

กรณีใช้เทคโนโลยีดิจิทัล (เอกสารแนบ C)

ASLAN Physical AI Agent

Complete Hardware & Software Architecture Specification

Document Version 3.0 | Engineering Release | January 2026

BOI 8.2.12 - Smart Electronics

Tuya IoT Platform

Edge AI + Cloud AI

10,000

Production Units

52

Component Types

5

AI Agents

240MHz

CPU Dual-Core

1 TOPS

AI Performance

~8 hrs

Battery Life



HARDWARE COMPONENTS

SENSORS & INPUT

MEMS Microphone Array

INMP441ACEZ

x4

Package: LGA-6 (4.72x3.76mm)

SNR: 61dB | **Sensitivity:** -26dBFS

Interface: I2S Digital | **Voltage:** 1.8-3.3V

PIR Motion Sensor

AM312 / EKMB1101111

x2

Detection: 3-5m, 100° cone

Response: <1s | **Current:** <20µA standby

Output: Digital 3.3V | **Size:** 10x10mm

Capacitive Touch IC

x1

MPR121OR2

Package: QFN-20 (3x3mm)

Channels: 12 electrodes

Interface: I2C 400kHz | **Voltage:** 1.71-3.6V

Ambient Light Sensor

x1

BH1750FVI-TR

Package: WSOF-6 (3.0x1.6mm)

Range: 1-65535 lux | **Accuracy:** ±20%

Interface: I2C | **Resolution:** 16-bit

Temp/Humidity Sensor

x1

SHTC3-TR-10KS

Package: DFN-4 (2x2mm)

Accuracy: ±0.2°C, ±2% RH

Interface: I2C | **Current:** 0.5µA sleep

6-Axis IMU

x1

MPU-6050

Package: QFN-24 (4x4mm)

Gyro: ±2000°/s | **Accel:** ±16g

Interface: I2C/SPI | **ADC:** 16-bit

ACTUATORS & OUTPUT

I2S Audio DAC/Amp

x2

MAX98357AETE+T

Package: TQFN-16 (3x3mm)
Output: 3.2W @ 4Ω | **THD+N:** 0.015%
Interface: I2S | **Voltage:** 2.5-5.5V

Speaker Driver

x2

40mm Full Range 5W / 4Ω

Frequency: 300Hz-20kHz
SPL: 85dB @ 1W/1m
Magnet: Neodymium | **Cone:** Paper

RGB LED Matrix (Eyes)

x2

WS2812B-2020

Matrix: 8x8 (64 LEDs per eye)
Package: 2020 (2x2mm per LED)
Protocol: Single-wire 800kbps NRZ

LED Driver IC

x1

TLC5940NT

Package: HTSSOP-28
Channels: 16 PWM | **Resolution:** 12-bit
Current: 120mA/ch | **Dot Correction:** 6-bit

Digital Servo Motor

x4

MG90S Metal Gear

Torque: 2.2kg-cm @ 4.8V
Speed: 0.1s/60° | **Angle:** 180°
Gear: Metal | **Weight:** 13.4g

Haptic Driver + LRA

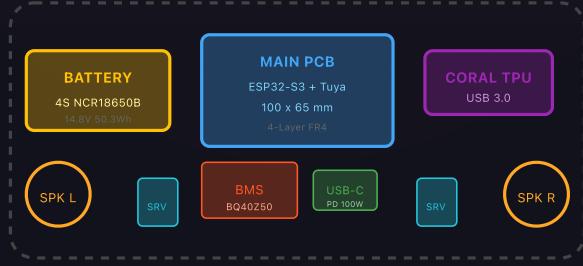
x1

DRV2605LDGSR + LRA

Package: VSSOP-10
Effects: 123 ROM patterns
Interface: I2C | **LRA:** 10mm coin

ASLAN AI GUARDIAN - FRONT VIEW





PROTOTYPE REFERENCE



Physical AI Agent Mascot Design - Production Prototype



PROCESSING & CONNECTIVITY

MAIN PROCESSING UNIT

Main MCU

x1

ESP32-S3-WROOM-1-N16R8

CPU: Xtensa LX7 Dual-Core 240MHz**Flash:** 16MB QSPI | **PSRAM:** 8MB Octal**Package:** 25.5x18mm module**GPIO:** 45 programmable | **ADC:** 2x 12-bit SAR

