

Genius Ultrasound & audio AI in smart manufacturing



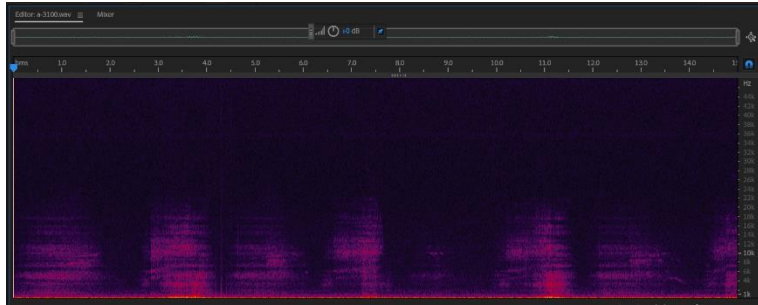
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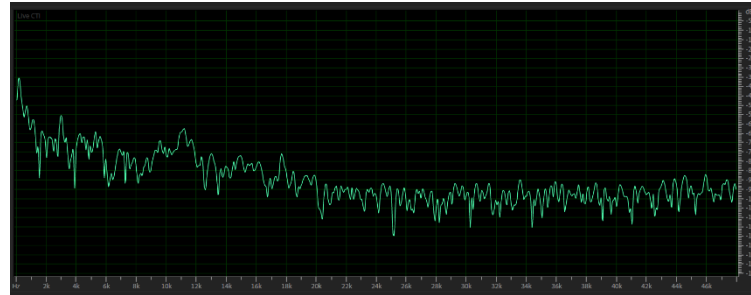
Sensors and AI in Smart Factory

	Vision	Vibration/ Accelerator	Temperature	Current/Voltage	Full Frequency Audio
Principle	Graphic information	3 axis moving determination	Light spectrum or electric resistance	Determine the electronic signals changes.	> 48 kHz audio recording, and analysis of the changes and meanings
Application	Product inspection, security	Manufacturing machine monitor	Gas leakage or chemical reaction	energy consumption, or operating stability	Moving or operating status
Advantage	Open sources, and hardware supports	High sensitivities, and lots of modules.	Quick and real-time image	Cable or component status determination	Energy, vibration, moving within limited distance
Weakness	Vision direction and light limitation.	Fragile, calibration.	Low sensitivity	Low sensitivity of other than energy consumption	Lack of hearable voice experiences, such as over 20 kHz signals.
Cost-performance ratio	High	Low	Low	Medium	High

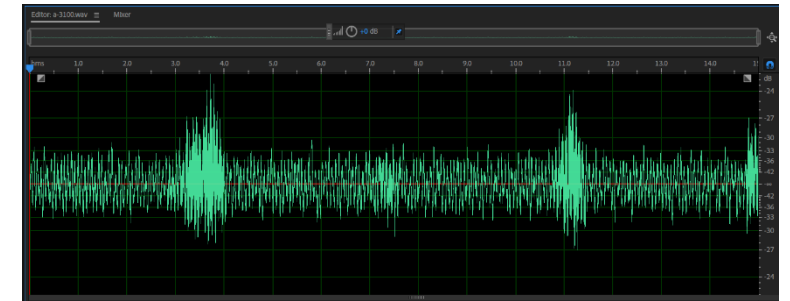
Typical Audio Graphics: with Audition and Praat



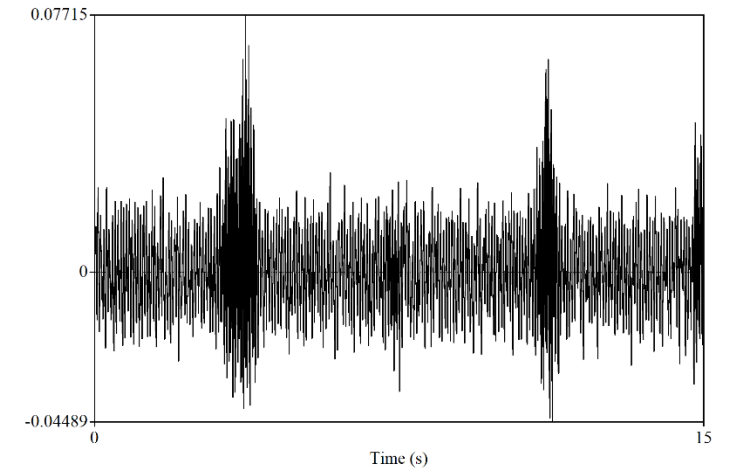
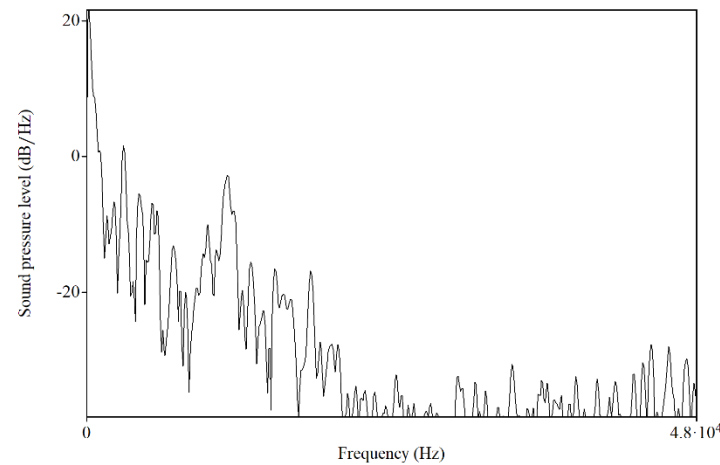
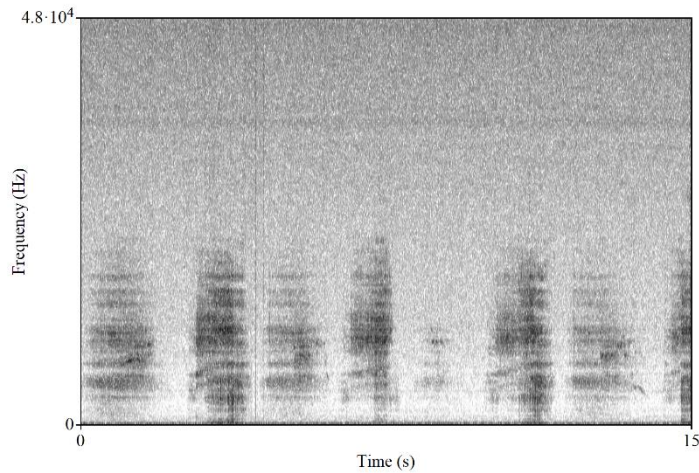
Spectrogram/spectral waterfall



