Low-Power Edge AI

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Low-Power AI Portfolio

LPAI Vision + Audio

Katana

Low-Power Edge AI: Vision + Audio

Katana 2.0

FY23 – FY25

LPAI Audio & Voice DSP

DBMD7

High Performance Audio DSP

DBM10L

Low-Power Audio Edge AI

DBM11

DBMD2/8/8D

DBMD4

Low-Power AI Applications

Smart Building

People counting
Space utilization management
Compliance (e.g. smoking, masks)

Industry 4.0

Meter auto-reading
Predictive maintenance
Track and trace / Asset monitoring
Sound / Vision event detection

Smart Home/Security

User detection
Sound event detection (SED)
Voice communication
Voice control
Biometric voice authentication

Ambient Assisted Living

Fall/mobility detection
Wellbeing tracking
Sound event detection (SED)
Voice communication

Smart Appliances

Voice control
Condition monitoring
Smart alerts
Biometric voice authentication

Consumer Electronics

Voice control
Voice communication
Visual wake-up
Biometric voice authentication

LPAI Audio / SmartVoice

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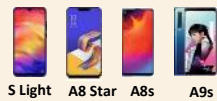# Products integrating **SmartVoice Solutions**

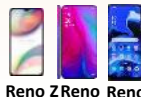> 40 Vendors

>100 products

> 100Mu shipped

Smartphone

SAMSUNG
S7   S7 Edge   S7   A8 A8+
S Light Luxury   A8 Star   A8s   A9s
A9   A9 Pro   A9 Star   A9 StarLite

OPPO
Reno Z   Reno   Reno2
Realme X2   K5

GENERAL MOBILE
GM9Pro

Sugar
S11

meitu
T9

Tablet

SAMSUNG
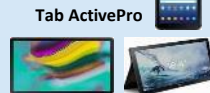Tab ActivePro
Tab-S5e   Tab-View2
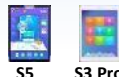Tab-A10.5   Tab-S4

FUJITSU
Bonito

YouXuePai 优学派
Umix6   U36

BBK
S5   S3 Pro

iFLYTEK
Office Smart

TCL

Lenovo
Smart Tab P10/M10   TB-X605F

Yoga Smart-Tab   M8 Smart-Tab

Speaker

Pioneer
F4

Sirena TECHNOLOGIES

HANSONG
Microdot XS

ONKYO
P3

LIBRE
MAVID   LS5BV

de Play-Fi
phorus
PS10

DSPG 3-mic Ref Kit

ue ULTIMATE EARS

MSC
HARMAN
ZOE

Portronics
Alexa Adapter

Wearable

SAMSUNG
Gear S2
Gear Sport

amazon
Echo Frames

breo
issex   idreamX

blueparrott
Jabra GN
B550

TATUNG
Aston Two

SKG
Cervical Massager

NORTEK
Nortek Libris 2.0

IoT

GoPro
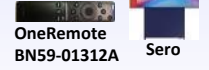Hero6   Hero7   Hero8   Max

arlo
Ultra 4K   Pro 3   Doorbell

facebook
Portal TV

SAMSUNG
OneRemote BN59-01312A   Sero

CYBIC

simplehuman

iFLYTEK

ROTAI

Alibaba.com
Portable projector

FSL Light Smart Voice

SERCOM
HOMIX Smart thermostat

Market–Proven Audio Edge AI Offering

Lowest-power audio edge AI processor

Two way **voice call** processing with AEC, NR and Beam forming

Multiple **simultaneous wake-word engines** support

Multi-microphone **ASR preprocessing**

Noise cancellation and **wind** noise reduction

Built-in solution for far & near field always-on wake-word detection

Highly-integrated HW and SW solution from **single vendor**

Scalable and attractive silicon & software roadmap

WLCSP & QFN packages

SmartVoice Product Offering by Segment

Remote Control (RCU)

