



**An-Najah National University**  
**Faculty of Engineering and Information Technology**  
**Department of Computer Engineering**

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**Prepared By**

Amani Hasan Anees Odeh

Dana Zafer Abd Alfattah Braik

**Supervised By**

Dr. Samer Arandi

Dr. Asmaa Afeefi

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# Disclaimer

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Lastly, this work is dedicated to the resilient people of Gaza. We proudly pay tribute to the families enduring hardship and to the martyrs who gave their lives for a noble cause. The strength and willpower of the people of Gaza continue to inspire and motivate us every day.

# Abstract

**Dahberha** is an innovative automated system designed to transform the traditional manual process of shaping labneh into a fully streamlined operation. The system begins by offering the user a flavor selection option via a keypad, allowing them to choose between **Summaq**, **Zaatar**, or **no flavor**. Once a choice is made, the selected ingredient is automatically dispensed and mixed with the labneh.

Following the mixing process, the system cuts the labneh into equal portions, ensuring uniform quantity in each piece. Next, each portion enters the shaping stage, where it is gently formed into a consistent spherical shape. This dedicated step ensures a visually uniform appearance for all labneh balls. Once shaped, the labneh balls are placed into containers in a clean and consistent manner. After packaging, olive oil is automatically added to preserve freshness and enhance taste. Finally, the container is sealed, completing the fully automated process.

By combining flavor selection, mixing, shaping, packing, oiling, and sealing into a single automated workflow, **Dahberha** enhances hygiene, saves time, reduces manual effort, and delivers a high-quality end product ready for consumption or sale.

# Introduction

A popular traditional dish in Middle Eastern homes, particularly in the Levant, is labneh. It has been meticulously made by grandmothers for generations using basic, tried-and-true techniques, such as mixing, forming into balls, and preserving in olive oil. It represents warmth and heritage in culture and is more than just cuisine.

By automating the labneh ball preparation procedure, Dahberha innovates this traditional method. Every step of the process, including choosing a flavor (plain, zaatar, or summaq), mixing, shaping, oiling, and packing, is completed quickly without sacrificing the dish's handcrafted feel. The method makes labneh preparation quicker, cleaner, and more reliable by fusing tradition with contemporary ease.

## Background

Labneh, especially in small, highly flavored balls, has long been a staple of Middle Eastern diet. Traditionally hand-made, the preparation is a delicate mix, precise shape, and easy packaging to assist both in taste and texture retention. While the traditional method is a rich cultural tradition, it is perhaps labor-intensive and tiring—especially within commercial settings where demand is high.

As demand for traditional Levantine food continues to increase, small food businesses and producers face increasing pressure to balance authenticity and efficiency. Application of manual methods in preparing labneh balls often results in inconsistency in size, imbalanced taste distribution, and unhygienic conditions. Additionally, excessive reliance on experienced labor also faces difficulties in mass production and minimizing costs.

To eradicate these issues, automation provides a silver bullet. While general food automation systems exist, comparatively few are specifically tailored to the unique requirements of labneh production. The Dahberha system was designed with that specific demand in mind. It automates some of the process's most crucial steps—flavor selection (summaq, zaatar, or plain), ingredients mixing, forming, cutting, oiling, and packaging—yielding uniform quality while reducing massively on human labor.

Through the addition of automation to labneh manufacturing, Dahberha increases efficiency, increases hygiene, and preserves the authentic flavor that has made labneh a staple of Middle Eastern food culture. This new method closes the space between tradition and technology, making it simpler than ever to mass-produce high-quality labneh.

# Constraints, Standards, and Earlier Coursework

## Constraints

During the development of **Dahberha**, several challenges arose due to the delicate nature of labneh and the complexity of automating its shaping and packaging. Unlike more solid or dry food materials, labneh is soft, sticky, and highly sensitive to handling, which imposed multiple constraints on the **mechanical, electrical, and control** design of the system.

### • Shaping Mechanism (Ball Formation)

One of the most technically demanding stages was achieving **uniform ball formation** from the labneh portions. Given the soft and sticky consistency of labneh, shaping required a delicate balance between **controlled motion** and **gentle handling** to avoid deformation.

To address this, we consulted mechanical engineering professors to understand how to apply motion and distributed force on soft materials. Based on their advice, we built a **custom shaping platform** using a **rectangular wooden plate** suspended by four springs (zambareks). A motor was mounted on top to generate a **controlled circular motion**, which helped roll each portion into a spherical shape.

However, during testing, the springs were too stiff and restricted movement. After multiple trials, we replaced them with **softer, custom-tuned springs**, which gave the plate the flexibility needed for effective shaping.

Another constraint was **alignment**—the size of each labneh portion had to match the **height and motion range** of the shaping plate. Proper alignment was critical to ensure smooth rolling without sticking or distortion.

### • Cutting Mechanism (Cutter Compatibility)

Determining whether the cutter could effectively handle sticky labneh was a major challenge. Various blade shapes and cutting motions were tested; some dragged the labneh instead of slicing it, causing **smearing or shape loss**.

We modified the blade geometry and motion to ensure **precise and clean cuts**, resulting in consistently shaped labneh balls across repeated cycles.

### • Scooping System (Belt Stage)

Selecting the right tool to **scoop labneh into the shaping area** was critical. Labneh tends to **stick** to metallic or rigid surfaces.

After testing multiple tool types, we opted for a **non-stick, food-grade material** with a smooth curvature and gentle slope. This allowed the ball to slide off easily without deforming or leaving residue.

### • Dual Scooping System & Collection Flow Constraints

Initially, our system used **two scooping tools** (qashtat) to drop the shaped balls into the packaging area. However, we faced two main issues:

1. **Ball Drop Misalignment:** Sometimes the labneh balls would **miss the target container** or land improperly.
2. **Ball Ejection During Cutting:** After being sliced, some labneh balls would **bounce or fall outside** the scooping area.

To solve these problems:

- We designed and installed a **dedicated channel** (مجری) beneath the scooping area to **guide the ball directly** into the packaging cup.
- We also added a **secondary guide chute** immediately after the cutting phase to **capture and redirect** balls that might otherwise fall outside the scooping zone.

These modifications improved **accuracy, hygiene, and efficiency** in the handoff between shaping and packaging stages.

#### • Piston and Material Handling

The piston mechanism was responsible for slicing uniform labneh portions. It had to apply **just the right amount of force**—too much would smear the labneh, and too little would cause incomplete cuts.

We tuned the **air pressure** and **return timing** of the piston to produce **clean, even portions** without damaging the product.

