Technische Hochschule Deggendorf

Faculty of Applied Computer Science

Master of Automotive Software Engineering

Mobile applications & interaction design in vehicles

Topic: Interior Light Control System

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Interior Light Control System

Overview:

The Interior Light Control System is a WiFi-enabled smart lighting solution designed for vehicle interiors. It intelligently controls cabin lighting based on ambient light levels and user-defined preferences via a rotary sensor. A mobile Android application provides real-time monitoring and manual control. This system is built using a **CC3200 LaunchPad** and a **Jetpack Compose-based Android application**.

This project demonstrates a practical use of **IoT and embedded systems** for enhancing user comfort and energy efficiency in automotive applications.

Problem Statement:

Traditional interior lighting in vehicles is either manually operated or triggered by door sensors, offering limited adaptability. Inconsistent lighting behavior can lead to:

- Inconvenient manual operation at night
- Unnecessary energy consumption when lights remain ON
- No remote control or status monitoring

The need arises for a smart, adaptive system that can automatically adjust to ambient light while still allowing manual override and remote monitoring through a mobile interface.

Target Users:

This solution is designed for:

- **Drivers of passenger cars**, especially those operating in varying lighting conditions
- **Rideshare drivers** who want automated comfort features
- **Vehicle hobbyists and engineers** building custom smart interiors
- Educational institutions teaching embedded systems and mobile development

System Components

Hardware

- **CC3200 LaunchPad**: WiFi-enabled microcontroller
- **Grove Light Sensor**: Measures ambient brightness
- **Grove Rotary Angle Sensor**: Selects manual/auto mode and threshold
- **Relay Module**: Switches the cabin light ON/OFF
- **Optional LED/Bulb**: Acts as the interior light
- **Power Source**: USB or vehicle 5V supply

Firmware (Energia Code)

- Starts a WiFi Access Point (LightControlAP)
- Serves REST API endpoints for mode/relay control and sensor data
- Implements automatic/manual/override logic for relay

Android App (Jetpack Compose)

- Connects to CC3200's WiFi AP
- Sends HTTP requests to control relay and mode
- Displays live light level, rotary input, mode, and relay state
- Offers a clean UI with theme toggle and connectivity status

Use Case Flow

Normal Auto Mode:

1. System powers on and defaults to **Auto mode**.
2. If ambient light is **below threshold**, relay is **activated** (light ON).
3. If ambient light is **above threshold**, relay is **deactivated** (light OFF).
4. Android app displays sensor values every 3 seconds.

Manual Mode:

1. User rotates the knob to enable manual mode.
2. Rotary value > threshold → relay turns ON.
3. Rotary value ≤ threshold → relay turns OFF.
4. Status is updated in the app.

Override Mode (Mobile Control):

1. User taps "Turn Relay ON/OFF (Override)" in the app.
2. Relay is toggled and override is activated.
3. System ignores sensor logic until /override?state=exit is triggered or reset.

Key API Endpoints

Endpoint	Function
/sensor	Returns JSON with current state
/relay?state=on	off
/mode?state=manual	auto
/override?state=exit	Cancels manual override

Benefits

- Hands-free operation with auto-light control

- Energy efficiency by preventing unnecessary light usage
- Real-time monitoring via Android app
- Manual override for safety and user preference
- Customizable threshold and mode selection using rotary sensor
- Standalone operation without internet—uses local WiFi AP

Future Enhancements

- Store user preferences with local memory or app storage
- Add biometric authentication before allowing override
- Implement Bluetooth fallback when WiFi is not available
- Include data logging for usage history or diagnostic

Android App Screenshots