Department of Computer Science and Engineering
University of Dhaka
CSE-3116: Microcontroller Lab Project Report

Smart Tea Maker Machine

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Project Motivation

Why a Smart Tea Maker?

"Bridging the gap between manual household tasks and modern IoT automation through a practical, hands-on engineering solution."

Task Automation

Automates the repetitive process of tea preparation, ensuring **consistency in taste** and **saving valuable time** for users in lab or home environments.

IoT & Remote Control

Demonstrates practical IoT implementation by **enabling remote Start/Stop functionality** and **process monitoring via a Wi-Fi** based browser interface.

Educational Value

Serves as a **comprehensive learning platform** for integrating multiple components: **ESP32, sensors (IR), actuators (motors/pumps), and web technologies.**

Project Innovations

Smart Design Features

Wi-Fi & Web UI

Full system control via a hosted web interface. Users can **Start, Stop, and override wait times** (CONTINUE) from any browser.

Direct IR Trigger

IR sensor directly triggers the relay for immediate pump activation, **reducing latency** and ensuring precise water dispensing.

Coordinated Motion

Synchronized state machine manages Servo (dosing) and **DC Motor (conveyor)** timing to prevent spills or empty cups.

Safety & Modularity

Relay-based isolation for the pump and a **modular shared-ground design** allow for easy extension with future sensors.

Components & Implementation

Hardware Configuration

5V Pump

L298 Motor Driver

ESP32 Microcontroller

6V DC Motor (Conveyor)

IR Sensor Module

Jumper Wire

3.7 V Lithium Battery

Servo Motor (Dispenser)

