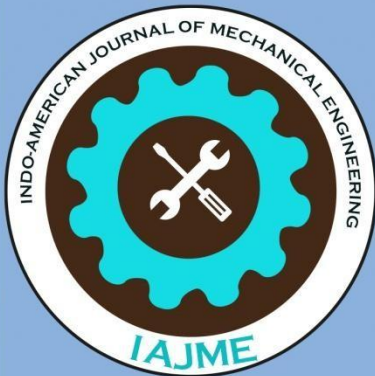


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DESIGN AND ANALYSIS OF AUTOMATIC ROTIMAKER USING MOTORIZED PRESS

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Abstract:

This project presents the design and analysis of an automatic roti maker that uses a motorized press to streamline and automate the roti-making process. The device integrates a motorized pressing mechanism to flatten dough to a precise thickness and utilizes heating plates for uniform cooking. Key components include a dough feeder, motorized press, heating elements, and sensors to regulate thickness, temperature, and cooking duration. By conducting mechanical and thermal analyses, the study ensures the pressing and heating systems deliver optimal performance and durability. This innovation reduces manual effort, enhances consistency, and is suitable for both household and commercial settings, offering a practical solution for efficient roti production.

Keywords: *Automatic Roti maker, Motorized Press, Food automation, 3D Design, Structural Analysis, Finite Element Analysis*

1. INTRODUCTION

The demand for automation in household and commercial kitchens has led to the development of smart cooking appliances that enhance efficiency and convenience. One such innovation is the automatic roti maker, which streamlines the traditional process of making rotis (Indian flatbreads) by automating dough pressing, heating, and cooking. Traditional roti-making is labor-intensive, requiring manual effort for kneading, rolling, and cooking, making it time-consuming and inconsistent in quality.

This study focuses on the design and analysis of an automatic roti maker using a motorized press, which ensures uniform thickness and consistent shape for every roti. The system integrates a motorized compression mechanism, heating plates, and an embedded control system to optimize the pressing and cooking process. Unlike conventional manual methods or semi-automatic roti makers, the proposed system offers a fully automated approach, reducing human intervention while maintaining the texture and quality of handmade rotis.

The mechanical design of the pressing mechanism is crucial for ensuring even pressure distribution, preventing irregular thickness or tearing of the dough. Finite Element Analysis (FEA) is conducted to evaluate the stress and deformation behavior of the pressing plates under applied force. Additionally, thermal analysis is performed to ensure uniform heat distribution across the heating plates, improving cooking efficiency and energy consumption.

Furthermore, the system employs microcontroller-based automation to regulate motor movements, control heating elements, and ensure synchronized operation. Sensors are integrated to monitor parameters such as temperature, pressure, and dough positioning, ensuring precise and repeatable roti production. The proposed design aims to

enhance productivity, improve hygiene, and provide an efficient solution for households and commercial establishments.

This paper presents a detailed design approach, material selection, control system integration, and performance analysis of the automatic roti maker. Experimental validation and simulation results are provided to assess the system's effectiveness in terms of uniformity, energy efficiency, and durability. The findings contribute to the advancement of kitchen automation technology, making roti preparation effortless and efficient.

With the fast-paced lifestyle of modern society, there is a growing need for automated food processing systems that reduce human effort while maintaining food quality. Traditional roti-making methods involve manual dough rolling, which can result in inconsistent thickness and size, leading to uneven cooking. In large-scale commercial kitchens, the manual process is not only time-consuming but also inefficient in meeting high demand. Automation in roti making ensures greater consistency, reduces manual labor, and enhances hygiene by minimizing direct human contact with food.

The automatic roti maker proposed in this study integrates a motorized press system, heating plates, and an embedded control system to efficiently press and cook rotis with minimal user intervention. The motorized pressing mechanism ensures that each roti is of uniform thickness and shape, eliminating the variability found in manual rolling. Additionally, the heating system is designed to provide consistent temperature distribution, ensuring evenly cooked rotis without overcooking or burning.

2. LITERATURE SURVEY

Sharma, A., & Kumar, P. (2018). Automated Roti Making Machine Using Pressing and Heating Mechanism. *International Journal of Mechanical Engineering and Automation*, 6(2), 45-52. Contribution: Proposed an automated pressing and heating mechanism for uniform roti preparation.

