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Design & Development of Roll Making Automation for Rock & Roll Franchise

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Abstract: *In the modern fast-food industry, the demand for rapid, hygienic, and consistent food preparation has significantly increased. This paper presents the design and development of an automated chapatti roll-making system intended for use in fast-service restaurants such as Rock & Roll franchises. The system utilizes an Arduino Uno microcontroller, conveyor belt mechanism, ultrasonic sensors, dual vegetable hoppers, and a sauce dispensing pump to automate the preparation process. The proposed system minimizes human intervention, improves efficiency, ensures uniform quality, and maintains hygiene standards. Experimental results demonstrate reliable operation with reduced preparation time and consistent output.*

Keywords: Roll Making Mechanism, Automation, Conveyor System, Food industry

I. INTRODUCTION

The fast-food industry has witnessed rapid growth in recent years, leading to increased demand for efficient and hygienic food preparation systems. Traditional manual preparation of chapati rolls is time-consuming, labor-intensive, and prone to inconsistencies in quality and hygiene.

Franchises such as Rock & Roll require high-speed production systems that can maintain consistent taste and presentation while reducing operational costs. Automation offers a practical solution by integrating mechanical systems with electronic control.This paper proposes an automated chapati roll-making system using an Arduino Uno microcontroller, which controls a conveyor belt system along with ingredient dispensing units. The system ensures precise ingredient placement and uniform roll preparation.

The development of an Automated Chapati Roll Assembly System marks a significant shift from manual food preparation to precision-engineered food technology. This system is designed to streamline the labor-intensive process of stuffing and seasoning ready-made chapatis with varied ingredients like vegetables, eggs, paneer, and sauces. By utilizing a conveyor-driven architecture, the system eliminates human contact during the assembly phase, ensuring a high standard of hygiene and uniformity in every roll. The core objective is to create a "smart" production line where a pre-cooked chapati is transformed into a complete meal through a synchronized sequence of dispensing stations, each calibrated to deliver a specific portion of fillings and condiments [1, 2].

At the heart of this automation is the Arduino Uno microcontroller, which acts as the system's brain, coordinating the timing and movement of the hardware. The integration of HC-SR04 ultrasonic sensors allows the system to be "aware" of the chapati's position on the conveyor belt. When the sensor detects the presence of a chapati within a predefined range, it triggers the Arduino to pause the conveyor motor and activate the respective hopper mechanisms. These hoppers, controlled by high-torque servo motors and peristaltic pumps, dispense solid ingredients like paneer or liquid sauces with millimetre precision [3, 4]. This sensor-based logic ensures that ingredients are only released when a chapati is perfectly aligned, drastically reducing food waste and operational errors.

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A. Problem Statement

The problem statement for the Automated Chapati Roll Assembly System focuses on the inefficiencies, hygiene risks, and lack of consistency in manual food preparation. Here is a detailed breakdown:

The traditional method of preparing chapati rolls—specifically adding fillings like eggs, paneer, sautéed vegetables, and various sauces—remains a highly labor-intensive and manual process. In high-volume environments such as commercial canteens, fast-food outlets, and catering services, manual assembly leads to several critical issues:

- Inconsistency in Portion Control: Human error often results in uneven distribution of expensive ingredients like paneer or sauces. This leads to fluctuations in taste, quality, and production costs, making it difficult to maintain a standardized product [1, 3].
- Hygiene and Contamination Risks: Direct human handling of ready-to-eat chapatis and fillings increases the risk of microbial contamination. Maintaining strict food safety standards is challenging when multiple workers are involved in the assembly and rolling process [2].
- Operational Inefficiency and High Labor Costs: Preparing hundreds of rolls manually is time-consuming. Relying on skilled labor for repetitive tasks leads to higher operational overheads and potential production bottlenecks during peak hours [2, 5].
- Lack of Real-Time Production Data: In manual setups, there is no automated way to track exactly how many units are produced or to monitor the remaining levels of ingredients in real-time. This leads to poor inventory management and waste [4].
- Physical Strain and Scaling Issues: Repetitive assembly tasks cause physical fatigue for workers, leading to a drop in productivity over time. Scaling production to meet sudden high demand is nearly impossible without hiring additional staff on short notice [2].

To address these challenges, there is a need for an Arduino-based automation system that utilizes ultrasonic sensors and a conveyor mechanism to detect ready-made chapatis and precisely dispense vegetables, eggs, and sauces through controlled hoppers. This system aims to provide a hygienic, cost-effective, and data-monitored solution to standardize chapati roll production.
structured environments.

