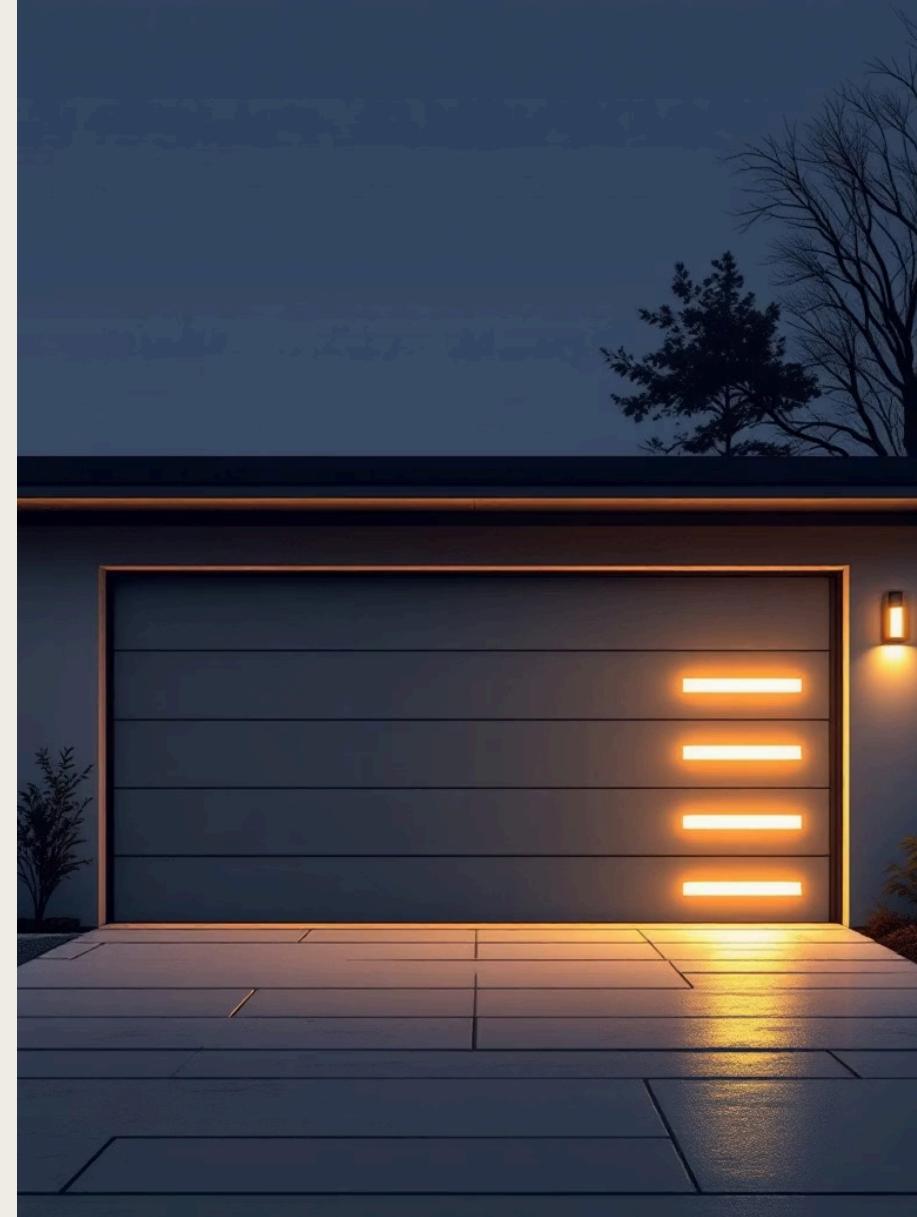


Smart Garage Door Control System

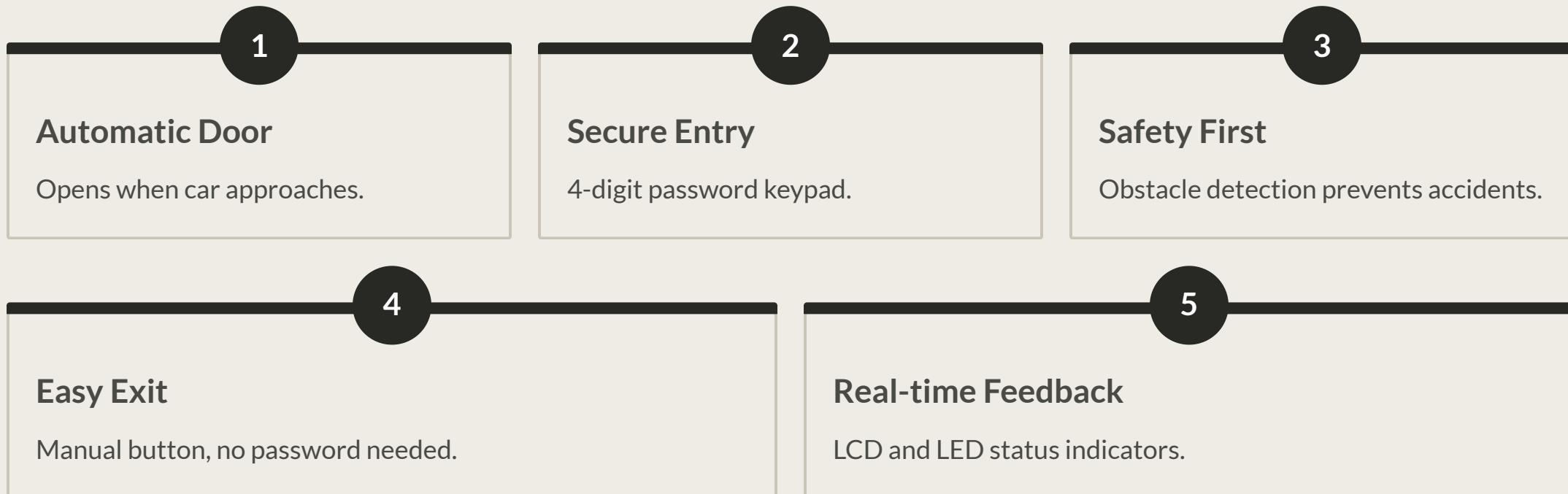
Automated garage access with password security and safety monitoring.

Built with PIC16F877A Microcontroller

Team: Anas Mohammad, Ahmed Elwakil, Hassan Mohammad, Abdulrahman Abo Mostafa, Ahmed Bahnasy, Mostafa Moheb, Ahmed M. Fayad