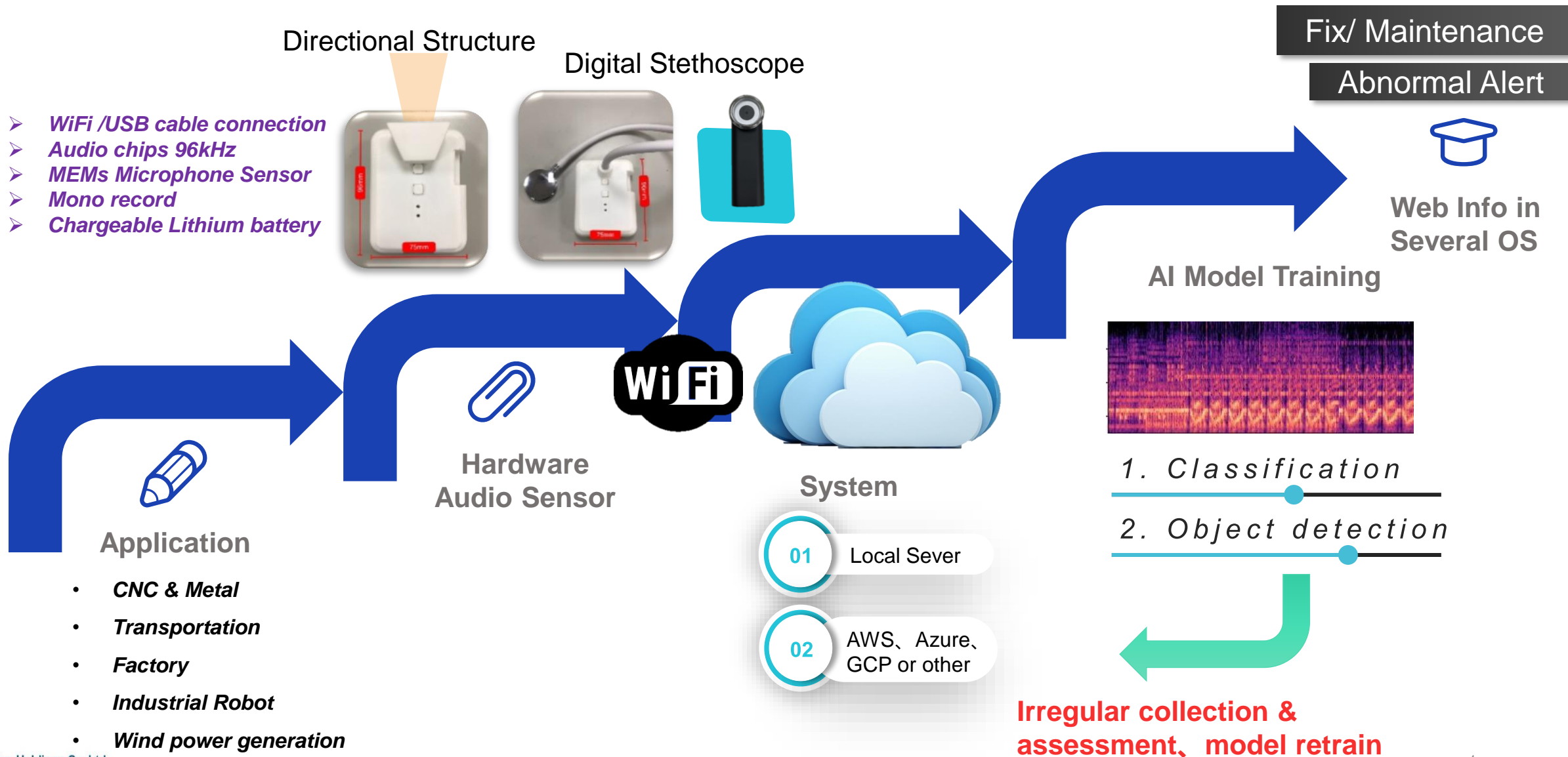
Spectrum



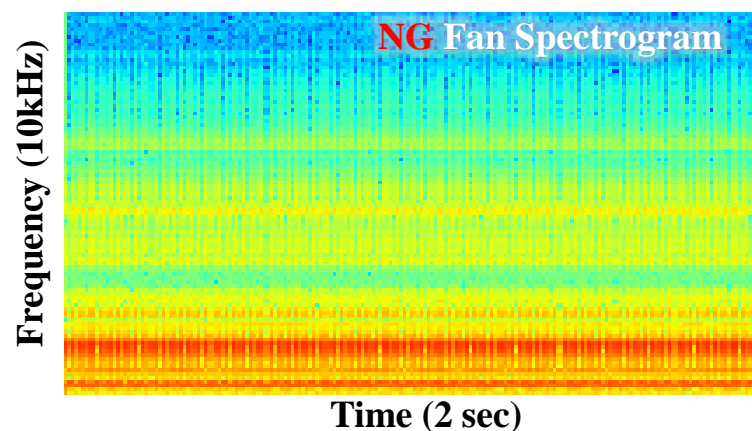
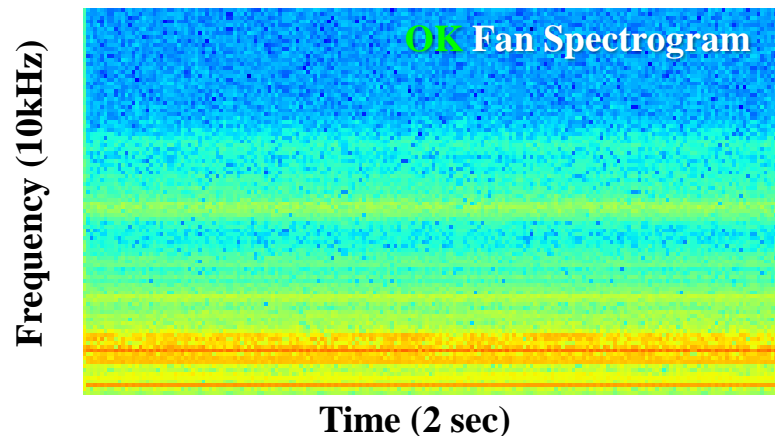
Waveform



Smart Factory Audio AI Technology and System



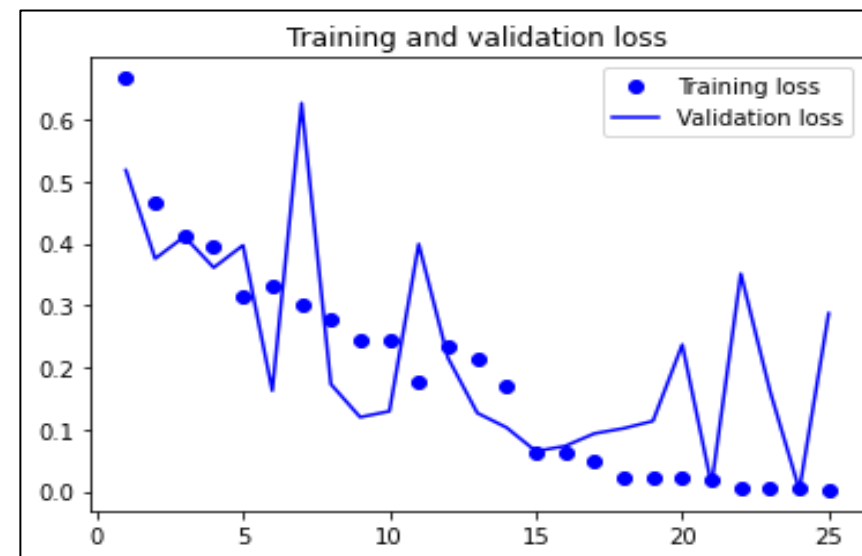
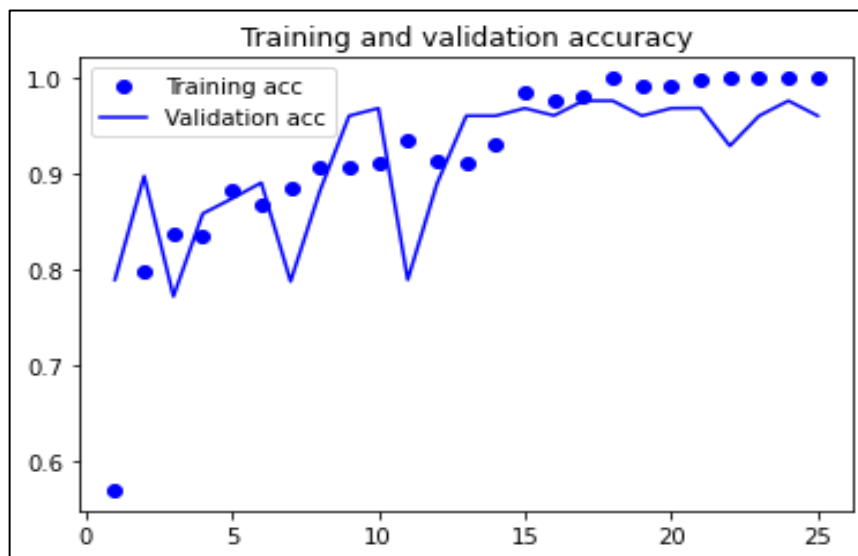
AI Validation Model



AI Model Specification :

- Classification Type : OK 、 NG
- OK Training Count : 410 pcs
- NG Training Count : 385 pcs
- Accuracy : 1.0
- Loss : 0.001719

Using audio data from verify to train the AI model to achieve testing.



Monitoring Classification

- **Mobility inspection:**
 - Check differential machines with differential AI models
- **Fixed real-time monitoring**
 - Continue monitoring for high value asset or production, such as the wafer or LCD screen.