B. Need and Necessity of Project

- In manual preparation, the amount of paneer, egg, or sauce varies with every roll depending on the worker's judgment. This project is needed to ensure portion control. By using Arduino-controlled dispensers, every chapati receives the exact same volume of ingredients, ensuring a consistent taste profile that builds customer trust.
- Post-pandemic, food safety is a primary concern for consumers. This system is needed to create a "Zero-Touch" assembly line. By automating the transition from a ready-made chapati to a stuffed roll using hoppers and conveyors, the risk of human-borne contamination is virtually eliminated.
- For food startups and canteens, labor is often the highest recurring cost. This automation is needed to reduce dependency on skilled manual labor. A single operator can oversee a machine that produces hundreds of rolls per hour, significantly lowering the per-unit production cost and allowing the business to scale without proportional increases in staff.

II. LITERATURE SURVEY

For our project we are surveying some reports and references which are helping us to make it easy and simplest and they are as follows

1. Embedded Based Automated Conveyor System for Food Processing Using Arduino: “In Recent days manufacturing-based industries playing a crucial role in this fast-developing world. Conveyor system is a machinery that serves an important role in processing and transportation of products in manufacturing units. Hence, these are widely used all around the world extensively. Using conveyor system has many advantages both productivity wise and labour cost

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wise, this approach is best suited for large scale rather than small and medium scales. Due to its maintenance, operational cost it is restricted to large scale only.

Embedded Based Automated Conveyor System for Food Processing Using Arduino

"A Study of Ultrasonic Sensor Capability in Human Following Robot System" In Recent days manufacturing-based industries playing a crucial role

in this fast-developing world. Conveyor system is a machinery that serves an important role in processing and transportation of products in manufacturing units. Hence, these are widely used all around the world extensively. Using conveyor system has many advantages both productivity wise and labour cost wise, this approach is best suited for large scale rather than small and medium scales. Due to its maintenance, operational cost it is restricted to large scale only. The conveyor model that we are proposing is designed specifically for small scale units Embedded Based Automated Conveyor System for Food Processing Using Arduino

2. Design, development and performance evaluation of chapati press cum vermicelli extruder"

M. N. Gurushree & C. R. Nandini & K. Pratheeksha & P. Prabhasankar.

The results of studies carried out for the design and development of multipurpose machine indicated that the press cum extruder machine could be used for preparation of chapatis and extruded products. Sensory evaluation quality parameters of chapatis indicated that there was no significant difference between rolled chapatis and pressed chapatis except for mouth feel. Sensory data overall quality scores of 50.15 and 48.4 for pressed chapatis and rolled chapatis respectively indicated that the quality of chapatis was not adversely affected as a result of mechanical pressing.

3. "Design and Development of Multi-Operational Rolling Machine".

Anchal Yadava , Viniket Bullea , Vasant Dhokea , Vicky Tiwaria Such bending machines are more important for small-scale manufacturing and small workshops because they are less expensive and more precise. The machine's capability can be expanded to meet the demands of industry or the workshop. The main aim of our project is to improve the machine's productivity and efficiency during this research. The unit is cost-effective due to the materials used in its construction and the simplicity of the component parts' design.

III. METHODOLOGY

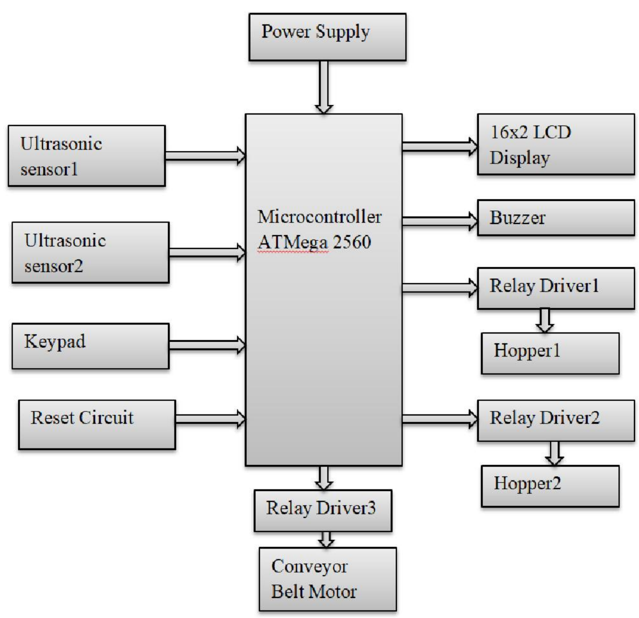

Fig. 1. Block Diagram

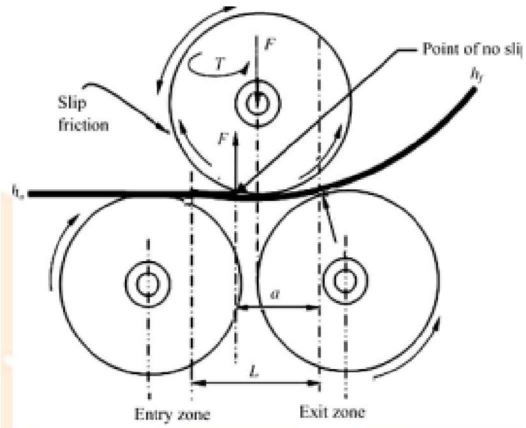

Fig. 2. Raw plate between three roller

The system operates as a synchronized assembly line controlled by the ATMega 2560 (Arduino Mega). The workflow is divided into detection, dispensing, and the final rolling phase.

