

## **PROJECT REPORT**

### **PIZZA AUTOMAT**

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### **EEE 3506 Programmable Logic Controllers**

## Ladder Diagram Workflow of Pizza Automat

The Ladder Diagrams presented in this slide show illustrate the step-by-step automation process of a pizza vending machine. The first step is the Power On & Power Off control using a classic latch circuit, which initializes the system and prepares it for operation. Next, the user proceeds with pizza customization through the HMI screen. When the pizza size is selected, the system adjusts the amount of ingredients accordingly. At this point, it checks whether there are enough ingredients available. If the check is successful, the system starts making the pizza and pre-heats the oven. The process continues with pouring the dough, followed by adding ingredients to the pizza based on the user's choices. After this, the plastic conveyor belt moves the pizza base into the oven. Once the baking is complete, the oven conveyor transports the pizza out. In the final step, the system slices the pizza and it becomes ready to eat. Each of these steps is modeled in the Ladder Diagram using relevant relays, timers, and sensors, designed in accordance with industrial automation logic.

## HMI of Pizza Automat

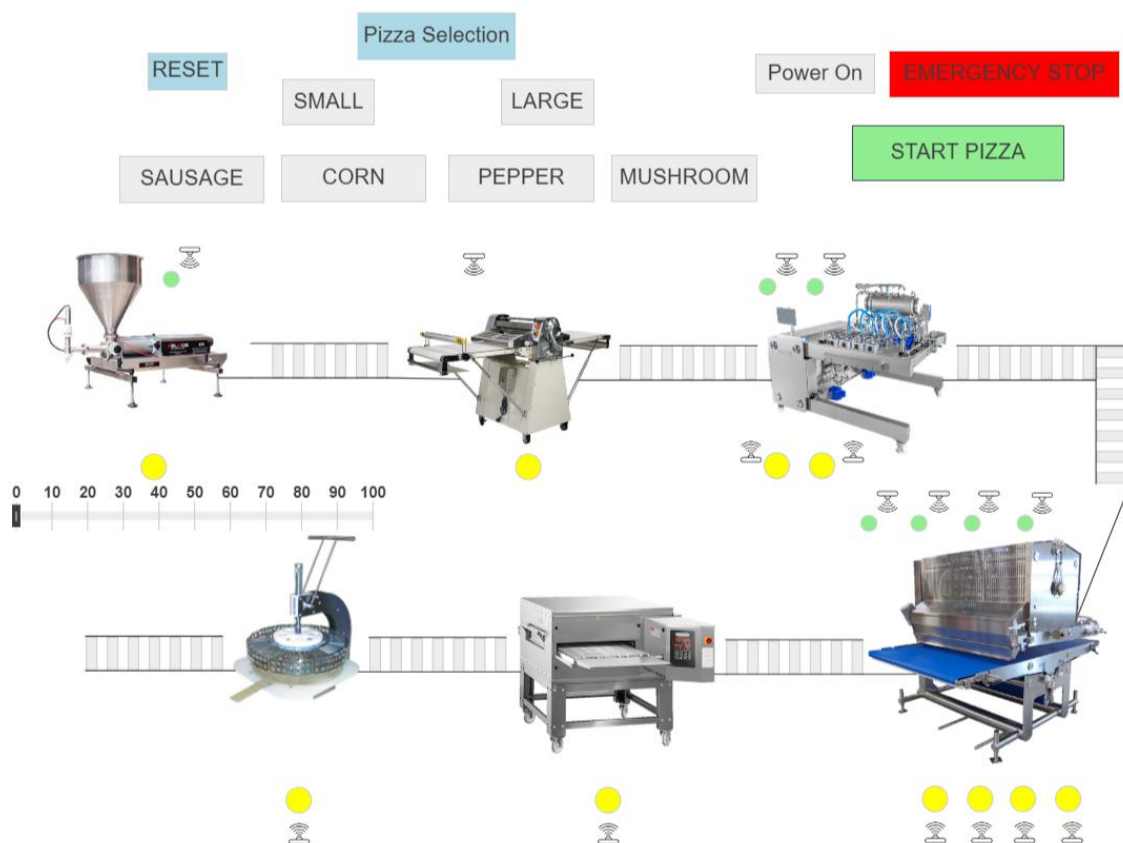