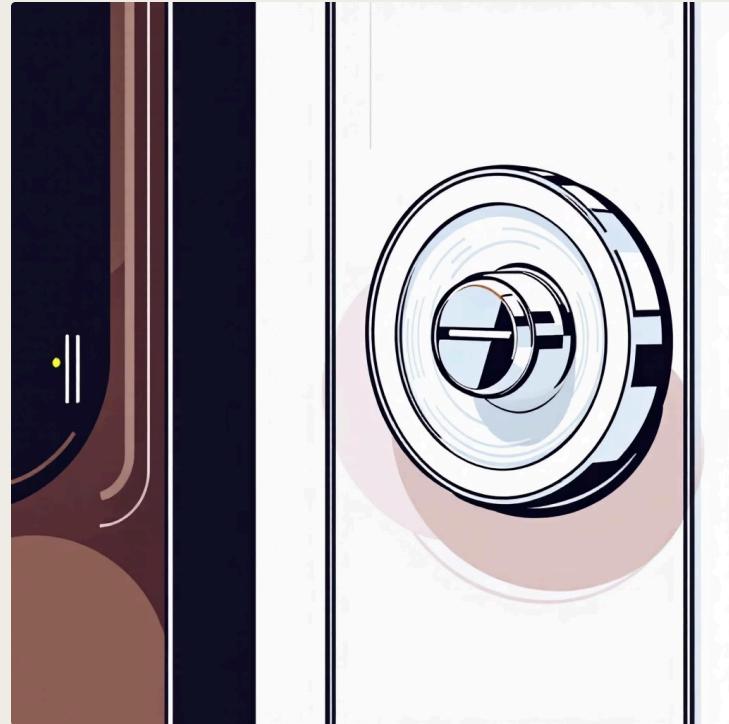


What We Built



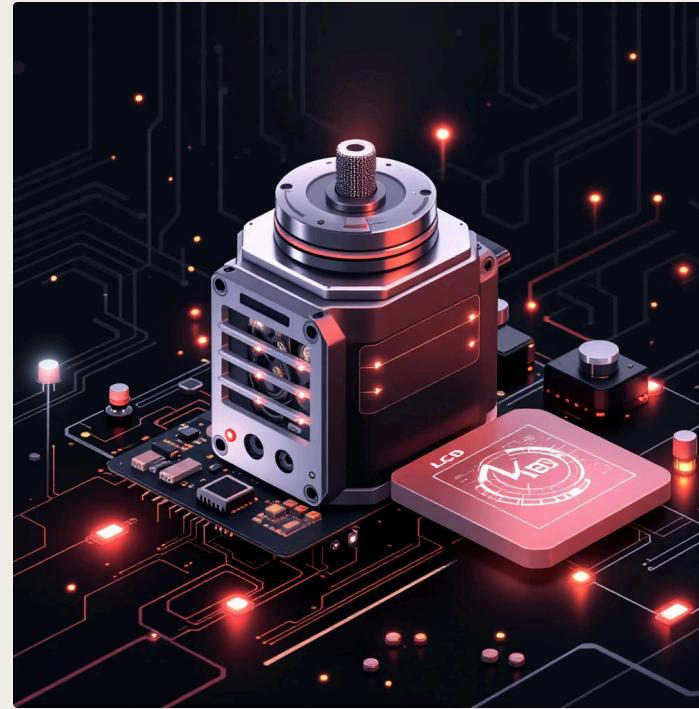
Core Technology: PIC16F877A microcontroller with state machine control.

Key Components



Sensing & Input

- 2× HC-SR04 Ultrasonic Sensors (entry & obstacle)
- 4×4 Matrix Keypad (password)
- Push Button (manual exit)



Control & Output

- PIC16F877A Microcontroller (brain)
- SG90 Servo Motor (door mechanism)
- 16×2 LCD Display (user feedback)
- Green/Red LEDs (visual status)

Total Cost: ~\$30-40 USD | Assembly Time: 2-3 hours



How It Works

1

Entry Mode

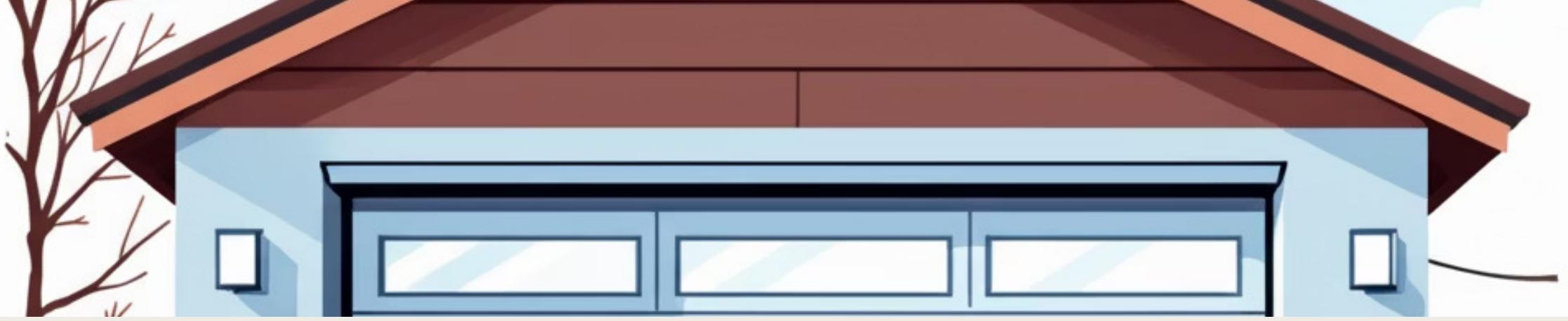
- Car detected (25cm)
- Enter 4-digit password
- Door opens to 90°
- Car passes, door auto-closes