Low-power always-on voice control

Smart Home/Security

Voice communication, SED & voice control for **security panels, sensors & cameras, video doorbells**
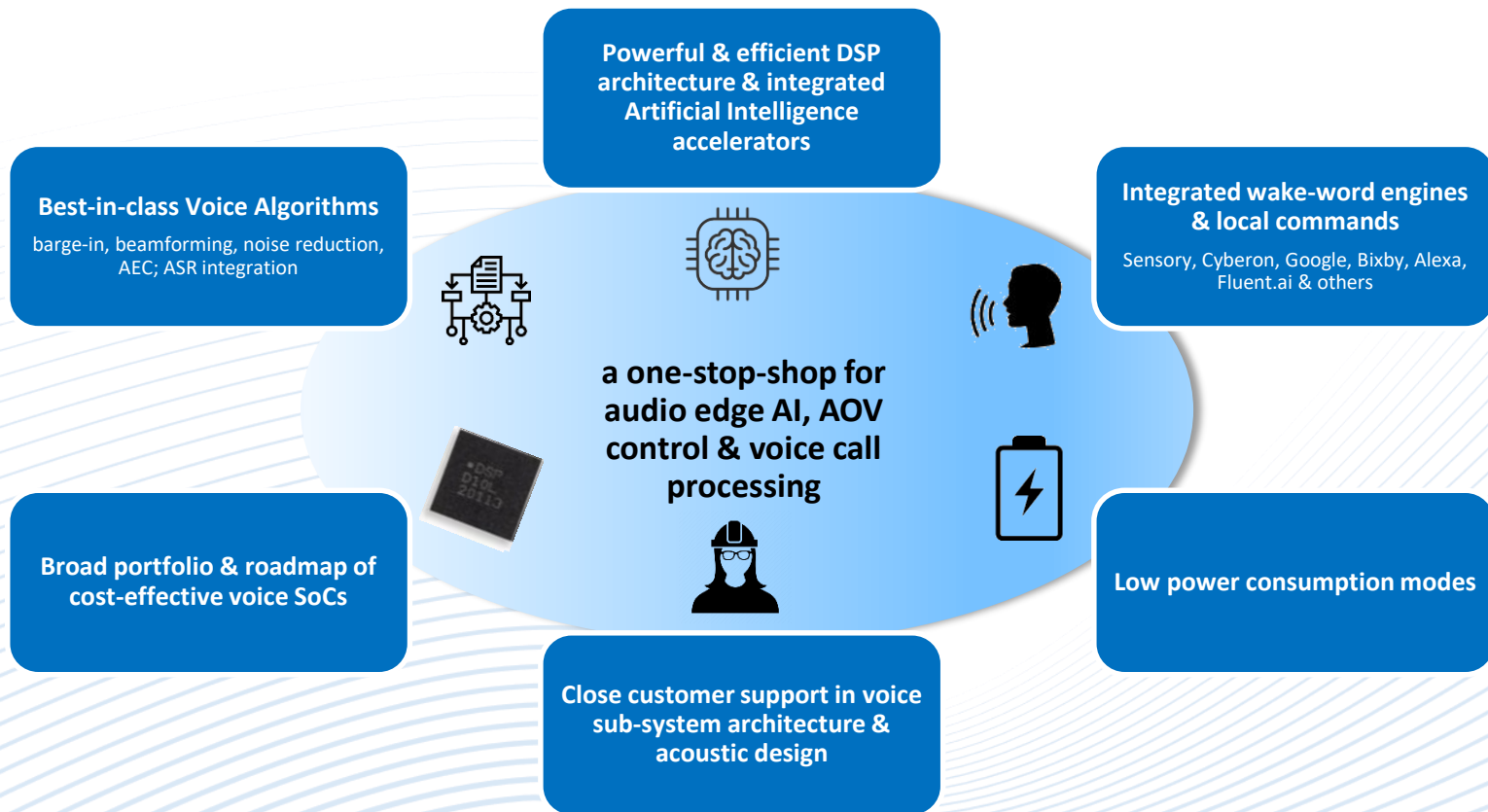
Smart Appliances

Voice control with local commands

FEATURES

Key available features
2022 roadmap features

SmartVoice Unique Technology Advantages

Powerful & efficient DSP architecture & integrated Artificial Intelligence accelerators

Best-in-class Voice Algorithms
barge-in, beamforming, noise reduction, AEC; ASR integration

Integrated wake-word engines & local commands
Sensory, Cyberon, Google, Bixby, Alexa, Fluent.ai & others

a one-stop-shop for audio edge AI, AOV control & voice call processing

Broad portfolio & roadmap of cost-effective voice SoCs

Low power consumption modes

Close customer support in voice sub-system architecture & acoustic design
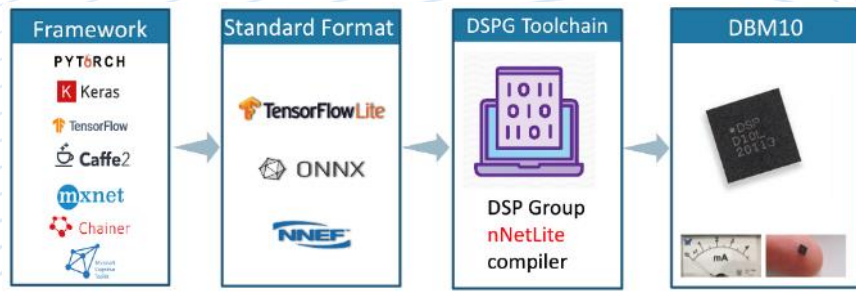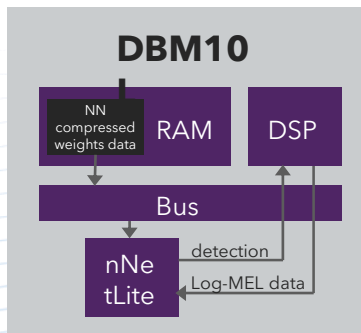
Audio Edge AI/ML with nNetLite

nNetLite Edge AI/ML core

Optimize ML-based algorithms for power & performance

Wake-word detection, local voice commands, sound event detection, etc.

