🏠 Smart Home Automation System - User Guide

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Overview

Our Smart Home Automation System is a comprehensive web-based platform that allows you to monitor, control, and optimize your home's energy consumption in real-time. The system integrates with ESP32 microcontrollers and MQTT protocols to provide seamless device management and intelligent automation.

Key Features

- **Real-time Device Monitoring**: Track all connected devices instantly
- **Intelligent Auto-Off System**: Automatically turn off devices to save energy
- **Comprehensive Analytics**: Detailed graphs and statistics
- **Mobile-Responsive Design**: Works perfectly on all devices
- **Demo Mode**: Showcase functionality with realistic fake data
- **Energy Cost Calculations**: Track savings and consumption costs

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Dashboard Features

🏠 Main Dashboard

The dashboard provides a complete overview of your smart home system:

System Status Cards
- **Connected Devices**: Shows how many devices are currently online
- **Energy Saved**: Real-time calculation of money saved through automation

- **Auto-Off Events**: Number of devices automatically turned off today
- **Monthly Runtime**: Total device operation time this month

Live Device Grid

- **Device Cards**: Each connected device displays:
    - Device name and type (Light, Fan, TV, etc.)
    - Current status (ON/OFF)
    - Real-time power consumption
    - Toggle switch for manual control
    - Runtime information

Smart Controls

- **Refresh Button**: Update all device statuses
- **Device Manager**: Add, remove, or configure devices
- **Settings**: System configuration and preferences

Device Management

Device Types Supported

Our system supports various smart home devices:

1. **Lighting Systems**
    - Smart LED bulbs
    - LED strips
    - Smart switches
2. **Climate Control**
    - Smart fans
    - Air conditioners
    - Heaters
3. **Entertainment**
    - Smart TVs
    - Audio systems
    - Gaming consoles
4. **Kitchen Appliances**
    - Smart refrigerators
    - Microwaves
    - Coffee makers
5. **Security & Monitoring**
    - Smart cameras
    - Motion sensors

- o   Door locks

Device Configuration

Each device can be configured with: - **Custom Names**: Personalize device names - **Power Ratings**: Set accurate wattage for calculations - **Auto-Off Timers**: Configure automatic shutdown times - **Room Assignment**: Organize devices by location

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Analytics & Graphs

📊 Graphs & Analytics Page

Comprehensive visualization of your energy data:

Available Chart Types
1. **Line Charts**: Track consumption over time
2. **Bar Charts**: Compare device usage
3. **Pie Charts**: Show consumption distribution
4. **Area Charts**: Visualize usage patterns

Data Insights
- **Daily Patterns**: See when devices are most active
- **Weekly Trends**: Identify usage patterns throughout the week
- **Monthly Comparisons**: Track long-term consumption changes
- **Device Rankings**: Which devices consume the most energy

Export Features
- Download charts as images
- Export data to CSV
- Generate consumption reports

Data Monitoring

📈 Data Viewer

Real-time monitoring of all system data:

Live Data Streams
- **Device Status Updates**: Real-time ON/OFF states
- **Power Consumption**: Live wattage readings
- **Network Status**: MQTT connection health
- **System Performance**: Response times and reliability

Historical Data

- **Event Logs**: Complete history of device actions
- **Consumption Records**: Historical power usage data
- **Auto-Off Events**: Log of automatic shutdowns
- **System Alerts**: Notifications and warnings

Auto-Off System

🤖 Intelligent Automation

Our smart auto-off system helps save energy automatically:

How It Works
1. **Motion Detection**: Devices turn off when no motion detected
2. **Time-Based Rules**: Automatic shutdown after set periods
3. **Schedule-Based**: Turn off devices at specific times
4. **Smart Learning**: Adapts to your usage patterns

Configurable Settings
- **Timeout Periods**: Set custom auto-off delays
- **Room-Based Rules**: Different settings per room
- **Device Priorities**: Some devices never auto-off
- **Manual Overrides**: Temporarily disable auto-off

Energy Savings
- **Automatic Calculation**: System calculates energy saved
- **Cost Tracking**: Shows money saved in real currency
- **Monthly Reports**: Detailed savings summaries
- **Environmental Impact**: CO_2 reduction calculations

Energy Calculations

💰 How We Calculate Your Savings

Power Consumption Formula
```
Power Consumption (kWh) = Device Wattage × Hours Used ÷ 1000
```

Cost Calculation
```
Energy Cost = Power Consumption (kWh) × Electricity Rate (per kWh)
```

Savings Calculation
```
Money Saved = (Auto-Off Hours × Device Wattage ÷ 1000) × Electricity Rate
```

Example Calculation

- **Device**: 60W LED Bulb
- **Auto-Off Time**: 3 hours daily
- **Electricity Rate**: $0.12 per kWh
- **Daily Savings**: (3 × 60 ÷ 1000) × $0.12 = $0.0216
- **Monthly Savings**: $0.0216 × 30 = $0.648
- **Annual Savings**: $0.648 × 12 = $7.78