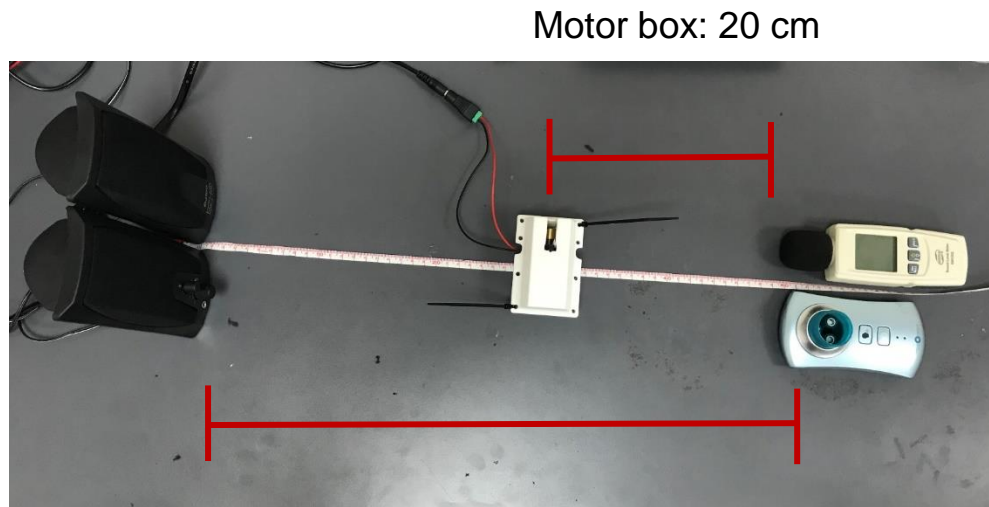
Experiments Model 3: Motor with differential rates

Background Voice:

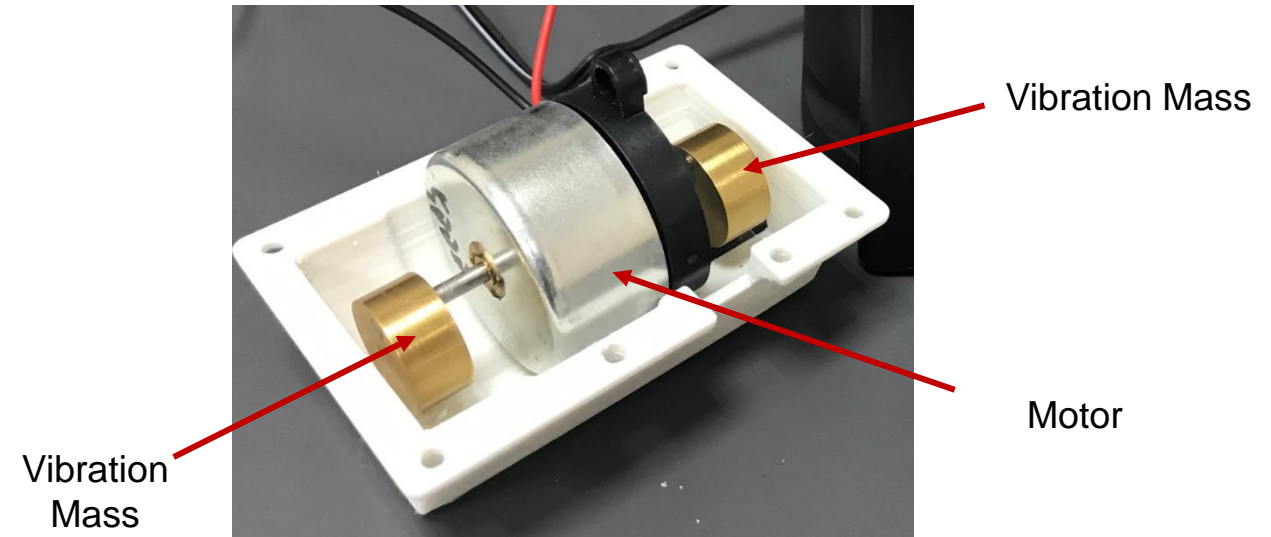
- NB+ speaker play general factory noise , average 96.8 dB .
(Voice source: https://www.youtube.com/watch?v=IXBGqt0T_ZY)
- GH circuit board engineer version 1

Control

- Motor: serial LD-SM3705-1202 with 22 g/piece, 20cm distance, adjusted with different voltages: 6.3, 8.3, 11.3 V