DBM10

Ultra Low Power, standalone NN Engine
Optimized for maximum efficiency per energy unit, resulting in ultra-low power inference with small to medium size neural networks

Programmability
Programmable and can be loaded with NN designs exported from popular training frameworks, such as TensorFlow and Caffe2

Optimized for Audio Processing
Optimized to handle trigger-word detection, local commands (10s) detection, mixture of audio and tracking sensors, proximity detection and other tasks, all in an always-on manner

Development Tools
Compiler & simulator enable partners to run NN designs in DSPG's SOCs with the nNetLite engine

Extended Flexibility
Incorporates an Embedded Controller Unit (ECU) for extended flexibility (e.g. to support special user-defined activation functions)

I/O Interface
Efficient data & messaging interface with the SmartVoice SoC

Sound Event Detection

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Highlights

- Edge AI-based technology utilizing ML hardware & software
- High detection rates with low false-alarms
- Always-on low power consumption enables extended life for battery-powered sensors
- OTA firmware-upgradeable

Enhanced home security

Glass Break　**Dog Bark**

Security

Synaptics SED Technology

Wellness

Safety

Helpful & life-enhancing features for elderly care / other

Human Activity / Behavioral Analytics

Alert & prevent hazards and evolving danger situations

T3 Fire Alarm　**T4 CO Alarm**

Edge Sound Detection: Key Market Requirements

✓ Low cost

✓ High detection rates at 15-20 feet distance

✓ Noise immunity (typical home / office noises)

✓ High accuracy (low false detection rate, high recall rate)

✓ Long battery life

✓ Firmware upgrade support

  ✓ Ability to upgrade / modify the sound event detection model

  ✓ Scalability: Ability to change the number or type of detectable sounds

> **Synaptics' SED technology provides a best-in-class solution for all applications, with lowest-in-class power consumption for long battery life**

SED Platforms & Applications

	Security Panel / Hub	Camera / Video Doorbell	Home Sensor / Multi-Sensor
Key Applications	**Security/Safety** Detect T3, T4, glass break, other safety/security sound events	**Security** Detect glass break, dog bark, other security sound events	**Security** – Detect T3/T4, glass break, dog bark, other security sound events **Ambient Assisted Living (AAL)** – Detect varied human activity (e.g. toilet flush); combine with other sensors (motion, temperature, light) for behavioral analytics
Power Source	**Line-powered** with battery backup support	**Battery powered** or **line-powered**	**Battery powered** or **line-powered**
Additional features	High-quality 2-way voice (connect with security call center) Voice control (Alexa/other)	High-quality 2-way voice (communicate with visitor) Voice control (Alexa/other)	High-quality 2-way voice (connect with security/AAL call center) Voice control (Alexa/other)
Platform	**DBMD7** / **DBM10L**	**DBM10L**	**DBM10L**

Technology Roadmap

Target sounds availability

Planned roadmap enhancements

Process for supporting additional sound types

Project Definition → Development → Deployment

- Detected sounds
- Target Device
- Environment

- Data Collection
- Training
- Testing

- Final Tuning
- Field Testing
- Feedback Improvements

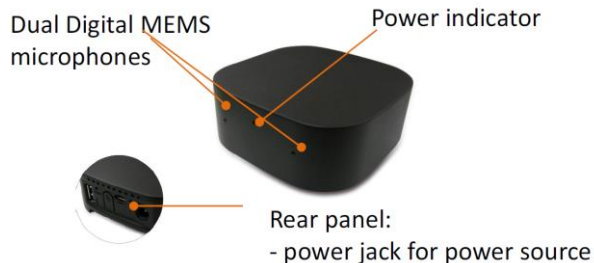# Blue by ADT Keypad

Blue by ADT Keypad

Overview

The Blue Keypad is a convenient, in-home controller for your security system. Use it to arm or disarm your system whenever you leave or come home. The keypad includes a panic feature to trigger the Panic Alarm in case of an emergency. It can also listen for alarms from your existing smoke and carbon monoxide detectors and send email/text alerts. (Smoke/CO alarm detection requires the keypad to be connected to AC power, and you will only receive notifications for self-monitoring.) You can also customize your keypad's settings from the Blue by ADT app at any time.
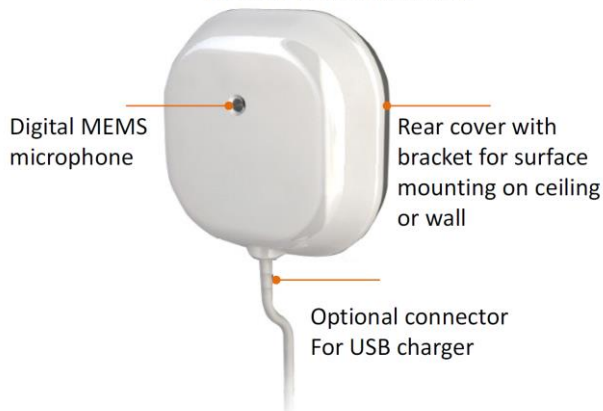
https://support.bluebyadt.com/s/article/Blue-by-ADT-Keypad
https://www.youtube.com/watch?v=52zLx-lBxvs&ab_channel=DSPGroup

