Main ESP32 Functional Architecture (Control Processor)

Layer 4: Touch/Tone Input
- Touch Input Handler
- Dual-Tone Detector (2800 Hz)

Layer 4 Functions:
- Touch sensor debouncing
- 2800 Hz tone detection
- Dual-tone window validation

Touch Event

Tone Detected

Layer 1: State Management Core
- Entry/Exit Actions
- Guard Evaluator
- FSM Controller (IDLE/CAL/MAZE/SOS)

Layer 1 Functions:
- FSM state management
- Guard condition evaluation
- Entry/exit action execution

Guard Evaluation

NAVCON

Enable/Suspend

State Transitions

Timeout Events

Sensor Data

Motion Commands

Layer 2 Functions:
- Color-based navigation rules
- Angle-based navigation rules
- Motion primitive generation
- Kinematic feedback processing

Layer 2: Navigation Decision (NAVCON)
- Color Rule Engine
- Angle Rule Engine
- Motion Primitive Gen
- Kinematic Feedback Proc

Layer 5: Supervision & Diagnostics
- QTP Test Hooks
- Episode Data Logger
- Watchdog Timers
- Timing Budget Monitor

Layer 3: Communication Protocol
- Timing Discipline
- SPI Telemetry Encoder
- SCS Frame Decoder
- SCS Frame Encoder

Layer 3 Functions:
- SCS frame encode/decode
- UART communication (19200 baud)
- SPI telemetry encoding (200 Hz)
- Anti-spam timing discipline

Timing Data

Telemetry Packets

Layer 5 Functions:
- Timing budget monitoring
- Watchdog timers (SS/MDPS)
- Episode state logging
- QTP test hook integration