An-Najah National University

Faculty of Engineering and Information Technology

Department of Computer Engineering

Graduation Project 2

Noodly

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1 Acknowledgments

We would like to begin by expressing our deepest gratitude to our families for their unwavering support, encouragement, and love throughout the journey of this project. To our parents, whose sacrifices and guidance have shaped us into who we are today, we are forever grateful.

We also extend our heartfelt thanks to our professors and academic advisors who have accompanied us throughout this journey, helping bring this project to life. A special thanks goes to Dr. Abdallah Hasan Rashed and Dr. Emad Natsheh for their continuous guidance, patience, and valuable insights, which have been instrumental in the development and success of our project.

We cannot forget our friends, whose constant support and uplifting messages kept us going through the toughest days. Their encouragement and friendship have played a vital role in our motivation and perseverance.

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.

2 Disclaimer

This report was prepared by students Shahd Hennawi and Talah Qamhieh in the Department of Engineering, Faculty of Engineering, An-

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3 Abstract

Instant noodles are among the most popular quick meals consumed worldwide, particularly by students and individuals with fast-paced lifestyles. However, preparing noodles manually can be time-consuming and inconsistent in quality. This inspired us to design a fully automated electromechanical system – the Noodle Machine – that prepares a complete bowl of noodles from start to finish based on user-defined preferences. The machine is designed to handle the entire preparation process automatically, from heating to serving the final product. it's controlled via a keypad and LCD screen which the user selects one of three available flavors and specifies the desired spiciness level.

The main objectives of this project are to streamline the preparation process, ensure consistency in taste and quantity, and provide a fully hands-free cooking experience. Our methodology involved integrating various hardware components including an Arduino- based controller, a piston-based dispenser system, stepper motors, relay, power supply...,

All components are synchronized via embedded software to execute each task in precise order and timing. Although there are some commercial machines that partially automate noodle vending or water heating, a fully customizable and automated noodle preparation system at a personal or semi-commercial scale is still relatively rare. Our project aims to fill this gap with a compact, cost-effective, and user-friendly solution

4 Introduction

Noodle preparation is a popular quick-meal practice that usually requires multiple manual steps and continuous attention from the cook. With the advancement of modern automation technologies, it has become possible to design machines that handle the entire cooking and serving process automatically, reducing preparation time and maintaining high hygiene standards. This project aims to develop an innovative automated system Noodly capable of preparing and serving a hot noodle meal with minimal human involvement.

4.1 Background

Traditional noodle preparation involves boiling noodles, adding spices or seasonings, and serving the meal. In busy environments such as malls, universities, or school cafeterias, this process is often slow and labor-intensive, requiring constant supervision to ensure proper cooking and cleanliness. Customers seeking a quick, fresh meal often experience long waiting times, and the manual process increases the possibility of contamination.

4.2 Objectives

The main objective of this project is to design and implement a fully automated machine that prepares a standard single-serving noodle meal quickly and hygienically. The system allows users to:

Select the number of meals to be prepared.

Choose one of three available spice mixes.

Adjust the spiciness level on a scale from 0 to 3.

Once the order is entered through a keypad and LCD interface, the machine automatically dispenses the serving bowl, adds the noodles and selected spices, pumps the required amount of water, cooks the meal to perfection, and finally delivers the ready-to-eat dish to the user.

4.3 Significance

The significance of this project lies in its ability to combine engineering and food service technology to provide a fast, clean, and user-friendly meal solution. By reducing the preparation time to five minutes or less and eliminating direct human contact during cooking, Noodly offers an attractive option for crowded public spaces and presents a promising opportunity for profitable commercial deployment in malls, universities, and school cafeterias.

4.4 Organization of the Report

The report begins with an overview of the project concept. Then it discusses in detail the motivations that led us to undertake this project and its importance. We then move on to a literature review, discussing the results and work related to the project. The methodology chapter then presents the steps involved in designing the machine, explaining the constraints and problems we encountered and how we addressed them. The results are then presented, and the report concludes with a discussion of the findings and recommendations for the development of the project.

5 Literature Review

The literature review for the Noodly system explores traditional methods of noodle preparation, advances in automated food service, and the persistent gap in solutions tailored to freshly prepared noodle dishes.

Traditional Methods of Noodle Preparation

Noodles are a widely consumed and culturally significant meal across many regions of the world. They are typically prepared by boiling dried noodles, adding broth or sauce, and serving them hot. In restaurants, cafeterias, and street stalls, this process remains largely manual, requiring continuous human involvement to monitor cooking time, maintain consistent flavor, and ensure proper hygiene. While this method preserves authenticity and allows personal customization, it is time-consuming and difficult to scale in high-traffic settings such as shopping malls or university canteens.

Automation in Quick-Service Food Processing

Rapid developments in food automation have introduced machines capable of preparing and serving meals with minimal human contact. Automated coffee brewers, pizza vending machines, and robotic beverage dispensers have demonstrated significant improvements in speed, hygiene, and product consistency (Sokolov et al., 2022; Haykir et al., 2023).

Research prototypes also show successful application of automation to noodle preparation. Biglete et al. (2018) designed a prototype automated instant-noodle vending machine that controls water temperature and ingredient dispensing. A related patent (WO2022023113A1) describes an automated noodle vending system capable of selecting flavors and dispensing cooked noodles without manual assistance. These studies confirm the potential of automation to improve efficiency and sanitation, yet they also reveal technical challenges—such as handling hydrated ingredients and maintaining texture—that limit direct application to freshly cooked noodle bowls.

Gap in Existing Automation Systems

Despite these advances, current vending technologies rarely integrate all the steps required for fresh noodle preparation—controlled noodle dispensing, hot water management, flavor addition, and secure serving—within a single, compact, and user-friendly design. Most existing machines are optimized for beverages or solid snacks and cannot maintain the quality and consistency demanded by a freshly prepared noodle meal (Ragozzino, 2018).

The Noodly project addresses this gap by automating the entire process of noodle bowl preparation—from cup placement and noodle dispensing to seasoning—delivering a standardized serving that combines the comfort of traditional noodles with the hygiene, speed, and reliability of modern food automation.

