Case Study: Low-Cost Smart Home Automation Project (Pakistan)

GIBES INOV – Embedded R&D and Prototyping Solutions

Industry Overview

Educational R&D teams frequently face challenges in delivering robust, production-ready smart home automation solutions due to:

- Limited firmware stability and poor WiFi reliability.
- Unscalable and incomplete codebases.
- Lack of professional-grade documentation and project handover quality.

Client Background

A university engineering team sought GIBES INOV's support to stabilize, optimize, and professionally document their smart home automation project to compete at a national mechatronics contest.

Key Metrics

Metric	Before GIBES INOV	After GIBES INOV	Result (
System Reliability	Prone to WiFi dropouts	Stable 99% uptime	High Reli
Project Documentation	Incomplete	Clean, documented codebase	Simplified H
Contest Result	Finalist potential	1st Place (Mechatronics Category)	Secured V

Challenges & Constraints

- Firmware was unstable, prone to crashes, and lacked non-blocking architecture.
- Project documentation was incomplete, making handover difficult.

- The system required OTA updates and mobile control integration to meet contest standards.

GIBES INOV Solution Architecture

Hardware Implementation

- Leveraged the client's existing ESP32 modules for low-cost embedded solutions.
- Ensured all modules were compatible with OTA updates and mobile integration.

Control Logic & Firmware

- Rewrote firmware using state machines and RTOS principles for robust, non-blocking operation.
- Implemented a reliable OTA update mechanism to ensure easy future upgrades.
- Optimized WiFi management for uninterrupted connectivity.

UI/Data Visualization

- Developed a polished custom mobile application for intuitive control and real-time visualization.
- Included clear dashboards and feedback for end-user convenience.

Deliverables

- Cleaned and scalable C++ firmware.
- Detailed project documentation for easy handover.
- Mobile app integration guide with step-by-step setup instructions.

Implementation Timeline

- **Week 1–2:** Firmware rewriting, OTA mechanism implementation, and initial mobile app integration.
- **Week 3–4:** Testing, debugging, documentation, and final project handover.

Results & Impact

- Achieved stable system operation with 99% uptime.
- Project fully documented for simplified future maintenance and academic review.
- Team secured 1st place in the national mechatronics contest.

About GIBES INOV

GIBES INOV empowers educational and R&D teams with professional-grade embedded systems, ensuring robust solutions, clear documentation, and measurable project success.