ODM SED Reference Design

Deep Neutral Network AI Technology

Dual Digital MEMS microphones

Power indicator

Rear panel:
- power jack for power source

(battery powered model)

Digital MEMS microphone

Rear cover with bracket for surface mounting on ceiling or wall

Optional connector
For USB charger

Features & Specifications

- Dual high quality MEMS microphone to listen the abnormal sound event around the house.
- Responds to specific alarm patterns to tell you what the event is e.g. T3 for smoke alarm, T4 for CO alarm and glass smashing etc.....
- Notify gateway if the event sound is detected and send phone-based notification at once no matter where you are.
- Privacy friendly, does not record or listen in on conversation
- Z-Wave[Plus] with SmartStart and S2 security
- Optional RF : Wi-Fi, ZigBee, LoRA, NB-IoT, Sigfox, LTE ....
- Power source : 5V/1A power adaptor
- Dimension : 85mm(L)*85mm(W)*35mm(H)

Preliminary

Z-WAVE PLUS · ZigBee · Bluetooth LE · Wifi · LTE 4G · ULE ALLIANCE · EVERSPRING

Biometric Voice Authentication

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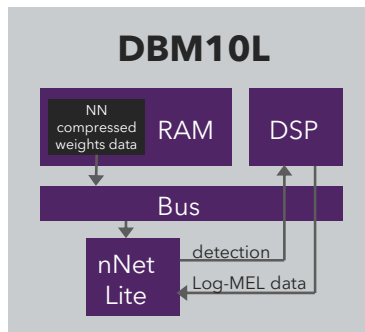# TinyML Edge Biometric Voice Authentication

AI-based TinyML edge voice biometrics, enabled on DBM10L's ultra-low power, audio-optimized NPU

Access your home, office, car with ease using your voice as a biometric key

Combine with face ID* for ultimate hands-free, secure access with dual-factor authentication

Implement on security panel to arm & disarm alarm

* Not provided by Synaptics

DBM10L

Implement parental controls on voice remote

Safeguard voice purchasing

Automatic user profile selection

Ultra-low power consumption

Combine with Synaptics' always-on voice feature

Text-Independent Individual Voice Pattern

Physical and Behavioral Factors Combine to Produce Unique and Text-Independent Voice Pattern for Every Individual

Behavioral characteristics

Pronunciation, emphasis speed of speech accents.
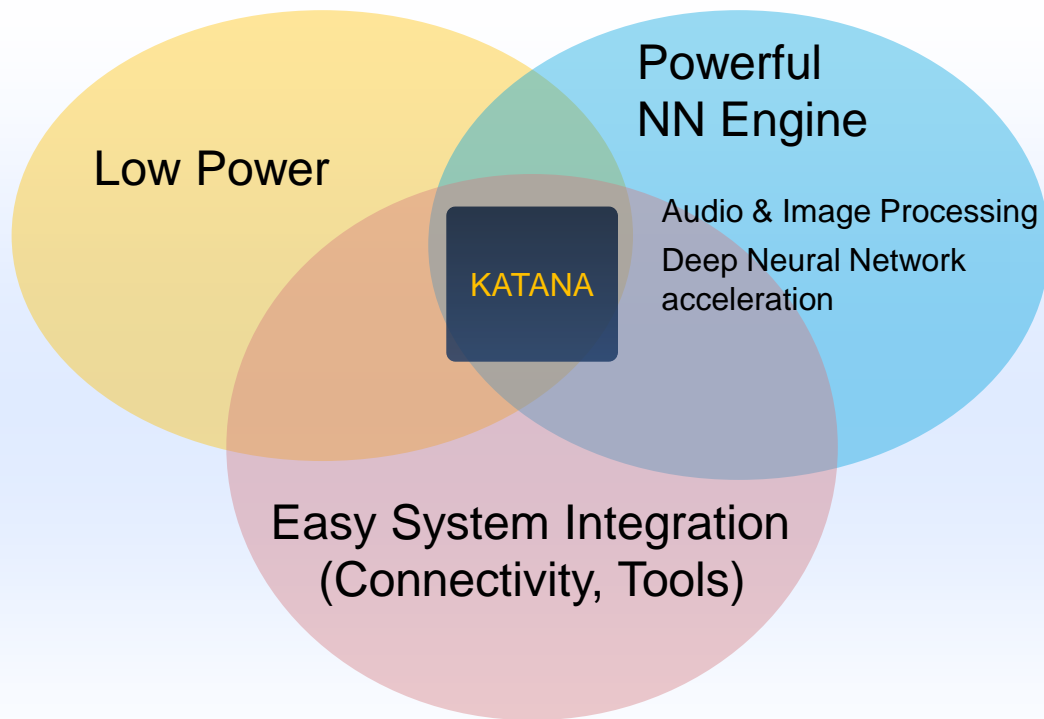
Physical characteristics

Unique physical traits of your vocal tracts, mouth shape & size, nasal passages

Voiceprint

LPAI Vision / Katana

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What is Katana Edge AI SoC?