AI Accelerator (NPU)

x1

Google Coral USB Accelerator

Chip: Edge TPU (ASIC)**Performance:** 4 TOPS (int8)**Interface:** USB 3.0/2.0 | **Power:** 2W**Models:** TensorFlow Lite Quantized

External Flash

x1

W25Q128JVSIQ

Package: SOIC-8 (208mil)**Capacity:** 128Mbit (16MB)**Interface:** SPI 133MHz | **Voltage:** 2.7-3.6V

WIRELESS COMMUNICATION

WiFi (Built-in ESP32-S3)

x1

802.11 b/g/n 2.4GHz

TX Power: 20.5dBm | **RX:** -97dBm**Security:** WPA3 | **Mode:** STA/AP/Mesh**Antenna:** PCB trace + u.FL connector

Bluetooth (Built-in)

x1

BLE 5.0 + Classic BT

BLE: 2Mbps PHY | **Range:** 400m (LoS)**Features:** Mesh, Long Range, Advertising Ext.**Profiles:** GATT, SPP, HID

Tuya IoT Module

x1

NBR3 (BK7231N)

WiFi: 802.11 b/g/n | **BLE:** 5.2**Flash:** 2MB | **Package:** 16x24mm

Protocol: Tuya Smart, MQTT, CoAP
Cloud: Tuya IoT Platform

POWER MANAGEMENT

Li-ion Battery Cell

x4

NCR18650B (Panasonic)

Capacity: 3400mAh | **Voltage:** 3.6V nom.
Config: 4S1P (14.8V 3400mAh)
Energy: 50.3Wh total

BMS + Charger IC

x1

BO40Z50RSMT-R1

Package: VQFN-32 (5x5mm)
Config: 2S-4S | **Accuracy:** 1%
Features: SOC, Balancing, Protection
Comm: SMBus/I2C

USB-C PD Controller

x1

FUSB302BMPX

Package: MLP-14 (2.5x2.5mm)
PD: Rev 3.0 | **Power:** Up to 100W
Interface: I2C | **CC Logic:** Built-in

DC-DC Buck (5V)

x1

TPS562201DDCR

Package: SOT-23-6
Input: 4.5-17V | **Output:** 5V/2A
Efficiency: 95% | **Freq:** 580kHz

LDO 3.3V

x2

AP2112K-3.3TRG1

Package: SOT-23-5
Output: 3.3V/600mA | **Dropout:** 250mV
PSRR: 70dB | **Noise:** 50µV RMS

Tuya IoT Smart Device Platform Integration



Connectivity

Module: Tuya WBR3 (BK7231N SoC)

WiFi: 802.11 b/g/n 2.4GHz

BLE: 5.2 for provisioning & control

Protocol: MQTT over TLS 1.3

OTA: Secure firmware updates

Cloud Services

Platform: Tuya IoT Development Platform

Region: Southeast Asia (Singapore DC)

API: RESTful + WebSocket

Integration: Alexa, Google Home, SmartThings

Analytics: Real-time device telemetry



Mobile App

SDK: Tuya Smart App SDK

Platforms: iOS 12+ / Android 5.0+

Features: Voice control, Scenes, Automation

Pairing: EZ Mode / AP Mode / BLE

Push: Real-time alerts & notifications

Embedded Software Stack

Operating System

FreeRTOS

v10.5.1 (ESP-IDF bundled)

