Residential Door Lock

1. **Describe the system and its function:** This system is a secure residential door that uses electronic locks, secure entry, easy exiting, and alarm state awareness.

   This system will use a numeric keypad and a RFID tag reader to grant entry to a residence and a fixed handle on the inside to grant exits. By making this an embedded real-time system, the door can support more than one lock to make the door more secure against intrusion. Solenoid locks can be placed along the top, bottom, and side of the door to strengthen it from brute force attacks. An embedded system that controls the door will need to respond to events to lock and unlock the door.

   When the residential security alarm system is in the fire alarm state, the door will need to unlock immediately. When the residential security alarm system is in either the panic or intrusion detection states, the door will need to close and lock. Otherwise, the door's locked status will reflect the desired state on the software switch on the inside of the door.

   When a person on the inside either changes the switch's state to unlocked or puts pressure on the door's inside handle, the door will unlock. If a person on the outside types in the correct code onto the keypad and has the correct RFID tag for that key code, the door will unlock.

2. **Explain the scope and nature of functional and temporal problems to be considered:** Because the locks are controlled by software, the locks will need to change state within a reasonable amount of time. Reading the typed keys from the numeric keypad needs to happen within a maximum amount of time to ensure that each key is read separately. If a maximum amount of time elapses after the last key was typed, then the input state needs to reset so that a new entry can be keyed in. The RFID needs to be read before the key code is entered in. When a person puts pressure on the handle, the locks need to open as fast as possible, not to exceed a maximum amount of time to avoid a tug-of-war with the door. When an alarm panic is triggered, the door needs to close and lock within a maximum amount of time for predictable security.

3. **Identify any crucial requirements and anything known generally and specifically about timing and performance in the system:** The spring-loaded door solenoids need to activate and deactivate within a fixed amount of time. The system will need to detect when this time overruns and take some measure to rectify the situation. Detecting lock piston state changes needs to happen within a fixed amount of time for the system to meet its other real-time requirements, such as the maximum amount of time needed to unlock the door in a fire emergency.

Ship Stabilizer System

1. **Describe the system and its function:** When a ship detects rotational movement from the port side to the starboard side, or vice-versa, as well as rotational movement from bow to stern, or vice-versa, it will adjust the stabilizer fins near the bow of the ship to counteract the rotation to keep the ship as even-keeled as possible.

2. **Explain the scope and nature of functional and temporal problems to be considered:** If the system does not adjust the stabilizer fin positions at the correct time, the ship might not maintain an even keel as well as it could. It needs to adjust the fins to the correct pitch at the right time and not over-correct. Continuous monitoring of the ship's rotational axes is required to provide movement instructions to the stabilizer fins as soon as possible.

3. **Identify any crucial requirements and anything known generally and specifically about timing and performance in the system:** The detection time for rotations will factor into the real-time requirements as will the time that it takes to adjust the stabilizer fins. The calculations performed on the CPU also need to be factored into the real-time analysis. The overall time that it takes to go from a physical rotation on the ship to the correct fin positions to counteract that rotation is the system's overall response time.

   The system will need to ensure that the fins are not put into a state that compromises the ship's safety, such as a rotational correction that aggravates the unwanted rotation, the ship might lean too much to one side or pitch too far forward or backward.

   The ship's speed also needs to be considered into the equations. A ship that is not moving relative to the water's surface probably won't benefit from stabilizer fins as they require movement.