2

Exit Mode

- Press EXIT button
- Door opens immediately
- Car clears, door auto-closes

Total cycle time: 20-30 seconds



Built-in Protection

Password Security

- 4-digit authentication
- 3 failed attempts → 60-sec lockout
- Real-time countdown

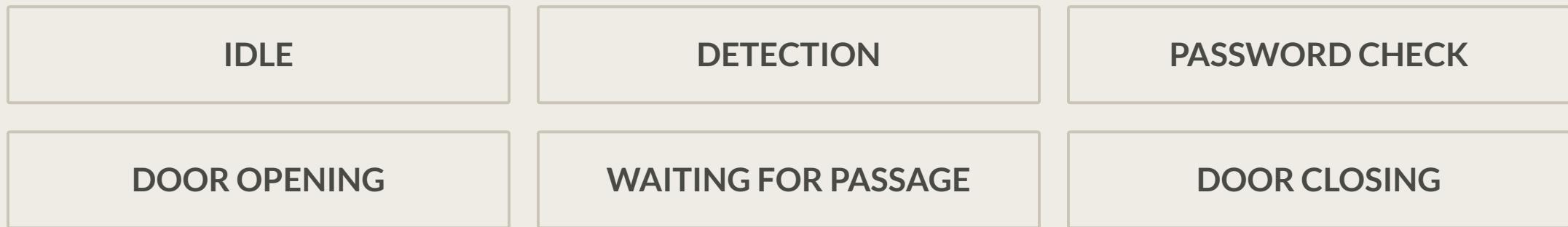
Physical Safety

- Inner sensor (15cm threshold)
- Door stops if obstacle detected
- 10-second open timeout

Edge Case Handling: System remains safe even with sensor failures.

Software Architecture

Control Strategy: State Machine



Key Algorithms

- Ultrasonic distance: $(\text{echo_time} \times 0.0343) / 2$
- Servo PWM control: 50 iterations @ 20ms
- Password validation & tracking

Resource Usage: 52% RAM | 31% ROM

Microcontroller Interface

PORTE	Status + Button	RE0 (green), RE1 (red), RE2 (button)
PORTE	Sensors + Servo	RC0-RC1 (outer), RC2-RC3 (inner), RC4 (PWM)
PORTE	LCD Data Bus	RD2 (RS), RD3 (EN), RD4-RD7 (D4-D7)
PORTE	Keypad Matrix	RB0-RB3 (cols), RB4-RB7 (rows)

Power Requirements: 5V DC @ 2A (servo peak: 500mA)



Multi-Layer Protection



Obstacle Detection

Inner sensor (<15cm) stops door closing. Door waits for clear path.