6 Methodology

6.1 Features and Component

6.1.1 Machine Body

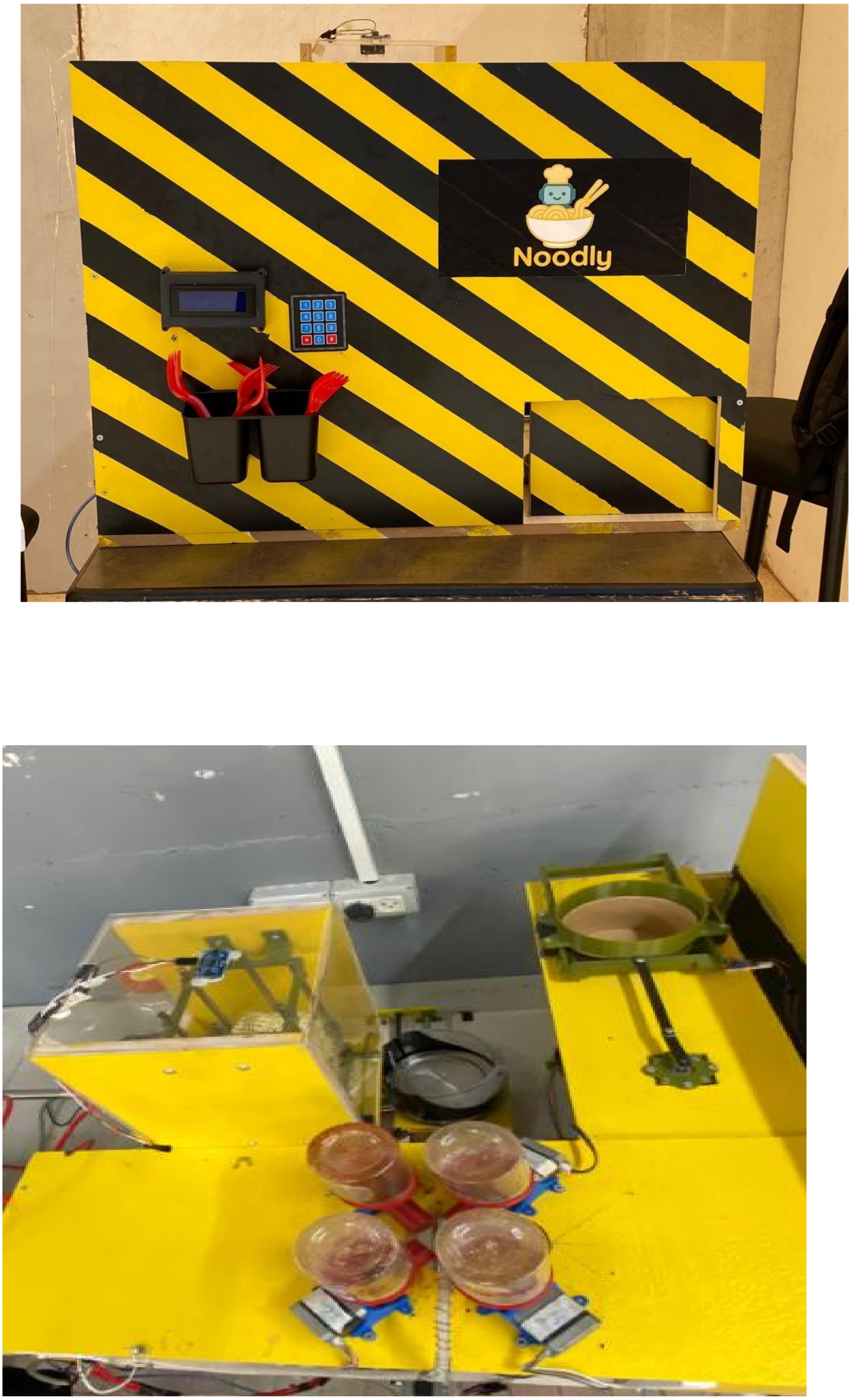


Figure 6.1: Machine design

6.1.2 Main Feature

6.1.2.1 User Input (Keypad & LCD Display)

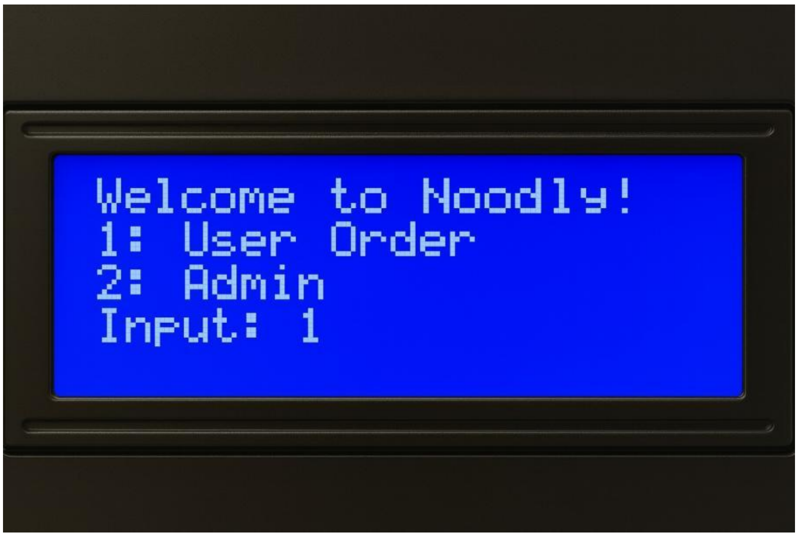
Figure 6.1.2.1: Menu

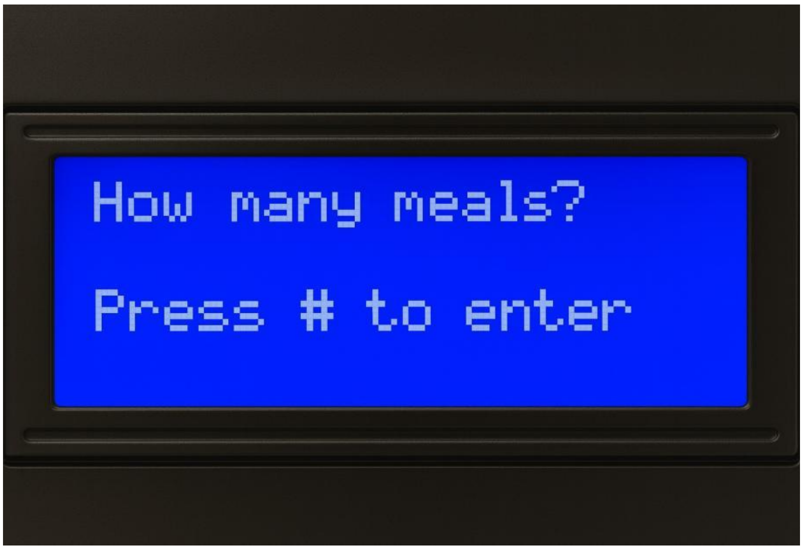
The system has two access modes: Admin and User, selected via the keypad:

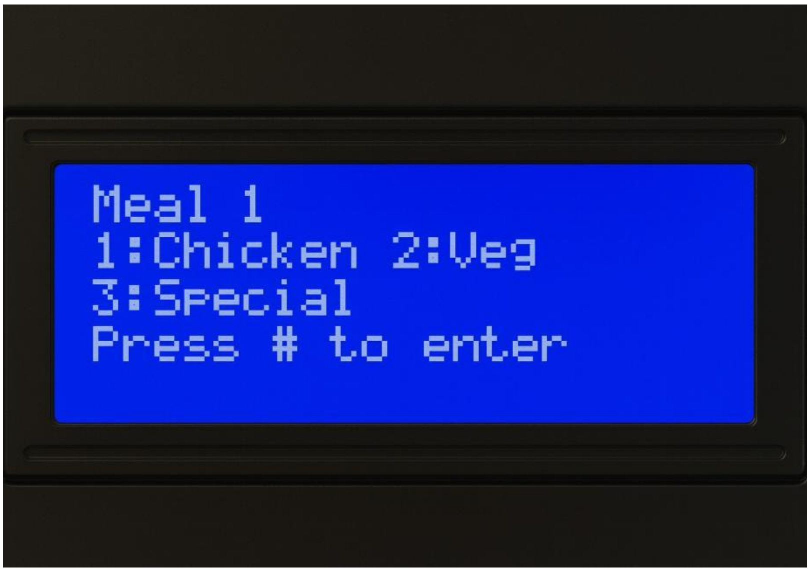
User Mode (Press 1):

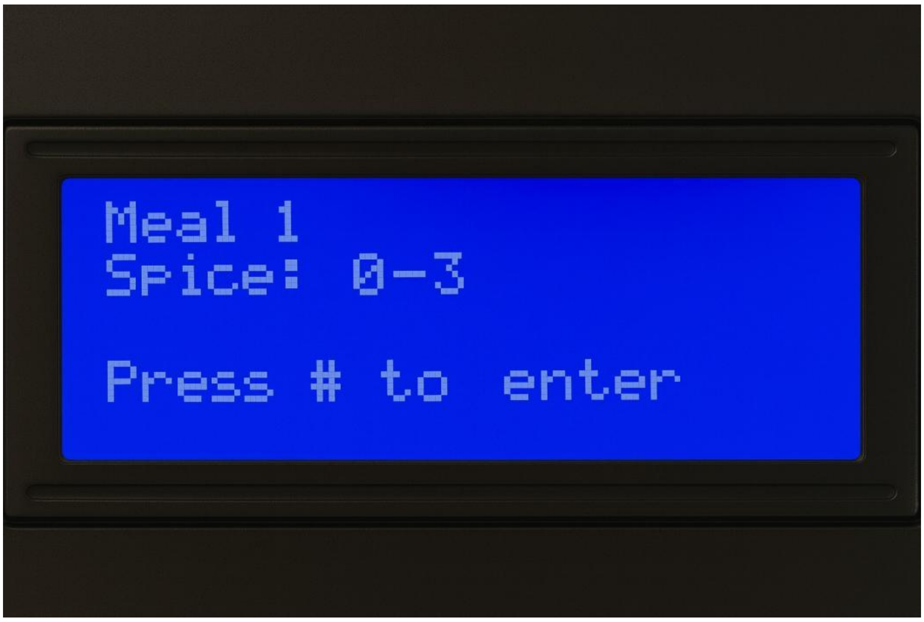
The customer enters the order details using the keypad: number of meals, Type of noodle for each meal (3 options available)., and desired Spice Level (0–3).

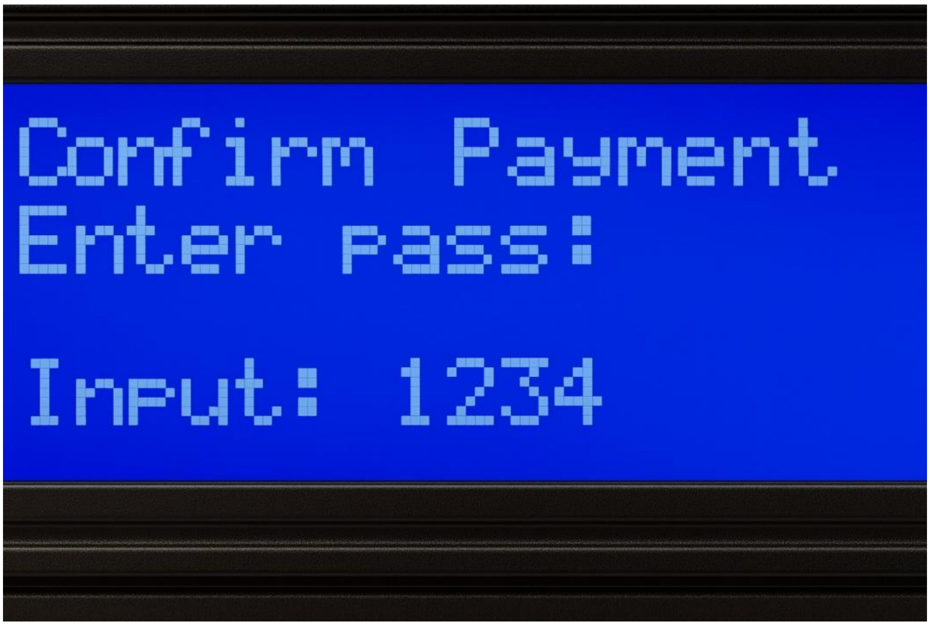
After completing the order, the system asks for a password to confirm payment. Once verified, the machine starts preparing the meal.