Speaker and GH hardware distance: 50 cm

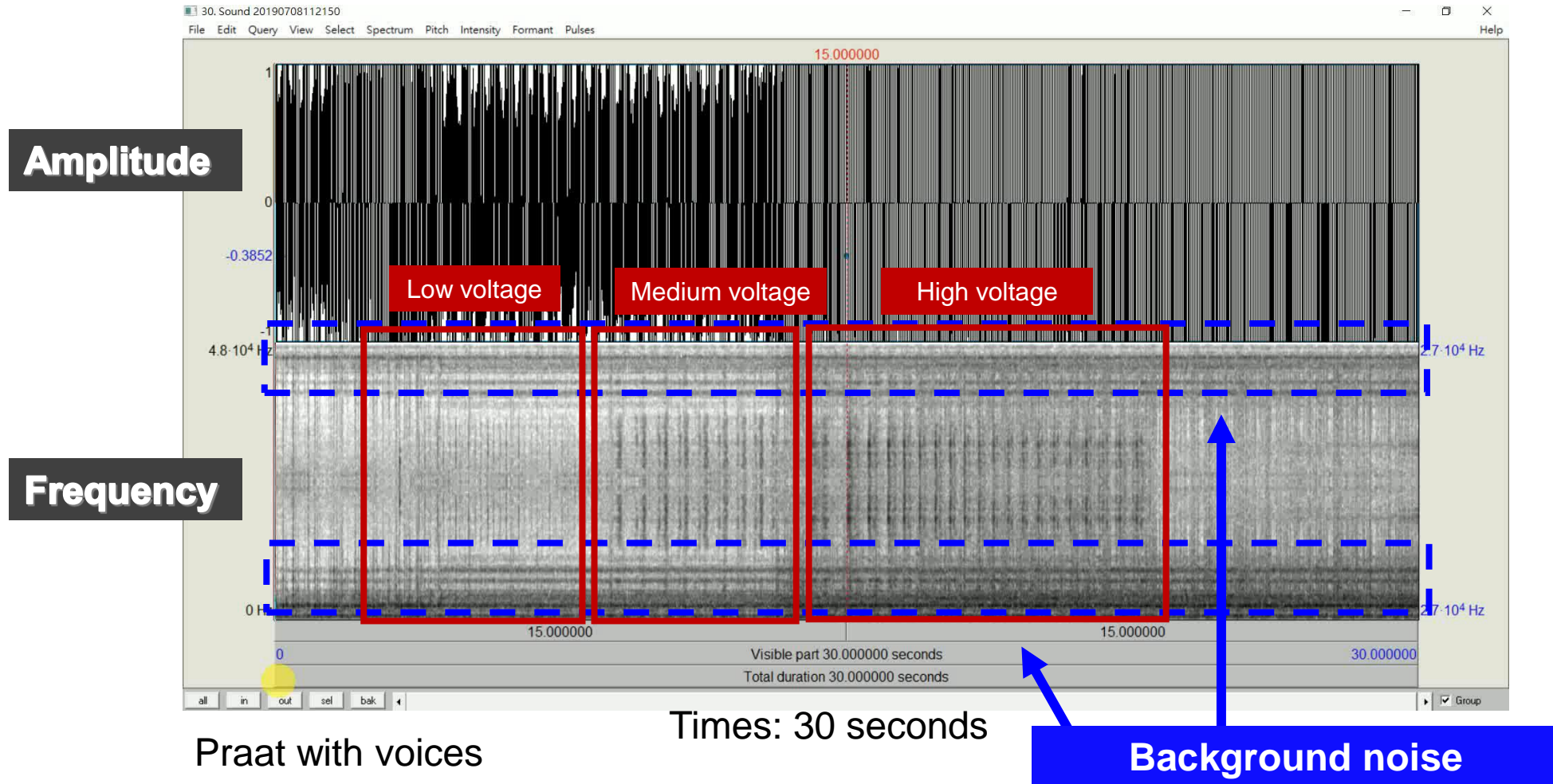


Plastic Case

Experiments Model 3: Motor with differential rates

Upper: Waveform

Lower: spectrogram, Frequency-time & coloring intensity



AI full frequency domain abnormal sound monitoring system

- ✓ Monitor equipment
- ✓ Digital records
- ✓ Periodic report analysis
- ✓ Predict the component life



AI monitoring system provides real-time alarms and predicts maintenance information

