ESE PROJECT
GROUP ONE

Ammar Haziq Bin Mohd Halim_Automation

Example: **Adaptive Cruise Control (ACC)**

Definition: systems that adjust vehicle velocity and provide a specified distance to the preceding vehicle by automatically controlling the throttle and/or the brake.

1. **Reactive systems**: Continuously react with the environment by measuring the distance and the relative velocity of the two successive vehicles.

2. **Real-time systems:** Timely response is important. Hard real time system. If the system does not give an appropriate response e.g. decelerate or accelerate in time, the car will crash.

3. **Continuous, Discrete, Hybrid:** The ACC system continuously monitors the speed of the vehicle and the distance to the car ahead using sensors like radar or LiDAR. The system computes (with differential formulas) the appropriate throttle and brake levels to ensure smooth acceleration or deceleration. The system also contains discrete states, such as "accelerating," "decelerating," or "cruising at a set speed."

4. **Dependability:**
   i. **Reliability:** Extended functionality ACC adapts to various driving conditions:
      a. Highway Driving: Maintains a steady speed and safe distance, reducing driver fatigue on long trips.
      b. Stop-and-Go Traffic: Automatically stops and starts your car, easing the stress of congested traffic.
      c. Night Driving and Adverse Weather: Enhances safety by maintaining optimal following distances, even in low-visibility conditions.
   j. **Availability:**
   k. **Safety:** Fault-tolerance mechanisms include redundancy in critical components such as multiple sensors (radar, LiDAR, cameras) to ensure functionality if one sensor fails.
   l. **Security:**

5. **Distributed Systems:** ACC system works with multiple other distributed system like braking system, throttle system and more concurrently.

Ajoke Sulaimon_Medical Devices

Medical Devices Application Domain

These are examples of medical devices and their embedded characteristics.

1. Pacemaker

- Characteristics:
    - o Real-time system: Detects and corrects abnormal heart rhythms within milliseconds.
    - o Dependable system: Adheres to safety standards and works when needed
    - o Hybrid system: Continuously monitors heart activity (continuous) and delivers discrete electrical impulses when irregularities are detected.

2. Infusion Pump

- Characteristics:
    - o Reactive system: Adjusts medication flow based on feedback from sensors or user settings.
    - o Dependable system: Precision control prevents overdoses, with safety mechanisms like alarms for occlusion or air bubbles.
    - o Real-time system: Ensures accurate delivery of medication within strict time constraints.

3. Ventilator

- Characteristics:
    - o Reactive system: Monitors a patient's breathing pattern and adjusts airflow and oxygen delivery instantly.
    - o Continuous system: Operates uninterrupted to maintain stable respiratory function.
    - o Distributed system: Connects to hospital monitoring networks for remote observation and control.

4. Defibrillator

- Characteristics:
    - o Real-time system: Delivers life-saving electrical shocks instantly when cardiac arrest is detected.
    - o Dependable system: Features self-check routines and fault-tolerant components to ensure operation when needed.
    - o Discrete system: Operates only when a triggering event (e.g., abnormal rhythm) occurs.

5. Imaging Systems (e.g., MRI, CT Scanners)

- Characteristics:
    - o Hybrid system: Collects continuous data during scanning and processes it in discrete intervals for image reconstruction.
    - o Real-time system: Provides immediate feedback to technicians during scans.
    - o Dependable system: Complies with strict safety standards to prevent excessive radiation exposure (e.g., IEC 60601).

Zahra Mahdion_7221957_Space Mission

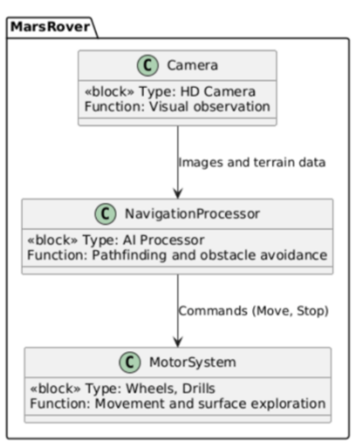
Space Mission Application Domain

These are examples of space mission systems and their embedded characteristics:

1. **Mars Rover Navigation System**
    - Characteristics:
        - Reactive system: Detects obstacles like rocks and adjusts its path autonomously.
        - Dependable system: Uses redundant sensors and fault-tolerant hardware to ensure reliable operations.
        - Hybrid system: Continuously analyzes terrain data and makes discrete decisions to navigate or stop.
2. **Rocket Launch Control System**
    - Characteristics:
        - Real-time system: Manages critical timing events like booster separation with millisecond precision.
        - Dependable system: Implements redundant control systems and real-time fault detection to avoid catastrophic failures.
        - Discrete system: Executes predefined commands at specific stages during the launch.
3. **Satellite Attitude and Orbit Control System (AOCS)**
    - Characteristics:
        - Continuous system: Monitors and adjusts orientation in real-time using gyroscopes and thrusters.
        - Discrete system: Activates specific commands, like repositioning antennas or adjusting orbit, based on mission requirements.
        - Distributed system: Coordinates with Earth-based control centers and other onboard systems for synchronized operation.
4. **Deep Space Communication System**
    - Characteristics:
        - Reactive system: Adjusts signal strength and orientation based on feedback from Earth stations.
        - Dependable system: Uses error correction and radiation-hardened components to ensure data integrity over long distances.
        - Distributed system: Operates as part of a global network, including ground stations and spacecraft, to relay mission-critical data.

Mars Rover (Space Mission)

Block Diagram for Mars Rover



sequence Diagram for Mars Rover