Application brief

Infineon battery powered Smart Alarm System (SAS)

Acoustic Event Detection (AED) and Artificial Intelligence (AI) sensor fusion based alarm system powered by Infineon XENSIV™ MEMS microphone, pressure sensor and PSoC6™ microcontroller

Infineon's battery powered Smart Alarm System (SAS) is designed to provide the highest accuracy alarm technology for smart building, smart retail, smart home security and IoT applications.

The SAS is a smart home security solution that leverages sensor fusion, embedded artificial intelligence algorithms, and machine learning techniques to detect intrusions and burglaries, and other acoustic events. The solution consists of Infineon's high performance single-to noise ratio (SNR) XENSIV™ MEMS microphones and digital pressure sensors. It combines the results of these sensors to accurately predict alarm triggering events like glass breaking, doors or windows being open by an intruder, and nearby alarm sounds, such as smoke and Carbon monoxide (CO) detectors, and accurately provides the user with up-to-date alarm conditions. The system also includes an embedded sensor fusion algorithms based off artificial intelligence(AI) and machine learning (ML) that combine the acoustic and pressure data to analyze unique patterns generated by the sensors to accurately differentiate and determine alarm conditions and triggering events. The AI/ML algorithm is capable of filtering out background noises, such as, baby crying or dog barking and other events that could generate a false positive.

The current SAS software can be configured for glass break, intrusion detection, and listening for smoke detector (T3) alarms and carbon monoxide (T4) alarms. The sensors can be utilized independently, for example, for intrusion detection or in sensor fusion mode, for example, glass break. In these examples, an AI algorithm running on Infineon's PSoC6 microcontroller does the following:
› Glass break – when a window or door glass is broken, the algorithm extracts the intensities in the frequency spectrum. At the same time, it captures the signature pattern of the change in pressure. The sensor fusion algorithm then synchronizes the output and triggers a glass break alarm.
› Intrusion alarm – when all windows and doors are closed, there is a stable pressure inside the room. Opening or closing a window or door triggers a pressure change within the room. Each pressure event has a signature pattern. Therefore, opening or closing a door or window triggers an intruder alarm.

Key features

› Sensor fusion design for high accuracy
› Designed for extreme low power operation for battery powered stand-alone sensors
› Protection from intrusion and other alarms
› Based on embedded AI/ML algorithm for glass break, intrusion detection and alarms that is training using real data in real environments
› Large coverage up to 50 m^2
› Battery life: 4-6 years
› Fully tested and qualified SW
› Already deployed in security system

