for food preparation and consumption. Furthermore, cost considerations are taken into account to balance performance requirements with budget constraints, ensuring that the selected materials meet quality standards while remaining economically viable for mass production. Overall, material selection is a critical aspect of the fabrication process, influencing the performance, longevity, and user experience of the popcorn machine.

4.3 COMPONENT FABRICATION

Component fabrication is a crucial phase in the construction of a popcorn machine, involving the precise manufacturing of individual parts according to design specifications. Skilled technicians and craftsmen utilize various fabrication techniques such as cutting, bending, welding, and machining to shape raw materials into functional components. For example, the popcorn chamber, typically made of stainless steel, undergoes processes such as cutting and welding to form its cylindrical shape, while the

heating element may be fabricated using precision machining techniques to ensure uniform heat distribution. Each component is meticulously crafted to meet dimensional tolerances, surface finish requirements, and functional specifications. Quality control measures are implemented throughout the fabrication process to ensure consistency, accuracy, and adherence to design standards. Once fabricated, components undergo inspection and testing to verify their integrity and suitability for assembly into the final popcorn machine. Effective component fabrication is essential for achieving a high-quality, reliable, and efficient popcorn machine that meets performance requirements and user expectations.

4.4 ELECTRICAL SYSTEM INTEGRATION

Electrical system integration is a pivotal phase in the fabrication process of a popcorn machine, where various electrical components are assembled and integrated to ensure the machine's functionality and safety. This phase involves the careful integration of components such as the heating element, temperature control mechanisms, switches, wiring harnesses, and safety features. Skilled electricians and technicians meticulously connect these components according to wiring diagrams and electrical schematics, ensuring proper insulation, grounding, and connectivity to prevent electrical hazards. The heating element, typically composed of high-resistance wire encased in a ceramic or metal housing, is integrated into the popcorn chamber to generate the heat necessary for popping corn kernels. Temperature control mechanisms, such as thermostats or electronic controllers, regulate the heating element's temperature to maintain optimal popping

conditions and prevent overheating. Additionally, switches and control panels are installed to enable user interaction, allowing operators to adjust settings, start/stop operation, and monitor machine status. Safety features such as thermal fuses, overheat protection mechanisms, and safety interlocks are integrated into the electrical system to safeguard against electrical malfunctions, overloads, and other potential hazards. Through meticulous planning, wiring, and testing, electrical system integration ensures the safe and reliable operation of the popcorn machine, providing users with a seamless and user-friendly popcorn popping experience.

4.5 MECHANICAL ASSEMBLY

Mechanical assembly represents a crucial stage in the fabrication process of a popcorn machine, where various mechanical components are meticulously assembled to form the functional structure of the appliance. Skilled technicians and craftsmen oversee the integration of components such as the popcorn chamber, ventilation system, agitator mechanism (if applicable), and control panel into the designated housing or casing. Each component is carefully positioned and secured within the assembly to ensure proper alignment, fit, and functionality. The popcorn chamber, typically made of stainless steel, is securely mounted within the machine to contain the popping kernels and facilitate heat transfer from the heating element. The ventilation system, comprising fans and air vents, is installed to ensure proper air circulation and heat dissipation during operation, preventing overheating and ensuring consistent popcorn popping. If the machine incorporates an agitator mechanism, it is integrated to facilitate the even distribution of

kernels and promote uniform popping. Additionally, the control panel, switches, and user interface elements are installed to provide operators with intuitive control over machine operation. Through meticulous attention to detail and precision assembly techniques, mechanical assembly ensures the structural integrity, functionality, and aesthetic appeal of the popcorn machine, contributing to a seamless and enjoyable popcorn popping experience for users.

4.6 SAFETY FEATURES INSTALLATION

Safety features installation is a critical aspect of the fabrication process for a popcorn machine, prioritizing the protection of users and the prevention of accidents. During this phase, various safety mechanisms are integrated into the machine to mitigate potential hazards and ensure safe operation. Thermal fuses, designed to disconnect power in the event of overheating, are installed to prevent fires or damage to the machine. Overheat protection mechanisms are implemented to monitor and regulate the temperature of the heating element, preventing it from reaching unsafe levels. Safety interlocks are incorporated to prevent the machine from operating when components are not properly assembled or when access panels are open, reducing the risk of injury to users. Additionally, emergency stop buttons may be installed to provide users with a quick and convenient means of halting machine operation in case of emergencies. Through meticulous planning and adherence to safety standards, safety features installation enhances the reliability and usability of the popcorn machine, providing peace of mind to operators and ensuring a safe and enjoyable popcorn popping experience.

4.7 SAFETY FEATURES

Safety features are integral components of any popcorn machine, designed to protect users and prevent accidents during operation. Several key safety features are typically incorporated into popcorn machines:

Thermal Fuses: Thermal fuses are safety devices designed to disconnect power to the heating element if the machine's temperature exceeds a certain threshold. This prevents overheating, reducing the risk of fire or damage to the machine.