In addition, **conventional sensors** like ultrasonic and infrared proved unreliable with labneh's soft, reflective surface. After testing various options, we selected an **industrial-grade proximity sensor**, which provided **accurate, contactless detection** and reliably triggered the shaping and cutting actions at the correct moment.

#### • Sensor Positioning for Accurate Cutting

Sensor placement was another constraint. The initial setup failed to detect the correct **cutting point**, resulting in **inconsistent portion sizes**.

Because labneh flow is not uniform, **static positioning** wasn't enough. We adopted a **hybrid approach**, using both **sensor data** and **timing synchronization** with the piston movement.

This improved the **cutting precision** and ensured uniform sizes.

#### • Electrical and Space Considerations

While high-current loads were not a concern, the system included several **low-voltage components** like relays, motors, and sensors that required **precise wiring**. Poor management could cause **false triggers** or **system instability**.

Moreover, the **mechanical layout**—including the piston, shaping mechanism, dual scoops, and packaging platform—had to be **compact yet efficient**. We carefully planned the internal structure to **prevent collisions**, ease maintenance, and ensure continuous flow throughout the process.

## Standards

Throughout the development of **Dahberha**, we adhered to essential electrical and mechanical standards to ensure the system's safety, durability, and ease of use. Given the presence of AC components, rotating parts, and delicate material handling, proper safety measures were prioritized at every stage of the design.

### Electrical Standards and Safety Measures We Followed:

### Wire Selection:

- **2.5mm<sup>2</sup> copper wires** were used for motors and load-bearing components to ensure proper current flow and reduce the risk of overheating or voltage drop.

### Relays:

- AC-powered components such as the **cutter motor** and **piston relay** were controlled through **relays housed in protective boxes**, providing electrical isolation and preventing accidental contact.

### Circuit Design and Insulation:

- All wiring was **neatly routed** and separated from moving mechanical parts to prevent friction damage or accidental disconnection.
- Electrical joints and terminals were **secured and insulated** using heat-resistant tubing or cold silicone to enhance system reliability and safety.

### Cutting Blade Safety:

- The cutting blade was securely mounted on a fixed holder with only the tip exposed for cutting functionality.
- It is surrounded by a protective structure on all sides, forming a partially enclosed area that allows safe operation while minimizing the risk of injury or contact.

### Keypad and LCD Interface:

- The system is controlled via a **4x4 membrane keypad** that allows users to select the desired flavor (summaq, zaatar, or none) and trigger the operation cycle.
- Feedback and operation status are displayed clearly on a **16x4 I2C LCD screen**, providing real-time updates about the current process stage.
- The interface is designed to be minimal and intuitive, enabling smooth interaction without requiring technical expertise or prior training.

### System Layout and Physical Safety:

- All **moving parts**—including the piston, shaping unit, cutter, and flavor dispensing mechanisms—were physically enclosed or shielded to prevent accidental contact during operation.
- The components were **strategically spaced** to allow safe operation, maintenance access, and organized wiring layout.
- Additional **support structures and mounts** were added to stabilize motors and mechanical parts during movement and to prevent vibrations from affecting performance.

These standards and safety implementations ensured that **Dahberha** remains a **safe, efficient, and user-friendly** automated system, capable of producing high-quality labneh balls while minimizing electrical and mechanical risks

## **Earlier Coursework**

During this project, we relied on several key courses that played a vital role in expanding our knowledge and ensuring the project's success:

- **Microcontrollers & Lab:**

This course was fundamental in understanding hardware implementation, serial communication, and programming Arduino to handle controller logic. It also provided practical experience with sensors and hardware components.

- **Electrical Circuits:**

It guided us in selecting the right resistors and sensors, ensuring proper integration of the hardware components.

- **Computer Networks:**

We gained insights into serial communication techniques, which were crucial for achieving system portability and improving efficiency.

- **Critical Thinking & Research:**

This course sharpened our ability to research effectively and document our work comprehensively.

- **Self-Learning:**

By exploring free online resources, we were able to overcome challenges and deepen our understanding of complex topics.

## **Literature Review**

The literature review for the Dahberha system explores traditional methods of labneh production, recent trends in food automation, and the lack of tailored solutions for culturally significant soft dairy products like labneh balls.

### **Traditional Methods of Labneh Ball Preparation:**

Labneh is a core element of Levantine cuisine, traditionally prepared through a manual process involving straining yogurt, hand-shaping it into small balls, and preserving them in olive oil. This method holds strong cultural and familial significance and has been practiced across generations.

While it preserves authenticity and flavor, the traditional approach is labor-intensive, time-consuming, and inconsistent in results. In environments that demand higher output—such as restaurants, catering services, or artisanal food producers—manual shaping often leads to variation in size, hygiene concerns, and slow production cycles.

### **Automation in Soft Dairy Product Processing**

Advancements in food automation have brought significant improvements in efficiency, cleanliness, and consistency, particularly in large-scale operations. However, most automation systems are designed for standardized, solid, or semi-solid products. These systems often fall short when applied to soft, sticky, and fragile materials like labneh.

Handling labneh requires delicate material control, non-stick surfaces, and precise motion to maintain the shape and texture of each ball. Additionally, customization features—such as flavor integration—are typically absent in generic automation equipment, making traditional dairy products difficult to automate effectively.

### **Gap in Existing Automation Systems**

Despite the progress in food technology, there is a noticeable gap in automation systems designed specifically for regional and cultural foods. Many traditional dishes require specialized handling, flexible mechanisms, and process customization to retain their original identity while adapting to modern production needs.

The Dahberha system addresses this gap by automating the entire process of labneh ball preparation. It combines multiple steps—flavor selection, gentle mixing, shaping, precise cutting, oil addition, and packaging—into a single streamlined workflow. The system ensures consistency, hygiene, and efficiency, all while maintaining the authenticity and cultural essence of the final product.