Figure1: HMI of Pizza Automat

## Ladder Diagram Elements and Their Descriptions

**The First Part:** The first step is the Power On & Power Off control using a classic latch circuit,

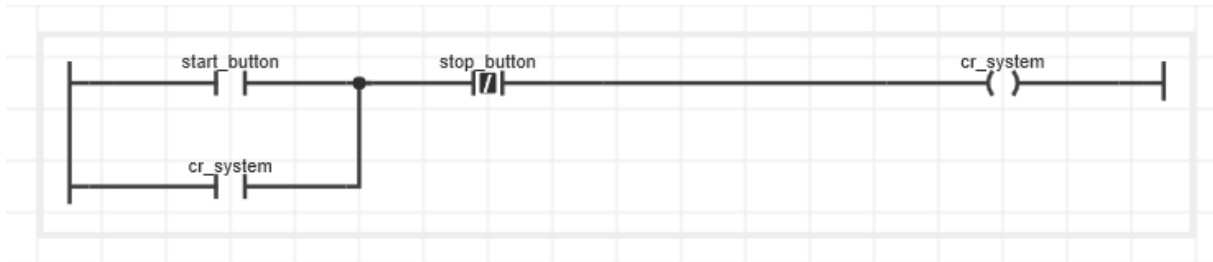


Figure2: The First Part

**The Second Part:**

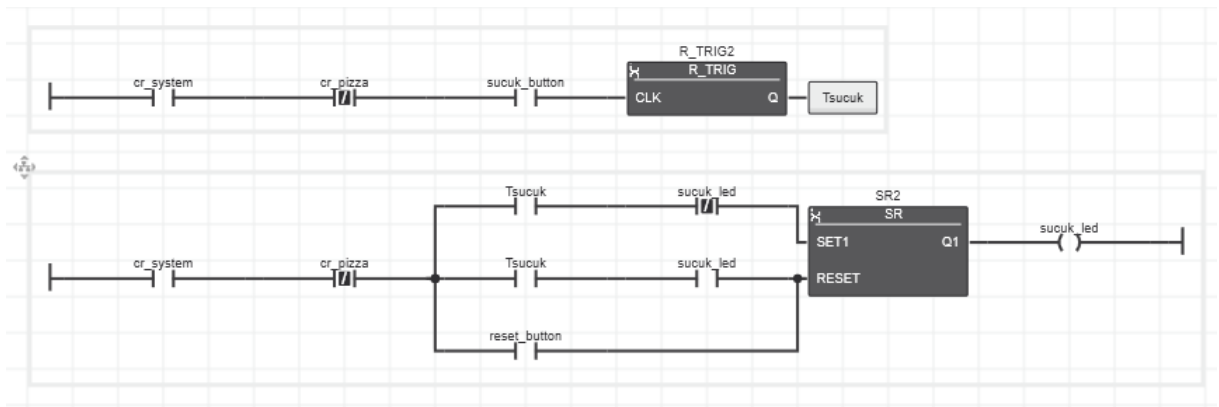


Figure3: The Second Part

### Upper Section (Triggering with R\_TRIG block):

- When cr\_system (system is active) and cr\_pizza (pizza selection is made) are both TRUE,
- If the user presses the sucuk\_button,
- The R\_TRIG2 block acts as a rising edge trigger. This ensures that only a single pulse is generated when the button is pressed.
- The output of this pulse is labeled Tsucuk, which is used to control the SET/RESET block in the lower section.

### Lower Section (LED Control with SR block):

- When both `cr_system` and `cr_pizza` conditions are TRUE, the SR2 block is activated if one of the following three conditions is met:
  - The `Tsucuk` signal is received (the user has pressed the `sucuk_button`),
  - The `sucuk_led` is already ON (self-holding logic),
  - Or the user presses the `reset_button` (this resets the SR block and turns OFF the `sucuk_led`).
- The Q1 output of the SR2 block controls the `sucuk_led`. That is, when the user selects `sucuk`, the LED turns ON, and it stays ON until the system is reset by the `reset_button`.

