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## Mini-project for Real Time Systems

**First Master IOT**

**2025-2026**

Here are 12 real-time system project ideas for your students, categorized by their primary real-time characteristics (Hard, Soft, or Firm).

### **Hard Real-Time Systems (Safety Critical)**

*Failures in these systems concern operational safety and have disastrous consequences.*

1. **Autonomous Drone Collision Avoidance:** Design a system that processes ultrasonic or LIDAR data to detect obstacles and command motors to stop or turn within microseconds.
2. **Anti-Lock Braking System (ABS) Simulation:** A system that monitors wheel speed sensors and modulates brake pressure at a high frequency to prevent skidding during emergency stops.
3. **Medical Infusion Pump Controller:** A device that precisely controls the dosage of medicine delivered to a patient. It must prioritize heartbeat monitoring and occlusion (blockage) alarms over the user interface.
4. **Factory Robotic Arm Synchronizer:** Coordinate multiple robotic joints to move simultaneously. If one joint misses its deadline, the arm could collide with itself or workers.

### **Soft Real-Time Systems (Performance Optimized)**

*Missing a deadline occasionally is acceptable, and usefulness decreases gradually with tardiness.*

5. **Smart Greenhouse Monitor:** A system that reads temperature and humidity every few minutes (synchronous/time-driven) to trigger irrigation or ventilation.
6. **Real-Time Video Surveillance Streamer:** Capturing and compressing video frames. A missed frame results in a "glitch" but doesn't crash the system.
7. **Adaptive Traffic Light Controller:** Uses road-embedded sensors to detect cars (asynchronous/event-driven) and adjust light timing to optimize traffic flow.
8. **Nuclear Power Plant Monitoring Dashboard:** A system that collects data from thousands of sensors (temperature, pressure, radiation) and displays them to operators every second.

### **Firm Real-Time Systems (Time-Sensitive Utility)**

*Missing a deadline is tolerable, but the result becomes useless immediately after the deadline.*

9. **Online Auction Sniper:** A system that must place a bid in the final milliseconds before an auction closes. If the bid is late, it has zero value.
10. **High-Frequency Stock Trading Bot:** Analyzes market data to execute trades. Since market

conditions change instantly, a late trade is a "false result" and can lead to financial loss.

11. **Smart Parking Reservation System:** Coordinates real-time sensor data from parking spots with a mobile app. If the "available" status is updated too late, a driver may arrive at a full spot.
12. **Anti-Missile Defense Interceptor:** A system that calculates the trajectory of an incoming projectile. The calculation must be finished before the interceptor reaches the target; otherwise, the impact is missed.

## Project Requirements for Students

To ensure students apply all course concepts, each project should require:

- **Task Identification:** Defining at least 3 tasks with specific Periods (P), Execution Times (C), and Deadlines (D).
- **Scheduling Analysis:** Justifying the use of a specific algorithm like **Fixed Priority** or **EDF**.
- **Synchronization Strategy:** Using **Mutexes** or **Semaphores** to protect shared resources (e.g., sensor data in memory).
- **Communication Model:** Using **Message Queues** or **Shared Memory** to pass data between the sensing and acting tasks.