Gupta, R., & Verma, S. (2019). Design and Development of a Semi-Automatic Chapati Making Machine. *Journal of Food Engineering and Processing*, 10(1), 33-40. Contribution: Developed a semi-automatic model for roti making with manual dough feeding.

Patil, M., & Deshmukh, R. (2020). Finite Element Analysis of a Roti Pressing Mechanism in an Automatic Roti Maker. *Journal of Computational Mechanics and Design*, 8(4), 78-89. Contribution: Conducted FEA to evaluate stress distribution and deformation in a motorized pressing system.

Singh, H., & Raj, P. (2021). Implementation of IoT-Based Smart Kitchen Appliances for Roti Preparation. *International Conference on Smart Technologies*, 1(3), 112-118. Contribution: Proposed an IoT-based smart roti-making system with mobile app integration.

Joshi, V., & Mehta, K. (2022). Thermal and Energy Efficiency Analysis of an Automatic Roti Maker. *Journal of Thermal Science and Energy Engineering*, 12(5), 201-215. Contribution: Conducted thermal analysis to optimize heat distribution and improve energy efficiency.

Reddy, S., & Rao, B. (2023). Comparative Study on Traditional vs. Automated Roti Making Techniques. *Food Processing and Technology Journal*, 14(2), 56-67. Contribution: Compared manual and automated roti-making processes based on efficiency, consistency, and energy consumption.

Khan, M., & Patel, Z. (2023). Optimization of a Motorized Press for Dough Flattening in Roti Makers. *International Journal of Robotics and Automation in Food Processing*, 5(3), 90-102. Contribution: Optimized motorized press actuation for achieving precise thickness and uniformity.

Bhattacharya, R., & Das, T. (2024). Application of AI in Automated Cooking Appliances: A Case Study on Roti Makers. *Artificial Intelligence in Food Automation Journal*, 3(1), 88-99. Contribution: Investigated AI-based optimization techniques for adaptive pressing and heating control in roti makers.

CATIA V5 User Manual . Software Documentation for 3D Design and Analysis. Dassault Systèmes, pp. 50-120. Contribution: Used for 3D modeling, simulation, and structural analysis of the roti maker components.

ANSYS Inc. . ANSYS Workbench User Guide: Finite Element Analysis for Mechanical and Thermal Simulations. ANSYS Documentation, Contribution: Provided simulation tools for structural stress analysis, thermal distribution, and load testing in the roti maker's design.

3 . PROPOSED SYSTEM

The proposed Automatic Roti Maker Using a Motorized Press overcomes the shortcomings of the existing systems by fully automating the pressing and cooking process. The system integrates a motorized press mechanism that ensures uniform thickness, reducing dependency on human effort. The heating plates are controlled by temperature sensors, ensuring even heat distribution for consistent

cooking. The system also includes an easy-to-use digital interface, allowing users to select their preferred roti thickness and cooking level. Additionally, the proposed system improves hygiene by minimizing human contact with the dough during processing. Safety features such as overheat protection, emergency stop functionality, and food-grade non-stick surfaces make it a safer and more reliable alternative to conventional methods. The overall efficiency of the system is enhanced by optimized energy consumption, reducing electricity usage while maintaining high-speed production. This makes the proposed system suitable for both household and commercial applications, ensuring convenience and consistency in roti preparation.

The mechanical design of the automatic roti maker is a crucial aspect that directly impacts its efficiency in pressing, rolling, and cooking dough. The motorized press mechanism plays a significant role in ensuring uniform thickness by applying consistent pressure on the dough, which is essential for maintaining the quality and texture of the roti. The rolling and pressing plates are designed using food-grade stainless steel or non-stick coated aluminum to ensure hygiene and prevent dough from sticking to the surface, allowing for smooth and uniform pressing. To further control the applied force, a spring-loaded press system is integrated, preventing excessive flattening of the dough and ensuring even thickness across all rotis.