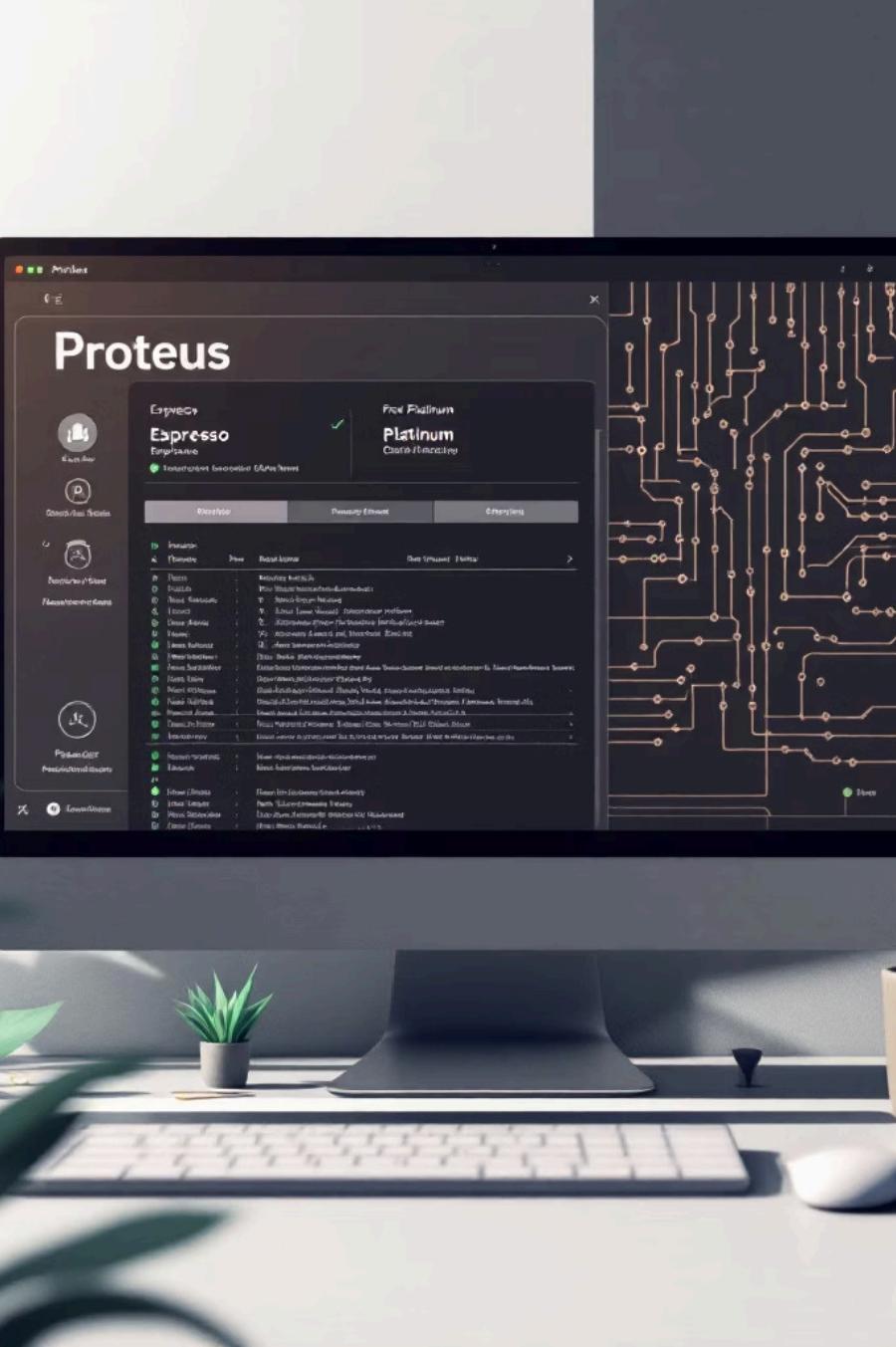
Timeout Protection

10-second window for passage.
Auto-recovery to safe state.



Lockout System

Prevents brute-force password attacks.



Validation Results

Proteus Simulation

- ✓ Full system verified
- ✓ All components responsive
- ✓ Edge cases tested

Hardware Status: Fully functional on breadboard prototype.

Performance Metrics

- Detection: 2-400cm range
- Door operation: ~5 seconds
- Response time: <100ms

Project Highlights

Achieved

- Complete embedded system
- Real-world safety features
- Modular code architecture
- Production-ready docs

Future Enhancements

- RFID card access
- Bluetooth/Wi-Fi control
- Multi-user password
- Entry/exit logging

Repository: https://github.com/AnasMohamed7/Smart_Garage.git