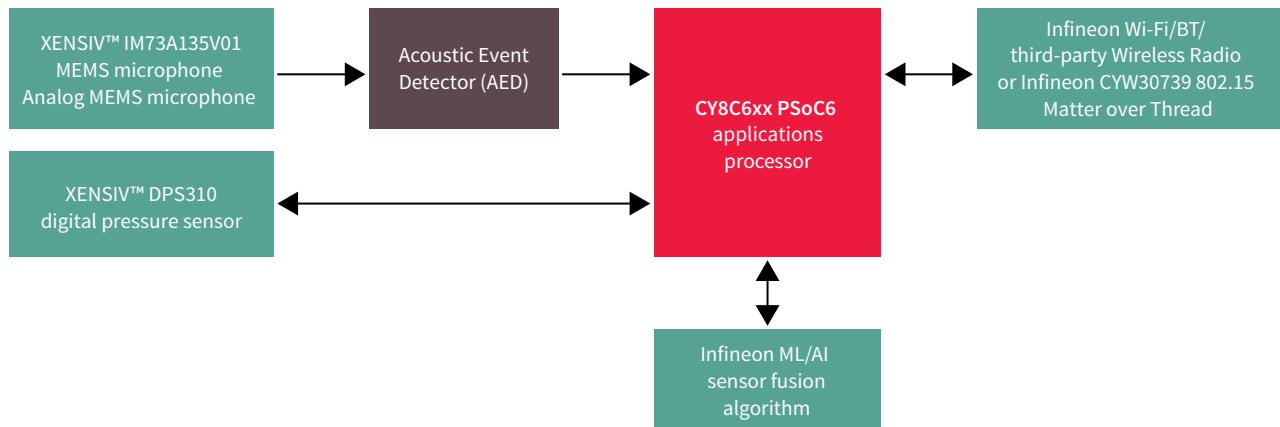## Key benefits

› F1 scores
  – Glass break detection system 99 %
  – Intrusion detection 96 %
› Power saving operation
› One system can secure a whole room
› Line of sight and close proximity to event is not required
› One Smart Alarm System can replace several sensors i.e. glass break + magnetic contact sensors
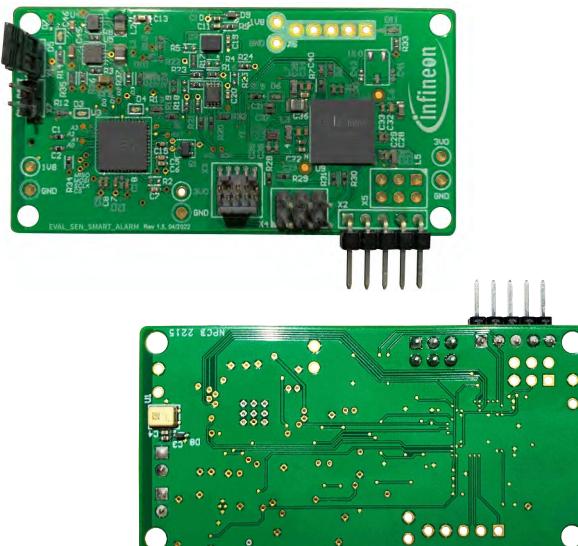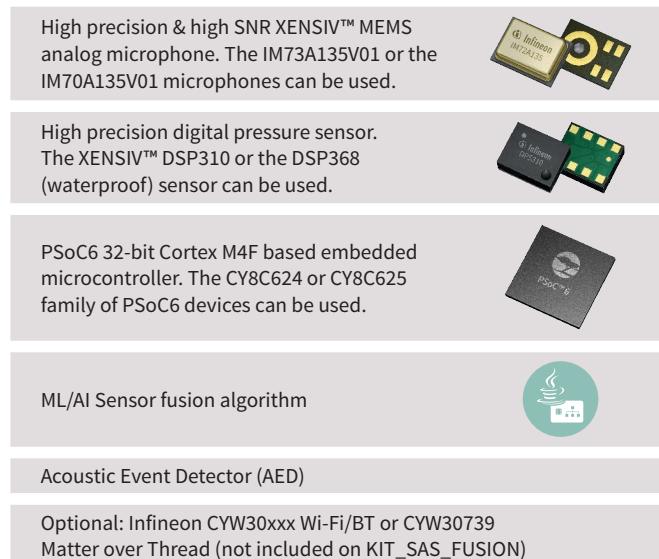› Adjustable sensitivity to match the environment

In addition to the sensor fusion technology, the Smart Alarm System also deploys an acoustic event detector (AED) device. This device is used to control power consumption and improve accuracy even further. The AED is an extremely power efficient device running in the micro amps range that is used to filter for sounds like those the alarm is monitoring. Only if such sounds are detected, then it will wake up the sensor fusion logic to provide the higher accuracy processing of the event. If there is no alarm, it will go back in to a deep sleep mode. Using an AED allows this technology to be battery powered.

Block diagram of the battery powered integrated alarm system

XENSIV™ IM73A135V01 MEMS microphone Analog MEMS microphone → Acoustic Event Detector (AED) → CY8C6xx PSoC6 applications processor ↔ Infineon Wi-Fi/BT/ third-party Wireless Radio or Infineon CYW30739 802.15 Matter over Thread

XENSIV™ DPS310 digital pressure sensor ↔ CY8C6xx PSoC6 applications processor

Infineon ML/AI sensor fusion algorithm ↕ CY8C6xx PSoC6 applications processor

The EVAL_SEN_SMART_ALARM is the evaluation and testing kit for the Smart Alarm System. This kit is show in the picture below and consist of the following major components

High precision & high SNR XENSIV™ MEMS analog microphone. The IM73A135V01 or the IM70A135V01 microphones can be used.	
High precision digital pressure sensor. The XENSIV™ DSP310 or the DSP368 (waterproof) sensor can be used.	
PSoC6 32-bit Cortex M4F based embedded microcontroller. The CY8C624 or CY8C625 family of PSoC6 devices can be used.	
ML/AI Sensor fusion algorithm	
Acoustic Event Detector (AED)	
Optional: Infineon CYW30xxx Wi-Fi/BT or CYW30739 Matter over Thread (not included on KIT_SAS_FUSION)	