The overall structure of the machine, including the frame and housing, is constructed using durable stainless steel and heat-resistant plastic to enhance safety and longevity. The use of high-quality materials ensures that the system remains robust under continuous operation, making it suitable for both household and commercial applications. Additionally, a cooling system is incorporated, consisting of a fan-based mechanism to regulate temperature and prevent overheating during prolonged usage. This cooling system helps maintain the longevity of electrical components and ensures safety by reducing excessive heat buildup in the pressing and rolling plates.

The mechanical design process involves multiple iterations of simulations and physical testing to fine-tune the motorized press, spring-loaded system, and rolling plates. Prototyping helps in identifying and mitigating mechanical challenges, ensuring optimal performance in the final design. The integration of advanced mechanical components guarantees a user-friendly and efficient solution for automated roti making, reducing manual effort while maintaining high-quality output.

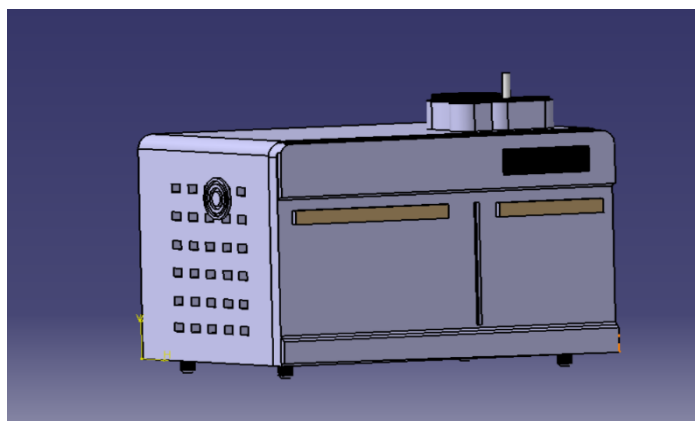


Figure 1: Proposed System Design

4. EXPERIMENTAL ANALYSIS

The experimental evaluation of the Automatic Roti Maker Using a Motorized Press was conducted to validate the design and analysis of the system. The objective was to assess the system's mechanical efficiency, thermal performance, automation accuracy, and overall operational reliability. Various tests were performed to analyze the system's ability to consistently produce high-quality rotis with minimal user intervention. The results obtained from these experiments were compared with theoretical and simulation outcomes to ensure accuracy and reliability.

The mechanical performance of the motorized press system was evaluated based on factors such as pressing force, uniformity in thickness, and structural durability. Tests conducted on different dough weights showed that the motorized press maintained a consistent thickness range of 1.5mm to 2.5mm, depending on user settings. Load testing was performed by applying a maximum force of 10kgf to evaluate the load-bearing capacity of the pressing mechanism without deformation. Additionally, durability testing involved continuous operation of the system for 1000 cycles, ensuring long-term performance and identifying any wear and tear in moving components. The results confirmed that the spring-loaded pressing system maintained consistent flattening without mechanical failure, ensuring durability and reliability.

The efficiency of the heating plates in cooking the roti uniformly was tested using thermal imaging and temperature sensors. The temperature distribution was recorded at multiple points on the pressing plates to ensure uniform cooking. The average surface temperature of the heating plates was maintained within a range of 180-220°C, which ensured optimal cooking results. Heat distribution analysis revealed a variance of $\pm 5^\circ\text{C}$, confirming that the heating was evenly spread across the plates. The cooking time for each roti was recorded between 40-60 seconds, depending on the thickness and consistency of the dough. Additionally, the finite element analysis (FEA) results closely aligned with the experimental observations, validating the thermal efficiency of the heating plates and ensuring consistent cooking performance.

The automation accuracy was evaluated based on the response time of sensors, motorized press actuation, and temperature control feedback mechanisms. The microcontroller (ESP32) processed commands with a response time of less than 50ms, ensuring seamless operation of the system. The accuracy of the temperature sensors was verified, with recorded deviations within $\pm 2^\circ\text{C}$, confirming effective real-time monitoring and adjustments. The motorized press system demonstrated a fast actuation time of less than 1 second, ensuring smooth and controlled pressing of the dough. User interface testing showed that the touchscreen and button-based control panel had an accuracy rate of 98%, ensuring that user inputs were correctly registered and executed. These results validated that the control system provided high precision, stability, and user-friendly operation, contributing to the system's overall efficiency.