Overheat Protection: Overheat protection mechanisms monitor and regulate the temperature of the heating element to ensure it remains within safe operating limits. These mechanisms automatically adjust power output or shut off the heating element if temperatures rise to dangerous levels.

Safety Interlocks: Safety interlocks are mechanisms that prevent the machine from operating unless all components are properly assembled and secured. For example, a safety interlock may prevent the machine from turning on if the popcorn chamber is not correctly installed or if access panels are open, reducing the risk of injury to users.

Emergency Stop Button: An emergency stop button provides users with a quick and accessible means of halting machine operation in case of emergencies or unforeseen hazards. Pressing the emergency stop button immediately cuts power to the machine, bringing it to a safe stop.

Insulated Housing: Popcorn machines may feature insulated housing to prevent external surfaces from becoming too hot during operation. This reduces the risk of burns or accidental contact with hot surfaces, enhancing user safety.

Ground Fault Circuit Interrupter (GFCI): Some popcorn machines may incorporate GFCI protection to detect electrical faults and quickly disconnect power to prevent electric shocks. GFCI protection is particularly important in environments where moisture or water may be present, such as commercial kitchens or concession stands.

Clear Safety Labels: Clear and prominent safety labels provide users with important safety information, including operating instructions, warnings, and precautions. These labels help users understand how to operate the machine safely and avoid potential hazards.

By incorporating these safety features into popcorn machines, manufacturers can ensure that their products meet stringent safety standards and provide users with a safe and enjoyable popcorn popping experience.

4.9 QUALITY ASSURANCE

Quality assurance is a critical aspect of the fabrication process for a popcorn machine, ensuring that the final product meets predefined standards of performance, reliability, and safety. Throughout the fabrication process, rigorous quality control measures are implemented to verify the integrity of components, assess manufacturing processes, and identify any deviations from established specifications. Quality assurance begins with the

selection of high-quality materials and continues through every stage of fabrication, assembly, and testing.

During component fabrication, skilled technicians and craftsmen adhere to strict quality standards to ensure that each part meets dimensional tolerances, surface finish requirements, and functional specifications. Quality control checks are conducted at various checkpoints to detect any defects or irregularities and address them promptly to prevent issues during assembly.

Mechanical assembly involves the integration of various components into the final structure of the popcorn machine. During this phase, quality assurance measures focus on verifying proper alignment, fit, and functionality of each component within the assembly. Assembly technicians conduct meticulous inspections to ensure that all components are securely fastened and properly positioned to meet design specifications.

Once the popcorn machine is fully assembled, comprehensive testing and evaluation are conducted to validate its performance and functionality. Quality assurance tests may include operational tests, stress tests, and safety tests to assess factors such as heating efficiency, popcorn popping rate, noise levels, and adherence to safety standards. Any discrepancies or issues identified during testing are addressed promptly to ensure that the final product meets quality standards. Throughout the fabrication process, documentation and record-keeping play a crucial role in quality assurance. Detailed records are maintained to track materials, processes, and test results, providing a traceable history of the fabrication process and facilitating quality audits and inspections.

By prioritizing quality assurance throughout the fabrication process, manufacturers can ensure that their popcorn machines deliver consistent performance, reliability, and safety, meeting the expectations of customers and stakeholders. Quality assurance instills confidence in the product and enhances the reputation of the manufacturer, contributing to long-term success in the market.

4.9 TESTING AND CALIBRATION

Testing and calibration represent pivotal phases in the fabrication process of a popcorn machine, ensuring that the final product meets stringent quality standards and performance specifications. During testing, comprehensive evaluations are conducted to assess various aspects of the machine's operation, functionality, and safety. This includes testing heating efficiency to verify the effectiveness of the heating element in popping corn kernels, assessing popcorn popping rate to ensure consistent and efficient popcorn production, and evaluating noise levels to determine if the machine operates within acceptable limits. Additionally, safety tests are conducted to validate the effectiveness of safety features such as thermal fuses, overheat protection mechanisms, and emergency stop buttons in preventing accidents and ensuring user safety.

Calibration is another crucial aspect of the testing phase, involving the adjustment and fine-tuning of operational parameters to optimize performance and accuracy. This may include calibrating temperature control mechanisms to maintain precise heating temperatures, adjusting timers and control systems to ensure accurate popcorn popping cycles, and fine-tuning sensory feedback mechanisms to provide users with intuitive and

responsive control over machine operation. Through meticulous testing and calibration, manufacturers can identify any deviations from design specifications and address them promptly to ensure that the final product meets performance requirements and quality standards.

Testing and calibration are iterative processes, with multiple rounds of testing conducted to validate design changes, improvements, and optimizations. This iterative approach allows manufacturers to refine and fine-tune the popcorn machine design, addressing any performance issues or shortcomings identified during testing. By conducting thorough testing and calibration, manufacturers can ensure that their popcorn machines deliver consistent performance, reliability, and safety, meeting the expectations of customers and stakeholders. Additionally, testing and calibration play a crucial role in product validation and quality assurance, instilling confidence in the product and enhancing its reputation in the market.