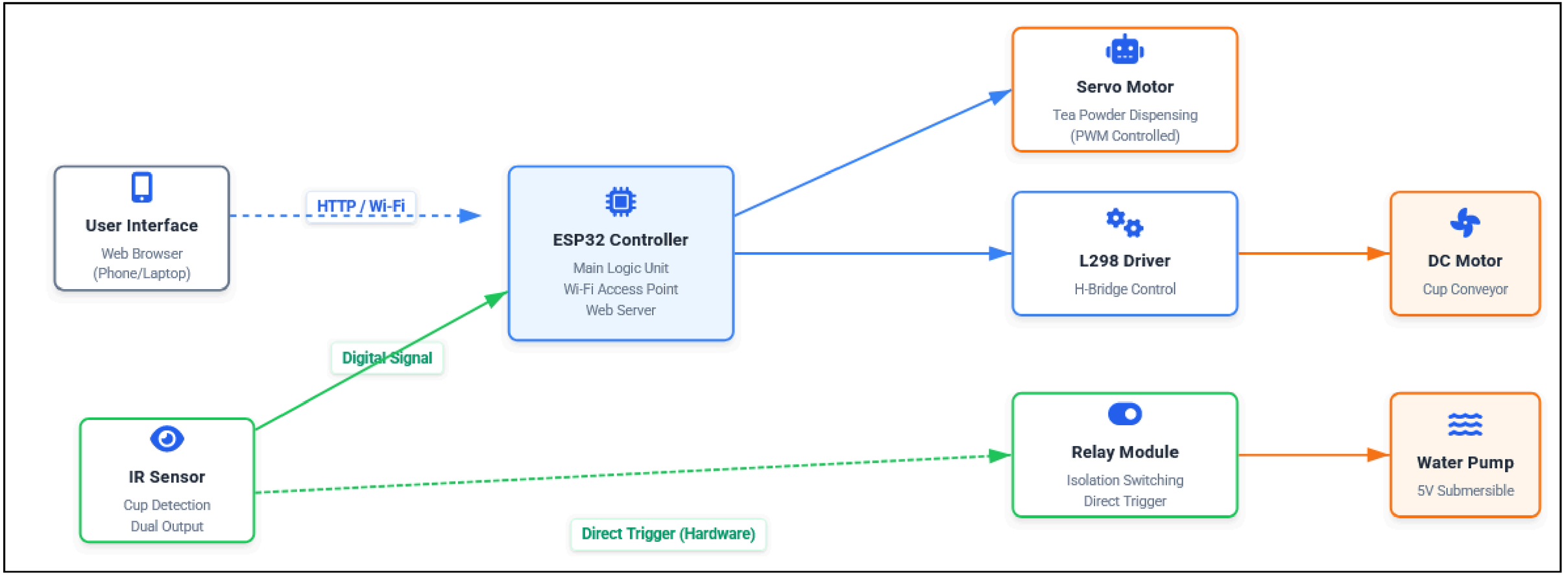
Relay Module

Components & Implementation

Software Environment

- IDE Arduino IDE
- Embedded C/C++
- ESP32 Wi-Fi + WebServer
- HTML & JavaScript

System Architecture

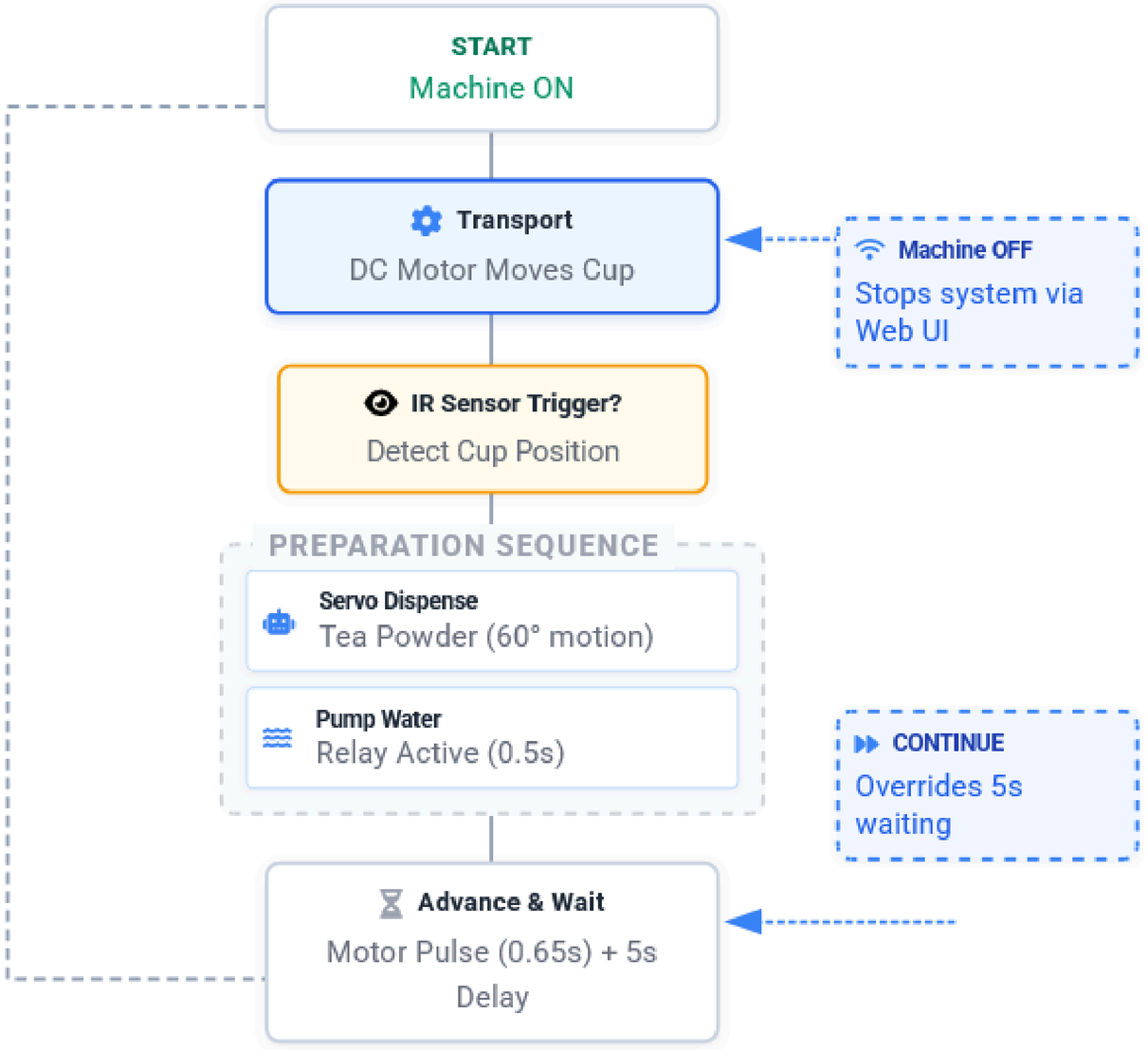