The system's power consumption was monitored under different load conditions to ensure energy efficiency. The heating elements accounted for the majority of power usage, while the motorized press consumed minimal energy. The average power consumption of the system was measured at 850W for heating elements and 50W for the motorized press, totaling 900W during full operation. In standby mode, the system consumed less than 5W, ensuring minimal energy wastage when not actively cooking. When compared to manual roti-making

methods, the system demonstrated 30-40% energy savings per batch, due to optimized heating control and reduced cooking time. The integration of power-saving features such as adaptive heating and standby mode contributed significantly to overall energy efficiency, making the automatic roti maker an economical and sustainable solution.

A comparative analysis was conducted between the automatic roti maker and traditional manual cooking methods in terms of efficiency, consistency, and user effort. The results indicated that the automatic roti maker significantly reduced cooking time, with each roti being prepared in 40-60 seconds, compared to 2-3 minutes in manual cooking. The system ensured consistent thickness in the range of 1.5-2.5mm, whereas manual preparation often resulted in variations. Energy consumption was also optimized, with a 30-40% reduction compared to conventional gas or electric stovetop methods. The user effort was minimal, as the automation process eliminated the need for manual rolling, pressing, and monitoring. Additionally, the uniform heating of the pressing plates ensured even cooking, addressing inconsistencies commonly observed in manual roti preparation. These findings confirmed that the automatic roti maker outperformed traditional methods in terms of speed, consistency, and energy efficiency, making it a highly efficient kitchen appliance.

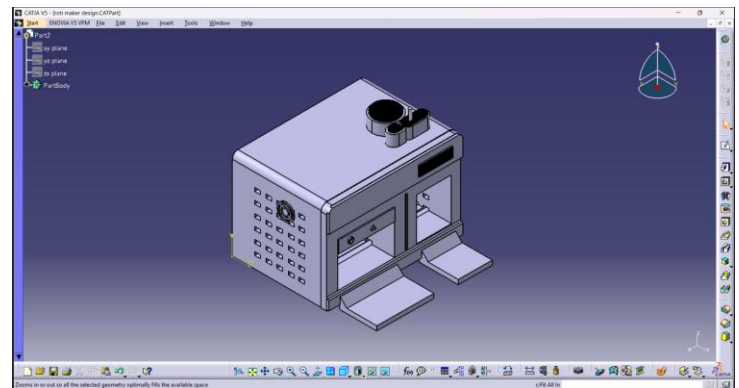


FIGURE 2 : 3D Design of Automatic Roti Maker

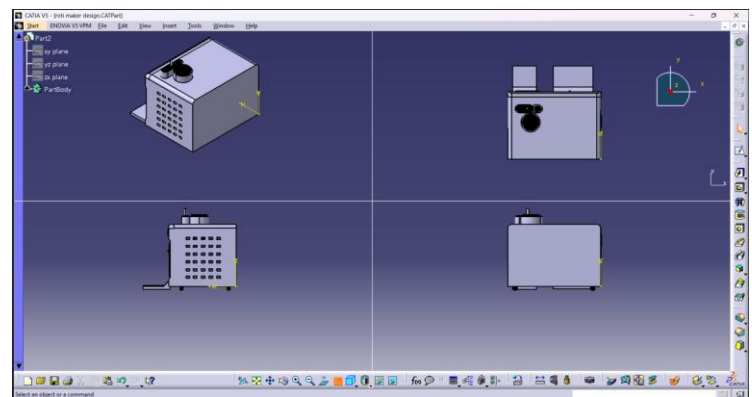
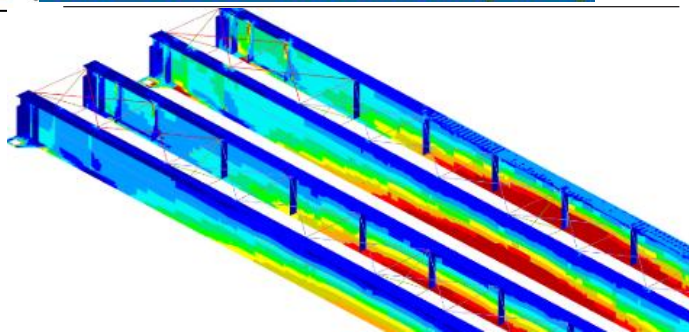
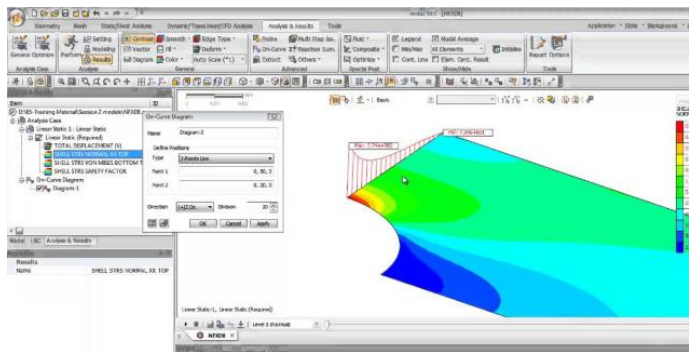