### The Third Part:

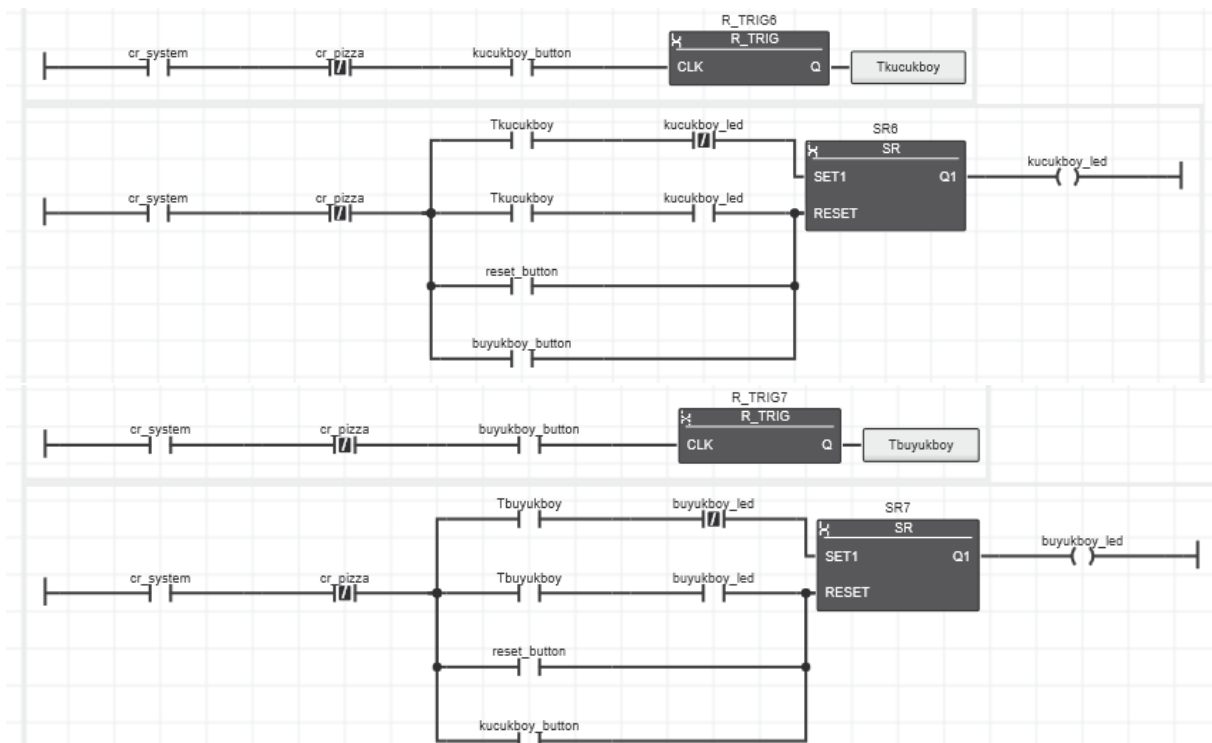


Figure4: The Third Part

This ladder diagram represents the control system we designed for selecting a small-size pizza. When the system and pizza selection are active, pressing the small-size button triggers an `R_TRIG` block, which activates the SR block and turns on the small-size LED. If the reset or large-size button is pressed, the system resets and the LED turns off.

We created this diagram to allow switching between different size options while ensuring only one selection is active at a time, with visual feedback provided through the LED. And the same logic was added in the diagram below for the large-size pizza as well.

#### The Fourth Part:



Figure5: The Fourth Part

We added this ladder diagram to prevent the system from operating when any of the essential pizza ingredients such as dough, sauce, cheese, sausage, corn, pepper, or mushrooms are detected as missing by the sensors.

#### The Fifth Part:

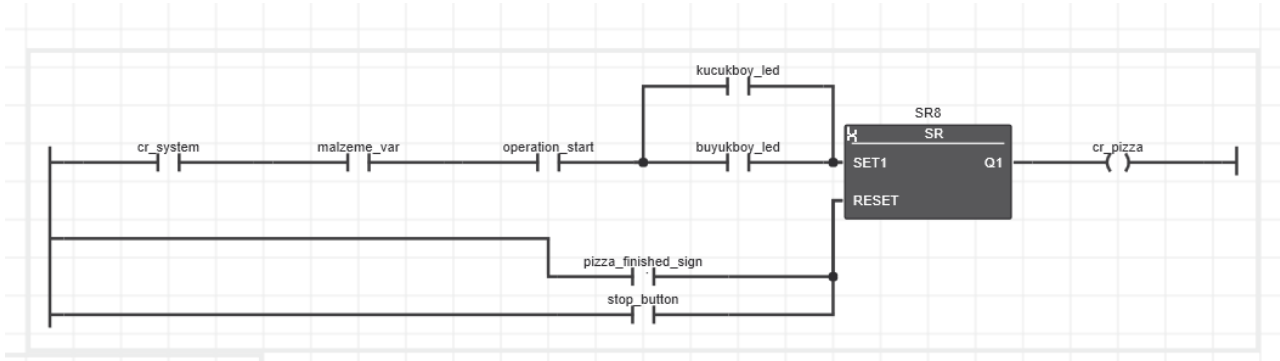


Figure6: The Fifth Part

In this diagram, the system is allowed to operate only if all required ingredients are available and a valid pizza size (either small or large) has been selected. Once the production is completed or a stop signal is received, the system automatically shuts down. This structure was developed with the same logic as the previous diagram, but focuses specifically on the production process.