Working Principle

Sequential Logic

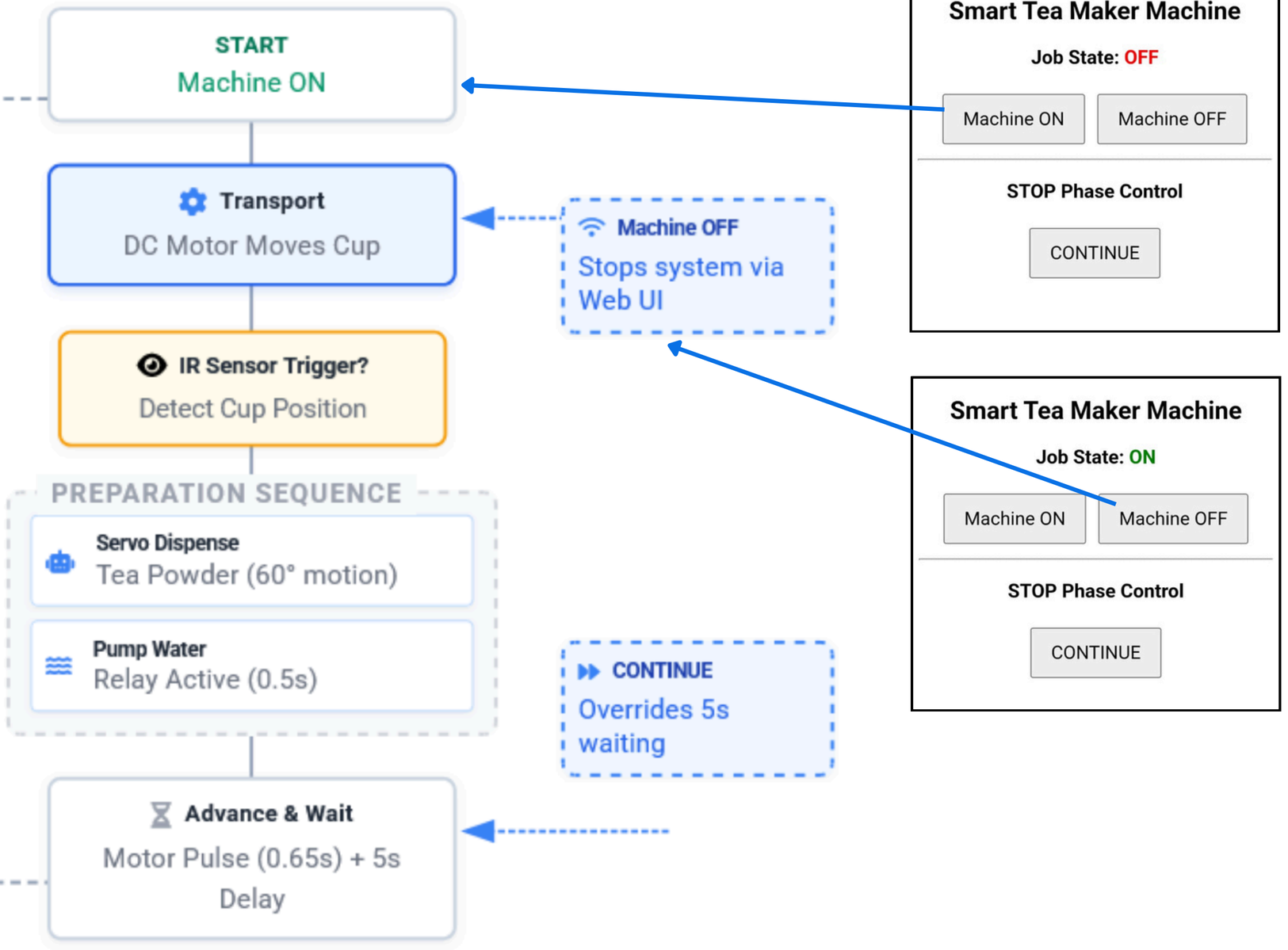
The system operates on a linear state machine logic. The ESP32 continuously monitors the IR sensor while driving the DC motor. Upon