# Methodology

## External design

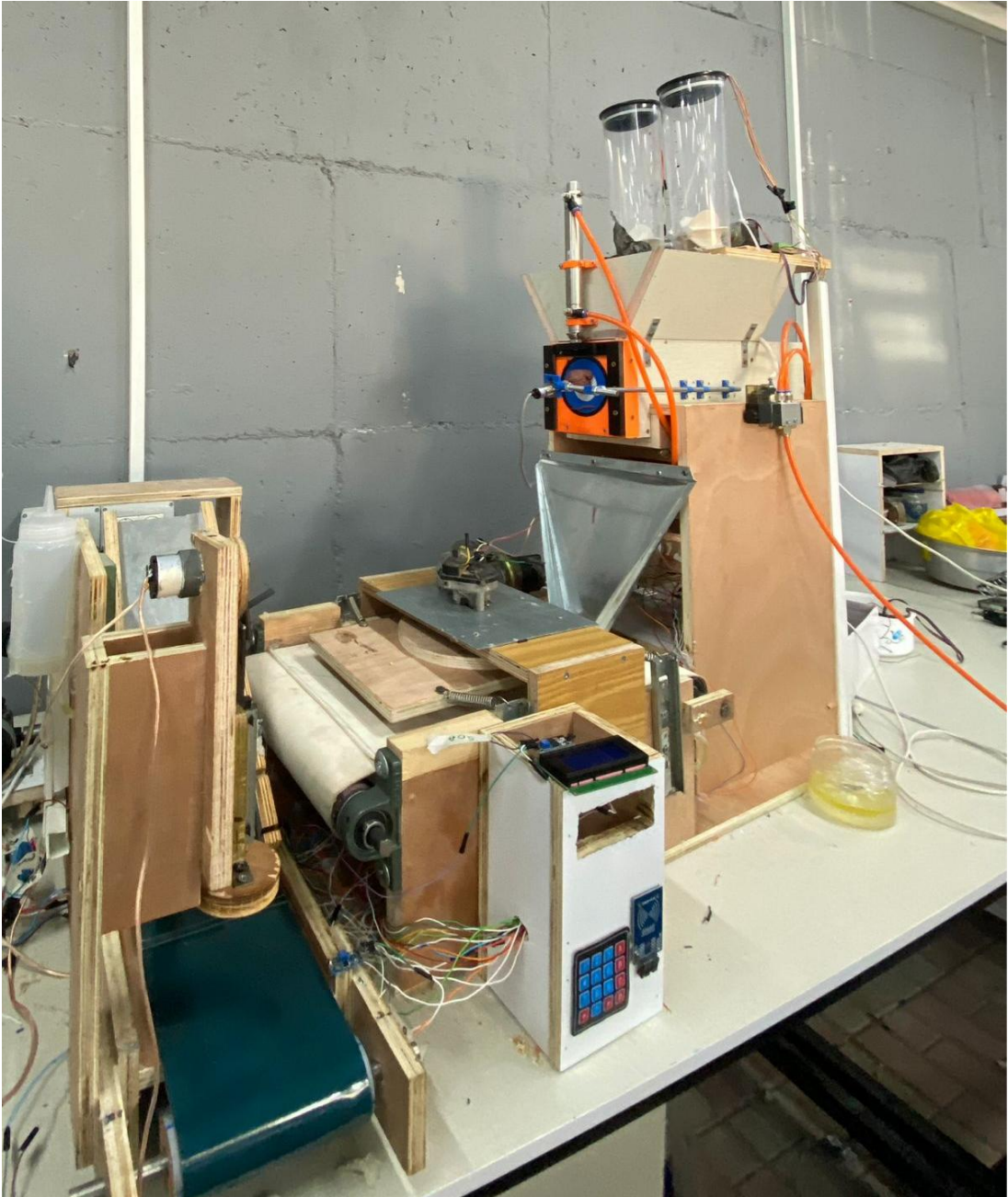


Figure 6.2.1: Dahberha System

# Hardware parts

## Microcontroller

- Arduino Mega 2560

## Motors and Drivers

- DC Motors
- Stepper Motor Nema 17 + TB6600 Driver (3.5A)
- Servo Motors

## Sensors

- Capacitive Proximity Sensor PNP
- Ultrasonic Sensor
- Laser Module and LDR Module

## Actuators

- Pneumatic Piston + Pneumatic Solenoid Valve 220V

## Power Supplies and Switching

- Power Supply (Computer)
- Relay 2Channel + Relay 1 Channel
- Rocker Switch

## Input Devices

- 4\*4 Keypad

## Other Components

- Connecting Wires
- Resistors
- pump
- LCD 16x4 (I2C)
- RFID Module

## Description

In this section, we will discuss each component and explain how it is used in our machine **Arduino Mega 2560**



Figure 6.2.2: Arduino Mega 2560

The heart of the **Dahberha** system is the **Arduino Mega**, which is responsible for managing all interactions between the various subsystems. It controls the motors, processes inputs from the **keypad** (such as flavor selection), and coordinates the entire operation flow — from dispensing ingredients to shaping, cutting, and packaging the labneh balls.

The Arduino Mega also gathers data from **sensors** (e.g., proximity sensors for ball detection), ensuring real-time monitoring of system performance and safety. It provides precise timing control for components such as the **stepper motors**, **servo motors**, and **pumps**.

One of the major advantages of the Arduino Mega is its **large number of I/O pins**, which makes it ideal for managing multiple devices simultaneously. It is also supported by the **Arduino IDE**, offering a user-friendly development environment suitable for both beginners and experienced developers. With **256 KB of flash memory**, it handles complex logic, task scheduling, and data processing without performance issues.

Overall, the **Arduino Mega** serves as the **central control unit** of the Dahberha system, efficiently integrating all mechanical and electrical parts into a synchronized, reliable automation workflow.

## Power supply computer



Figure 6.2.3: Power supply computer

In our project, we used a computer power supply to give different parts and modules steady, dependable power. Its dependability and capacity to supply adequate power across several voltage rails are the reasons we used it.

## Rocker switch



Figure 6.2.4: Rocker switch

In the **Dahberha** system, a **rocker switch** was used as a simple on/off control for the **main power supply**. This allowed the operator to easily power the system up or down during testing, maintenance, or daily use. While it does not serve as an emergency stop or control high-voltage components, the rocker switch adds a practical layer of manual control and ensures the system can be safely shut off when not in operation.

## The Laser Module and LDR



Figure 6.2.5: The Laser Module and LDR

## Laser Module and LDR Module

The Dahberha system utilizes a **Laser Module** in conjunction with an **LDR (Light Dependent Resistor)** sensor to accurately detect the presence and position of the labneh cup. When the cup interrupts the laser beam, the LDR sensor registers the change and triggers a sequence of actions, including **dropping the labneh ball, dispensing olive oil, and closing the cup**. This detection method ensures that each step is executed only when the cup is properly aligned, enhancing the system's **precision, cleanliness, and overall operational efficiency**.

