Smart IoT-Based Medication Box Reminder: Progress Report

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Project Progress
The project is at 50% completion. Key hardware components—ESP32, 4 LEDs, buzzer, servo motor, and ultrasonic sensor—are installed and functioning. The GitHub repository is in active use, and main features such as timed LED-buzzer alerts and ultrasonic-triggered servo opening are operational. PID control is applied to manage servo motion smoothly.

Mathematical Enhancements
Fourier analysis is used to identify noise and periodic patterns in ultrasonic data, guiding the design of basic filtering methods. Laplace transforms are applied to model the servo system, perform initial stability checks, and tune PID parameters based on transfer functions.

Challenges and Roadblocks
The servo occasionally vibrates when returning to its position. The ultrasonic sensor shows inconsistent readings at times. ESP32 COM port connection errors have disrupted uploads. Power demand during buzzer and servo activation suggests the need for more reliable power regulation.

Hardware Status
All planned components are integrated. Wiring is functional but will be revised for better organization. Servo and ultrasonic sensor performance are under review. Power usage during peak operations has been noted for optimization.

Data Collection Plan
Sensor data will be recorded in CSV format. Preprocessing will include outlier removal and smoothing filters. Data will be validated manually and stored locally, with the option for cloud-based backup later in development.

Remaining Timeline

Over the span of five weeks, the project progressed from enhancing core functionality to finalizing the complete system. Key improvements included integrating ultrasonic-triggered servo and buzzer responses, optimizing control systems with PID, and applying Fourier and Laplace analyses for signal and system modeling. The final weeks focused on rigorous testing, data validation, and comprehensive documentation to prepare for presentation.

Table 1

Five-Week Development Timeline for Smart IoT-Based Medication Box Reminder

Week	Duration	Key Activities and Milestones
Week 1	Functionality Enhancement	Improved LED timer logic, added buzzer alerts, refined servo movement and integration.
Week 2	Sensor and Control System Enhancement	Tuned PID control, linked ultrasonic sensor to servo and buzzer for responsive actions.
Week 3	Mathematical Optimization	Applied Laplace transforms for servo modeling, used Fourier to analyze signal patterns.
Week 4	Testing and Data Collection	Collected and validated sensor data, performed performance checks, identified issues.
Week 5	Documentation and Finalization	Final wiring review, updated codebase, completed documentation and final presentation.