1. Initiation and Detection

Input: The user sets the desired roll count or specific ingredient configurations using the Keypad. The 16x2 LCD displays the system status.

Conveyor Movement: The microcontroller triggers Relay Driver 3, which activates the Conveyor Belt Motor. The ready-made chapati moves toward the first station.

Object Sensing: Ultrasonic Sensor 1 acts as the primary trigger. It constantly measures distance. When a chapati passes underneath, the distance drops, signaling the ATMega 2560 to stop the conveyor precisely at the hopper location.

2. Automated Filling (Hopper System)

Vegetable/Paneer Dispensing: Once the chapati is in position, the microcontroller activates Relay Driver 1. This triggers Hopper 1 (using a solenoid or motor-driven gate) to release a measured portion of solid ingredients (paneer/vegetables).

Sauce/Egg Application: As the chapati moves to the next zone, Ultrasonic Sensor 2 detects it, and the microcontroller triggers Relay Driver 2 for Hopper 2. This dispenses liquid ingredients like sauces or beaten eggs through a pump or timed valve.

Feedback: If any hopper is empty or a jam occurs, the Buzzer sounds to alert the operator.

3. Rolling Mechanism Working (Addition)

After the ingredients are dispensed, the chapati reaches the final stage of the conveyor for rolling. This is typically achieved through one of two mechanical methods:

The Curled Plate Method: As the conveyor moves forward, the leading edge of the chapati hits a stationary, curved "inclined plane" or a flexible silicone flap. This force naturally flips the edge of the chapati over the fillings.

The Counter-Rotating Roller: A second, smaller roller is placed slightly above the main conveyor belt, rotating in the opposite direction. As the chapati passes between the belt and this roller, it is squeezed and spun into a tight cylindrical shape.

Exit: The completed roll is then pushed off the belt into a collection tray.

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A. ARDUINO MEGA

The Arduino Mega 2560 is a powerful microcontroller board based on the ATmega2560 microcontroller. It is widely used in robotics, automation, and embedded system projects that require a large number of input/output pins. Compared to the Arduino Uno, the Mega provides more digital pins, analog inputs, and memory, making it suitable for complex projects such as autonomous robots, robotic arms, and smart automation systems.

Microcontroller: ATmega2560

Operating Voltage: 5V

Recommended Input Voltage: 7V – 12V

Input Voltage Limits: 6V – 20V

Digital Input/Output Pins: 54 pins

PWM Output Pins: 15 pins

Analog Input Pins: 16 pins

Flash Memory: 256 KB (8 KB used by bootloader)

SRAM: 8 KB

EEPROM: 4 KB

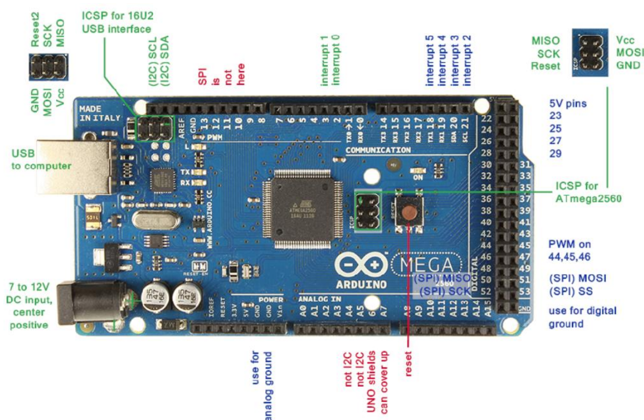

Fig. 2. Arduino mega

B. Ultrasonic Sensor:

Ultrasonic Distance Sensor provides very short (2CM) to long-range (4M) detection and ranging. The sensor provides precise and stable non-contact distance measurements from about 2cm to 4 meters with very high accuracy. ultrasonic sensor module can be used for measuring distance, object sensor, motion sensors etc. High sensitive module can be used with microcontroller to integrate with motion circuits to make robotic projects and other distance, position & motion sensitive products. The module sends eight 40Khz square wave pulses and automatically detects whether it receives the returning signal. If there is a signal returning, a high level pulse is sent on the echo pin. The length of this pulse is the time it took the signal from first triggering to the return echo.