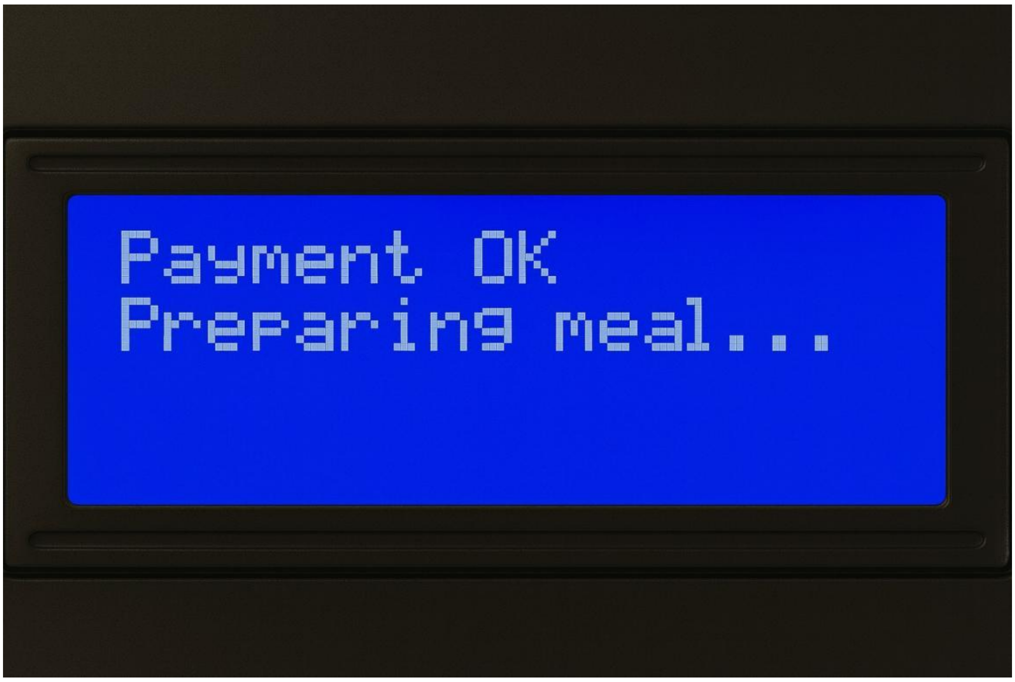

Welcome to Noodly!
1: User Order
2: Admin
Input: 1


How many meals?
Press # to enter


Meal 1
1:Chicken 2:Veg
3:Special
Press # to enter

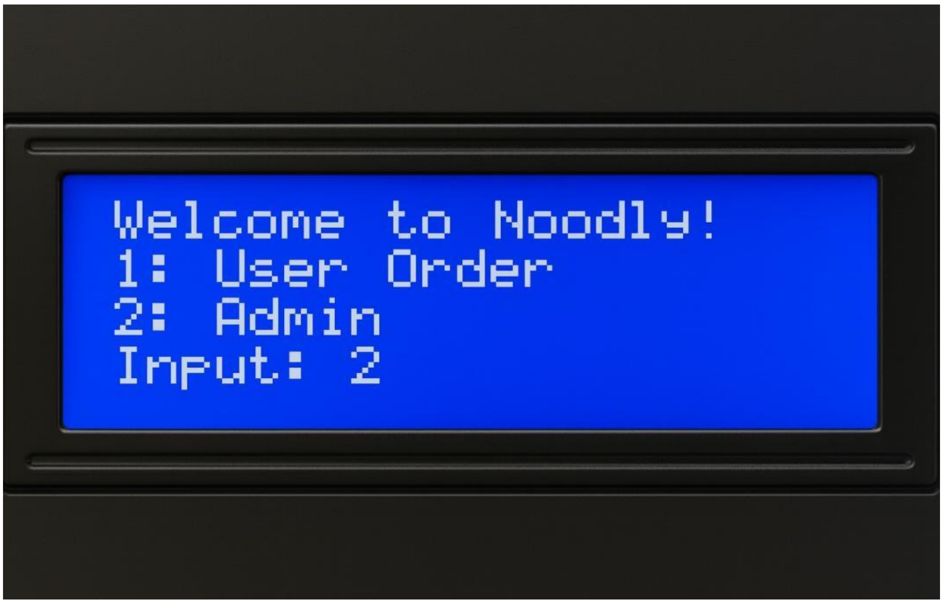

Meal 1
Spice: 0-3
Press # to enter


Confirm Payment
Enter pass:
Input: 1234



Admin Mode (Press 2):

When pressed, the system requests an admin password. Once verified, the administrator can view the total profit.




Enter Password:
****


Total Profit:
$0

6.1.2.2 Cup Dispenser

The cup dispenser releases a cup into the serving area. A Hall Effect sensor is used to ensure the dispenser returns to its home position after dropping the cup.

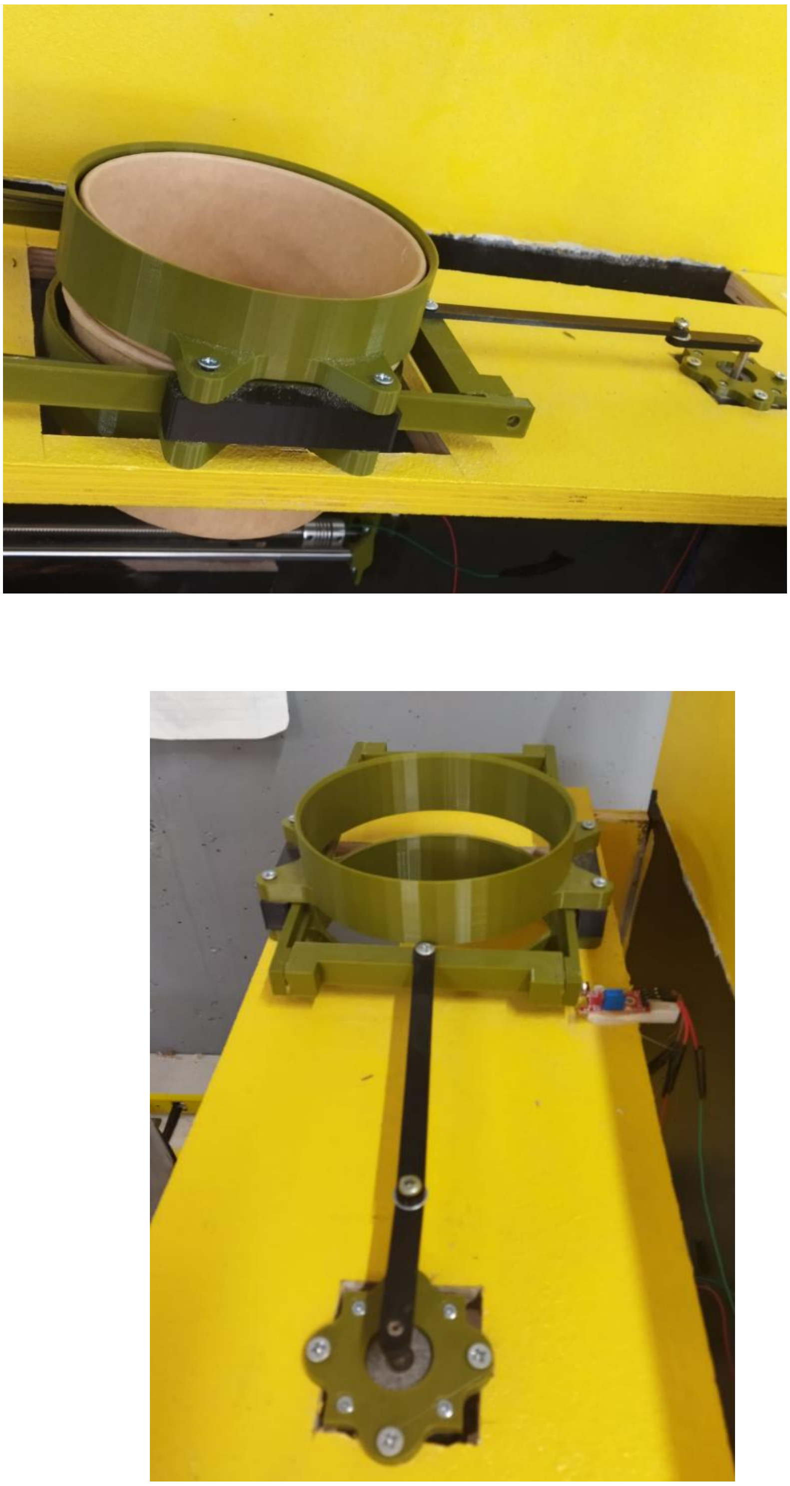


Figure 6.1.2.2: Cup Dispenser

6.1.2.3 Rail & Kettle Movement

At the start of the machine operation, the kettle moves along the rail to its home position, guided by a limit switch that ensures accurate homing. Once the kettle reaches the noodle dispensing station, a Hall Effect sensor confirms when it has arrived at the middle point, allowing precise noodle placement.

After dispensing the noodles, the kettle returns to the home position near the water and spice pumps to receive the correct amount of water and selected spices. Finally, the kettle moves to the serving area near the gate, where the cooking process begins and the prepared meal is poured into the cup.

Figure 6.1.2.3: Rail & Kettle

6.1.2.4 Eject Noodle

At the noodle station, an air piston pushes the noodle block into the kettle.

An ultrasonic sensor checks if a noodle block is present before dispensing, ensuring reliable operation.