Intelligent system provides the monitoring results by working stage

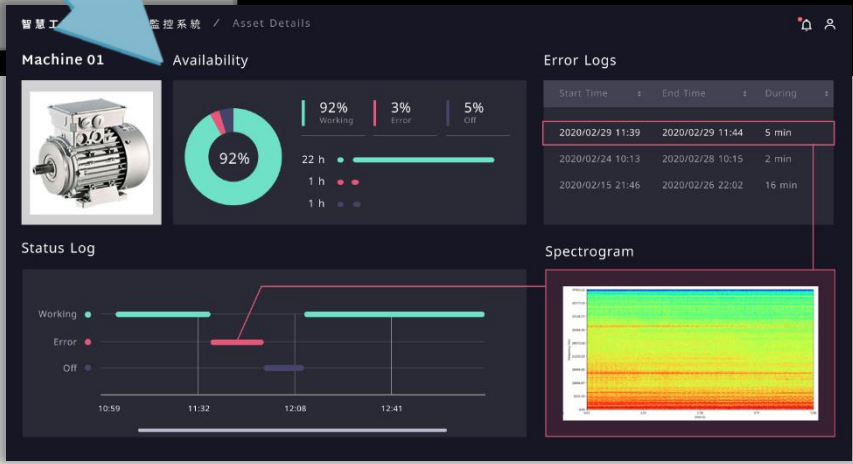


Full frequency domain sound monitor

AI analysis

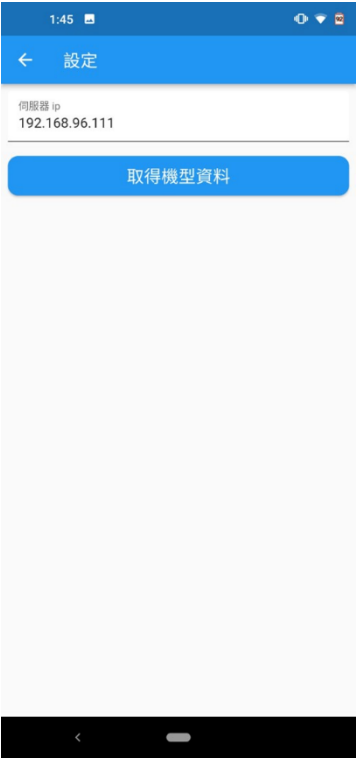
Digital records

Wireless transmit to server



Smartphone Monitoring APP UI

IP Input Connecting
Control Console



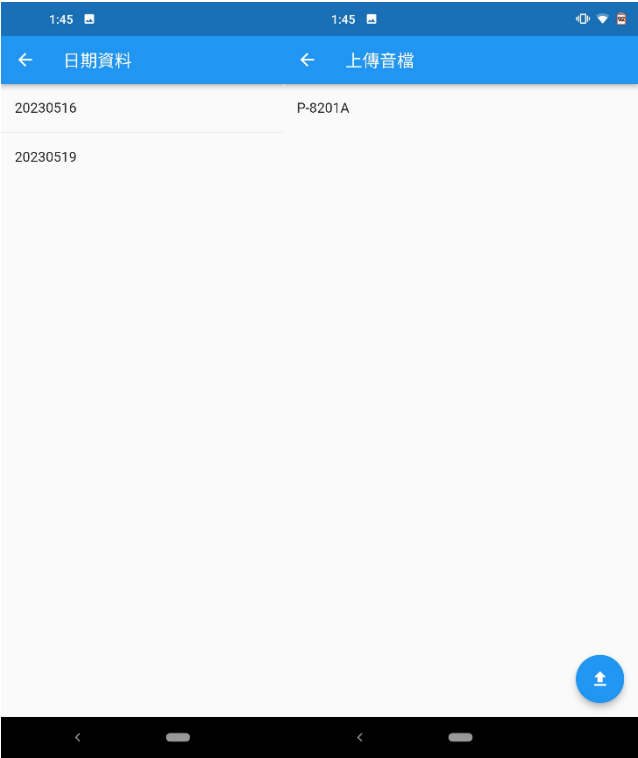
Text Input for
Constructing Device
Information Schematic



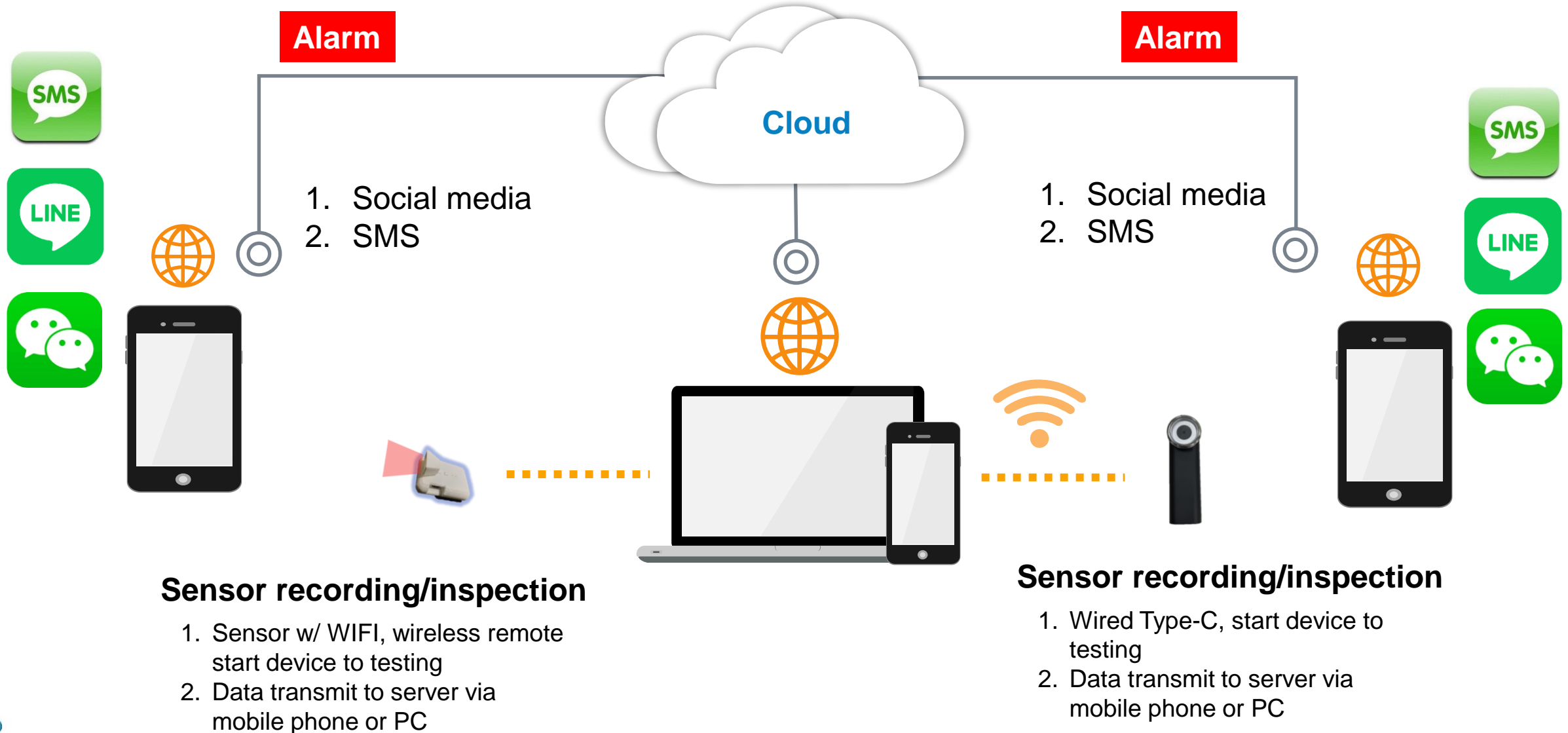
Microphone Connection Diagram



Date and Device Data
Transmission Diagram



The Warning/ Alarm Process of Abnormal Sound for AI Monitoring



Pros of Audio monitoring



EASY to INSTALL

No need to connect existing equipment, the abnormal sound can be detected through the ultrasonic audio equipment.