detection, it triggers a synchronized sequence of servo and pump actions.

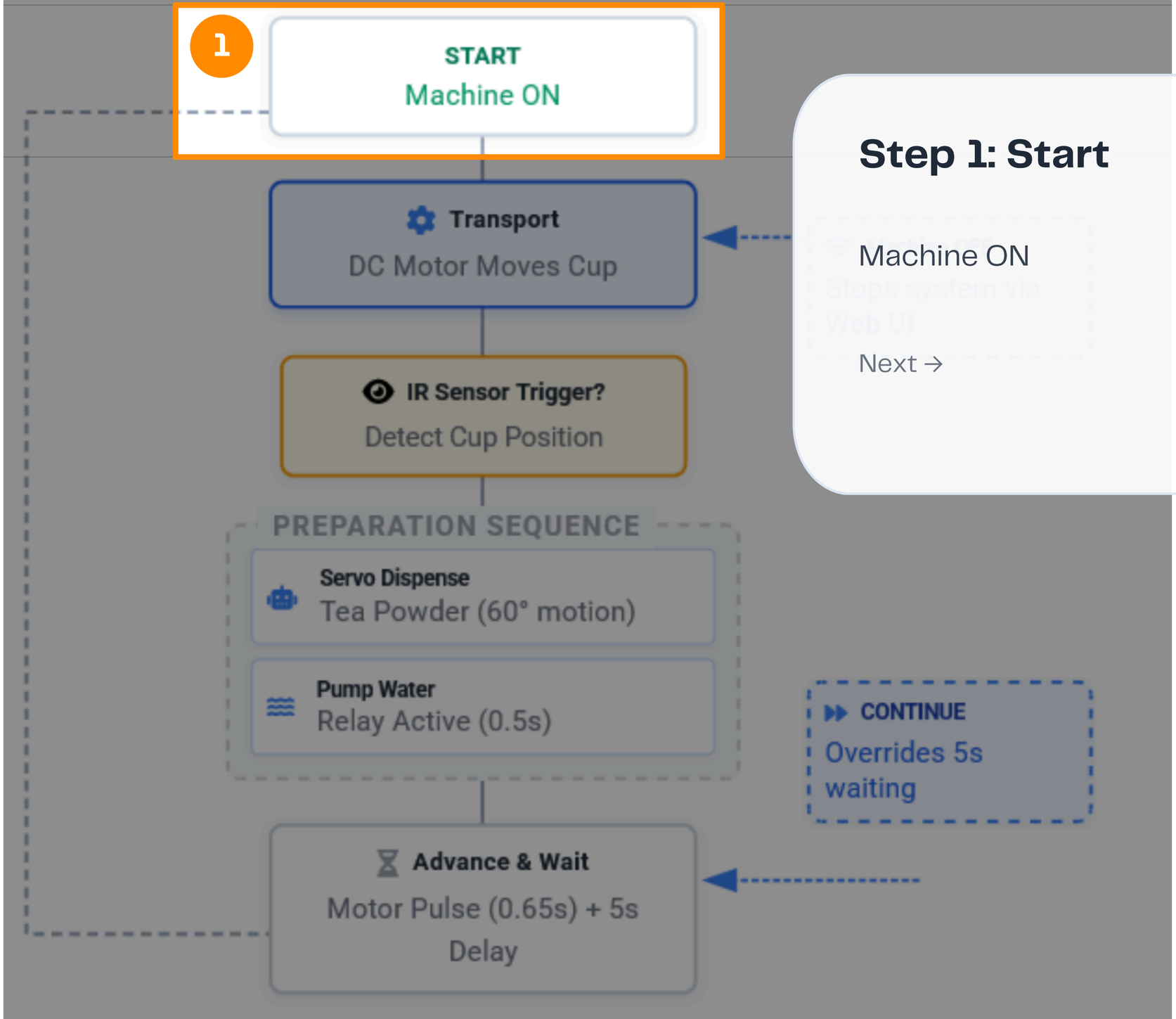
1. Cup Detection stops conveyor immediately
2. Servo dispenses powder (0° → 60° → 0°)
3. Pump dispenses water for 0.5s