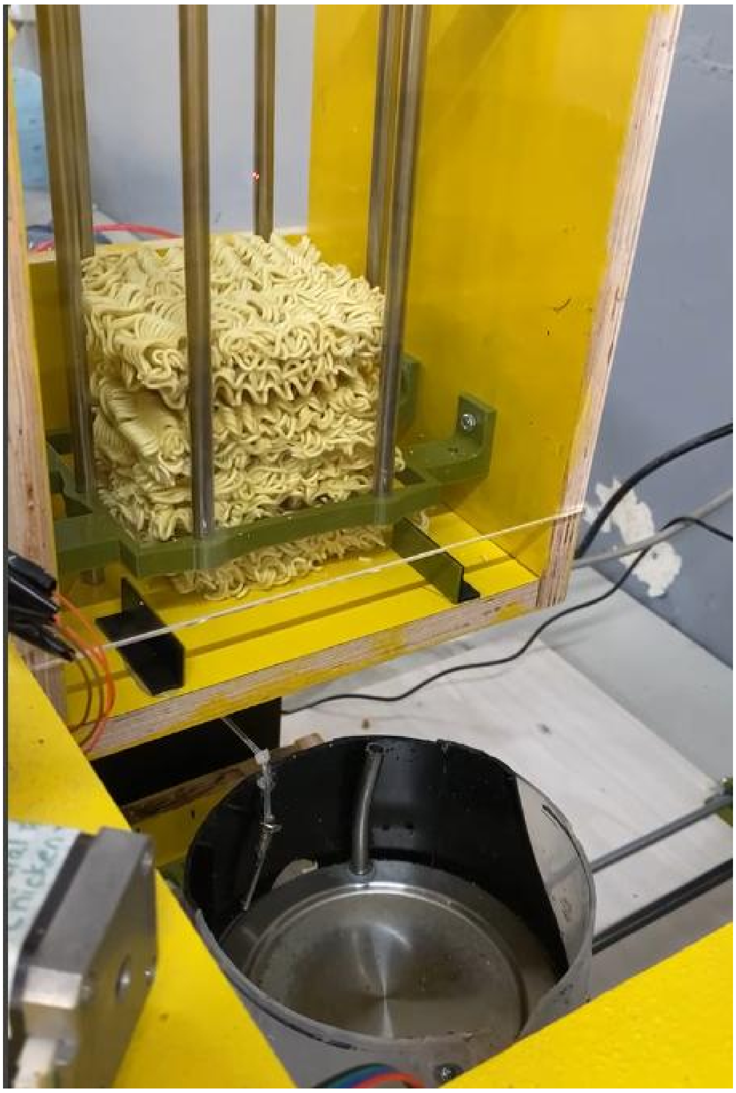


Figure 6.1.2.4: Eject Noodle


Special
chicken

6.1.2.5 Salt, Spice Dispenser

According to the user's choice, the selected type of spices is added into the kettle. The dispensing

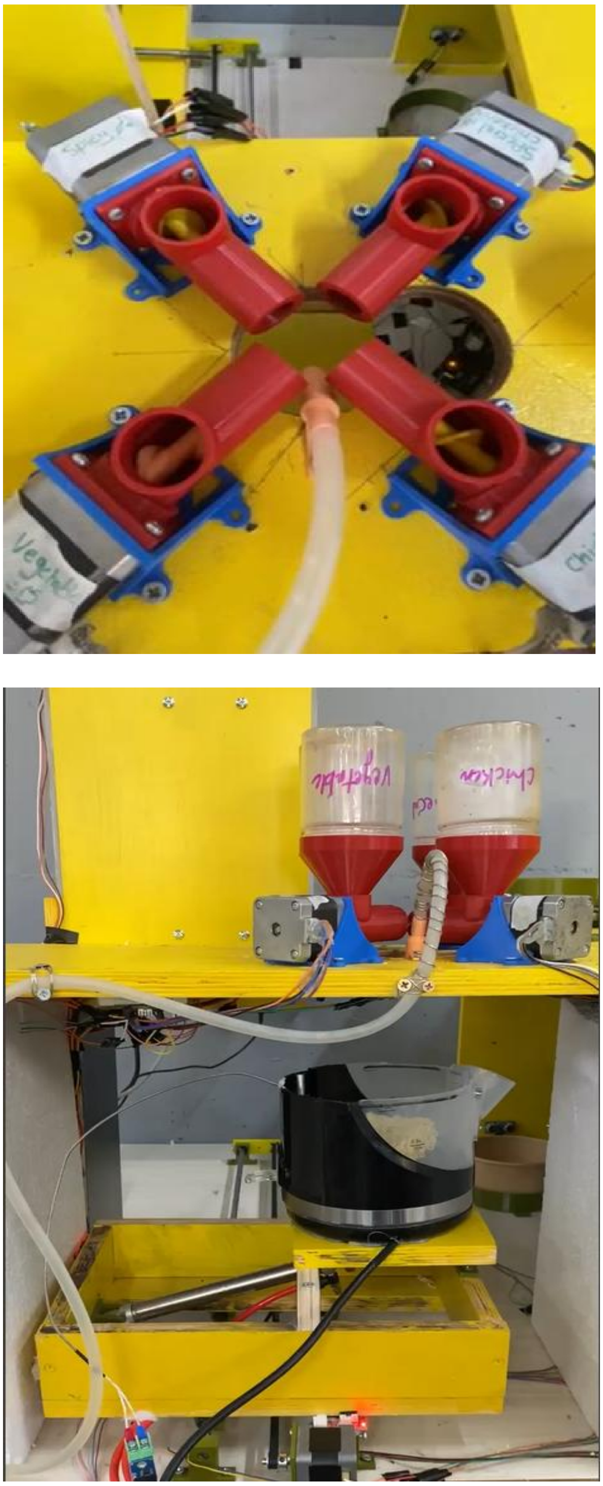


Figure 6.1.2.4: Salt,Spice Dispenser

6.1.2.6 Water Pump

A water pump supplies the correct amount of water into the kettle, providing the necessary liquid for proper noodle cooking.

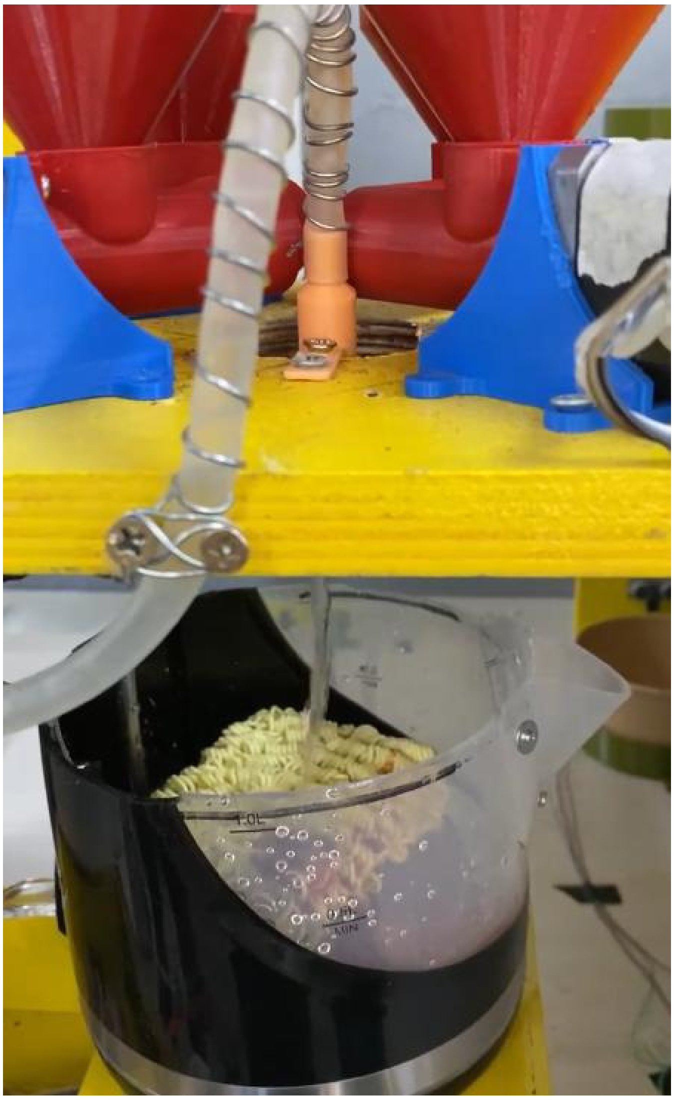
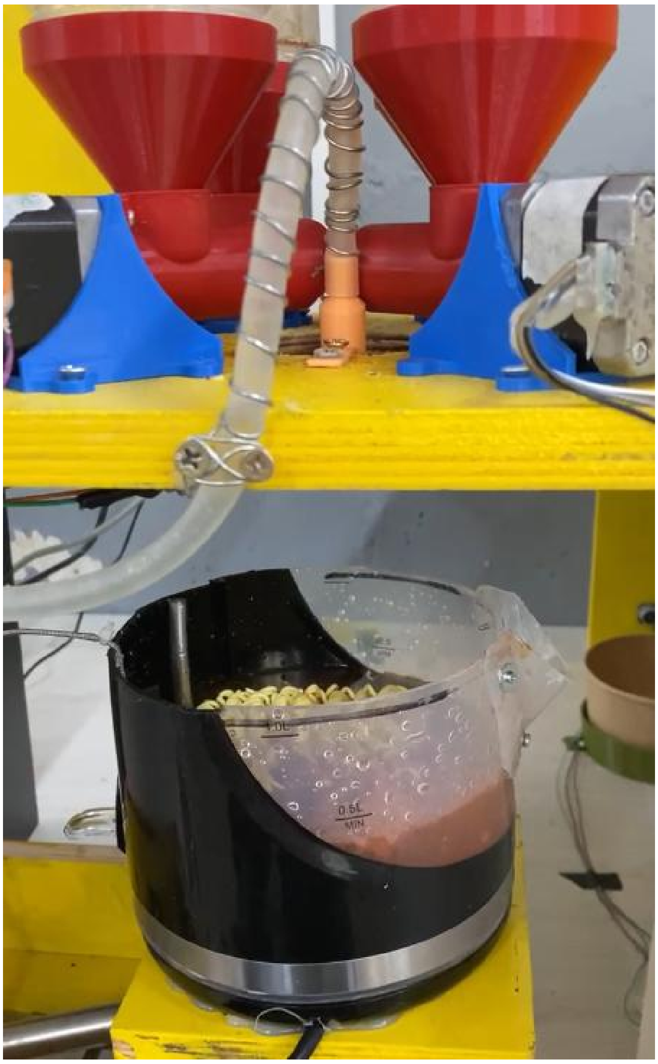


Figure 6.1.2.6 Water Pump


1.0L
0.5L
MIN

6.1.2.7 Boiling the kettle

The heating kettle cooks the noodles with water and spices according to the user's selected heat level.

