Design And Development of a Semi-Automated Kottu Making Machine

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***Abstract*—This research discusses the design and development of a semi-automated Kottu-making machine. The objectives are to create a machine that can prepare multiple types of Kottu (e.g., chicken, beef, vegetable, egg) at once, and to reduce the time and labour costs associated with traditional Kottu-making methods. The machine allows for the preparation of four Kottu at once on separate stainless-steel rotary pans. A Scotch yoke mechanism was identified to provide accurate reciprocating chopping motion, with motorised mechanisms assisting the rotation of the pans to provide the option of mixing, and the rotation of the motorised handles used for mixing and chopping. A single pan prototype was fabricated to test the core mechanical functionality of the system, and a 3D model was designed using SOLIDWORKS. The prototype development and testing phases have been completed. Experimental results show that proper mixing requires a pan rotation speed of 10–20 RPM, while 200 RPM motors were used to drive the mixing handles. To prepare four portions manually, the process typically takes 12–24 minutes, whereas with the machine, the time can be reduced by up to 9 minutes. The number of chopping strokes required to achieve proper consistency ranges from 50 to 200, depending on portion size and ingredients. Ingredient addition takes approximately 1–3 minutes per pan, and preparing a single portion of Kottu requires only 3–6 minutes when ensuring both proper mixing and chopping. Mixing effectiveness is achieved at 10–20 RPM, while chopping and mixing times vary depending on motor RPM, which can be controlled by adjusting the voltage supply. Overall, the results confirm that the semi-automated Kottu-making machine provides enhanced productivity, consistent quality, and improved food safety for small- and medium-scale food service operations, while preserving the traditional taste through modern automation.**

***Keywords*— Kottu-Making Machine, Semi-Automation, Food Processing, Scotch Yoke Mechanism**

I. INTRODUCTION

There is a higher demand for street foods and fast foods among Sri Lankan people. Examples include Fried rice, Kottu, Parotta, roti, String Hoppers, Pastry items, buns, pizza, and many more. Among those foods, Kottu has the highest demand among Sri Lankan people. It is fast-moving, very tasty food. All of the Sri Lankan people love to eat Kottu. But in Sri Lankan hotels and street food stalls still use traditional methods to make Kottu, which is made by hand, and there must be a special Kottu chef to make a Kottu and have to pay more salary to them. They use a metal tray to chop the Kottu roti by using two stainless steel spoons. Because of that, the chef who makes the Kottu gets tired of doing that because of the heat of the cooker and working conditions; they always have to move their hands to chop the Kottu and cannot be able to handle more Kottu orders at one time. so that raising concerns about productivity, hygiene. Sweating and hair can be able to mix with Kottu when made by hand because most of the Sri Lankan hotels do not use hygiene equipment like masks, chef caps, gloves, and aprons. And some hotels also do not use any spoons to add some ingredients, they all add them by it using their own hand, at least without using gloves or without washing their hands. Some Hotels use a Kottu roti cutting machine to cut rotti but they all make Kottu food by hand.

II. METHODOLOGY

A. Identifying Requirements

The first step involved identifying the requirements of hotels and restaurants that prepare Kottu. Key factors considered in this research include production capacity, efficiency, hygiene standards, customization options, portion size, ingredient variety, and the types of Kottu prepared. Feedback from chefs, hotel staff, and managers was gathered to ensure the design aligns with practical industry needs. efficient and easy to use, ensuring that the machine can make four portions of Kottu at the same time.

B. Conceptual Design

Conceptual sketches with various mechanisms for rotating pans, chopping, and ingredient feeding were developed and evaluated for functionality, cost, size, manufacturability, and simplicity. The most feasible design was selected to enable preparing four portions of Kottu simultaneously with improved efficiency and usability