## 8-Channel and 2-Channel Relays

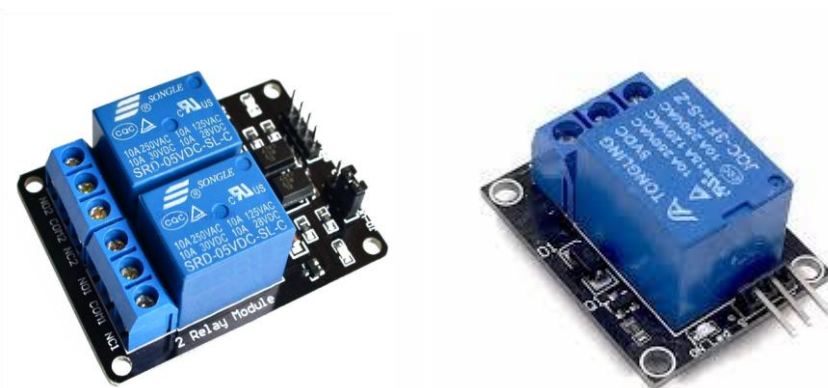


Figure 6.2.6: 2-Channel and 1-Channel Relays

The **Dahberha system** utilized both a **2-channel relay module** and a **1-channel relay module** to individually control key motorized components. Relays played a central role in the automation process by enabling the safe switching of high-current devices through low-voltage signals received from the microcontroller. Each relay output was assigned to a single component to ensure dedicated and isolated control, which enhanced the system's reliability and safety. One output of the 1-channel relay module was used to control the **DC motor** responsible for mechanical movement, while the second output managed the **oil pump** that dispenses olive oil into the labneh cup. The **2-channel relay module** was solely dedicated to operating the **piston cutter**, allowing it to activate precisely during the cutting phase. By assigning each relay output to a specific task, the system achieved clear separation of functions, stable operation, and ensured that all actions were carried out in a timely and interference-free manner.

#### 4\*4 Keypad



Figure 6.2.7: 4x4 Keypad

The Dahberha system uses a **4x4 keypad** as the primary input method for user interaction. This keypad allows the user to select the desired flavor—Zaatar, Summaq, or No Flavor—by pressing specific buttons, as well as to input the number of labneh balls they want (up to five pieces). The keypad provides a simple, cost-effective, and reliable interface. Its compact layout and intuitive labeling make it ideal for controlling food automation processes efficiently without requiring a complex user interface.

#### Pump:



Figure 6.2.8: pump

The Dahberha system includes a **DC pump** dedicated to dispensing **olive oil** into the container after the labneh balls are placed. This step replicates the traditional method of preserving labneh in oil but in an automated and hygienic manner. The pump ensures accurate and consistent oil quantities for each batch, contributing to both flavor and shelf life. It is activated at the appropriate stage in the process through relay control, providing smooth and controlled flow without manual intervention.

#### **LCD Display:**

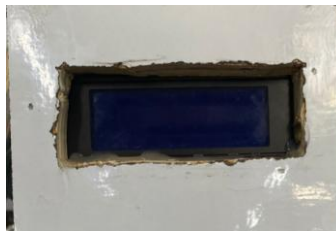


Figure 6.2.9: lcd

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The Dahberha system features a **16x4 LCD display** that serves as a user interface to guide and inform the operator throughout the process. Upon startup, the LCD shows a **welcome message**, creating a friendly and interactive experience. As the user interacts with the **4x4 keypad**—selecting flavors or entering the number of labneh balls—the corresponding information is **immediately displayed on the LCD**, ensuring clear communication and ease of use.

In addition, the system integrates an **RFID module** for managing payments or user authentication. This feature allows users to **scan their RFID card** to confirm or process an order, offering a seamless and modern method for secure and efficient transaction handling within the automated workflow.

## First-stage

### Flavor Dispensing Mechanism



Figure 6.2.10: Flavor Dispensing Mechanism

## Components

### Stepper Motor (NEMA 17)

To dispense the selected flavor into the labneh cup, we used **NEMA 17 stepper motors** due to their **high precision and controllable steps**. Each motor is responsible for rotating a flavor container (Zaatar, Summaq, or none) to allow a specific amount of flavor to be dropped. The precise control offered by these motors ensures consistency and prevents over- or under-dispensing.

### Stepper Motor Driver (Microstep Driver)

Each NEMA 17 motor is connected to a **Microstep Driver (DC 9–42VDC)**, which allows us to control the step resolution and current levels using onboard DIP switches. This driver receives control signals (step, direction, enable) from the Arduino and ensures **smooth and reliable motor operation**.

### Ultrasonic Sensor

To detect the presence of the labneh cup before dispensing the flavor, we integrated an **ultrasonic sensor**. The sensor checks whether a cup is positioned correctly under the dispenser. Only when detection is confirmed will the flavor be released, helping to **prevent waste and ensure precision** in the flavoring stage.

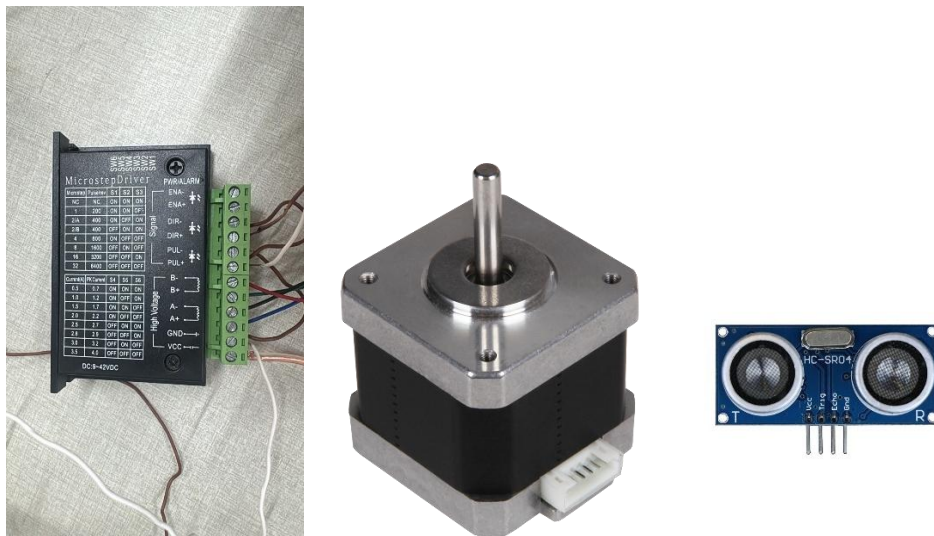


Figure 6.2.10.1: Microstep driver, NEMA 17 motor, and ultrasonic sensor.

