Software Requirements Specification (SRS)
Smart Car Security System

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1. Introduction

1.1 Purpose

This document specifies the software requirements for an embedded application that monitors vehicle security and lighting conditions using an **ESP32 DevKit V1**, sending notifications via MQTT to Claude Cloud and a mobile app. The system detects motion, object proximity, temperature, and ambient light, providing visual alerts and automatic lighting control.

1.2 Scope

The scope of this project includes the embedded software running on the ESP32, responsible for:

- Peripheral configuration (ADC, GPIO, I2C).
- Data acquisition from sensors (MPU6050, Ultrasonic, LM35, LDR, GSM).
- Communication via Wi-Fi (MQTT) and optionally GSM (SIM800L)
- Sending real-time alerts to a mobile app.

1.3 Glossary

Term	**Definition**
ESP32	Microcontroller with Wi-Fi and Bluetooth support.
MQTT	Lightweight messaging protocol for IoT devices.
Blynk Cloud	Cloud service for receiving, processing, and distributing sensor data.
IMU (MPU6050)	Sensor for detecting vehicle motion or vibration.
Ultrasonic Sensor (HC-SR04)	Measures distance to nearby objects.
LM35	Temperature sensor for detecting high temperature / potential fire.
LDR	Light sensor for detecting ambient light to control headlights.
LED	Visual indicator for alerts.
SIM800L	GSM module for SMS/call alerts

2. Overall Description

2.1 Product Perspective

This system is a standalone embedded application using **ESP32**, directly interfacing with sensors and output devices. It processes sensor inputs, triggers alerts, controls headlights automatically, and communicates with Claude Cloud via MQTT or GSM.

2.2 User Characteristics

- Users interact with the system via a **SW Button** to enable or disable the system.
- Alerts and vehicle status are visible via **LEDs** and the mobile **App**.

2.3 System Constraints

- ESP32 operates at 3.3V logic level.
- Stable power supply required for reliable operation.
- ⍰ SIM800L requires 3.7–4.2V external supply.
- ⍰

3. Specific Requirements

3.1 Functional Requirements (FR)

ID	Description	Priority
FR-001	Continuously read IMU values to detect significant motion.	High
FR-002	Continuously read Ultrasonic Sensor to measure distance to nearby objects.	High
FR-003	Continuously read LM35 temperature sensor.	High
FR-004	Continuously read LDR for ambient light detection.	High
FR-005	Enter "Alert" state if motion, proximity, or high temperature is detected.	High
FR-006	Turn ON Alert LED when system is in "Alert" state.	High
FR-008	System can be toggled ON/OFF using SW Button.	High
FR-009	Send sensor data and alerts to Claude Cloud via MQTT.	High

ID	Description	Priority
FR-010	App receives real-time notifications and displays system status.	High
FR-011	Send SMS alert via GSM module when Wi-Fi/MQTT fails.	High
FR-012	Send fire alert (high temperature) via SMS immediately.	High

3.2 Interface Requirements

3.2.1 User Interface (Input)

Interface	Physical Source	ESP32 Pin	Software Function
System Toggle	Push Button	GPIO7	Toggles system ON/OFF
Motion Input	MPU6050 (I2C)	SDA → GPIO21, SCL → GPIO22	Detect vehicle motion/acceleration
Distance Input	Ultrasonic Sensor	Trig → GPIO9, Echo → GPIO10	Measure distance to nearby objects
Temperature Input	LM35	ADC → GPIO34	Detect high temperature
Light Input	LDR	ADC → GPIO35	Detect ambient light

3.3 Hardware Pin Assignments (ESP32 DevKit V1)

Component	**ESP32 Pin**	**Function**	**Notes**
SIM800L	GPIO16 , GPIO17	Provides backup communication and emergency alerting	• SMS alert on intrusion, proximity detection, or fire. • Works when Wi-Fi or MQTT is offline.
MPU6050	GPIO21 (SDA), GPIO22 (SCL)	I2C Communication	Motion sensor
Ultrasonic Sensor	GPIO12 (Trig), GPIO14 (Echo)	Distance Measurement	
LM35	GPIO4	ADC Input	Temperature sensor
LDR	GPIO34	ADC Input	Ambient light sensor
Power	3.3V / GND	Supply	ESP32 and sensors powered from 3.3V