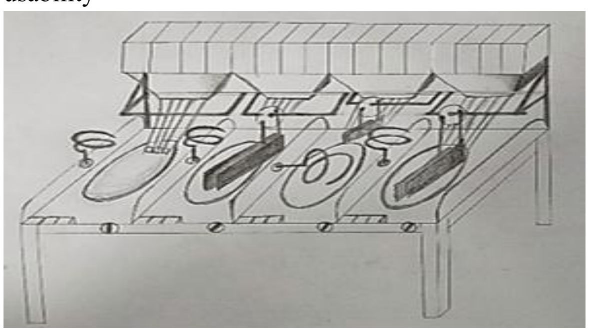

Fig. 1: Conceptual Design

C. 3D Modelling and Design Development

The selected concept was further developed into a detailed 3D model using SOLIDWORKS. Each component was designed individually, including the frame, rotating pans, heat regulators, chopping mechanism, and feeding systems. Careful attention was given to measurements and component alignment to ensure seamless assembly and operation. Slots were designed to hold four removable and rotatable pans; each aligned with motors for smooth rotation and mixing.

Fig. 2: 3D Design of Semi-Automated Kottu Making Machine

D. Material Selection

Material selection was based on durability, hygiene, and strength. The base structure was designed using metal box bars to provide stability and withstand the vibrations generated during operation. Stainless steel was selected for the pans due to its hygienic properties and ease of cleaning. The design ensured that the frame could support the combined weight and forces from the chopping blades and mixing system.

E. Subsystem Design

Rotating Pan System: Four round stainless-steel pans, placed on sets of round wheels, were designed to rotate under motor control. Each pan was equipped with a dedicated heat regulator, enabling precise temperature control., Chopping Mechanism: Kottu blades mounted on a screw axis were incorporated to produce a reciprocating motion, mimicking the traditional chopping process while being robust enough to handle varying ingredients., Feeding System: A vibrating feeding system was designed for adding Kottu roti portions, ensuring proper portioning and avoiding blockages. A separate vibrating feeder was allocated for ingredients such as vegetables, meat, salt, and chilies. and components. Assemble the base structure, pans, chopping mechanism, and feeding systems. Ensure all parts are aligned correctly and that the electrical components, such as motors and heat regulators, function as intended. Then, after making the prototype, test the machine and make any necessary adjustments.

F. Prototype Fabrication and Assembly

Following the finalization of the 3D design, a Bill of Materials (BOM) was prepared, and the prototype was fabricated using the selected materials and components. The base structure, pans, chopping mechanism, and feeding systems were assembled with careful alignment. Motors and heat regulators were installed and tested to confirm their functionality.

G. Testing and Adjustments

The completed prototype was subjected to initial testing to evaluate performance. Adjustments were made where necessary to improve mechanical alignment, stability, and operational efficiency. The testing phase ensured that the machine met the design objectives and functioned reliably for practical use.