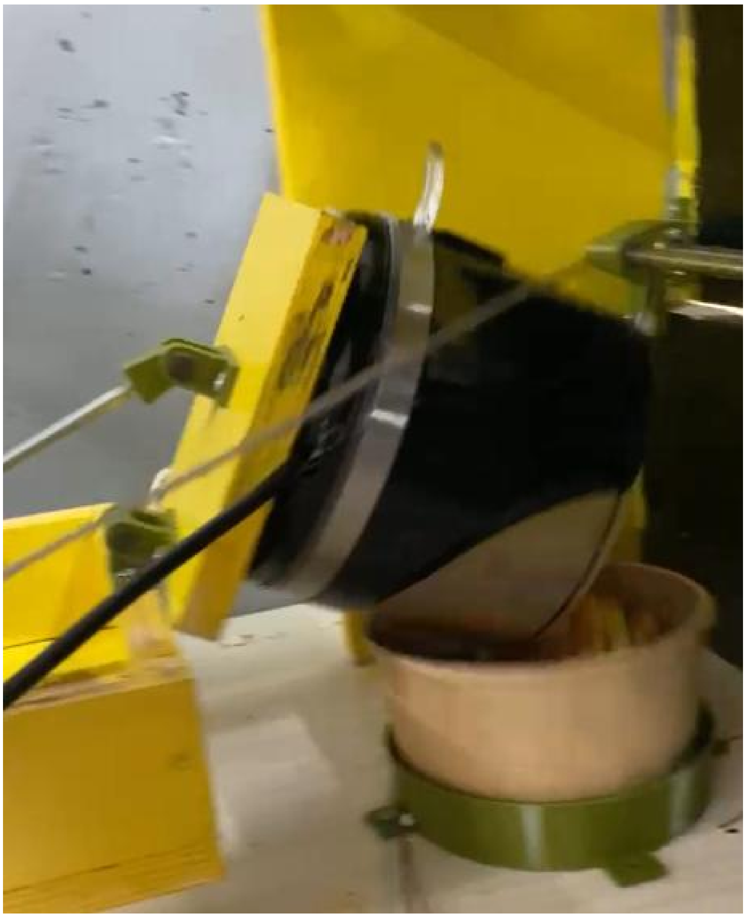
A temperature sensor monitors the water temperature and controls the heating element, turning it on or off as needed to maintain the correct cooking temperature.

Figure 6.1.2.7 Boiling the kettle

6.1.2.8 Pour into the Cup

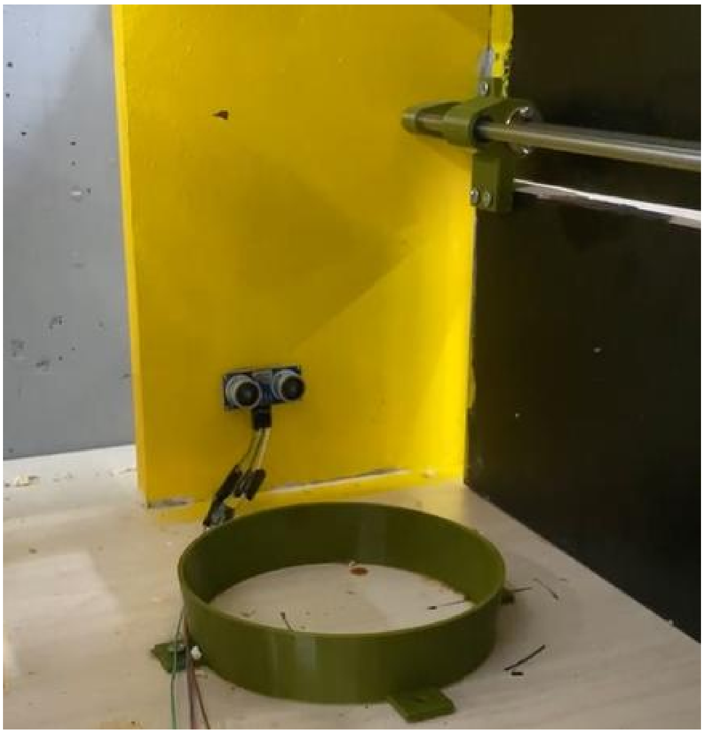
After cooking, an air piston tilts the kettle to pour the noodles into the cup.

An ultrasonic sensor checks for the presence of a cup before serving.



6.1.2.9 Opening the door

Once the user takes the cup, the sensor detects removal, and the gate automatically closes.



6.2 Hardware Overview

6.2.1 Lcd Display

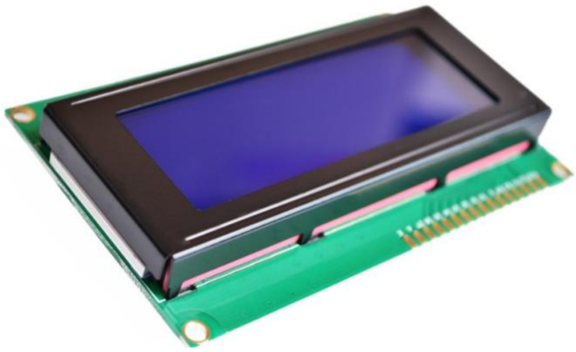


Figure 6.2.1: LCD

The 20x4 LCD (Liquid Crystal Display) is a widely used display module that can show up to 20 characters per line across 4 lines. It is commonly used in embedded systems and microcontroller-based projects to display text, numbers, and simple symbols.

6.2.2 Keypad 3x4

Figure 6.2.2: Keypad

The 3x4 Keypad is a matrix-style input device consisting of 12 keys arranged in 3 rows and 4 columns. It is commonly used for entering numeric data or simple commands into embedded systems. Each key press connects a specific row and column, which the microcontroller detects to identify the pressed key.

6.2.3 Arduino Mega

The Arduino Mega 2560 is one of the most popular Arduino development boards, widely used for projects requiring a large number of inputs and outputs (I/O). Its features make it ideal for advanced and complex projects, such as robotics, control systems, and home automation. It contains an ATmega2560 microcontroller with 54 digital inputs/outputs, 16 analog inputs, 256 KB of flash memory , 8 KB SRAM, 4 UART , and a USB interface for connecting to a computer and downloading programs.

It is used to control multi-axis robots, CNC projects, 3D printers, advanced sensor reading systems, and control displays, motors, and user interfaces.

The Arduino Mega 2560 board is programmed using the Arduino IDE in simplified C++ and supports most popular Arduino libraries.

Figure 6.2.3: Arduino Mega

6.2.4 MAX6675 Temperature Sensor

measures temperatures ranging from 0 °C to 1024 °C with a resolution of 0.25 °C. The module converts the analog signal from the thermocouple into a digital value and communicates with a microcontroller (such as Arduino) using the SPI (Serial Peripheral Interface) protocol.

In our project, the MAX6675 sensor is used to monitor the water temperature inside the kettle. This allows the system to ensure that the water reaches the required boiling point before it is dispensed into the bowl, providing accuracy and safety in the cooking process.

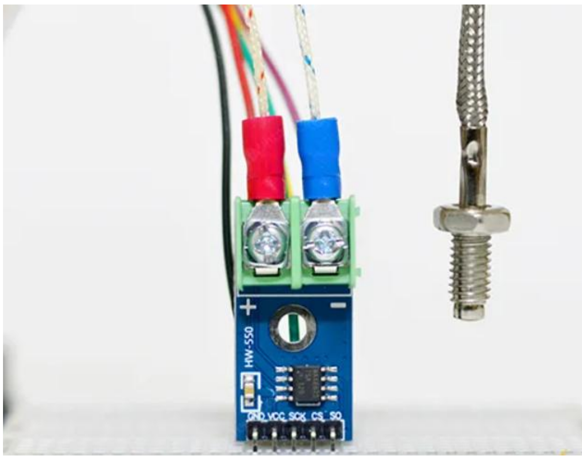


Figure 6.2.4: MAX6675

6.2.5 Hall effect sensor

The Hall Effect sensor is an electronic device that detects the presence of a magnetic field. It works by generating a voltage (Hall voltage) when exposed to a magnetic field, which can be used as a digital signal for position sensing.

In our project, we used two Hall Effect sensors for different purposes:

Rail position detection: one sensor is placed on the rail to indicate when the cart reaches the middle point.

Cup dispenser homing: another sensor is used to confirm that the cup dispenser has returned to its home position after operation.

