Work Division

## 1. Project Overview

The **Manufacturing Line Design System** automates quality control in a beverage factory using the **STM32F401CB** microcontroller (LQFP48, Cortex-M4, 128 KB Flash, 64 KB SRAM). It:

Measures bottle fill levels via a water level sensor (analog, ADC on PA0) and compares against thresholds (2.0V–2.5V for “OK”).

Detects bottle proximity (<10 cm) with an ultrasonic sensor (HC-SR04, PB0–PB1) to trigger stepper motor activation.

Diverts defective bottles (underfilled or overfilled) using a stepper motor (28BYJ-48, PB12–PB15).

Displays status (fill level, proximity, defect status) on a 16x2 I2C LCD (PB6–PB7).

Includes a button (PB10) for start/stop and an LED (PC13) for status.

The system will be simulated in **Proteus 8.13+**, with tasks divided among **Natnael**, **Surafel**, **Cherinet**, and **Yafet**, each focusing on a single module while collaborating on integration, testing, and documentation.

## 2. Team Member Responsibilities

Each member is responsible for developing, testing, and integrating their assigned module, contributing to the Proteus schematic, and documenting their work. Tasks are summarized below.

### Natnael: Water Level Sensor and ADC Module

**Primary Tasks**:

Add water level sensor to Proteus schematic (output to PA0, VCC to 3.3V, GND to ground; simulate with 0–3.3V potentiometer).

Configure ADC1 (PA0, Channel 0) in STM32CubeMX (single conversion, 12-bit, 55.5 cycles sampling).

Write code to read analog voltage, convert to fill level, and apply thresholds (2.0V–2.5V for “OK”, <2.0V for underfilled, >2.5V for overfilled).

Provide function (e.g., float get\_fill\_level(void)) for defect detection.

Test in Proteus by adjusting potentiometer (1.5V, 2.2V, 2.8V) and verifying via UART (PA9–PA10).

**Secondary Tasks**:

Collaborate with Cherinet to integrate ADC output with stepper trigger.

Assist in main loop development to combine ADC and ultrasonic inputs.

Test full system in Proteus, ensuring accurate defect detection.

Document ADC module (code, schematic, thresholds, test results).

Contribute to final report and presentation.

### Surafel: Ultrasonic Sensor Module

**Primary Tasks**:

Add HC-SR04 to Proteus schematic (TRIG to PB0, ECHO to PB1, VCC to 5V, GND to ground; simulate ECHO with pulse generator).

Configure PB0 (output), PB1 (input), and TIM2 (1 MHz) in STM32CubeMX for precise timing.

Write code to measure distance (<10 cm to trigger stepper) using HAL\_GPIO\_WritePin(GPIOB, GPIO\_PIN\_0, GPIO\_PIN\_SET) for TRIG.

Provide function (e.g., uint32\_t get\_distance\_cm(void)) for proximity detection.

Test in Proteus with pulse generator (e.g., 580 µs for 10 cm) and logic analyzer for PB0–PB1.

**Secondary Tasks**:

Collaborate with Cherinet to gate stepper activation (distance < 10 cm).

Assist in main loop to integrate ultrasonic with ADC and stepper.

Test full system in Proteus, verifying proximity triggers.

Document ultrasonic module (code, timing, simulation setup).

Contribute to final report and presentation.

### Cherinet: Stepper Motor Module

**Primary Tasks**:

Add 28BYJ-48 and ULN2003 to Proteus schematic (IN1–IN4 to PB12–PB15, VCC to 5V, GND to ground; simulate with LEDs).

Configure PB12–PB15 as GPIO outputs in STM32CubeMX.

Write code for 8-step sequence (512 steps for 90°), using HAL\_GPIO\_WritePin(GPIOB, GPIO\_PIN\_12, GPIO\_PIN\_SET) for IN1–IN4.

Implement function to rotate 90° when triggered by ADC and ultrasonic inputs.

Test in Proteus, verifying LED sequence with logic analyzer.

**Secondary Tasks**:

Lead main loop development, combining ADC (Natnael) and ultrasonic (Surafel) inputs:

Collaborate with Natnael and Surafel for integration.

Test full system in Proteus, ensuring stepper activates correctly.

Document stepper module (code, sequence, integration).

Contribute to final report and presentation.

### Yafet: I2C LCD Module

**Primary Tasks**:

Add 16x2 LCD with PCF8574 to Proteus schematic (SDA to PB7, SCL to PB6, VCC to 5V, GND to ground).

Configure I2C1 (PB6–PB7, 100 kHz) in STM32CubeMX.

Write code to initialize PCF8574 and display status (e.g., “Level: X.XX V”, “Dist: XX cm”, “Bottle OK”/“Defective”).

Implement function to update LCD every 500 ms.

Test in Proteus with I2C debugger, verifying text updates.