## Second Stage:

### Flavor Mixing and Cutting Machine

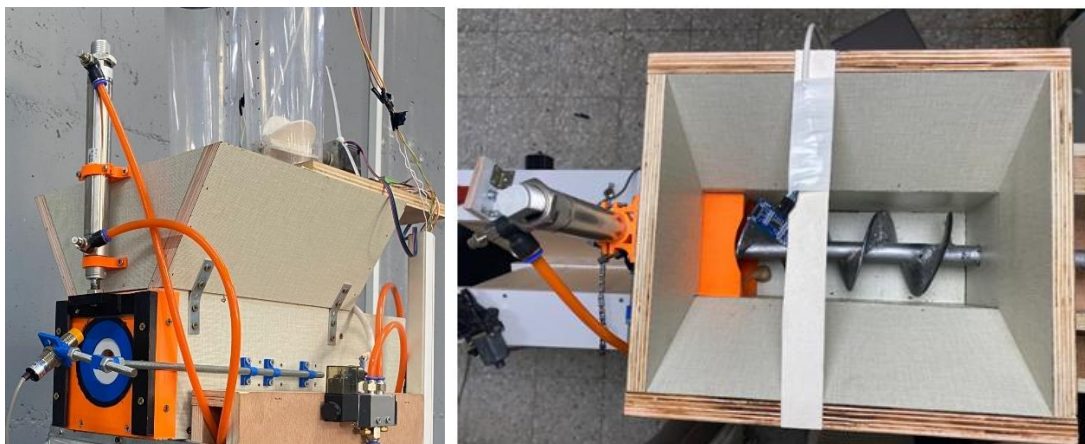


Figure 6.2.10.2: Flavor Mixing and Cutting Machine

## Component:

### DC motor:

We use a DC motor, specifically a Windshield Wiper Motor, in the first-stage labneh cutting system. The motor is connected to a screw mechanism that pushes the labneh forward to prepare it for cutting. We chose the Windshield Wiper Motor because it provides strong torque, which is necessary to apply enough force to handle the soft and sticky texture of labneh effectively.

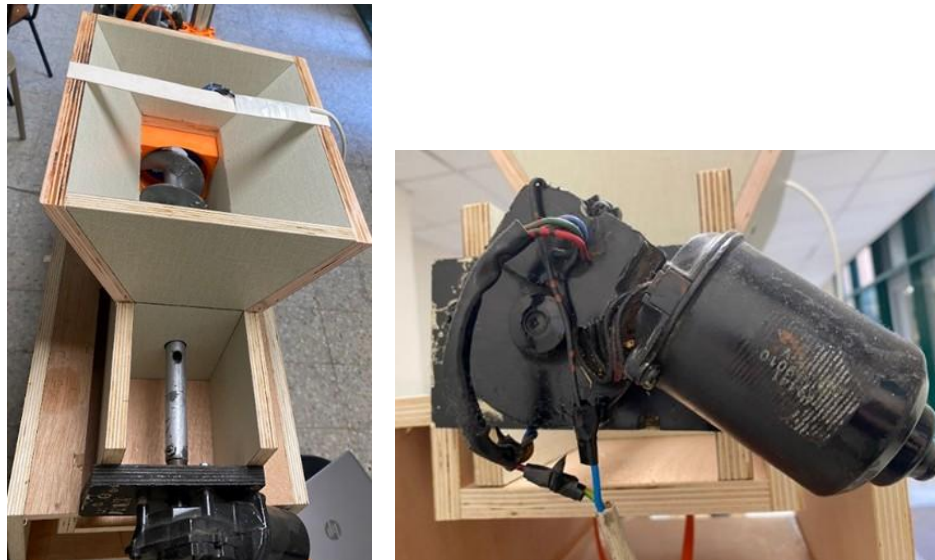


Figure 6.2.10.3: DC motor: Windshield Wiper Motor

## Third-Stage:

### Pneumatic Piston + Pneumatic Solenoid Valve 220V

We employ pneumatic pistons with larger diameters to provide sufficient surface area for generating the necessary force to handle labneh portions. A 125 mm diameter piston was selected to achieve an optimal balance between power and gentleness, ensuring smooth and consistent slicing without deforming the soft texture of the labneh. Each piston is controlled by a 220V pneumatic solenoid valve, which regulates the flow of compressed air and ensures accurate timing and response during the cutting process.



Figure 6.2.10.4: Pneumatic piston for the Labneh cutter machine

### Capacitive Proximity Sensor PNP

The Capacitive Proximity Sensor (PNP) is a specialized industrial sensor capable of detecting the presence of specific materials based on their dielectric properties. In our project, it is used to detect labneh as it exits the machine nozzle during portioning or shaping.

This sensor was chosen because of its **high accuracy and reliability** in detecting **soft and non-reflective materials** like labneh, which are often difficult to detect using traditional infrared or ultrasonic sensors.

#### How It Works:

The sensor operates by monitoring changes in capacitance. When labneh enters its electric field, it causes a disturbance, increasing the capacitance. This change is detected by the sensor, which then signals the system to proceed with the next stage, such as shaping or cutting.

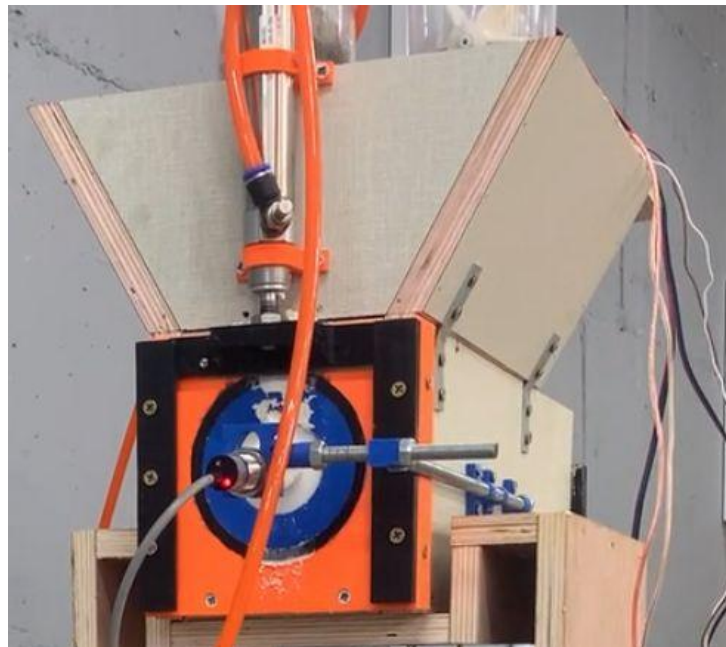


Figure 6.2.10.5: Capacitive Proximity Sensor PNP

### Ultrasonic

The ultrasonic sensor is used to detect the Labaneh level, indicating whether it is full or running low.