Mobile Support

⊞ Responsive Design

Our system works perfectly on all devices:

Mobile Features

- **Touch-Optimized Controls**: Easy device switching
- **Responsive Layout**: Adapts to screen size
- **Fast Loading**: Optimized for mobile networks
- **Gesture Support**: Swipe and tap interactions

Tablet Support

- **Grid Layout**: Multiple device cards visible
- **Split Screen**: View multiple sections simultaneously
- **Portrait/Landscape**: Works in both orientations

Desktop Experience

- **Full Dashboard**: Complete overview on large screens
- **Multiple Windows**: Open several sections at once
- **Keyboard Shortcuts**: Quick navigation and controls

Demo Mode

🎭 Showcase Features

Perfect for demonstrations and testing:

Demo Mode Features

- **Realistic Data**: 16 fake devices with authentic behavior
- **Historical Data**: 1000+ events for comprehensive testing
- **Live Simulations**: Devices appear to respond in real-time
- **Guest-Friendly**: No setup required for demonstrations

How to Access Demo Mode

1. **Settings Menu**: Click the settings gear icon
2. **Enter Password**: Use the demo password (protected)
3. **Instant Switch**: System immediately shows demo data
4. **24-Hour Session**: Stays active for full day

Demo Devices Include

- Living Room TV (120W)
- Bedroom Fan (75W)
- Kitchen Light (40W)
- Office AC (1500W)
- Smart Fridge (150W)
- Gaming Console (200W)
- And 10 more realistic devices!

Technical Architecture

🔧 System Components

Frontend Technology

- **React.js**: Modern web application framework
- **TypeScript**: Type-safe JavaScript
- **Material-UI**: Professional UI components
- **Responsive Design**: Mobile-first approach

Backend Integration

- **MQTT Protocol**: Real-time device communication
- **WebSocket**: Live data streaming
- **REST APIs**: Data management
- **Supabase**: Cloud database and authentication

Hardware Integration

- **ESP32 Microcontrollers**: Device connectivity
- **WiFi Communication**: Wireless device control
- **Sensor Integration**: Motion and environmental sensors
- **Smart Relays**: Device switching and control

Data Management

- **Real-time Database**: Instant data synchronization
- **Historical Storage**: Long-term data retention
- **Backup Systems**: Data protection and recovery
- **Analytics Engine**: Consumption pattern analysis

Getting Started

🚀 Quick Setup Guide

1. **Access the System**
   o Open your web browser
   o Navigate to the home automation dashboard
   o System works on any device with internet
2. **Explore Features**
   o **Dashboard**: Main overview of all devices
   o **Analytics**: Detailed consumption graphs
   o **Data Viewer**: Real-time monitoring
   o **Settings**: System configuration
3. **Try Demo Mode**
   o Click settings icon
   o Enter demo password
   o Explore with realistic fake data
   o Perfect for learning the system

💡 Tips for Best Experience

- **Regular Monitoring**: Check dashboard daily
- **Customize Settings**: Adjust auto-off timers
- **Review Analytics**: Monitor monthly patterns
- **Update Device Names**: Use descriptive names
- **Enable Notifications**: Stay informed of system status

Support & Maintenance

📞 System Health

The system includes comprehensive health monitoring: - **Connection Status**: MQTT and database connectivity - **Device Response**: Individual device health checks - **Performance Metrics**: System speed and reliability - **Error Logging**: Automatic issue detection

🔄 Regular Updates

- **Automatic Updates**: System updates itself
- **Feature Additions**: New capabilities added regularly
- **Security Patches**: Continuous security improvements
- **Performance Optimizations**: Faster, more efficient operation

Conclusion

This Smart Home Automation System represents the future of intelligent home management. With its comprehensive monitoring, intelligent automation, and user-friendly interface, it provides everything needed to create an efficient, cost-effective, and environmentally friendly smart home.

The system's combination of real-time monitoring, predictive automation, and detailed analytics makes it an invaluable tool for modern homeowners who want to take control of their energy consumption while enjoying the convenience of automated device management.

Document Version: 1.0
Last Updated: November 14, 2025
System Version: Latest

📋 Quick Reference

Key Statistics Dashboard Shows:

- **Connected Devices**: Real-time device count
- **Energy Saved**: Automatic savings calculation
- **Auto-Off Events**: Daily automation actions
- **Monthly Runtime**: Total device operation time

Main Navigation:

- 🏠 **Dashboard**: Main system overview
- 📊 **Analytics**: Graphs and detailed analysis
- 📈 **Data Viewer**: Real-time monitoring
- ⚙️ **Settings**: System configuration

Emergency Controls:

- **Manual Override**: Disable all automation
- **System Refresh**: Update all device statuses
- **Demo Mode**: Switch to demonstration data
- **Reset Settings**: Return to default configuration