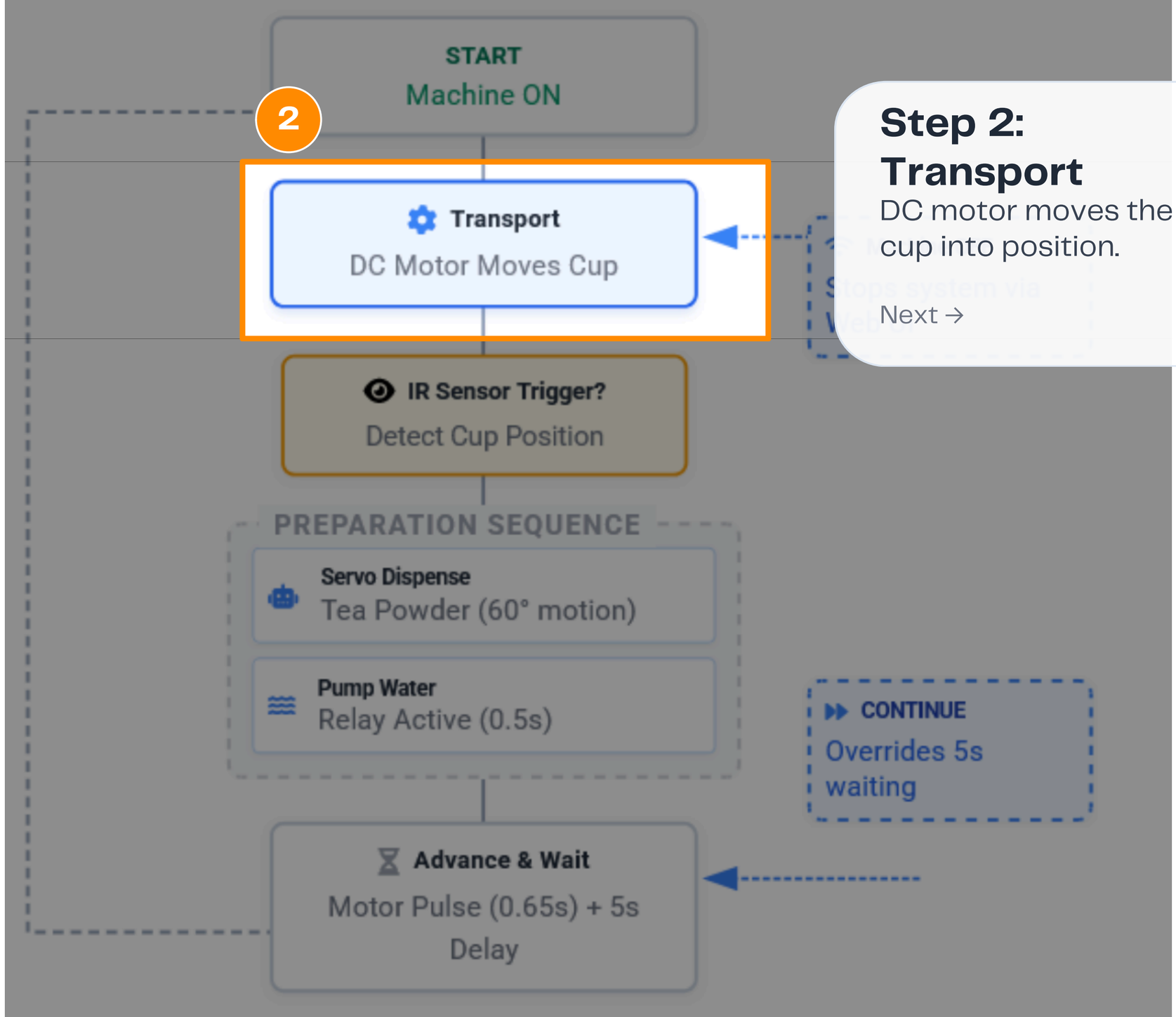


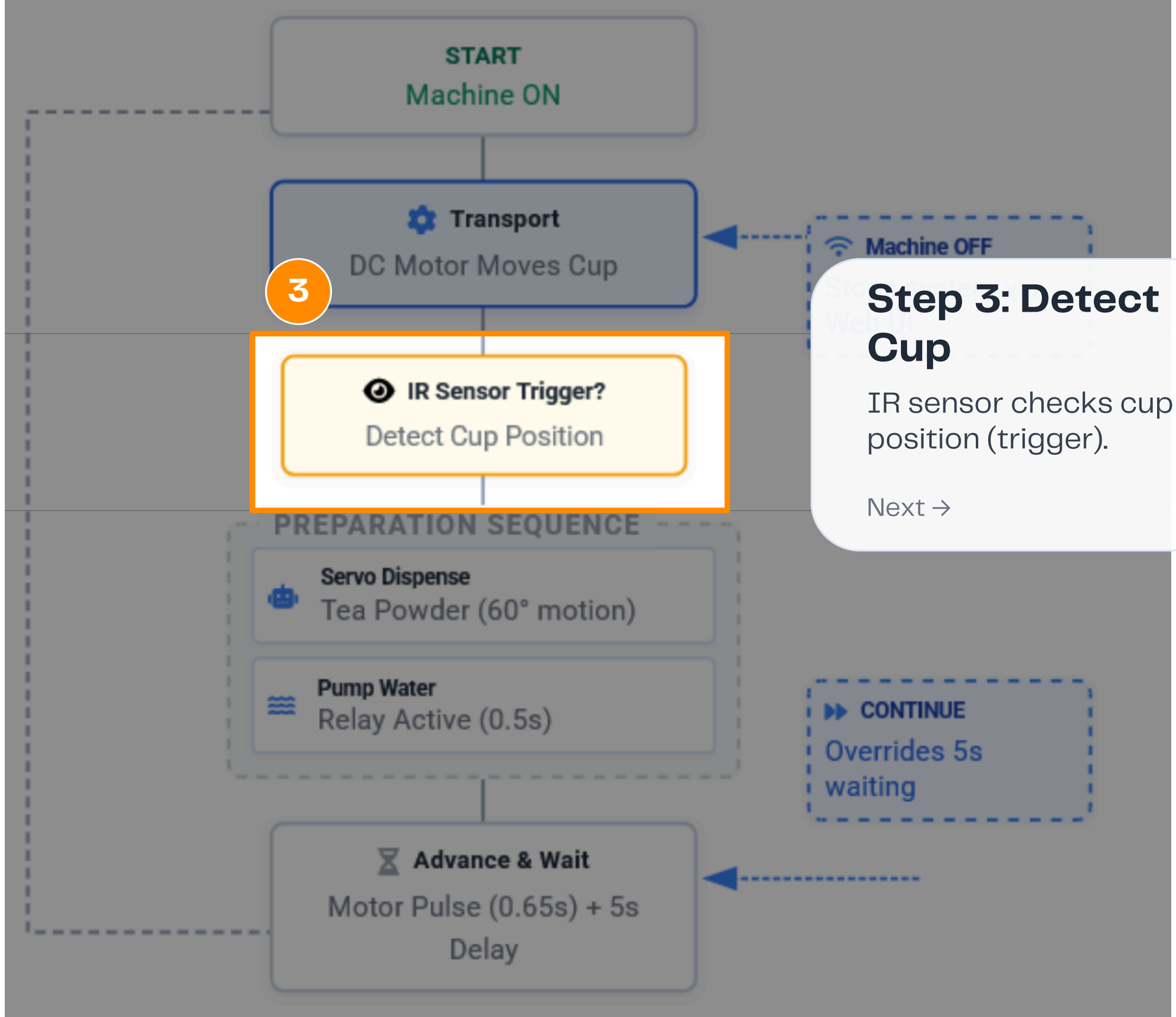