TAILORED

Customize the AI model.



SECURITY

Transform the sound into a spectrogram & analyze to keep the security.



COST REDUCE

Reduce manpower & fixture/tooling early maintenance.



QUALITY IMPROVE

Early detect abnormality & reduce the defects, increase the quality/benefits.

Smart audio monitoring solution

Hi-Res ADC & sensors to provide the AI intelligent analysis service

Hi-Res ADC electronic module

Wired USB/Type C ultrasound mic & WiFi 16 bits 96 kHz
MEMs Recorder

Hi-Res ADC mechanical module

2 plug-in module: sound cover & stethoscope

Audio sensor

moving, physical, chemical ultrasound sensor



Physical ultrasound sensor

Distance measuring, moving speed & freq. change, position trigger or temp./humidity measuring via audio intensity change

Chemical ultrasound sensor

Adjust ultrasonic intensity via resistance chemical sensor

Intelligent AI analysis

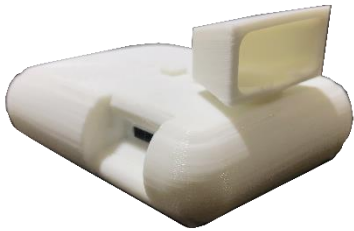
Determine the equipment operation via audio spectrogram, enhance the detection effect by combining the above components

Moving parts sensing module

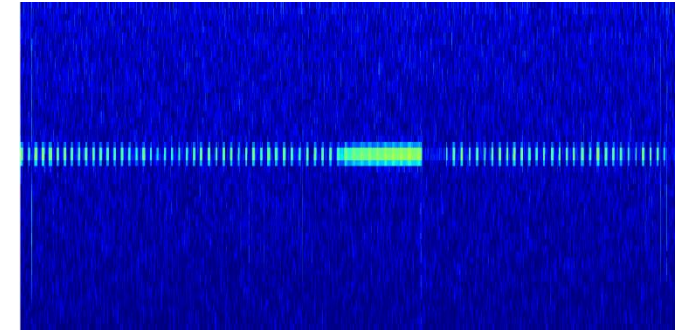
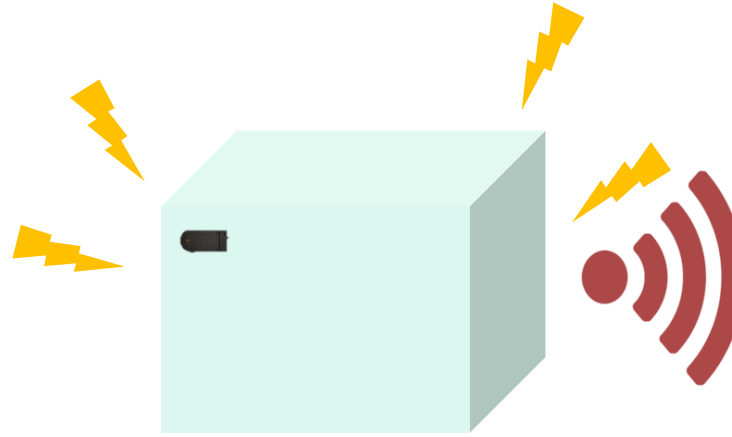


Ultrasonic emitter module :

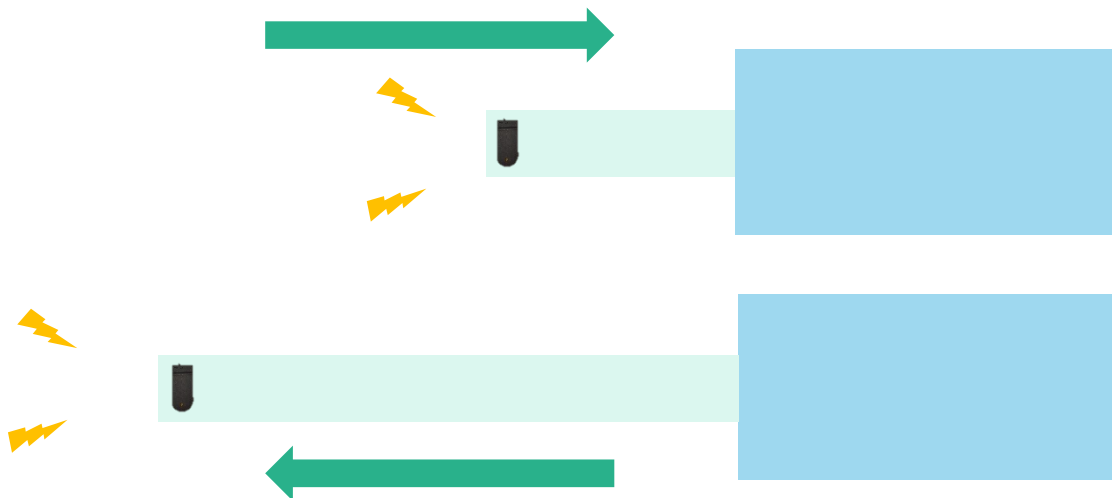
Emit single-frequency ultrasound, and **adjust the suitable frequency** according to the needs of the scene as well