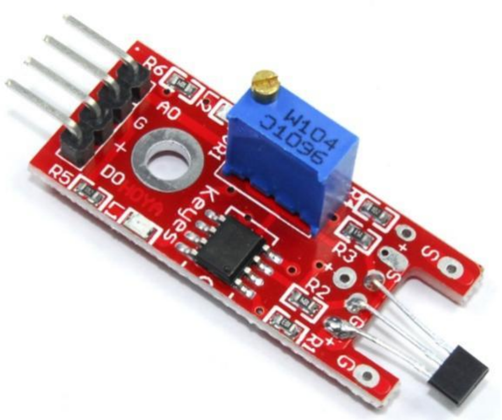


Figure 6.2.5: Hall effect sensor

6.2.6 Ultrasonic Sensor

Figure 6.2.6: Ultrasonic Sensor

An ultrasonic sensor is used to measure distances using high-frequency sound waves. It works by sending a sound pulse through a trig, waiting for it to reflect off an object, and receiving it through an echo unit. The time between transmission and reception is then calculated, multiplied by the speed of sound, and then divided by 2 to calculate the actual distance.

This sensor was used in our project to measure the distance to the cup to determine whether it was present. We also used a probe in the noodle box to determine whether there were pieces.

6.2.7 Limit Switch

It is a mechanical switch to determine the end of the axis movement. It was used to determine the start and end points so that the stepper motor does not deviate from its actual path. one limit switches were used on the rail to indicate when the cart reaches its home position

Figure 6.2.7: Limit Switch

6.2.8 Stepper Motor

The NEMA17 stepper motor is widely popular due to its small size and high torque, making it suitable for use in a wide variety of applications. It requires 200 steps to complete a full rotation, and these steps feature a precise angle of 1.8 degrees per step. Its coils can handle a maximum current of 3.5 amps per coil and can also apply voltages ranging from 3 to 12 volts.

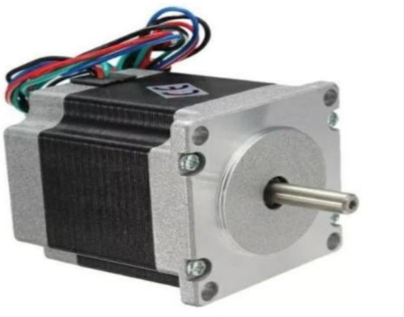


Figure 6.2.8: Stepper motor NEMA 17

6.2.9 A4988 Stepper Motor Driver

The A4988 is a micro stepping motor driver commonly used to control bipolar stepper motors. It allows precise control of motor position and speed by sending step and direction signals from a microcontroller. The driver supports different step resolutions (full step, half step, quarter step, eighth step, and sixteenth step), making it suitable for applications that require accurate motion.

In our project, the A4988 driver is used to control the stepper motors that move mechanical parts such as the rail and the cup dispenser. By adjusting the current limit and micro stepping mode, we achieved smooth, reliable, and precise movements for the system's automation.

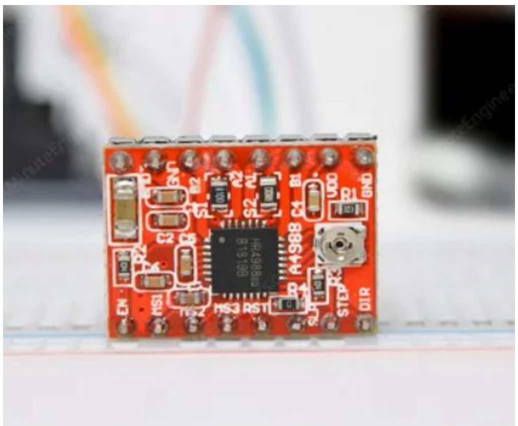


Figure 6.2.9: A4988 Driver

6.2.10 Relays 8 Channels

Figure 6.2.10: Relays 8 Channels

A relay is an electrically controlled device that turns electrical connections on and off, or turns other devices on and off within the same or another electrical network. We used low-power relays to turn the pump on and off, as well as to turn the kettle on and off, and to control the air piston

6.2.11 Intercom Wires

Figure 6.2.11: Intercom Wires

We used them for wiring and connecting different components together.

6.2.12 Arduino Wires

To be able to connect the components to the Arduino

Figure 6.2.12: Arduino Wires

6.2.12 Arduino USB Cable

Plugging in the USB cable to the Arduino Mega 2560 allowed it to connect to the laptop. That enabled uploading code from the Arduino IDE, powered the board during development, and monitored the system before an external power supply would be used.

Figure 6.2.12: Arduino USB Cable

6.2.13 Air Piston

The air piston is a mechanical device that uses compressed air to produce linear motion and force. It consists of a cylinder body, a piston rod, and valves that control the airflow. When compressed air enters one side of the piston, it pushes the piston rod outward; when air enters from the opposite side, it retracts. This allows precise control of motion, speed, and force.

The air piston (pneumatic cylinder) is used in our project to perform two main functions: pushing the noodle block into the cooking area and tilting the kettle to pour the soup into the bowl. It provides automatic and precise motion for both tasks.

Figure 6.2.13: Piston

6.2.14 Pump

The pump is an electromechanical device used to move liquids by creating pressure or suction. It is commonly used in automation systems to control the flow of water or other fluids.

In our project, the pump is used to transfer water from the storage container into the kettle. This ensures a controlled amount of water is delivered for cooking the noodles, providing both accuracy and efficiency in the process.

Figure 6.2.14: Pump

6.2.15 Power Supply

We used a computer power supply to supply the project components with the appropriate voltage. It takes electricity from the 220V socket and converts it into suitable voltages such as 12V, 5V, and 3.3V to power the 3.3V sensors and 12V steppers.

Figure 6.2.15: Power Supply

6.3 Mobile Application

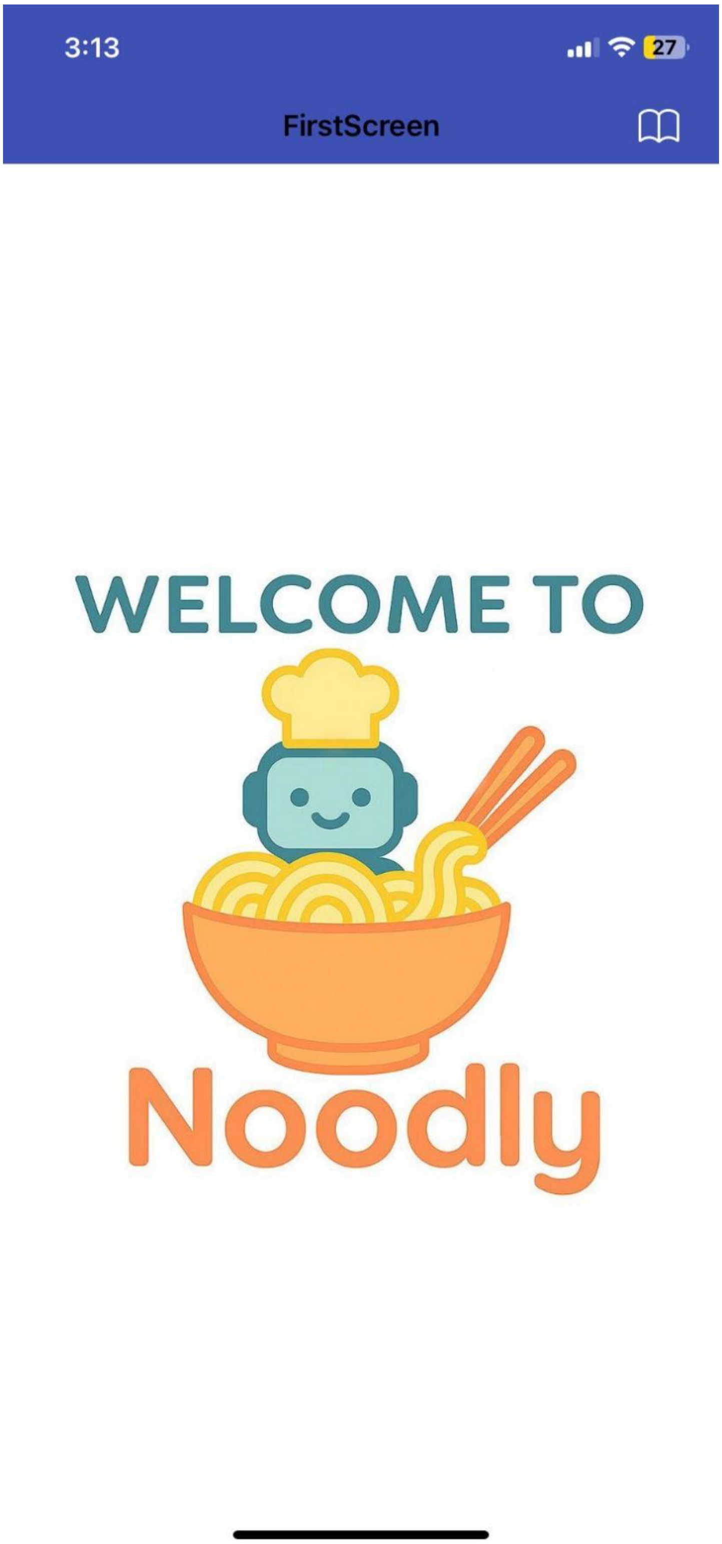
In addition to the keypad and LCD interface, a mobile application was developed to allow users to place their orders remotely. The application provides a user-friendly interface where customers can:

Select the number of meals.

Choose the type of spices for each meal.

Set the desired cooking heat level.