Figure 6.2.10.6: Ultrasonic

## Fourth-stage

### Circular Labneh Forming Machine



Figure 6.2.11: circular machine

## Components

### DC motor

We use a DC motor (car window type) in the **circular labneh shaping machine**. This motor is responsible for rotating a wooden arm positioned above a conveyor belt. As labneh portions move along the lower belt, the wooden arm — driven in a circular motion by the DC motor — gently rolls the labneh into uniform ball shapes.

This motion closely **mimics the natural hand movement** used in traditional labneh ball shaping. A **belt mechanism (qashet)** helps release the shaped labneh ball from the surface and prepares the system for the next portion.

Additionally, **four metal springs (zumbarak)** are attached to the wooden arm through a **steel support frame**, allowing flexible and responsive motion during the shaping process. These springs help absorb pressure and maintain a smooth rolling movement.



Figure 6.2.12: Rolled Labneh Ball result

## Fifth-stage

### Container Drop Mechanism



Figure 6.2.13: Container Drop Mechanism

## Components

Servo motor

In this stage, **two servo motors** are used to control the release of the labneh container. When activated, both servo motors **rotate 90 degrees**, allowing the container to be gently lowered onto the next section of the system.

Once released, the container **remains lowered and moves forward along the second scraper (qashet)**. It continues moving until it reaches **LDR sensor 1**, which detects the container's presence and stops its motion, signaling that it's ready to receive the shaped labneh balls.



Figure 6.2.14: Pathway for dropping the labneh balls

## Sixth-stage

### Oil Dispensing Pump

An oil dispensing pump is used to release the appropriate amount of olive oil into each container of labneh balls. Since the pump operates based on time rather than volume, the system calculates the total dispensing time according to the number of labneh balls selected by the user (1–10). The container is designed to fit up to five balls per layer, so if more than five balls are selected, a second layer is formed.

Based on practical testing, the system determines that a single layer (up to 5 balls) requires approximately **8 seconds** of oil dispensing to ensure full coverage. If two layers are present (i.e., more than 5 balls), the pump operates for a total of **15 seconds**. This logic ensures that both layers receive sufficient and even oil distribution.



Figure 6.2.15: Oil Dispensing Pump

## Seventh-stage

### Lid Placement and Sealing Mechanism

At this stage of the process, a lid is dispensed through a specially designed inclined track. As the container moves forward on the conveyor belt, it automatically picks up a lid from the track. A DC motor-powered mechanism is then used to press and securely seal the lid onto the container. The pressing system includes a wooden circular plate attached to a rotating arm, which applies downward force to ensure the lid is firmly fixed in place. This mechanism ensures consistent and reliable lid application for each container passing through the system.



Figure 6.2.16: Lid Placement and Sealing Mechanism

## The system can be controlled in two ways:

- **App**

To make *Dahberha* more user-friendly and accessible, we developed a **web-based interface** that allows users to easily interact with the system. Through the website, users can select the desired quantity of labneh balls, choose the flavor (Zaatar, Summaq, or none), and start the entire process with just a few clicks.

The website communicates with the **ESP32** microcontroller, which sends the selected data to the Arduino. The system then responds in real time — mixing, cutting, and shaping the labneh accordingly.

An **admin panel** is also available for system monitoring, allowing supervisors to view sensor data, check machine status, and perform maintenance or troubleshooting when needed. This helps ensure smooth, safe, and reliable operation at all times.