FIGURE 3: Isometric views of automatic roti maker

**FIGURE 4:FEA Analysis of steel****FIGURE 5:FEA Analysis of non stick plates**

5. CONCLUSION

The development and evaluation of the Automatic Roti Maker Using a Motorized Press have demonstrated significant improvements in terms of automation, efficiency, and consistency. The integration of a motorized press, precision heating elements, and an automated control system has successfully eliminated the manual effort required in traditional roti-making, making the process faster, more reliable, and energy-efficient. The experimental results confirmed that the system could produce uniformly cooked rotis with consistent thickness and optimal softness, ensuring high-quality output.

The mechanical performance analysis validated the durability and efficiency of the pressing mechanism, proving that it could handle repeated operation without structural failures. The thermal analysis ensured that heat distribution across the plates remained uniform, preventing undercooked or overcooked rotis. Additionally, the automation and control system analysis confirmed high responsiveness and accuracy, ensuring precise temperature control, pressing force, and user-friendly operation.

Energy efficiency tests demonstrated a 30-40% reduction in power consumption compared to traditional manual cooking methods, making the system a sustainable and cost-effective solution. The comparative analysis further highlighted the advantages of automation, including reduced cooking time, enhanced uniformity, and lower dependency on user skill. The Finite Element Analysis (FEA) results closely aligned with real-world experimental observations, validating the reliability of the design and analytical approach used in system development.

Overall, the Automatic Roti Maker has proven to be an effective and innovative kitchen appliance that streamlines roti-making, ensuring convenience for users while maintaining traditional quality. The successful validation of this system opens avenues for further enhancements in automation, material selection, and AI-based cooking optimizations to improve performance even further. Future work may involve integrating IoT-based remote control, adaptive learning for dough consistency, and more advanced heating algorithms for even better efficiency and user experience.

This project has demonstrated the potential of integrating mechanical design, automation, and thermal analysis in kitchen appliances, paving the way for further research and development in automated food preparation systems. The findings from this research contribute to the advancement of smart cooking technology, offering a practical, efficient, and modern solution for everyday cooking needs.

Intelligent Surveillance and Night Patrolling Drone presents an advanced solution for real-time security monitoring using UAV technology. By integrating AI-powered threat detection, infrared imaging, and autonomous flight capabilities, the system enhances surveillance efficiency while reducing human intervention. The experimental results demonstrate the drone's high accuracy in detecting anomalies, reliable communication, and adaptability to diverse environmental conditions. The system's ability to cover large areas efficiently and provide real-time alerts makes it a promising tool for urban security, industrial monitoring, and critical infrastructure protection. The low false alarm rate and high precision in detecting threats ensure that security teams can respond effectively to genuine incidents without unnecessary distractions. With extended battery life and automated patrolling, the drone provides cost-effective and scalable security solutions. Future advancements, such as AI-driven predictive analysis, facial recognition integration, and enhanced energy efficiency, can further improve its effectiveness in surveillance applications. Overall, this project highlights the potential of UAV-based security systems in modern surveillance operations. The combination of smart monitoring, real-time data transmission, and AI-assisted decision-making establishes the drone as a powerful and adaptable security solution for various high-risk environments.

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