Low Power

Powerful
NN Engine

Audio & Image Processing

Deep Neural Network
acceleration

KATANA

Easy System Integration
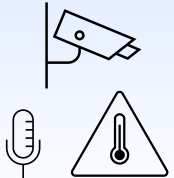(Connectivity, Tools)

Underserved Market Requirements

Products where Accessing Power is Difficult

- Retrofits in existing sites

- Outdoor and remote locations

- Monitoring moving or mobile people, valued assets, etc.

- Infrastructure level large-scale deployments
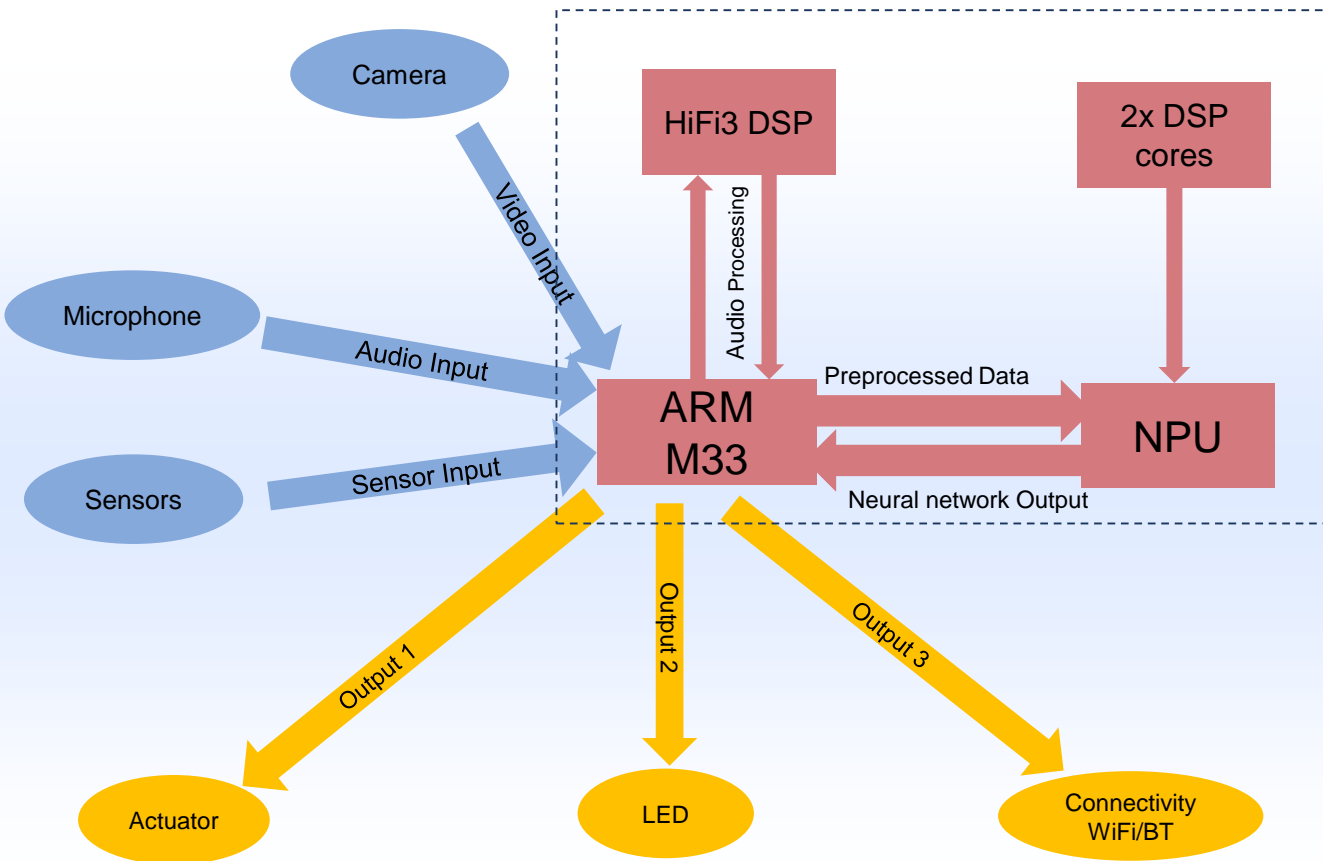
Unmet Industry Needs

Long battery life (2+ years)

Compact heat-sink design

Rapid, easy deployment

Flexible, multiple AI domains supported

Ex: image, sound, voice, temp, water, pressure, current, motion, position, etc.