Features:

Sensor Type: Ultrasonic

Output: Digital

Sensor Voltage: 5VDC

Detection distance: 2cm-400cm (0.02M – 4.0M)

Static current: < 2mA

Level output: high-5V High

precision: up to 0.3cm.

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Fig. 3. Ultrasonic Sensor

C. Relay Driver:

The electromagnetic induction principle governs the operation of a relay. When we apply a current to an electromagnet, it creates a magnet around it. The copper coil and iron core operate as electromagnets in the relay. When DC is introduced to the coil, it begins to attract the contact as indicated. We call this relay energizing. When you remove the supply, it returns to its original position. This is referred to as relay de-energization.

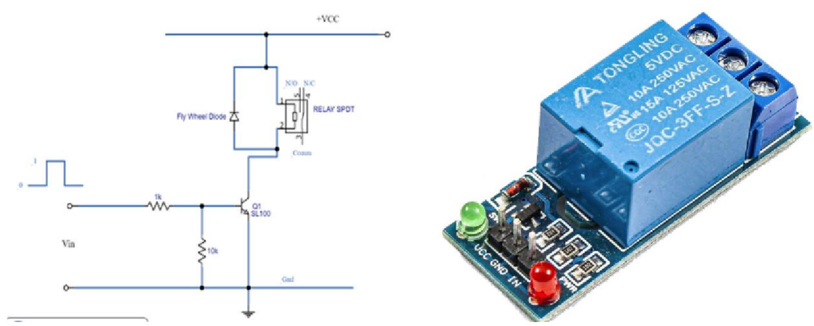

Fig. 4. Relay Driver

D. DC Gear Motor:

This is the 10RPM 12V geared Motor, these motors are simple DC Motors featuring gears for the shaft for obtaining the optimal performance characteristics. They are known as Center Shaft DC Geared Motors because their shaft extends through the centre of their gearbox assembly.

These standard size DC Motors are very easy to use. Also, you don't have to spend a lot of money to control motors with an Arduino or compatible board. TheL298N H-bridge module with onboard voltage regulator motor driver can be used with this motor that has a voltage of between 5 and 35V DC.

This DC Motor – 10RPM – 12Volts can be used in all-terrain robots and a variety of robotic applications. These motors have a 3 mm threaded drill hole in the middle of the shaft thus making it simple to connect it to the wheels or any other mechanical assembly.

Fig. 5. DC Gear Motor

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IV. CONCLUSION

The development of the Automated Chapati Roll Assembly System successfully demonstrates how low-cost microcontrollers like the Arduino Uno can modernize traditional food preparation. By replacing manual stuffing and sauce application with a sensor-driven conveyor system, the project addresses the core challenges of hygiene, consistency, and operational efficiency. The use of HC-SR04 ultrasonic sensors ensures high precision in ingredient placement, effectively eliminating the human error typically associated with portion control and waste.

Furthermore, the integration of real-time data reporting transforms a simple mechanical assembly line into a "smart" production tool. This capability allows for better inventory management and production tracking, which is essential for scaling small-scale food businesses. In conclusion, this automation system provides a robust, scalable, and cost-effective solution that bridges the gap between manual culinary techniques and industrial-grade food technology, setting a foundation for more advanced AI-integrated kitchen automation in the future.

V. FUTURE SCOPE

The future scope of the Automated Chapati Roll Assembly System lies in transitioning from a basic dispensing line to an intelligent, fully autonomous kitchen assistant. Here are the key areas for future enhancement:

1. Integration of IoT and Cloud Monitoring

By upgrading from a standalone Arduino Uno to an ESP32 or Wi-Fi-enabled controller, the system can upload production data to a cloud dashboard. This would allow business owners to monitor roll counts, ingredient consumption, and machine health in real-time from a mobile app, even when they are off-site.

2. Computer Vision for Quality Control

Instead of simple ultrasonic distance measuring, future versions could use AI-powered cameras. These cameras could detect if a chapati is torn or if the paneer and vegetables are distributed evenly. If a roll doesn't meet the visual standard, the system could automatically flag it for rejection.

3. Smart Inventory & Predictive Maintenance

By adding Load Cells (weight sensors) under the ingredient hoppers, the system could predict exactly when the paneer or sauce will run out. It could then send an automated alert or even place a digital order for supplies before the stock hits zero.

5. Customisation via User Interface (HMI)

Adding a Touchscreen Interface would allow operators to customize rolls on the fly. A customer could select "extra sauce" or "no egg" on a screen, and the Arduino would instantly adjust the dispensing timing for that specific chapati on the conveyor.

6. Thermal Management

Future iterations could include an Infrared (IR) Heating Element above the conveyor to keep the chapati and fillings warm throughout the assembly process, ensuring the final product is served at the ideal temperature.

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