Assignment nr.2
FSMs and Task-based Architectures: Smart Waste Disposal System

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1 Introduction

This project implements a Smart Waste Disposal System for liquid waste using an Arduino-based embedded system and a PC application for monitoring and operator control. It is based on a finite state machine (FSM) and task-based architecture.

2 Finite State Machine and Task Decriptions

The Arduino project developed through PlatformIO was developed to manage the whole system through a change of states. In particular, we planned to divide the solution into 3 main tasks, which are:

1. **WasteTask**
   Manages waste disposal operations, the main task for the proper functioning of the entire system. It provides for the following states:

   - **CLOSED**: the neutral state of the system.
   - **OPEN**: when a user wants to throw something away he presses the open button and opens the door.
   - **RECEIVED**: reception of waste.

- **ERRORED**: if the temperature increases too much
- **FULL**: when the container fills up, so capacity goes to zero.
- **EMPTYING**: when the operator empties the container.

2. **SleepingTask**
Manages the shutdown of the system when no user is detected in the proximity of the waste container. It provides for the following states:

- **AWAKE**: the system is in normal mode of operation.
- **SLEEPING**: if no users were found nearby.

3. **TemperatureTask**
Manages the temperature changes of the waste inside the container. It provides for the following states:

- **STABLE**: the temperature is below the maximum threshold.
- **UNSTABLE**: the temperature is above the maximum threshold for a temporarily period.
- **DANGER**: the temperature has been above the threshold for too long.

3 Dashboard for Monitoring and Control

The Operator Dashboard, developed in Java, provides real-time monitoring and operator control for the system. The GUI interacts with the Arduino system via a serial connection, displaying the container's current status and allowing user actions.

3.1 Features

- **Visual Representation of Waste Levels**: The GUI includes a container panel, which dynamically updates to show the percentage of waste in the container.

- **Real-time Updates**: Serial communication allows the GUI to receive data from the Arduino system, such as waste level and temperature status.

- **User Interaction**: Buttons are provided to control the container, including:

  - **Empty the Container**: Decreases the waste level progressively when pressed.
  - **Restore the Container**: Resets the container waste level.

4 Conclusion

The Smart Waste Disposal System successfully integrates hardware and software to provide an efficient and user-friendly solution for liquid waste management. The finite state machine ensures reliable operations, while the task-based architecture and the Java GUI simplify development and future scalability.