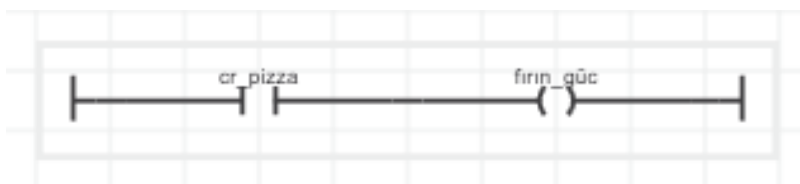


Figure7 The Fifth Part 2

This diagram initiates the oven heating process as soon as the pizza start command is given.

### The Sixth Part:

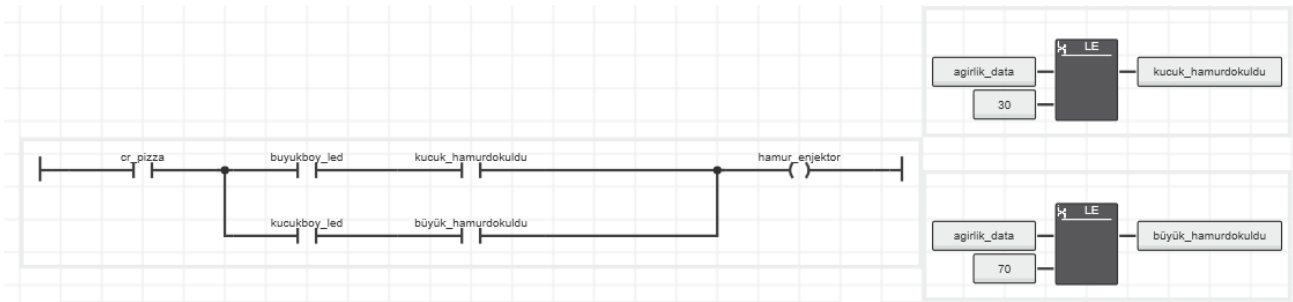


Figure8: The Sixth Part

In this rung of our Ladder Diagram, we used the LE (Less Than or Equal) comparison instruction to set different weight limits for small and large pizza selections. Accordingly, the dough dispensing machine will continue operating until the weight measured by the sensor reaches the predefined value based on the selected pizza size. Once this threshold is exceeded, the machine will automatically stop.