Required Solution

Synaptics KATANA

Katana Low Power M/L AI System – System Architecture

- Interface capability with wide spectrum of sensing devices, including:
  - Cameras
  - Microphones
  - PIR Sensors
  - Accelerometers

- Low power ARM M33 core for custom Application Code

- 4x Advanced DSP Cores for Neural Processing Engine implementation

- Standard HiFi3 Tensilica DSP Core for Audio algorithms.

- Low power connectivity with low power WiFi and BLE

- Large number of GPIOs help interface with wide range of I/O devices

Katana Applications

Fall Detection System for Ambient Assisted Living

Wearable (pendant/watch) Fall Detection systems are inaccurate
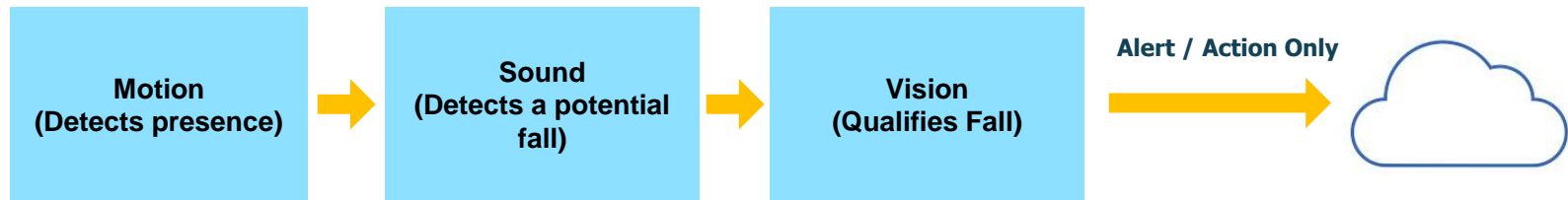
Don't work unless they are charged-up and in use

Associated "old person" stigma reduces use, limits adoption

Frequently misplaced and lost

Edge AI Vision based systems are accurate, non-intrusive and secure

FALL DETECTION SYSTEM

| Motion (Detects presence) | → | Sound (Detects a potential fall) | → | Vision (Qualifies Fall) | → | Alert / Action Only |

Fall Detection System Architecture

Motion → PIR → KATANA

Vision → Camera → KATANA

Sound → Microphone → KATANA

KATANA ↔ WiFi/BT/Other

Smart Building – People Detection/Counting

Use Cases

People awareness
Detect the presence of a person, differentiate between one and many, and estimate the number of people present

People counting
Accurate count of people entering and leaving a space: meeting room, retail shop, facility
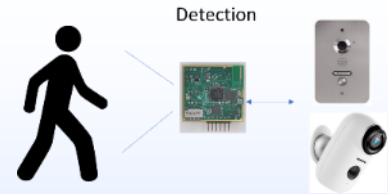
Applications
Security and Space Utilization

Social Distancing

Traffic Counting

Products
- Doorbell, cameras
- Entrance of the conference room
- Entrance/exit of the building / store (counting)
- Area: cafeteria, corridors, register

Detection

People Detection/Counting System

Turnkey Solution from ETA Compute

Tally™: Battery-Operated Space-Monitoring Doorway-Mounted Sensor

- Accurately detects and track people entering and leaving a space
  - Maintain people counts for conference rooms, breakrooms and enclosed offices, shops, classrooms, transport.
  - Reporting period: From 5mn to days

- Battery operated with extended 3 years battery life
  - Low installation cost and Low infrastructure cost
  - Low maintenance cost

- Easy to integrate with existing networks and gateways
  - Standard Bluetooth Low Energy (BLE) wireless interface

- Private and secure
  - Local processing, only meta data shared to the cloud
  - State of the art IoT security

- Customizable
  - Option for compliance and safety: Helmet, Smoking, Mask, Distancing
  - Flexible architecture allows for feature extension and custom use cases