Real-time OS with SMP support

ESP-IDF

v5.1.2

Espressif IoT Development Framework

Partition Table

Custom 16MB layout

OTA A/B, NVS, SPIFFS, Model

Communication

Tuya IoT SDK

v2.0.0

Device connectivity & cloud sync

MQTT Client

esp-mqtt v1.3.0

Pub/Sub to cloud AI agents

mbed TLS

v3.4.0

TLS 1.3, X.509, ECDSA

HTTP/2 Client

nghttp2

REST API communication

AI/ML Runtime

TensorFlow Lite Micro

v2.14.0

On-device ML inference

Edge Impulse SDK

v1.42.0

Wake word, keyword spotting

ESP-SR

v1.4.0

Thai speech recognition (AFE)

libedgetpu

v2.0

Coral TPU inference runtime

Audio & Media

ESP-ADF

v2.6

Audio Development Framework

Opus Codec

v1.4

Audio compression for streaming

LED Strip Driver

RMT peripheral

WS2812B 800kbps protocol

LVGL

v8.3

LED matrix animation engine

System Architecture & Data Flow



Bill of Materials (BOM) - Per Unit

#	Component	Part Number	Package	Qty	Unit (THB)	Total	Supplier
SENSORS & INPUT DEVICES							
1	MEMS Microphone I2S	INMP441ACEZ	LGA-6 4.72x3.76mm	4	95	380	Mouser / DigiKey
2	PIR Motion Sensor	AM312	Module 10x10mm	2	35	70	Local / AliExpress
3	12-Ch Touch Controller	MPR121QR2	QFN-20 3x3mm	1	85	85	Mouser / DigiKey
4	Ambient Light Sensor	BH1750FVI-TR	WSOF-6 3x1.6mm	1	45	45	Mouser
5	Temp/Humidity Sensor	SHTC3-TR-10KS	DFN-4 2x2mm	1	120	120	DigiKey / Sensirion
6	6-Axis IMU	MPU-6050	QFN-24 4x4mm	1	95	95	Mouser / InvenSense
Sensors Subtotal:						795	
PROCESSING & MEMORY							
7	Main MCU Module	ESP32-S3-WROOM-1-N16R8	Module 25.5x18mm	1	320	320	Espressif / Mouser
8	AI Accelerator TPU	Coral USB Accelerator	USB Dongle	1	2,400	2,400	Google Coral
9	External Flash 16MB	W25Q128JVSIQ	SOIC-8 208mil	1	55	55	DigiKey / Winbond
10	MicroSD Card Slot	DM3AT-SF-PEJM5	Push-Push SMD	1	35	35	Hirose / DigiKey
11	MicroSD Card 32GB	SanDisk Industrial	MicroSD	1	380	380	SanDisk
Processing Subtotal:						3,190	
IoT CONNECTIVITY							
12	Tuya WiFi+BLE Module	WBR3 (BK7231N)	Module 16x24mm	1	85	85	Tuya / AliExpress

#	Component	Part Number	Package	Qty	Unit (THB)	Total	Supplier
13	2.4GHz Chip Antenna	ANT-2.4-CHP-T	SMD 6.5x2.2mm	2	25	50	Linx / DigiKey
IoT Subtotal:						135	
ACTUATORS & OUTPUT							
14	I2S Audio DAC/Amp	MAX98357AETE+T	TQFN-16 3x3mm	2	105	210	Mouser / Maxim
15	Speaker 5W 4ohm 40mm	AS04008PS-2-R	40mm Driver	2	130	260	PUI Audio / DigiKey
16	RGB LED (Eyes) 2020	WS2812B-2020	2020 SMD	128	2.5	320	WorldSemi / LCSC
17	LED PWM Driver 16-Ch	TLC5940NT	HTSSOP-28	1	85	85	TI / DigiKey
18	RGB LED Strip 1m	WS2812B IP30 60/m	Strip 1m	1	280	280	Local / AliExpress
19	Digital Servo Motor	MG90S Metal Gear	Micro Servo	4	75	300	TowerPro / Local
20	Haptic Driver IC	DRV2605LDGSR	VSSOP-10	1	65	65	TI / DigiKey
21	LRA Vibration Motor	G0832012D	Coin 8x3.2mm	1	45	45	Jinlong / AliExpress
Actuators Subtotal:						1,565	
POWER MANAGEMENT							
22	Li-ion Battery Cell	NCR18650B	18650 Cylindrical	4	320	1,280	Panasonic / EVE
23	Smart BMS IC 4S	BQ40Z50RSMT-R1	VQFN-32 5x5mm	1	280	280	TI / DigiKey
24	USB-C PD Controller	FUSB302BMPX	MLP-14 2.5x2.5mm	1	95	95	onsemi / DigiKey
25	DC-DC Buck 5V 2A	TPS562201DDCR	SOT-23-6	1	35	35	TI / DigiKey
26	LDO 3.3V 600mA	AP2112K-3.3TRG1	SOT-23-5	2	12	24	Diodes Inc / DigiKey