### The Seventh Part:

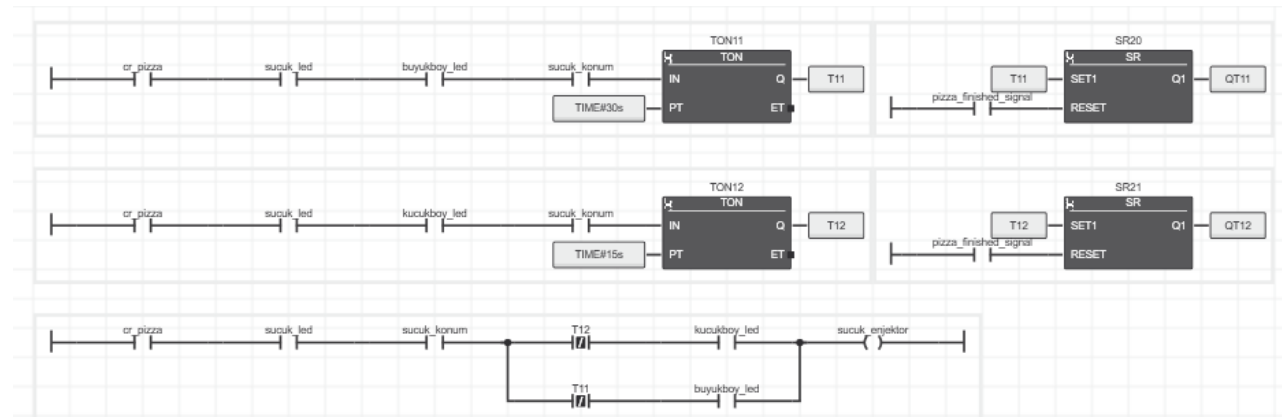


Figure9: The Seventh Part

This section manages the dispensing time for the selected ingredient based on the selected pizza size. Once the dough reaches the correct position, a timer (TON11 or TON12) starts depending on whether a large or small pizza was selected. The timer ensures that the dispensing lasts for 30 seconds for large pizzas and 15 seconds for small ones. Once the timer finishes, a Set/Reset (SR) block sets the pizza\_finished\_signal, indicating the end of the ingredient dispensing process. Meanwhile, a separate rung checks the same conditions and keeps the injector active during the entire timing period. This setup ensures that the dispensing process is accurately controlled according to pizza size.

This logic is repeated individually for each selected ingredient, with each having its own dispensing time based on its characteristics and required amount.

## The Eighth Part:

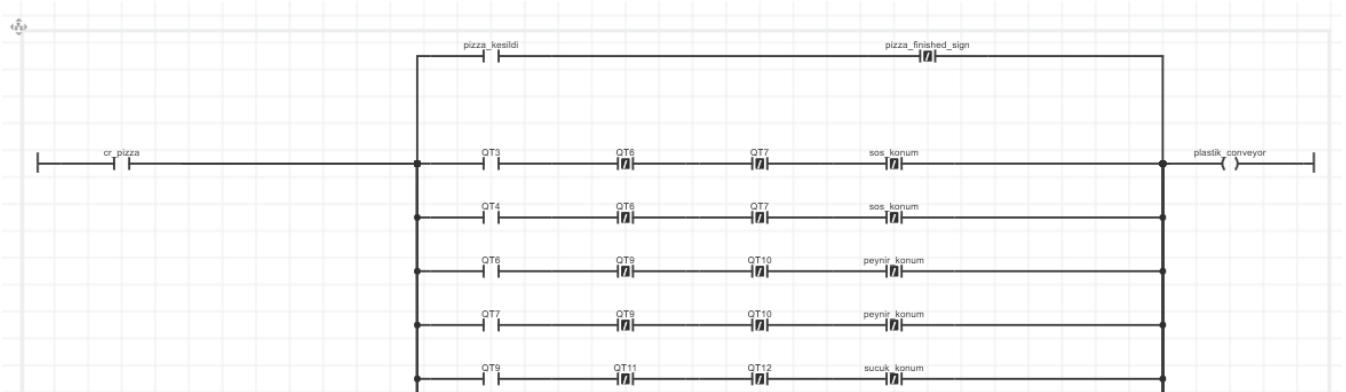


Figure10: The Eighth Part

In this part of the program, we used logic to determine when the conveyor should operate. Separate rungs were created to activate the conveyor during ingredient addition for both small and large pizza selections. Since the conveyor is used throughout the entire process, this section automates its operation. Similarly, we applied the same logic to the oven conveyor, which operates independently, by adding corresponding rungs to control its stop condition.