6.3.1 Start Page



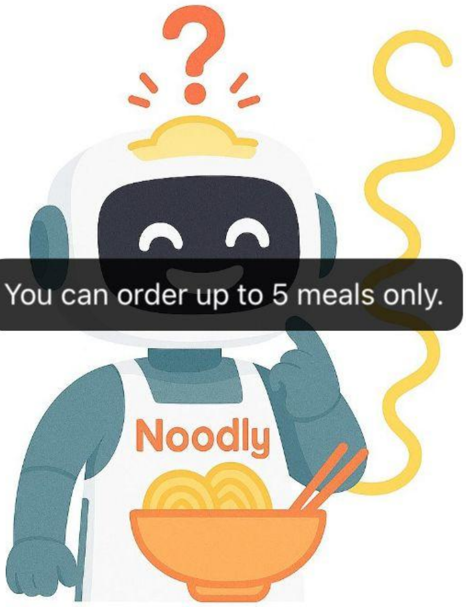
6.3.2 Order Screen

3:15

OrderScreen

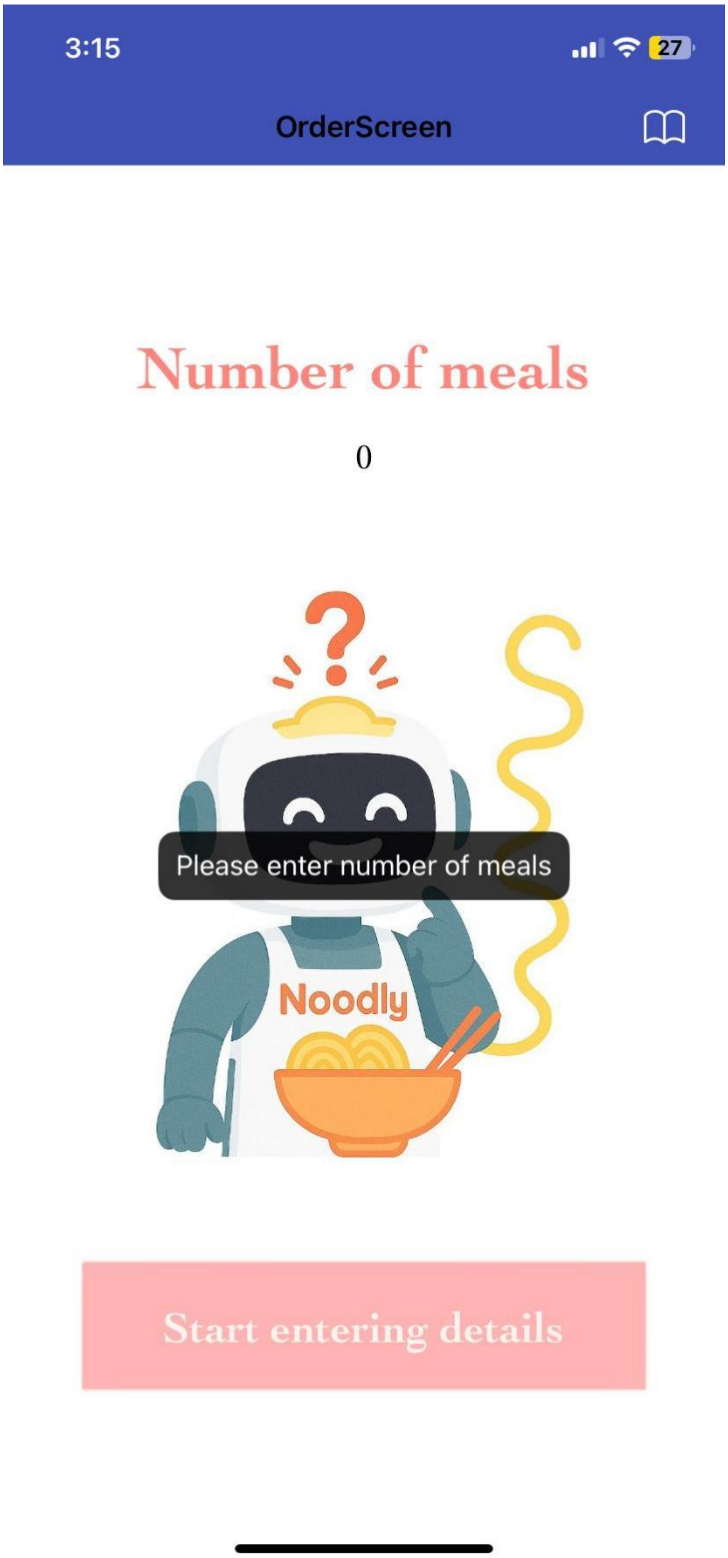
Number of meals

6



You can order up to 5 meals only.

Start entering details


3:15
27
OrderScreen
Number of meals
0
Please enter number of meals
Noodly
Start entering details


3:15
27
OrderScreen
Number of meals
write here
Please enter number of meals
Noodly
Start entering details