Figure 6.2.17: ESP32

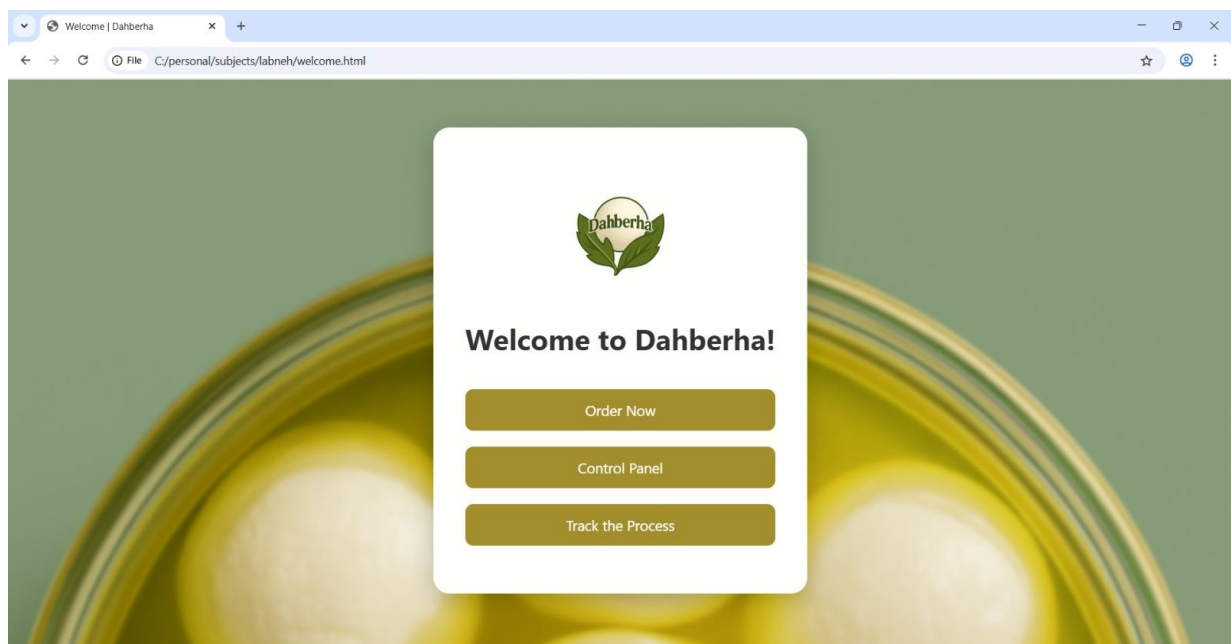


Figure 6.2.18: user-side application

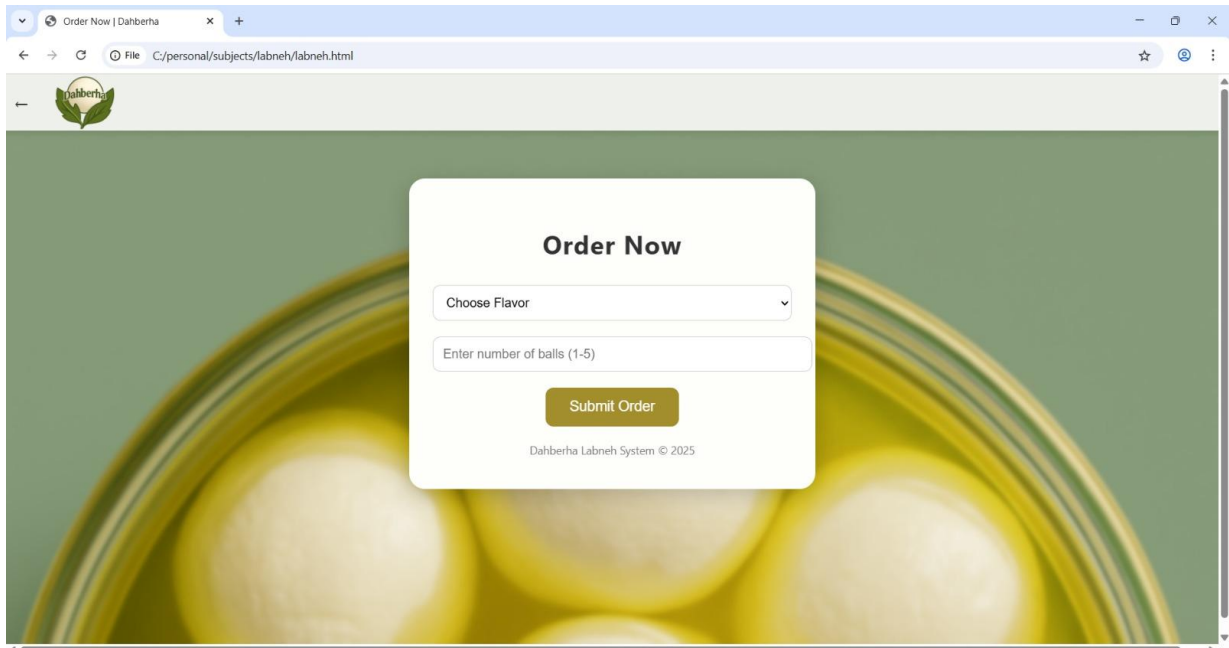


Figure 6.2.18.1: user-side application

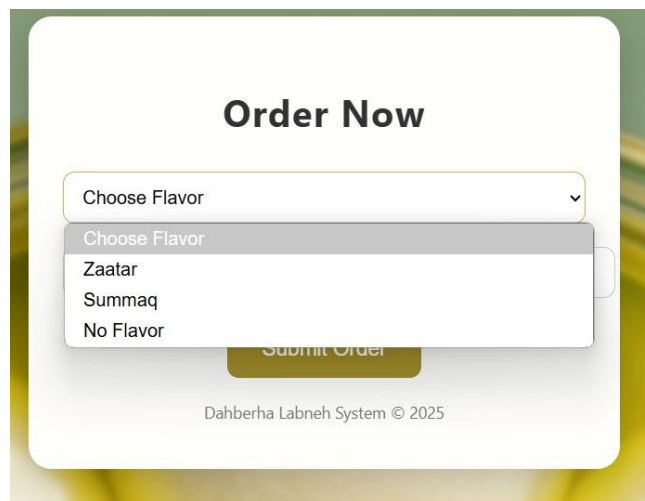


Figure 6.2.18.2: user-side application

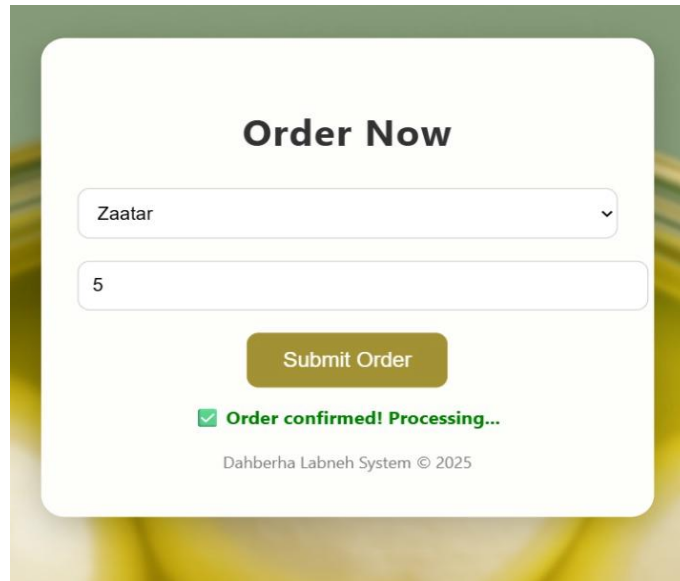


Figure 6.218.3: user-side application

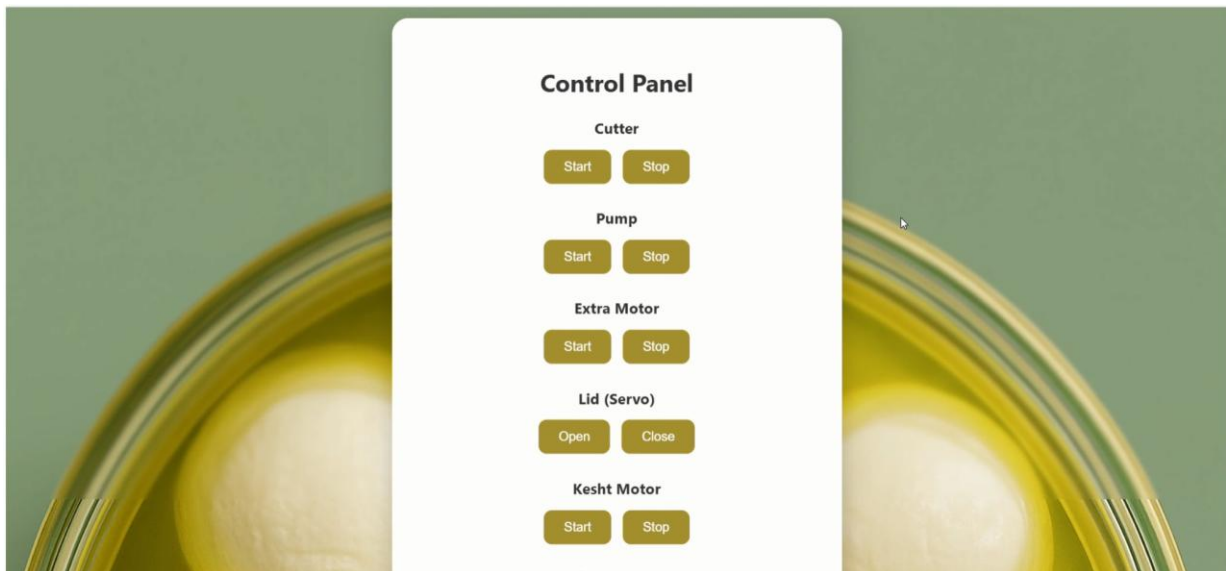


Figure 6.2.18.4: admin-side application

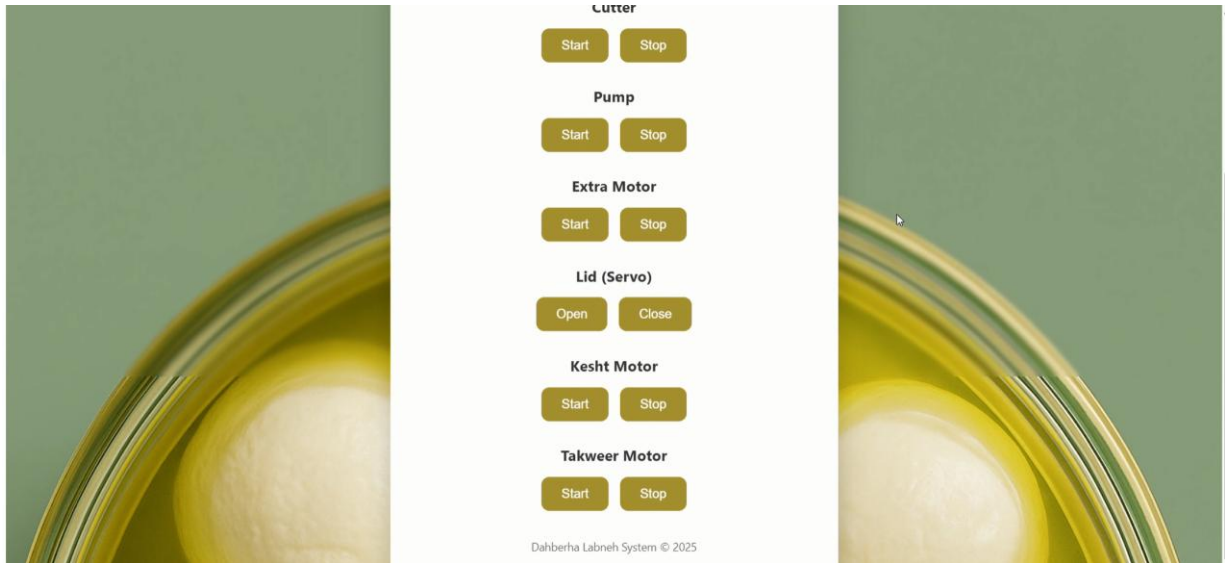


Figure 6.2.18.5: admin-side application

- **LCD screen with a Keypad:**



Figure 6.2.19: Welcome screen

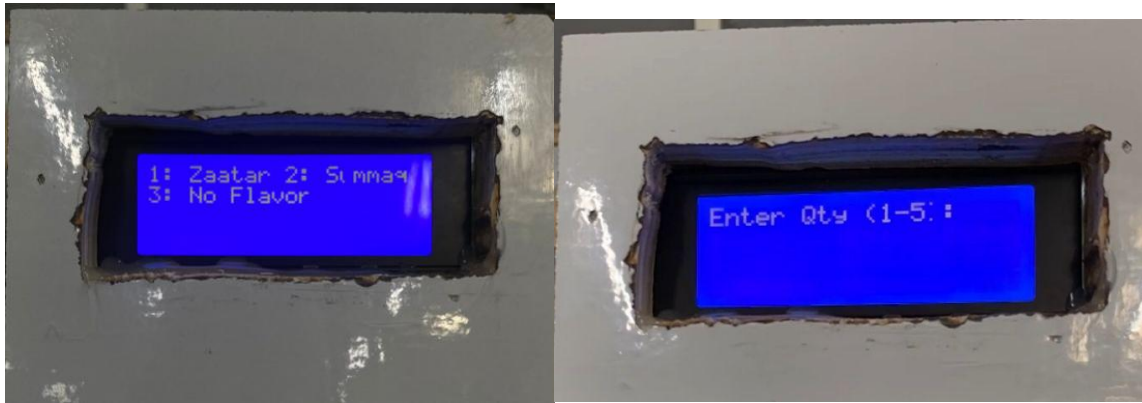


Figure 6.2.19.1: User input screen

**Using the Keypad, the user can:**

- Control the **quantity** of labneh balls.
- Select the **desired flavor** to be added.

## Results and Discussion



Figure 6.2.20: Results

The *Dahberha* system successfully streamlines the traditional process of shaping labneh into an efficient, automated workflow. From flavor selection to final packaging, the system maintains consistency in shape, portion size, and hygiene—all while reducing the manual effort typically required in traditional preparation.

One of the most notable outcomes is the accuracy of the shaping process, where labneh portions are gently rolled into uniform spherical shapes that closely resemble the manual method used in Middle Eastern kitchens. This not only preserves the authenticity of the product but also ensures a professional appearance suitable for market-ready packaging.

Additionally, the system offers valuable support to home users, especially homemakers, by significantly reducing the time and effort needed to prepare labneh balls. What once required skilled hands and careful attention can now be done at the press of a button—making traditional food preparation more accessible and less labor-intensive.