## The Ninth Part:

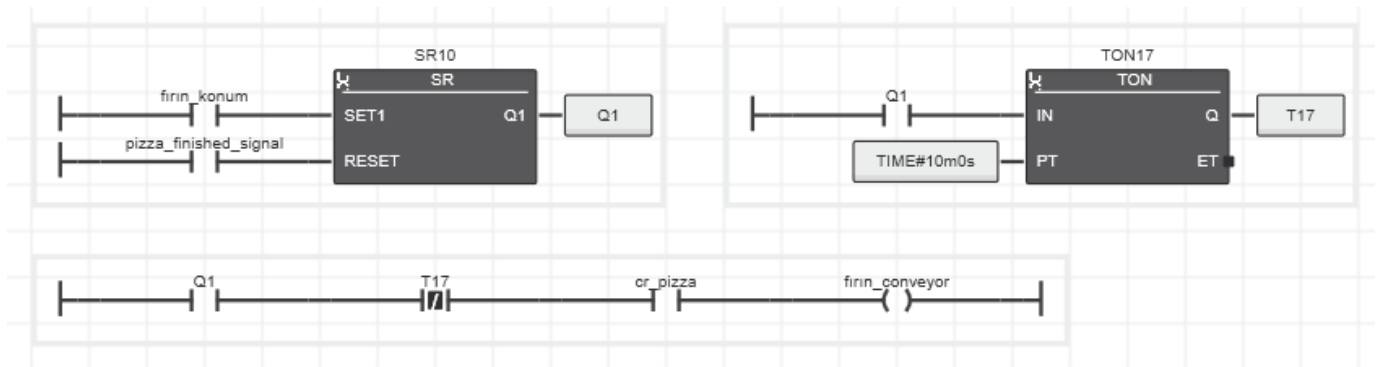


Figure11: The Ninth Part

This rung controls the oven conveyor, which operates independently from the main conveyor described in the previous step. It includes a timer and a Set/Reset block to keep the conveyor running for a predefined baking duration. Since the baking process is consistent regardless of whether the pizza is small or large, a single, common baking time was sufficient. Therefore, we designed this step as a shared stage for all pizza sizes.

### The Tenth Part:

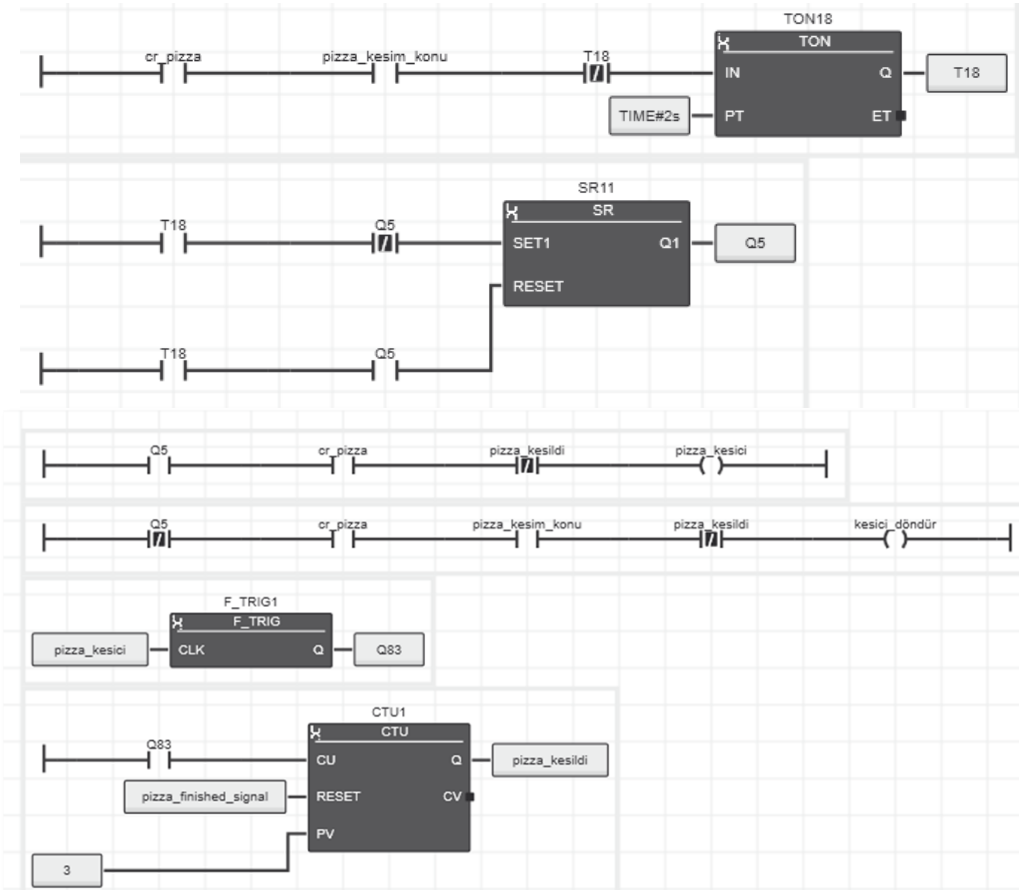


Figure12: The Tenth Part

This section of the Ladder Diagram handles the final stage of the pizza process: slicing the baked pizza into 6 pieces. To achieve this, the cutting arm is activated to rotate three times.

First, when the pizza reaches the cutting position, a 2-second delay is triggered using the TON timer to ensure proper alignment. After the delay, a Set/Reset (SR) block activates the output Q5, which initiates the slicing operation.

The F\_TRIG (falling edge trigger) detects each activation pulse from the cutter, ensuring that the system only counts one signal per cut. These pulses are counted by a CTU (Count Up) block. Once the counter reaches 3, the `pizza_kesildi` (pizza sliced) flag is set, indicating that the slicing process is complete. The cutter then stops automatically.