III. RESULTS AND DISCUSSION

A. Simulation Results

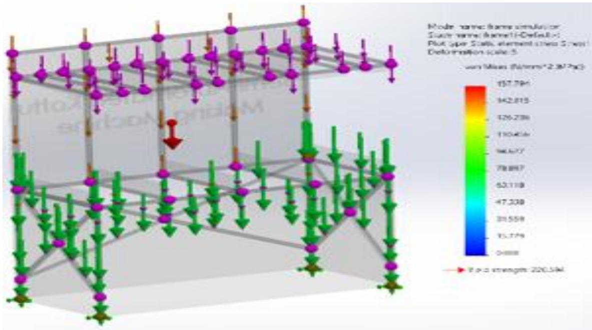

Fig. 3: Yield Strength Simulation

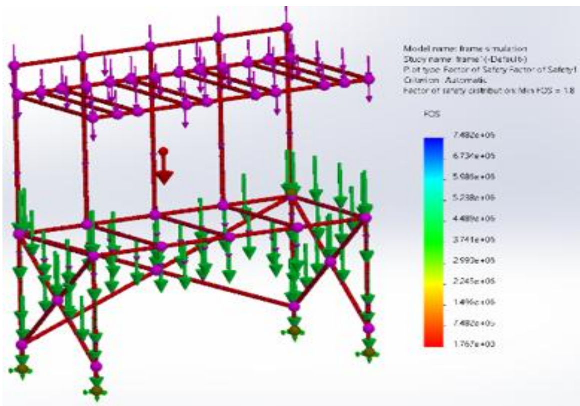

Fig. 4: Factor of Safety Simulation

The structural frame of the semi-automated Kottu-making machine was fabricated out of 25 mm square tube box structural bars that have a wall thickness of 1.6 mm. These bars were chosen due to their strength, durability, and ease of fabrication. Each box bar is 5.5 meters long and approximately weighs 6.7 kg. The box structural bars used for the frame had a total length of 34 meters and an estimated self-weight of 42 kg. The total applied load on the frame, which includes all the mechanical components, is approximately 102 kg. The structural analysis verifies that the maximum stress acting on the frame was 157.79 MPa and the yield strength of the material was 220.59 MPa. With a factor of safety at 1.8, the design of the frame is acceptable, and the semi-automated Kottu-making machine can operate successfully with no threat of deformation or failure.

B. Motor Selections.

For Belt Drive

- Required motor RPM = 15 to 60 RPM
- Load: 10 kg on the pulley
- Required Motor Torque = 2.45 Nm

For Lift Kottu Spoons and Chopping the Kottu

- Load applied on pan = 5 kg
- Weight of mechanism = 6 kg
- Crank radius = 80 mm = 0.08 m
- Required Motor Torque = 8.63 Nm

Kottu Mixing Motor

- Weight of Kottu portion: 1 kg
- Weight of mixer blade: 0.4 kg
- Total rotating mass: 1.4 kg
- Radius of mixing container: 0.1 m (100 mm)
- Rotation speed: 30 RPM (assumed)
- Required Motor Torque = 0.138 Nm

C. Prototype Testing

Fig. 5: Prototype of the Semi-Automated Kottu Making Machine

Prototype testing of the semi-automated Kottu-making machine was conducted with portion sizes of 490 g and 621 g to evaluate its performance. The chopping mechanism, powered by wiper motors, operated between 50 and 200 strokes depending on portion size and ingredients, delivering the required texture comparable to traditional methods. For mixing, 200 RPM motors were used to rotate the handles, achieving the required 10–20 RPM for uniform mixing. The average time required to add ingredients to each pan was 1–3 minutes, while the overall preparation time per portion, including mixing and chopping, was 3–6 minutes. In comparison, preparing four portions manually requires 12–24 minutes, whereas the machine reduces preparation time by up to 9 minutes. Additionally, the chopping and mixing speeds could be adjusted by regulating motor voltage, offering flexibility for different Kottu varieties. From an economic standpoint, manual preparation of four portions typically requires four laborers, costing Rs. 12,000/= – Rs. 20,000/= per day (at Rs. 3,000/=, Rs. 5,000/= per laborer in 2025/2026). The developed machine, however, enables a single operator to prepare four types of Kottu simultaneously, significantly reducing labor costs while improving efficiency, hygiene, and consistency.

Fig. 6: Testing Results

IV. CONCLUSION

The semi-automated Kottu-making machine represents an early-stage effort in design and fabrication aimed at transforming the preparation of Kottu, a popular Sri Lankan Street food. The machine was modeled in SOLIDWORKS and designed to simultaneously chop, mix, and cook four portions of Kottu, reducing manual dependency, preparation time, physical strain, and hygiene-related concerns. A prototype was fabricated to validate the feasibility of the design, ensuring both the correct motion of moving components and the mechanical integrity of subsystems. Key mechanisms, including the Scotch yoke chopping unit, the rotating pan frame, and the mixing handles, were successfully fabricated and assembled using steel box bars, bearings, razor wheels, and wooden components. Testing confirmed that the Scotch yoke mechanism delivered reliable reciprocating chopping motion, while the rotating pans and mixing system facilitated smooth, consistent movement.

Although food-based operational testing has not yet been conducted, the prototype demonstrated that the design is mechanically sound, structurally stable, and aligned with the initial project objectives. This validation provides a strong foundation for further development. The next steps include integrating electrical systems, enhancing safety features, refining materials, and conducting comprehensive food-based trials. Ultimately, the semi-automated Kottu-making machine has the potential to provide restaurants and hotels with a cost-effective, hygienic, and efficient.

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