3:25

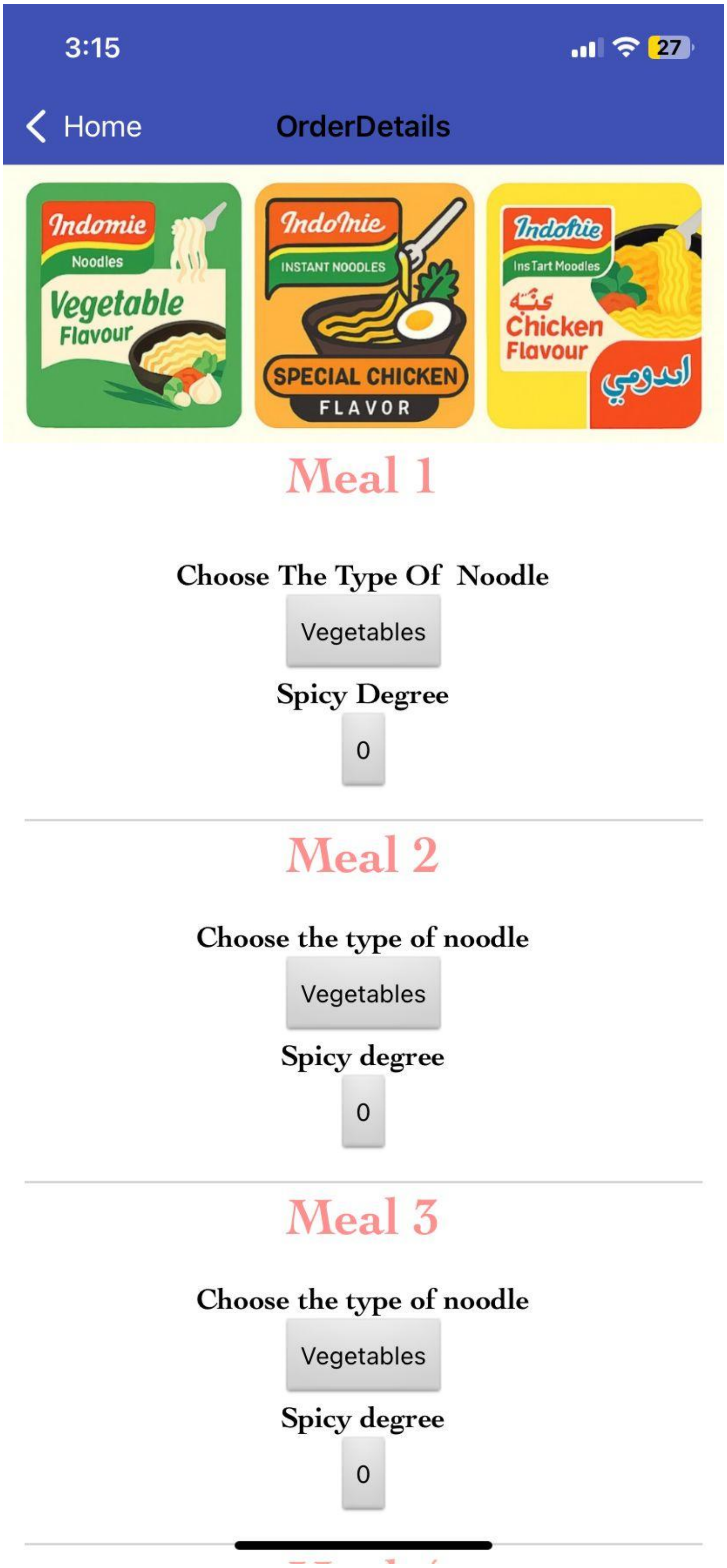
< Home OrderScreen

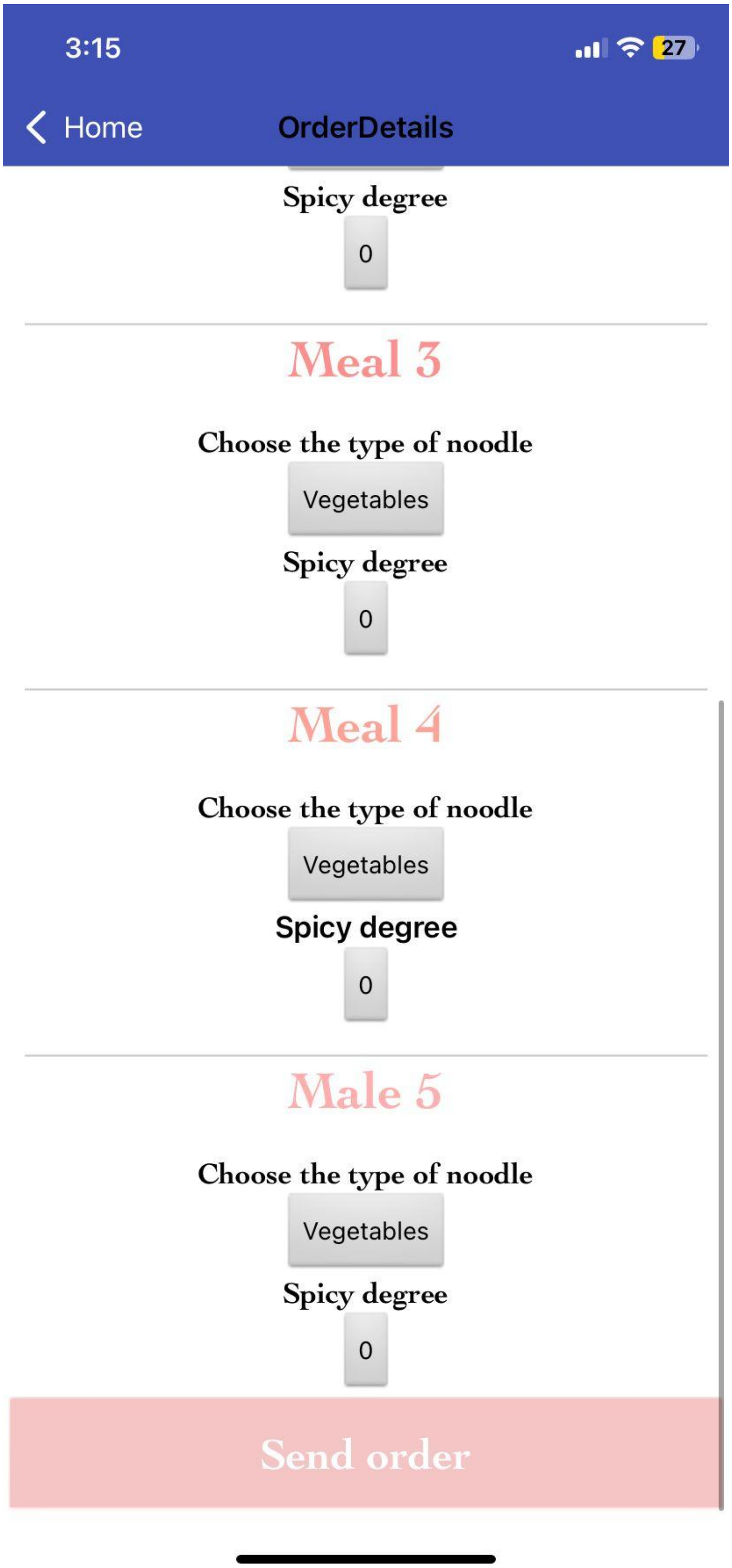
Number of meals

5

Start entering details

6.3.2.3 Order Details




3:15
27
Home
OrderDetails
Spicy degree
0
Meal 3
Choose the type of noodle
Vegetables
Spicy degree
0
Meal 4
Choose the type of noodle
Vegetables
Spicy degree
0
Male 5
Choose the type of noodle
Vegetables
Spicy degree
0
Send order


3:15
27
OrderDetails
PayScreen
PAY &
COLLECT
Pay

6.4 Standards and Specifications

During the development of the noodle-making machine, we adhered to widely recognized engineering and safety standards to ensure accurate operation and user safety. IEEE 11073 guided the proper use of sensors for precise monitoring and control, with the MAX6675 thermocouple used to continuously measure water temperature in the kettle, ensuring optimal cooking conditions. IEEE 61508 was applied to maintain functional safety, as the system verifies the presence of noodles and cups using Hall Effect and Ultrasonic sensors, performs homing via limit switches, and ensures that pistons, pumps, and heaters operate only under safe conditions. IEEE 754 was followed to guarantee precise calculations for stepper motor movements and timing sequences, allowing accurate dispensing of noodles, spices, and water. The machine's software employs libraries such as AccelStepper for stepper motor control, LiquidCrystal_I2C and Keypad for the user interface, and digital I/O for controlling pumps, pistons, heaters, and relays. The functional flow is carefully structured: homing is performed at startup, sensors verify conditions before dispensing, the temperature sensor regulates the heater during cooking, and the machine only proceeds to serving when all safety checks are satisfied. This comprehensive adherence to standards and specifications ensures reliable, safe, and precise meal preparation throughout the automated process.

6.5 Problems Solution

During the development of the noodle-making machine, several challenges were encountered and addressed to ensure smooth operation. Initially, it was difficult to dispense noodles accurately into the cups without spillage. This was solved by implementing an air piston, which reliably pushed the noodles into the cup. Another challenge was ensuring that the kettle moved precisely to the correct stations for dispensing noodles, spices, and water. This was addressed by integrating limit switches and Hall Effect sensors, which provided accurate position feedback for safe and precise movement. Additionally, verifying the presence of noodles and cups before dispensing was critical to prevent errors and spills. Ultrasonic sensors were used to detect the presence of items, ensuring that the system only operates when conditions are correct. Finally, maintaining the correct cooking temperature required continuous monitoring, which was achieved using a MAX6675 thermocouple sensor to control the heater automatically. These solutions collectively improved the reliability, safety, and efficiency of the machine.

6.6 Constraints

Constraints refer to the limitations and conditions considered during the design of the project to ensure proper and safe operation. For the noodle-making machine, these include:

Mechanical Constraints:

Rail length and movement limits of the kettle to ensure precise positioning at all stations.

Stepper motors and pistons must have sufficient power to push noodles and cups without misalignment or malfunction.

Sensor Constraints:

The range and accuracy of Hall Effect and Ultrasonic sensors to reliably detect the presence of noodles and cups.

Sensitivity of the MAX6675 temperature sensor to maintain correct cooking temperatures.

Operational Constraints:

The maximum number of meals that can be prepared within a given time.

Required cooking time for each heat level and the correct amount of water and spices.

Ensuring user safety by controlling the serving gate and preventing operation if a cup or plate is missing.

Software Constraints:

Precise timing and motor step calculations to synchronize all components.

Handling emergency cases, such as missing noodles or cups, safely and reliably.

Results and Discussion

The Noodly system successfully transforms the manual preparation of instant noodles into a fast, fully automated process. Using a keypad and LCD interface, users first enter their order by selecting the number of meals, the desired spice mix (three flavor options), and the spiciness level for each serving (from 0 to 3). After confirming the order, the system executes all preparation steps without further human intervention.

A cup dispenser places a serving bowl at the receiving station, and a motorized rail moves a cooking kettle to each processing stage. A pneumatic piston pushes a pre-measured portion of noodles into the kettle, after which the selected spices are added automatically. A water pump dispenses the precise amount of water required for cooking. The kettle is heated until the water reaches 68 °C, at which point the heater switches off and then reactivates when the temperature drops, maintaining an optimal cooking range. Cooking typically takes 2.5 to 3 minutes, ensuring that the noodles and spices are thoroughly blended. Once cooking is complete, a pneumatic piston tilts the kettle to pour the meal into the serving bowl, and an automated gate opens to allow the user to collect the finished dish.

Experimental testing confirmed that the system consistently produced single-serving meals of standard size and satisfying portion weight. Preparation time for an entire order never exceeded five minutes, even during continuous operation. The automated temperature control maintained a steady cooking environment and prevented over-heating, while the fully enclosed process minimized human contact, resulting in a high level of hygiene and food safety compared with traditional manual preparation.

The keypad and LCD interface provided a smooth and intuitive user experience, allowing customers to customize flavor and spiciness level while monitoring order status in real time. During extended testing sessions, the system maintained accurate motion control and stable power consumption with no misalignment or component failure.

In addition to the user ordering mode, Noodly includes an admin mode for the machine owner or operator. Accessed through the same keypad with a secure password, this mode displays the total daily profit based on the number of meals sold. With a fixed meal price of 5 NIS, for example, five completed orders would automatically register a revenue of 25 NIS. This feature provides immediate financial feedback and supports simple commercial operation without additional accounting hardware.

Public demonstrations at the TEDI-Najah Expo 2025 offered further validation. Visitors praised the system's speed, cleanliness, and novelty, with many expressing excitement about having a smaller household version. Comments such as "I finally have my dream machine for fast and delicious noodles!" highlighted strong consumer enthusiasm and confirmed the project's potential as a profitable commercial product.

These results demonstrate that Noodly meets its primary objectives of speed, reliability, hygiene, and ease of use, while also showing clear promise for future commercialization and possible adaptation to smaller, home-scale models.

Conclusions

In conclusion, the development of the Noodly automated noodle cooking machine demonstrated the successful integration of hardware components, sensors, and control systems to create a fully functional prototype. The system was designed to automate the preparation of instant noodles, from dispensing ingredients to cooking and serving, while ensuring accuracy, efficiency, and safety. Furthermore, the addition of a mobile application enhanced user interaction by enabling remote control and customization of orders. Although some technical challenges were faced during the design and implementation, such as ingredient dispensing and temperature control, practical solutions were applied to overcome them. Overall, the project provided valuable hands-on experience in embedded systems, mechatronics, and IoT-based applications, and it highlighted the potential of automation in simplifying daily tasks.

Future Work

For future development, several enhancements can be implemented to improve the flexibility and user experience of the system. One possible extension is allowing the user to customize the **amount of water** used during cooking, based on personal preference. Another improvement could be providing different **sizes of noodle portions** to accommodate varying appetites. Additionally, the system could be upgraded to include an option for adding **vegetable toppings** according to the user's choice, which would enrich the nutritional value of the meal. Furthermore, the machine could be expanded with an additional **container for other types of pasta** to increase variety. Finally, integrating a **payment system** that accepts both **cash (shekels)** and **credit cards** would make the machine more practical and user-friendly.