Smart Tea Maker

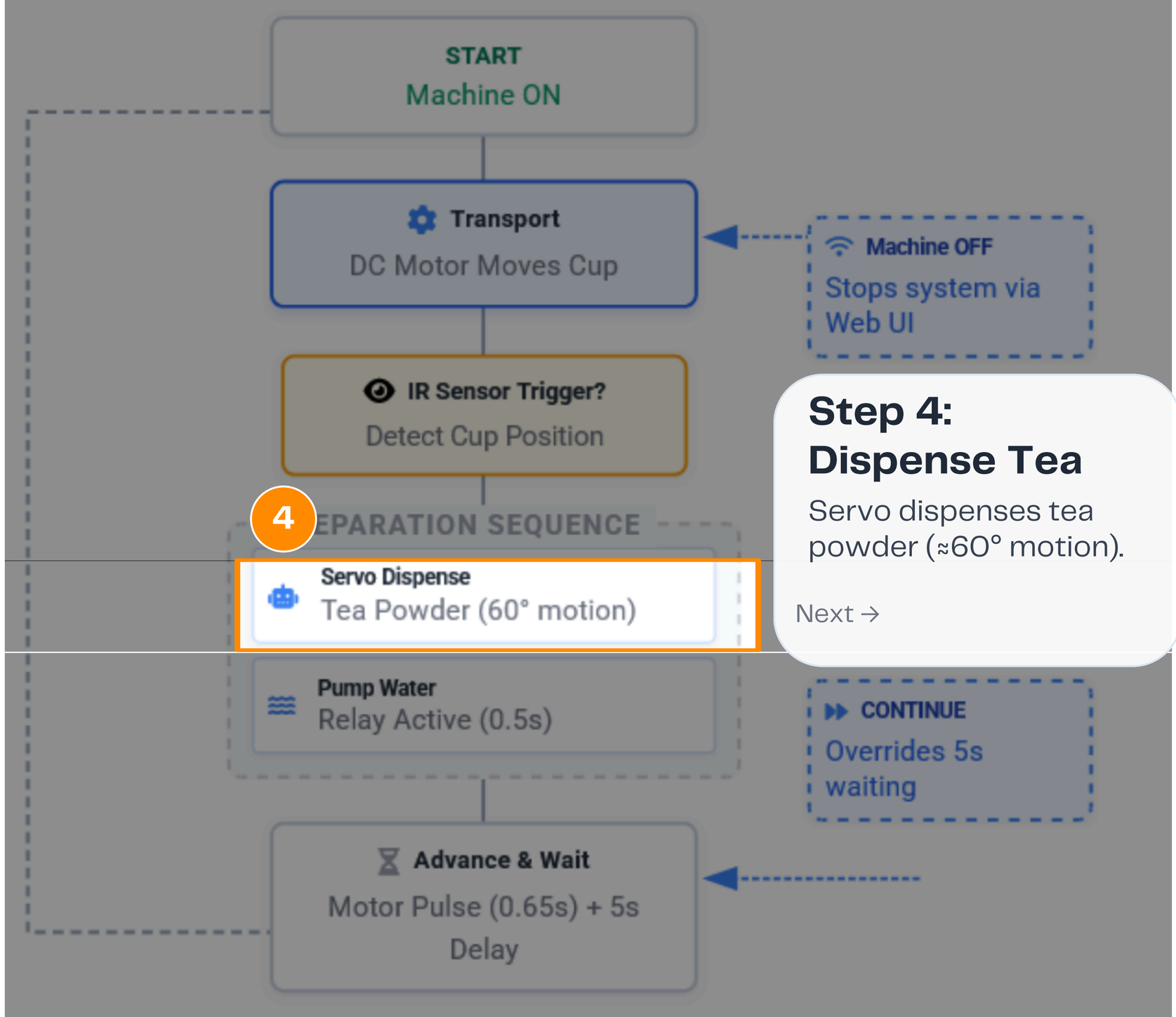
Workflow (step-by-step)