#	Component	Part Number	Package	Qty	Unit (THB)	Total	Supplier
27	USB-C Receptacle	USB4110-GF-A	SMD Mid-mount	1	55	55	GCT / DigiKey
28	Battery Holder 4x18650	BH-18650-PC	Plastic Holder	1	55	55	Local Supplier
Power Subtotal:						1,824	
PCB & CONNECTORS							
29	Main PCB 4-Layer	Custom FR4 1.6mm	100x65mm ENIG	1	480	480	JLCPCB / PCBWay
30	Sensor Sub-PCB 2-Layer	Custom FR4 1.0mm	40x30mm HASL	3	95	285	JLCPCB
31	FPC Cable Set	Custom 0.5mm pitch	Various lengths	1	220	220	Local / AliExpress
32	Connectors JST/Molex	Mixed Set	Various	1	280	280	Local Supplier
33	Passive Components	R/C/L/D Kit 0402/0603	SMD Kit	1	180	180	LCSC / Local
PCB Subtotal:						1,445	
ENCLOSURE & MECHANICAL							
34	Main Body Shell ABS	Custom Injection Mold	220x160x80mm	1	920	920	Local Manufacturer
35	Plush Fabric Cover	Premium Polyester	Custom Sewn	1	480	480	Local Supplier
36	Speaker Grill Mesh	Steel Mesh Powder Coated	40mm Circle	2	40	80	Local Supplier
37	Mounting Hardware	M2/M3 Screws, Standoffs	Set	1	95	95	Local Supplier
38	Rubber Feet Anti-slip	SJ5302 Clear	12.7mm Bumper	4	10	40	3M / DigiKey
Enclosure Subtotal:						1,615	
ASSEMBLY & QA							
39	SMT Assembly Service	Pick & Place	-	1	380	380	JLCPCB SMT

#	Component	Part Number	Package	Qty	Unit (THB)	Total	Supplier
40	Final Assembly Labor	Manual Assembly	-	1	280	280	In-house
41	Functional Test + QC	Full Test Suite	-	1	180	180	In-house
42	Firmware Flash + Config	Production Image	-	1	60	60	In-house
Assembly Subtotal:							900
PACKAGING & ACCESSORIES							
43	Gift Box Premium	Custom Cardboard	280x200x120mm	1	220	220	Local Supplier
44	USB-C Cable 1m PD	60W Rated	Braided	1	95	95	Local Supplier
45	User Manual + QSG	Printed Booklet	A5 Color	1	30	30	In-house Print
46	Warranty Card	1 Year Coverage	Card	1	12	12	In-house
Packaging Subtotal:							357
TOTAL COST PER UNIT:							11,826 THB
PRODUCTION (10,000 units):							118,260,000 THB
Bulk Discount (-15%):							100,521,000 THB

220mm

Height

160mm

Width

80mm

Depth

~450g

Weight

14.8V**50.3Wh**

Battery (4S)

Energy

ASLAN AI GUARDIAN PLATFORM

Complete Hardware & Software Architecture Document v3.0
BOI Category 8.2.12 - Smart Electronics | Tuya IoT Platform Integration
ASLAN WEALTH COMPANY LIMITED | January 2026

46 Component Types | 52 Total Parts | Production Ready