SMART NATION TRANSLATIONAL LAB
Intelligent Edge Analytics for Noise Sensing
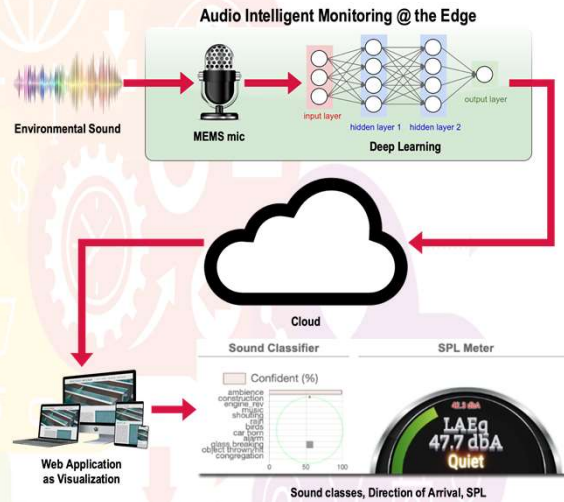
Existing Urban Noise Monitoring

- Based on Sound Pressure Level (SPL), insufficient information on what type of noise
- Provides no history tracking of incidents, not helping in creating policy for mitigation
- Class 1 SPL meter is used: high cost
- No remote alert monitoring capability
- No functional upgrade capability, once installed, this only measures SPL

Audio Intelligent Monitoring at the Edge (AIME)

- Provides holistic monitoring of noise (SPL/noise class/noise duration/DoA)
- Deployed as POC initiative in different areas in Singapore
- Provides 24/7 monitoring with end-to-end capability from sensing up to visualization
- Upgrade possibilities even for deployed sensors, for different sound class / remote alert system
- Using edge computed solution, deep learning and cloud technology for low cost, ease upgradability and flexibility

How It Works

- Environmental sound picked up by MEMs microphones
- Edge analytics for environmental sound
  - Multiclass classification
  - Real-time inference
  - Directional sensing of environmental sound
  - Robust to background noise
- Web application to show types of sound continuously
  - Further visualization of sound statistics

Audio Intelligent Monitoring @ the Edge

Environmental Sound → MEMS mic → Deep Learning (input layer, hidden layer 1, hidden layer 2, output layer) → Cloud → Web Application as Visualization / Sound Classifier · SPL Meter

LAEq 47.7 dBA Quiet

Sound classes, Direction of Arrival, SPL

Machine Learning Performance

	A	C	E.R	M	S/S	R	B	C.H	Alarm	G.B	O.TH	Con.	C.C	Exp
Ambient	97	0	0	0	0	1	0	0	0	0	0	0	0	0
Constr.	0	98	0	0	0	0	0	0	0	0	0	0	0	0
Eng.Rev	20	1	70	0	0	6	0	0	0	0	0	0	0	0
Music	0	0	0	99	0	0	0	0	0	0	0	0	0	0
Shout/Scr	3	0	0	0	71	0	0	0	19	0	0	0	4	0
Rain	0	0	2	0	0	97	0	0	0	0	0	0	0	0
Birds	1	0	0	0	0	0	96	0	0	0	0	0	0	0
CarHorn	0	0	0	0	2	0	0	97	0	0	0	1	0	0
Alarm	8	0	0	0	2	0	0	0	87	0	0	0	0	0
GlassBreak	0	0	0	0	0	0	0	0	0	99	0	0	0	0
Obj.ThrowHit	0	0	0	0	0	0	0	0	0	0	99	0	0	0
Congregation	2	0	0	0	0	0	0	0	0	0	0	95	0	0
CarCrash	0	0	0	0	0	0	0	0	0	0	0	0	99	0
Explosion	4	0	0	0	0	0	0	0	0	0	0	0	0	94

(a) Version 3.8 model on val. set

Figure 1: Model predictions Version 3.8 results

Hardware Specifications

Weight	750 gram
Dimensions (W x H x D)	135 x 185 x 85mm (without mic)
IP Rating	IP66
Input Power	90 to 264V AC
Microphone	7ch array mic (UMA-8)
Power consumption	5W (optional solar powered)
Data Interface	Built-in Ethernet (*LTE GSM)
Direction-of-arrival	Single source (20 deg acc)

Deployment Prototype (with Directional of Arrival)

Lamppost — Array of microphones, Windshield, Enclosure Cover

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