**Functional Specification – Project "al-iman"**

**Pocket Prayer Assistant – ESP32-S3 Based**  
**Version**: 1.0  
**Date**: June 2025

**1. Project Overview**

**al-iman** is a smart, pocket-sized prayer companion built on the **ESP32-S3** to help Muslims monitor and enhance their prayer experience. It integrates a **color display**, **GPS**, and a **proximity sensor** to visually and functionally guide the user throughout daily salat.

The firmware should be optimized for:

* Fast startup
* Energy efficiency (sleep modes)
* Clear, minimal UI for spiritual focus

**2. Project Priorities**

| **Priority** | **Feature** |
| --- | --- |
| 🟥 High | **Prayer Counter (Rak‘ah & Sujood Detection)** |
| 🟧 Medium | Qibla Orientation (via GPS or fallback) |
| 🟨 Medium | Hadith of the Day (Multilingual) |
| 🟩 Low | Config Menu with Night Mode & Themes |

**3. Core Functionalities**

**3.1. Prayer Counter (Main Module)**

* Detect **sujood** via VL53L0X sensor (proximity below 10 cm)
* Track **rak‘ah count** based on sujood patterns (2 sujoods = 1 rak‘ah)
* Display:
  + Rak‘ah count (1 to 4)
  + Sujood status (first or second)
  + Current prayer status: **in progress**, **completed**
  + **Icons** for each posture: standing, bowing, prostration

**3.2. Qibla Orientation**

* Uses GPS coordinates to calculate direction to Makkah
* Displays a rotating arrow pointing to Qibla
* Caches last known location in case of GPS unavailability

**3.3. Hadith of the Day**

* 20+ daily hadiths per language (FR, EN, AR, IT)
* Selected by day of year (modulo)
* Appears after boot or on demand

**3.4. Config Menu**

* Language selection
* Night mode (auto/manual)
* Wallpaper (day/night)
* Buzzer volume
* Auto-sleep timer (30s, 1m, 5m)

**3.5. Display Manager**

* 240x240 ST7701S LCD
* Image switching based on night mode
* Font rendering (basic 8x8 + extended support)
* Icons for:
  + GPS fix status
  + Night/day theme
  + Buzzer level
  + Settings

**4. Hardware Summary**

| **Component** | **Model** |
| --- | --- |
| Microcontroller | ESP32-S3 |
| Display | ST7701S (RGB 240x240) |
| Distance Sensor | VL53L0X via I²C (0x29) |
| GPS Module | NEO-6M or compatible |
| Audio | Buzzer (GPIO driven) |
| Storage | Internal Flash + NVS |
| Power Management | Sleep mode supported |

**5. Software Guidelines**

* Framework choice is **left to developer discretion**:
  + ESP-IDF only
  + Arduino core
  + Mixed (hybrid ESP-IDF + Arduino)
* Requirements:
  + Fast boot (< 2 sec)
  + Non-blocking tasks where possible
  + Responsive, flicker-free display
  + Persistent settings using NVS or similar

**6. Icons & UI Elements**

| **Icon** | **Purpose** |
| --- | --- |
| 🙇 Ruku‘ | Bowing posture |
| 🧍 Qiyām | Standing posture |
| 🤲 Sujood | Prostration (1st / 2nd) |
| 🔢 Rak‘ah | Display number from 1 to 4 |
| 🧭 Qibla Arrow | Rotation based on angle to Makkah |
| 🌙 Night Mode | Indicate active dark mode |
| 🌞 Day Mode | Indicate light theme |
| 📡 GPS | Fix status icon |
| 🗓️ Date | Gregorian or Hijri (optional) |
| ⚙️ Settings | Access to configuration menu |
| 🔊 Buzzer | Mute / Low / High |

All icons should be designed in 32x32 or 48x48 pixels (preferably indexed bitmaps for performance) except for PRYER ICONS that shall be 96x96.