## Conclusion and Recommendations

In conclusion, *Dahberha* successfully fulfills its objective of simplifying and automating the traditional labneh ball preparation process, all while preserving the quality, texture, and authenticity of the final product. The system significantly eases the workload involved in shaping labneh manually—particularly benefiting homemakers and small-scale producers who often face difficulties with the repetitive and delicate nature of the task.

The results demonstrate that the system offers consistent, hygienic, and reliable output with minimal user effort. By transforming a manual culinary tradition into a streamlined, semi-industrial process, *Dahberha* strikes a thoughtful balance between cultural heritage and modern convenience.

## Future Work

To further enhance the performance and reliability of the *Dahberha* system, several future improvements are proposed. One major upgrade is the integration of a **cooling system** to preserve labneh freshness during extended operation, especially in warm environments.

Additionally, automating the **labneh input process** is a key goal, so that the system can continue operating without manual intervention when the current supply runs out. This will improve system autonomy and reduce user workload.

Expanding the range of **available flavors** is also a priority. Currently, the system supports only zaatar and summaq; future versions will offer more flavor options and ensure that each one is dispensed through a **separate channel** to avoid cross-contamination.

Finally, incorporating **a sensor to confirm cup presence and correct positioning** before dispensing will improve overall system reliability and prevent waste due to misaligned containers.

These future developments will make *Dahberha* more robust, user-friendly, and suitable for larger-scale or commercial use.

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