4.11 FINISHING TOUCHES

In the fabrication process of a popcorn machine, the phase of finishing touches encompasses the final steps to enhance the aesthetic appeal, functionality, and usability of the product. These touches add polish and refinement to the popcorn machine, contributing to its overall quality and user experience. One key aspect of finishing touches is the application of paint or coatings to the exterior surfaces of the machine. This not only provides a protective layer against corrosion and wear but also allows for customization and branding to align with the manufacturer's branding and aesthetic

preferences. Additionally, labeling and signage are applied to the machine to provide clear instructions, safety warnings, and branding elements. This includes labeling control panels, switches, and other user interface elements with intuitive icons and instructions to facilitate ease of operation. Furthermore, branding elements such as logos, product names, and contact information may be prominently displayed to enhance brand recognition and awareness. Other finishing touches may include the installation of decorative accents, such as trim, molding, or decals, to enhance the visual appeal of the popcorn machine and differentiate it in the marketplace. Overall, finishing touches are essential for adding the final polish and refinement to the popcorn machine, ensuring that it not only performs optimally but also delights users with its aesthetics and usability.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.1 SUMMARY

The development and fabrication of an electric popcorn machine represent a significant advancement in domestic appliance technology, emphasizing convenience, efficiency, and safety. The project commenced with a thorough analysis of existing popcorn machines, highlighting their limitations and areas for improvement. The primary objective was to design a machine that is user-friendly, energy-efficient, and capable of producing popcorn swiftly without compromising on quality.

The fabrication process involved several critical stages, beginning with the conceptual design. Various components were selected based on their functionality, durability, and cost-effectiveness. These components included the heating element, popping chamber, power supply, and safety features. The design process was supported by computer-aided design (CAD) software, which facilitated precise modeling and simulation of the machine.

Subsequently, the assembly phase integrated these components into a cohesive unit. The heating element was carefully calibrated to ensure optimal popping temperature, while the popping chamber was designed to maximize heat distribution and popcorn yield. Safety features, such as thermal cutoffs and insulation, were incorporated to prevent overheating and ensure user safety.

Testing and evaluation were critical components of the fabrication process. The machine underwent rigorous testing to assess its performance, including popping efficiency, energy consumption, and safety standards. The results demonstrated that the electric popcorn machine met the desired specifications, producing high-quality popcorn efficiently and safely.

5.2 CONCLUSION

The fabrication of the electric popcorn machine has successfully addressed the initial objectives and identified limitations in existing designs. Key conclusions drawn from this project include:

Efficiency and Performance: The electric popcorn machine has proven to be highly efficient, with a popping time significantly reduced compared to conventional methods. The use of an optimized heating element and well-designed popping chamber ensures maximum heat utilization and popcorn yield.

Energy Consumption: One of the significant achievements of this project is the reduced energy consumption. The machine's design incorporates energy-saving features without compromising on performance, making it an eco-friendly alternative to traditional popcorn-making methods.

User Safety: Enhanced safety features, including thermal cutoffs and proper insulation, ensure the machine operates safely, minimizing the risk of accidents. These safety measures make the machine suitable for home use, providing peace of mind to users.

User-Friendly Design: The electric popcorn machine is designed with the end-user in mind. Its intuitive controls, easy assembly, and maintenance-free operation make it accessible to a broad audience, from children to adults.

Market Potential: The success of this project indicates a strong market potential for the electric popcorn machine. Its combination of efficiency, safety, and user-friendliness makes it an attractive product for both domestic and commercial use.

5.3 RECOMMENDATIONS

While the electric popcorn machine project has achieved its primary goals, several areas for improvement and further research have been identified. The following recommendations are proposed:

Advanced Material Use: Future iterations of the machine could benefit from advanced materials that offer better heat resistance and durability. Exploring lightweight, high-strength materials could enhance the machine's portability and longevity.

Automation and Smart Features: Integrating smart technology could further improve the user experience. Features such as automatic shut-off, digital controls, and connectivity with smart home systems could make the machine more convenient and efficient.

Energy Optimization: Although the machine is already energy-efficient, ongoing research into more advanced energy-saving technologies could further reduce its environmental impact. Exploring alternative power sources, such as solar energy, could also be beneficial.

Enhanced Safety Measures: While the current safety features are adequate, additional measures could be explored to further minimize risks. For instance, implementing real-time monitoring systems that detect potential malfunctions could prevent accidents before they occur.

Market Research and Consumer Feedback: Conducting extensive market research and gathering consumer feedback can provide valuable insights into user preferences and potential improvements. This data can guide future design modifications and marketing strategies to better meet consumer needs.

In conclusion, the fabrication of the electric popcorn machine is a testament to innovative design and engineering. By addressing efficiency, safety, and user-friendliness, the project not only meets current market demands but also sets the stage for future advancements in domestic appliance technology. Continued research and development will ensure that these machines remain at the forefront of convenience and performance in the kitchen.

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