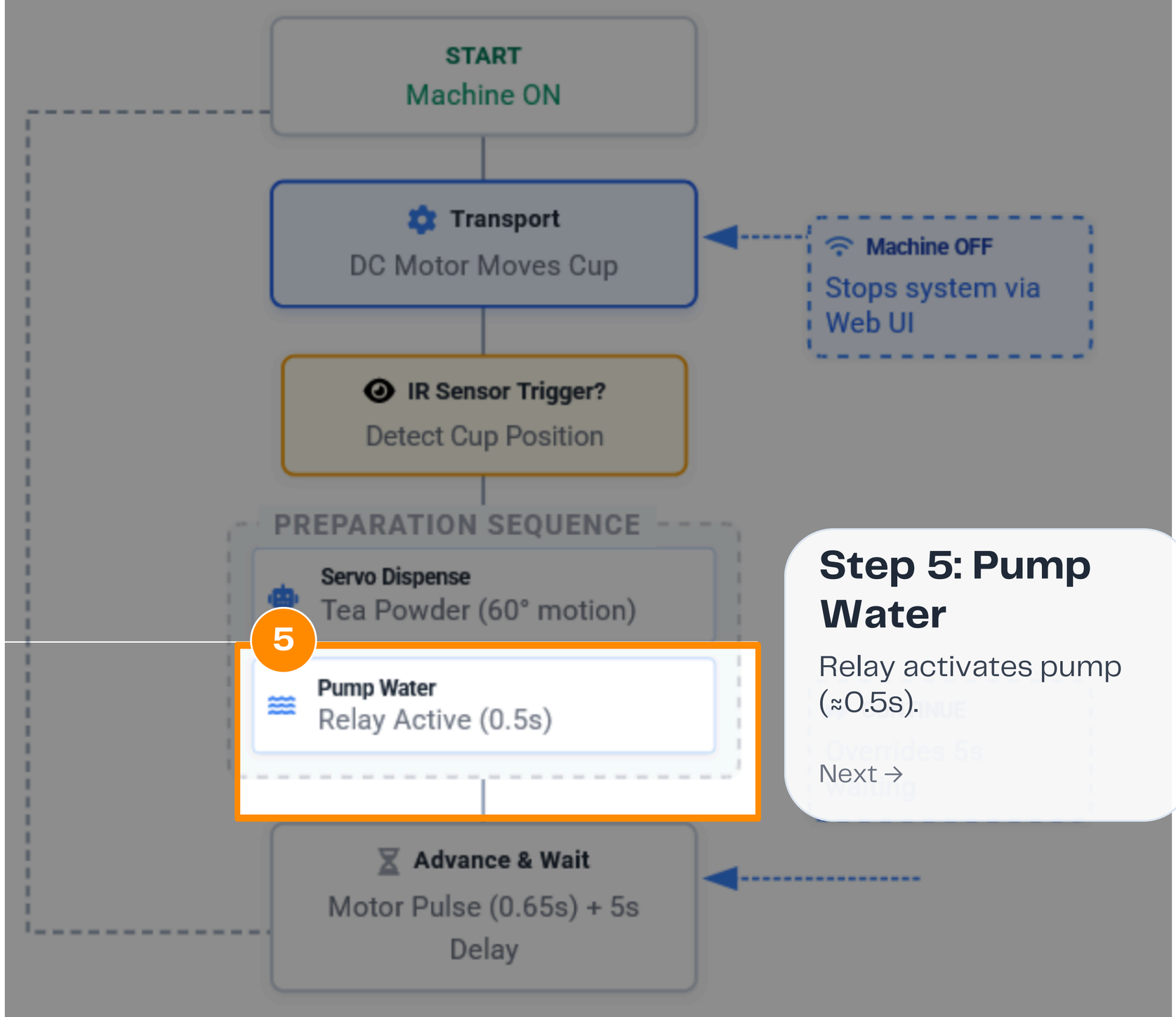



1
START
Machine ON
Transport
DC Motor Moves Cup
IR Sensor Trigger?
Detect Cup Position
PREPARATION SEQUENCE
Servo Dispense
Tea Powder (60° motion)
Pump Water
Relay Active (0.5s)
CONTINUE
Overrides 5s waiting
Advance & Wait
Motor Pulse (0.65s) + 5s Delay
Step 1: Start
Machine ON
Next →


START
Machine ON
2
Transport
DC Motor Moves Cup
IR Sensor Trigger?
Detect Cup Position
PREPARATION SEQUENCE
Servo Dispense
Tea Powder (60° motion)
Pump Water
Relay Active (0.5s)
CONTINUE
Overrides 5s waiting
Advance & Wait
Motor Pulse (0.65s) + 5s Delay
Step 2: Transport
DC motor moves the cup into position.
Next →


START
Machine ON
Transport
DC Motor Moves Cup
3
IR Sensor Trigger?
Detect Cup Position
PREPARATION SEQUENCE
Servo Dispense
Tea Powder (60° motion)
Pump Water
Relay Active (0.5s)
Advance & Wait
Motor Pulse (0.65s) + 5s Delay
Machine OFF
CONTINUE
Overrides 5s waiting
Step 3: Detect Cup
IR sensor checks cup position (trigger).
Next →


START
Machine ON
Transport
DC Motor Moves Cup
Machine OFF
Stops system via Web UI
IR Sensor Trigger?
Detect Cup Position
4
EPARATION SEQUENCE
Servo Dispense
Tea Powder (60° motion)
Pump Water
Relay Active (0.5s)
CONTINUE
Overrides 5s waiting
Advance & Wait
Motor Pulse (0.65s) + 5s Delay
Step 4: Dispense Tea
Servo dispenses tea powder (≈60° motion).
Next →



Step 5: Pump Water

Relay activates pump (≈0.5s).