Exit: 1

Enter: 2

Eta Compute

Eta Compute Confidential

6

Smart Cities/Factories/Homes – Meter Reader

Battery Powered Analog Meter Reader

Digital reader for traditional analog meter

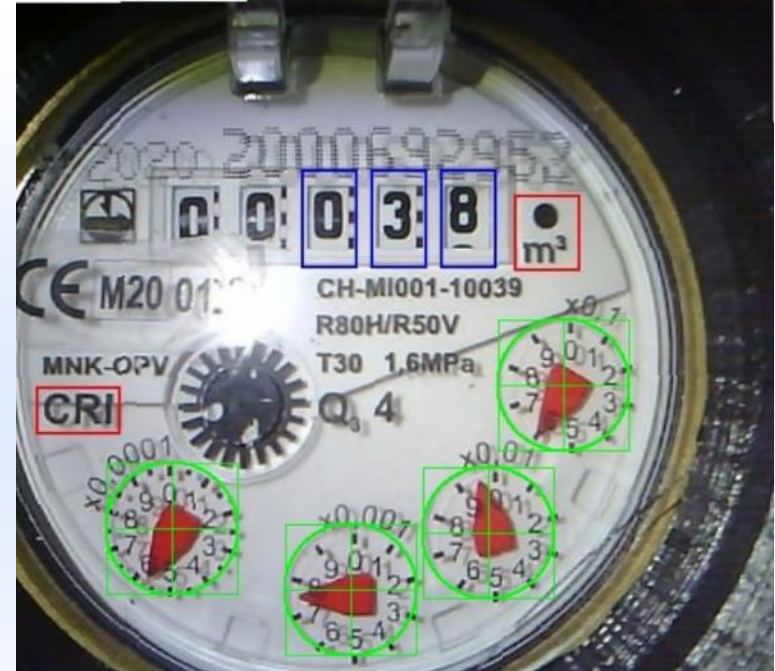AI model can be optimized for any dial, meter, gauge, counters, etc.

Non-invasive: does not affect the normal system operation

Applications: Factories, Homes, Office Buildings, Automotive

Home electricity, gas, water meters

Factory dials, gauges

Car speedometer, odometer, gas gauge

Meter Reading System

Low Power Presence Detection & Vision Co-processor

Privacy Protected Image Sensing
- All image data stays on device
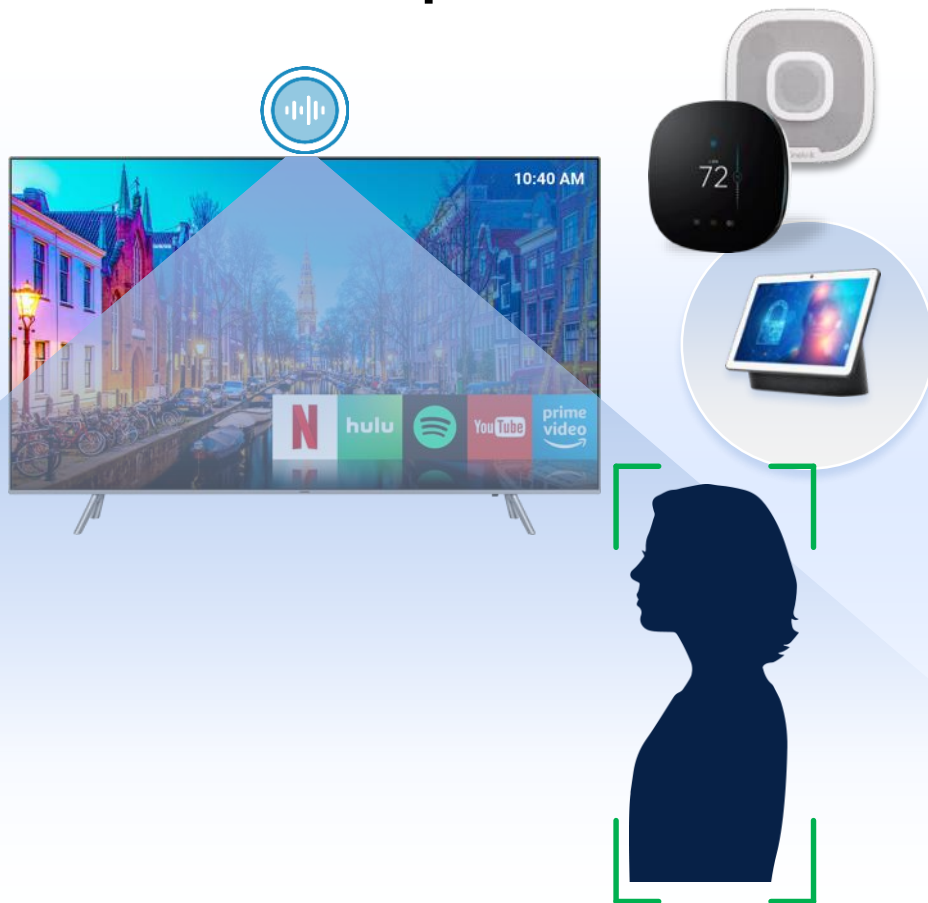
Enables wide range of use cases
- Wake on Approach
- Dim/Turn off/Lock on leave
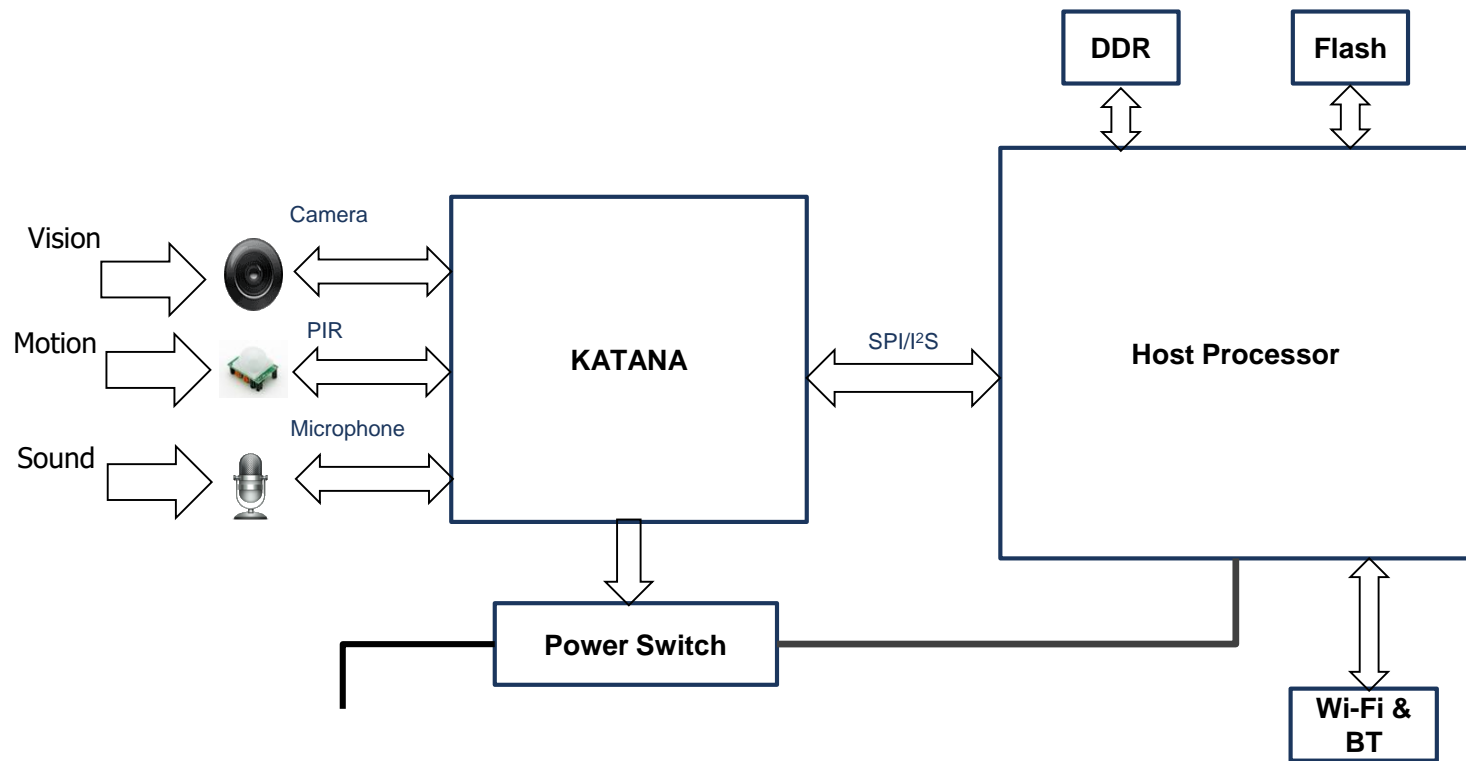- Adaptive User Interface: Adults vs. Kids etc.