The **distance, intensity, and cycles** of the object moving are calculated through the APP algorithm when the emitter approach (or away from) the recorder



Analyze the ultrasonic signal generated from the vibration into vibration data through the GH APP algorithm

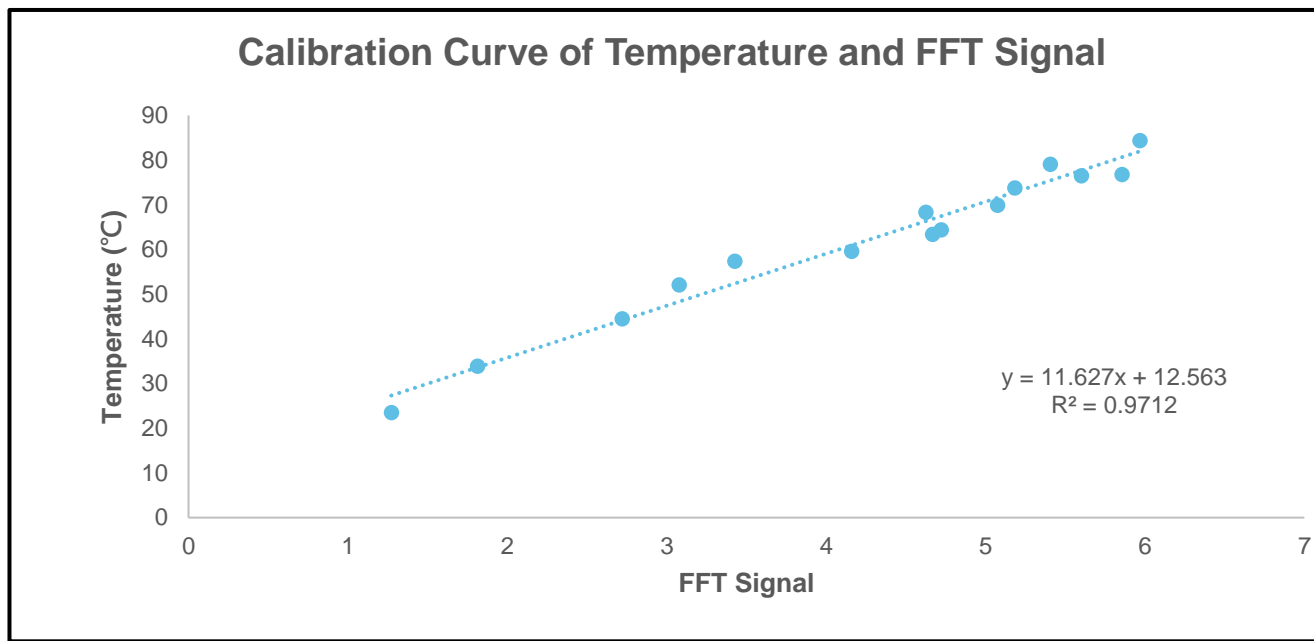


Application scenario : Moving parts such as hydraulic rods, robots, push equipment, etc.

Temperature sensor data

Calibration curve of temperature and FFT Signal

No.	Temperature (°C)	FFT Signal
1	23.5	1.27187
2	33.9	1.812481
3	44.5	2.72028
4	52.1	3.076399
5	57.4	3.42678
6	59.6	4.160275
7	63.4	4.66622
8	64.4	4.722342
9	68.3	4.6258
10	69.9	5.075372
11	73.8	5.182765
12	76.5	5.601646
13	76.8	5.856073
14	79.1	5.406375
15	84.4	5.967403



	Temperature (°C)	FFT Signal	FFT Temperature (°C)	%
T1	72.9	5.118606079	72.07703288	1.14%
T2	66.4	5.099171055	71.85106186	7.89%
T3	50	3.503179874	53.29447239	6.38%
T4	39.2	2.475096233	41.3409439	5.32%
T5	31.7	2.004443564	35.86866532	12.34%

Benefits and Value of Smart Audio Product

CNC & metal finishing

Extend the service life of drills and tools, reduce costs, and early detection of anomaly

Factory

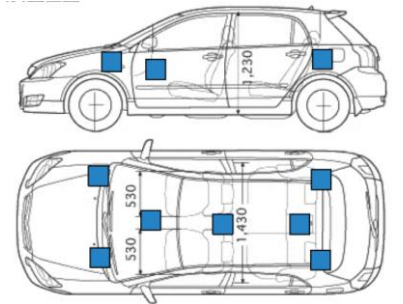
Predict the smooth and stable movement of motors, air compressors, and machinery; improve the efficiency of daily inspections, maintenance, and continuous monitoring

Robot

Normal/abnormal prediction based on the sound generated by the motion of bearings, rotating motors, geared motors, etc.

Public transportation examine

Vehicle inspection; monitor the track and its conditions



Wind power

Continuously judge the safety of equipment operation such as gears and rotating speed



Services

Hardware	System Integration	Rental Model
<ul style="list-style-type: none">• Directional or stethoscope modules to improve audio collection.• Wireless connect: WiFi AP on the same circuit board.• AI server and NAS to build AI model and store the voice files for future advance training.)	<ul style="list-style-type: none">• System embed with factory system, and web-based information.• Basic: normal and abnormal• Advance: distinguish the abnormal situation to save time replacement or fix.	<ul style="list-style-type: none">• Monthly payment• Provide SOP to use audio device, software and the determination.

A light blue world map is centered in the background of the slide.

THANK YOU

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