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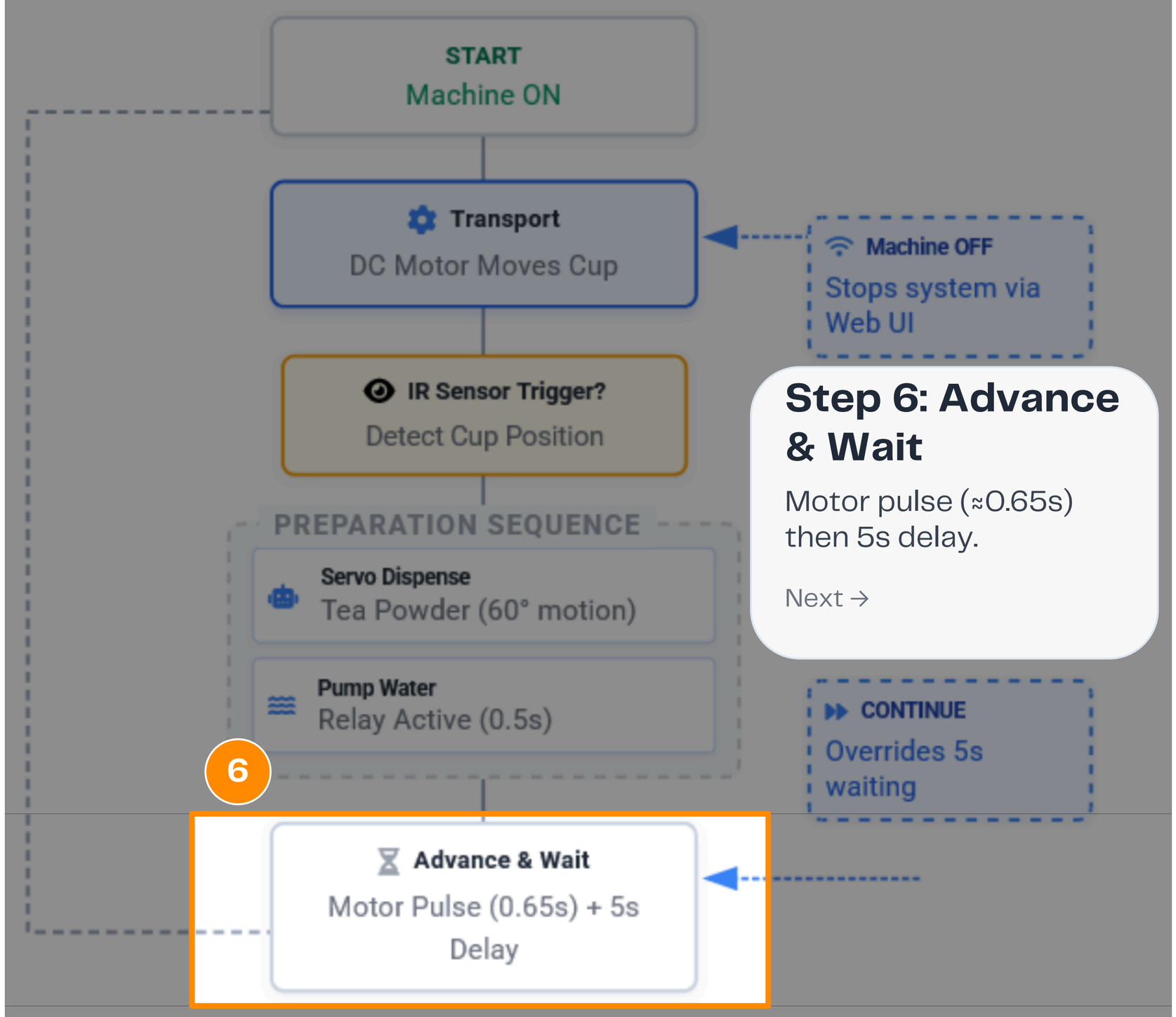

START
Machine ON
Transport
DC Motor Moves Cup
Machine OFF
Stops system via Web UI
IR Sensor Trigger?
Detect Cup Position
PREPARATION SEQUENCE
Servo Dispense
Tea Powder (60° motion)
Pump Water
Relay Active (0.5s)
CONTINUE
Overrides 5s waiting
6
Advance & Wait
Motor Pulse (0.65s) + 5s Delay
Step 6: Advance & Wait
Motor pulse (≈0.65s) then 5s delay.
Next →

Challenges & Solutions

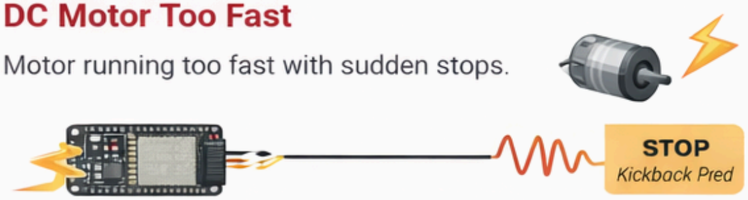
Key Challenges

Servo Voltage Drops

Servo activation caused voltage drops, resetting the ESP32.

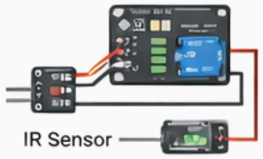
DC Motor Too Fast

Motor running too fast with sudden stops.



IR Sensor Switching Issue

IR sensor output was less responsive.



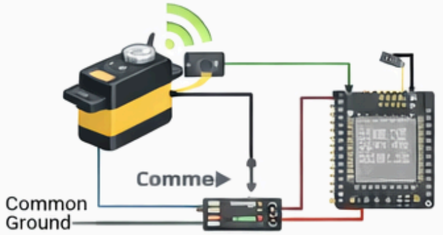
Wi-Fi Latency

Delays in command execution when router signal was weak.

How We Addressed Them

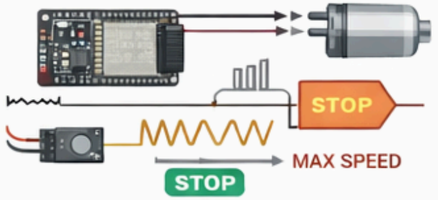
Separate Servo Power

Used a separate power source and unified ground to stabilize servo operation.



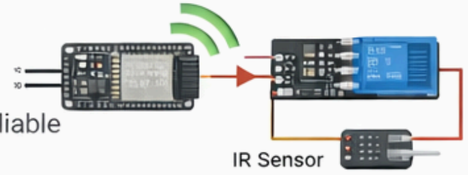
Motor Speed Control

Implemented PWM for smooth operation, full-speed brief kickbacks after stopping.



Direct IR Relay Control

Connected IR sensor output directly to the relay for fast, reliable switching.



AP Mode Optimization

Switched ESP32 to AP Mode for direct, low-latency local control.

Conclusion

We have successfully designed and implemented a **Smart Tea Maker Machine** that automates the entire brewing process. By integrating **ESP32, sensors, and actuators,** we demonstrated a practical IoT solution that enhances efficiency and user convenience.

Thank You