Range of Sensing Options
- Occupancy Detection, People Counting, Kids vs. Adults, Animals vs. Humans, etc.
- Measure social distancing, space utilization etc

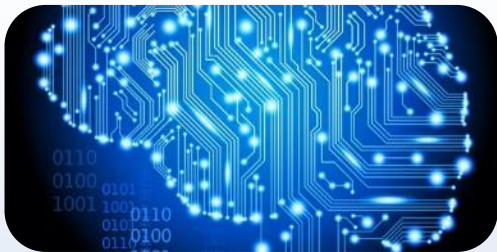**Enables battery powered and energy star rated sensors**
- Smart home, laptops, CE

Low-power Co-processor System Architecture

Neural Network based Audio AI Capability

Based on advanced machine learning and neural networking processing to optimize for best combination of False Rejection / False Acceptance performance

Optimized to run on Synaptics' Voice DSPs

Supports up to 5 different Keywords including customization

Audio event detection – Glass Breaking, Fire Alarm, Baby crying etc.

WORLD's FIRST DSP + Wakeword solution to pass Amazon's far-field requirement with only 2-mic

(Qualified as "Far-field" in May 2018)

Katana Edge EVK

Base Board:
- Microphone
- Accel/Gyro
- Light Sensor

BCM430132 Connectivity Module
- BLE
- WiFi + BLE
- IoT ready

Katana SoC Module
- Vision AI
- Voice AI
- Sensor Fusion AI

HiMax HM01B0 Camera Module

Battery operated, connectivity and IoT provisioning

Thank You